CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Transcat – Denver
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Aurora, CO 80011

Fulfills the requirements of

ISO/IEC 17025:2017

and the national standards

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

In the fields of

CALIBRATION & DIMENSIONAL MEASUREMENT

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

Jason Stine, Vice President

Expiry Date: 16 August 2028
Certificate Number: AC-2489.10

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

AND

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

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CALIBRATION AND DIMENSIONAL MEASUREMENT

ISO/IEC 17025 Accreditation Granted: **03 July 2026**

Certificate Number: **AC-2489.10** Certificate Expiry Date: **16 August 2028**

CALIBRATION

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Acceleration	(0.5 to 1) Hz (1 to 5) Hz (5 to 10) Hz (10 to 99) Hz 100 Hz (101 to 920) Hz (921 to 5 000) Hz (5 001 to 10 000) Hz (10 to 15) kHz (15 to 20) kHz	1.1 % of reading 0.8 % of reading 0.8 % of reading 1.2 % of reading 0.75 % of reading 1 % of reading 1.4 % of reading 1.8 % of reading 2.2 % of reading 2.8 % of reading	Comparison to Master Accelerometer

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH Meters	4 pH 7 pH 10 pH	0.012 pH 0.011 pH 0.012 pH	Comparison to Accredited pH Solutions

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Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Conductivity Meters	1 µS 10 µS 100 µS 1 000 µS 1 413 µS 10 000 µS 100 000 µS 150 000 µS 200 000 µS	0.3 µS 0.3 µS 2.1 µS 5 µS 4 µS 44 µS 330 µS 570 µS 670 µS	Comparison to Accredited Conductivity Solutions

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sine Wave Flatness – Measure [1]	Up to 3 V 10 Hz to 1 MHz (1 to 10) MHz (10 to 30) MHz (30 to 50) MHz (50 to 80) MHz (80 to 100) MHz	 0.15 % of reading 0.16 % of reading 0.18 % of reading 0.25 % of reading 0.41 % of reading 0.48 % of reading	Comparison to Thermal Voltage Converter, Keysight 3458A, Opt. 002 8.5 Digit Multimeter
DC Current – Source [1]	Up to 2 pA (2 to 20) pA (20 to 200) pA (0.2 to 2) nA (2 to 20) nA (20 to 200) nA (0.2 to 2) µA	0.8 % of reading + 10 fA 0.44 % of reading + 10 fA 0.3 % of reading + 30 fA 0.077 % of reading + 100 fA 0.076 % of reading + 1 pA 0.041 % of reading + 10 pA 0.029 % of reading + 0.1 nA	Comparison to Keithley 263 Calibrator/Source
DC Current – Source [1]	(2 to 220) µA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	40 µA/A + 6 nA 36 µA/A + 7 nA 35 µA/A + 40 nA 48 µA/A + 0.7 µA 80 µA/A + 12 µA	Comparison to Fluke 5730A Multiproduct Calibrator
DC Current – Source [1]	(2.2 to 11) A	0.036 % of reading + 0.48 mA	Comparison to Fluke 5730A/5725A Multiproduct Calibrator with Amplifier

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source [1]	(11 to 20.5) A	0.082 % of reading + 0.75 mA	Comparison to Fluke 5520A Multiproduct Calibrator
DC Current – Source [1]	(1 to 10) A (10 to 100) A (100 to 300) A	0.01 % of reading 0.06 % of reading 0.12 % of reading	Comparison to Guideline 9211 Multi-tap DC Current Shunt, Current Source
DC Clamp-on Ammeters (Non-Toroidal Type) Transformer Type Sensor [1]	(20 to 150) A (150 to 1 000) A	0.5 % of reading + 0.14 A 0.51 % of reading + 0.5 A	Comparison to Fluke 5520A Multiproduct Calibrator, 5500A/COIL 50-turn Coil
DC Current – Measure [1]	Up to 2 pA (2 to 20) pA (20 to 200) pA (0.2 to 2) nA (2 to 20) nA (20 to 200) nA	2.1 % of reading + 6.6 fA 1.9 % of reading + 7 fA 1.9 % of reading + 10 fA 0.3 % of reading + 0.5 pA 0.3 % of reading + 1 pA 0.3 % of reading + 10 pA	Comparison to Keithley 617 Programmable Electrometer
DC Current – Measure [1]	(0.2 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	25 µA/A + 46 pA 25 µA/A + 0.12 nA 33 µA/A + 0.92 nA 29 µA/A + 5.8 nA 29 µA/A + 58 nA 46 µA/A + 0.58 µA 0.013 % of reading + 12 µA	Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter
DC Current – Measure [1]	(1 to 10) A (10 to 100) A (100 to 300) A	0.01 % of reading 0.06 % of reading 0.12 % of reading	Comparison to Guideline 9211 Multi-tap DC Current Shunt, Digital Multimeter
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	 0.025 % of reading + 16 nA 0.016 % of reading + 10 nA 0.01 % of reading + 8 nA 0.028 % of reading + 12 nA 0.11 % of reading + 65 nA	Comparison to Fluke 5730A Multiproduct Calibrator

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source [1]	(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 (2.2 to 3) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.025 % of reading + 40 nA 0.016 % of reading + 35 nA 0.01 % of reading + 35 nA 0.02 % of reading + 0.11 µA 0.11 % of reading + 0.65 µA 0.025 % of reading + 0.4 µA 0.016 % of reading + 0.35 µA 0.01 % of reading + 0.35 µA 0.02 % of reading + 0.55 µA 0.11 % of reading + 5 µA 0.025 % of reading + 4 µA 0.016 % of reading + 3.5 µA 0.01 % of reading + 2.5 µA 0.02 % of reading + 3.5 µA 0.11 % of reading + 10 µA 0.024 % of reading + 35 µA 0.045 % of reading + 80 µA 0.7 % of reading + 0.16 mA 0.18 % of reading + 0.1 mA 0.06 % of reading + 0.1 mA 0.6 % of reading + 1 mA 2.5 % of reading + 5 mA	Comparison to Fluke 5730A Multiproduct Calibrator
AC Current – Source [1]	(3 to 11) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	 0.06 % of reading + 2 mA 0.1 % of reading + 2 mA 3 % of reading + 2 mA	Comparison to Fluke 5730A Multiproduct Calibrator, Fluke 5725A Amplifier
AC Current – Source [1]	(11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	 0.12 % of reading + 5 mA 0.15 % of reading + 5 mA 3 % of reading + 5 mA	Comparison to Fluke 5520A Multiproduct Calibrator

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 (33 to 330) mA (10 to 30) kHz	 1.2 % of reading + 0.4 µA 0.78 % of reading + 0.6 µA 0.31 % of reading + 4 µA 0.31 % of reading + 0.2 mA	Comparison to Fluke 5520A Multiproduct Calibrator
AC Clamp-on Ammeters (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	Comparison to Fluke 5520A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
AC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor [1]	(20 to 150) A (45z 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	Comparison to Fluke 5520A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
AC Current – Measure [1]	Up to 100 µA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz (0.1 to 1) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (1 to 10) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (10 to 100) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	 0.46 % of reading + 35 nA 0.17 % of reading + 35 nA 0.072 % of reading + 35 nA 0.072 % of reading + 35 nA 0.46 % of reading + 0.23 µA 0.17 % of reading + 0.23 µA 0.07 % of reading + 0.23 µA 0.038 % of reading + 0.23 µA 0.46 % of reading + 2.3 µA 0.17 % of reading + 2.3 µA 0.071 % of reading + 2.3 µA 0.038 % of reading + 2.3 µA 0.48 % of reading + 23 µA 0.17 % of reading + 23 µA 0.071 % of reading + 23 µA 0.037 % of reading + 23 µA	Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure [1]	(0.1 to 1) A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	 0.46 % of reading + 0.23 mA 0.19 % of reading + 0.23 mA 0.097 % of reading + 0.23 mA 0.12 % of reading + 0.23 mA	Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter
AC Current – Measure [1]	(1 to 20) A (50 to 100) Hz (100 to 300) Hz 300 Hz to 1 kHz (1 to 3) kHz (3 to 4) kHz (4 to 5) kHz	 0.02 % of reading 0.03 % of reading 0.03 % of reading 0.06 % of reading 0.07 % of reading 0.09 % of reading	Comparison to Fluke Y5020 Precision AC Current Shunt, Precision Digital Multimeter
AC Current – Measure [1]	(20 to 100) A (50 to 60) Hz 400 Hz 1 kHz	 0.022 % of reading + 5 mA 0.026 % of reading + 5 mA 0.11 % of reading + 1.3 mA	Comparison to AC Current Shunt, Agilent 3458A 8.5 Digit Multimeter
AC Resistance – Measure [1]	1 kHz 20 Ω to 100 kΩ	 0.039 % of reading + 10 mΩ	Comparison to General Radio 1689 Precision LCR Meter
AC Resistance – Measure	50 Hz to 100 kHz (0.1 to 15) Ω 100 Hz to 100 kHz (15 to 420) Ω 100 Hz to 10 kHz (0.42 to 32) kΩ 100 Hz to 100 kHz (32 to 320) kΩ (0.32 to 10) MΩ	 0.12 % of reading 0.06 % of reading 0.06 % of reading 0.06 % of reading 0.12 % of reading	Comparison to Agilent 4284A Precision LCR Meter
AC Resistance – Measure	0.1 Ω 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ	0.17 % of reading 0.12 % of reading 0.12 % of reading 0.05 % of reading 0.05 % of reading 0.13 % of reading 0.26 % of reading	Comparison to Impedance Standards
DC Resistance – Source [1] (Fixed Artifacts)	333 μΩ 1 mΩ 10 mΩ 100 mΩ	0.12 % of reading 0.06 % of reading 0.01 % of reading 0.01 % of reading	Comparison to Guideline 9211 Precision Multi-tap DC Current Shunt

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DC Resistance – Source [1] (Artifacts)	1 Ω 10 kΩ	10 μΩ 54 mΩ	Comparison to Fluke 742A Resistance Standard
DC High Resistance – Source [1] (Variable Artifact)	1 GΩ 10 GΩ 100 GΩ 1 TΩ	0.2 % of reading 0.5 % of reading 0.55 % of reading 0.56 % of reading	Comparison to IET Labs HRRS-Q-8-100k-10 kV Precision Decade Resistor
DC Resistance – Source [1] (Fixed Artifacts)	0 Ω 1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	40 μΩ 95 μΩ/Ω 95 μΩ/Ω 23 μΩ/Ω 23 μΩ/Ω 10 μΩ/Ω 10 μΩ/Ω 6.5 μΩ/Ω 6.5 μΩ/Ω 6.5 μΩ/Ω 6.5 μΩ/Ω 8.5 μΩ/Ω 8.5 μΩ/Ω 13 μΩ/Ω 18 μΩ/Ω 40 μΩ/Ω 47 μΩ/Ω 100 μΩ/Ω	Comparison to Fluke 5730A Multiproduct Calibrator
DC Resistance – Measure [1]	(0 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 12 μΩ/Ω + 5.8 mΩ 13 μΩ/Ω + 58 mΩ 21 μΩ/Ω + 2.3 Ω 62 μΩ/Ω + 0.12 kΩ 0.059 % of reading + 1.2 kΩ 0.82 % of reading + 12 kΩ	Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter characterized with Standard Resistors.
DC High Resistance – Measure [1]	(1 to 2) GΩ (2 to 20) GΩ (20 to 200) GΩ	1.7 % of reading + 0.1 MΩ 1.7 % of reading + 1 MΩ 1.8 % of reading + 10 MΩ	Comparison to Keithley 617 Electrometer

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source [1]	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V	7.5 µV/V + 0.4 µV 5 µV/V + 0.7 µV 3.5 µV/V + 2.5 µV 3.5 µV/V + 4 µV 5 µV/V + 40 µV	Comparison to Fluke 5730A Multiproduct Calibrator
DC Voltage – Source [1]	(220 to 1 100) V	6.5 µV/V + 0.4 mV	Comparison to Fluke 5730A Multiproduct Calibrator, Fluke 5725A Amplifier
DC High Voltage – Source [1]	(1.1 to 20) kV (20 to 36) kV	0.096 % of reading + 1.1 V 0.096 % of reading + 10 V	Comparison to High Voltage Source, Vitrek 4700 Digital HV Meter, Vitrek HVL-100 High Voltage Probe
DC Voltage – Measure [1]	(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 7.7 µV/V + 35 µV 15 µV/V + 0.12 mV 18 µV/V + 0.12 mV 21 µV/V + 0.12 mV	Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter
DC High Voltage – Measure [1]	(1 to 5) kV (5 to 10) kV (10 to 20) kV (20 to 50) kV (50 to 70) kV (70 to 100) kV	0.04 % of reading + 0.26 V 0.04 % of reading + 1.7 V 0.065 % of reading + 1.1 V 0.066 % of reading + 10 V 0.067 % of reading + 28 V 0.069 % of reading + 81 V	Comparison to Vitrek 4700 Digital HV Meter, Associated High Voltage Probes
AC Voltage – Source [1]	Up to 2.2 mV (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % of reading + 4 µV 0.009 % of reading + 4 µV 0.008 % of reading + 4 µV 0.02 % of reading + 4 µV 0.05 % of reading + 5 µV 0.11 % of reading + 10 µV 0.14 % of reading + 20 µV 0.27 % of reading + 20 µV	Comparison to Fluke 5730A Multiproduct Calibrator

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AC Voltage – Source [1]	(2.2 to 22) mV		Comparison to Fluke 5730A Multiproduct Calibrator
	(10 to 20) Hz	0.024 % of reading + 4 µV	
	(20 to 40) Hz	0.009 % of reading + 4 µV	
	(0.04 to 20) kHz	0.008 % of reading + 4 µV	
	(20 to 50) kHz	0.02 % of reading + 4 µV	
	(50 to 100) kHz	0.05 % of reading + 5 µV	
	(100 to 300) kHz	0.11 % of reading + 10 µV	
	(300 to 500) kHz	0.14 % of reading + 20 µV	
	(0.5 to 1) MHz	0.27 % of reading + 20 µV	
	(22 to 220) mV		
	(10 to 20) Hz	0.024 % of reading + 12 µV	
	(20 to 40) Hz	0.009 % of reading + 7 µV	
	40 Hz to 20 kHz	0.005 7 % of reading + 7 µV	
	(20 to 50) kHz	0.012 % of reading + 7 µV	
	(50 to 100) kHz	0.031 % of reading + 17 µV	
	(100 to 300) kHz	0.066 % of reading + 20 µV	
	(300 to 500) kHz	0.14 % of reading + 25 µV	
	500 kHz to 1 MHz	0.27 % of reading + 45 µV	
	(0.22 to 2.2) V		
	(10 to 20) Hz	0.024 % of reading + 40 µV	
	(20 to 40) Hz	0.009 % of reading + 15 µV	
	40 Hz to 20 kHz	0.004 2 % of reading + 8 µV	
	(20 to 50) kHz	0.006 7 % of reading + 10 µV	
	(50 to 100) kHz	0.008 5 % of reading + 30 µV	
	(100 to 300) kHz	0.034 % of reading + 80 µV	
	(300 to 500) kHz	0.1 % of reading + 0.2 mV	
	500 kHz to 1 MHz	0.17 % of reading + 0.3 mV	
	(2.2 to 22) V		
	(10 to 20) Hz	0.024 % of reading + 0.4 mV	
	(20 to 40) Hz	0.009 % of reading + 0.15 mV	
	40 Hz to 20 kHz	0.004 2 % of reading + 0.05 mV	
	(20 to 50) kHz	0.006 7 % of reading + 0.1 mV	
	(50 to 100) kHz	0.008 3 % of reading + 0.2 mV	
	(100 to 300) kHz	0.026 % of reading + 0.6 mV	
	(300 to 500) kHz	0.1 % of reading + 2 mV	
	500 kHz to 1 MHz	0.15 % of reading + 3.2 mV	

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AC Voltage – Source [1]	(22 to 220) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	 0.024 % of reading + 4 mV 0.009 % of reading + 1.5 mV 0.005 2 % of reading + 0.6 mV 0.008 % of reading + 1 mV 0.015 % of reading + 2.5 mV 0.09 % of reading + 16 mV 0.44 % of reading + 40 mV 0.8 % of reading + 80 mV	Comparison to Fluke 5730A Multiproduct Calibrator
AC Voltage – Source [1]	(220 to 750) V (30 to 50) kHz (50 to 100) kHz (220 to 1 100) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	 0.06 % of reading + 11 mV 0.23 % of reading + 45 mV 0.009 % of reading + 4 mV 0.017 % of reading + 6 mV 0.06 % of reading + 11 mV	Comparison to Fluke 5730A Multiproduct Calibrator, Fluke 5725A Amplifier
AC Voltage – Measure [1]	Up to 1 mV 100 kHz to 1 MHz (1 to 3) MHz (3 to 10) MHz (10 to 20) MHz (1 to 3) mV 100 kHz to 1 MHz (1 to 3) MHz (3 to 10) MHz (10 to 20) MHz (3 to 100) mV 100 kHz to 1 MHz (1 to 3) MHz (3 to 10) MHz (10 to 20) MHz (20 to 30) MHz	 1.8 % of reading + 2.4 µV 3.5 % of reading + 2.4 µV 9.3 % of reading + 2.4 µV 23 % of reading + 2.4 µV 0.97 % of reading + 2 µV 3.5 % of reading + 2 µV 9.3 % of reading + 2 µV 23 % of reading + 2 µV 0.91 % of reading + 3 µV 1.8 % of reading + 3 µV 2.9 % of reading + 3 µV 6.9 % of reading + 3 µV 14 % of reading + 3 µV	Comparison to Rohde & Schwarz URE3 RMS Voltmeter
AC Voltage – Measure [1]	Up to 10 mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 4) MHz	 0.04 % of reading + 3.5 µV 0.03 % of reading + 1.2 µV 0.04 % of reading + 1.2 µV 0.15 % of reading + 1.2 µV 0.59 % of reading + 1.2 µV 4.6 % of reading + 2.3 µV 1.5 % of reading + 5.8 µV 8.1 % of reading + 8.1 µV	Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter

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AC Voltage – Measure [1]	(10 to 100) mV		Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter
	(1 to 40) Hz	0.013 % of reading + 4 µV	
	40 Hz to 1 kHz	0.009 5 % of reading + 2 µV	
	(1 to 20) kHz	0.017 % of reading + 2 µV	
	(20 to 50) kHz	0.037 % of reading + 2 µV	
	(50 to 100) kHz	0.093 % of reading + 2 µV	
	(100 to 300) kHz	0.36 % of reading + 10 µV	
	300 kHz to 1 MHz	1.2 % of reading + 10 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	
	(1 to 2) MHz	1.8 % of reading + 0.12 mV	
	(2 to 4) MHz	4.6 % of reading + 0.81 mV	
	(4 to 8) MHz	4.6 % of reading + 0.92 mV	
	(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	

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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 (1 to 40) Hz 40Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (100 to 700) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	 0.024 % of reading + 4.6 mV 0.024 % of reading + 2.3 mV 0.024 % of reading + 2.3 mV 0.041 % of reading + 2.3 mV 0.14 % of reading + 2.3 mV 0.46 % of reading + 12 mV 1.7 % of reading + 12 mV 0.048 % of reading + 46 mV 0.048 % of reading + 23 mV 0.071 % of reading + 23 mV 0.19 % of reading + 23 mV 0.35 % of reading + 23 mV	Comparison to Agilent 3458A Opt 002 8.5 Digit Multimeter
AC High Voltage – Measure [1]	(0.7 to 5) kV (10 to 200) Hz (200 to 450) Hz (5 to 10) kV (10 to 200) Hz (200 to 450) Hz (10 to 20) kV (30 to 70) Hz (70 to 200) Hz (200 to 450) Hz (20 to 50) kV (30 to 70) Hz (70 to 200) Hz (200 to 450) Hz (50 to 70) kV (30 to 70) Hz (70 to 200) Hz	 0.14 % of reading + 0.34 V 0.47 % of reading + 0.34 V 0.16 % of reading + 1.9 V 0.47 % of reading + 1.9 V 0.16 % of reading + 1.4 V 1.2 % of reading + 1.4 V 2.9 % of reading + 1.8 V 0.16 % of reading + 11 V 1.2 % of reading + 11 V 2.9 % of reading + 21 V 0.16 % of reading + 28 V 1.2 % of reading + 28 V	Comparison to Vitrek 4700 Digital HV Meter, Associated High Voltage Probes
Capacitance – Source [1] (Fixed Artifacts)	1 kHz (0.1 to 0.5) nF 0.5 nF to 1.4 µF	 0.59 pF 0.12 % of reading + 18 fF	Comparison to Arco SS32 Capacitor Set

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source [1] (Fixed Artifacts)	1 pF		Comparison to HP 16380A Series, HP 16830C Series Standard Air Capacitor Set
	1 kHz to 1 MHz	0.32 fF	
	(1 to 2) MHz	0.62 fF	
	(2 to 3) MHz	1.1 fF	
	(3 to 4) MHz	1.6 fF	
	(4 to 5) MHz	2.2 fF	
	(5 to 10) MHz	6.3 fF	
	(10 to 13) MHz	9.3 fF	
	10 pF		
	1 kHz to 5 MHz	2.5 fF	
	(5 to 10) MHz	3.7 fF	
	(10 to 13) MHz	4.5 fF	
	100 pF		
	1 kHz to 3 MHz	27 fF	
	(3 to 4) MHz	31 fF	
	(4 to 5) MHz	39 fF	
	(5 to 10) MHz	86 fF	
	(10 to 13) MHz	0.13 pF	
	1 000 pF		
	20 Hz to 1 MHz	0.27 pF	
	(1 to 2) MHz	0.43 pF	
	(2 to 3) MHz	0.74 pF	
	(3 to 4) MHz	1.1 pF	
	(4 to 5) MHz	1.6 pF	
	(5 to 10) MHz	4.8 pF	
	(10 to 13) MHz	7 pF	
	10 nF		
	120 Hz to 10 kHz	2.4 pF	
	(10 to 100) kHz	2.9 pF	
	100 nF		
	120 Hz to 10 kHz	25 pF	
	(10 to 100) kHz	30 pF	
	1µF		
	120 Hz to 10 kHz	0.37 nF	
	(10 to 100) kHz	1.1 nF	
	10µF		
	20 Hz to 1 kHz	3.4 nF	
	(1 to 10) kHz	6.1 nF	
	(10 to 100) kHz	34 nF	

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Dissipation Factor – Source [4] (Fixed Artifacts)	1 pF		Comparison to HP 16380A Series, HP 16830C Series Standard Air Capacitor Set
	1 kHz to 1 MHz	0.000 23	
	(1 to 2) MHz	0.000 15	
	(2 to 3) MHz	0.000 23	
	(3 to 4) MHz	0.000 35	
	(4 to 5) MHz	0.000 50	
	(5 to 10) MHz	0.001 4	
	(10 to 13) MHz	0.002 1	
	10 pF		
	1 kHz to 5 MHz	0.000 15	
	(5 to 10) MHz	0.000 2	
	(10 to 13) MHz	0.000 24	
	100 pF		
	1 kHz to 3 MHz	0.000 12	
	(3 to 4) MHz	0.000 13	
	(4 to 5) MHz	0.000 15	
	(5 to 10) MHz	0.000 4	
	(10 to 13) MHz	0.000 6	
	1 000 pF		
	20 Hz to 1 MHz	0.000 12	
	(1 to 2) MHz	0.000 15	
	(2 to 3) MHz	0.000 25	
	(3 to 4) MHz	0.000 38	
	(4 to 5) MHz	0.000 53	
	(5 to 10) MHz	0.001 5	
	(10 to 13) MHz	0.002 1	
	10 nF		
	120 Hz to 100 kHz	0.000 23	
	100 nF		
	120 Hz to 100 kHz	0.000 29	
	1 µF		
	120 Hz to 100 kHz	0.000 41	
	10 µF		
	20 Hz to 1 kHz	0.000 29	
	(1 to 10) kHz	0.000 7	
	(10 to 100) kHz	0.001 8	

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source [1] (Simulated)	10 Hz to 10 kHz (0.19 to 1.1) nF 10 Hz to 3 kHz (1.1 to 3.3) nF 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 0.39 % of reading + 7.8 pF 0.2 % of reading + 7.8 pF 0.2 % of reading + 78 pF 0.2 % 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 0.32 % of reading + 23 nF 0.35 % of reading + 78 nF 0.37 % of reading + 0.23 µF 0.37 % 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	Comparison to Fluke 5520A Multiproduct Calibrator
Capacitance – Measure [1]	1 kHz Up to 10 pF (10 to 100) pF 100 pF to 1 µF (1 to 100) µF (0.1 to 1) mF	0.48 % of reading + 58 fF 0.062 % of reading + 58 fF 0.03 % of reading + 58 fF 0.04 % of reading 0.24 % of reading	Comparison to General Radio 1689 Precision LCR Meter

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Measure [1]	1 MHz (10 to 90) pF 90 pF to 10 nF 100 kHz (12 to 90) pF 90 pF to 100 nF (0.1 to 100) µF 10 kHz (10 to 80) pF 80 pF to 1 µF 400 Hz 10 nF to 10 µF (100 to 120) Hz 10 nF to 100 µF 100 µF to 12 mF	 0.12 % of reading 0.06 % of reading 0.12 % of reading 0.06 % of reading 0.12 % of reading 0.12 % of reading 0.06 % of reading 0.06 % of reading 0.06 % of reading 0.12 % of reading	Comparison to Agilent 4284A Precision LCR Meter
Inductance – Source [1] (Artifact)	1 kHz 100 mH	 0.14 mH	Comparison to Standard Inductor
Inductance – Measure [1]	100 Hz to 1 kHz (1 to 100) mH (0.1 to 10) H 400 Hz 5 µH to 5 mH 5 mH to 10 H (100 to 120) Hz (0.12 to 20) mH 20 mH to 10 H 1 kHz 1 µH to 1 mH 10 kHz 5 nH to 120 µH 120 µH to 100 mH	 0.04 % of reading + 0.1 µH 0.057 % of reading + 1.4 µH 0.12 % of reading 0.06 % of reading 0.12 % of reading 0.06 % of reading 0.12 % of reading 0.12 % of reading 0.06 % of reading	Comparison to Agilent 4284A Precision LCR Meter

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes [1]			Comparison to Fluke 9500B Oscilloscope Calibrator, Fluke 9530 3.2 GHz Active Head, Fluke 9560 Active Head w/ 70 ps Capability
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 1 mVp-p to 5 Vp-p	0.78 % of reading + 7.8 µV 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			
Square Wave	9.009 1 ns to 83 µs 83 µs to 55s	0.19 µs/s 2.3 µs/s	
Sine Wave	450.5 ps to 9.009 ns	0.19 µs/s	
Pulse	900.91 ns to 83 µs 83 µs to 55s	0.19 µs/s 2.3 µs/s	
Triangle Wave	900.91 ns to 83 µs 83 µs to 55s	0.19 µs/s 2.3 µs/s	

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes [1,2]			
Rise Time			
into 50 Ω load			
Rate: 10 Hz to 2 MHz	5 mVp-p to 3 Vp-p		
	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	Comparison to 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
	425 mVp-p to 575 mVp-p		
	25 ps (nominal)	5.7 ps	
	200 mVp-p		
	16 ps (nominal)	2.1 ps	
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	
Phase – Source [1]	Up to 180°		Comparison to Fluke 5520A Multiproduct Calibrator
	(10 to 65) Hz	0.11°	
	(65 to 500) Hz	0.2°	
	500 Hz to 1 kHz	0.4°	
	(1 to 5) kHz	1.9°	
	(5 to 10) kHz	3.9°	
	(10 to 20) kHz	7.8°	

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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	Comparison to Fluke 5520A 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		Comparison to Fluke 5520A Multiproduct Calibrator
	(3 to 100) mW	0.089 % of reading	
	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	

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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		Comparison to 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 C		
	(0 to 250) °C	0.24 °C	
	(250 to 1 000) °C	0.19 °C	
	(1 000 to 1 500) °C	0.21 °C	
	(1 500 to 1 800) °C	0.24 °C	
	(1 800 to 2 000) °C	0.27 °C	
	(2 000 to 2 250) °C	0.33 °C	
	(2 250 to 2 315) °C	0.37 °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	

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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		Comparison to 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	
Bandwidth Flatness Measure [1] into VSWR (1.2:1) (wrt Reference Frequency)			Comparison to Fluke 9500B/3200 Oscilloscope Calibrator, Fluke 9530 3.2 GHz Active Head
	5 mVp-p to 5 Vp-p		
	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	

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Bandwidth Flatness Measure [1] into VSWR (1.2:1)	5 mVp-p to 5 Vp-p 100 Hz to 300 MHz (300 to 550) MHz 5 mVp-p to 3 Vp-p 550 MHz to 1.1 GHz (1.1 to 2.5) GHz 5 mVp-p to 2 Vp-p (2.5 to 3) GHz 25 mVp-p to 2 Vp-p (3 to 6) GHz	 1.6 % of reading 1.9 % of reading 2.3 % of reading 2.3 % of reading 2.3 % of reading 3.1 % of reading	Comparison to Fluke 9500B/1100 Oscilloscope Calibrator, Fluke 9560 6 GHz Active Head
AC Voltage – Source [1] Wide-Band Voltage (50 Ω)	30 Hz to 500 kHz (0.33 to 1.1) mV (1.1 to 3.3) mV (3.3 to 11) mV (11 to 33) mV (33 to 110) mV (110 to 330) mV (0.33 to 1.1) V (1.1 to 3.5) V	 0.62 % of reading + 0.78 µV 0.54 % of reading + 1.2 µV 0.054 % of reading + 3.1 µV 0.47 % of reading + 6.2 µV 0.47 % of reading + 16 µV 0.39 % of reading + 39 µV 0.39 % of reading + 0.16 mV 0.31 % of reading + 0.19 mV	Comparison to Fluke 5730A Multiproduct Calibrator
AC Voltage – Source [1] Wide-Band Voltage (50 Ω) 1 kHz Reference	(0.33 to 1.1) mV (10 to 30) Hz (30 to 119.99) Hz 120 Hz to 1.199 9 kHz (1.2 to 11.999) kHz (12 to 119.99) kHz 120 Hz to 1.199 9 MHz (1.2 to 2) MHz (2 to 11.9) MHz (12 to 20) MHz (20 to 30) MHz	 0.23 % of reading 0.078 % of reading 0.078 % of reading 0.078 % of reading 0.078 % of reading 0.16 % of reading + 1.2 µV 0.16 % of reading + 1.2 µV 0.16 % of reading + 1.2 µV 0.16 % of reading + 1.2 µV 2.1 % of reading + 5.8 µV	Comparison to Fluke 5730A Multiproduct Calibrator

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1] Wide-Band Voltage (50 Ω) 1 kHz Reference	(1.1 to 3.3) mV		Comparison to Fluke 5730A Multiproduct Calibrator
	(10 to 30) Hz	0.23 % of reading	
	(30 to 119.99) Hz	0.078 % of reading	
	120 Hz to 1.199 9 kHz	0.078 % of reading	
	(1.2 to 11.999) kHz	0.078 % of reading	
	(12 to 119.99) kHz	0.078 % of reading	
	120 Hz to 1.199 9 MHz	0.078 % of reading + 1.2 µV	
	(1.2 to 2) MHz	0.078 % of reading + 1.2 µV	
	(2 to 11.9) MHz	0.23 % of reading + 1.2 µV	
	(12 to 20) MHz	0.39 % of reading + 1.2 µV	
	(20 to 30) MHz	1.2 % of reading + 1.2 µV	
	(3.3 to 11) mV		
	(10 to 30) Hz	0.23 % of reading	
	(30 to 119.99) Hz	0.078 % of reading	
	120 Hz to 1.199 9 kHz	0.078 % of reading	
	(1.2 to 11.999) kHz	0.078 % of reading	
	(12 to 119.99) kHz	0.078 % of reading	
	120 Hz to 1.199 9 MHz	0.078 % of reading + 1.2 µV	
	(1.2 to 2) MHz	0.078 % of reading + 1.2 µV	
	(2 to 11.9) MHz	0.16 % of reading + 1.2 µV	
	(12 to 20) MHz	0.31 % of reading + 1.2 µV	
	(20 to 30) MHz	0.78 % of reading + 1.2 µV	
	(11 to 33) mV		
	(10 to 30) Hz	0.23 % of reading	
	(30 to 119.99) Hz	0.078 % of reading	
	120 Hz to 1.199 9 kHz	0.078 % of reading	
	(1.2 to 11.999) kHz	0.078 % of reading	
	(12 to 119.99) kHz	0.078 % of reading	
	120 Hz to 1.199 9 MHz	0.078 % of reading + 1.2 µV	
	(11 to 16.5) mV		
	(1.2 to 2) MHz	0.16 % of reading + 1.2 µV	
	(2 to 11.9) MHz	0.23 % of reading + 1.2 µV	
	(12 to 20) MHz	0.39 % of reading + 1.2 µV	
	(20 to 30) MHz	0.85 % of reading + 1.2 µV	
	(16.5 to 33) mV		
	(1.2 to 2) MHz	0.078 % of reading + 1.2 µV	
	(2 to 11.9) MHz	0.16 % of reading + 1.2 µV	
	(12 to 20) MHz	0.31 % of reading + 1.2 µV	
	(20 to 30) MHz	0.78 % of reading + 1.2 µV	

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1] Wide-Band Voltage (50 Ω) 1 kHz Reference	(33 to 110) mV		Comparison to Fluke 5730A Multiproduct Calibrator
	(10 to 30) Hz	0.23 % of reading	
	(30 to 119.99) Hz	0.078 % of reading	
	120 Hz to 1.199 9 kHz	0.078 % of reading	
	(1.2 to 11.999) kHz	0.078 % of reading	
	(12 to 119.99) kHz	0.078 % of reading	
	120 Hz to 1.199 9 MHz	0.078 % of reading + 1.2 µV	
	(33 to 55) mV		
	(1.2 to 2) MHz	0.16 % of reading + 1.2 µV	
	(2 to 11.9) MHz	0.23 % of reading + 1.2 µV	
	(12 to 20) MHz	0.39 % of reading + 1.2 µV	
	(20 to 30) MHz	0.85 % of reading + 1.2 µV	
	(55 to 110) mV		
	(1.2 to 2) MHz	0.078 % of reading + 1.2 µV	
	(2 to 11.9) MHz	0.16 % of reading + 1.2 µV	
	(12 to 20) MHz	0.31 % of reading + 1.2 µV	
	(20 to 30) MHz	0.78 % of reading + 1.2 µV	
	(110 to 330) V		
	(10 to 30) Hz	0.23 % of reading	
	(30 to 119.99) Hz	0.078 % of reading	
	120 Hz to 1.199 9 kHz	0.078 % of reading	
	(1.2 to 11.999) kHz	0.078 % of reading	
	(12 to 119.99) kHz	0.078 % of reading	
	120 Hz to 1.199 9 MHz	0.078 % of reading + 1.2 µV	
	(110 to 165) mV		
	(1.2 to 2) MHz	0.16 % of reading + 1.2 µV	
	(2 to 11.9) MHz	0.23 % of reading + 1.2 µV	
	(12 to 20) MHz	0.39 % of reading + 1.2 µV	
	(20 to 30) MHz	0.85 % of reading + 1.2 µV	
	(165 to 330) mV		
	(1.2 to 2) MHz	0.078 % of reading + 1.2 µV	
	(2 to 11.9) MHz	0.16 % of reading + 1.2 µV	
	(12 to 20) MHz	0.31 % of reading + 1.2 µV	
	(20 to 30) MHz	0.78 % of reading + 1.2 µV	
	(0.33 to 1.1) V		
	(10 to 30) Hz	0.23 % of reading	
	(30 to 119.99) Hz	0.078 % of reading	
	120 Hz to 1.199 9 kHz	0.078 % of reading	
	(1.2 to 11.999) kHz	0.078 % of reading	
	(12 to 119.99) kHz	0.078 % of reading	
	120 Hz to 1.199 9 MHz	0.078 % of reading + 1.2 µV	

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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1] Wide-Band Voltage (50 Ω) 1 kHz Reference	(0.33 to 0.55) V (1.2 to 2) MHz (2 to 11.9) MHz (12 to 20) MHz (20 to 30) MHz (0.55 to 1.1) V (1.2 to 2) MHz (2 to 11.9) MHz (12 to 20) MHz (20 to 30) MHz (1.1 to 3.5) V (10 to 30) Hz (30 to 119.99) Hz 120 Hz to 1.199 9 kHz (1.2 to 11.999) kHz (12 to 119.99) kHz 120 Hz to 1.199 9 MHz (1.1 to 1.75) V (1.2 to 2) MHz (2 to 11.9) MHz (12 to 20) MHz (20 to 30) MHz (1.75 to 3.5) V (1.2 to 2) MHz (2 to 11.9) MHz (12 to 20) MHz (20 to 30) MHz	 0.16 % of reading + 1.2 µV 0.23 % of reading + 1.2 µV 0.39 % of reading + 1.2 µV 0.85 % of reading + 1.2 µV 0.078 % of reading + 1.2 µV 0.16 % of reading + 1.2 µV 0.31 % of reading + 1.2 µV 0.78 % of reading + 1.2 µV 0.23 % of reading 0.078 % of reading 0.078 % of reading 0.078 % of reading 0.078 % of reading 0.078 % of reading + 1.2 µV 0.16 % of reading + 1.2 µV 0.23 % of reading + 1.2 µV 0.39 % of reading + 1.2 µV 0.85 % of reading + 1.2 µV 0.078 % of reading + 1.2 µV 0.16 % of reading + 1.2 µV 0.31 % of reading + 1.2 µV 0.78 % of reading + 1.2 µV	Comparison to Fluke 5730A Multiproduct Calibrator

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Amplitude Modulation – AM Depth Measure [1] Rate: 50 Hz to 10 kHz Rate: 20 Hz to 10 kHz	 (5 to 99) % Depth 150 kHz to 10 MHz (> 0 to 99) % Depth 150 kHz to 10 MHz	 2.4 % Depth 3.5 % Depth	Comparison to HP 8902A Measuring Receiver

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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Amplitude Modulation – AM Depth Measure [1]			Comparison to HP 8902A Measuring Receiver
Rate: 50 Hz to 50 kHz	(5 to 99) % Depth		
	10 MHz to 1.3 GHz	1.4 % Depth	
	(1.3 to 26.5) GHz	1.9 % Depth	
Rate: 20 Hz to 100 kHz	(> 0 to 99) % Depth		
	10 MHz to 1.3 GHz	3.5 % Depth	
	(1.3 to 26.5) GHz	3.5 % Depth	
Frequency Modulation – Measure [1]			Comparison to HP 8902A Measuring Receiver
Rate: 50 Hz to 10 kHz	≤ 40 kHz peak		
	250 kHz to 10 MHz	2.4 % Deviation	
Rate: 50 Hz to 100 kHz	≤ 400 kHz peak		
	10 MHz to 26.5 GHz	1.4 % Deviation	
Rate: 20 Hz to 200 kHz	≤ 400 kHz peak		
	10 MHz to 26.5 GHz	5.8 % Deviation	
Phase Modulation – Measure [1]			Comparison to HP 8902A Measuring Receiver
Rate: 200 Hz to 10 kHz	< 40 rad Deviation		
	150 kHz to 10 MHz	4.9 % Deviation	
Rate: 200 Hz to 20 kHz	< 40 rad Deviation		
	10 MHz to 26.5 GHz	3.8 % Deviation	
Harmonic Distortion [1]	(-80 to 0) dBc		Comparison to Agilent 8563E Spectrum Analyzer
	30 Hz to 6.5 GHz	1.7 dB	
	(6.5 to 22) GHz	2.6 dB	
	(22 to 26.5) GHz	3.4 dB	
Total Harmonic Distortion – Measure [1]	(-80 to 0) dB		Comparison to Agilent 8903B Audio Analyzer
	20 Hz to 20 kHz	1.2 dB	
	(20 to 100) kHz	2.3 dB	
AM Total Harmonic Distortion – Measure [1]	(-80 to 0) dB		Comparison to Agilent 8903B Audio Analyzer
	20 Hz to 100 kHz	2.7 dB	
Total Harmonic Distortion – Measure [1]	3 Hz to 5 MHz	16 % of reading + 0.021 % THD	Comparison to Agilent E4440A PSA Spectrum Analyzer

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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Absolute RF Power – Measure [1]	100 kHz to 2.6 GHz (-20 to -10) dBm (-10 to 0) dBm (0 to 10) dBm (10 to 20) dBm (20 to 30) dBm (2.6 to 12.2) GHz (-20 to -10) dBm (-10 to 0) dBm (0 to 10) dBm (10 to 20) dBm (20 to 30) dBm	 0.11 dB 0.1 dB 0.1 dB 0.11 dB 0.23 dB 0.14 dB 0.13 dB 0.13 dB 0.14 dB 0.25 dB	Comparison to Agilent 8902A Measuring Receiver, Agilent 11722A Power Sensor, Agilent 11792A Microwave Converter, Agilent 11793A Microwave Converter
Absolute RF Power – Measure [1]	(12.2 to 17.75) GHz (-20 to -10) dBm (-10 to 0) dBm (0 to 10) dBm (10 to 20) dBm (20 to 30) dBm (17.75 to 26.5) GHz (-20 to -10) dBm (-10 to 0) dBm (0 to 5) dBm	 0.15 dB 0.14 dB 0.14 dB 0.15 dB 0.25 dB 0.2 dB 0.2 dB 0.2 dB	Comparison to Agilent 8902A Measuring Receiver, Agilent 11722A Power Sensor, Agilent 11792A Microwave Converter, Agilent 11793A Microwave Converter
Tuned RF Absolute Power – Measure [1]	2.5 MHz to 26.5 GHz (-127 to -120) dB (-120 to -110) dB (-110 to -100) dB (-100 to -90) dB (-90 to -80) dB (-80 to -70) dB (-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	 0.27 dB 0.27 dB 0.27 dB 0.27 dB 0.27 dB 0.17 dB 0.17 dB 0.17 dB 0.17 dB 0.17 dB 0.16 dB 0.16 dB 0.16 dB	Comparison to Agilent 8902A Opt 50 Measuring Receiver, Agilent 11722A Power Sensor, Agilent 11792A Microwave Converter, Agilent 11793A Microwave Converter

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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned RF Relative Power – Measure [1]	2.5 MHz to 26 GHz (-127 to -120) dB (-120 to -110) dB (-110 to -100) dB (-100 to -90) dB (-90 to -80) dB (-80 to -70) dB (-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	 0.23 dB 0.23 dB 0.23 dB 0.23 dB 0.22 dB 0.084 dB 0.081 dB 0.074 dB 0.071 dB 0.068 dB 0.064 dB 0.06 dB 0.056 dB	Comparison to Agilent 8902A Opt 50 Measuring Receiver, Agilent 11722A Power Sensor, Agilent 11792A Microwave Converter, Agilent 11793A Microwave Converter
Reflection (VSWR) [1,4] 10 MHz to 18 GHz	(Rho) 0.022 to 0.1 0.1 to 0.2 0.2 to 0.3 0.3 to 0.4	 0.022 0.027 0.033 0.042	Comparison to VSWR Bridge
RF Power – Measure [1]	10 MHz to 18 GHz (-30 to -20) dBm (-20 to 10) dBm (10 to 20) dBm	 0.26 dB 0.1 dB 0.17 dB	Comparison to EPM Power Meter, HP 8481A Power Sensor
RF Power – Measure [1]	100 kHz to 4.2 GHz (-30 to -20) dBm (-20 to 10) dBm (10 to 20) dBm	 0.26 dB 0.1 dB 0.17 dB	Comparison to EPM Power Meter, HP 8482A Power Sensor
RF Power – Measure [1]	50 MHz to 18 GHz (-30 to -20) dBm (-20 to 10) dBm (10 to 20) dBm (18 to 26.5) GHz (-30 to -20) dBm (-20 to 10) dBm (10 to 20) dBm	 0.26 dB 0.1 dB 0.17 dB 0.3 dB 0.18 dB 0.22 dB	Comparison to EPM Power Meter, HP 8485A Power Sensor

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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Power – Measure [1]	9 kHz to 6 GHz (-60 to -50) dBm (-50 to -40) dBm (-40 to -10) dBm (-10 to 0) dBm (0 to 20) dBm	 3.3 dB 0.29 dB 0.17 dB 0.15 dB 0.13 dB	Comparison to EPM Power Meter, HP E9304A Power Sensor
Amplitude Modulation – Measure [1] Rate: 50 Hz to 10 kHz Rate: 50 Hz to 100 kHz Rate: 20 Hz to 100 kHz	 (5 to 99) % Depth 100 kHz to 10 MHz (20 to 99) % Depth 10 MHz to 3 GHz (5 to 20) % Depth 10 MHz to 3 GHz (3 to 26.5) GHz (20 to 99) % Depth (3 to 26.5) GHz	 1.1 % Depth 1 % Depth 3 % Depth 5.2 % Depth 1.9 % Depth	Comparison to Agilent E4440A PSA Spectrum Analyzer
Amplitude Modulation Distortion – Measure [1] Rate: 20 Hz to 1 kHz	 > 1% Depth 10 kHz to 10 MHz 10 MHz to 26.5 GHz	 15 % of reading 16 % of reading	Comparison to Agilent E4440A PSA Spectrum Analyzer
Frequency Modulation – Measure [1] Rate: 20 Hz to 10 kHz Rate: 50 Hz to 200 kHz	 Deviation Rate > 0.2 250 kHz to 10 MHz Deviation Rate > 1.2 250 kHz to 10 MHz Deviation Rate > 0.2 10 MHz to 6.6 GHz Deviation Rate > 0.45 10 MHz to 6.6 GHz Deviation Rate > 0.2 (6.6 to 13.2) GHz Deviation Rate > 0.8 (6.6 to 13.2) GHz Deviation Rate > 0.2 (13.2 to 26.5) GHz Deviation Rate > 16 (13.2 to 26.5) GHz	 1.8 % Deviation 1.3 % Deviation 3 % Deviation 1.3 % Deviation 4.8 % Deviation 1.3 % Deviation 1.8 % Deviation 1.3 % Deviation	Comparison to Agilent E4440A PSA Spectrum Analyzer

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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation Distortion – Measure [1] Rate: 20 Hz to 1 kHz	Deviation > 500 Hz 1 MHz to 6.6 GHz Deviation > 2.3 kHz (6.6 to 13.2) GHz Deviation > 2.7 kHz (13.2 to 26.5) GHz	 14 % of reading 14 % of reading 14 % of reading	Comparison to Agilent E4440A PSA Spectrum Analyzer
Phase Modulation – Measure [1]	> 0.7 rad 100 kHz to 6.6 GHz > 0.3 rad 100 kHz to 6.6 GHz > 2 rad (6.6 to 13.2) GHz > 0.6 rad (6.6 to 13.2) GHz > 4 rad (13.2 to 26.5) GHz > 1.2 rad (13.2 to 26.5) GHz	 1.3 % of reading 3.5 % of reading 1.3 % of reading 3.5 % of reading 1.3 % of reading 3.5 % of reading	Comparison to Agilent E4440A PSA Spectrum Analyzer
Phase Modulation Distortion – Measure [1] Rate: (20 to 500) Hz	> 0.8 rad 1 MHz to 6.6 GHz > 1.8 rad (6.6 to 13.2) GHz > 3.5 rad (13.2 to 26.5) GHz	 16 % of reading 17 % of reading 15 % of reading	Comparison to Agilent E4440A PSA Spectrum Analyzer
Phase Modulation Distortion – Measure [1] Rate: 500 Hz to 1 kHz	> 0.4 rad 1 MHz to 6.6 GHz > 0.8 rad (6.6 to 13.2) GHz > 1.2 rad (13.2 to 26.5) GHz	 15 % of reading 14 % of reading 14 % of reading	Comparison to Agilent E4440A PSA Spectrum Analyzer

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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Power – Power Meter Reference	50 MHz 1 mW Reference	0.43 % of reading	Comparison to HP 478A Thermistor, Agilent 3458A 8.5 Digit Multimeter, HP 432A Analog Power Meter
Tuned Relative RF Power – Measure [1]	100 kHz to 3.05 GHz (-120 to -110) dBm (-110 to -100) dBm (-100 to -90) dBm (-90 to -80) dBm (-80 to -70) dBm (-70 to -60) dBm (-60 to -50) dBm (-50 to -40) dBm (-40 to -30) dBm (-30 to -20) dBm (-20 to -10) dBm (-10 to 0) dBm (3.05 to 6.6) GHz (-120 to -110) dBm (-110 to -100) dBm (-100 to -90) dBm (-90 to -80) dBm (-80 to -70) dBm (-70 to -60) dBm (-60 to -50) dBm (-50 to -40) dBm (-40 to -30) dBm (-30 to -20) dBm (-20 to -10) dBm (-10 to 0) dBm	 0.18 dB 0.11 dB 0.098 dB 0.093 dB 0.089 dB 0.078 dB 0.073 dB 0.06 dB 0.056 dB 0.051 dB 0.048 dB 0.045 dB 0.29 dB 0.11 dB 0.098 dB 0.094 dB 0.089 dB 0.078 dB 0.073 dB 0.06 dB 0.055 dB 0.051 dB 0.048 dB 0.044 dB	Comparison to Agilent E4440A PSA Spectrum Analyzer

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned Relative RF Power – Measure [1]	(6.6 to 13.2) GHz		Comparison to Agilent E4440A PSA Spectrum Analyzer
	(-110 to -100) dBm	0.25 dB	
	(-100 to -90) dBm	0.099 dB	
	(-90 to -80) dBm	0.093 dB	
	(-80 to -70) dBm	0.091 dB	
	(-70 to -60) dBm	0.085 dB	
	(-60 to -50) dBm	0.073 dB	
	(-50 to -40) dBm	0.07 dB	
	(-40 to -30) dBm	0.055 dB	
	(-30 to -20) dBm	0.051 dB	
	(-20 to -10) dBm	0.048 dB	
	(-10 to 0) dBm	0.045 dB	
	(13.2 to 18) GHz		
	(-110 to -100) dBm	0.61 dB	
	(-100 to -90) dBm	0.19 dB	
	(-90 to -80) dBm	0.094 dB	
	(-80 to -70) dBm	0.091 dB	
	(-70 to -60) dBm	0.085 dB	
	(-60 to -50) dBm	0.082 dB	
	(-50 to -40) dBm	0.073 dB	
	(-40 to -30) dBm	0.067 dB	
	(-30 to -20) dBm	0.052 dB	
	(-20 to -10) dBm	0.048 dB	
	(-10 to 0) dBm	0.045 dB	
	(18 to 26.5) GHz		
	(-100 to -90) dBm	0.46 dB	
	(-90 to -80) dBm	0.13 dB	
	(-80 to -70) dBm	0.09 dB	
	(-70 to -60) dBm	0.085 dB	
	(-60 to -50) dBm	0.082 dB	
	(-50 to -40) dBm	0.078 dB	
	(-40 to -30) dBm	0.066 dB	
	(-30 to -20) dBm	0.063 dB	
	(-20 to -10) dBm	0.048 dB	
	(-10 to 0) dBm	0.044 dB	

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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned Relative RF Power – Measure [1]	100 kHz to 3.05 GHz (-120 to -110) dBm (-110 to -100) dBm (-100 to -90) dBm (-90 to -80) dBm (-80 to -70) dBm (-70 to -60) dBm (-60 to -50) dBm (-50 to -40) dBm (-40 to -30) dBm (-30 to -20) dBm (-20 to -10) dBm (-10 to 0) dBm	 0.21 dB 0.15 dB 0.15 dB 0.15 dB 0.14 dB 0.14 dB 0.14 dB 0.13 dB 0.13 dB 0.13 dB 0.12 dB 0.12 dB	Comparison to Agilent E4440A PSA Spectrum Analyzer
Tuned Absolute RF Power – Measure [1]	100 kHz to 3.05 GHz (-120 to -110) dBm (-110 to -100) dBm (-100 to -90) dBm (-90 to -80) dBm (-80 to -70) dBm (-70 to -60) dBm (-60 to -50) dBm (-50 to -40) dBm (-40 to -30) dBm (-30 to -20) dBm (-20 to -10) dBm (-10 to 0) dBm (3.05 to 6.6) GHz (-120 to -110) dBm (-110 to -100) dBm (-100 to -90) dBm (-90 to -80) dBm (-80 to -70) dBm (-70 to -60) dBm (-60 to -50) dBm (-50 to -40) dBm (-40 to -30) dBm (-30 to -20) dBm (-20 to -10) dBm (-10 to 0) dBm	 0.21 dB 0.16 dB 0.16 dB 0.15 dB 0.15 dB 0.15 dB 0.14 dB 0.14 dB 0.14 dB 0.13 dB 0.13 dB 0.13 dB 0.33 dB 0.19 dB 0.18 dB 0.18 dB 0.18 dB 0.17 dB 0.17 dB 0.17 dB 0.17 dB 0.17 dB 0.16 dB 0.16 dB	Comparison to Agilent E4440A PSA Spectrum Analyzer

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned Absolute RF Power – Measure [1]	(6.6 to 13.2) GHz		Comparison to Agilent E4440A PSA Spectrum Analyzer
	(-110 to -100) dBm	0.3 dB	
	(-100 to -90) dBm	0.19 dB	
	(-90 to -80) dBm	0.18 dB	
	(-80 to -70) dBm	0.18 dB	
	(-70 to -60) dBm	0.18 dB	
	(-60 to -50) dBm	0.17 dB	
	(-50 to -40) dBm	0.17 dB	
	(-40 to -30) dBm	0.17 dB	
	(-30 to -20) dBm	0.17 dB	
	(-20 to -10) dBm	0.16 dB	
	(-10 to 0) dBm	0.16 dB	
	(13.2 to 18) GHz		
	(-110 to -100) dBm	0.63 dB	
	(-100 to -90) dBm	0.25 dB	
	(-90 to -80) dBm	0.19 dB	
	(-80 to -70) dBm	0.19 dB	
	(-70 to -60) dBm	0.19 dB	
	(-60 to -50) dBm	0.19 dB	
	(-50 to -40) dBm	0.18 dB	
	(-40 to -30) dBm	0.18 dB	
	(-30 to -20) dBm	0.18 dB	
	(-20 to -10) dBm	0.17 dB	
	(-10 to 0) dBm	0.17 dB	
	(18 to 26.5) GHz		
	(-100 to -90) dBm	0.52 dB	
	(-90 to -80) dBm	0.3 dB	
	(-80 to -70) dBm	0.29 dB	
	(-70 to -60) dBm	0.29 dB	
	(-60 to -50) dBm	0.29 dB	
	(-50 to -40) dBm	0.29 dB	
	(-40 to -30) dBm	0.28 dB	
	(-30 to -20) dBm	0.28 dB	
	(-20 to -10) dBm	0.28 dB	
	(-10 to 0) dBm	0.28 dB	

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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Angle Measuring Devices [5]	Up to 85°	1.5″	Comparison to Master Angle Blocks
Angle Measuring Devices [5]	90°	1.9″	Comparison to Master Square
Micrometers, Calipers [1,5] (Outside, Inside, and Depth)	(0.05 to 48) in	(8+ 8*L*) µin	Comparison to Gage Blocks
Anvil Flatness [1]	Up to 1 in	4.5 µin	Comparison to Optical Flats
Indicators [1,5] (Dial and Digital)	Up to 1 in	75 µin	Comparison to Dial Indicator Calibrator
Indicators [1,5] (Dial and Digital)	(1 to 5) in	(44 + 4*L*) µin	Comparison to Horizontal Comparator
Length – Single Axis [5] Outside Measurement Inside Dimension	 Up to 5 in Up to 5 in	 (6 + 8*L*) µin (22 + 3*L*) µin	Comparison to Horizontal Comparator
Height Measuring Equipment [1,5]	(0.4 to 8) in (8 to 48) in	(29 + 6*L*) µin (12 + 8*L*) µin	Comparison to Gage Blocks
Cylindrical Plug Gages [5] Outside Diameter	 Up to 5 in	 (6 + 8*L*) µin	Comparison to Horizontal Comparator
Cylindrical Pin Gages Outside Diameter	 (0.004 to 1) in	 36 µin	Direct measure using Laser Micrometer
Cylindrical Ring Gages [5] Inside Diameter	 Up to 5 in	 (22 + 3*L*) µin	Comparison to Horizontal Comparator
Profilometers, Surface Roughness Testers [1]	Ra 19 µin 118 µin	 2.3 µin 2.6 µin	Comparison to Roughness Specimen
Rulers, Tape Measures [5]	Up to 16 in	(120 +10*L*) µin	Comparison to Vision System
Thread Plug Gages [5] Pitch Diameter, 60° Major Diameter	 Up to 1 in (1 to 3) in (3 to 5) in Up to 5 in	 79 µin 84 µin 94 µin (6 + 8*L*) µin	Comparison to Universal Length Measuring System, Master Thread Wires Horizontal Comparator
Thread Ring Gages Pitch Diameter	 Up to 1 in (1 to 3) in (3 to 5) in	 79 µin 84 µin 94 µin	Tactile Fit using Master Thread Plug

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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Wire Crimpers/Dies Crimp Height Die Diameter	 Up to 0.8 in (0.011 to 0.5) in	 180 µin 0.001 2 in	 Comparison to Height Micrometer Class Z Pin Gage Set

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force Measuring Equipment	(1 to 200) lbf	0.06 % of reading	Comparison to Deadweights
Torque Measuring Devices [1] (Wrenches, Electronic, etc.)	(0.5 to 15) ozf·in (15 to 200) ozf·in (4 to 80) lbf·in (80 to 1 000) lbf·in (20 to 2 000) lbf·ft (1 000 to 5 000) lbf·ft	0.83 % of reading 0.4 % of reading 0.43 % of reading 0.4 % of reading 0.4 % of reading 1 % of reading	Comparison to Torque Calibration System
Torque Calibration System (Analyzers, Transducers, etc.)	(0.5 to 16) ozf·in (1 to 40) lbf·in (40 to 260) lbf·in (260 to 3 000) lbf·in	0.83 % of reading 0.08 % of reading 0.07 % of reading 0.07 % of reading	Comparison to Torque Wheels, Torque Arms, NIST Class F Weights
Torque Multipliers	(150 to 2 700) N·m (110 to 2 000) lbf·ft (2 700 to 4 000) N·m (2 000 to 3 000) lbf·ft (4 000 to 27 000) N·m (3 000 to 20 000) lbf·ft	1.1 % of reading 1.1 % of reading 1.3 % of reading 1.3 % of reading 1.4 % of reading 1.4 % of reading	Comparison to Torque Calibration System
Torque Angle	45° 90° 135° 180° 360°	0.49° 0.49° 0.49° 0.49° 0.49°	Comparison to Torque Angle Fixture
Hydraulic Torque Devices	(150 to 2 700) N·m (110 to 2 000) lbf·ft (2 700 to 4 000) N·m (2 000 to 3 000) lbf·ft (4 000 to 27 000) N·m (3 000 to 20 000) lbf·ft	1.1 % of reading 1.1 % of reading 1.3 % of reading 1.3 % of reading 1.3 % of reading 1.3 % of reading	Comparison to Torque Calibration System

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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales & Balances [1,6] (SI)	(5 to 500) mg (0.5 to 5) g (5 to 10) g (10 to 30) g 30 g to 9 kg (9 to 15) kg	12 µg 40 µg 58 µg 89 µg 0.000 32 % of reading 0.000 34 % of reading	ASTM E617 Class 1 weights and internal calibration procedure utilized for the calibration of the weighing system.
Scales & Balances [1,6] (SI)	Up to 100 mg (100 to 500) mg (0.5 to 5) g (5 to 10) g (10 to 20) g (20 to 30) g (30 to 100) g 100 g to 20 kg	16 µg 29 µg 58 µg 82 µg 0.12 mg 0.18 mg 0.35 mg 0.005 9 % of reading	ASTM E617 Class 2 weights and internal calibration procedure utilized for the calibration of the weighing system.
Scales & Balances [1,6] (Avoirdupois)	Up to 0.02 lb (0.02 to 1) lb (1 to 5) lb (5 to 977) lb	2.3 mg 0.041 % of reading 0.038 % of reading 0.036 % of reading	NIST Class F weights and internal calibration procedure utilized for the calibration of the weighing system.
Pneumatic Pressure Devices (Absolute Pressure)	Up to 13.2 psia (13.2 to 40) psia (40 to 120) psia (120 to 350) psia (350 to 1 015) psia	0.001 9 psi 0.008 2 % of reading + 0.001 5 psi 0.008 3 % of reading + 0.004 6 psi 0.008 3 % of reading + 0.013 psi 0.008 2 % of reading + 0.044 psi	Comparison to Mensor CPC6050 Pressure Controller
Pneumatic Pressure Devices (Gauge Pressure)	(-60 to -22) inH_2O (-22 to 22) inH_2O (22 to 60) inH_2O (60 to 72) inH_2O (72 to 804) inH_2O	0.009 % of reading + 0.000 15 inH_2O 0.002 2 inH_2O 0.009 % of reading + 0.000 15 inH_2O 0.006 7 inH_2O 0.009 % of reading + 0.000 15 inH_2O	Comparison to DHI PPC4 Pressure Controller
Pneumatic Pressure Devices (Gauge Pressure)	(-14.7 to -1.8) psig (-1.8 to 25) psig (25 to 105) psig (105 to 335) psig (335 to 1 000) psig	0.002 5 psi 0.008 2 % of reading + 0.002 3 psi 0.008 3 % of reading + 0.004 9 psi 0.008 3 % of reading + 0.013 psi 0.008 2 % of reading + 0.044 psi	Comparison to Mensor CPC6050 Pressure Controller
Pneumatic Pressure Devices (Gauge Pressure)	(10 to 3 000) psig (3 000 to 30 000) psig	0.38 psi 0.01 % of reading	Comparison to Fluke RPM 4 Reference Pressure Monitor

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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Hydraulic Pressure Devices (Gauge Pressure)	(5 to 15 000) psig	0.02 % of reading	Comparison to Fluke P3125-PSI Oil Deadweight Tester

Photometry and Radiometry

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Illuminance	(15 to 3 500) lx (3 500 to 35 000) lx	1.8 % of reading 2 % of reading	Comparison to Standard Lamp (Illuminant A – CIE)
Illuminance	(1.4 to 325) fc (325 to 3 252) fc	1.8 % of reading 2 % of reading	Comparison to Standard Lamp (Illuminant A – CIE)

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity – Measure [1]	(10 to 30) °C (10 to 90) %RH	1.3 %RH	Comparison to Temperature/Humidity Indicator/Probe
Relative Humidity – Source	(-10 to 15) °C (10 to 75) %RH (75 to 95) %RH (15 to 35) °C (10 to 95) %RH (35 to 70) °C (10 to 50) %RH (50 to 75) %RH (75 to 95) %RH	 0.5 %RH 0.65 %RH 0.5 %RH 0.5 %RH 0.7 %RH 0.85 %RH	Comparison to Two-pressure Humidity Generator
Temperature – Source [1] (Thermocouple Probes, RTD's, Thermistors)	(-25 to 140) °C (140 to 660) °C	0.06 °C 0.03 °C	Comparison to AccuMac AM1760 Secondary SPRT, Hart 1575 Super Thermometer, Hart Drywell

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Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Measure [1]	(-195 to 0) °C (0 to 420) °C (420 to 660) °C	0.001 % of reading + 0.011 °C 0.001 % of reading + 0.025 °C 0.001 % of reading + 0.037 °C	Direct measure using AccuMac AM1760 Secondary SPRT, Hart Black Stack
Temperature – Measure [1]	(-195 to 0) °C (0 to 420) °C (420 to 660) °C	0.001 % of reading + 0.01 °C 0.001 % of reading + 0.02 °C 0.001 % of reading + 0.031 °C	Direct measure using AccuMac AM1760 Secondary SPRT, Hart 1575 Super Thermometer
Infrared Temperature – Measuring Equipment [1]	(-15 to 0) °C (0 °C to 50) °C (50 °C to 100) °C (100 °C to 120) °C (120 °C to 200) °C (200 °C to 350) °C (350 °C to 500) °C	0.8 °C 0.65 °C 0.7 °C 0.76 °C 0.95 °C 1.6 °C 2.1 °C	Comparison to Blackbody Source (flat plate) ε = (0.9 to 1), λ = (8 to 14) µm

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Reference [1]	10 MHz	3.8 pHz/Hz	Comparison to Fluke 910R GPS Frequency Standard
Stopwatches, Timers [1]	Up to 599 s/mon	58 ms/d	Comparison to Vibrograf TM-4500 Timometer
AC Duty Cycle – Source [1] Square Wave: < 3.3 Vp-p Freq: 0.1 Hz to 100 kHz	(1 to 10) % Duty Cycle 10 µs to 100 s (10 to 49) % Duty Cycle 10 µs to 100 s 50 % Duty Cycle 10 µs to 100 s (51 to 90) % Duty Cycle 10 µs to 100 s (90 to 99) % Duty Cycle 10 µs to 100 s	0.62 % of reading + 78 ns 0.039 % of reading + 78 ns 0.001 6 % of reading + 78 ns 0.039 % of reading + 78 ns 0.62 % of reading + 78 ns	Comparison to Fluke 5522A Multiproduct Calibrator

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Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Optical Rotational Speed – Source [1,5]	Up to 100 000 rpm	0.003 2 % of reading + 0.01 rpm	Comparison to Agilent 33250A Function Generator
Rotational Speed – Measure [1,5]	(10 to 999.9) rpm (1 000 to 99 999) rpm	0.058 % of reading + 0.12 rpm 0.082 % of reading + 1.2 rpm	Reflective Measure utilizing the Extech 461995 Photo Tachometer.
Rise Time – Source [1,2]	≥ 14 ps	2.4 ps	Comparison to Pulser
Rise Time – Source [1,2]	25 Vp-p 350 ps	64 ps	Comparison to Rise Time Pulse Generator
Rise Time – Measure	≥ 17 ps	3.9 ps	Comparison to Sampling System

DIMENSIONAL MEASUREMENT

2 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurement – 2D [5]	X-Y Axis: Up to 16 in	(120 + 10*L*) µin	Vision System utilized as the Reference Standard for Dimensional Measurement.
Angles [5]	Up to 2 in Up to 360° (2 to 16) in Up to 360°	0.072° (0.062 + 0.000 5*L*)°	Vision System utilized as the Reference Standard for Dimensional Measurement.

3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurement – 3D [5]	X: Up to 24 in Y: Up to 24 in Z: Up to 24 in	(90 + 8.8*L*) µin	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.

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3 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional Measurement – 3D	X: Up to 30 in Y: Up to 30 in Z: Up to 24 in	300 µin	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Dimensional Measurement – 3D	X: Up to 39 in Y: Up to 36 in Z: Up to 24 in	390 µin	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Dimensional Measurement – 3D	X: Up to 39 in Y: Up to 48 in Z: Up to 24 in	430 µin	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Dimensional Measurement – 3D	X: Up to 39 in Y: Up to 54 in Z: Up to 24 in	450 µin	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Dimensional Measurement – 3D	X: Up to 39 in Y: Up to 62 in Z: Up to 24 in	490 µin	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Angle Measurements – 3D [5]	X: Up to 1 in Y: Up to 1 in Z: Up to 1 in Up to 360°	12″	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Angle Measurements – 3D [5]	X: Up to 3 in Y: Up to 3 in Z: Up to 3 in Up to 360°	4.5″	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Angle Measurements – 3D [5]	X: Up to 12 in Y: Up to 12 in Z: Up to 12 in Up to 360°	1.9″	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.
Angle Measurements – 3D [5]	X: Up to 39 in Y: Up to 62 in Z: Up to 24 in Up to 360°	1.6″	Zeiss CONTURA G2 Coordinate Measuring Machine utilized for Dimensional Measurement.

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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 500 ps, 150 ps, 70 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.
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 the laboratory for more information regarding uncertainties at frequency and power factor combinations other than the ones shown.
4. This parameter is a unitless measurement.
5. ″ = arc-minute; L = length in inches; rpm = revolutions per minute.
6. 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.
7. Unless otherwise specified in the far-right column under the field of Calibration, the calibration procedure utilized by the laboratory was developed internally.
8. The legal entity for this site is Transcat, Inc.

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