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Transcat - Houston
16115 Park Row
Houston, TX 77084

Fulfills the requirements of

ISO/IEC 17025:2017

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

In the field of

CALIBRATION

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R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 07 September 2023
Certificate Number: AC-2489.02

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

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CALIBRATION

Valid to: **September 7, 2023** Certificate Number: **AC-2489.02**

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source/Measure	Up to 1 pA (1 to 10) pA (10 to 100) pA (0.1 to 1) nA (1 to 10) nA (10 to 100) nA (0.1 to 1) µA (1 to 10) µA	1.4 % of reading + 7 fA 0.53 % of reading + 7 fA 0.18 % of reading + 3 fA 0.059 % of reading + 0.2 pA 0.057 % of reading + 2 pA 0.056 % of reading + 20 pA 0.054 % of reading + 0.3 nA 0.05 % of reading + 2 nA	Keithley 6430 Sub-femtoamp Remote SourceMeter
DC Current – Source/Measure	Up to 100 nA (0.1 to 1) µA (1 to 10) µA (10 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 10) A (10 to 20) A (20 to 30) A (30 to 100) A	1.5 pA 21 µA/A 7.2 µA/A 6.5 µA/A 2.8 µA/A 5.1 µA/A 2 µA/A 2.4 µA/A 4.8 µA/A 4 µA/A 10 µA/A 36 µA/A	Standard Shunts, Current Source
DC Current – Source/Measure [1]	Up to 100 µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	26 µA/A + 0.92 nA 26 µA/A + 5.8 nA 26 µA/A + 58 nA 43 µA/A + 0.58 µA 0.13 mA/A + 12 µA	HP 3458A opt 002 8.5 Digit Multimeter, Current Source

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure [1]	(1 to 3) A (3 to 10) A	0.12 % of reading + 1.2 mA 0.18 % of reading + 1.3 mA	Fluke 8846A 6.5 Digit Multimeter
	(10 to 100) A	0.15 mA/A + 2 mA	Ohms Labs CS-100 Precision Shunt, Agilent 3458A 8.5 Digit Multimeter
DC Clamp-on Ammeters (Non-Toroidal Type) Transformer Type Sensor [1]	(20 to 150) A (150 to 1 000) A (1 000 to 5 000) A	0.51 % of reading + 0.14 A 0.51 % of reading + 0.5 A 0.58 % of reading	Fluke 5520A Multiproduct Calibrator, Fluke 5500A/COIL, Fluke 55120A Transconductance Amplifier, 1 kA and 6 kA Coils
AC Current – Source [1]	Up to 220 µA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (0.22 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	 0.032 % of reading + 16 nA 0.019 % of reading + 10 nA 0.015 % of reading + 8 nA 0.03 % of reading + 12 nA 0.11 % of reading + 65 nA 0.03 % of reading + 40 nA 0.018 % of reading + 35 nA 0.014 % of reading + 35 nA 0.021 % of reading + 0.11 µA 0.11 % of reading + 0.65 µA 0.039 % of reading + 0.4 µA 0.019 % of reading + 0.35 µA 0.014 % of reading + 0.35 µA 0.021 % of reading + 0.55 µA 0.11 % of reading + 5 µA 0.033 % of reading + 4 µA 0.018 % of reading + 3.5 µA 0.014 % of reading + 2.5 µA 0.021 % of reading + 3.5 µA 0.11 % of reading + 10 µA 0.027 % of reading + 35 µA 0.046 % of reading + 80 µA 0.7 % of reading + 0.16 mA	Fluke 5720A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source [1]	(2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.048 % of reading + 0.17 mA 0.096 % of reading + 0.38 mA 0.36 % of reading + 0.75 mA	Fluke 5720A Multiproduct Calibrator, Fluke 5725A Amplifier
	(11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	 0.097 % of reading + 3.8 mA 0.12 % of reading + 3.8 mA 2.3 % of reading + 3.8 mA	Fluke 5520A Multiproduct Calibrator
AC Current – Source [1] (Extended Frequency Ranges)	(29 to 330) µA (10 to 30) kHz (0.33 to 3.3) mA (10 to 30) kHz (3.3 to 33) mA (10 to 30) kHz (29 to 330) mA (10 to 30) kHz	 1.2 % of reading + 0.31 µA 0.78 % of reading + 0.47 µA 0.31 % of reading + 3.1 µA 0.31 % of reading + 0.16 mA	Fluke 5520A Multiproduct Calibrator
AC Clamp-on Ammeter (Toroidal Type) Transformer Type 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	 0.3 % of reading + 26 mA 0.83 % of reading + 47 mA 0.35 % of reading + 0.12 A 1.1 % of reading + 0.22 A	Fluke 5520A Multiproduct Calibrator, 1 kA Coil
AC Clamp-on Ammeter (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	 0.57 % of reading + 0.25 A 1 % of reading + 0.25 A 0.6 % of reading + 0.9 A 1.3 % of reading + 0.92 A	Fluke 5520A Multiproduct Calibrator, 1 kA Coil
	(1 to 6) kA (10 to 300) Hz (1 to 2) kA (300 to 440) Hz (2 to 6) kA (300 to 440) Hz	 0.62 % of reading 0.8 % of reading 0.66 % of reading	Fluke 5520A Multiproduct Calibrator, Fluke 55120A Transconductance Amplifier, 6 kA 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		Agilent 3458A Opt 002 8.5 Digit Multimeter
	(10 to 20) Hz	0.46 % of reading + 23 nA	
	(20 to 45) Hz	0.17 % of reading + 23 nA	
	(45 to 100) Hz	0.071 % of reading + 23 nA	
	100 Hz to 1 kHz	0.037 % of reading + 23 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	0.48 % 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	0.038 % of reading + 23 µA	
	(0.1 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	
	(1 to 3) A		Fluke 8846A 6.5 Digit Multimeter
	10 Hz to 5 kHz	0.24 % of reading + 0.1 mA	
	(5 to 10) kHz	1.2 % of reading + 0.1 mA	
	(3 to 10) A		
	10 Hz to 5 kHz	0.81 % of reading + 0.4 mA	
	10 A to 100 A		Agilent 3458A opt 002 8.5 Digit Multimeter, Ohms Lab CS-100 Current Shunt
	(50 to 60) Hz	0.22 mA/A + 5 mA	
	400 Hz	0.26 mA/A + 5 mA	
	1 kHz	1.1 mA/A + 1.3 mA	
DC Voltage – Source/Measure (Fixed Points)	0 V (floor)	59 nV	Ratio Metric with Zener
	100 mV	0.8 µV/V	
	1 V	0.29 µV/V	
	10 V	0.2 µV/V	
	19 V	0.46 µV/V	
	100 V	0.28 µV/V	
	1 000 V	0.54 µV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source/Measure (Fixed Points)	10 mV < V < 100 mV 100 mV < V ≤ 1 000V	8.6 µV/V 7.4 µV/V + 59 nV	Fluke 8508 8.5 Digit Multimeter, Ratio Metric with Zener
DC Voltage – Measure (Fixed Points)	1 mV ≤ V < 10 mV 10 mV	100 µV/V 13 µV/V	Fluke 8508 8.5 Digit Multimeter
DC Voltage – Source/Measure [1] (Variable Points)	(0 to 100) mV (0.1 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 7.6 µV/V + 35 µV 14 µV/V + 0.12 mV 18 µV/V + 0.12 mV 21 µV/V + 0.12 mV	Agilent 3458A opt 002 8.5 Digit Multimeter, Fluke 5720A Multiproduct Calibrator
DC High Voltage – Measure [1]	(1 to 10) kV	0.049 % of reading + 0.62 V	Vitrek 4700 High Voltage Meter
	(10 to 20) kV (20 to 35) kV	0.08 % of reading + 0.35 V 0.14 % of reading + 1 V	Vitrek 4700 High Voltage Meter, Vitrek HVP-35 High Voltage Probe
	(15 to 30) kV (30 to 45) kV (45 to 70) kV	0.065 % of reading + 1 V 0.09 % of reading + 3 V 0.17 % of reading + 1 V	Vitrek 4700 High Voltage Meter, Vitrek HVL-70 High Voltage Probe
	(25 to 100) kV	0.11 % of reading + 0.5 V	Vitrek 4700 High Voltage Meter, HVL-100 High Voltage Probe
AC Voltage – Source [1]	Up to 2.2 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 500 kHz to 1 MHz	0.16 % of reading + 4 µV 0.1 % of reading + 4 µV 0.078 % of reading + 4 µV 0.13 % of reading + 4 µV 0.17 % of reading + 5 µV 0.33 % of reading + 10 µV 0.47 % of reading + 20 µV 0.58 % of reading + 20 µV	Fluke 5720A Multiproduct Calibrator

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		Fluke 5720A Multiproduct Calibrator
	(10 to 20) Hz	0.042 % 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 to 50) kHz	0.03 % of reading + 4 µV	
	(50 to 100) kHz	0.058 % 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 5 % of reading + 7 µV	
	(20 to 50) kHz	0.021 % of reading + 7 µV	
	(50 to 100) kHz	0.047 % of reading + 17 µV	
	(100 to 300) kHz	0.091 % 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	0.027 % 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 to 50) kHz	0.008 % 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 to 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	
	(22 to 220) V		
	(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 to 50) kHz	0.009 3 % of reading + 1 mV	
	(50 to 100) kHz	0.016 % of reading + 2.5 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		Fluke 5720A Multiproduct Calibrator
	(100 to 300) kHz	0.09 % of reading + 16 mV	
	(300 to 500) kHz	0.44 % of reading + 40 mV	
	500 kHz to 1 MHz	0.8 % of reading + 40 mV	
	(220 to 750) V		
	(30 to 50) kHz	0.061 % of reading + 11 mV	
	(50 to 100) kHz	0.23 % of reading + 45 mV	
	(220 to 1 100) V		
	40 Hz to 1 kHz	0.011 % of reading + 4 mV	
	(1 to 20) kHz	0.017 % of reading + 6 mV	
	(20 to 30) kHz	0.061 % of reading + 11 mV	
AC Voltage – Measure [1]	Up to 10 mV		Agilent 3458A opt 002 8.5 Digit Multimeter
	(1 to 40) Hz	0.04 % of reading + 3.5 µV	
	40 Hz to 1 kHz	0.03 % of reading + 1.2 µV	
	(1 to 20) kHz	0.04 % 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	
	(0.3 to 1) MHz	1.5 % of reading + 5.8 µV	
	(1 to 4) MHz	8.1 % of reading + 8.1 µV	
	(10 to 100) mV		
	(1 to 40) Hz	0.013 % of reading + 4.6 µV	
	40 Hz to 1 kHz	0.009 7 % 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	1.8 % of reading + 12 µV	
	(2 to 4) MHz	4.7 % of reading + 81 µV	
	(4 to 8) MHz	4.7 % of reading + 92 µV	
	(8 to 10) MHz	17 % of reading + 0.12 mV	
	(0.1 to 1) V		
	(1 to 40) Hz	0.008 8 % of reading + 46 µV	
	40 Hz to 1 kHz	0.008 3 % 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	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure [1]	(0.1 to 1) V		Agilent 3458A opt 002 8.5 Digit Multimeter
	(1 to 2) MHz	1.8 % of reading + 0.12 mV	
	(2 to 4) MHz	4.6 % of reading + 81 µV	
	(4 to 8) MHz	4.6 % of reading + 0.92 µV	
	(8 to 10) MHz	17 % of reading + 1.2 mV	
	(1 to 10) V		
	(1 to 40) Hz	0.009 5 % of reading + 0.46 mV	
	40 Hz to 1 kHz	0.023 % 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	
	(2 to 4) MHz	4.6 % of reading + 8.1 mV	
	(4 to 8) MHz	4.6 % of reading + 9.2 mV	
	(8 to 10) MHz	17 % of reading + 12 mV	
	(10 to 100) V		
	(1 to 40) Hz	0.024 % of reading + 4.6 mV	
	40Hz 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 % of reading + 46 mV	
	40 Hz to 1 kHz	0.047 % of reading + 23 mV	
	(1 to 20) kHz	0.071 % of reading + 23 mV	
	(20 to 50) kHz	0.19 % of reading + 23 mV	
	(50 to 100) kHz	0.35 % of reading + 23 mV	
AC High Voltage – Measure [1]	(0.7 to 10) kV		Vitrek 4700 High Voltage Meter
	60 Hz	0.17 % of reading + 0.16 V	
	(10 to 20) kV		Vitrek 4700 High Voltage Meter, Vitrek HVP-35 High Voltage Probe
	60 Hz	0.17 % of reading + 0.6 V	
	(20 to 35) kV		
	60 Hz	0.23 % of reading + 3.5 V	
	(12.5 to 25) kV		Vitrek 4700 High Voltage Meter, Vitrek HVL-70 High Voltage Probe
	60 Hz	0.15 % of reading + 1.4 V	
	(25 to 37.5) kV		
	60 Hz	0.16 % of reading + 2.8 V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC High Voltage – Measure [1]	(37.5 to 50) kV 60 Hz	0.2 % of reading + 0.2 V	Vitrek 4700 High Voltage Meter, Vitrek HVL-70 High Voltage Probe
	(25 to 75) kV 60 Hz	0.19 % of reading + 3.5 V	Vitrek 4700 High Voltage Meter, HVL-100 High Voltage Probe
Capacitance – Source [1] (Simulation)	10 Hz to 10 kHz (0.19 to 3.3) pF 10 Hz to 1 kHz (3.3 to 11) nF (11 to 110) nF (110 to 330) nF (10 to 600) Hz (0.33 to 1.1) µF (10 to 300) Hz (1.1 to 3.3) µF (10 to 150) Hz (3.3 to 11) µF (10 to 120) Hz (11 to 33) µF (10 to 80) Hz (33 to 110) µF DC to 50 Hz (110 to 330) µF DC to 20 Hz (0.33 to 1.1) mF DC to 6 Hz (1.1 to 3.3) mF DC to 2 Hz (3.3 to 11) mF DC to 0.6 Hz (11 to 33) mF DC to 0.2 Hz (33 to 110) mF	0.39 % of reading + 7.8 pF 0.21 % of reading + 7.8 pF 0.21 % of reading + 78 pF 0.21 % of reading + 0.23 nF 0.2 % of reading + 0.78 nF 0.2 % of reading + 2.3 nF 0.2 % of reading + 7.8 nF 0.31 % of reading + 23 nF 0.35 % of reading + 78 nF 0.35 % of reading + 0.23 µF 0.35 % of reading + 0.78 µF 0.35 % of reading + 2.3 µF 0.35 % of reading + 7.8 µF 0.58 % of reading + 23 µF 0.85 % of reading + 78 µF	Fluke 5520A Multiproduct Calibrator
Capacitance – Measure [1] 10 Hz to 1 MHz (Fixed Points)	0.33 mF 0.8 mF 1 mF 1.2 mF 3 mF	0.048 % of reading 0.027 % of reading 0.024 % of reading 0.023 % of reading 0.018 % of reading	Time/Charge Method utilizing the HP 3458A 8.5 Digit Multimeter.

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Capacitance – Measure [1] 10 Hz to 1 MHz (Fixed Points)	3.3 mF 8 mF 10 mF 12 mF 30 mF 80 mF 100 mF	0.017 % of reading 0.016 % of reading 0.016 % of reading 0.016 % of reading 0.015 % of reading 0.014 % of reading 0.014 % of reading	Time/Charge Method utilizing the HP 3458A 8.5 Digit Multimeter.
Capacitance – Measure 10 Hz to 1 MHz (Fixed Points)	0.1 pF 100 kHz 1 MHz 1 pF 10 kHz 100 kHz 1 MHz 2 MHz 10 pF 1 kHz 10 kHz 100 kHz 1 MHz 2 MHz 100 pF 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz 2 MHz 1 nF 20 Hz 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz 2 MHz	 1.4 % of reading 1.8 % of reading 1.4 % of reading 0.37 % of reading 0.44 % of reading 1.1 % of reading 1.4 % of reading 0.28 % of reading 0.28 % of reading 0.3 % of reading 0.75 % of reading 2.1 % of reading 0.23 % of reading 0.17 % of reading 0.21 % of reading 0.23 % of reading 0.3 % of reading 1.8 % of reading 0.3 % of reading 0.1 % of reading 0.1 % of reading 0.1 % of reading 0.14 % of reading 0.53 % of reading	Agilent E4980A LCR Meter

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Capacitance – Measure 10 Hz to 1 MHz (Fixed Points)	10 nF		Agilent E4980A LCR Meter
	20 Hz	0.31 % of reading	
	100 Hz	0.12 % of reading	
	1 kHz	0.092 % of reading	
	10 kHz	0.092 % of reading	
	100 kHz	0.092 % of reading	
	1 MHz	0.25 % of reading	
	2 MHz	0.67 % of reading	
	100 nF		
	20 Hz	0.16 % of reading	
	100 Hz	0.092 % of reading	
	1 kHz	0.092 % of reading	
	10 kHz	0.092 % of reading	
	100 kHz	0.18 % of reading	
	1 MHz	0.33 % of reading	
	2 MHz	0.97 % of reading	
	1 µF		
	20 Hz	0.15 % of reading	
	100 Hz	0.092 % of reading	
	1 kHz	0.092 % of reading	
	10 kHz	0.18 % of reading	
	100 kHz	0.25 % of reading	
	1 MHz	0.79 % of reading	
	10 µF		
	20 Hz	0.15 % of reading	
	100 Hz	0.092 % of reading	
	1 kHz	0.16 % of reading	
	10 kHz	0.28 % of reading	
	100 kHz	0.73 % of reading	
	100 µF		
	20 Hz	0.16 % of reading	
	100 Hz	0.17 % of reading	
	1 kHz	0.29 % of reading	
	10 kHz	0.8 % of reading	
DC Resistance – Source/Measure	Up to 100 µΩ	0.63 nΩ	Standard Resistors, Current Source, Digital Multimeter
	(0.1 Ω to 1) mΩ	6.1 µΩ/Ω	
	(1 to 10) mΩ	7.2 µΩ/Ω	
	(10 to 100) mΩ	2.5 µΩ/Ω	
	(0.1 to 1) Ω	4.4 µΩ/Ω	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Resistance – Source/Measure	(1 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	0.41 μΩ/Ω 0.67 μΩ/Ω 0.82 μΩ/Ω 2.4 μΩ/Ω 0.29 μΩ/Ω 1.4 μΩ/Ω 16 μΩ/Ω 19 μΩ/Ω	Standard Resistors, MI 6242B Resistance Bridge
Resistance Ratio	1 Ω to 1 kΩ	0.16 μΩ/Ω	MI 6242B Resistance Bridge
DC Resistance – Source/Measure [1]	Up 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 12 μΩ/Ω + 0.58 mΩ 12 μΩ/Ω + 5.8 mΩ 12 μΩ/Ω + 58 mΩ 20 μΩ/Ω + 2.3 Ω 62 μΩ/Ω + 0.12 kΩ 0.59 mΩ/Ω + 1.2 kΩ 0.82 % of reading + 12 kΩ	Agilent 3458A opt 002 8.5 Digit Multimeter, Decade Resistor
	(1 to 10) GΩ (10 to 100) GΩ (0.1 to 1) TΩ (1 to 10) TΩ (10 to 100) TΩ	0.073 % of reading + 10 kΩ 0.074 % of reading + 0.1 MΩ 0.075 % of reading + 1 MΩ 0.19 % of reading + 10 MΩ 0.59 % of reading + 0.1 GΩ	Keithley 6430 Sub-Femtoamp Remote Sourcemeter, Voltage Source
DC Resistance – Source	10 MΩ 100 MΩ 1 GΩ	19 μΩ/Ω 30 μΩ/Ω 53 μΩ/Ω	Standard Resistors
DC Resistance – Source [1]	(10 to 100) MΩ (0.1 to 1) GΩ (1 to 10) GΩ (10 to 100) GΩ (0.1 to 1) TΩ	0.08 % of reading 0.25 % of reading 0.41 % of reading 0.84 % of reading 2.5 % of reading	IET HRRS-B-7-100k-5kV High Resistance Substituter
DC Resistance – Measure	(0.1 to 1) GΩ (1 to 20) GΩ	32 μΩ/Ω 0.14 mΩ/Ω	Double Substitution Method using Standard Resistors and Fluke 8508 8.5 Digit Multimeter.

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Impedance – Measure [3]	0.1 Ω		Agilent E4980A LCR Meter
	1 kHz	1.8 % of reading	
	10 kHz	1.6 % of reading	
	100 kHz	1 % of reading	
	1 MHz	1.5 % of reading	
	1 Ω		
	20 Hz	0.67 % of reading	
	100 Hz	0.43 % of reading	
	1 kHz	0.33 % of reading	
	10 kHz	0.32 % of reading	
	100 kHz	0.31 % of reading	
	1 MHz	0.38 % of reading	
	2 MHz	0.92 % of reading	
	10 Ω		
	20 Hz	0.29 % of reading	
	100 Hz	0.2 % of reading	
	1 kHz	0.17 % of reading	
	10 kHz	0.19 % of reading	
	100 kHz	0.19 % of reading	
	1 MHz	0.27 % of reading	
	2 MHz	0.67 % of reading	
	100 Ω		
	20 Hz	0.16 % of reading	
	100 Hz	0.092 % of reading	
	1 kHz	0.092 % of reading	
	10 kHz	0.12 % of reading	
	100 kHz	0.12 % of reading	
	1 MHz	0.2 % of reading	
	2 MHz	0.53 % of reading	
	1 kΩ		
	20 Hz	0.15 % of reading	
	100 Hz	0.092 % of reading	
	1 kHz	0.092 % of reading	
	10 kHz	0.092 % of reading	
	100 kHz	0.092 % of reading	
	1 MHz	0.14 % of reading	
	2 MHz	0.3 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Impedance – Measure [3]	10 kΩ		Agilent E4980A LCR Meter
	20 Hz	0.15 % of reading	
	100 Hz	0.092 % of reading	
	1 kHz	0.092 % of reading	
	10 kHz	0.092 % of reading	
	100 kHz	0.1 % of reading	
	1 MHz	0.29 of reading	
	2 MHz	0.87 of reading	
	100 kΩ		
	20 Hz	0.17 % of reading	
	100 Hz	0.1 % of reading	
	1 kHz	0.1 % of reading	
	10 kHz	0.17 % of reading	
	100 kHz	0.28 % of reading	
	1 MHz	0.38 % of reading	
	2 MHz	1.3 % of reading	
Flatness Relative to 1 kHz 7 V / 3.2 V	10 Hz	0.009 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator
	20 Hz	0.008% of reading	
	50 Hz	0.006 % of reading	
	105 Hz	0.007 % of reading	
	200 Hz	0.006 % of reading	
	2 kHz	0.006 % of reading	
	10 kHz	0.006 % of reading	
	20 kHz	0.008 % of reading	
	50 kHz	0.007 % of reading	
	100 kHz	0.007 % of reading	
	200 kHz	0.007 % of reading	
	500 kHz	0.009 % of reading	
	700 kHz	0.013 % of reading	
	1 MHz	0.016 % of reading	
	1.2 MHz	0.016 % of reading	
	2 MHz	0.021 % of reading	
	3 MHz	0.024 % of reading	
	4 MHz	0.028% of reading	
	6 MHz	0.031 % of reading	
	8 MHz	0.034 % of reading	
	9 MHz	0.034 % of reading	
	10 MHz	0.034 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Flatness Relative to 1 kHz 7 V / 3.2 V	12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz 35 MHz 40 MHz 45 MHz 50 MHz	0.042 % of reading 0.046 % of reading 0.052 % of reading 0.062 % of reading 0.087 % of reading 0.1 % of reading 0.11 % of reading 0.12 % of reading 0.15 % of reading 0.17 % of reading 0.20 % of reading 0.25 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator
Flatness Relative to 1 kHz 2.2 V / 2 V	10 Hz 20 Hz 50 Hz 105 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz	0.012 % of reading 0.012 % of reading 0.007 % of reading 0.008 % of reading 0.006 % of reading 0.007 % of reading 0.007 % of reading 0.008 % of reading 0.007% of reading 0.007 % of reading 0.007 % of reading 0.009 % of reading 0.014 % of reading 0.017 % of reading 0.017 % of reading 0.021 % of reading 0.026 % of reading 0.029 % of reading 0.033 % of reading 0.037 % of reading 0.036 % of reading 0.036 % of reading 0.045 % of reading 0.049 % of reading 0.054 % of reading 0.065 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Flatness Relative to 1 kHz 2.2 V / 2 V	23 MHz 26 MHz 28 MHz 30 MHz 35 MHz 40 MHz 45 MHz 50 MHz	0.045 % of reading 0.049 % of reading 0.054 % of reading 0.065 % of reading 0.089 % of reading 0.1 % of reading 0.12 % of reading 0.12 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator
Flatness Relative to 1 kHz 2.2 V / 1 V	10 Hz 20 Hz 50 Hz 105 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz	0.014 % of reading 0.013 % of reading 0.008 % of reading 0.009 % of reading 0.007 % of reading 0.007 % of reading 0.007 % of reading 0.008 % of reading 0.007 % of reading 0.007 % of reading 0.007 % of reading 0.009 % of reading 0.014 % of reading 0.017 % of reading 0.017 % of reading 0.022 % of reading 0.027 % of reading 0.031 % of reading 0.035 % of reading 0.039 % of reading 0.04 % of reading 0.04 % of reading 0.049 % of reading 0.052 % of reading 0.056 % of reading 0.066 % of reading 0.049 % of reading 0.052 % of reading 0.056 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Flatness Relative to 1 kHz 2.2 V / 1 V	30 MHz 35 MHz 40 MHz 45 MHz 50 MHz	0.066 % of reading 0.09 % of reading 0.11 % of reading 0.12 % of reading 0.13 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator
Flatness Relative to 1 kHz 0.7 V / 0.64 V	10 Hz 20 Hz 50 Hz 105 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz	0.017 % of reading 0.016 % of reading 0.009 % of reading 0.01 % of reading 0.008 % of reading 0.007 % of reading 0.007 % of reading 0.009 % of reading 0.008 % of reading 0.008 % of reading 0.008 % of reading 0.01 % of reading 0.015 % of reading 0.018 % of reading 0.018 % of reading 0.023 % of reading 0.028 % of reading 0.032 % of reading 0.037 % of reading 0.041 % of reading 0.042 % of reading 0.042 % of reading 0.052 % of reading 0.055 % of reading 0.059 % of reading 0.069 % of reading 0.052 % of reading 0.055 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Flatness Relative to 1 kHz 0.7 V / 0.64 V	28 MHz 30 MHz 35 MHz 40 MHz 45 MHz 50 MHz	0.059 % of reading 0.069 % of reading 0.093 % of reading 0.11 % of reading 0.12 % of reading 0.13 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator
Flatness Relative to 1 kHz 0.7 V / 0.32 V	10 Hz 20 Hz 50 Hz 105 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz	0.014 % of reading 0.014 % of reading 0.008 % of reading 0.008 % of reading 0.007 % of reading 0.008 % of reading 0.007 % of reading 0.009 % of reading 0.008 % of reading 0.008 % of reading 0.008 % of reading 0.010 % of reading 0.015 % of reading 0.017 % of reading 0.018 % of reading 0.022 % of reading 0.028 % of reading 0.031 % of reading 0.034 % of reading 0.038 % of reading 0.038 % of reading 0.038 % of reading 0.049 % of reading 0.053 % of reading 0.060 % of reading 0.071 % of reading 0.049 % of reading 0.053 % of reading 0.06 % of reading 0.071 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Flatness Relative to 1 kHz 0.7 V / 0.32 V	35 MHz 40 MHz 45 MHz 50 MHz	0.094 % of reading 0.11 % of reading 0.12 % of reading 0.13 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator
Flatness Relative to 1 kHz 0.22 V / 0.1 V	10 Hz 20 Hz 50 Hz 105 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz	0.018 % of reading 0.017 % of reading 0.01 % of reading 0.01 % of reading 0.008 % of reading 0.008 % of reading 0.008 % of reading 0.009 % of reading 0.009 % of reading 0.009 % of reading 0.009 % of reading 0.01 % of reading 0.016 % of reading 0.019 % of reading 0.019 % of reading 0.023 % of reading 0.03 % of reading 0.034 % of reading 0.038 % of reading 0.043 % of reading 0.043 % of reading 0.044 % of reading 0.055 % of reading 0.059 % of reading 0.064 % of reading 0.075 % of reading 0.055 % of reading 0.059 % of reading 0.064 % of reading 0.075 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Flatness Relative to 1 kHz 0.22 V / 0.1 V	35 MHz 40 MHz 45 MHz 50 MHz	0.098 % of reading 0.12 % of reading 0.13 % of reading 0.14 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator
Flatness Relative to 1 kHz 0.07 V / 32 mV	10 Hz 20 Hz 50 Hz 105 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz	0.019 % of reading 0.018 % of reading 0.009 % of reading 0.01 % of reading 0.008 % of reading 0.009 % of reading 0.009 % of reading 0.01 % of reading 0.009 % of reading 0.009 % of reading 0.01 % of reading 0.011 % of reading 0.016 % of reading 0.02 % of reading 0.02 % of reading 0.024 % of reading 0.031 % of reading 0.034 % of reading 0.039 % of reading 0.044 % of reading 0.044 % of reading 0.045 % of reading 0.057 % of reading 0.063 % of reading 0.07 % of reading 0.08 % of reading 0.057 % of reading 0.063 % of reading 0.07 % of reading 0.08 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Flatness Relative to 1 kHz 0.07 V / 32 mV	35 MHz 40 MHz 45 MHz 50 MHz	0.1 % of reading 0.12 % of reading 0.13 % of reading 0.14 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator
Flatness Relative to 1 kHz 22 mV / 10 mV	10 Hz 20 Hz 50 Hz 105 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz	0.022 % of reading 0.021 % of reading 0.011 % of reading 0.011 % of reading 0.009 % of reading 0.009 % of reading 0.009 % of reading 0.01 % of reading 0.01 % of reading 0.01 % of reading 0.01 % of reading 0.012 % of reading 0.017 % of reading 0.021 % of reading 0.021 % of reading 0.025 % of reading 0.033 % of reading 0.037 % of reading 0.043 % of reading 0.048 % of reading 0.049 % of reading 0.05 % of reading 0.063 % of reading 0.068 % of reading 0.073 % of reading 0.084 % of reading 0.063 % of reading 0.068 % of reading 0.073% of reading 0.084 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Flatness Relative to 1 kHz 22 mV / 10 mV	35 MHz 40 MHz 45 MHz 50 MHz	0.11 % of reading 0.12 % of reading 0.14 % of reading 0.15 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator
Flatness Relative to 1 kHz 7 mV / 3.2 mV	10 Hz 20 Hz 50 Hz 105 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz	0.022 % of reading 0.022 % of reading 0.01 % of reading 0.011 % of reading 0.009 % of reading 0.01 % of reading 0.01 % of reading 0.011 % of reading 0.01 % of reading 0.01 % of reading 0.01 % of reading 0.012 % of reading 0.018 % of reading 0.021 % of reading 0.021 % of reading 0.025 % of reading 0.034 % of reading 0.036 % of reading 0.042 % of reading 0.047 % of reading 0.048 % of reading 0.049 % of reading 0.063 % of reading 0.069 % of reading 0.076 % of reading 0.087 % of reading 0.063 % of reading 0.069 % of reading 0.076 % of reading 0.087 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Flatness Relative to 1 kHz 7 mV / 3.2 mV	35 MHz 40 MHz 45 MHz 50 MHz	0.11 % of reading 0.13 % of reading 0.14 % of reading 0.15 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator
Flatness Relative to 1 kHz 2.2 mV / 1 mV	10 Hz 20 Hz 50 Hz 105 Hz 200 Hz 2 kHz 10 kHz 20 kHz 50 kHz 100 kHz 200 kHz 500 kHz 700 kHz 1 MHz 1.2 MHz 2 MHz 3 MHz 4 MHz 6 MHz 8 MHz 9 MHz 10 MHz 12 MHz 15 MHz 17 MHz 20 MHz 23 MHz 26 MHz 28 MHz 30 MHz	0.025 % of reading 0.024 % of reading 0.011 % of reading 0.012 % of reading 0.01 % of reading 0.01 % of reading 0.01 % of reading 0.011 % of reading 0.01 % of reading 0.011 % of reading 0.011 % of reading 0.013 % of reading 0.018 % of reading 0.022 % of reading 0.022 % of reading 0.026 % of reading 0.036 % of reading 0.039 % of reading 0.045 % of reading 0.051 % of reading 0.052 % of reading 0.053 % of reading 0.068 % of reading 0.073 % of reading 0.079 % of reading 0.09 % of reading 0.068 % of reading 0.073 % of reading 0.079 % of reading 0.09 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Flatness Relative to 1 kHz 2.2 mV / 1 mV	35 MHz 40 MHz 45 MHz 50 MHz	0.11 % of reading 0.13 % of reading 0.14 % of reading 0.15 % of reading	Fluke 5790B AC Measurement Standard, EL1100 3 V Thermal converter, 4 dB attenuator, 10 dB attenuator, (3) 20 dB attenuators, Fluke 5730A Multiproduct Calibrator
Low Frequency – AC/DC Difference Measurement (Voltage)	2 mV 10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz 6 mV 10 Hz 20 Hz 40 Hz 100 Hz 1 kHz 10 kHz 20 kHz 50 kHz 100 kHz 300 kHz 500 kHz 800 kHz 1 MHz	 0.56 V/V 0.35 mV/V 0.45 mV/V 0.39 mV/V 0.34 mV/V 0.32 mV/V 0.32 mV/V 0.35 mV/V 0.44 mV/V 0.51 mV/V 0.61 mV/V 0.75 mV/V 0.76 mV/V 0.23 mV/V 0.23 mV/V 0.23 mV/V 0.19 mV/V 0.18 mV/V 0.17 mV/V 0.2 mV/V 0.22 mV/V 0.3 mV/V 0.41 mV/V 0.49 mV/V 0.58 mV/V 0.63 mV/V	Fluke 792A AC/DC Transfer Standard

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Low Frequency – AC/DC Difference Measurement (Voltage)	10 mV		Fluke 792A AC/DC Transfer Standard
	10 Hz	0.11 mV/V	
	20 Hz	0.11 mV/V	
	40 Hz	89 µV/V	
	100 Hz	0.14 mV/V	
	1 kHz	88 µV/V	
	10 kHz	0.11 mV/V	
	20 kHz	83 µV/V	
	50 kHz	0.1 mV/V	
	100 kHz	0.16 mV/V	
	300 kHz	0.22 mV/V	
	500 kHz	0.3 mV/V	
	800 kHz	0.33 mV/V	
	1 MHz	0.42 mV/V	
	20 mV		
	10 Hz	84 µV/V	
	20 Hz	68 µV/V	
	40 Hz	64 µV/V	
	100 Hz	0.11 mV/V	
	1 kHz	67 µV/V	
	10 kHz	81 µV/V	
	20 kHz	62 µV/V	
	50 kHz	0.11 mV/V	
	100 kHz	0.16 mV/V	
	300 kHz	0.22 mV/V	
	500 kHz	0.31 mV/V	
	800 kHz	0.38 mV/V	
	1 MHz	0.39 mV/V	
	60 mV		
	10 Hz	0.1 mV/V	
	20 Hz	45 µV/V	
	40 Hz	35 µV/V	
	100 Hz	33 µV/V	
	1 kHz	32 µV/V	
	10 kHz	37 µV/V	
	20 kHz	35 µV/V	
	50 kHz	40 µV/V	
	100 kHz	77 µV/V	
	300 kHz	0.15 mV/V	
	500 kHz	0.22 mV/V	
	800 kHz	0.29 mV/V	
	1 MHz	0.3 mV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Low Frequency – AC/DC Difference Measurement (Voltage)	0.1 V		Fluke 792A AC/DC Transfer Standard
	10 Hz	46 µV/V	
	20 Hz	29 µV/V	
	40 Hz	21 µV/V	
	100 Hz	15 µV/V	
	1 kHz	14 µV/V	
	10 kHz	26 µV/V	
	20 kHz	29 µV/V	
	50 kHz	30 µV/V	
	100 kHz	45 µV/V	
	300 kHz	90 µV/V	
	500 kHz	0.13 mV/V	
	800 kHz	0.19 mV/V	
	1 MHz	0.2 mV/V	
	0.2 V		
	10 Hz	35 µV/V	
	20 Hz	21 µV/V	
	40 Hz	29 µV/V	
	100 Hz	16 µV/V	
	1 kHz	12 µV/V	
	10 kHz	20 µV/V	
	20 kHz	17 µV/V	
	50 kHz	28 µV/V	
	100 kHz	48 µV/V	
	300 kHz	76 µV/V	
	500 kHz	0.11 mV/V	
	800 kHz	0.16 mV/V	
	1 MHz	0.19 mV/V	
	0.6 V		
	10 Hz	28 µV/V	
	20 Hz	24 µV/V	
	40 Hz	7.6 µV/V	
	100 Hz	8.7 µV/V	
	1 kHz	9.2 µV/V	
	10 kHz	7.8 µV/V	
	20 kHz	9.7 µV/V	
	50 kHz	8.6 µV/V	
	100 kHz	30 µV/V	
	300 kHz	26 µV/V	
	500 kHz	47 µV/V	
	800 kHz	60 µV/V	
	1 MHz	81 µV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Low Frequency – AC/DC Difference Measurement (Voltage)	1V		Fluke 792A AC/DC Transfer Standard
	10 Hz	29 µV/V	
	20 Hz	18 µV/V	
	40 Hz	6.5 µV/V	
	100 Hz	6.7 µV/V	
	1 kHz	7 µV/V	
	10 kHz	6 µV/V	
	20 kHz	6 µV/V	
	50 kHz	8.2 µV/V	
	100 kHz	14 µV/V	
	300 kHz	22 µV/V	
	500 kHz	35 µV/V	
	800 kHz	36 µV/V	
	1 MHz	48 µV/V	
	2 V		
	10 Hz	25 µV/V	
	20 Hz	15 µV/V	
	40 Hz	6.6 µV/V	
	100 Hz	6.4 µV/V	
	1 kHz	6.5µV/V	
	10 kHz	6.2 µV/V	
	20 kHz	6.8 µV/V	
	50 kHz	7.9 µV/V	
	100 kHz	14 µV/V	
	300 kHz	33 µV/V	
	500 kHz	33 µV/V	
	800 kHz	32 µV/V	
	1 MHz	45 µV/V	
	6 V		
	10 Hz	32 µV/V	
	20 Hz	16 µV/V	
	40 Hz	5.6 µV/V	
	100 Hz	6.1 µV/V	
	1 kHz	5.8 µV/V	
	10 kHz	6.3 µV/V	
	20 kHz	5.8 µV/V	
	50 kHz	6.5 µV/V	
	100 kHz	9.4 µV/V	
	300 kHz	20 µV/V	
	500 kHz	27 µV/V	
	800 kHz	33 µV/V	
	1 MHz	42 µV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Low Frequency – AC/DC Difference Measurement (Voltage)	10 V		Fluke 792A AC/DC Transfer Standard
	10 Hz	26 µV/V	
	20 Hz	15 µV/V	
	40 Hz	5.5 µV/V	
	100 Hz	6.3 µV/V	
	1 kHz	5.9 µV/V	
	10 kHz	5.5 µV/V	
	20 kHz	5.6 µV/V	
	50 kHz	7.3 µV/V	
	100 kHz	9.6 µV/V	
	300 kHz	20 µV/V	
	500 kHz	35 µV/V	
	800 kHz	56 µV/V	
	1 MHz	81 µV/V	
	20 V		
	10 Hz	37 µV/V	
	20 Hz	17 µV/V	
	40 Hz	8 µV/V	
	100 Hz	7.9 µV/V	
	1 kHz	7.7 µV/V	
	10 kHz	7.9 µV/V	
	20 kHz	7.8 µV/V	
	50 kHz	8.9 µV/V	
	100 kHz	12 µV/V	
	300 kHz	22 µV/V	
	500 kHz	28 µV/V	
	800 kHz	37 µV/V	
	1 MHz	55 µV/V	
	60 V		
	10 Hz	36 µV/V	
	20 Hz	17 µV/V	
	40 Hz	7.1 µV/V	
	100 Hz	6.9 µV/V	
	1 kHz	7.3 µV/V	
	10 kHz	7.0 µV/V	
	20 kHz	7.7 µV/V	
	50 kHz	15 µV/V	
	100 kHz	11 µV/V	
	300 kHz	33 µV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Low Frequency – AC/DC Difference Measurement (Voltage)	100 V		Fluke 792A AC/DC Transfer Standard
	10 Hz	27 µV/V	
	20 Hz	15 µV/V	
	40 Hz	7.2 µV/V	
	100 Hz	6.9 µV/V	
	1 kHz	7 µV/V	
	10 kHz	7.1 µV/V	
	20 kHz	7.6 µV/V	
	50 kHz	12 µV/V	
	100 kHz	18 µV/V	
	200 V		
	10 Hz	44 µV/V	
	20 Hz	17 µV/V	
	40 Hz	10 µV/V	
	100 Hz	10 µV/V	
	1 kHz	9.7 µV/V	
	10 kHz	9.8 µV/V	
	20 kHz	10.3 µV/V	
	50 kHz	12 µV/V	
	100 kHz	19 µV/V	
	600 V		
	10 Hz	54 µV/V	
	20 Hz	29 µV/V	
	40 Hz	14 µV/V	
	100 Hz	15 µV/V	
	1 kHz	13 µV/V	
	10 kHz	18 µV/V	
	20 kHz	20 µV/V	
	50 kHz	32 µV/V	
	100 kHz	72 µV/V	
	1 000 V		
	10 Hz	54 µV/V	
	20 Hz	22 µV/V	
	40 Hz	13 µV/V	
	100 Hz	12 µV/V	
	1 kHz	13 µV/V	
	10 kHz	16 µV/V	
	20 kHz	22 µV/V	
	50 kHz	47 µV/V	
	100 kHz	67 µV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure (Current w/ Voltage Output Reading)	0.1 mA		Fluke 792A AC/DC Transfer Standard, Fluke A40 Current Shunts
	10 Hz	75 µV/V	
	20 Hz	70 µV/V	
	40 Hz	61 µV/V	
	400 Hz	59 µV/V	
	1 kHz	56 µV/V	
	5 kHz	73 µV/V	
	10 kHz	83 µV/V	
	20 kHz	0.12 mV/V	
	30 kHz	0.16 mV/V	
	0.2 mA		
	10 Hz	95 µV/V	
	20 Hz	56 µV/V	
	40 Hz	59 µV/V	
	400 Hz	45 µV/V	
	1 kHz	43 µV/V	
	5 kHz	69 µV/V	
	10 kHz	81 µV/V	
	20 kHz	0.12 mV/V	
	30 kHz	0.19 mV/V	
	0.3 mA		
	10 Hz	71 µV/V	
	20 Hz	70 µV/V	
	40 Hz	49 µV/V	
	400 Hz	47 µV/V	
	1 kHz	47 µV/V	
	5 kHz	47 µV/V	
	10 kHz	49 µV/V	
	20 kHz	68 µV/V	
	30 kHz	0.12 mV/V	
	1 mA		
	10 Hz	56 µV/V	
	20 Hz	47 µV/V	
	40 Hz	41 µV/V	
	400 Hz	34 µV/V	
	1 kHz	30 µV/V	
	5 kHz	34 µV/V	
	10 kHz	37 µV/V	
	20 kHz	43 µV/V	
	30 kHz	36 µV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure (Current w/ Voltage Output Reading)	2 mA		Fluke 792A AC/DC Transfer Standard, Fluke A40 Current Shunts
	10 Hz	54 µV/V	
	20 Hz	42 µV/V	
	40 Hz	46 µV/V	
	400 Hz	38 µV/V	
	1 kHz	38 µV/V	
	5 kHz	39 µV/V	
	10 kHz	41 µV/V	
	20 kHz	41 µV/V	
	30 kHz	48 µV/V	
	3 mA		
	10 Hz	51 µV/V	
	20 Hz	40 µV/V	
	40 Hz	35 µV/V	
	400 Hz	33 µV/V	
	1 kHz	33 µV/V	
	5 kHz	32 µV/V	
	10 kHz	32 µV/V	
	20 kHz	38 µV/V	
	30 kHz	44 µV/V	
	10 mA		
	10 Hz	0.1 mV/V	
	20 Hz	53 µV/V	
	40 Hz	38 µV/V	
	400 Hz	37 µV/V	
	1 kHz	32 µV/V	
	5 kHz	31 µV/V	
	10 kHz	32 µV/V	
	20 kHz	42 µV/V	
	30 kHz	63 µV/V	
	20 mA		
	10 Hz	0.14 mV/V	
	20 Hz	84 µV/V	
	40 Hz	78 µV/V	
	400 Hz	77 µV/V	
	1 kHz	76 µV/V	
	5 kHz	76 µV/V	
	10 kHz	76 µV/V	
	20 kHz	78 µV/V	
	30 kHz	93 µV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure (Current w/ Voltage Output Reading)	30 mA		Fluke 792A AC/DC Transfer Standard, Fluke A40 Current Shunts
	10 Hz	0.15 mV/V	
	20 Hz	92 µV/V	
	40 Hz	72 µV/V	
	400 Hz	66 µV/V	
	1 kHz	66 µV/V	
	5 kHz	67 µV/V	
	10 kHz	73 µV/V	
	20 kHz	85 µV/V	
	30 kHz	0.11 mV/V	
	0.1 A		
	10 Hz	0.14 mV/V	
	20 Hz	64 µV/V	
	40 Hz	53 µV/V	
	400 Hz	51 µV/V	
	1 kHz	48 µV/V	
	5 kHz	48 µV/V	
	10 kHz	49 µV/V	
	20 kHz	61 µV/V	
	30 kHz	78 µV/V	
	0.2 A		
	10 Hz	0.15 mV/V	
	20 Hz	58 µV/V	
	40 Hz	39 µV/V	
	400 Hz	37 µV/V	
	1 kHz	40 µV/V	
	5 kHz	34 µV/V	
	10 kHz	33 µV/V	
	20 kHz	49 µV/V	
	30 kHz	68 µV/V	
	0.3 A		
	10 Hz	0.12 mV/V	
	20 Hz	56 µV/V	
	40 Hz	43 µV/V	
	400 Hz	33 µV/V	
	1 kHz	32 µV/V	
	5 kHz	31 µV/V	
	10 kHz	36 µV/V	
	20 kHz	43 µV/V	
	30 kHz	72 µV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure (Current w/ Voltage Output Reading)	0.5 A		Fluke 792A AC/DC Transfer Standard, Fluke A40 Current Shunts
	10 Hz	0.26 mV/V	
	20 Hz	51 µV/V	
	40 Hz	75 µV/V	
	400 Hz	50 µV/V	
	1 kHz	45 µV/V	
	5 kHz	37 µV/V	
	10 kHz	29 µV/V	
	20 kHz	47 µV/V	
	30 kHz	79 µV/V	
	1 A		
	10 Hz	98 µV/V	
	20 Hz	50 µV/V	
	40 Hz	38 µV/V	
	400 Hz	39 µV/V	
	1 kHz	35 µV/V	
	5 kHz	39 µV/V	
	10 kHz	48 µV/V	
	20 kHz	80 µV/V	
	30 kHz	0.12 mV/V	
	2 A		
	10 Hz	0.11 mV/V	
	20 Hz	56 µV/V	
	40 Hz	42 µV/V	
	400 Hz	37 µV/V	
	1 kHz	35 µV/V	
	5 kHz	42 µV/V	
	10 kHz	43 µV/V	
	20 kHz	55 µV/V	
	30 kHz	0.11 mV/V	
	3 A		
	10 Hz	0.13 mV/V	
	20 Hz	66 µV/V	
	40 Hz	57 µV/V	
	400 Hz	56 µV/V	
	1 kHz	55 µV/V	
	5 kHz	61 µV/V	
	10 kHz	63 µV/V	
	20 kHz	83 µV/V	
	30 kHz	0.14 mV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure (Current w/ Voltage Output Reading)	5 A		Fluke 792A AC/DC Transfer Standard, Fluke A40 Current Shunts
	10 Hz	0.13 mV/V	
	20 Hz	67 µV/V	
	40 Hz	56 µV/V	
	400 Hz	61 µV/V	
	1 kHz	53 µV/V	
	5 kHz	58 µV/V	
	10 kHz	69 µV/V	
	20 kHz	88 µV/V	
	30 kHz	0.18 mV/V	
	10 A		
	10 Hz	0.15 mV/V	
	20 Hz	84 µV/V	
	40 Hz	65 µV/V	
	400 Hz	64 µV/V	
	1 kHz	62 µV/V	
	5 kHz	62 µV/V	
	10 kHz	62 µV/V	
	20 kHz	0.1 mV/V	
	30 kHz	0.15 mV/V	
	20 A		
	10 Hz	0.15 mV/V	
	20 Hz	0.12 mV/V	
	40 Hz	81 µV/V	
	400 Hz	81 µV/V	
	1 kHz	77 µV/V	
	5 kHz	77 µV/V	
	10 kHz	77 µV/V	
	20 kHz	0.13 mV/V	
	30 kHz	0.18 mV/V	
	100 A		
	10 Hz	0.16 mV/V	
	20 Hz	0.16 mV/V	
	40 Hz	96 µV/V	
	400 Hz	86 µV/V	
	1 kHz	86 µV/V	
	5 kHz	0.12 mV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	2 mV		Fluke 792A AC/DC Transfer Standard
	10 Hz	0.56 mV/V	
	20 Hz	0.35 mV/V	
	40 Hz	0.45 mV/V	
	100 Hz	0.39 mV/V	
	1 kHz	0.34 mV/V	
	10 kHz	0.32 mV/V	
	20 kHz	0.32 mV/V	
	50 kHz	0.35 mV/V	
	100 kHz	0.44 mV/V	
	300 kHz	0.51 mV/V	
	500 kHz	0.61 mV/V	
	800 kHz	0.75 mV/V	
	1 MHz	0.76 mV/V	
	6 mV		
	10 Hz	0.23 mV/V	
	20 Hz	0.23 mV/V	
	40 Hz	0.23 mV/V	
	100 Hz	0.19 mV/V	
	1 kHz	0.18 mV/V	
	10 kHz	0.17 mV/V	
	20 kHz	0.2 mV/V	
	50 kHz	0.22 mV/V	
	100 kHz	0.3 mV/V	
	300 kHz	0.41 mV/V	
	500 kHz	0.49 mV/V	
	800 kHz	0.58 mV/V	
	1 MHz	0.63 mV/V	
	10 mV		
	10 Hz	0.11 mV/V	
	20 Hz	0.11 mV/V	
	40 Hz	89 µV/V	
	100 Hz	0.14 mV/V	
	1 kHz	88 µV/V	
	10 kHz	0.11 mV/V	
	20 kHz	83 µV/V	
	50 kHz	0.1 mV/V	
	100 kHz	0.16 mV/V	
	300 kHz	0.22 mV/V	
	500 kHz	0.3 mV/V	
	800 kHz	0.33 mV/V	
	1 MHz	0.42 mV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	20 mV		Fluke 792A AC/DC Transfer Standard
	10 Hz	84 µV/V	
	20 Hz	68 µV/V	
	40 Hz	64 µV/V	
	100 Hz	0.11 mV/V	
	1 kHz	67 µV/V	
	10 kHz	81 µV/V	
	20 kHz	62 µV/V	
	50 kHz	0.11 mV/V	
	100 kHz	0.16 mV/V	
	300 kHz	0.22 mV/V	
	500 kHz	0.31 mV/V	
	800 kHz	0.38 mV/V	
	1 MHz	0.39 mV/V	
	60 mV		
	10 Hz	0.1 mV/V	
	20 Hz	45 µV/V	
	40 Hz	35 µV/V	
	100 Hz	33 µV/V	
	1 kHz	32 µV/V	
	10 kHz	37 µV/V	
	20 kHz	35 µV/V	
	50 kHz	40 µV/V	
	100 kHz	77 µV/V	
	300 kHz	0.15 mV/V	
	500 kHz	0.22 mV/V	
	800 kHz	0.29 mV/V	
	1 MHz	0.3 mV/V	
	0.1 V		
	10 Hz	46 µV/V	
	20 Hz	29 µV/V	
	40 Hz	21 µV/V	
	100 Hz	15 µV/V	
	1 kHz	14 µV/V	
	10 kHz	26 µV/V	
	20 kHz	29 µV/V	
	50 kHz	30 µV/V	
	100 kHz	45 µV/V	
	300 kHz	90 µV/V	
	500 kHz	0.13 mV/V	
	800 kHz	0.19 mV/V	
	1 MHz	0.2 mV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	0.2 V		Fluke 792A AC/DC Transfer Standard
	10 Hz	35 µV/V	
	20 Hz	21 µV/V	
	40 Hz	29 µV/V	
	100 Hz	16 µV/V	
	1 kHz	12 µV/V	
	10 kHz	20 µV/V	
	20 kHz	17 µV/V	
	50 kHz	28 µV/V	
	100 kHz	48 µV/V	
	300 kHz	76 µV/V	
	500 kHz	0.11 mV/V	
	800 kHz	0.16 mV/V	
	1 MHz	0.19 mV/V	
	0.6 V		
	10 Hz	28 µV/V	
	20 Hz	24 µV/V	
	40 Hz	7.6 µV/V	
	100 Hz	8.7 µV/V	
	1 kHz	9.2 µV/V	
	10 kHz	7.8 µV/V	
	20 kHz	9.7 µV/V	
	50 kHz	8.6 µV/V	
	100 kHz	30 µV/V	
	300 kHz	26 µV/V	
	500 kHz	47 µV/V	
	800 kHz	60 µV/V	
	1 MHz	81 µV/V	
	1 V		
	10 Hz	29 µV/V	
	20 Hz	18 µV/V	
	40 Hz	6.5 µV/V	
	100 Hz	6.7 µV/V	
	1 kHz	7 µV/V	
	10 kHz	6 µV/V	
	20 kHz	6 µV/V	
	50 kHz	8.2 µV/V	
	100 kHz	14 µV/V	
	300 kHz	22 µV/V	
	500 kHz	35 µV/V	
	800 kHz	36 µV/V	
	1 MHz	48 µV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	2 V		Fluke 792A AC/DC Transfer Standard
	10 Hz	25 µV/V	
	20 Hz	15 µV/V	
	40 Hz	6.6 µV/V	
	100 Hz	6.4 µV/V	
	1 kHz	6.5µV/V	
	10 kHz	6.2 µV/V	
	20 kHz	6.8 µV/V	
	50 kHz	7.9 µV/V	
	100 kHz	14 µV/V	
	300 kHz	33 µV/V	
	500 kHz	33 µV/V	
	800 kHz	32 µV/V	
	1 MHz	45 µV/V	
	6 V		
	10 Hz	32 µV/V	
	20 Hz	16 µV/V	
	40 Hz	5.6 µV/V	
	100 Hz	6.1 µV/V	
	1 kHz	5.8 µV/V	
	10 kHz	6.3 µV/V	
	20 kHz	5.8 µV/V	
	50 kHz	6.5 µV/V	
	100 kHz	9.4 µV/V	
	300 kHz	20 µV/V	
	500 kHz	27 µV/V	
	800 kHz	33 µV/V	
	1 MHz	42 µV/V	
	10 V		
	10 Hz	26 µV/V	
	20 Hz	15 µV/V	
	40 Hz	5.5 µV/V	
	100 Hz	6.3 µV/V	
	1 kHz	5.9 µV/V	
	10 kHz	5.5 µV/V	
	20 kHz	5.6 µV/V	
	50 kHz	7.3 µV/V	
	100 kHz	9.6 µV/V	
	300 kHz	20 µV/V	
	500 kHz	35 µV/V	
	800 kHz	56 µV/V	
	1 MHz	81 µV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	20 V		Fluke 792A AC/DC Transfer Standard
	10 Hz	37 µV/V	
	20 Hz	17 µV/V	
	40 Hz	8 µV/V	
	100 Hz	7.9 µV/V	
	1 kHz	7.7 µV/V	
	10 kHz	7.9 µV/V	
	20 kHz	7.8 µV/V	
	50 kHz	8.9 µV/V	
	100 kHz	12 µV/V	
	300 kHz	22 µV/V	
	500 kHz	28 µV/V	
	800 kHz	37 µV/V	
	1 MHz	55 µV/V	
	60 V		
	10 Hz	36 µV/V	
	20 Hz	17 µV/V	
	40 Hz	7.1 µV/V	
	100 Hz	6.9 µV/V	
	1 kHz	7.3 µV/V	
	10 kHz	7.0 µV/V	
	20 kHz	7.7 µV/V	
	50 kHz	15 µV/V	
	100 kHz	11 µV/V	
	300 kHz	33 µV/V	
	100 V		
	10 Hz	27 µV/V	
	20 Hz	15 µV/V	
	40 Hz	7.2 µV/V	
	100 Hz	6.9 µV/V	
	1 kHz	7 µV/V	
	10 kHz	7.1 µV/V	
	20 kHz	7.6 µV/V	
	50 kHz	12 µV/V	
	100 kHz	18 µV/V	
	200 V		
	10 Hz	44 µV/V	
	20 Hz	17 µV/V	
	40 Hz	10 µV/V	
	100 Hz	10 µV/V	
	1 kHz	9.7 µV/V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	200 V		Fluke 792A AC/DC Transfer Standard
	10 kHz	9.8 µV/V	
	20 kHz	10 µV/V	
	50 kHz	12 µV/V	
	100 kHz	19 µV/V	
	600 V		
	10 Hz	54 µV/V	
	20 Hz	29 µV/V	
	40 Hz	14 µV/V	
	100 Hz	15 µV/V	
	1 kHz	13 µV/V	
	10 kHz	18 µV/V	
	20 kHz	20 µV/V	
	50 kHz	32 µV/V	
	100 kHz	72 µV/V	
	1 000 V		
	10 Hz	54 µV/V	
	20 Hz	22 µV/V	
	40 Hz	13 µV/V	
	100 Hz	12 µV/V	
	1 kHz	13 µV/V	
	10 kHz	16 µV/V	
	20 kHz	22 µV/V	
	50 kHz	47 µV/V	
	100 kHz	67 µV/V	
Inductance – Measure [3]	1 µH		Agilent E4980A LCR Meter
	10 kHz	1.6 % of reading	
	100 kHz	0.36 % of reading	
	1 MHz	0.27 % of reading	
	2 MHz	0.66 % of reading	
	10 µH		
	10 kHz	0.37 % of reading	
	100 kHz	0.2 % of reading	
	1 MHz	0.2 % of reading	
	2 MHz	0.3 % of reading	
	100 µH		
	1 kHz	0.4 % of reading	
	10 kHz	0.2 % of reading	
	100 kHz	0.12 % of reading	
	1 MHz	0.14 % of reading	
	2 MHz	0.72 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inductance – Measure [3]	1 mH		Agilent E4980A LCR Meter
	100 Hz	0.55 % of reading	
	1 kHz	0.18 % of reading	
	10 kHz	0.12 % of reading	
	100 kHz	0.092 % of reading	
	1 MHz	0.23 % of reading	
	2 MHz	0.88 % of reading	
	10 mH		
	20 Hz	0.85 % of reading	
	100 Hz	0.22 % of reading	
	1 kHz	0.092 % of reading	
	10 kHz	0.092 % of reading	
	100 kHz	0.1 % of reading	
	1 MHz	0.35 % of reading	
	2 MHz	1.3 % of reading	
	100 mH		
	20 Hz	0.28 % of reading	
	100 Hz	0.1 % of reading	
	1 kHz	0.092 % of reading	
	10 kHz	0.092 % of reading	
	100 kHz	0.21 % of reading	
	1 MHz	0.88 % of reading	
	1 H		
	20 Hz	0.16 % of reading	
	100 Hz	0.092 % of reading	
	1 kHz	0.092 % of reading	
	10 kHz	0.1 % of reading	
	100 kHz	0.31 % of reading	
	10 H		
	20 Hz	0.15 % of reading	
	100 Hz	0.092 % of reading	
	1 kHz	0.1 % of reading	
	10 kHz	0.21 % of reading	
	100 kHz	0.69 % of reading	
	100 H		
	20 Hz	0.15 % of reading	
	100 Hz	0.10 % of reading	
	1 kHz	0.15 % of reading	
	10 kHz	0.62 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current Harmonics – Source [1,3]			Fluke 6105A Electrical Power Quality Calibrator
Carrier Range: 0.25A	Up to 75 mA		
	(16 to 850) Hz	61 µA/A + 21 µA	
	850 Hz to 6.5 kHz	0.46 mA/A + 22 µA	
Carrier Range: 0.5A	Up to 0.15 A		
	(16 to 850) Hz	70 µA/A + 21 µA	
	850 Hz to 6.5 kHz	0.46 mA/A + 23 µA	
Carrier Range: 1 A	Up to 0.3 A		
	(16 to 850) Hz	70 µA/A + 29 µA	
	850 Hz to 6.5 kHz	0.46 mA/A + 29 µA	
Carrier Range: 2 A	Up to 0.6 A		
	(16 to 850) Hz	70 µA/A + 0.1 mA	
	850 Hz to 6.5 kHz	0.46 mA/A + 0.1 mA	
Carrier Range: 5 A	Up to 1.5 A		
	(16 to 850) Hz	70 µA/A + 0.1 mA	
	850 Hz to 6.5 kHz	0.46 mA/A + 0.1 mA	
Carrier Range: 10 A	Up to 3 A		
	(16 to 850) Hz	74 µA/A + 0.29 mA	
	850 Hz to 6.5 kHz	0.46 mA/A + 0.29 mA	
Carrier Range: 20 A	Up to 6 A		
	(16 to 850) Hz	75 µA/A + 0.45 mA	
	850 Hz to 6.5 kHz	0.46 mA/A + 0.45 mA	
AC Voltage Harmonics – Source [1,3]			Fluke 6105A Electrical Power Quality Calibrator
Carrier Range: 23 V	Up to 6.9 V		
	(16 to 850) Hz	58 µV/V + 1 mV	
	850 Hz to 6.5 kHz	0.52 mV + 1 mV	
Carrier Range: 90 V	Up to 90 V		
	(16 to 850) Hz	69 µV/V + 6 mV	
	850 Hz to 6.5 kHz	0.52 mV + 6 mV	
Carrier Range: 360 V	Up to 108 V		
	(16 to 850) Hz	69 µV/V + 13 mV	
	850 Hz to 6.5 kHz	0.52 mV + 13 mV	
Carrier Range: 650 V	Up to 195 V		
	(16 to 850) Hz	70 µV/V + 22 mV	
	850 Hz to 6.5 kHz	0.52 mV/V + 22 mV	
Carrier Range: 1 008 V	Up to 302 V		
	(16 to 850) Hz	70 µV/V + 33 mV	
	850 Hz to 6.5 kHz	0.52 mV/V + 33 mV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes [1,4]			Fluke 9500B Oscilloscope Calibrator, Fluke 9530 3.2 GHz Active Head, Fluke 9550 Active Head w/ 25 ps Capability, Fluke 9560 Active Head w/ 70 ps Capability, Tektronix 067-1330-000 Calibration Fixture
Amplitude – DC			
into 50 Ω load	(-5 to 5) V	0.023 % of reading + 19 µV	
into 1 MΩ load	(-200 to 200) V	0.023 % of reading + 19 µV	
Amplitude – Square Wave			
Rate: 10 Hz to 10 kHz			
into 50 Ω load	40 µVp-p to 1 mVp-p	0.78 % of reading + 7.8 µV	
	1 mVp-p to 5 Vp-p	0.078 % of reading + 7.8 µV	
into 1 MΩ load	40 µVp-p to 1 mVp-p	0.78 % of reading + 7.8 µV	
Rate: 10 Hz to 100 kHz			
into 50 Ω load	1 mVp-p to 5 Vp-p	0.16 % of reading + 7.8 µV	
into 1 MΩ load	1 mVp-p to 200 Vp-p	0.78 % of reading + 7.8 µV	
Time Markers			
100 mVp-p to 1 Vp-p			
into 50 Ω load	9.009 1 ns to 83 µs	0.19 µs/s	
Square Wave	83 µs to 55s	2.3 µs/s	
	450.5 ps to 9.009 ns	0.19 µs/s	
Sine Wave			
	900.91 ns to 83 µs	0.19 µs/s	
Pulse	83 µs to 55s	2.3 µs/s	
	900.91 ns to 83 µs	0.19 µs/s	
Triangle Wave	83 µs to 55s	2.3 µs/s	
Rise Time			
into 50 Ω load	5 mVp-p to 3 Vp-p		
Rate: 10 Hz to 2 MHz	500 ps (nominal)	290 ps	
	150 ps (nominal)	34 ps	
Rate: 10 Hz to 1 MHz	25 mVp-p to 2 Vp-p		
	70 ps (nominal)	21 ps	
	425 mVp-p to 575 mVp-p		
	25 ps (nominal)	5.7 ps	
	200 mVp-p		
	16 ps (nominal)	2.1 ps	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes [1,4]			Fluke 9500B Oscilloscope Calibrator, Fluke 9530 3.2 GHz Active Head, Fluke 9550 Active Head w/ 25 ps Capability, Fluke 9560 Active Head w/ 70 ps Capability, Tektronix 067-1330-000 Calibration Fixture
Leveled Sine Wave 50 kHz Reference into 50 Ω load	5 mVp-p to 5 Vp-p 50 kHz to 10 MHz	1.2 % of reading	
Input Impedance Measure	(10 to 40) Ω	0.39 % of reading	
	(40 to 90) Ω	0.083 % of reading	
	(90 to 150) Ω	0.39 % of reading	
	(50 to 800) kΩ	0.39 % of reading	
	(0.8 to 1.2) MΩ	0.083 % of reading	
	(1.2 to 12) MΩ	0.39 % of reading	
Input Capacitance Measure	(1 to 35) pF	1.6 % of reading + 0.19 pF	
	(35 to 95) pF	2.3 % of reading + 0.19 pF	
Bandwidth Flatness Measure [1] into VSWR (1.2:1) (wrt Reference Frequency)	5 mVp-p to 5 Vp-p		Fluke 9500B/3200 Oscilloscope Calibrator, Fluke 9530 3.2 GHz Active Head
	100 Hz to 300 MHz	1.6 % of reading	
	(300 to 550) MHz	1.9 % of reading	
	5 mVp-p to 3 Vp-p		
	550 MHz to 1.1 GHz	2.7 % of reading	
	(1.1 to 2.5) GHz	3.1 % of reading	
	5 mVp-p to 2 Vp-p		
	(2.5 to 3.2) GHz	3.1 % of reading	
Bandwidth Flatness Measure [1] into VSWR (1.2:1) (wrt Reference Frequency)	5 mVp-p to 5 Vp-p		Fluke 9500B/1100 Oscilloscope Calibrator, Fluke 9560 Active Head w/ 70 ps Capability
	100 Hz to 300 MHz	1.6 % of reading	
	(300 to 550) MHz	1.9 % of reading	
	5 mVp-p to 3 Vp-p		
	550 MHz to 1.1 GHz	2.3 % of reading	
	(1.1 to 2.5) GHz	2.3 % of reading	
	5 mVp-p to 2 Vp-p		
	(2.5 to 3.2) GHz	2.3 % of reading	
	25 mVp-p to 2 Vp-p		
	(3 to 6) GHz	3.1 % of reading	
Risetime – Source	≥ 14 ps	2.4 ps	Pulser System
Risetime – Measure	≤ 500 ps	2.5 ps	Agilent 83484A, 86100C Oscilloscope Mainframe

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Risetime – Measure	(28 to 300) ps (0.3 to 5) ns (5 to 100) ns 100 ns	14 % of reading 4.7 % of reading 1.4 % of reading 0.73 % of reading	Sampling System
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source [1]	Type B (250 to 350) °C (350 to 445) °C (445 to 580) °C (580 to 750) °C (750 to 1 000) °C (1 000 to 1 820) °C Type C (0 to 250) °C (250 to 1 000) °C (1 000 to 1 500) °C (1 500 to 1 800) °C (1 800 to 2 000) °C (2 000 to 2 250) °C (2 250 to 2 315) °C Type E (-270 to -245) °C (-245 to -195) °C (-195 to -155) °C (-155 to -90) °C (-90 to 0) °C (0 to 15) °C (15 to 890) °C (890 to 1 000) °C Type J (-210 to -180) °C (-180 to -120) °C (-120 to -50) °C (-50 to 990) °C (990 to 1 200) °C Type K (-270 to -255) °C (-255 to -195) °C (-195 to -115) °C (-115 to -55) °C (-55 to 1 000) °C (1 000 to 1 372) °C	 1.2 °C 0.9 °C 0.71 °C 0.55 °C 0.45 °C 0.35 °C 0.24 °C 0.19 °C 0.21 °C 0.24 °C 0.27 °C 0.33 °C 0.37 °C 1.6 °C 0.24 °C 0.12 °C 0.095 °C 0.08 °C 0.076 °C 0.064 °C 0.074 °C 0.15 °C 0.12 °C 0.093 °C 0.08 °C 0.094 °C 2.5 °C 0.85 °C 0.16 °C 0.12 °C 0.087 °C 0.096 °C	Ectron 1140A Thermocouple Calibrator/Simulator

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 N		Ectron 1140A Thermocouple Calibrator/Simulator
	(-270 to -260) °C	5.4 °C	
	(-260 to -200) °C	1.5 °C	
	(-200 to -140) °C	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	
	Type R		
	(-50 to -30) °C	0.8 °C	
	(-30 to 45) °C	0.69 °C	
	(45 to 160) °C	0.49 °C	
	(160 to 380) °C	0.35 °C	
	(380 to 775) °C	0.3 °C	
	(775 to 1 768) °C	0.26 °C	
	Type S		
	(-50 to -30) °C	0.76 °C	
	(-30 to 45) °C	0.68 °C	
	(45 to 105) °C	0.49 °C	
	(105 to 310) °C	0.41 °C	
	(310 to 615) °C	0.35 °C	
	(615 to 1 768) °C	0.31 °C	
	Type T		
	(-270 to -255) °C	1.9 °C	
	(-255 to -240) °C	0.6 °C	
	(-240 to -210) °C	0.36 °C	
	(-210 to -150) °C	0.22 °C	
	(-150 to -40) °C	0.15 °C	
	(-40 to 100) °C	0.095 °C	
	(100 to 400) °C	0.08 °C	
DC Power – Source [1]			Fluke 5520A Multiproduct Calibrator
(0.33 to 330) mA	11 µW to 330 µW	0.018 % of reading	
(0.33 to 3) A	11 W to 3 kW	0.017 % of reading	
(3 to 20.5) A	99 mW to 20.9 kW	0.054 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power – Source [1,4]			Fluke 5520A Multiproduct Calibrator
PF = 1			
3.3 mA to 3 A	(10 to 45) Hz		
	0.11 mW to 99 W	0.18 % of reading	
3.3 mA to 20.5 A	(45 to 65) Hz		
	0.11 mW to 20.9 kW	0.14 % of reading	
33 mA to 3 A	(65 to 500) Hz		
	11 mW to 3.06 kW	0.16 % of reading	
33 mA to 20.5 A	500 Hz to 1 kHz		
	11 mW to 20.9 kW	0.17 % of reading	
(3 to 20.5) A	(65 to 500) Hz		
	9.9 W to 20.9 kW	0.16 % of reading	
AC Power – Source [1,4]			Fluke 6105A Electrical Power Quality Calibrator
PF = 1			
(0.5 to 20) A	(65 to 850) Hz		
	23 W to 13 kW	0.024 % of reading	
Phase – Source [1]	(0 to 180) °		Fluke 5520A Multiproduct Calibrator
	(10 to 65) Hz	0.11 °	
	(65 to 500) Hz	0.2 °	
	500 Hz to 1 kHz	0.39 °	
	(1 to 5) kHz	1.9 °	
	(5 to 10) kHz	3.9 °	
	(10 to 30) kHz	7.8 °	
Phase – Source			Clark-Hess 5002 Bridge Set (equal amplitude)
5 V	(0 to 360) °		
	1 Hz to 5 kHz	0.004 °	
	(5 to 50) kHz	0.008 °	
	(50 to 200) kHz	0.033 °	
Phase – Source			Clark-Hess 5500-2 Phase Standard (ratio independent)
50 mV to 100 V	(0 to 360) °		
	1 Hz to 1 kHz	0.004 °	
	(1 to 5) kHz	0.008 °	
	(5 to 50) kHz	0.012 °	
	(50 to 200) kHz	0.028 °	
(100 to 120) V	1 Hz to 1 kHz	0.012 °	
	(1 to 5) kHz	0.024 °	
	(5 to 50) kHz	0.036 °	
	(50 to 200) kHz	0.094 °	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase – Measure	(0 to 360) ° 1 Hz to 10 kHz (10 to 50) kHz (50 to 100) kHz (100 to 200) kHz	 0.002 3 ° 0.002 7 ° 0.01 ° 0.012 °	Phase Verification Bridge Set (1:1)

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dips and Interrupts – Measure	Ratio: (0 to 100) % (0 to 360) °	 1.3 % of reading	Agilent Infinity Oscilloscope
Electrical Fast Transients – Measure	(0.25 to 4) kV	2.6 % of reading	Agilent Infinity Oscilloscope, Haefely HV Attenuators
Electrostatic Discharge – Measure	(0.1 to 15) kV	2.5 % of reading	Tektronix TDS7404 Oscilloscope, KeyTech CTC-3 Target, Barth HV Attenuators
Harmonic Flicker – Measure	(100 to 230) V (50 to 400) Hz	3.6 % of reading	Tektronix TDS1012B Oscilloscope, Keysight DMM, CNS HFC-II Load, Ohms Lab CS100 Shunt
Surge – Measure (Open)	(0.25 to 4) kV	1.3 % of reading	Agilent Infinity Oscilloscope, Tektronix 6015A HV Probe
Surge – Measure (Short)	(0.25 to 4) kV	1.4 % of reading	Agilent Infinity Oscilloscope, Tegam RF Current Probe
Impulse – Source (60 dBu nominal)	Band A (10 to 150) kHz Band B 150 kHz to 30 MHz Band C & D 30 MHz to 1 GHz	 13 % of reading 13 % of reading 20 % of reading	Schwarzbeck IGLK 2914 High Power Pulse Generator
Modulation – Measure Amplitude Modulation Frequency Modulation Phase Modulation	 50 Hz to 50 kHz 50 Hz to 100 kHz 150 kHz to 1.3 GHz	 1.3 % of reading 1.6 % of reading 4.3 % of reading	Keysight 8902A Receiver

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Power – Measure (Noise Figure)	(-40 to 0) dB 10 MHz to 26.5 GHz	0.4 dB	Keysight E4440A Spectrum Analyzer w/ Opt 219 Personality Module, Keysight 346C Noise Source
RF Power – Transfer Measure	(-20 to 10) dBm 9 kHz to 18 GHz 10 MHz to 26.5 GHz (26.5 to 50) GHz	 1.3 % of reading 2.6 % of reading 4.8 % of reading	Tegam 2510A Power Standard, Tegam 1803A Power Meter
RF Power Absolute – Measure	50 MHz 1 mW Reference	3.2 µW	HP 478A Thermistor, Tegam 1830A RF Power Meter
RF Power – Measure [1]	(-60 to 20) dBm 9 kHz to 18 GHz (-70 to 20) dBm (26.5 to 40) GHz (40 to 50) GHz (-30 to 10) dBm 30 MHz to 26.5 GHz (10 to 30) dBm 30 MHz to 26.5 GHz	2.6 N5532A Power Sensor 3.8 % of reading 5.1 % of reading 3.3% of reading 5.7 % of reading	Agilent E4419B Power Meter, Agilent E9304A H18 Power Sensor, Agilent 8487A Power Sensor, Keysight E4440A Spectrum Analyzer, Keysight N5532A Power Sensor
Tuned RF Power – Measure	30 MHz to 26.5 GHz (-114 to -78) dBm (-78 to -58) dBm (-58 to 0) dBm	 4.8 % of reading 4 % of reading 3.5 % of reading	Keysight E4440A Spectrum Analyzer, Agilent E4419B Power Meter, Keysight N5532A Power Sensor
Tuned Relative RF Power – Measure	30 MHz to 26.5 GHz (-114 to -78) dBm (-78 to -58) dBm (-58 to 0) dBm	 3.4 % of reading 2.3 % of reading 1.1 % of reading	Keysight E4440A Spectrum Analyzer, Agilent E4419B Power Meter, Keysight N5532A Power Sensor
Attenuation – Source	(0 to 50) dB 30 MHz	 1.6 % of reading	Agilent 11812A Verification Kit
Sine Flatness (RF)	9 kHz to 6 GHz	0.073 dB	Agilent E4418B Power Meter, Agilent E9304A Power Sensor

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Signal Source Phase Noise – Measure 1 MHz to 50 GHz	10 mHz ≤ offset ≤ 1 MHz 1 MHz ≤ offset ≤ 30 MHz offset > 30 MHz	1.6 dB 2 dB 3 dB	Rhode & Schwarz FSWP Phase Noise Analyzer
Spectral Analysis – Measure (Amplitude) (w/o pre-amp)	(-127 to 30) dBm 3 Hz to 3 GHz (3.0 to 6.6) GHz (6.6 to 13.2) GHz (13.2 to 22) GHz (22 to 26.5) GHz (26.5 to 40) GHz (33 to 50) GHz	 0.9 dB 1.1 dB 1.4 dB 1.4 dB 1.7 dB 3.6 dB 3.6 dB	Keysight E4440A Spectrum Analyzer, Keysight 11970A/11970Q Mixers
Thermal Noise – Source ENR	5 dB, 15 dB, or 21 dB 10 MHz 100 MHz 1 GHz 2 GHz 3 GHz 4 GHz 5 GHz 6 GHz 7 GHz 8 GHz 9 GHz 10 GHz 11 GHz 12 GHz 13 GHz 14 GHz 15 GHz 16 GHz 17 GHz 18 GHz 19 GHz 20 GHz 21 GHz 22 GHz 23 GHz 24 GHz 25 GHz 26 GHz 26.5 GHz	 0.15 dB 0.14 dB 0.14 dB 0.15 dB 0.13 dB 0.13 dB 0.15 dB 0.14 dB 0.14 dB 0.14 dB 0.19 dB 0.18 dB 0.18 dB 0.18 dB 0.19 dB 0.19 dB 0.20 dB 0.20 dB 0.19 dB 0.20 dB 0.20 dB 0.21 dB 0.20 dB 0.21 dB 0.24 dB 0.21 dB 0.20 dB 0.21 dB 0.21 dB	HP 346C Noise Source, Noise Test Set, Noise Figure Analyzer

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Attenuation – Measure (Tuned RF Relative Power)	2.5 MHz to 26.5 GHz (-120 to -110) dB (-110 to -100) dB (-100 to -90) dB (-90 to -80) dB (-80 to -70) dB	 0.12 dB 0.1 dB 0.099 dB 0.09 dB 0.082 dB	Agilent 8902A Measuring Receiver, Agilent 11793A Microwave Sensor
Attenuation – Measure (Tuned RF Relative Power)	2.5 MHz to 26.5 GHz (-70 to -60) dB (-60 to -50) dB (-50 to -40) dB (-40 to -30) dB (-30 to -20) dB (-20 to -10) dB (-10 to 0) dB	 0.077 dB 0.069 dB 0.06 dB 0.056 dB 0.048 dB 0.038 dB 0.026 dB	Agilent 8902A Measuring Receiver, Agilent 11793A Microwave Sensor
RF Impedance – Measure	5 Hz to 3 GHz 1 Ω to 2 kΩ	 3 % of reading	Keysight E5061B Vector Network Analyzer
RF Current – Measure (Insertion Loss)	(-90 to 10) dB 10 kHz to 400 MHz	 2.9 dB	Keysight E5061B Vector Network Analyzer, FCC BCICF-1 Cal Fixture
RF Current – Measure (Transfer Z)	(-90 to 10) dB 10 kHz to 400 MHz	 2.2 dB	Keysight E5061B Vector Network Analyzer, FCC BCICF-1 Cal Fixture
Transmission Longitudinal Conversion Loss	(-90 to 10) dB 10 kHz to 100 MHz	 5.6 % of reading	Schaffner BCS-1000 Bridge, Keysight E5061B Vector Network Analyzer
S-Parameter S11-S22 – Measure [6] (0 to 1) Lin Mag (BNC)	 (-90 to 10) dB 10 Hz to 100 kHz 100 kHz to 10 MHz	 0.03 0.03	Agilent E5061B Vector Network Analyzer, Agilent 8550CK Calibration Kit
S-Parameter S11-S22 – Measure [6] (0 to 1) Lin Mag (7 mm)	 (-90 to 10) dB 300 kHz to 1.3 GHz (1.3 to 3) GHz (3 to 6) GHz	 0.006 0.007 0.013	Agilent 8753ES Network Analyzer, Agilent 8550C Calibration Kit
S-Parameter S11-S22 – Measure [6] (0 to 1) Lin Mag (N-type)	 (-90 to 10) dB (10 to 500) MHz 500 MHz to 2 GHz	 0.025 0.017	Agilent N5230A Network Analyzer, Agilent N4690C Ecal Calibration Kit

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
S-Parameter S11-S22 – Measure [6] (0 to 1) Lin Mag (3.5 mm)	(-90 to 10) dB (10 to 500) MHz 500 MHz to 2 GHz (2 to 26.5) GHz	 0.026 0.025 0.076	Agilent N5230A Network Analyzer, Agilent N4692C Ecal Calibration Kit
S-Parameter S11-S22 – Measure [6] (0 to 1) Lin Mag (2.9 mm)	(-90 to 10) dB (10 to 500) MHz 500 MHz to 2 GHz (2 to 26.5) GHz	 0.026 0.025 0.076	Agilent N5230A Network Analyzer, Agilent N4692C Ecal Calibration Kit
S-Parameter S11-S22 – Measure [6] (0 to 1) Lin Mag (2.4 mm)	(-90 to 10) dB 50 MHz to 50 GHz	 0.22	Agilent N5225A Microwave Network Analyzer, Agilent N4692C Ecal Calibration Kit
S-Parameter S21-S12 – Measure (BNC)	(-50 to 10) dB 10 Hz to 100 kHz 100 kHz to 10 MHz (10 to 500) MHz	 0.57 dB 0.37 dB 0.36 dB	Agilent E5061B Vector Network Analyzer, Agilent 8550CK Calibration Kit
S-Parameter S21-S12 – Measure (7 mm)	(-50 to 10) dB 300 kHz to 1.3 GHz (1.3 to 3) GHz	 0.24 dB 0.25 dB	Agilent 8753ES Network Analyzer, Agilent 85050C Calibration Kit
S-Parameter S21-S12 – Measure (N-type)	(-30 to 10) dB (10 to 500) MHz (-50 to 10) dB (10 to 500) MHz (-50 to 10) dB 500 MHz to 2 GHz (2 to 18) GHz	 0.43 dB 2.6 dB 0.17 dB 0.39 dB	Agilent N5230A Network Analyzer, Agilent N4690C Ecal Calibration Kit
S-Parameter S21-S12 – Measure (3.5 mm)	(-30 to 10) dB (10 to 500) MHz (-50 to 10) dB (10 to 500) MHz (-50 to 10) dB 500 MHz to 2 GHz (2 to 26.5) GHz	 0.5 dB 2.6 dB 0.28 dB 0.79 dB	Agilent N5230A Network Analyzer, Agilent N4692C Ecal Calibration Kit

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
S-Parameter S21-S12 – Measure (2.9 mm)	(-30 to 10) dB (10 to 500) MHz (-50 to 10) dB (10 to 500) MHz (-50 to 10) dB 500 MHz to 2 GHz (2 to 26.5) GHz (26.5 to 40) GHz	0.49 dB 2.7 dB 0.28 dB 0.79 dB 0.82 dB	Agilent N5230A Network Analyzer, Agilent N4692C Ecal Calibration Kit
S-Parameter S21-S12 – Measure (2.4 mm)	(-30 to 10) dB (50 to 500) MHz (-50 to 10) dB (50 to 500) MHz (-50 to 10) dB 500 MHz to 2 GHz (2 to 26.5) GHz (26.5 to 50) GHz	0.24 dB 0.93 dB 0.14 dB 0.56 dB 0.86 dB	Agilent N5225A Microwave Network Analyzer, Agilent 85056D Calibration Kit
Harmonic Distortion – Measure	10 Hz to 100 kHz	0.7 dB	Agilent U8903A Audio Analyzer
Risetime – Measure	≤ 500 ps	2.5 ps	Agilent 83484A, 86100C Oscilloscope Mainframe
Total Harmonic Distortion CW, Modulation	5 Hz to 500 kHz 500 kHz to 1 MHz	1.4 dB 2.3 dB	Krohn-Hite 6900B Distortion Analyzer
Harmonic Distortion	100 kHz to 2.9 GHz (2.9 to 6.5) GHz (6.5 to 13.2) GHz (13.2 to 22) GHz (22 to 26.5) GHz	1.7 dB 1.9 dB 2.6 dB 2.9 dB 3.7 dB	Spectrum Analyzer

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angles	(0 to 60) °	8.3″	Sine Bar
	90 °	2.8″	Master Square
Micrometers and Calipers [1,2] (Outside, Inside, Depth)	(0.05 to 1) in (1 to 9) in (9 to 15) in (15 to 40) in	(13 + 1*L*) µin (9 + 4*L*) µin (10 + 4*L*) µin (16 + 4*L*) µin	Comparison to Gage Blocks

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Anvil Flatness [1]	Up to 1 in Diameter	4.5 µin	Optical Flats
Anvil Parallelism [1]	Up to 1 in	4.5 µin	Optical Parallels
Bore Gages [1,2]	(0.125 to 0.25) in (0.25 to 1) in (1 to 6) in	33 µin 33 µin (26 + 7*L*) µin	Characterized Rings
Dial Indicators [1,2]	Up to 1 (1 to 6) in	(10 + 2*L*) µin (5 + 5*L*) µin	Comparison to Gage Blocks
Length Single Axis [2] Outside Dimension	 (0 to 1.0) in (1.0 to 7.0) in (7.0 to 21) in	 (6 + 1*L*) µin (4.3 + 3.5*L*) µin (1 + 4*L*) µin	Universal Length Measuring Machine
Length Single Axis Inside Dimension	(0.04 to 0.125) in (0.125 to 0.25) in (0.025 to 1) in (1 to 2.5) in (2.5 to 10) in (10 to 14) in	(9 + 1*L*) µin (9 + 1*L*) µin (9 + 1*L*) µin (10 + 3*L*) µin (14 + 3*L*) µin (23 + 3*L*) µin	Universal Length Measuring Machine
Height Gages [1,2]	Up to 1 in (1 to 9) in (9 to 15) in (15 to 40) in	(13 + 1*L*) µin (9 + 4*L*) µin (10 + 4*L*) µin (14 + 4*L*) µin	Comparison to Gage Blocks
Thread Wires	2 TPI to 120 TPI (0.008 to 0.5) in	 12 µin	Universal Length Measuring Machine
Cylindrical Plug Gages [2] Outside Diameter	 Up to 1 in (1 to 7) in	 12 µin (10 + 3*L*) µin	Universal Length Measuring Machine
Cylindrical Ring Gages [2] Inside Diameter	(0.04 to 0.125) in (0.125 to 0.25) in (0.025 to 1) in (1 to 2.5) in (2.5 to 10) in (10 to 14) in	(9 + 3*L*) µin (9 + 3*L*) µin (9 + 3*L*) µin (9 + 3*L*) µin (14 + 3*L*) µin (25 + 3*L*) µin	Universal Length Measuring Machine, Working Reference Rings
Pin Gages Outside Diameter	(0.004 to 0.5) in (0.5 to 1) in	53 µin 53 µin	Laser Micrometer
Step Height	Up to 1 in	32 µin	Gage Amplifier, Probe, Gage Blocks

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thread Plug Gages [2]			
Pitch Diameter 60° Thread	Up to 1 in (1 to 4) in (4 to 7) in	79 µin 80 µin 83 µin	Universal Length Measuring Machine, Thread Wires
Major Diameter	Up to 1 in (1 to 7) in	13 µin (10 + 3*L*) µin	
Tapered Thread Plug Gage Pitch Diameter	Up to 3 in	90 µin	Universal Length Measuring Machine
Standoff	Up to 1 in	31 µin	Gage Blocks, Amplifier
Thread Ring Gages Inner Pitch Diameter	Up to 1 in (1 to 4) in (4 to 7) in	79 µin 80 µin 83 µin	Master Plug Uncertainty

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination (Metric)	1 mg 2 mg 5 mg 10 mg 20 mg 50 mg 100 mg 200 mg 500 mg 1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g 500 g	64 µg 64 µg 97 µg 84 µg 73 µg 64 µg 65 µg 76 µg 78 µg 83 µg 0.16 mg 0.13 mg 0.14 mg 0.16 mg 0.11 mg 0.35 mg 0.39 mg 1 mg	Echelon III

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination (Metric)	1 kg 2 kg 4 kg 5 kg 6 kg 7 kg 8 kg 16 kg 32 kg	1.6 mg 10 mg 12 mg 13 mg 15 mg 16 mg 18 mg 98 mg 0.21 g	Echelon III
Balances and Scales [1,7]	Up to 1 g (1 to 50) g (50 to 100) g (100 to 200) g (200 to 500) g (500 to 1) kg (1 to 2) kg (2 to 4) kg (4 to 5) kg (5 to 6) kg (6 to 7) kg	76 µg 0.15 mg 0.35 mg 0.56 mg 1 mg 1.6 mg 10 mg 12 mg 13 mg 15 mg 16 mg	ASTM E617 Class 1 & Class 2 weights and internal calibration procedure utilized in the calibration of the weighing system.
Balances and Scales [1,7]	(7 to 8) kg (8 to 16) kg (16 to 32) kg (32 to 64) kg (64 to 114) kg	18 mg 98 mg 0.21 g 0.45 g 0.6 g	ASTM E617 Class 1 & Class 2 weights and internal calibration procedure utilized in the calibration of the weighing system.
Pneumatic Absolute Pressure Devices	(0.2 to 1.45) psia	0.001 % of reading + 0.000 29 psi	Ruska 2465 Gas Piston Gauge
	(1.45 to 50) psia (50 to 1 000) psia	0.001 5 % of reading 0.001 9 % of reading	DHI FPG 7601 Absolute Piston Gauge
Pneumatic Pressure Devices	(-14.7 to -0.2) psiv (0.2 to 100) psig (100 to 1 000) psig	0.001 4 % of reading 0.001 4 % of reading 0.001 9 % of reading	Ruska 2465 Gas Piston Gauge
Pneumatic Pressure Devices	(-60 to 60) inH_2O	0.002 9 % of reading	DHI FPG 7601 Absolute Piston Gauge
Hydraulic Pressure Devices	(72.5 to 7 250) psig (200 to 20 000) psig (20 000 to 72 500) psig	0.002 % of reading + 0.002 9 psi 0.003 % of reading + 0.007 3 psi 0.006 % of reading + 0.015 psi	DHI PG7000 Piston Gauge
Determination of Piston Area	(0.2 to 100) psi (100 to 1 000) psi	0.001 1% of reading 0.001 7 % of reading	Ruska 2465 Gas Piston Gauge

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Determination of Piston Area	(72.5 to 7 250) psig (200 to 20 000) psig (20 000 to 72 500) psig	0.001 7 % of reading 0.002 6 % of reading 0.005 1 % of reading	DHI PG7000 Piston Gauge (Gas to 6 000 psi)
Pneumatic Pressure – Source [1]	(-14.7 to -0.2) psiv (0.2 to 100) psig	0.001 4 % of reading 0.001 4 % of reading	Ruska 2465 Gas Piston Gauge (Gauge Mode)
	(0.2 to 100) psia	0.001 2 % of reading	Ruska 2465 Gas Piston Gauge (Absolute Mode)
	(100 to 1 000) psi	0.001 9 % of reading	Ruska 2465 Gas Piston Gauge (Absolute or Gauge Mode)
Hydraulic Pressure Devices [1]	(50 to 15 000) psig	0.011 % of reading + 0.17 psi	Ametek T-150 Deadweight Tester
Pneumatic Absolute Pressure – Source	(0.000 27 to 0.005 1) Pa (0.000 7 to 0.027) Pa	22 % of reading 8 % of reading	Ion Gauge
	(0.028 to 2 500) Pa	0.05 % of reading + 0.07 Pa	Capacitive Diaphragm Gauge
Gas Flow Devices	(1 to 10) sccm (20 to 200) sccm (0.2 to 2) slm (2 to 20) slm (20 to 50) slm (50 to 100) slm	0.22 % of reading + 0.004 2 sccm 0.25 % of reading + 0.001 7 sccm 0.25 % of reading + 0.000 02 slm 0.25 % of reading + 0.000 36 slm 0.34 % of reading 0.34 % of reading	Fluke Molbox, Fluke Molblocs
Torque – Hydraulic [1] (1 000 to 10 000) psig	(270 to 2 700) N·m (2 700 to 4 000) N·m (200 to 2 000) lbf·ft (2 000 to 20 000) lbf·ft	1.3 % of reading 1.3 % of reading 1.3 % of reading 1.3 % of reading	Torque Calibration System
Torque Multipliers [1]	(270 to 2 700) N·m (2 700 to 4 000) N·m (200 to 2 000) lbf·ft (2 000 to 20 000) lbf·ft	1.5 % of reading 1.5 % of reading 1.5 % of reading 1.5 % of reading	Torque Calibration System
Torque Devices [1]	2 lbf·in to 811 lbf·ft	1.2 % of reading	Torque Calibrator

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Humidity – Measure [1]	(-40 to 10) °C (10 to 90) %RH (90 to 99) %RH (10 to 30) °C (10 to 90) %RH (90 to 99) %RH (30 to 180) °C (10 to 90) %RH (90 to 99) %RH	 3.5 % RH 4.6 % RH 1.3 % RH 2.4 % RH 3.5 % RH 4.6 % RH	Master Thermohygrometer
Temperature – Source	(-20 to 100) ºC 100 ºC to 150) ºC (150 to 230) °C (230 to 300) °C (300 to 420) °C (420 to 660) °C	0.011 ºC 0.013 °C 0.016 °C 0.018 °C 0.074 °C 0.12 °C	Liquid Baths, Metrology Wells, SPRT, Super Thermometer
Temperature – Measure [1]	(-195 to 0) ºC (0 to 420) °C (420 to 660) °C	0.015 ºC 0.022 ºC 0.039 ºC	SPRT, Fluke Black Stack
Temperature – Measure [1]	(660 to 750) °C (750 to 1 000) °C	1.3 °C 1.8 °C	Type K Thermocouple Probe w/ Reader
Infrared Temperature Measuring Devices [1]	(-15 to 0) °C (0 to 50) °C (50 to 100) °C (100 to 120) °C (120 to 200) °C (200 to 350) °C (350 to 500) °C	0.8 °C 0.65 °C 0.7 °C 0.76 °C 0.95 °C 1.6 °C 2.1 °C	Black Body Source (Flat Plate) ε = (0.9 to 1), λ = (8 to 14) µm
Isothermal Block Verification [1]	Ambient (~ 23 °C)	0.02 °C	Thermocouple Half Junction

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source/Measure [8]	10 MHz	3.7 pHz/Hz	Fluke 910R GPS Frequency Standard

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tachometers [1]	(5 to 100) rpm (100 to 1 000) rpm (1 000 to 10 000) rpm (10 000 to 100 000) rpm (100 000 to 200 000) rpm	0.12 % of reading + 0.001 2 rpm 0.12 % of reading + 0.012 rpm 0.12 % of reading + 0.12 rpm 0.14 % of reading + 1.2 rpm 0.14 % of reading + 12 rpm	Comparison to Master Non-contact/Laser Tachometer
Frequency – Measure (without Pre-amp)	(-127 to 30) dBm 3 Hz to 10 MHz 10 MHz to 1 GHz (1 to 10) GHz (10 to 26.5) GHz	 0.2 Hz 1.2 Hz 1.2 Hz 3.1 Hz	Keysight PSA E4440A Spectrum Analyzer
Frequency – Measure (with Pre-amp)	(-127 to 30) dBm (26.5 to 50) GHz	 3.3 Hz	Keysight PSA E4440A Spectrum Analyzer
Time Interval/Duty Cycle – Measure	10 s interval	8.5 nHz	Fluke PM6681R Rubidium Counter

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; ″ = arc-second.
3. As frequency & amplitude deviate from the listed values, uncertainty may be higher than stated. If needed, contact laboratory for more information regarding uncertainties at frequency and range combinations other than the ones shown.
4. The stated uncertainty is the laboratory's ability to source a fast rise pulse that is approximately 500 ps, 125 ps, and 25 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. The known source rise time is mathematically removed from the total measured rise time measured on the DUT.
5. 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.
6. This parameter is a unitless measurement.
7. 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.
8. Uncertainty values of derivatives of 10 MHz will differ due to resolution, noise and gating errors.
9. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.02.

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