



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Transcat-Phoenix
8240 S. Kyrene Road, Suite 107
Tempe, AZ 85284

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 field of

CALIBRATION

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

A handwritten signature in black ink, appearing to be 'J. Stine', is positioned above a horizontal line.

Jason Stine, Vice President

Expiry Date: 07 September 2025
Certificate Number: AC-2489.11



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)**

Transcat – Phoenix

8240 S. Kyrene Road, Suite 107
Tempe, AZ 85284
Ryan Verdin 928-543-1728

CALIBRATION

Valid to: **September 7, 2025**

Certificate Number: **AC-2489.11**

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sine Wave Flatness ¹ (into 50 Ω load)	(0.3 to 1) 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	0.073 % of reading 0.11 % of reading 0.3 % of reading 0.66 % of reading 1.5 % of reading 2.4 % of reading	Agilent 11050A Thermal Convertor
Sine Wave Flatness ¹ (into 50 Ω load)	(1 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	0.071 % of reading 0.086 % of reading 0.17 % of reading 0.35 % of reading 0.85 % of reading 1.3 % of reading	Agilent 11049A Thermal Convertor
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 0.011 % of reading + 8 nA 0.028 % of reading + 12 nA 0.11 % of reading + 65 nA	Fluke 5720A 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		Fluke 5720A Multiproduct Calibrator
	(10 to 20) Hz	0.025 % of reading + 40 nA	
	(20 to 40) Hz	0.016 % of reading + 35 nA	
	40 Hz to 1 kHz	0.011 % of reading + 35 nA	
	(1 to 5) kHz	0.028 % of reading + 0.11 µA	
	(5 to 10) kHz	0.11 % of reading + 0.65 µA	
	(2.2 to 22) mA		
	(10 to 20) Hz	0.025 % of reading + 0.4 µA	
	(20 to 40) Hz	0.016 % of reading + 0.35 µA	
	40 Hz to 1 kHz	0.011 % of reading + 0.35 µA	
	(1 to 5) kHz	0.02 % of reading + 0.55 µA	
	(5 to 10) kHz	0.11 % of reading + 5 µA	
	(22 to 220) mA		
	(10 to 20) Hz	0.025 % of reading + 4 µA	
	(20 to 40) Hz	0.016 % of reading + 3.5 µA	
40 Hz to 1 kHz	0.011 % of reading + 2.5 µA		
(1 to 5) kHz	0.02 % of reading + 3.5 µA		
(5 to 10) kHz	0.11 % of reading + 10 µA		
(0.22 to 2.2) A			
20 Hz to 1 kHz	0.025 % of reading + 35 µA		
(1 to 5) kHz	0.045 % of reading + 80 µA		
(5 to 10) kHz	0.7 % of reading + 0.16 mA		
AC Current – Source ¹	(2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.046 % of reading + 0.17 mA 0.095 % of reading + 0.38 mA 0.36 % of reading + 0.75 mA	Fluke 5720A 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	0.095 % of reading + 4 mA 0.12 % of reading + 4 mA 2.3 % of reading + 4 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 kHz to 30 kHz (33 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



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Clamp-on Ammeters ¹ (Toroidal Type) Transformer Type Sensor	(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	0.35 % of reading + 30 mA 0.94 % of reading + 50 mA 0.34 % of reading + 0.13 A 1.2 % of reading + 0.23 A	Fluke 5520A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
AC Clamp-on Ammeters ¹ (Non-Toroidal Type) Hall Effect Sensor	(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	0.68 % of reading + 0.29 A 1.2 % of reading + 0.29 A 0.66 % of reading + 1 A 1.4 % of reading + 1.1 A	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 100 mA to 1 A (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 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	Agilent 3458A opt 002 8.5 Digit Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure ¹	(1 to 30) 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	0.065 % of reading + 0.23 mA 0.065 % of reading + 0.23 mA 0.065 % of reading + 0.23 mA 0.37 % of reading + 0.23 mA 0.37 % of reading + 0.23 mA 0.37 % of reading + 0.23 mA	Agilent 34330A Current Shunt, Agilent 3458A opt 002 8.5 Digit Multimeter
DC Current – Source ¹	(0.2 to 220) μ A (0.2 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	40 μ A/A + 6 nA 35 μ A/A + 7 nA 35 μ A/A + 40 nA 45 μ A/A + 0.7 μ A 80 μ A/A + 12 μ A	Fluke 5730A Multiproduct Calibrator
DC Current – Source ¹	(2.2 to 11) A	0.036 % of reading + 0.48 mA	Fluke 5730A Multiproduct Calibrator, Fluke 5725A Amplifier
DC Current – Source/Measure ¹	Up to 100 μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	33 μ A/A + 0.92 nA 29 μ A/A + 5.8 nA 29 μ A/A + 58 nA 46 μ A/A + 0.58 μ A 0.013 % of reading + 12 μ A	Agilent 3458A opt 002 8.5 Digit Multimeter, Current Source
DC Current – Source/Measure ¹	(1 to 20) A	0.45 mA/A	Agilent 34330A Current Shunt, Agilent 3458A opt 002 8.5 Digit Multimeter, DC Current Source
DC Clamp-on Ammeters ¹ (Non-Toroidal Type) Hall Effect Sensor	(20 to 150) A (150 to 1 000) A	0.53 % of reading + 0.17 A 0.52 % of reading + 0.58 A	Fluke 5520A Multiproduct Calibrator, Fluke 5500A/COIL 50-turn Coil
DC Current – Measure ¹	(20 to 100) A	0.046 % of reading	L&N 4361 Current Shunt, Agilent 3458A opt 002 8.5 Digit Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 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	Agilent 3458A opt 002 8.5 Digit Multimeter, Decade Resistor
DC Resistance – Source/Measure ¹	(10 to 100) MΩ (0.1 to 1) GΩ (1 to 10) GΩ (10 to 100) GΩ (100 to 300) GΩ (300 to 700) GΩ (0.7 to 1) TΩ	0.012 % of reading + 0.28 kΩ 0.012 % of reading + 9.7 kΩ 0.012 % of reading + 0.42 MΩ 0.012 % of reading + 45 MΩ 0.016 % of reading + 45 MΩ 0.016 % of reading + 0.11 GΩ 0.016 % of reading + 0.49 GΩ	Extended Arm Bridge
DC Resistance – Source ¹ (Fixed Artifacts)	10 μΩ 100 μΩ 1 mΩ 10 mΩ 100 mΩ	0.4 % of reading 0.046 % of reading 0.046 % of reading 35 μΩ/Ω 67 μΩ/Ω	Standard Resistors
DC Resistance – Source ^{1,6} (Simulation)	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 0.11 mΩ/Ω	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 Voltage – Source ¹	Up to 2.2 mV		Fluke 5730A Multiproduct Calibrator
	(10 to 20) Hz	0.024 % of reading + 4 μV	
	(20 to 40) Hz	0.009 % of reading + 4 μV	
	40 Hz 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	
	500 kHz to 1 MHz	0.27 % of reading + 20 μV	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.024 % of reading + 4 μV	
	(20 to 40) Hz	0.009 % of reading + 4 μV	
	40 Hz 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	
	500 kHz 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	0.0057 % 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	0.0042 % of reading + 8 μV		
(20 to 50) kHz	0.0067 % of reading + 10 μV		
(50 to 100) kHz	0.0085 % 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		



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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(2.2 to 22) V		Fluke 5730A Multiproduct Calibrator
	(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 + 50 μV	
	(20 o 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	0.26 % 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	
	(22 to 220) V		
	(10 to 20) Hz	0.024 % of reading + 4 mV	
	(20 to 40) Hz	0.009 % of reading + 1.5 mV	
	40 Hz to 20 kHz	0.005 2 % of reading + 0.6 mV	
	(20 o 50) kHz	0.008 % of reading + 1 mV	
	(50 to 100) kHz	0.015 % of reading + 2.5 mV	
(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 + 80 mV		
(220 to 250) V			
(15 to 50) Hz	0.03 % of reading + 16 mV		
(250 to 1 100) V			
50 Hz to 1 kHz	0.007 % of reading + 3.5 mV		
AC Voltage – Source ¹	(220 to 750) V	0.06 % of reading + 11 mV	Fluke 5730A Multiproduct Calibrator, Fluke 5725A Amplifier
	(30 to 50) kHz	0.23 % of reading + 45 mV	
	(50 to 100) kHz		
	(220 to 1 100) V	0.009 % of reading + 4 mV	
	40 Hz to 1 kHz	0.017 % of reading + 6 mV	
(1 to 20) kHz			



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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 Wideband Flatness (into 50 Ω load) (1 kHz Reference)	(0.33 to 1.1) mV		Fluke 5730A/03 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 kHz to 1.199 9 MHz	0.16 % of reading + 1.2 μV	
	(1.2 to 2) MHz	0.16 % of reading + 1.2 μV	
	(2 to 11.9) MHz	0.31 % of reading + 1.2 μV	
	(12 to 20) MHz	0.47 % of reading + 1.2 μV	
	(20 to 30) MHz	2.1 % of reading + 5.8 μV	
	(1.1 to 3.3) 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 kHz 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 kHz 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		



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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 Wideband Flatness (into 50 Ω load) (1 kHz Reference)	(11 to 33) mV		Fluke 5730A/03 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 kHz 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	
	(33 to 110) 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 kHz to 1.199 9 MHz	0.078 % of reading + 1.2 μV	
(110 to 330) 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 kHz 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 Wideband Flatness (into 50 Ω load) (1 kHz Reference)	(0.33 to 1.1) 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 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 kHz to 1.199 9 MHz	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 0.23 % 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	Fluke 5730A/03 Multiproduct Calibrator
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 (10 to 100) 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 2) MHz (2 to 4) MHz (4 to 8) MHz (8 to 10) MHz	0.04 % of reading + 3.5 μV 0.03 % of reading + 1.3 μV 0.04 % of reading + 1.3 μV 0.15 % of reading + 1.3 μV 0.59 % of reading + 1.3 μV 4.6 % of reading + 2.3 μV 1.5 % of reading + 5.8 μV 8.1 % of reading + 8.1 μV 0.013 % of reading + 4.6 μV 0.009 7 % of reading + 2.3 μV 0.017 % of reading + 2.3 μV 0.038 % of reading + 2.3 μV 0.093 % of reading + 2.3 μV 0.36 % of reading + 12 μV 1.2 % of reading + 12 μV 1.8 % of reading + 12 μV 4.7 % of reading + 81 μV 4.7 % of reading + 92 μV 17 % of reading + 0.1 mV	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 Voltage – Measure ¹	(0.1 to 1) V		Agilent 3458A opt 002 8.5 Digit Multimeter
	(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	
	(10 to 100) V		
	(1 to 40) Hz	0.024 % of reading + 4.6 mV	
	40 Hz to 1 kHz	0.024 % of reading + 2.3 mV	
	(1 to 20) kHz	0.024 % of reading + 2.3 mV	
	(20 to 50) kHz	0.041 % of reading + 2.3 mV	
	(50 to 100) kHz	0.14 % of reading + 2.3 mV	
(100 to 300) kHz	0.46 % of reading + 12 mV		
300 kHz to 1 MHz	1.7 % of reading + 12 mV		
(100 to 700) V			
(1 to 40) Hz	0.048 % of reading + 46 mV		
40 Hz to 1 kHz	0.048 % 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		



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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	Up to 1 mV		Rohde & Schwarz URE3 RMS Voltmeter
	100 kHz to 1 MHz	1.8 % of reading + 2.4 μV	
	(1 to 3) MHz	3.5 % of reading + 2.4 μV	
	(3 to 10) MHz	9.3 % of reading + 2.4 μV	
	(10 to 20) MHz	23 % of reading + 2.4 μV	
	(1 to 3) mV		
	100 kHz to 1 MHz	1.8 % of reading + 2.4 μV	
	(1 to 3) MHz	1.8 % of reading + 2.4 μV	
	(3 to 10) MHz	1.8 % of reading + 2.4 μV	
	(10 to 20) MHz	1.8 % of reading + 2.4 μV	
	(3 to 100) mV		
	100 kHz to 1 MHz	1.8 % of reading + 2.4 μV	
(1 to 3) MHz	1.8 % of reading + 2.4 μV		
(3 to 10) MHz	1.8 % of reading + 2.4 μV		
(10 to 20) MHz	1.8 % of reading + 2.4 μV		
(20 to 30) MHz	1.8 % of reading + 2.4 μV		
AC High Voltage – Measure ¹	(0.7 to 5) kV		Vitrek 4700 Digital HV Meter, Vitrek HVL Series Probes
	10 mHz to 10 Hz	0.15 % of reading + 0.17 V	
	(10 to 30) Hz	0.13 % of reading + 0.29 V	
	(30 to 200) Hz	0.11 % of reading + 0.37 V	
	(200 to 450) Hz	0.48 % of reading + 0.17 V	
	(450 to 600) Hz	0.88 % of reading + 0.17 V	
	(5 to 30) kV		
	10 mHz to 10 Hz	0.2 % of reading + 2.4 V	
	(10 to 30) Hz	0.15 % of reading + 2.4 V	
	(30 to 200) Hz	0.12 % of reading + 2.4 V	
	(200 to 450) Hz	0.71 % of reading + 2.4 V	
	(450 to 600) Hz	1.4 % of reading + 2.4 V	
	(30 to 50) kV		
	10 mHz to 10 Hz	0.25 % of reading + 2.5 V	
	(10 to 30) Hz	0.19 % of reading + 2.5 V	
	(30 to 70) Hz	0.14 % of reading + 2.5 V	
	(70 to 200) Hz	0.7 % of reading + 2.5 V	
	(200 to 450) Hz	2.9 % of reading + 2.5 V	
	(50 to 70) kV		
	10 mHz to 10 Hz	0.37 % of reading + 2.6 V	
	(10 to 30) Hz	0.27 % of reading + 2.6 V	
(30 to 70) Hz	0.18 % of reading + 2.6 V		
(70 to 200) Hz	1.2 % of reading + 2.6 V		
(200 to 450) Hz	1.7 % of reading + 2.6 V		



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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 (220 to 1 100) V	7.5 μ V/V + 0.4 μ V 5 μ V/V + 0.7 μ V 3.5 μ V/V + 2.5 μ V 3.5 μ V/V + 4 μ V 5 μ V/V + 40 μ V 6.5 μ V/V + 0.4 mV	Fluke 5730A Multiproduct Calibrator
DC Voltage – Measure ¹	Up to 100 mV (0.1 to 10) V (10 to 100) V (100 to 500) V (500 to 700) V (700 to 1 000) V	8.3 μ V/V + 0.35 μ V 5.3 μ V/V + 0.35 μ V 7.6 μ V/V + 35 μ V 11 μ V/V + 0.12 mV 14 μ V/V + 0.12 mV 21 μ V/V + 0.12 mV	Agilent 3458A opt 002 8.5 Digit Multimeter
DC High Voltage – Measure ¹	(1 to 10) kV (10 to 35) kV (35 to 50) kV (50 to 70) kV (70 to 100) kV	0.042 % of reading + 92 mV 0.047 % of reading + 2.4 V 0.056 % of reading + 2.4 V 0.088 % of reading + 2.4 V 0.17 % of reading + 2.5 V	Vitrek 4700 Digital HV Meter, Vitrek HVL Series Probes
Capacitance – Source ¹	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) μ F (10 to 300) Hz (1.1 to < 3.3) μ F (10 to 150) Hz (3.3 to < 11) μ F (10 to 120) Hz (11 to < 33) μ F (10 to 80) Hz (33 to < 110) μ F DC to 50 Hz (110 to < 330) μ F	0.39 % of reading + 7.8 pF 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 0.21 % of reading + 0.78 nF 0.21 % of reading + 2.3 nF 0.21 % of reading + 7.8 nF 0.32 % of reading + 23 nF 0.36 % of reading + 78 nF 0.36 % of reading + 0.23 μ F	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
Capacitance – Source ¹	DC to 20 Hz (0.33 to < 1.1) mF	0.35 % of reading + 0.78 μF	Fluke 5520A Multiproduct Calibrator
	DC to 6 Hz (1.1 to < 3.3) mF	0.35 % of reading + 2.3 μF	
	DC to 2 Hz (3.3 to < 11) mF	0.35 % of reading + 7.8 μF	
	DC to 0.6 Hz (11 to < 33) mF	0.58 % of reading + 23 μF	
	DC to 0.2 Hz (33 to < 110) mF	0.85 % of reading + 78 μF	
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source ¹	Type B (250 to 350) °C	1.2 °C	Ectron 1140A Thermocouple Calibrator/Simulator
	(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		

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 K		Ectron 1140A Thermocouple Calibrator/Simulator
	(-270 to -255) °C	2.5 °C	
	(-255 to -195) °C	0.85 °C	
	(-195 to -115) °C	0.16 °C	
	(-115 to -55) °C	0.12 °C	
	(-55 to 1 000) °C	0.087 °C	
	(1 000 to 1 372) °C	0.096 °C	
	Type N		
	(-270 to -260) °C	5.4 °C	
	(-260 to -200) °C	1.5 °C	
	(-200 to -140) °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		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Power – Source ¹ (0.33 to 330) mA	11 μ W to 1.1 mW 1.1 mW to 0.11 W (0.11 to 110) W (110 to 330) W	0.024 % of reading 0.027 % of reading 0.024 % of reading 0.018 % of reading	Fluke 5520A Multiproduct Calibrator
(0.33 to 3) A	11 μ W to 110 mW (0.11 to 990) W (0.99 to 3) kW	0.044 % of reading 0.053 % of reading 0.009 6 % of reading	
(3 to 20.5) A	99 mW to 0.99 W 0.99 W to 6.8 kW (6.8 to 20.5) kW	0.088 % of reading 0.07 % of reading 0.04 % of reading	
AC Power – Source ^{1,2} PF = 1 (3.3 to 9) mA	(10 to 65) Hz (0.11 mW to 3) mW 3 mW to 9 W (10 to 65) W	0.13 % of reading 0.077 % of reading	Fluke 5520A Multiproduct Calibrator
(9 to 33) mA	(0.3 to 10) mW 10 mW to 33 W	0.089 % of reading 0.077 % of reading	
AC Power – Source ^{1,2} PF = 1 (33 to 90) mA	(10 to 65) Hz (1 to 30) mW 30 mW to 90 W	0.071 % of reading 0.057 % of reading	Fluke 5520A Multiproduct Calibrator
(90 to 330) mA	(10 to 65) Hz (3 to 100) mW 100 mW to 300 W	0.089 % of reading 0.078 % of reading	
(0.33 to 0.9) A	(10 to 65) Hz (11 to 300) mW (0.3 to 900) W	0.071 % of reading 0.081 % of reading	
(0.9 to 2.2) A	(10 to 65) Hz (30 to 720) mW 0.72 W to 2 kW	0.089 % of reading 0.079 % of reading	
(2.2 to 4.5) A	(10 to 65) Hz 80 mW to 1.4 W 1.4 W to 4.5 kW	0.088 % of reading 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
Oscilloscopes ^{1,3} Leveled Sine Wave – Source into 50 Ω load	5 mVp-p to 5 Vp-p 50 kHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 5 mVp-p to 3.5 Vp-p 600 MHz to 1.1 GHz	1.8 % of reading + 0.23 mV 2.8 % of reading + 0.23 mV 3.2 % of reading + 0.23 mV 4 % of reading + 0.23 mV 5 % of reading + 0.23 mV	Fluke 5520A/11 Multiproduct Calibrator
Bandwidth/Flatness – Source (50 kHz Reference) into 50 Ω load	5 mVp-p to 5.5 Vp-p 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 5 mVp-p to 3.5 Vp-p 600 MHz to 1.1 GHz	1.4 % of reading + 78 μV 1.8 % of reading + 78 μV 3.2 % of reading + 78 μV 3.9 % of reading + 78 μV	
Input Impedance – Measure	(40 to 60) Ω (0.5 to 1.5) MΩ	0.082 % of reading 0.081 % of reading	
Input Capacitance – Measure	(5 to 50) pF	3.9 % of reading + 0.39 pF	
Waveform Generator – Source Amplitude (Sine, Square, Triangle) into 50 Ω load	10 Hz to 10 kHz		
into 1 MΩ load	1.8 mVp-p to 2.5 Vp-p 1.8 mVp-p to 55 Vp-p	2.3 % of reading + 78 μV 2.3 % of reading + 78 μV	
Frequency (Sine, Square, Triangle)	10 Hz to 10 kHz	0.001 9 % of reading + 12 mHz	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Total Harmonic Distortion	20 Hz to 100 kHz	0.7 dB	HP 8903B Audio Analyzer



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
Total Harmonic Distortion	100 kHz to 2.9 GHz	1 dB	HP 8563E Spectrum Analyzer	
Distortion – Measure	20 Hz to 20 kHz (20 to 100) kHz	1.2 dB 2.3 dB	HP 8903B Audio Analyzer	
RF Power – Power Meter Reference	50 MHz 1 mW Reference	0.43 % of reading	Thermistor Mount, Analog Power Meter, 8.5 Digit Multimeter	
RF Power – Measure	9 kHz to 10 MHz (-60 to < -50) dBm (-50 to < -40) dBm (-40 to < -20) dBm (-20 to < 10) dBm (10 to 20) dBm (20 to 30) dBm 10 MHz to 6 GHz (-70 to < -60) dBm (-60 to < -50) dBm (-50 to < -20) dBm (-20 to < 10) dBm (10 to 20) dBm (20 to 30) dBm (6 to 18) GHz (-70 to < -60) dBm (-60 to < -50) dBm (-50 to < -20) dBm (-20 to < 10) dBm (10 to 20) dBm (20 to 30) dBm (18 to 26.5) GHz (-30 to < -20) dBm (-20 to < 10) dBm (10 to 20) dBm (20 to 30) dBm	3.3 dB 0.29 dB 0.16 dB 0.1 dB 0.13 dB 0.23 dB 1.1 dB 0.16 dB 0.13 dB 0.11 dB 0.13 dB 0.27 dB 1.1 dB 0.16 dB 0.13 dB 0.11 dB 0.17 dB 0.27 dB 0.3 dB 0.18 dB 0.22 dB 0.27 dB	Power Sensor, Power Meter, Sensor Module, Measuring Receiver	
Amplitude Modulation – Measure	Rate: 50 Hz to 10 kHz Rate: 20 Hz to 10 kHz Rate: 50 Hz to 50 kHz	(5 to 99) % Depth 150 kHz to 10 MHz (> 0 to 99) % Depth 150 kHz to 10 MHz (5 to 99) % Depth 10 MHz to 1.3 GHz	2.4 % Depth 3.5 % Depth 1.4 % Depth	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 – Measure Rate: 20 Hz to 100 kHz Rate: 50 Hz to 50 kHz Rate: 20 Hz to 100 kHz	(> 0 to 99) % Depth 10 MHz to 1.3 GHz (5 to 99) % Depth (1.3 to 26.5) GHz (> 0 to 99) % Depth (1.3 to 26.5) GHz	3.5 % Depth 1.9 % Depth 3.5 % Depth	HP 8902A Measuring Receiver
Frequency Modulation – Measure Rate 50 Hz to 10 kHz Rate: 50 Hz to 100 kHz Rate: 20 Hz to 200 kHz	≤ 40 kHz peak 250 kHz to 10 MHz ≤ 400 kHz peak 10 MHz to 26.5 GHz ≤ 400 kHz peak 10 MHz to 26.5 GHz	2.4 % Deviation 1.4 % Deviation 5.8 % Deviation	HP 8902A Measuring Receiver
Phase Modulation – Measure Rate: 200 Hz to 10 kHz Rate: 200 Hz to 20 kHz	< 40 rad Deviation 150 kHz to 10 MHz < 40 rad Deviation 10 MHz to 26.5 GHz	4.9 % Deviation 3.8 % Deviation	HP 8902A Measuring Receiver
Tuned RF Absolute Power – Measure	2.5 MHz to 26.5 GHz (-127 to -120) dBm (-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	0.26 dB 0.26 dB 0.26 dB 0.26 dB 0.26 dB 0.25 dB 0.25 dB 0.25 dB 0.25 dB 0.14 dB 0.14 dB 0.14 dB 0.14 dB	HP 8902A OPT 050 Measuring Receiver, HP 11722A Power Sensor; or HP 11792A, HP 11793A Power Sensors



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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	2.5 MHz to 26.5 GHz		HP 8902A OPT 050 Measuring Receiver, HP 11722A Power Sensor; or HP 11792A, HP 11793A Power Sensors
	(-127 to -120) dBm	0.23 dB	
	(-120 to -110) dBm	0.23 dB	
	(-110 to -100) dBm	0.23 dB	
	(-100 to -90) dBm	0.23 dB	
	(-90 to -80) dBm	0.22 dB	
	(-80 to -70) dBm	0.084 dB	
	(-70 to -60) dBm	0.081 dB	
	(-60 to -50) dBm	0.074 dB	
	(-50 to -40) dBm	0.071 dB	
	(-40 to -30) dBm	0.068 dB	
	(-30 to -20) dBm	0.064 dB	
(-20 to -10) dBm	0.06 dB		
(-10 to 0) dBm	0.056 dB		
Amplitude Modulation – Measure			Agilent E4440A PSA Spectrum Analyzer
Rate 50 Hz to 10 kHz	(5 to 99) % Depth		
	10 kHz to 10 MHz	1 % Depth	
Rate: 50 Hz to 100 kHz	(20 to 99) % Depth		
	10 MHz to 3 GHz	0.9 % Depth	
Rate: 50 Hz to 100 kHz	(5 to 20) % Depth		
	10 MHz to 3 GHz	3 % Depth	
Rate: 20 Hz to 100 kHz	(20 to 99) % Depth		
	(3 to 26.5) GHz	1.9 % Depth	
Rate: 50 Hz to 100 kHz	(5 to 20) % Depth		
	(3 to 26.5) GHz	5.2 % Depth	
Rate 20 Hz to 1 kHz	> 1 % Depth		
	100 kHz to 10 MHz	15 % of reading	
Rate 20 Hz to 1 kHz	> 1 % Depth		
	10 MHz to 26.5 GHz	16 % of reading	
Frequency Modulation – Measure			Agilent E4440A PSA Spectrum Analyzer
Rate 20 Hz to 10 kHz	Deviation/Rate > 0.2		
	250 kHz to 10 MHz	1.8 % Deviation	
Rate 20 Hz to 10 kHz	Deviation/Rate > 1.2		
	250 kHz to 10 MHz	1.3 % Deviation	
Rate 50 Hz to 200 kHz	Deviation/Rate > 0.2		
	10 MHz to 6.6 GHz	1.8 % Deviation	
Rate 50 Hz to 200 kHz	Deviation/Rate > 0.45		
	10 MHz to 6.6 GHz	1.3 % Deviation	
Rate 50 Hz to 200 kHz	Deviation/Rate > 0.2		
	(6.6 to 13.2) GHz	3 % Deviation	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation – Measure Rate 50 Hz to 200 kHz	Deviation/Rate > 8 (6.6 to 13.2) GHz	1.3 % Deviation	Agilent E4440A PSA Spectrum Analyzer
Rate 50 Hz to 200 kHz	Deviation/Rate > 0.2 (13.2 to 26.5) GHz	4.8 % Deviation	
Rate 50 Hz to 200 kHz	Deviation/Rate > 16 (13.2 to 26.5) G	1.3 % Deviation	
Frequency Modulation Distortion – Measure Rate 20 Hz to 1 kHz	Deviation > 500 Hz 1 MHz to 6.6 GHz	14 % of reading	Agilent E4440A PSA Spectrum Analyzer
Rate 20 Hz to 1 kHz	Deviation > 2.3 kHz (6.6 to 13.2) GHz	14 % of reading	
Rate 20 Hz to 1 kHz	Deviation > 2.7 kHz (13.2 to 26.5) GHz	14 % of reading	
Phase Modulation – Measure	> 0.7 rad 100 kHz to 6.6 GHz	1.3 % of reading	Agilent E4440A PSA Spectrum Analyzer
	> 0.3 rad 100 kHz to 6.6 GHz	3.5 % of reading	
	> 2 rad (6.6 to 13.2) GHz	1.3 % of reading	
	> 0.6 rad (6.6 to 13.2) GHz	3.5 % of reading	
	> 4 rad (13.2 to 26.5) GHz	1.3 % of reading	
	> 1.2 rad (13.2 to 26.5) GHz	3.5 % of reading	
Phase Modulation Distortion – Measure Rate 20 Hz to 500 Hz	> 0.8 rad 1 MHz to 6.6 GHz	16 % of reading	Agilent E4440A PSA Spectrum Analyzer
Rate 500 Hz to 1 kHz	> 0.4 rad 1 MHz to 6.6 GHz	15 % of reading	
Rate 20 Hz to 500 Hz	> 1.8 rad (6.6 to 13.2) GHz	17 % of reading	
Rate 500 Hz to 1 kHz	> 0.8 rad (6.6 to 13.2) GHz	14 % of reading	
Rate 20 Hz to 500 Hz	> 3.5 rad (13.2 to 26.5) GHz	15 % of reading	
Rate 500 Hz to 1 kHz	> 1.2 rad (13.2 to 26.5) GHz	14 % of reading	



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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	100 kHz to 2 MHz		Agilent E4440A PSA Spectrum Analyzer
	(-127 to -120) dB	1.1 dB	
	(-120 to -110) dB	0.61 dB	
	(-110 to -100) dB	0.19 dB	
	(-100 to -90) dB	0.092 dB	
	(-90 to -80) dB	0.08 dB	
	(-80 to -70) dB	0.076 dB	
	(-70 to -60) dB	0.058 dB	
	(-60 to -50) dB	0.052 dB	
	(-50 to -40) dB	0.051 dB	
	(-40 to -30) dB	0.042 dB	
	(-30 to -20) dB	0.036 dB	
	(-20 to -10) dB	0.03 dB	
	(-10 to 0) dB	0.024 dB	
	(2 to 10) MHz		
	(-127 to -120) dB	0.73 dB	
	(-120 to -110) dB	0.37 dB	
	(-110 to -100) dB	0.11 dB	
	(-100 to -90) dB	0.085 dB	
	(-90 to -80) dB	0.08 dB	
	(-80 to -70) dB	0.068 dB	
	(-70 to -60) dB	0.06 dB	
	(-60 to -50) dB	0.055 dB	
	(-50 to -40) dB	0.054 dB	
	(-40 to -30) dB	0.045 dB	
	(-30 to -20) dB	0.039 dB	
	(-20 to -10) dB	0.034 dB	
	(-10 to 0) dB	0.029 dB	
	10 MHz to 6.6 GHz		
	(-127 to -120) dB	0.41 dB	
	(-120 to -110) dB	0.17 dB	
	(-110 to -100) dB	0.1 dB	
	(-100 to -90) dB	0.085 dB	
	(-90 to -80) dB	0.072 dB	
	(-80 to -70) dB	0.068 dB	
	(-70 to -60) dB	0.06 dB	
(-60 to -50) dB	0.055 dB		
(-50 to -40) dB	0.054 dB		
(-40 to -30) dB	0.045 dB		
(-30 to -20) dB	0.039 dB		
(-20 to -10) dB	0.034 dB		
(-10 to 0) dB	0.029 dB		

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned RF Relative Power – Measure	(6.6 to 13.2) GHz		Agilent E4440A PSA Spectrum Analyzer
	(-127 to -120) dB	0.67 dB	
	(-120 to -110) dB	0.33 dB	
	(-110 to -100) dB	0.11 dB	
	(-100 to -90) dB	0.085 dB	
	(-90 to -80) dB	0.08 dB	
	(-80 to -70) dB	0.068 dB	
	(-70 to -60) dB	0.06 dB	
	(-60 to -50) dB	0.055 dB	
	(-50 to -40) dB	0.054 dB	
	(-40 to -30) dB	0.045 dB	
	(-30 to -20) dB	0.039 dB	
	(-20 to -10) dB	0.034 dB	
	(-10 to 0) dB	0.029 dB	
	(13.2 to 18) GHz		
	(-127 to -120) dB	1.1 dB	
	(-120 to -110) dB	0.61 dB	
	(-110 to -100) dB	0.19 dB	
	(-100 to -90) dB	0.092 dB	
	(-90 to -80) dB	0.08 dB	
	(-80 to -70) dB	0.076 dB	
	(-70 to -60) dB	0.06 dB	
	(-60 to -50) dB	0.055 dB	
	(-50 to -40) dB	0.054 dB	
	(-40 to -30) dB	0.045 dB	
	(-30 to -20) dB	0.039 dB	
	(-20 to -10) dB	0.034 dB	
	(-10 to 0) dB	0.029 dB	
	(18 to 26.5) GHz		
	(-127 to -120) dB	1.8 dB	
	(-120 to -110) dB	1.2 dB	
	(-110 to -100) dB	0.51 dB	
	(-100 to -90) dB	0.14 dB	
	(-90 to -80) dB	0.08 dB	
	(-80 to -70) dB	0.076 dB	
	(-70 to -60) dB	0.06 dB	
(-60 to -50) dB	0.055 dB		
(-50 to -40) dB	0.054 dB		
(-40 to -30) dB	0.045 dB		
(-30 to -20) dB	0.039 dB		
(-20 to -10) dB	0.034 dB		
(-10 to 0) dB	0.029 dB		

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned RF Absolute Power – Measure	100 kHz to 2 MHz		Agilent E4440A PSA Spectrum Analyzer
	(-127 to -120) dB	1.1 dB	
	(-120 to -110) dB	0.62 dB	
	(-110 to -100) dB	0.21 dB	
	(-100 to -90) dB	0.13 dB	
	(-90 to -80) dB	0.12 dB	
	(-80 to -70) dB	0.12 dB	
	(-70 to -60) dB	0.11 dB	
	(-60 to -50) dB	0.1 dB	
	(-50 to -40) dB	0.1 dB	
	(-40 to -30) dB	0.1 dB	
	(-30 to -20) dB	0.097 dB	
	(-20 to -10) dB	0.095 dB	
	(-10 to 0) dB	0.094 dB	
	(2 to 10) MHz		
	(-127 to -120) dB	0.42 dB	
	(-120 to -110) dB	0.19 dB	
	(-110 to -100) dB	0.13 dB	
	(-100 to -90) dB	0.12 dB	
	(-90 to -80) dB	0.12 dB	
	(-80 to -70) dB	0.11 dB	
	(-70 to -60) dB	0.11 dB	
	(-60 to -50) dB	0.11 dB	
	(-50 to -40) dB	0.1 dB	
	(-40 to -30) dB	0.1 dB	
	(-30 to -20) dB	0.099 dB	
	(-20 to -10) dB	0.097 dB	
	(-10 to 0) dB	0.095 dB	
	10 MHz to 3.05 GHz		
	(-127 to -120) dB	0.42 dB	
	(-120 to -110) dB	0.19 dB	
	(-110 to -100) dB	0.13 dB	
	(-100 to -90) dB	0.12 dB	
	(-90 to -80) dB	0.12 dB	
	(-80 to -70) dB	0.11 dB	
	(-70 to -60) dB	0.11 dB	
(-60 to -50) dB	0.11 dB		
(-50 to -40) dB	0.1 dB		
(-40 to -30) dB	0.1 dB		
(-30 to -20) dB	0.099 dB		
(-20 to -10) dB	0.097 dB		
(-10 to 0) dB	0.095 dB		

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned RF Absolute Power – Measure	(3.05 to 6.6) GHz		Agilent E4440A PSA Spectrum Analyzer
	(-127 to -120) dB	0.42 dB	
	(-120 to -110) dB	0.2 dB	
	(-110 to -100) dB	0.14 dB	
	(-100 to -90) dB	0.13 dB	
	(-90 to -80) dB	0.13 dB	
	(-80 to -70) dB	0.12 dB	
	(-70 to -60) dB	0.12 dB	
	(-60 to -50) dB	0.12 dB	
	(-50 to -40) dB	0.12 dB	
	(-40 to -30) dB	0.11 dB	
	(-30 to -20) dB	0.11 dB	
	(-20 to -10) dB	0.11 dB	
	(-10 to 0) dB	0.11 dB	
	(6.6 to 13.2) GHz		
	(-127 to -120) dB	0.68 dB	
	(-120 to -110) dB	0.34 dB	
	(-110 to -100) dB	0.15 dB	
	(-100 to -90) dB	0.13 dB	
	(-90 to -80) dB	0.13 dB	
	(-80 to -70) dB	0.12 dB	
	(-70 to -60) dB	0.12 dB	
	(-60 to -50) dB	0.12 dB	
	(-50 to -40) dB	0.12 dB	
	(-40 to -30) dB	0.11 dB	
	(-30 to -20) dB	0.11 dB	
	(-20 to -10) dB	0.11 dB	
	(-10 to 0) dB	0.11 dB	
	(13.2 to 18) GHz		
	(-127 to -120) dB	1.1 dB	
	(-120 to -110) dB	0.62 dB	
	(-110 to -100) dB	0.22 dB	
	(-100 to -90) dB	0.14 dB	
	(-90 to -80) dB	0.13 dB	
	(-80 to -70) dB	0.13 dB	
	(-70 to -60) dB	0.12 dB	
(-60 to -50) dB	0.12 dB		
(-50 to -40) dB	0.12 dB		
(-40 to -30) dB	0.11 dB		
(-30 to -20) dB	0.11 dB		
(-20 to -10) dB	0.11 dB		
(-10 to 0) dB	0.11 dB		

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tuned RF Absolute Power – Measure	(18 to 26.5) GHz		Agilent E4440A PSA Spectrum Analyzer
	(-127 to -120) dB	1.8 dB	
	(-120 to -110) dB	1.2 dB	
	(-110 to -100) dB	0.53 dB	
	(-100 to -90) dB	0.22 dB	
	(-90 to -80) dB	0.19 dB	
	(-80 to -70) dB	0.19 dB	
	(-70 to -60) dB	0.18 dB	
	(-60 to -50) dB	0.18 dB	
	(-50 to -40) dB	0.18 dB	
	(-40 to -30) dB	0.18 dB	
	(-30 to -20) dB	0.18 dB	
(-20 to -10) dB	0.18 dB		
(-10 to 0) dB	0.17 dB		
Phase Noise – Measure	1 MHz to 3 GHz	3.9 dB	Agilent E4440A PSA Spectrum Analyzer
	(3 to 6.6) GHz	4.2 dB	
	(6.6 to 22) GHz	4.4 dB	
	(22 to 26.5) GHz	4.7 dB	
Spectral Analysis – Measure	3 Hz to 3 GHz	0.93 dB	Agilent E4440A PSA Spectrum Analyzer
	(3 to 6.6) GHz	1.9 dB	
	(6.6 to 13.2) GHz	3 dB	
	(13.2 to 22) GHz	3.1 dB	
	(22 to 26.5) GHz	3.4 dB	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Micrometers, Calipers ^{1,4} Length – Outside/Inside/Depth/Step	(0.05 to 1) in (1 to 9) in (9 to 15) in (15 to 40) in	13 μin (9 + 4L) μin (11 + 4L) μin (16 + 4L) μin	Gage Blocks, Long Gage Blocks
Anvil Flatness	Up to 1 in Diameter	4.4 μin	Optical Flats
Test Indicators ^{1,4}	Up to 0.4 in (0.45 to 3) in	7 μin (17 + 5.3L) μin	Gage Blocks, Surface Plate



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Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Height Measuring Equipment ⁴	(0.01 to 8) in (8 to 40) in	(17 + 3.4L) μin (15 + 4.3L) μin	Gage Blocks, Long Gage Blocks, Surface Plate
Height – Measure ⁴	(0.01 to 6) in (6 to 12) in	(24 + 2.6L) μin (14 + 4.4L) μin	Gage Blocks, Long Gage Blocks, Surface Plate
Pin Gages – Outside Diameter	(0.004 to 1) in	36 μin	Laser Micrometer
Steel Rules, Steel Tapes	Up to 40 in	0.005 5 in	ME-HZ1000 Ruler Calibrator

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force Measuring Equipment (Tension and Compression)	(1 to 250) lbf	0.017 % of reading	Deadweights
Torque Measuring Instruments ¹	20 ozf·in to 600 lbf·ft	1 % of reading	Torque Calibrator
Torque Angle ¹	45° 90° 135° 180° 360°	0.35° 0.35° 0.35° 0.35° 0.35°	Comparison to Torque Angle Fixture
Balances ^{1,5} Avoirdupois	(0.07 to 0.18) oz (0.18 to 1.8) oz 1.8 oz to 58 lb	0.13 mg 0.001 7 % of reading 0.000 6 % of reading	Class S Weights and internal calibration procedure utilized in the calibration of the weighing device.
SI (metric)	(2 to 5) g (5 to 50) g 50 g to 26 kg	0.13 mg 0.001 7 % of reading 0.000 6 % of reading	



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Balances ^{1,5} Avoirdupois	Up to 0.018 oz (0.018 to 0.2) oz (0.2 to 0.4) oz (0.4 to 0.7) oz 0.7 oz to 13 lb	12 µg 40 µg 60 µg 90 µg 0.000 3% of reading	ASTM E617 Class 1 Weights and internal calibration procedure utilized in the calibration of the weighing device.
SI (metric)	Up to 500 mg 500 mg to 5 g (5 to 10) g (10 to 20) g 20 g to 6 kg	12 µg 40 µg 60 µg 90 µg 0.000 3% of reading	
Scales ^{1,5} Avoirdupois	(50 to 600) lb	0.012 % of reading	NIST Class F Weights and internal calibration procedure utilized in the calibration of the weighing device.
SI (metric)	(22 to 272) kg	0.012 % of reading	
Absolute Pressure – Source (Pneumatic)	Up to 25 psia (25 to 500) psia	0.001 9 psi 0.007 % of reading + 0.001 psi	Ruska 7250xi Pressure Controller/Calibrator
Gauge Pressure – Source (Pneumatic)	(-15 to 25) psig (25 to 500) psig	0.001 7 psi 0.007 % of reading	Ruska 7250xi Pressure Controller/Calibrator
Gauge Pressure – Source (Hydraulic)	Up to 1 500 psig (1 500 to 15 000) psig	0.36 psi 0.023 % of reading	Fluke RPM4-E-DWT Electronic Deadweight Tester
Gas Flow	(0.1 to 10) slpm (10 to 680) slpm	0.23 % of reading 0.15 % of reading	Bell Prover
Liquid Flow	(0.001 to 47) gpm	0.1 % of reading	
	(0.004 to 178) lpm (0.4 to 23 500) pph	0.1 % of reading 0.1 % of reading	

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature Measuring Instruments ¹ (Probes, Thermometers, etc.)	(0 to 100) °C	0.038 °C	Comparison to Hart 5609A PRT, Digital Readout, Drywell
Temperature – Measure ¹	(-195 to 0) °C (0 to 420) °C (420 to 600) °C	0.012 °C 0.025 °C 0.036 °C	Hart 56A PRT, Digital Readout
Infrared Temperature Measuring Equipment	(-15 to 0) °C (0 to 50) °C (50 to 100) °C	0.79 °C 0.53 °C 0.67 °C	Blackbody Source (flat plate) $\epsilon = (0.9 \text{ to } 1)$, $\lambda = (8 \text{ to } 14) \mu\text{m}$
Infrared Temperature Measuring Equipment	(100 to 120) °C (120 to 200) °C (200 to 350) °C (350 to 500) °C	0.75 °C 0.97 °C 1.7 °C 2.2 °C	Blackbody Source (flat plate) $\epsilon = (0.9 \text{ to } 1)$, $\lambda = (8 \text{ to } 14) \mu\text{m}$

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Duty Cycle – Source Square Wave: < 3.3 Vp-p Freq: 0.01 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	0.62 % of reading + 78 ns 0.4 % of reading + 78 ns 0.02 % of reading + 78 ns	Fluke 5522A Multiproduct Calibrator
AC Duty Cycle – Source Square Wave: < 3.3 Vp-p Freq: 0.01 Hz to 100 kHz	(51 to 90) % Duty Cycle 10 μs to 100 s (90 to 99) % Duty Cycle 10 μs to 100 s	0.04 % of reading + 78 ns 0.62 % of reading + 78 ns	Fluke 5522A Multiproduct Calibrator
Frequency – Source/Measure	10 MHz	3.7 pHz/Hz	Pendulum GPS-89 GPS Frequency Standard
Frequency – Measure	1 Hz to 10 kHz 10 kHz to 10 MHz (10 to 225) MHz 225 MHz to 26.5 GHz	19 pHz/Hz + 4.5 μHz 19 pHz/Hz + 18 μHz 19 pHz/Hz + 0.64 mHz 0.21 $\mu\text{Hz/Hz}$ + 0.12 Hz	Agilent 53132A Universal Counter, Pendulum GPS-89 GPS Frequency Standard, Keysight PSA E4440A Spectrum Analyzer

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Period – Measure	(1 to 100) s	45 μ s	Agilent 53132A Universal Counter, Pendulum GPS-89 GPS Frequency Standard
Rise Time – Measure	17.5 ps 20 GHz	12 ps	Agilent 86100A Wide-bandwidth Oscilloscope, Agilent 83478A Plug-in
Stopwatches, Timers	Up to 19.99 s/d	59 ms/d	Helmut Klein TM-4500 Timometer

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 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 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.
 3. The stated uncertainty is the laboratory’s ability to source a fast rise pulse that is approximately 250 ps. In the typical application of measuring rise time of an oscilloscope, this value is one of the contributing factors, but other factors are derived from the DUT.
 4. L = length in inches.
 5. The CMC for scales and balances is highly dependent upon the resolution of the unit under test. The CMC presented here does not include the resolution of the unit under test. The resolution will be included in the reported measurement uncertainty at the time of calibration.
 6. The fixed value stated on the Scope is an approximate value.
 7. This location is part of a Multi-site Organization whose legal entity name is Transcat, Inc.
 8. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.11.



Jason Stine, Vice President