



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Techmaster Electronics, LLC
1070 Joshua Way
Vista, CA 92081
(and satellite locations as listed on the scope)

Fulfills the requirements of

ISO/IEC 17025:2017

and national standard

ANSI/NCSL Z540-1-1994 (R2002)

In the field of

CALIBRATION, DIMENSIONAL MEASUREMENT AND TESTING

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: 29 October 2026

Certificate Number: AC-1736



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)

Techmaster Electronics, Inc.

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Vista, CA 92081

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CALIBRATION, DIMENSIONAL MEASUREMENT AND TESTING

ISO/IEC 17025 Accreditation Granted: **29 October 2024**

Certificate Number: **AC-1736** Certificate Expiry Date: **29 October 2026**

Satellite Locations in:

[Techmaster Electronics, Inc.](#)
[1070 Joshua Way](#)
[Vista, CA 92081](#)

[Techmaster Electronics, Inc.](#)
[2225 Martin Ave, Suite I](#)
[Santa Clara, CA 95050](#)

[Techmaster Electronics, Inc.](#)
[6120 Hanging Moss Rd.](#)
[Orlando, FL 32807](#)

[Techmaster Electronics, Inc.](#)
[4614 Sinclair Rd.](#)
[San Antonio, TX 78222](#)

Services performed at main site laboratory

Techmaster Electronics, Inc.

1070 Joshua Way
Vista, CA 92081

CALIBRATION

Acoustics and Vibration

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sound Level Meters	(94, 114) dB 1 kHz	0.28 dB	Sound Calibrator

Chemical Quantities

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH – Source ⁶	4.01 pH 7.00 PH 10.00 pH	0.017 pH 0.018 pH 0.031 pH	Comparison to Standard Solutions
Conductivity – Source ⁶	100 µS/cm 500 µS/cm 1 400 µS/cm 10 000 µS/cm	1.4 µS/cm 6.2 µS/cm 17 µS/cm 120 µS/cm	Comparison to Standard Solutions

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source ¹	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V 220 V to 1.1 kV	6.8 µV/V + 0.48 µV 4.6 µV/V + 0.8 µV 3.2 µV/V + 3.2 µV 2.4 µV/V + 27 µV 4.7 µV/V + 43 µV 6 µV/V + 0.85 mV	Comparison to High Performance Multifunction Calibrator
DC Voltage – Source ¹ Fixed Points	1 V 1.018 V 10 V	14 µV 17 µV 35 µV	Comparison to DC Reference Standard

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Measure ¹	(Up to 200) mV 200 mV to 2 V (2 to 20) V (20 to 200) V 200 V to 1 kV	6.7 μ V/V + 0.2 μ V 4.3 μ V/V + 0.5 μ V 4.3 μ V/V + 4.8 μ V 6.7 μ V/V + 98 μ V 6.7 μ V + 0.63 mV	Comparison to Precision 8.5 Digit Multimeter
DC High Voltage – Measure ¹	Up to 10 kV (10 to 100) kV	0.35 mV/V + 0.09 V 0.63 mV/V + 4.1 V	Comparison to High Voltage Meter
DC Current – Source ¹	Up to 220 μ A 220 μ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A	0.003 7 % of reading + 5.8 nA 0.003 1 % of reading + 7.4 nA 0.003 1 % of reading + 44 nA 0.004 % of reading + 0.69 μ A 72 μ A/A + 14 μ A 0.023 % of reading + 0.47 mA	Comparison to High Performance Multifunction Calibrator w/ Transconductance Amplifier
DC Current – Source ¹	330 mA to 1.1 A (1.1 to 3) A (3 to 11) A (11 to 20) A	0.15 mA/A + 44 μ A 0.27 mA/A + 0.13 mA 0.39 mA/A + 0.41 mA 0.79 mA/A + 0.41 mA	Comparison to Multi Product Calibrator
DC Current – Source ¹ Clamp-On Meters	(10 to 16.5) A (16.5 to 150) A (150 to 1 025) A	0.5 % of reading + 0.55 A 0.5 % of reading + 0.57 A 0.5 % of reading + 0.74 A	Comparison to Multi Product Calibrator w/ Current Coil
DC Power – Source ¹ 33 mV to 1 020 V 329.99 mA range 2.9999 A range 20.5 A range	10 μ W to 330 W 10 mW to 3 kW 100 mW to 21 kW	0.01 % of reading + 1.2 nW 0.04 % of reading 0.1 % of reading	Comparison to Multi Product Calibrator
DC Power – Measure ¹	Up to 10 W (>10 to 15) W (>15 to 100) W (>100 to 150) W	0.043% of reading + 0.074 W 0.043 % of reading + 0.015 W 0.043 % of reading + 0.098 W 0.043 % of reading + 0.15 W	Comparison to Precision Power Analyzer
DC Current – Measure ¹	Up to 200 μ A (200 μ A to 2) mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A	15 μ A/A + 0.49 nA 15 μ A/A + 4.8 nA 17 μ A/A + 48 nA 59 μ A/A + 0.96 μ A 0.23 mA/A + 25 μ A 0.49 mA/A + 0.36 mA	Comparison to Precision 8.5 Digit Multimeter
DC Current – Measure ¹	(1 to 100) A (100 to 600) A (600 to 1 000) A	85 μ A/A 127 μ A/A 0.29 % of reading + 0.02 A	Indirect Method Precision 8.5 Digit Multimeter w/ Current Shunts

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(1 to 2.2) mV		Comparison to High Performance Multifunction Calibrator w/ Transconductance Amplifier
	(10 to 20) Hz	0.013 % of reading + 7.2 μ V	
	(20 to 40) Hz	0.008 3 % of reading + 4.2 μ V	
	40 Hz to 20 kHz	0.007 2 % of reading + 4.2 μ V	
	(20 to 50) kHz	0.016 % of reading + 4.6 μ V	
	(50 to 100) kHz	0.042 % of reading + 5.3 μ V	
	(100 to 300) kHz	0.095 % of reading + 10 μ V	
	(300 to 500) kHz	0.13 % of reading + 20 μ V	
	500 kHz to 1 MHz	0.25 % of reading + 21 μ V	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.021 % of reading + 4.9 μ V	
	(20 to 40) Hz	0.008 3 % of reading + 4.3 μ V	
	40 Hz to 20 kHz	0.007 % of reading + 4.4 μ V	
	(20 to 50) kHz	0.017 % of reading + 4.8 μ V	
	(50 to 100) kHz	0.042 % of reading + 6.1 μ V	
	(100 to 300) kHz	0.092 % of reading + 12 μ V	
	(300 to 500) kHz	0.13 % of reading + 22 μ V	
	500 kHz to 1 MHz	0.22 % of reading + 33 μ V	
	(22 to 220) mV		
	(10 to 20) Hz	0.022 % of reading + 16 μ V	
	(20 to 40) Hz	0.006 4 % of reading + 15 μ V	
	40 Hz to 20 kHz	0.004 4 % of reading + 10 μ V	
	(20 to 50) kHz	0.009 % of reading + 14 μ V	
	(50 to 100) kHz	0.028 % of reading + 23 μ V	
	(100 to 300) kHz	0.056 % of reading + 35 μ V	
	(300 to 500) kHz	0.13 % of reading + 39 μ V	
	500 kHz to 1 MHz	0.23 % of reading + 0.12 mV	
	220 mV to 2.2 V		
	(10 to 20) Hz	0.021 % of reading + 0.1 mV	
	(20 to 40) Hz	82 μ V/V + 32 μ V	
40 Hz to 20 kHz	39 μ V/V + 22 μ V		
(20 to 50) kHz	44 μ V/V + 62 μ V		
(50 to 100) kHz	71 μ V/V + 55 μ V		
(100 to 300) kHz	0.3 mV/V + 0.12 mV		
(300 to 500) kHz	0.89 mV/V + 0.3 mV		
500 kHz to 1 MHz	1.5 mV/V + 0.6 mV		

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(2.2 to 22) V		Comparison to High Performance Multifunction Calibrator w/ Transconductance Amplifier
	(10 to 20) Hz	0.2 mV/V + 1.1 mV	
	(20 to 40) Hz	68 μV/V + 0.63 mV	
	40 Hz to 20 kHz	19 μV/V + 0.7 mV	
	(20 to 50) kHz	44 μV/V + 0.61 mV	
	(50 to 100) kHz	0.006 1 % of reading + 0.65 mV	
	(100 to 300) kHz	0.19 mV/V + 1.9 mV	
	(300 to 500) kHz	0.9 mV/V + 2.8 mV	
	500 kHz to 1 MHz	1.1 mV/V + 11 mV	
	(22 to 220) V		
	(10 to 20) Hz	0.2 mV/V + 11 mV	
	(20 to 40) Hz	44 μV/V + 17 mV	
	40 Hz to 20 kHz	38 μV/V + 4.1 mV	
	(20 to 50) kHz	53 μV/V + 8 mV	
	(50 to 100) kHz	0.11 mV/V + 10 mV	
	(100 to 300) kHz	0.84 mV/V + 19 mV	
	(300 to 500) kHz	4.2 mV/V + 45 mV	
	500 kHz to 1 MHz	7.7 mV/V + 90 mV	
	(220 to 1 100) V		
	40 Hz to 1 kHz	50 μV/V + 27 mV	
(1 to 20) kHz	0.1 mV/V + 31 mV		
(20 to 30) kHz	0.41 mV/V + 70 mV		
(220 to 750) V			
(30 to 50) kHz	0.45 mV/V + 12 mV		
(50 to 100) kHz	1.8 mV/V + 21 mV		

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	Up to 200 mV		Comparison to Precision 8.5 Digit Multimeter
	(1 to 10) Hz	0.2 mV/V + 29µV	
	(10 to 40) Hz	0.17 mV/V + 5 µV	
	(40 to 100) Hz	0.14 mV/V + 5 µV	
	100 Hz to 2 kHz	0.17 mV/V + 2 µV	
	(2 to 10) kHz	0.17 mV/V + 5 µV	
	(10 to 30) kHz	0.42 mV/V + 10 µV	
	(30 to 100) kHz	0.93 mV/V + 24 µV	
	200 mV to 2 V		
	(1 to 10) Hz	0.19 mV/V + 0.33 mV	
	(10 to 40) Hz	0.15 mV/V + 3 µV	
	(40 to 100) Hz	0.12 mV/V + 24 µV	
	100 Hz to 2 kHz	0.17 mV/V + 24 µV	
	(2 to 10) kHz	0.14 mV/V + 24 µV	
	(10 to 30) kHz	0.27 mV/V + 48 µV	
	(30 to 100) kHz	0.7 mV/V + 0.24 mV	
	(2 to 20) V		
	(1 to 10) Hz	0.18 mV/V + 3.3 mV	
	(10 to 40) Hz	0.14 mV/V + 0.3 mV	
	(40 to 100) Hz	0.11 mV/V + 0.24 mV	
	100 Hz to 2 kHz	0.15 mV/V + 0.24 mV	
	(2 to 10) kHz	0.14 mV/V + 0.24 mV	
	(10 to 30) kHz	0.27 mV/V + 0.48 mV	
	(30 to 100) kHz	0.69 mV/V + 2.4 mV	
	(100 to 300) kHz	3.6 mV/V + 24 mV	
	300 kHz to 1 MHz	12 mV/V + 0.24 mV	
	(20 to 200) V		
	1 to 10 Hz	0.19 mV/V + 58 mV	
	(10 to 40) Hz	0.15 mV/V + 2.7 mV	
	(40 to 100) Hz	0.12 mV/V + 2.4 mV	
100 Hz to 2 kHz	0.15 mV/V + 2.4 mV		
(2 to 10) kHz	0.14 mV/V + 2.4 mV		
(10 to 30) kHz	0.27 mV/V + 4.8 mV		
(30 to 100) kHz	0.69 mV/V + 24 mV		
(100 to 300) kHz	3.6 mV/V + 0.24 mV		
300 kHz to 1 MHz	12 mV/V + 2.4 V		

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	200 V to 1 kV (1 to 10) Hz (10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.19 mV/V + 84 mV 0.16 mV/V + 24 mV 0.29 mV/V + 24 mV 0.28 mV/V + 48 mV 0.72 mV/V + 0.24 V	Comparison to Precision 8.5 Digit Multimeter
AC High Voltage - Measure ¹	Up to 10 kV (30 to 200) Hz (200 to 450) Hz (450 to 600) Hz (10 to 100) kV (30 to 70) Hz (70 to 200) Hz	1.4 mV/V + 0.14 V 4.6 mV/V + 0.14V 8.7 mV/V + 0.14V 1.4 mV/V + 0.7 V 17 % of reading + 0.7 V	Comparison to High Voltage Meter
AC Voltage Flatness - Source ¹ (Referenced to 1 kHz)	0.3 mV to 3.5 V (10 to 30) Hz 30 Hz to 120 kHz (0.3 to 1.1) mV 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz (1.1 to 3) mV 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz 3 mV to 3.5 V 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.35 % of reading 0.12 % of reading 0.24 % of reading + 3 μV 0.47 % of reading + 3 μV 0.7 % of reading + 3 μV 1.8 % of reading + 15 μV 0.12 % of reading + 3 μV 0.35 % of reading + 3 μV 0.58 % of reading + 3 μV 1.8 % of reading + 3 μV 0.12 % of reading + 3 μV 0.24 % of reading + 3 μV 0.47 % of reading + 3 μV 1.2 % of reading + 3 μV	Comparison to High Performance Multifunction Calibrator (Wideband)

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage Flatness – Measure ¹	Up to 3 V (10 to 100) Hz 100 Hz to 10 kHz (10 to 30) kHz 30 kHz to 1 MHz (1 to 10) MHz (10 to 30) MHz (30 to 50) MHz (50 to 70) MHz (70 to 80) MHz (80 to 100) MHz	0.2 % of reading 0.051% of reading 0.059 % of reading 0.13 % of reading 0.21% of reading 0.26% of reading 0.42 % of reading 0.65 % of reading 0.77% of reading 0.97 % of reading	Indirect Method Precision 8.5 Digit Multimeter w/ Thermal Converters



Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	Up to 2.2 mV		Comparison to AC Measurement Standard
	(10 to 20) Hz	1.6 mV/V + 1.6 μV	
	(20 to 40) Hz	1.6 mV/V + 1.6 μV	
	40 Hz to 20 kHz	0.4 mV/V + 1.7 μV	
	(20 to 50) kHz	0.8 mV/V + 2.2 μV	
	(50 to 100) kHz	1.2 mV/V + 2.7 μV	
	(100 to 300) kHz	2.3 mV/V + 4.1 μV	
	(300 to 500) kHz	2.4 mV/V + 8.1 μV	
	500 kHz to 1 MHz	3.5 mV/V + 8.1 μV	
	(2.2 to 7) mV		
	(10 to 20) Hz	0.8 mV/V + 1.4 μV	
	(20 to 40) Hz	0.4 mV/V + 1.5 μV	
	40 Hz to 20 kHz	0.2 mV/V + 1.5 μV	
	(20 to 50) kHz	0.4 mV/V + 2.1 μV	
	(50 to 100) kHz	0.6 mV/V + 2.6 μV	
	(100 to 300) kHz	1.2 mV/V + 4.1 μV	
	(300 to 500) kHz	1.3 mV/V + 6 μV	
	500 kHz to 1 MHz	2 mV/V + 6 μV	
	(7 to 22) mV		
	(10 to 20) Hz	0.3 mV/V + 1.6 μV	
	(20 to 40) Hz	0.3 mV/V + 1.6 μV	
	40 Hz to 20 kHz	0.1 mV/V + 1.7 μV	
	(20 to 50) kHz	0.2 mV/V + 2.3 μV	
	(50 to 100) kHz	0.3 mV/V + 2.7 μV	
	(100 to 300) kHz	0.8 mV/V + 4.1 μV	
	(300 to 500) kHz	0.9 mV/V + 6.1 μV	
	500 kHz to 1 MHz	1.4 mV/V + 6.1 μV	
	(22 to 70) mV		
(10 to 20) Hz	2 mV/V + 5.3 μV		
(20 to 40) Hz	80 μV/V + 6.3 μV		
40 Hz to 20 kHz	40 μV/V + 6.8 μV		
(20 to 50) kHz	0.1 mV/V + 6.4 μV		
(50 to 100) kHz	0.23 mV/V + 5.8 μV		
(100 to 300) kHz	0.5 mV/V + 6 μV		
(300 to 500) kHz	0.7 mV/V + 9.4 μV		
500 kHz to 1 MHz	1.1 mV/V + 9 μV		

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(70 to 220) mV		Comparison to AC Measurement Standard
	(10 to 20) Hz	0.2 mV/V + 1.6 μV	
	(20 to 40) Hz	80 μV/V + 1.7 μV	
	40 Hz to 20 kHz	40 μV/V + 1.8 μV	
	(20 to 50) kHz	70 μV/V + 2.2 μV	
	(50 to 100) kHz	0.2 mV/V + 2.6 μV	
	(100 to 300) kHz	0.3 mV/V + 4.1 μV	
	(300 to 500) kHz	0.4 mV/V + 8 μV	
	500 kHz to 1 MHz	1 mV/V + 8 μV	
	(220 to 700) mV		
	(10 to 20) Hz	0.21 mV/V + 1.5 μV	
	(20 to 40) Hz	0.21 mV/V + 1.5 μV	
	40 Hz to 20 kHz	30 μV/V + 1.7 μV	
	(20 to 50) kHz	50 μV/V + 2.1 μV	
	(50 to 100) kHz	80 μV/V + 2.6 μV	
	(100 to 300) kHz	0.2 mV/V + 4 μV	
	(300 to 500) kHz	0.3 mV/V + 8 μV	
	500 kHz to 1 MHz	0.3 mV/V + 8 μV	
	700 mV to 2.2 V		
	(10 to 20) Hz	0.2 mV/V + 4.2 μV	
	(20 to 40) Hz	0.62 mV/V + 13 μV	
	40 Hz to 20 kHz	0.17 mV/V + 23 μV	
	(20 to 50) kHz	0.41 mV/V + 16 μV	
	(50 to 100) kHz	0.67 mV/V + 12 μV	
	(100 to 300) kHz	0.16 mV/V + 6 μV	
	(300 to 500) kHz	0.26 mV/V + 4 μV	
	500 kHz to 1 MHz	9 mV/V + 1.1 μV	
	(2.2 to 7) V		
	(10 to 20) Hz	0.2 mV/V + 1.1 μV	
	(20 to 40) Hz	0.7 mV/V + 3.2 μV	
40 Hz to 20 kHz	0.23 mV/V + 8.4 μV		
(20 to 50) kHz	0.5 mV/V + 4.4 μV		
(50 to 100) kHz	0.8 mV/V + 2.7 μV		
(100 to 300) kHz	0.19 mV/V + 1.1 μV		
(300 to 500) kHz	0.4 mV/V + 0.5 μV		
500 kHz to 1 MHz	1.2 mV/V + 0.2 μV		

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(7 to 22) V		Comparison to AC Measurement Standard
	(10 to 20) Hz	0.2 mV/V + 3.7 μV	
	(20 to 40) Hz	0.7 mV/V + 11 μV	
	40 Hz to 20 kHz	0.3 mV/V + 26 μV	
	(20 to 50) kHz	0.5 mV/V + 15 μV	
	(50 to 100) kHz	0.8 mV/V + 9.1 μV	
	(100 to 300) kHz	0.29 mV/V + 4 μV	
	(300 to 500) kHz	0.4 mV/V + 1.9 μV	
	500 kHz to 1 MHz	1.2 mV/V + 0.6 μV	
	(22 to 70) V		
	(10 to 20) Hz	0.2 mV/V + 9.1 μV	
	(20 to 40) Hz	70 μV/V + 27 μV	
	40 Hz to 20 kHz	30 μV/V + 55 μV	
	(20 to 50) kHz	60 μV/V + 32 μV	
	(50 to 100) kHz	90 μV/V + 19 μV	
	(100 to 300) kHz	0.2 mV/V + 9.1 μV	
	(300 to 500) kHz	0.4 mV/V + 4.4 μV	
	500 kHz to 1 MHz	1.2 mV/V + 1.5 μV	
	(70 to 220) V		
	(10 to 20) Hz	0.20 mV/V + 7.1 μV	
	(20 to 40) Hz	70 μV/V + 21 μV	
	40 Hz to 20 kHz	30 μV/V + 45 μV	
	(20 to 50) kHz	70 μV/V + 21 μV	
	(50 to 100) kHz	0.1 mV/V + 14 μV	
	(100 to 300) kHz	0.21 mV/V + 6.8 μV	
	(300 to 500) kHz	0.5 mV/V + 2.8 μV	
	(220 to 700) V		
	(10 to 20) Hz	0.2 mV/V + 77 μV	
(20 to 40) Hz	0.1 mV/V + 0.16 mV		
40 Hz to 20 kHz	40 μV/V + 0.37 mV		
(20 to 50) kHz	0.13 mV/V + 0.12 mV		
(50 to 100) kHz	0.5 mV/V + 31 μV		
700 V to 1 kV			
(10 to 20) Hz	0.2 mV/V + 31 μV		
(20 to 40) Hz	0.1 mV/V + 62 μV		
40 Hz to 20 kHz	40 μV/V + 0.16 mV		
(20 to 50) kHz	0.13 mV/V + 47 μV		
(50 to 100) kHz	0.5 mV/V + 12 μV		

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	Up to 10 mV		Comparison to Precision 8.5 Digit Multimeter AC BAND < 2 MHz
	(1 to 40) Hz	3.5 μ V/V + 4.6 μ V	
	40 Hz to 1 kHz	2.4 μ V/V + 3.2 μ V	
	(1 to 20) kHz	3.5 μ V/V + 4.6 μ V	
	(20 to 50) kHz	12 μ V/V + 3.2 μ V	
	(50 to 100) kHz	58 μ V/V + 3.2 μ V	
	(100 to 300) kHz	0.47 mV/V + 3.8 μ V	
	(10 to 100) mV		
	(1 to 40) Hz	86 μ V/V + 4.6 μ V	
	40 Hz to 1 kHz	86 μ V/V + 2.3 μ V	
	(1 to 20) kHz	0.17 mV/V + 2.3 μ V	
	(20 to 50) kHz	0.35 mV/V + 2.3 μ V	
	(50 to 100) kHz	0.93 mV/V + 2.3 μ V	
	(100 to 300) kHz	3.5 mV/V + 12 μ V	
	300 kHz to 1 MHz	12 mV/V + 12 μ V	
	(1 to 2) MHz	18 mV/V + 12 μ V	
	100 mV to 1 V		
	(1 to 40) Hz	92 μ V/V + 50 μ V	
	40 Hz to 1 kHz	92 μ V/V + 31 μ V	
	(1 to 10) V		
	(1 to 20) kHz	0.17 mV/V + 31 μ V	
	(20 to 50) kHz	0.35 mV/V + 31 μ V	
	(50 to 100) kHz	0.93 mV/V + 31 μ V	
	(100 to 300) kHz	3.5 mV/V + 0.12 mV	
300 kHz to 1 MHz	12 mV/V + 0.12 mV		
(1 to 2) MHz	18 mV/V + 0.12 mV		
(10 to 100) V			
(1 to 40) Hz	91 μ V/V + 0.14 mV		
40 Hz to 1 kHz	91 μ V/V + 0.14 mV		
(1 to 20) kHz	0.17 mV/V + 0.14 mV		
(20 to 50) kHz	0.35 mV/V + 0.14 mV		
(50 to 100) kHz	0.93 mV/V + 0.14 mV		
(100 to 300) kHz	3.5 mV/V + 0.16 mV		
300 kHz to 1 MHz	1.2 mV/V + 0.16 mV		
(1 to 2) MHz	1.8 mV/V + 0.16 mV		

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Measure ¹	(100 to 750) V (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	0.45 mV/V + 2.7 mV 0.45 mV/V + 2.7 mV 0.45 mV/V + 2.7 mV 0.56 mV/V + 2.7 mV 1.5 mV/V + 2.7 mV 4.7 mV/V + 2.7 mV 18 mV/V + 2.7 mV	Comparison to Precision 8.5 Digit Multimeter AC BAND < 2 MHz
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 11 mV to 10 V 45 Hz to 100 kHz 100 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (11 to 100) V 45 Hz to 100 kHz 100 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (8 to 10) MHz (100 to 750) V 45 Hz to 100 kHz	0.46 mV/V + 47 mV 0.46 mV/V + 24 mV 0.69 mV/V + 24 mV 1.4 mV/V + 24 mV 3.5 mV/V + 24 mV 1 mV/V + 7.5 μV 14 mV/V + 6.5 μV 81 mV/V + 8.6 μV 0.24 V + 9.7 μV 1 mV/V + 0.7 mV 24 mV/V + 0.58 mV 47 mV/V + 0.81 mV 47 mV/V + 0.93 mV 0.18 V + 1.2 mV 1.5 mV/V + 2.7 mV	Comparison to Precision 8.5 Digit Multimeter AC BAND > 2 MHz

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	(2.2 to 22) mA		Comparison to High Performance Multifunction Calibrator
	(10 to 20) Hz	0.003 4 % of reading + 20 μA	
	(20 to 40) Hz	0.002 5 % of reading + 12 μA	
	40 Hz to 1 kHz	0.007 2 % of reading + 0.95 μA	
	(1 to 5) kHz	0.015 % of reading + 1.5 μA	
	(5 to 10) kHz	0.1 % of reading + 5.1 μA	
	(22 to 220) mA		
	(10 to 20) Hz	0.004 6 % of reading + 0.15 mA	
	(20 to 40) Hz	0.003 5 % of reading + 85 μA	
	40 Hz to 1 kHz	0.006 2 % of reading + 12 μA	
	(1 to 5) kHz	0.014 % of reading + 16 μA	
	(5 to 10) kHz	0.089 % of reading + 38 μA	
	220 mA to 2.2 A		
	20 Hz to 1 kHz	0.18 mA/A + 0.17 mA	
(1 to 5) kHz	0.32 mA/A + 0.27 mA		
(5 to 10) kHz	5.1 mA/A + 2.8 mA		
(2.2 to 11) A			
40 Hz to 1 kHz	0.3 mA/A + 1.1 mA		
(1 to 5) kHz	0.74 mA/A + 53 μA		
(5 to 10) kHz	2.8 mA/A + 0.2 mA		
AC Current – Source ¹	(11 to 20) A		Comparison to Multi Product Calibrator
	(45 to 100) Hz	1.2 mA/A + 5 mA	
	100 Hz to 1kHz	1.5 mA/A + 5 mA	
	(1 to 5) kHz	30 mA/A + 5 mA	
AC Current – Source ¹	(9 to 220) μA		Comparison to High Performance Multifunction Calibrator
	(10 to 20) Hz	0.02 % of reading + 26 nA	
	(20 to 40) Hz	0.01 % of reading + 30 nA	
	40 Hz to 1 kHz	0.01 % of reading + 8.3 nA	
	(1 to 5) kHz	0.02 % of reading + 36 nA	
	(5 to 10) kHz	0.1 % of reading + 63 nA	
	220 μA to 2.2 mA		
	(10 to 20) Hz	0.004 8 % of reading + 1.4 μA	
	(20 to 40) Hz	0.006 1 % of reading + 0.44 μA	
	40 Hz to 1 kHz	0.007 2 % of reading + 95 nA	
	(1 to 5) kHz	0.016 % of reading + 0.18 μA	
	(5 to 10) kHz	0.1 % of reading + 0.65 μA	

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹ Clamp-On Meters	(10 to 16.5) A (45 to 65) Hz (65 to 440) Hz	0.28 % of reading + 0.16 A 0.79 % of reading + 0.13 A	Comparison to Multi Product Calibrator w/ Current Coil
	(16.5 to 150) A (45 to 65) Hz (65 to 440) Hz	0.28 % of reading + 0.31 A 0.79 % of reading + 0.16 A	
	(150 to 1 025) A (45 to 65) Hz (65 to 440) Hz	0.29 % of reading + 1.3 A 0.8 % of reading + 1.2 A	
AC Power – Source ¹ PF = 1 (10 to 45) Hz 33 mV to 32.9999 V (3.3 mA to 2.99999 A)	110 μW to 99 W	0.19 % of reading	Comparison to Multi Product Calibrator
	(45 to 65) Hz 33 mV to 1020 V (3.3 mA to 20.5 A)	110 μW to 21 kW 0.15 % of reading	

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power – Measure ¹	Up to 15 W (0.1 to 66) Hz	0.1 % of reading + 0.012 W	Comparison to Precision Power Analyzer
	66 Hz to 1 kHz (> 15 to 30) W	0.068 % of reading + 0.018 W	
	(0.1 to 66) Hz 66 Hz to 1 kHz	0.1 % of reading + 0.023 W	
	(> 30 to 60) W	0.068 % of reading + 0.035 W	
	(0.1 to 66) Hz 66 Hz to 1 kHz	0.1 % of reading + 0.046 W	
	(> 60 to 100) W	0.068 % of reading + 0.071 W	
	(0.1 to 66) Hz 66 Hz to 1 kHz	0.1 % of reading + 0.076 W	
	(> 100 to 150) W	0.068 % of reading + 0.12 W	
	(0.1 to 66) Hz 66 Hz to 1 kHz	0.1 % of reading + 0.12 W	
	(> 150 to 300) W	0.068 % of reading + 0.18 W	
	(0.1 to 66) Hz 66 Hz to 1 kHz	0.1 % of reading + 0.24 W	
	(> 300 to 600) W	0.068 % of reading + 0.36 W	
Phase – Source ¹	+/- 179.99 ($\Delta\Phi^\circ$)		Comparison to Multi Product Calibrator
	(10 to 65) Hz	0.09°	
	(65 to 500) Hz	0.2°	
	500 Hz to 1 kHz	0.39°	
	(1 to 5) kHz	1.9°	
	(5 to 10) kHz	3.9°	
Phase – Measure ¹	(10 to 30) kHz	7.8°	Comparison to Phase Meter Vista, CA
	(0 to 360)°		
	10 Hz to 50 kHz	0.084°	
	(50 to 100) kHz	0.41°	

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure ¹	(1 to 10) A (3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz (5 to 10) kHz (10 to 100) A (50 to 60) Hz (100 to 300) A (50 to 60) Hz	20 mA/A + 6 mA 11 mA/A + 6 mA 1.5 mA/A + 6 mA 3.5 mA/A + 70 mA 0.6 A 0.8 A	Indirect Method Precision 8.5 Digit Multimeter / Shunts
AC Current – Measure ¹	Up to 200 μ A 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz 200 μ A to 2 mA 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz (2 to 20) mA 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz (20 to 200) mA 10 Hz to 10 kHz (10 to 30) kHz 200 mA to 2 A 10 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (2 to 20) A 10 Hz to 2 kHz (2 to 10) kHz	0.42 mA/A + 24 nA 0.88 mA/A + 24 nA 4.8 mA/A + 24 nA 0.36 mA/A + 0.24 μ A 0.86 mA/A + 0.24 μ A 4.8 mA/A + 0.24 μ A 0.37 mA/A + 2.4 μ A 0.86 mA/A + 2.4 μ A 4.8 mA/A + 2.4 μ A 0.35 mA/A + 24 μ A 0.75 mA/A + 24 μ A 0.75 mA/A + 0.25 mA 0.87 mA/A + 0.27 mA 3.6 mA/A + 0.26 mA 0.99 mA/A + 2.4 mA 3.1 mA/A + 2.4 mA	Comparison to Precision 8.5 Digit Multimeter
Resistance – Source ¹	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω to 1.1 k Ω (1.1 to 3.3) k Ω (3.3 to 11) k Ω (11 to 33) k Ω (33 to 110) k Ω	1.7 m Ω / Ω + 35 $\mu\Omega$ 23 $\mu\Omega$ / Ω + 3.3 m Ω 31 $\mu\Omega$ / Ω + 1.9 m Ω 32 $\mu\Omega$ / Ω + 2.8 m Ω 33 $\mu\Omega$ / Ω + 2.3 m Ω 32 $\mu\Omega$ / Ω + 30 m Ω 5 $\mu\Omega$ / Ω + 1.4 Ω 32 $\mu\Omega$ / Ω + 0.3 Ω 33 $\mu\Omega$ / Ω + 0.34 Ω	Comparison to Multi Product Calibrator

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source ¹	(110 to 330) kΩ 330 kΩ to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ 330 MΩ to 1.1 GΩ	37 μΩ/Ω + 3.1 Ω 38 μΩ/Ω + 2.6 Ω 71 μΩ/Ω + 36 Ω 0.13 mΩ/Ω + 0.38 kΩ 0.22 mΩ/Ω + 7.4 kΩ 0.42 mΩ/Ω + 32 kΩ 3.6 mΩ/Ω + 0.12 MΩ 18 mΩ/Ω + 0.59 MΩ	Comparison to Multi Product Calibrator
Resistance – Source ¹ Fixed Points	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	48 μΩ 0.15 mΩ 0.22 mΩ 0.28 mΩ 0.63 mΩ 1.2 mΩ 2.3 mΩ 7.8 mΩ 15 mΩ 77 mΩ 0.15 Ω 1 Ω 1.9 Ω 16 Ω 40 Ω 0.48 kΩ 1.1 kΩ 12 kΩ	Comparison to High Performance Multiproduct Calibrator
Resistance – Source ¹ Fixed Points	0.1 Ω 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ	0.56 mΩ 0.29 mΩ 2.3 mΩ 1.8 mΩ 35 mΩ 0.12 Ω 1.3 Ω	Comparison to Four Terminal Pair Resistor Set

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Measure ¹	Up to 2Ω (2 to 20) Ω (20 to 200) Ω 200 Ω to 2 kΩ (2 to 20) kΩ (20 to 200) kΩ 200 kΩ to 2 MΩ (2 to 20) MΩ (20 to 200) MΩ 200 MΩ to 2 GΩ	23 μΩ/Ω + 5.9 μΩ 12 μΩ/Ω + 18 μΩ 9.8 μΩ/Ω + 80 μΩ 12 μΩ/Ω + 0.94 mΩ 11 μΩ/Ω + 47 mΩ 11 μΩ/Ω + 60 mΩ 13 μΩ/Ω + 1.2 Ω 28 μΩ/Ω + 0.12 kΩ 0.15 mΩ/Ω + 1.2 kΩ 1.9 mΩ/Ω + 12 kΩ	Comparison to Precision 8.5 Digit Multimeter
LCR Impedance – Source ¹	DC to 1 kHz 100 mΩ 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ	0.42 mΩ 1.3 mΩ 6.3 mΩ 33 mΩ 310 mΩ 3.1 Ω 32 Ω 460 Ω 13 kΩ 33 kΩ	Comparison to Impedance Calibrator
LCR Impedance – Source ¹	(0.1 to 1) kHz 10 pF 100 pF 1 nF 10 nF 100 nF 1 μF 10 μF 100 μF (10 to 50) kHz 10 μH (1 to 10) kHz 100 μH (0.1 to 1) kHz 1 mH 10 mH 100 mH 1 H 10 H	0.062 pF 0.12 pF 0.001 7 nF 0.024 nF 0.067 nF 0.001 5 μF 0.006 9 μF 0.13 μF 0.12 μH 0.24 μH 0.001 3 mH 0.012 mH 0.12 mH 0.001 2 H 0.012 H	Comparison to Impedance Calibrator

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Impedance – Measure ¹	20 Hz to 1 MHz (1 to 10) mΩ (> 10 to 100) mΩ > 100 mΩ to 1 Ω (> 1 to 10) Ω (> 10 to 100) Ω > 100 Ω to 1 kΩ (> 1 to 10) kΩ (> 10 to 100) kΩ > 100 kΩ to 1 MΩ (> 1 to 10) MΩ (> 10 to 100) MΩ	12 % of reading + 0.29 mΩ 1.2 % of reading + 0.29 mΩ 0.53 % of reading + 0.29 mΩ 0.41 % of reading + 0.29 mΩ 0.42 % of reading + 0.29 mΩ 0.45 % of reading + 0.29 mΩ 0.54 % of reading + 0.29 mΩ 0.56 % of reading + 0.29 mΩ 1.2 % of reading + 0.29 mΩ 1.3 % of reading + 0.29 mΩ 12 % of reading + 0.29 mΩ	Precision LCR Meter
Capacitance – Source ¹ 10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz DC to 50 Hz DC to 20 Hz DC to 6 Hz DC to 2 Hz DC to 0.6 Hz DC to 0.2 Hz	(220 to 399.9) pF (0.4 to 1.099 9) nF (1.1 to 3.299 9) nF (3.3 to 10.999 9) nF (11 to 32.999 9) nF (33 to 109.999) nF (110 to 329.999) nF (0.33 to 1.099 99) μF (1.1 to 3.299 99) μF (3.3 to 10.999 9) μF (11 to 32.999 9) μF (33 to 109.999) μF (110 to 329.999) μF (0.33 to 1.099 99) mF (1.1 to 3.299 99) mF (3.3 to 10.999 9) mF (11 to 32.999 9) mF (33 to 110) mF	0.58 % of reading + 12 pF 0.57 % of reading + 12 pF 0.57 % of reading + 12 pF 0.22 % of reading + 27 pF 0.29 % of reading + 0.12 nF 0.29 % of reading + 0.13 nF 0.29 % of reading + 0.35 nF 0.28 % of reading + 1.5 nF 0.29 % of reading + 3.5 nF 0.29 % of reading + 1.3 nF 0.46 % of reading + 36 nF 0.53 % of reading + 0.12 μF 0.53 % of reading + 0.35 μF 0.5 % of reading + 1.5 μF 0.52 % of reading + 3.6 μF 0.51 % of reading + 13 μF 0.86 % of reading + 35 μF 1.3 % of reading + 0.13 mF	Comparison to Multi Product Calibrator
Fixed Capacitance ¹ @ 1 kHz	(100 to 500) pF 500 pF to 5 nF (5 to 50) nF (50 to 100) nF (100 to 500) nF 500 nF to 1.5 μF	0.64 pF 3.7 pF 32 pF 63 pF 0.59 nF 0.63 nF	Comparison to Capacitance Standard Set

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹	1 pF		Comparison to Standard Air Capacitor Set
	1 kHz to 3 MHz	1.2 fF	
	4 MHz	1.3 fF	
	5 MHz	1.5 fF	
	10 MHz	2.8 fF	
	13 MHz	3.9 fF	
	10 pF		
	1 kHz to 13 MHz	12 fF	
	100 pF		
	1 kHz to 10 MHz	0.12 pF	
13 MHz	0.13 pF		
1 nF	1 kHz to 4 MHz	1.2 pF	
	5 MHz	1.3 pF	
	10 MHz	2.2 pF	
	13 MHz	3 pF	
Capacitance – Measure ¹	(1 to 10) nF	0.052 pF	Comparison to Digit Multimeter/LCR Meter
	(10 to 100) nF	0.041 pF	
	(0.1 to 1) μF	0.37 nF	
	(1 to 10) μF	0.018 μF	
	(10 to 100) μF	0.041 μF	
	(100 to 1 000) μF	0.56 μF	
	(1 to 10) mF	0.018 mF	
(10 to 100) mF	0.059 mF		
Inductance - Source ¹ 0.1 to 1 kHz	200 μH	0.58 μH	Comparison to Standard Value Inductors
	2 mH	2.4 μH	
	20 mH	24 μH	
	200 mH	0.24 mH	
	2 H	2.4 mH	
Inductance – Measure ¹	0.001 nH to 99.999 999 H		Comparison to Precision LCR Meter
	Up to 1 kHz	0.062 % of reading + 0.007 mH	
	1 kHz to 1 MHz	0.56 % of reading + 0.007 mH	

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Source and Measure ¹	Type C		Comparison to Multi Product Calibrator
	(0 to 150) °C	0.29 °C	
	(150 to 650) °C	0.32 °C	
	(650 to 1 000) °C	0.28 °C	
	(1 000 to 1 800) °C	0.48 °C	
	(1 800 to 2 316) °C	0.71 °C	
	Type E		
	(-250 to -100) °C	0.43 °C	
	(-100 to -25) °C	0.21 °C	
	(-25 to 350) °C	0.17 °C	
	(350 to 650) °C	0.14 °C	
	(650 to 1 000) °C	0.19 °C	
	Type J		
	(-210 to -100) °C	0.35 °C	
	(-100 to -30) °C	0.2 °C	
	(-30 to 150) °C	0.14 °C	
	(150 to 760) °C	0.19 °C	
	(760 to 1 200) °C	0.26 °C	
	Type K		
	(-200 to -100) °C	0.28 °C	
	(-100 to -25) °C	0.21 °C	
	(-25 to 120) °C	0.23 °C	
	(120 to 1 000) °C	0.25 °C	
	(1 000 to 1 372) °C	0.33 °C	
	Type N		
	(-200 to -100) °C	0.39 °C	
	(-100 to -25) °C	0.27 °C	
	(-25 to 120) °C	0.23 °C	
(120 to 410) °C	0.18 °C		
(410 to 1 300) °C	0.27 °C		
Type R			
(0 to 250) °C	0.83 °C		
(250 to 400) °C	0.42 °C		
(400 to 1 000) °C	0.31 °C		
(1 000 to 1 767) °C	0.38 °C		
Type S			
(0 to 250) °C	0.55 °C		
(250 to 1 000) °C	0.34 °C		
(1 000 to 1 400) °C	0.32 °C		
(1 400 to 1 767) °C	0.41 °C		

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Source and Measure ¹	Type T (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.63 °C 0.35 °C 0.26 °C 0.22 °C	Comparison to Multi Product Calibrator
Electrical Simulation of RTD Temperature Indicating Devices – Source and Measure ¹	Pt 385 (100 Ω) (-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C Pt 3926 (100 Ω) (-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C Pt 3916 (100 Ω) (-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C Pt 385 (200 Ω) (-200 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.05 °C 0.07 °C 0.09 °C 0.1 °C 0.12 °C 0.23 °C 0.05 °C 0.07 °C 0.09 °C 0.1 °C 0.12 °C 0.25 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.09 °C 0.1 °C 0.23 °C 0.04 °C 0.05 °C 0.12 °C 0.13 °C 0.14 °C 0.16 °C	Comparison to Multi Product Calibrator

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Temperature Indicating Devices – Source and Measure ¹	Pt 385 (500 Ω)		Comparison to Multi Product Calibrator
	(-200 to -80) °C	0.04 °C	
	(-80 to 100) °C	0.05 °C	
	(100 to 260) °C	0.06 °C	
	(260 to 400) °C	0.08 °C	
	(400 to 600) °C	0.09 °C	
	(600 to 630) °C	0.11 °C	
	Pt 385 (1000 Ω)		
	(-200 to 0) °C	0.03 °C	
	(0 to 100) °C	0.04 °C	
	(100 to 260) °C	0.05 °C	
	(260 to 300) °C	0.06 °C	
	(300 to 600) °C	0.07 °C	
(600 to 630) °C	0.23 °C		
PtNi 385 (120 Ω) (Ni 120)			
(-80 to 100) °C	0.08 °C		
(100 to 260) °C	0.14 °C		
CU 427 (10 Ω)			
(100 to 260) °C	0.3 °C		
Oscilloscopes ¹			Comparison to Multi Product Calibrator
DC Voltage			
into 50 Ω load	(-6.6 to 6.6) V	0.2 % of reading + 36 μV	
into 1 MΩ load	(-130 to 130) V	0.039 % of reading + 37 μV	
Square Wave			
into 50 Ω	10 Hz to 10 kHz	0.2 % of reading + 65 μV	
	1 mVp-p to 6.6 Vp-p		
into 1 MΩ	10 Hz to 1 kHz	0.078 % of reading + 36 μV	
	1 mVp-p to 130 Vp-p	0.19 % of reading + 39 μV	
	(1 to 10) kHz		
	1 mVp-p to 130 Vp-p		
Leveled Sine Amplitude Reference @ 50 kHz	5 mV to 5.5 V	15 mV/V + 0.49 mV	

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes ¹ Leveled Sine Amplitude (relative to 50 kHz) 5 mV to 5.5 V Time Markers (5-2-1 sequence) into 50 Ω load Edge Transition Time (Rise Time)	5 mV to 5.5 V 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz (1 to 50) ns 100 ns to 20 ms 50 ms to 5 s < 300 ps	14 mV/V + 0.12 mV 17 mV/V + 0.14 mV 32 mV/V + 0.15 mV 40 mV/V + 0.16 mV 0.001 1 % of reading + 0.048 ps 0.000 2 % of reading + 7 ps 0.4 % of reading 80 ps	Comparison to Multi Product Calibrator
Oscilloscopes ¹ Square Wave Signal 10 Hz to 10 kHz into 50 Ω load into 1 M Ω load DC Signal into 50 Ω load into 1 MΩ load	10 Hz to 10 kHz 1 mVp-p to 6.6 V p-p 1 mVp-p to 130 V p-p 1 mVp-p to 6.6 V p-p 1 mVp-p to 130 V p-p	2.5 mV/V + 40 μV 0.5 mV/V + 5 μV 2.5 mV/V + 40 μV 0.5 mV/V + 5 μV	Comparison to Oscilloscope Calibrator

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes ¹			
Leveled Sine Wave Absolute Amplitude	5 mV to 5.5 V 50 kHz Reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 500) MHz (500 to 600) MHz	20 mV/V + 0.3 mV 35 mV/V + 0.3 mV 40 mV/V + 0.3 mV 55 mV/V + 0.3 mV 60 mV/V + 0.3 mV	Comparison to Oscilloscope Calibrator
Square Wave Signal Leveled Sine Wave Flatness referenced to 50 kHz reference	5 mV to 5.5 V 10 MHz Reference 600 MHz to 1.6 GHz (1.6 to 2.1) GHz	20 mV/V + 0.3 mV 70 mV/V + 0.3 mV 80 mV/V + 0.3 mV	
Time Markers (5-2-1 sequence) into 50 Ω load			
Fast Edge Mode	(1 to 50) ns 100 ns to 20 ms 50 ms to 5 s	0.001 1 % of reading + 0.048 ps 0.000 2 % of reading + 7 ps 0.4 % of reading	
Programmable Rise Time	5 s to 50 ms 20 ms to 500 ps	2.5 μs/s + 5 μHz 0.33 μs/s	
	(1 to 100) kHz	< 0.15 ns/s to 25 ps	
Rise Time ¹ (measurement)	20 ps to 100 μs	81 ns	Comparison to Oscilloscope
Rise Time ¹ (measurement)	1 ns to 10 μs 10 μs to 100 μs	1.2 ns 2.9 ns	Comparison to Oscilloscope
ESD Simulators			
Contact Voltage (Positive and Negative)	(1 to 8) kV	1.2 % of reading	Procedure IEC 61000-4-2 (Ed.2, 2008); Multimeters, ESD Target, Attenuator and Oscilloscope
Rise Time	(0.6 to 1) ns	0.000 12 % Δ time reading + 11 ps	
Peak Current	(3.75 to 33) A	2.1 % of reading	
30 ns Current	(2 to 20.8) A	3.4 % of reading	
60 ns Current	(1 to 10.4) A	6.3 % of reading	

Electrical – DC/Low Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
ESD Simulators Air Discharge Voltage (Positive and Negative) Rise Time RC Time Constant (at ± 15 kV)	(0.7 to 1) ns (1 to 30) kV 600 ns ± 130 ns 330 pF probe 300 ns ± 60 ns 150 pF probe	1.2 % of reading 0.000 12 % Δ time reading + 11 ps 0.000 12 % Δ time reading + 11 ps	Procedure IEC 61000-4-2 (Ed.2, 2008); Multimeters, ESD Target, Attenuator and Oscilloscope
EFT/Burst Generator Voltage (±) Rise Time Impulse Duration Burst Duration Burst Period	10 V to 8 kV 5 ns ± 30 % 50 ns ± 30 % 15 ns ± 20 % 300 ms ± 20 %	2.7 % of reading 0.008 % Δ time reading 0.008 % Δ time reading 0.008 % Δ time reading 0.008 % Δ time reading	Procedure IEC 61000-4-4 (Ed.3, 2012); Fast Rise Oscilloscope w/ EFT Verification Set
Surge Generator Front Time Rise Time Open Circuit (±) Short Circuit (±) Time to Half-Value (±) Open Circuit Voltage (±) Short Circuit Voltage (±) Ring Wave Voltage Ring Wave Rise Time	(1.2 to 50) μs (1.2 to 50) μs (20 to 700) μs 10 V to 12 kV (0.125 to 3) kA 1 kV ± 10 % 1.5 μs ± 0.5 μs	0.008 % Δ time reading 0.008 % Δ time reading 0.008 % Δ time reading 2.9 % of reading 2.9 % of reading 2.9 % of reading 0.008 % Δ time reading	Procedure IEC 61000-4-5 (Ed. 3.1, 2017), IEC 61000-4-11 (Ed 3.0, 2020), IEC 61000-4-18 (Ed. 2.0, 2019); Fast Rise Oscilloscope, Current Probes, Oscilloscope Probes
Gauss Meter ¹	100 G 200 G 500 G 1 000 G	1.4 G 2.5 G 6.4 G 7.7 G	Procedure IEEE Std 1309 (2013); Reference Magnetic Field Block

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Attenuation - Source Coaxial, 10 dB Step	(0 to 120) dB 1 kHz 500 MHz 1 GHz	0.11 dB 0.28 dB 0.39 dB	Comparison to Standard Piston Attenuator
RF Attenuation Source Coaxial, 1 dB Step	DC to 12.4 GHz (0 to 11) dB (12.4 to 18) GHz (0 to 11) dB	0.6 dB 0.8 dB	Comparison to Standard Electronic Programmable Attenuator
RF Attenuation Source Coaxial, 10 dB Step	DC to 12.4 GHz (0 to 10) dB 20 dB 30 dB 40 dB 50 dB 60 dB 70 dB (80 to 110) dB (12.4 to 18) GHz (0 to 10) dB 20 dB 30 dB 40 dB 50 dB 60 dB 70 dB (80 to 110) dB	0.51 dB 0.71 dB 0.91 dB 1.2 dB 1.5 dB 1.8 dB 2.1 dB 2.4 dB 0.61 dB 0.81 dB 1.2 dB 1.6 dB 2 dB 2.4 dB 2.8 dB 3.2 dB	Comparison to Standard Electronic Programmable Attenuator
RF Absolute Power Source Into 50 Ω 0.001 Hz to 100 kHz SWR 1.2:1 100 kHz to 10 MHz SWR ≤ 1.2:1 (10 to 20) MHz SWR ≤ 1.2:1	(3 to 10) Vp-p 1 mVp-p to 3Vp-p (3 to 10) Vp-p 1 mVp-p to 3 Vp-p 100 mVp-p to 3 Vp-p (1 to 100) mVp-p	0.13 dB 0.22 dB 0.41 dB 0.61 dB 0.61 dB 0.91 dB	Comparison to Synthesized Signal Sources
RF Absolute Power Source Into 50 Ω Into 50 Ω/75 Ω	13.01 dBm 1 kHz to 25 MHz 200 Hz to 80 MHz	0.12 dB 0.18 dB	Comparison to Synthesized Level Generator

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power Into 50 Ω, In 2 dB steps Relative to Full Output	200 Hz to 80 MHz (0 to -38) dBm (-40 to -58) dBm (-60 to -98) dBm	0.21 dB 0.21 dB 0.27 dB	Comparison to Synthesized Level Generator
RF Absolute Power Into 75 Ω, In 2 dB steps Relative to Full Output	(0 to -38) dBm 200 Hz to 25 MHz (25 to 80) MHz (-40 to -58) dBm 200 Hz to 25 MHz (25 to 80) MHz (-60 to -98) dBm 200 Hz to 25 MHz (25 to 80) MHz	0.21 dB 0.36 dB 0.28 dB 0.54 dB 0.45 dB 1.7 dB	Comparison to Synthesized Level Generator
RF Absolute Power Source Into 50 Ω			
SWR ≤ 1.6:1	(+10 to -10) dBm 10 MHz to 2 GHz (2 to 20) GHz	1.5 dB 1.7 dB	
SWR ≤ 1.6:1	(+5 to -10) dBm 10MHz to 2 GHz	0.82 dB	
SWR ≤ 1.8:1	(2 to 20) GHz (20 to 40) GHz	0.96 dB 1.2 dB	
SWR ≤ 2:1	(+2.5 to -10) dBm (40 to 50) GHz	2.3 dB	Comparison to Synthesized Level Generator
SWR ≤ 1.6:1	(-10 to -60) dBm 10MHz to 2 GHz	1.2 dB	
SWR ≤ 1.8:1	(2 to 20) GHz	1.3dB	
SWR ≤ 2:1	(20 to 40) GHz (40 to 50) GHz	1.6 dB 2.3 dB	
SWR ≤ 1.6:1	(-60 to -110) dBm 10 MHz to 2 GHz	1.8 dB	
SWR ≤ 1.8:1	(2 to 20) GHz	1.9 dB	
SWR ≤ 2:1	(20 to 40) GHz (40 to 50) GHz	2.2 dB 3.3 dB	

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power Source Into 50 Ω	(+24 to -48) dBm Up to 300 MHz (+14 to -48) dBm 300 MHz to 3GHz (3 to 4) GHz (-48 to -84) dBm 100 kHz to 10 MHz (10 to 300) MHz 300 MHz to 1.4 GHz (-48 to -74) dBm (1.4 to 4) GHz (-74 to -84) dBm (1.4 to 4) GHz (-84 to -94) dBm 100 kHz to 300 MHz 300 MHz to 4 GHz (-94 to -130) dBm (10 to 128) MHz 300 MHz to 4 GHz	0.06 dB 0.08 dB 0.52 dB 0.52 dB 0.32 dB 0.53 dB 0.53 dB 1 dB 0.53 dB 1 dB 0.73 dB 1.6 dB	Comparison to Synthesized Low Phase Noise Level Generator
RF Absolute Power Source Into 75 Ω	(+14 to -23) dBm Up to 125 MHz (125 to 300) MHz 300 MHz to 1.4 GHz (1.4 to 3) GHz (3 to 4) GHz (-23 dBm to -54) dBm Up to 300 MHz 300 MHz to 4 GHz (-54 to -80) dBm 100 kHz to 300 MHz 300 MHz to 4 GHz (-80 to -90) dBm 100 kHz to 300 MHz 300 MHz to 4 GHz (-90 to -100) dBm 100 kHz to 300 MHz 300 MHz to 4 GHz (-100 to 120) dBm 10 MHz to 4GHz	0.07 dB 0.16 dB 0.26 dB 0.33 dB 0.52 dB 0.16 dB 0.52 dB 0.23 dB 0.54 dB 0.7 dB 1 dB 0.76 dB 1 dB 1.6 dB	Comparison to Synthesized Low Phase Noise Level Generator

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Tuned Power – Measure (relative)	100 kHz to 4.2 GHz (+30 to 0) dB (0 to -30) dB (-30 to -60) dB (-60 to -90) dB (-90 to -129) dB (4.2 to 18) GHz (+30 to 0) dB (0 to -30) dB (-30 to -60) dB (-60 to -90) dB (-90 to -129) dB (18 to 26.5) GHz (+30 to 0) dB (0 to -30) dB (-30 to -60) dB (-60 to -90) dB (-90 to -129) dB (26.5 to 50) GHz (+30 to 0) dB (0 to -30) dB (-30 to -60) dB (-60 to -90) dB (-90 to -129) dB	0.14 dB 0.16 dB 0.19 dB 0.21 dB 0.25 dB 0.18 dB 0.2 dB 0.22 dB 0.24 dB 0.28 dB 0.24 dB 0.25 dB 0.27 dB 0.29 dB 0.32 dB 0.2 dB 0.21 dB 0.23 dB 0.25 dB 0.29 dB	Comparison to Measuring Receiver System
Digital Modulation - Measure Carrier Frequency 2 MHz to 2.65 GHz Error Vector Magnitude for Modulation Types: MSK, GMSK, BPSK, DQPSK, Π/4DQPSK, 8PSK, 16QAM, 32 QAM and QPSK Phase Error for Modulation Types: MSK, GMSK, BPSK, DQPSK, Π/4DQPSK, 8PSK, 16QAM, 32 QAM and QPSK	(0 to 15) % (1 to 100) kHz 100 kHz to 1 MHz 1 MHz to 2.65 GHz (0 to 3)° (1 to 100) kHz (0.1 to 1) MHz 1 MHz to 2.65 GHz	0.33 % of reading 0.51 % of reading 1 % of reading 0.18° 0.34° 0.57°	Comparison to Vector Signal Analyzer

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Digital Modulation - Measure Error Vector Magnitude for FSK Modulation	Modulation Frequency 3.2 kHz 1.152 kHz	0.54 % of reading 1.5 % of reading	Comparison to Vector Signal Analyzer
Amplitude Modulation - Source (11 to 13.5) MHz	Rate:50 Hz to 50 kHz, (5 to 99) % Depth	0.1 % of reading	Comparison to AM/FM Test Source, Analog Modulation Sources
20 Hz to 100 kHz	Rate: (20 to 50) Hz (5 to 99) % Depth	0.25 % of reading	
DC to 15 kHz	Rate:9 kHz to 3.2 GHz (0 to 100) % Depth	5 % of reading	
Amplitude Modulation - Source DC to 100 kHz	Rate:250 kHz to 50 GHz (0 to 99) % Depth	1.2 % of reading + 0.07 AM	Comparison to AM/FM Test Source, Analog Modulation Sources
Amplitude Modulation - Measure 100 kHz to 10 MHz	Rate: 50 Hz to 10 kHz, (5 to 99) % Depth	0.001 4 % of reading + 0.009 AM	Comparison to Microwave Measuring Receiver System
10 MHz to 3 GHz	50 Hz to 100 kHz, (20 to 99) % Depth	0.001 % of reading + 0.007 AM	
Amplitude Modulation - Measure 10 MHz to 3 GHz	50 Hz to 100 kHz, (5 to 20) % Depth	0.001 % of reading + 0.029 AM	Comparison to Microwave Measuring Receiver System
(3 to 26.5) GHz	50 Hz to 100 kHz, (5 to 20) % Depth	0.01 % of reading + 0.052 AM	
(3 to 26.5) GHz	50 Hz to 100 kHz, (20 to 99) % Depth	0.01 % of reading + 0.018 AM	
(26.5 to 31.15) GHz	50 Hz to 100kHz, (5 to 20) % Depth (20 to 99) % Depth	0.08 % of reading + 0.000 2 AM 0.02 % of reading + 0.000 14 AM	

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Amplitude Modulation - Measure (31.15 to 50) GHz	50 Hz to 100 kHz, (5 to 20) % Depth (20 to 99) % Depth	0.3 % of reading + 0.000 05 AM 0.07 % of reading + 0.000 046 AM	Comparison to Microwave Measuring Receiver System
Amplitude Modulation - Measure 150 kHz to 10 MHz Rate: 50 Hz to 10 kHz, Depth: 5 % to 99 % Rate: 20 Hz to 10 kHz, Depth: to 99 % 10 MHz to 1.3 GHz Rate: 50 Hz to 50 kHz, Depth: 5 % to 99 % Rate: 20 Hz to 10 kHz, Depth: to 99 % (1.3 to 26.5) GHz Rate: 50 Hz to 10 kHz, Depth: 5 % to 99 % 10 MHz to 26.5 GHz Rate: 20 Hz to 10 kHz, Depth: to 99 %	(5 to < 10) % Depth (10 to 99) % Depth (5 to < 10) % Depth (10 to 99) % Depth (5 to < 10) % Depth (10 to 99) % Depth (5 to < 10) % Depth (10 to 99) % Depth (5 to < 10) % Depth (10 to 99) % Depth	0.01 % of reading + 0.023 AM 0.06 % of reading + 0.023 AM 0.01 % of reading + 0.035 AM 0.06 % of reading + 0.035 AM 0.01 % of reading + 0.012 AM 0.06 % of reading + 0.012 AM 0.01 % of reading + 0.035 AM 0.06 % of reading + 0.035 AM 0.03 % of reading + 0.018 AM 0.07 % of reading + 0.018 AM 0.03 % of reading + 0.035 AM 0.07 % of reading + 0.035 AM	Comparison to Microwave Measuring Receiver System
Frequency Modulation - Measure 250 kHz to 10 MHz 10 MHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 26.5) GHz (26.5 to 50.0) GHz	Rate: 20 Hz to 10 kHz Dev:20 Hz to 40 kHz pk Rate: 50 Hz to 200 kHz Dev:250 Hz to 400 kHz pk Rate: 50 Hz to 200 kHz Dev:250 Hz to 400 kHz pk Rate: 50 Hz to 100 kHz Dev:250 Hz to 400 kHz pk Rate: 20 Hz to 10 kHz Dev:20 Hz to 40 kHz pk	1.7 % of reading + 5.7 Hz 1.1 % of reading + 6.6 Hz 1.8 % of reading + 5.1 Hz 1.2 % of reading + 6.1 Hz 2.9 % of reading + 4 Hz 1.2 % of reading + 6.4 Hz 4.4 % of reading + 3.8Hz 1.2 % of reading + 7.6 Hz 10 % of reading + 4.2 Hz 1 % of reading + 12 Hz	Comparison to Microwave Measuring Receiver System

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation - Measure 250 kHz to 10 MHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM 10 MHz to 26.5 GHz 10 MHz to 1.3 GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (> 1.3 to 6.2) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (> 6.2 to 12.4) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM	Rate: 20 Hz to 10 kHz ≤ 40 kHz pk Rate: 50 Hz to 100 kHz ≤ 400 kHz pk Rate: 50 Hz to 100 kHz ≤ 400 kHz pk	0.024 FM + 2.4 Hz Pk 0.024 FM + 8 Hz Pk 0.012 FM + 2.4 Hz Pk 0.012 FM + 14 Hz Pk 0.012 FM + 66 Hz Pk 0.012 FM + 19 Hz Pk 0.012 FM + 23 Hz Pk 0.012 FM + 75 Hz Pk 0.012 FM + 35 Hz Pk 0.012 FM + 39 Hz Pk 0.012 FM + 91 Hz Pk	Comparison to Microwave Measuring Receiver System
Frequency Modulation - Measure (> 12.4 to 18.6) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (> 18.6 to 26.5) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM	Rate: 50 Hz to 100 kHz ≤ 400 kHz pk	0.012 FM + 51 Hz Pk 0.012 FM + 55 Hz Pk 0.012 FM + 110 Hz Pk 0.012 FM + 67 Hz Pk 0.012 FM + 71 Hz Pk 0.012 FM + 130 Hz Pk	Comparison to Microwave Measuring Receiver System

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation - Measure 10 MHz to 26.5 GHz 10 MHz to 1.3 GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (>1.3 to 6.2) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM	Rate: 50 Hz to 100 kHz ≤ 400 kHz pk	0.058 FM + 3.9 Hz Pk 0.058 FM + 8 Hz Pk 0.058 FM + 66 Hz Pk 0.058 FM + 19 Hz Pk 0.058 FM + 23 Hz Pk 0.058 FM + 75 Hz Pk	Comparison to Microwave Measuring Receiver System
Frequency Modulation - Measure (> 6.2 to 12.4) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (> 12.4 to 18.6) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (> 18.6 to 26.5) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM	Rate: 20 Hz to 200 kHz ≤ 400 kHz pk	0.058 FM + 35 Hz Pk 0.058 FM + 39 Hz Pk 0.058 FM + 91 Hz Pk 0.058 FM + 51 Hz Pk 0.058 FM + 55 Hz Pk 0.058 FM + 110 Hz Pk 0.058 FM + 67 Hz Pk 0.058 FM + 71 Hz Pk 0.058 FM + 130 Hz Pk	Comparison to Microwave Measuring Receiver System

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation - Source (11 to 13.5) MHz	Rate: DC to 10 kHz Dev.: ≤ 100 kHz peak	0.1 % of reading	Comparison to AM/FM Test Source
(11 to 13.5) MHz	Rate: DC to 10 kHz Dev.: ≤ 200 kHz peak	0.25 % of reading	
(88 to 108) MHz	Rate: DC to 100 kHz Dev.: ≤ 100 kHz peak	0.1 % of reading	
(88 to 108) MHz	Rate: DC to 100 kHz Dev.: ≤ 200 kHz peak	0.25 % of reading	
(352 to 432) MHz	Rate: DC to 100 kHz Dev.: ≤ 100 kHz peak	0.1 % of reading	
Frequency Modulation - Source (352 to 432) MHz	Rate: DC to 100 kHz Dev.: ≤ 200 kHz peak	0.25 % of reading	Comparison to Analog Modulation Sources
9 kHz to 1 GHz	Rate: DC to 150 kHz Dev.: ≤ 200 kHz peak	3 % of reading + 30 Hz	
(1 to 2) GHz	Rate: DC to 150 kHz Dev.: ≤ 400 kHz peak	3 % of reading + 60 Hz	
(2 to 3) GHz	Rate: DC to 150 kHz Dev.: ≤ 400 kHz peak	3 % of reading + 120 Hz	
Frequency Modulation - Source 1 kHz rate Max. Dev. 2 MHz Max. Dev. 4 MHz Max. Dev. 8 MHz Max. Dev. 16 MHz Max. Dev. 32 MHz Max. Dev. 64 MHz Max. Dev. 128 MHz	250 kHz to 1 GHz (1 to 2) GHz (2 to 3.2) GHz (3.2 to 10) GHz (10 to 20) GHz (20 to 40) GHz (40 to 50) GHz	40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz	Comparison to Analog Modulation Sources

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase Modulation - Measure > 0.7 rad Dev. > 0.6 rad Dev. > 1.2 rad Dev. > 1.3 rad Dev. > 2.4 rad Dev.	100 kHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 26.5) GHz (26.5 to 31.5) GHz (31.5 to 50) GHz	1.2 % of reading + 0.007 1 rad 1.2 % of reading + 0.007 1 rad 1.2 % of reading + 0.007 3 rad 1 % of reading + 0.007 3 rad 1 % of reading + 0.008 rad	Comparison to Microwave Measuring Receiver System
Phase Modulation - Measure 150 kHz to 10 MHz (0 to < 4) rad pk PM (≥ 4 to < 40) rad pk PM 10 MHz to 1.3 GHz (0 to < 4) rad pk PM (≥ 4 to < 40) rad pk PM (≥ 40 to < 400) rad pk PM 1.3 to 26.5 GHz (0 to < 4) rad pk PM (≥ 4 to < 40) rad pk PM (≥ 40 to < 400) rad pk PM	200 Hz to 10 kHz Rate ≤ 40 rad pk 200 Hz to 20 kHz Rate ≤ 400 rad pk 200 Hz to 20 kHz Rate ≤ 400 rad pk	4.7 % of reading + 0.001 rad 4.7 % of reading + 0.008 rad 3.5 % of reading + 0.001 rad 3.5 % of reading + 0.008 rad 3.5 % of reading + 0.09 rad 3.5 % of reading + 0.001 rad 3.5 % of reading + 0.008 rad 3.5 % of reading + 0.09 rad	Comparison to Microwave Measuring Receiver System
Phase Modulation - Source Rate: 20 Hz to 10 kHz Carrier: 9 kHz to 1 GHz (1 to 2) GHz (2 to 3.2) GHz 250 kHz to 1 GHz (>1 to 2) GHz (>2 to 3.2) GHz (>3.2 to 10) GHz (>10 to 20) GHz (>20 to 40) GHz (>40 to 50) GHz	(0 to 10) rad (0 to 20) rad (0 to 40) rad Max. Dev. (0 to 20) rad (0 to 40) rad (0 to 80) rad (0 to 160) rad (0 to 320) rad (0 to 640) rad (0 to 1 280) rad	0.05 rad + 3 % of reading 0.1 rad + 3 % of reading 0.2 rad + 3 % of reading 0.012 rad + 6 % of reading 0.012 rad + 6 % of reading 0.012 rad + 6 % of reading 0.012 rad + 6 % of reading 0.012 rad + 6 % of reading 0.012 rad + 6 % of reading 0.012 rad + 6 % of reading	Comparison to Analog Modulation Sources
Distortion – Measure	(0.01 to 100) % Distortion 250 kHz to 50 GHz	0.065 % of reading	Comparison to Microwave Measuring Receiver System

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Distortion – Measure Fundamental Frequency 20 Hz to 20 kHz (20 to 100) kHz	(-99 to 0) dB (-99 to 0) dB	1.2 dB 2.3 dB	Comparison to Distortion Analyzer
Power Reference – Measure 50 MHz	1 mW	5.5 μ W	Indirect Method Primary Standards Lab (H75) Thermistor Mount, Power Meter, Precision 8.5-digit Multimeter
Absolute Power – Measure	9 kHz to 4.2 GHz (+20 to -30) dBm 10 MHz to 18 GHz (-20 to -70) dBm 50 MHz to 26.5 GHz (+20 to -30) dBm (26.5 to 50) GHz (+20 to -30) dBm (-20 to -70) dBm	0.3 % of Reading + 0.65 dB 0.44 % of reading + 0.32 dB 0.24 % of reading + 0.86 dB 0.46 % of reading + 0.94 dB 1.6 % of reading + 0.67 dB	Comparison to RF Power Meters/Sensors
Power Meter – Range Calibration	3 μ W 10 μ W 30 μ W 100 μ W 300 μ W 1 mW 3 mW 10 mW 30 mW 100 mW	21 nW 19 nW 21 nW 77 nW 0.11 μ W 0.29 μ W 0.64 μ W 6.4 μ W 13 μ W 0.10 mW	Comparison to Power Meter Range Calibrator w/ Precision DC Voltage Source
Noise Figure – Source	15 dB ENR 10 MHz to 1.5 GHz (1.5 to 3) GHz (3 to 7) GHz (7 to 18) GHz (18 to 26.5) GHz	0.29 dB 0.25 dB 0.26 dB 0.37 dB 0.42 dB	Comparison to Primary Standards Lab Noise Source
Noise Figure – Measure	100 kHz to 30 MHz >30 MHz to 3 GHz (>3 to 26.5) GHz	0.43 dB 0.42 dB 0.47 dB	Comparison to Noise Figure Measurement System w/ Standard Noise Sources

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Single Sideband Phase Noise - Measure	1 MHz to 26.5 GHz (26.5 to 50) GHz	1.8 dB 1.8 dB	Comparison to Phase Noise Measurement System
Power Sensor Calibration Factor	(-60 to < 0 > to 23) dBm 9 kHz to 10 MHz >10 MHz to 4 GHz (>4 to 10 GHz) (>10 to 18 GHz) (>18 to 26.5 GHz) (>26.5 to 44 GHz) (>44 to 50 GHz)	1.3 % of reading 1.4 % of reading 1.7 % of reading 1.9 % of reading 3.8 % of reading 5.1 % of reading 7.6 % of reading	Comparison to Signal Sources, Precision Level Source and Tegam System
Current Probes/ Bulk Current Injection Probes Insertion Loss Transfer Impedance	(0 to 100) dB 20Hz to 300 kHz 300 kHz to 1 MHz 1 MHz to 3 GHz (0 to 100) dB 20 Hz to 300 kHz 300 kHz to 1 MHz 1 MHz to 3 GHz	1.1 dB 1 dB 1.9 dB 1.1 dB 1 dB 1.9 dB	Comparison to Network/RF Impedance Analyzers, attenuator, type N calibration kit
Transmission S_{12}/S_{21} - Measure Phase and Magnitude	9 kHz to 1.3 GHz (-180 to 180) ^o (0 to 10) dB (-10 to 0) dB (-20 to -10) dB (-60 to -20) dB (-70 to -60) dB (-80 to -70) dB (-90 to -80) dB (1.3 to 3) GHz (0 to 10) dB (-10 to 0) dB (-20 to -10) dB (-60 to -20) dB (-70 to -60) dB (1.3 to 3) GHz (-80 to -70) dB (-90 to -80) dB	0.18 dB (1 ^o) 0.057 dB (0.43 ^o) 0.072 dB (0.8 ^o) 0.086 dB (0.89 ^o) 0.13 dB (1.2 ^o) 0.3 dB (2.4 ^o) 0.92 dB (6.9 ^o) 0.12 dB (4.1 ^o) 0.063 dB (0.48 ^o) 0.077 dB (0.8 ^o) 0.093 dB (0.94 ^o) 0.13 dB (1.2 ^o) 0.32 dB (2.6 ^o) 0.92 dB (7.4 ^o)	Comparison to LF Vector Network Analyzer, Calibration Kits

Electrical – RF/Microwave

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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Transmission S_{12}/S_{21} - Measure Phase and Magnitude	50 MHz to 2 GHz (-180 to 180)°		Comparison to Vector Network Analyzer w/ Calibration Kits
	(0 to 10) dB	0.07 dB (0.46°)	
	(-10 to 0) dB	0.054 dB (0.36°)	
	(-20 to -10) dB	0.075 dB (0.5°)	
	(-30 to -20) dB	0.12 dB (0.83°)	
	(-40 to -30) dB	0.29 dB (1.9°)	
	(-50 to -40) dB	2.3 dB (5.5°)	
	(-60 to -50) dB	5.9 dB (5.7°)	
	(2 to 8) GHz		
	(0 to 10) dB	0.09 dB (0.59°)	
	(-10 to 0) dB	0.07 dB (0.46°)	
	(-20 to -10) dB	0.087 dB (0.57°)	
	(-30 to -20) dB	0.1 dB (0.69°)	
	(-40 to -30) dB	0.12 dB (0.81°)	
	(-50 to -40) dB	0.15 dB (0.98°)	
	(-60 to -50) dB	0.22 dB (1.4°)	
	(-70 to -60) dB	0.45 dB (3.1°)	
	(-80 to -70) dB	1.2 dB (8.7°)	
	(-90 to -80) dB	3.4 dB (8.7°)	
	(8 to 20) GHz		
	(-180 to 180)°		
	(0 to 10) dB	0.19 dB (1.3°)	
	(-10 to 0) dB	0.17 dB (1.1°)	
	(-20 to -10) dB	0.18 dB (1.2°)	
	(-30 to -20) dB	0.2 dB (1.3°)	
	(-40 to -30) dB	0.22 dB (1.4°)	
	(-50 to -40) dB	0.24 dB (1.6°)	
	(-60 to -50) dB	0.32 dB (2.1°)	
(-70 to -60) dB	0.6 dB (4.1°)		
(-80 to -70) dB	1.6 dB (8.7°)		
(-90 to -80) dB	4.2 dB (11°)		

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Transmission S ₁₂ /S ₂₁ - Measure Phase and Magnitude	(20 to 50) GHz (0 to 10) dB (-10 to 0) dB (-20 to -10) dB (-30 to -20) dB (-40 to -30) dB (-50 to -40) dB (-60 to -50) dB (-70 to -60) dB (-80 to -70) dB (-90 to -80) dB	0.54 dB (3.7°) 0.5 dB (3.4°) 0.49 dB (3.3°) 0.5 dB (3.4°) 0.52 dB (3.5°) 0.55 dB (3.7°) 0.65 dB (4.4°) 1.1 dB (7.6°) 2.7 dB (8.9°) 6.6 dB (11°)	Comparison to Vector Network Analyzer w/ Calibration Kits
Transmission S ₁₂ /S ₂₁ – Measure Magnitude Phase	(-90 to 10) dB (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz < /= 0 to < /+ 60° 0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.014 dB 0.043 dB 0.11 dB 0.14 dB 0.023° 0.013° 0.064° 0.017°	Comparison to Vector Network Analyzer w/ Calibration Kits
Reflection S ₁₁ /S ₂₂ - Measure Phase and Magnitude ^{2,3}	9 kHz to 1.3 GHz (-180 to 180)° (< 0.03) Γ (< 0.2) Γ (< 0.4) Γ (< 0.6) Γ (< 0.8) Γ (< 1) Γ (1.3 to 3) GHz (< 0.03) Γ (< 0.2) Γ (< 0.4) Γ (< 0.6) Γ (< 0.8) Γ (< 1) Γ	0.002 3 (1.4°) 0.003 5 (1.4°) 0.006 1 (1.1°) 0.008 3 (0.94°) 0.01 (0.83°) 0.012 (0.7°) 0.005 6 (1.8°) 0.003 5 (1.8°) 0.008 (1.3°) 0.011 (1.2°) 0.013 (1°) 0.016 (0.89°)	Comparison to LF Vector Network Analyzer, Calibration Kits

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Reflection S_{11}/S_{22} – Measure Phase and Magnitude ^{2,3}	50 MHz to 2 GHz (-180 to 180)°		Comparison to Vector Network Analyzer w/ Calibration Kits
	(<0.03) Γ	0.01 (3.3°)	
	(<0.2) Γ	0.012 (3.3°)	
	(<0.4) Γ	0.014 (2°)	
	(<0.6) Γ	0.017 (1.6°)	
	(<0.8) Γ	0.021 (1.5°)	
	(<1) Γ	0.026 (1.5°)	
	(2 to 8) GHz		
	(<0.03) Γ	0.01 (3.5°)	
	(<0.2) Γ	0.012 (3.5°)	
	(<0.4) Γ	0.015 (2.2°)	
	(<0.6) Γ	0.019 (1.8°)	
	(<0.8) Γ	0.024 (1.7°)	
	(<1) Γ	0.003 (1.7°)	
	(8 to 20) GHz		
	(<0.03) Γ	0.002 4 (7.8°)	
	(<0.2) Γ	0.002 7 (7.8°)	
	(<0.4) Γ	0.003 3 (4.8°)	
(<0.6) Γ	0.004 2 (4°)		
(<0.8) Γ	0.053 (3.8°)		
(<1) Γ	0.067 (3.9°)		
(20 to 50) GHz			
(-180 to 180)°			
(<0.03) Γ	0.06 (19°)		
(<0.2) Γ	0.066 (11°)		
(<0.4) Γ	0.079 (11°)		
(<0.6) Γ	0.097 (9.3°)		
(<0.8) Γ	0.12 (8.8°)		
(<1) Γ	0.15 (8.8°)		
Reflection S_{11}/S_{22} – Measure Magnitude ^{2,3} Phase	(< 0.03 to < 1) Γ		Comparison to Vector Network Analyzer w/ Calibration Kits
	(0.045 to 2) GHz	0.011 Γ	
	(2 to 20) GHz	0.011 Γ	
	(20 to 40) GHz	0.018 Γ	
	(40 to 50) GHz	0.023 Γ	
	<= 0 to <= 60°		
	(0.045 to 2) GHz	0.023°	
	(2 to 20) GHz	0.013°	
	(20 to 40) GHz	0.064°	
	(40 to 50) GHz	0.017°	

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) 7mm Test Ports Reflection S ₁₁ /S ₂₂ – Magnitude ^{2,3} Phase	≤ 0.1 to $\leq 1 \Gamma$ (0.000 3 to 1) GHz (1 to 3) GHz (3 to 6) GHz ≤ 0 to $\leq 60^\circ$ (0.000 3 to 1) GHz (1 to 3) GHz (3 to 6) GHz	0.003 8 Γ 0.003 9 Γ 0.005 1 Γ 2° 2.1° 2.7°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Network Analyzer System Verification (Corrected Performance) N-Type Test Ports Reflection S ₁₁ /S ₂₂ – Magnitude ^{2,3} Phase	≤ 0.1 to $\leq 1 \Gamma$ (0.0003 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz ≤ 0 to $\leq 60^\circ$ (0.000 3 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz	0.009 Γ 0.001 Γ 0.001 5 Γ 0.004 1 Γ 0.46° 0.64° 0.65° 1.3°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) 3.5mm Test Ports Reflection S_{11}/S_{22} – Magnitude ^{2,3} Phase	≤ 0.1 to $\leq 1 \Gamma$ (0.045 to 2) G Γ Hz (2 to 20) GHz (20 to 26.5) GHz ≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 26.5) GHz	0.000 76 Γ 0.001 Γ 0.003 Γ 0.34° 0.36° 0.64°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Network Analyzer System Verification (Corrected Performance) 2.4mm Test Ports Reflection S_{11}/S_{22} – Magnitude ^{2,3} Phase	≤ 0.1 to $\leq 1 \Gamma$ (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz ≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.003 8 Γ 0.003 8 Γ 0.004 4 Γ 0.005 5 Γ 0.96° 1.3° 1.5° 2.3°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) 7mm Test Ports Transmission S_{21}/S_{122} – Magnitude Phase	≤ 0.1 to ≤ 1 dB (0.0003 to 1) GHz (1 to 3) GHz (3 to 6) GHz ≤ 0 to $\leq 60^\circ$ (0.0003 to 1) GHz (1 to 3) GHz (3 to 6) GHz	0.16 dB 0.16 dB 0.17 dB 1.4° 1.5° 2.2°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Network Analyzer System Verification (Corrected Performance) N-Type Test Ports Transmission S_{21}/S_{122} – Magnitude Phase	≤ 0.1 to ≤ 1 dB (0.0003 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz ≤ 0 to $\leq 60^\circ$ (0.0003 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz	0.018 dB 0.019 dB 0.02 dB 0.024 dB 0.18° 0.2° 0.23° 0.24°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) 3.5mm Test Ports Transmission S_{21}/S_{122} – Magnitude Phase	≤ 0.1 to ≤ 1 dB (0.045 to 2) GHz (2 to 20) GHz (20 to 26.5) GHz ≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 26.5) GHz	0.018 dB 0.019 dB 0.032 dB 0.18° 0.18° 0.32°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Network Analyzer System Verification (Corrected Performance) 2.4mm Test Ports Transmission S_{21}/S_{122} – Magnitude Phase	≤ 0.1 to ≤ 1 dB (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz ≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.023 dB 0.033dB 0.055 dB 0.068 dB 0.23° 0.41° 0.97° 1.8°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Scalar Network Analyzer Absolute Log Error Dynamic Accuracy	21 dB (0 to 140) dB	0.04 dB 0.02 dB	Comparison to Scalar Network Analyzer Calibrator
Network Analyzer Dynamic Accuracy	(0 to 140) dB	0.02 dB	Comparison to Dynamic Accuracy Test Set

Electrical – RF/Microwave

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Impulse Spectral Amplitude Source CISPR Band A CISPR Band B CISPR Band C and D CISPR Band E	(10 to 150) kHz 150 kHz to 30 MHz 30 MHz to 1 GHz (1 to 18) GHz	0.82 dB 0.82 dB 1.1 dB 1.5 dB	Comparison to Pulse Generator
Sinewave Output for CISPR Checks Source @ 60 dB/ μ V	(0 to -70) dB 100 kHz (1, 10, and 100) MHz	0.35 dB 0.35 dB	
Peak and Average Detector Response	(0 to -70) dB CISPR Band A thru D	1.3 dB	
LISN (Line Impedance Stabilization Network) & AMN (Artificial Mains Network) Insertion Loss	(-20 to 0) dB 10 Hz to 1 000 MHz	0.25 dB	Comparison to RF Impedance/Network Analyzers, Calibration Kits
Isolation (De-Coupling Factor)	(-90 to 0) dB 10 Hz to 1 000 MHz	2.3 dB	
Impedance (Magnitude)	0.1 Ω to 1 k Ω 10 Hz to 1 000 MHz	2.4 % of reading	
Impedance (Phase)	(-180 to 180) $^{\circ}$ 10 Hz to 1 000 MHz	2.6 $^{\circ}$	
CDN (Coupling-Decoupling Network) & ISN (Impedance Stabilization Network) Insertion Loss	(-20 to 0) dB 10 Hz to 1000 MHz	0.25 dB	Comparison to RF Impedance/Network Analyzers, Calibration Kits
Isolation (De-Coupling Factor)	(-90 to 0) dB 10 Hz to 1000 MHz	2.3 dB	
Impedance (Magnitude)	0.1 Ω to 1 k Ω 10 Hz to 1 000 MHz	2.4 % of reading	
Impedance (Phase)	(-180 to 180) $^{\circ}$ 10 Hz to 1 000 MHz	2.6 $^{\circ}$	
LCL (Longitudinal Conversion Loss)	(-20 to 0) dB 10 Hz to 1 000 MHz	2.3 dB	

Length – Dimensional Metrology

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Test, Dial Indicators, Thickness Gages ¹	Up to 4 in	$(57 + 0.26L) \mu\text{in}$	Comparison to Gage Blocks
Calipers ¹	Up to 54 in	$(52 + 46L) \mu\text{in}$	Comparison to Gage Blocks, Standard Rings, Rod Sets
Micrometers ¹ (Linearity Only)	Up to 54 in	$(52 + 46L) \mu\text{in}$	Comparison to Gage Blocks, Rod Sets
Pin and Plug Gages ¹	Up to 25 mm	5 μm	Comparison to Micrometer
Pin and Plug Gages	Up to 2.36 in	180 μin	Laser Micrometer & Pin Gages
Height Gages	Up to 12 in	$(750 + 4.7L) \mu\text{in}$	Comparison to Gage Blocks
Depth Gages	Up to 12 in	$(160 + 4.1L) \mu\text{in}$	Comparison to Gage Blocks
Steel Rulers	Up to 48 in	0.036 in	Comparison to Gage Blocks
Tape Measures	Up to 50 ft	0.036 in	Comparison to Gage Blocks
Protractor/Angle	Up to 90°	0.069°	Comparison to Angle Gage Blocks
Roughness Testers ¹	118 μin	3.8 μin	Comparison to Roughness Standard
Roughness Specimens ¹	Up to 118 μin	4.1 μin	Comparison to Surface Roughness Meter
Coating Thickness Gauge ¹	49 μm 117 μm 281 μm 404 μm	2 μm 5.6 μm 9.2 μm 19 μm	Comparison to Plastic Shims

Mass and Mass Related

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force-Measuring Equipment Tension / Compression	Up to 1 000 lbf (1 000 to 10 000) lbf (10 000 to 20 000) lbf (20 000 to 30 000) lbf (30 000 to 40 000) lbf (40 000 to 50 000) lbf	5.1 lbf 24 lbf 47 lbf 70 lbf 93 lbf 120 lbf	Comparison to Reference Load Cells
Barometric Pressure Measurement	Up to 39 psia	0.014 psi	Comparison to Digital Barometer / Precision Absolute Manometer
Force-Measuring Equipment Tension / Compression	(0.1 to 50) kgf	0.042 mgf/gf + 7.1 gf	Comparison to NIST Class F Weights
Pressure – Source/Pressure gages and transducers ¹	(-12 to 300) psi (300 to 10 000) psi	0.2 psi 1.4 psi	Comparison to Pressure Calibration System
Torque – Measure/Torque Tools ¹	(20 to 200) ozf·in (5 to 50) lbf·in (40 to 400) lbf·in (100 to 1000) lbf·in (25 to 250) lbf·ft (60 to 600) lbf·ft	0.34 % of reading + 0.36 ozf·in 0.34 % of reading + 0.042 lbf·in 0.34 % of reading + 0.24 lbf·in 0.34 % of reading + 0.54 lbf·in 0.34 % of reading + 0.15 lbf·ft 0.34 % of reading + 0.28 lbf·ft	Comparison to Torque Transducers
Torque – Source/Analyzers and Measuring Equipment	(1 to 10) lbf·in (10 to 25) lbf·in (25 to 50) lbf·in (50 to 100) lbf·in (100 to 150) lbf·in (150 to 250) lbf·in	0.021 % of reading + 0.009 lbf·in 0.017 % of reading + 0.011 lbf·in 0.033 % of reading + 0.022 lbf·in 0.035 % of reading + 0.040 lbf·in 0.038 % of reading + 0.042 lbf·in 0.04 % of reading + 0.045 lbf·in	Comparison to Calibration Wheels Standard Weights
Scales & Balances ^{1,10}	1 mg to 10 g (10 to 500) g (0.5 to 1) kg (1 to 2) kg	0.034 mg 0.7 mg 1.5 mg 2.9 mg	Comparison to ASTM E617 Class 0 weights and internal calibration procedure utilized in the calibration of the weighing system.

Mass and Mass Related

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales & Balances ^{1,10}	(2 to 20) kg (20 to 40) kg (40 to 50) kg	2.3 g 4.6 g 5.8 g	Comparison to ASTM E617 Class 6 weights, NIST Class F weights, and internal calibration procedure utilized in the calibration of the weighing system.
Scales & Balances ¹	(0.001 to 0.05) lb (0.1 to 1) lb (1 to 2) lb (2 to 5) lb (5 to 10) lb (10 to 20) lb (20 to 50) lb	0.000 012 lb 0.000 18 lb 0.000 24 lb 0.000 6 lb 0.001 1 lb 0.002 4 lb 0.006 lb	Comparison to NIST Class F weights and internal calibration procedure utilized in the calibration of the weighing system.
Pipettes	(1 to 10) μL (> 10 to 100) μL (> 100 to 1000) μL	0.051 μL 0.079 μL 0.17 μL	Comparison to Pipette Calibration Balances

Thermodynamic

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Radiation (Infrared) ¹ Thermometers	(50 to 100)°C (100 to 300)°C (300 to 500)°C	1.7 °C 5.3 °C 8.2 °C	Comparison to Blackbody Source (Flat plate) $\epsilon = 0.95, \lambda = (8 \text{ to } 14) \mu\text{m}$
Relative Humidity – Measure ¹	Up to 90 %RH (90 to 95) %RH	1.6 % RH 2.2 % RH	Comparison to Humidity Probe Monitor
Temperature – Measure ¹	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 420) °C (420 to 650) °C	0.03 °C 0.05 °C 0.07 °C 0.11 °C 0.14 °C	Comparison to Reference Thermometer w/ PRT

Time and Frequency

Vista, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source ¹	1 μHz to 80 MHz	5.8 x 10 ⁻⁹ MHz	Comparison to Frequency Synthesizer w/ GPS Reference Signal Generator
Frequency – Source ¹	1 Hz to 50 GHz	5.8 x 10 ⁻¹⁰ GHz	Comparison to Synthesized Sweeper w/ GPS Reference
Frequency – Measure ¹	1 μHz to 12.4 GHz 1 Hz to 50 GHz	5.8 x 10 ⁻¹⁰ GHz 5.8 x 10 ⁻¹¹ GHz	Comparison to Electronic Counters, Analyzers w/ GPS Reference
Time Interval	50 ns to 999 s	5 ps/s + 0.43 ns	Comparison to Universal Counter w/ GPS Reference
Period ¹	4.44 ns to 10 s	0.012 % of reading + 0.17 ns	Comparison to Universal Counter w/ GPS Reference
Rise/Fall Time – Measure ¹	1 ns to 10 μs 10 μs to 100 μs	1.2 ns 2.9 ns	Comparison to Digital Oscilloscope Or Universal Counter w/ GPS Reference
Pulse Width – Measure ¹	> 5 ns	1.1 ns	Comparison to Universal Counter w/ GPS Reference
Stop Watches – Totalize Method	1s to 24 hr	0.06 % of reading + 44 ms	Comparison to Universal Counter and Synthesizer w/ GPS Reference

TESTING

Environmental

Vista, CA

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
Face Velocity Test Airflow Smoke Pattern Test Leak/Backstreaming Test	ISO 14644-1 ISO 16644-2 ISO 14644-3 ISO 16644-7 ANSI/ASHRAE 110 IEST-RP-CC002.4	Flow hood Devices Test	Comparison to Thermal Anemometer Aerosol Generator Digital Aerosol Photometer
Airborne Particle Count Survey Airflow Measurement Airflow Smoke Pattern Test HEPA/ULPA filter leak Test Biological Safety Cabinet Classification	ISO 14644-1 ISO 16644-2 ISO 14644-3 ISO 16644-7 IEST-RP-CC034.2 IEST-RP-CC006.3 NSF/ANSI49-2004 Annex	Biological Safety Cabinet Test	Comparison to Particle Counter Balometer Aerosol Generator Digital Aerosol Photometer Thermal Anemometer
Airflow Measurement Air Pressure Difference Test Airflow Smoke Pattern Test HEPA/ULPA filter leak Test Airborne Particle Count Survey Lighting Level Sound Level Test Temperature Test Humidity Test Temperature/Humidity Uniformity Test Recovery Test	ISO 14644-1 ISO 14644-2 ISO 14644-3 IEST-RP-CC006.3 IEST-RP-CC034.2 ISO/DIS 7726 In-house Method	Clean Room Test	Comparison to Balometer Differential Pressure Meter Digital Aerosol Photometer, Aerosol Generator Particle Counter Light meter Sound level meter Temperature & humidity meter Thermal Anemometer.
Airborne Particle Count Survey Airflow Velocity Laminar Hood HEPA/ULPA filter leak Test Induction Leak/Backstreaming Test Airflow Smoke Pattern Test Lighting Level Sound Level Test	ISO 14644-1 ISO 14644-2 ISO 14644-3 ISO 14644-7 IEST-RP-CC002.4 IEST-RP-CC006.3 IEST-RP-CC034.2 In-house Method	Laminar Air Flow Workstation Test	Comparison to Particle Counter Thermal Anemometer Aerosol Generator Digital Aerosol Photometer Light meter Sound level meter

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Services performed at satellite laboratory

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CALIBRATION

Acoustics and Vibration

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Vibration	(0.2 to 36) gpk (1 to 20) Hz (20 to 100) Hz (100 to 2500) Hz (2500 to 10 000) Hz	3.1 % of reading + 0.04 g 3.1 % of reading + 0.04 g 3.1 % of reading + 0.04 g 3.4 % of reading + 0.04 g	Comparison to Vibration Calibrator System

Chemical Quantities

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH – Source ⁶	4.01 pH 7.00 PH 10.00 pH	0.017 pH 0.018 pH 0.031 pH	Comparison to Standard Solutions
Conductivity – Source ⁶	100 µS/cm 500 µS/cm 1 400 µS/cm 10 000 µS/cm	1.4 µS/cm 6.2 µS/cm 17 µS/cm 120 µS/cm	Comparison to Standard Solutions

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source ¹	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V 220 V to 1.1 kV	7.5 $\mu\text{V/V} + 0.4 \mu\text{V}$ 5 $\mu\text{V/V} + 1 \mu\text{V}$ 3.5 $\mu\text{V/V} + 3.1 \mu\text{V}$ 3.5 $\mu\text{V/V} + 8.1 \mu\text{V}$ 5 $\mu\text{V/V} + 83 \mu\text{V}$ 6.5 $\mu\text{V/V} + 0.68 \text{ mV}$	Comparison to High Performance Multifunction Calibrator
DC Voltage – Measure ¹	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 V to 1 kV	7.2 $\mu\text{V/V} + 0.55 \mu\text{V}$ 7 $\mu\text{V/V} + 0.42 \mu\text{V}$ 6.9 $\mu\text{V/V} + 0.86 \mu\text{V}$ 9.2 $\mu\text{V/V} + 38 \mu\text{V}$ 9.3 $\mu\text{V/V} + 0.13 \text{ mV}$	Comparison to Precision 8.5 Digit Multimeter
DC High Voltage – Measure ¹	Up to 10 kV (10 to 100) kV	0.35 $\text{mV/V} + 0.09 \text{ V}$ 0.63 $\text{mV/V} + 4.1 \text{ V}$	Comparison to High Voltage Meter
DC Current – Source ¹	Up to 220 μA 220 μA to 2.2 mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	40 $\mu\text{A/A} + 6 \text{ nA}$ 35 $\mu\text{A/A} + 7.6 \text{ nA}$ 35 $\mu\text{A/A} + 48 \text{ nA}$ 55 $\mu\text{A/A} + 0.74 \mu\text{A}$ 0.13 $\text{mA/A} + 13 \mu\text{A}$	Comparison to High Performance Multifunction Calibrator
DC Current – Source ¹	330 mA to 1.1 A (1.1 to 3) A (3 to 11) A (11 to 20) A	0.15 $\text{mA/A} + 44 \mu\text{A}$ 0.27 $\text{mA/A} + 0.13 \text{ mA}$ 0.39 $\text{mA/A} + 0.41 \text{ mA}$ 0.79 $\text{mA/A} + 0.41 \text{ mA}$	Comparison to Multi Product Calibrator
DC Current – Source ¹ Clamp-On Meters	(10 to 16.5) A (16.5 to 150) A (150 to 1 025) A	0.5 % of reading + 0.55 A 0.5 % of reading + 0.57 A 0.5 % of reading + 0.74 A	Comparison to Multi Product Calibrator w/ Current Coil
DC Power – Source ¹ 33 mV to 1 020 V 329.99 mA range 2.9999 A range 20.5 A range	10 μW to 330 W 10 mW to 3 kW 100 mW to 21 kW	0.01 % of reading + 1.2 nW 0.04 % of reading 0.1 % of reading	Comparison to Multi Product Calibrator
DC Current – Measure ¹	Up to 100 nA 100 nA to 1 μA (1 to 10) μA (10 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	22 $\mu\text{A/A} + 93 \text{ pA}$ 18 $\mu\text{A/A} + 0.1 \text{ nA}$ 28 $\mu\text{A/A} + 0.14 \text{ nA}$ 30 $\mu\text{A/A} + 0.98 \text{ nA}$ 30 $\mu\text{A/A} + 6.5 \text{ nA}$ 30 $\mu\text{A/A} + 63 \text{ nA}$ 44 $\mu\text{A/A} + 1 \mu\text{A}$ 0.14 $\text{mA/A} + 12 \mu\text{A}$	Comparison to Precision 8.5 Digit Multimeter

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure ¹	(1 to 100) A (100 to 600) A (600 to 1 000) A	85 μ A/A 127 μ A/A 0.29 % of reading + 0.02 A	Indirect Method Precision 8.5 Digit Multimeter w/ Current Shunts
AC Voltage – Source ¹	(1 to 2.2) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (2.2 to 22) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (22 to 220) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz 220 mV to 2.2 V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.55 mV/V + 4.5 μ V 0.21 mV/V + 4.5 μ V 0.11 mV/V + 4.5 μ V 0.37 mV/V + 4.5 μ V 0.85 mV/V + 7 μ V 1.1 mV/V + 13 μ V 1.7 mV/V + 25 μ V 3.4 mV/V + 25 μ V 0.55 mV/V + 5 μ V 0.21 mV/V + 5 μ V 0.11 mV/V + 5 μ V 0.37 mV/V + 5 μ V 0.85 mV/V + 7 μ V 1.1 mV/V + 12 μ V 1.7 mV/V + 25 μ V 3.4 mV/V + 25 μ V 0.55 mV/V + 13 μ V 0.21 mV/V + 8 μ V 0.11 mV/V + 8 μ V 0.32 mV/V + 8 μ V 0.85 mV/V + 25 μ V 1.1 mV/V + 25 μ V 1.7 mV/V + 35 μ V 3.4 mV/V + 80 μ V 0.24 mV/V + 45 μ V 90 μ V/V + 25 μ V 45 μ V/V + 21 μ V 75 μ V/V + 22 μ V 0.11 mV/V + 82 μ V 0.42 mV/V + 0.11 mV 1 mV/V + 0.22 mV 1.7 mV/V + 0.31 mV	Comparison to High Performance Multifunction Calibrator w/ Transconductance Amplifier

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(2.2 to 22) V		Comparison to High Performance Multifunction Calibrator w/ Transconductance Amplifier
	(10 to 20) Hz	0.24 mV/V + 0.44 mV	
	(20 to 40) Hz	90 μV/V + 0.24 mV	
	40 Hz to 20 kHz	45 μV/V + 0.19 mV	
	(20 to 50) kHz	75 μV/V + 0.11 mV	
	(50 to 100) kHz	0.1 mV/V + 0.59 mV	
	(100 to 300) kHz	0.28 mV/V + 0.81 mV	
	(300 to 500) kHz	1 mV/V + 2.1 V	
	500 kHz to 1 MHz	1.5 mV/V + 3.3 V	
	(22 to 220) V		
	(10 to 20) Hz	0.24 mV/V + 4.4 mV	
	(20 to 40) Hz	90 μV/V + 2.3 mV	
	40 Hz to 20 kHz	52 μV/V + 1.8 mV	
	(20 to 50) kHz	80 μV/V + 1.9 mV	
	(50 to 100) kHz	0.15 mV/V + 5.3 mV	
	(100 to 300) kHz	0.9 mV/V + 17 mV	
	(300 to 500) kHz	4.4 mV/V + 41 mV	
	500 kHz to 1 MHz	8 mV/V + 81 mV	
	(220 to 250) V		
	(15 to 50) Hz	0.3 mV/V + 17 mV	
	50 Hz to 1 kHz	70 μV/V + 3.9 mV	
	(1 to 20) kHz	0.17 mV/V + 6.8 mV	
	(20 to 30) kHz	0.6 mV/V + 12 mV	
	220 V to 1.1 kV		
40 Hz to 1 kHz	90 μV/V + 5.3 mV		
(1 to 20) kHz	0.17 mV/V + 6.8 mV		
(20 to 30) kHz	0.6 mV/V + 12 mV		
(220 to 750) V			
(30 to 50) kHz	0.6 mV/V + 12 mV		
(50 to 100) kHz	2.3 mV/V + 46 mV		

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(1 to 10) mV		Comparison to Precision 8.5 Digit Multimeter
	(1 to 40) Hz	0.36 mV/V + 3.6 μV	
	40 Hz to 1 kHz	0.23 mV/V + 1.4 μV	
	(1 to 20) kHz	0.32 mV/V + 1.7 μV	
	(20 to 50) kHz	1.2 mV/V + 1.6 μV	
	(50 to 100) kHz	5.7 mV/V + 2 μV	
	(100 to 300) kHz	46 mV/V + 2.6 μV	
	(10 to 100) mV		
	(1 Hz to 40) Hz	72 μV/V + 0.85 mV	
	40 Hz to 1 kHz	84 μV/V + 0.26 mV	
	(1 to 20) kHz	0.17 mV/V + 0.26 mV	
	100 mV to 10 V		
	(1 Hz to 40) Hz	71 μV/V + 0.73 mV	
	40 Hz to 1 kHz	80 μV/V + 0.26 mV	
	(1 to 20) kHz	160 μV/V + 0.26 mV	
	(20 to 50) kHz	0.35 mV/V + 0.25 mV	
	(50 to 100) kHz	0.93 mV/V + 0.27 mV	
	(100 to 300) kHz	3.5 mV/V + 1.2 mV	
	300 kHz to 1 MHz	12 mV/V + 1.2 mV	
	(1 to 2) MHz	18 mV/V + 1.2 mV	
(10 to 100) V			
(1 to 40) Hz	0.24 mV/V + 4.7 mV		
40 Hz to 1 kHz	0.15 mV/V + 16 mV		
(1 to 20) kHz	0.15 mV/V + 17 mV		
(20 to 50) kHz	0.36 mV/V + 8.6 mV		
(50 to 100) kHz	1.4 mV/V + 3.9 mV		
(100 to 300) kHz	4.8 mV/V + 12 mV		
300 kHz to 1 MHz	18 mV/V + 12 mV		
100 V to 1 kV			
(1 to 40) Hz	0.46 mV/V + 50 mV		
40 Hz to 1 kHz	0.46 mV/V + 28 mV		
(1 to 20) kHz	0.69 mV/V + 29 mV		
(20 to 50) kHz	1.5 mV/V + 24 mV		
(50 to 100) kHz	3.6 mV/V + 24 mV		
AC High Voltage - Measure ¹	Up to 10 kV		Comparison to High Voltage Meter
	(30 to 200) Hz	1.4 mV/V + 0.14 V	
	(200 to 450) Hz	4.6 mV/V + 0.14V	
	(450 to 600) Hz	8.7 mV/V + 0.14V	
	(10 to 100) kV		
	(30 to 70) Hz	1.4 mV/V + 0.7 V	
	(70 to 200) Hz	17 % of reading + 0.7 V	

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage Flatness - Source ¹ (Referenced to 1 kHz)	0.3 mV to 3.5 V (10 to 30) Hz	0.35 % of reading	Comparison to High Performance Multifunction Calibrator (Wideband)
	30 Hz to 120 kHz	0.12 % of reading	
	(0.3 to 1.1) mV 120 kHz to 2 MHz	0.24 % of reading + 3 μV	
	(2 to 10) MHz	0.47 % of reading + 3 μV	
	(10 to 20) MHz	0.7 % of reading + 3 μV	
	(20 to 30) MHz	1.8 % of reading + 15 μV	
	(1.1 to 3) mV 120 kHz to 2 MHz	0.12 % of reading + 3 μV	
	(2 to 10) MHz	0.35 % of reading + 3 μV	
	(10 to 20) MHz	0.58 % of reading + 3 μV	
	(20 to 30) MHz	1.8 % of reading + 3 μV	
	3 mV to 3.5 V 120 kHz to 2 MHz	0.12 % of reading + 3 μV	
	(2 to 10) MHz	0.24 % of reading + 3 μV	
(10 to 20) MHz	0.47 % of reading + 3 μV		
(20 to 30) MHz	1.2 % of reading + 3 μV		
AC Voltage Flatness – Measure ¹	Up to 3 V (10 to 100) Hz	0.2 % of reading	Indirect Method Precision 8.5 Digit Multimeter w/ Thermal Converters
	100 Hz to 10 kHz	0.051% of reading	
	(10 to 30) kHz	0.059 % of reading	
	30 kHz to 1 MHz	0.13 % of reading	
	(1 to 10) MHz	0.21% of reading	
	(10 to 30) MHz	0.26% of reading	
	(30 to 50) MHz	0.42 % of reading	
	(50 to 70) MHz	0.65 % of reading	
	(70 to 80) MHz	0.77% of reading	
	(80 to 100) MHz	0.97 % of reading	

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	Up to 10 mV		Comparison to Precision 8.5 Digit Multimeter AC BAND < 2 MHz
	(1 to 40) Hz	3.5 μ V/V + 4.6 μ V	
	40 Hz to 1 kHz	2.4 μ V/V + 3.2 μ V	
	(1 to 20) kHz	3.5 μ V/V + 4.6 μ V	
	(20 to 50) kHz	12 μ V/V + 3.2 μ V	
	(50 to 100) kHz	58 μ V/V + 3.2 μ V	
	(100 to 300) kHz	0.47 mV/V + 3.8 μ V	
	(10 to 100) mV		
	(1 to 40) Hz	86 μ V/V + 4.6 μ V	
	40 Hz to 1 kHz	86 μ V/V + 2.3 μ V	
	(1 to 20) kHz	0.17 mV/V + 2.3 μ V	
	(20 to 50) kHz	0.35 mV/V + 2.3 μ V	
	(50 to 100) kHz	0.93 mV/V + 2.3 μ V	
	(100 to 300) kHz	3.5 mV/V + 12 μ V	
	300 kHz to 1 MHz	12 mV/V + 12 μ V	
	(1 to 2) MHz	18 mV/V + 12 μ V	
	100 mV to 1 V		
	(1 to 40) Hz	92 μ V/V + 50 μ V	
	40 Hz to 1 kHz	92 μ V/V + 31 μ V	
	(1 to 10) V		
	(1 to 20) kHz	0.17 mV/V + 31 μ V	
	(20 to 50) kHz	0.35 mV/V + 31 μ V	
	(50 to 100) kHz	0.93 mV/V + 31 μ V	
	(100 to 300) kHz	3.5 mV/V + 0.12 mV	
300 kHz to 1 MHz	12 mV/V + 0.12 mV		
(1 to 2) MHz	18 mV/V + 0.12 mV		
(10 to 100) V			
(1 to 40) Hz	91 μ V/V + 0.14 mV		
40 Hz to 1 kHz	91 μ V/V + 0.14 mV		
(1 to 20) kHz	0.17 mV/V + 0.14 mV		
(20 to 50) kHz	0.35 mV/V + 0.14 mV		
(50 to 100) kHz	0.93 mV/V + 0.14 mV		
(100 to 300) kHz	3.5 mV/V + 0.16 mV		
300 kHz to 1 MHz	1.2 mV/V + 0.16 mV		
(1 to 2) MHz	1.8 mV/V + 0.16 mV		

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Measure ¹	(100 to 750) V (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	0.45 mV/V + 2.7 mV 0.45 mV/V + 2.7 mV 0.45 mV/V + 2.7 mV 0.56 mV/V + 2.7 mV 1.5 mV/V + 2.7 mV 4.7 mV/V + 2.7 mV 18 mV/V + 2.7 mV	Comparison to Precision 8.5 Digit Multimeter AC BAND < 2 MHz
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 11 mV to 10 V 45 Hz to 100 kHz 100 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (11 to 100) V 45 Hz to 100 kHz 100 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (8 to 10) MHz (100 to 750) V 45 Hz to 100 kHz	0.46 mV/V + 47 mV 0.46 mV/V + 24 mV 0.69 mV/V + 24 mV 1.4 mV/V + 24 mV 3.5 mV/V + 24 mV 1 mV/V + 7.5 μV 14 mV/V + 6.5 μV 81 mV/V + 8.6 μV 0.24 V + 9.7 μV 1 mV/V + 0.7 mV 24 mV/V + 0.58 mV 47 mV/V + 0.81 mV 47 mV/V + 0.93 mV 0.18 V + 1.2 mV 1.5 mV/V + 2.7 mV	Comparison to Precision 8.5 Digit Multimeter AC BAND > 2 MHz

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	Up to 220 μ A		Comparison to High Performance Multifunction Calibrator
	(10 to 20 Hz)	0.25 mA/A + 16 nA	
	(20 to 40) Hz	0.16 mA/A + 10 nA	
	40 Hz to 1 kHz	0.12 mA/A + 8 nA	
	(1 to 5) kHz	0.28 mA/A + 12 nA	
	(5 to 10) kHz	1.1 mA/A + 65 nA	
	220 μ A to 2.2 mA		
	(10 to 20 Hz)	0.25 mA/A + 40 nA	
	(20 to 40) Hz	0.16 mA/A + 36 nA	
	40 Hz to 1 kHz	0.12 mA/A + 36 nA	
	(1 to 5) kHz	0.2 mA/A + 0.11 μ A	
	(5 to 10) kHz	1.1 mA/A + 0.65 μ A	
	(2.2 to 22) mA		
	(10 to 20 Hz)	0.25 mA/A + 0.41 μ A	
	(20 to 40) Hz	0.16 mA/A + 0.36 μ A	
	40 Hz to 1 kHz	0.12 mA/A + 0.36 μ A	
	(1 to 5) kHz	0.2 mA/A + 0.56 μ A	
	(5 to 10) kHz	1.1 mA/A + 5.1 μ A	
	(22 to 220) mA		
	(10 to 20) Hz	0.25 mA/A + 4.1 μ A	
	(20 to 40) Hz	0.16 mA/A + 3.6 μ A	
	40 Hz to 1 kHz	0.12 mA/A + 2.6 μ A	
	(1 to 5) kHz	0.2 mA/A + 3.6 μ A	
	(5 to 10) kHz	1.1 mA/A + 11 μ A	
220 mA to 2.2 A			
20 Hz to 1 kHz	0.25 mA/A + 36 μ A		
(1 to 5) kHz	0.45 mA/A + 81 μ A		
(5 to 10) kHz	7 mA/A + 0.18 mA		
(2.2 to 11) A			
40 Hz to 1 kHz	0.46 mA/A + 0.21 mA		
(1 to 5) kHz	0.95 mA/A + 0.4 mA		
(5 to 10) kHz	3.6 mA/A + 0.76 mA		
(11 to 20) A			
(45 to 100) Hz	1.2 mA/A + 5 mA		
100 Hz to 1kHz	1.5 mA/A + 5 mA		
(1 to 5) kHz	30 mA/A + 5 mA		

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹ Clamp-On Meters	(10 to 16.5) A (45 to 65) Hz (65 to 440) Hz	0.28 % of reading + 0.16 A 0.79 % of reading + 0.13 A	Comparison to Multi Product Calibrator w/ Current Coil
	(16.5 to 150) A (45 to 65) Hz (65 to 440) Hz	0.28 % of reading + 0.31 A 0.79 % of reading + 0.16 A	
	(150 to 1 025) A (45 to 65) Hz (65 to 440) Hz	0.29 % of reading + 1.3 A 0.8 % of reading + 1.2 A	
AC Power – Source ¹ PF = 1 (10 to 45) Hz 33 mV to 32.9999 V (3.3 mA to 2.99999 A)	110 μW to 99 W	0.19 % of reading	Comparison to Multi Product Calibrator
	(45 to 65) Hz 33 mV to 1020 V (3.3 mA to 20.5 A)	110 μW to 21 kW 0.15 % of reading	
Phase – Source ¹	+/- 179.99 (ΔΦ°)		Comparison to Multi Product Calibrator
	(10 to 65) Hz	0.09°	
	(65 to 500) Hz	0.2°	
	500 Hz to 1 kHz	0.39°	
	(1 to 5) kHz	1.9°	
	(5 to 10) kHz (10 to 30) kHz	3.9° 7.8°	

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure ¹	Up to 100 μ A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz 100 μ A to 100 mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz 100 μ A to 100 mA (20 to 50) kHz (50 to 100) kHz 100 mA to 1 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	4.7 mA/A + 36 nA 1.8 mA/A + 35 nA 0.71 mA/A + 35 nA 0.7 mA/A + 35 nA 4.7 mA/A + 24 μ A 1.8 mA/A + 24 μ A 0.71 mA/A + 24 μ A 0.36 mA/A + 23 μ A 0.71 mA/A + 24 μ A 4.7 mA/A + 47 μ A 6.5 mA/A + 0.18 mA 4.7 mA/A + 0.24 mA 1.9 mA/A + 0.24 mA 0.95 mA/A + 0.24 mA 1.1 mA/A + 0.26 mA 3.5 mA/A + 0.24 mA 12 mA/A + 0.47 mA	Comparison to Precision 8.5 Digit Multimeter
AC Current – Measure ¹	(1 to 10) A (3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz (5 to 10) kHz (10 to 100) A (50 to 60) Hz (100 to 300) A (50 to 60) Hz	20 mA/A + 6 mA 11 mA/A + 6 mA 1.5 mA/A + 6 mA 3.5 mA/A + 70 mA 0.6 A 0.8 A	Indirect Method Precision 8.5 Digit Multimeter / Shunts
Resistance – Source ¹	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω to 1.1 k Ω (1.1 to 3.3) k Ω (3.3 to 11) k Ω (11 to 33) k Ω (33 to 110) k Ω	1.7 m Ω / Ω + 35 $\mu\Omega$ 23 $\mu\Omega$ / Ω + 3.3 m Ω 31 $\mu\Omega$ / Ω + 1.9 m Ω 32 $\mu\Omega$ / Ω + 2.8 m Ω 33 $\mu\Omega$ / Ω + 2.3 m Ω 32 $\mu\Omega$ / Ω + 30 m Ω 5 $\mu\Omega$ / Ω + 1.4 Ω 32 $\mu\Omega$ / Ω + 0.3 Ω 33 $\mu\Omega$ / Ω + 0.34 Ω	Comparison to Multi Product Calibrator

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source ¹	(110 to 330) kΩ 330 kΩ to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ 330 MΩ to 1.1 GΩ	37 μΩ/Ω + 3.1 Ω 38 μΩ/Ω + 2.6 Ω 71 μΩ/Ω + 36 Ω 0.13 mΩ/Ω + 0.38 kΩ 0.22 mΩ/Ω + 7.4 kΩ 0.42 mΩ/Ω + 32 kΩ 3.6 mΩ/Ω + 0.12 MΩ 18 mΩ/Ω + 0.59 MΩ	Comparison to Multi Product Calibrator
Resistance – Source ¹ Fixed Points	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	0.12 mΩ 0.22 mΩ 0.28 mΩ 0.58 mΩ 1.3 mΩ 2.4 mΩ 10 mΩ 20 mΩ 90 mΩ 0.19 Ω 1.3 Ω 2.5 Ω 24 Ω 47 Ω	Comparison to High Performance Multifunction Calibrator
Resistance – Source ¹ Fixed Points	1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	47 Ω 0.47 kΩ 1.3 kΩ 12 kΩ	Comparison to High Performance Multifunction Calibrator
Resistance – Source ¹ Fixed Point	0.1 Ω 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ	0.56 mΩ 0.29 mΩ 2.3 mΩ 1.8 mΩ 35 mΩ 0.12 Ω 1.3 Ω	Comparison to Four Terminal Pair Resistor Set

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Measure ¹	Up to 10 Ω (> 10 to 100) Ω > 100 Ω to 1 kΩ (> 1 to 10) kΩ (> 10 to 100) kΩ > 100 kΩ to 1 MΩ (> 1 to 10) MΩ (> 10 to 100) MΩ > 100 MΩ to 1 GΩ	21 μΩ/Ω + 62 μΩ 17 μΩ/Ω + 0.59 mΩ 15 μΩ/Ω + 0.67 mΩ 15 μΩ/Ω + 6.1 mΩ 15 μΩ/Ω + 62 mΩ 21 μΩ/Ω + 2.4 Ω 45 μΩ/Ω + 0.38 kΩ 0.58 mΩ/Ω + 1.2 kΩ 5.8 mΩ/Ω + 11 kΩ	Comparison to Precision 8.5 Digital Multimeter
Capacitance – Source ¹	10 Hz to 10 kHz (220 to 399.9) pF 10 Hz to 10 kHz (0.4 to 1.099 9) nF 10 Hz to 3 kHz (1.1 to 3.299 9) nF 10 Hz to 1 kHz (3.3 to 10.999 9) nF 10 Hz to 1 kHz (11 to 32.999 9) nF 10 Hz to 1 kHz (33 to 109.999) nF 10 Hz to 1 kHz (110 to 329.999) nF (10 to 600) Hz (0.33 to 1.099 99) μF (10 to 300) Hz (1.1 to 3.299 99) μF (10 to 150) Hz (3.3 to 10.999 9) μF (10 to 120) Hz (11 to 32.999 9) μF (10 to 80) Hz (33 to 109.999) μF DC to 50 Hz (110 to 329.999) μF DC to 20 Hz (0.33 to 1.099 99) mF DC to 6 Hz (1.1 to 3.299 99) mF DC to 2 Hz (3.3 to 10.999 9) mF DC to 0.6 Hz (11 to 32.999 9) mF DC to 0.2 Hz (33 to 110) mF	0.58 % of reading + 12 pF 0.57 % of reading + 12 pF 0.57 % of reading + 12 pF 0.22 % of reading + 27 pF 0.29 % of reading + 0.12 nF 0.29 % of reading + 0.13 nF 0.29 % of reading + 0.35 nF 0.28 % of reading + 1.5 nF 0.29 % of reading + 3.5 nF 0.29 % of reading + 1.3 nF 0.46 % of reading + 36 nF 0.53 % of reading + 0.12 μF 0.53 % of reading + 0.35 μF 0.5 % of reading + 1.5 μF 0.52 % of reading + 3.6 μF 0.51 % of reading + 13 μF 0.86 % of reading + 35 μF 1.3 % of reading + 0.13 mF	Comparison to Multi Product Calibrator
Fixed Capacitance ¹ @ 1 kHz	(100 to 500) pF 500 pF to 5 nF (5 to 50) nF (50 to 100) nF (100 to 500) nF 500 nF to 1.5 μF	0.64 pF 3.7 pF 32 pF 63 pF 0.59 nF 0.63 nF	Comparison to Capacitance Standard Set

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹	1 pF		Comparison to Standard Air Capacitor Set
	1 kHz to 3 MHz	1.2 fF	
	4 MHz	1.3 fF	
	5 MHz	1.5 fF	
	10 MHz	2.8 fF	
	13 MHz	3.9 fF	
	10 pF		
	1 kHz to 13 MHz	12 fF	
	100 pF		
	1 kHz to 10 MHz	0.12 pF	
13 MHz	0.13 pF		
1 nF	1 kHz to 4 MHz	1.2 pF	
	5 MHz	1.3 pF	
	10 MHz	2.2 pF	
	13 MHz	3 pF	
Capacitance – Measure ¹	(1 to 10) nF	0.052 pF	Comparison to Digit Multimeter/LCR Meter
	(10 to 100) nF	0.041 pF	
	(0.2 to 1) μF	0.37 nF	
	(1 to 10) μF	0.018 μF	
	(10 to 100) μF	0.041 μF	
	(100 to 1 000) μF	0.56 μF	
	(1 to 10) mF	0.018 mF	
(10 to 100) mF	0.059 mF		
Inductance – Source ¹	200 μH	0.58 μH	Comparison to Standard Value Inductors
	2 mH	2.4 μH	
	20 mH	24 μH	
	200 mH	0.24 mH	
	2 H	2.4 mH	
0.1 to 1 kHz			
Inductance – Measure ¹	0.001 nH to 99.999 999 H		Comparison to Precision LCR Meter
	Up to 1 kHz	0.062 % of reading + 0.007 mH	
	1 kHz to 1 MHz	0.56 % of reading + 0.007 mH	
Electrical Simulation of Thermocouple Indicating Devices – Source and Measure ¹	Type C		Comparison to Multi Product Calibrator
	(0 to 150) °C	0.29 °C	
	(150 to 650) °C	0.32 °C	
	(650 to 1 000) °C	0.28 °C	
	(1 000 to 1 800) °C	0.48 °C	
	(1 800 to 2 316) °C	0.71 °C	

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Source and Measure ¹	Type E		Comparison to Multi Product Calibrator
	(-250 to -100) °C	0.43 °C	
	(-100 to -25) °C	0.21 °C	
	(-25 to 350) °C	0.17 °C	
	(350 to 650) °C	0.14 °C	
	(650 to 1 000) °C	0.19 °C	
	Type J		
	(-210 to -100) °C	0.35 °C	
	(-100 to -30) °C	0.2 °C	
	(-30 to 150) °C	0.14 °C	
	(150 to 760) °C	0.19 °C	
	(760 to 1 200) °C	0.26 °C	
	Type K		
	(-200 to -100) °C	0.28 °C	
	(-100 to -25) °C	0.21 °C	
	(-25 to 120) °C	0.23 °C	
	(120 to 1 000) °C	0.25 °C	
	(1 000 to 1 372) °C	0.33 °C	
	Type N		
	(-200 to -100) °C	0.39 °C	
	(-100 to -25) °C	0.27 °C	
	(-25 to 120) °C	0.23 °C	
	(120 to 410) °C	0.18 °C	
	(410 to 1 300) °C	0.27 °C	
	Type R		
	(0 to 250) °C	0.83 °C	
	(250 to 400) °C	0.42 °C	
	(400 to 1 000) °C	0.31 °C	
(1 000 to 1 767) °C	0.38 °C		
Type S			
(0 to 250) °C	0.55 °C		
(250 to 1 000) °C	0.34 °C		
(1 000 to 1 400) °C	0.32 °C		
(1 400 to 1 767) °C	0.41 °C		
Type T			
(-250 to -150) °C	0.63 °C		
(-150 to 0) °C	0.35 °C		
(0 to 120) °C	0.26 °C		
(120 to 400) °C	0.22 °C		

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Temperature Indicating Devices – Source and Measure ¹	Pt 385 (100 Ω)		Comparison to Multi Product Calibrator
	(-200 to 0) °C	0.05 °C	
	(0 to 100) °C	0.07 °C	
	(100 to 300) °C	0.09 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 630) °C	0.12 °C	
	(630 to 800) °C	0.23 °C	
	Pt 3926 (100 Ω)		
	(-200 to 0) °C	0.05 °C	
	(0 to 100) °C	0.07 °C	
	(100 to 300) °C	0.09 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 630) °C	0.12 °C	
	Pt 3916 (100 Ω)		
	(-200 to -190) °C	0.25 °C	
	(-190 to -80) °C	0.04 °C	
	(-80 to 0) °C	0.05 °C	
	(0 to 100) °C	0.06 °C	
	(100 to 260) °C	0.07 °C	
	(260 to 300) °C	0.08 °C	
	(300 to 400) °C	0.09 °C	
	(400 to 600) °C	0.1 °C	
	(600 to 630) °C	0.23 °C	
	Pt 385 (200 Ω)		
	(-200 to 100) °C	0.04 °C	
	(100 to 260) °C	0.05 °C	
	(260 to 300) °C	0.12 °C	
	(300 to 400) °C	0.13 °C	
	(400 to 600) °C	0.14 °C	
	(600 to 630) °C	0.16 °C	
Pt 385 (500 Ω)			
(-200 to -80) °C	0.04 °C		
(-80 to 100) °C	0.05 °C		
(100 to 260) °C	0.06 °C		
(260 to 400) °C	0.08 °C		
(400 to 600) °C	0.09 °C		
(600 to 630) °C	0.11 °C		

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Temperature Indicating Devices – Source and Measure ¹	Pt 385 (1000 Ω) (-200 to 0) °C	0.03 °C	Comparison to Multi Product Calibrator
	(0 to 100) °C	0.04 °C	
	(100 to 260) °C	0.05 °C	
	(260 to 300) °C	0.06 °C	
	(300 to 600) °C	0.07 °C	
	(600 to 630) °C	0.23 °C	
	PtNi 385 (120 Ω) (Ni 120) (-80 to 100) °C	0.08 °C	
(100 to 260) °C	0.14 °C		
CU 427 (10 Ω) (100 to 260) °C	0.3 °C		
Oscilloscopes ¹ – DC Voltage into 50 Ω load into 1 MΩ load	(-6.6 to 6.6) V (-130 to 130) V	0.2 % of reading + 36 μV 0.039 % of reading + 37 μV	Comparison to Multi Product Calibrator
Square Wave into 50 Ω load	10 Hz to 10 kHz 1 mVp-p to 6.6 Vp-p	0.2 % of reading + 65 μV	
into 1 MΩ load	10 Hz to 1 kHz 1 mVp-p to 130 Vp-p (1 to 10) kHz 1 mVp-p to 130 Vp-p	0.078 % of reading + 36 μV 0.19 % of reading + 39 μV	
Leveled Sine Amplitude Reference @ 50 kHz	5 mV to 5.5 V	1.5 % of reading + 0.49 mV	

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes ¹ Leveled Sine Amplitude (relative to 50 kHz) Time Markers (5-2-1 sequence) into 50 Ω load Edge Transition Time (Rise Time)	5 mV to 5.5 V 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz (1 to 50) ns 100 ns to 20 ms 50 ms to 5 s < 300 ps	14 mV/V + 0.12 mV 17 mV/V + 0.14 mV 32 mV/V + 0.15 mV 40 mV/V + 0.16 mV 0.001 1 % of reading + 0.048 ps 0.000 2 % of reading + 7 ps 0.4 % of reading 80 ps	Comparison to Multi Product Calibrator
Rise Time ¹ (measurement)	20 ps to 100 μs 1 ns to 10 μs (10 to 100) μs	81 ns 1.2 ns 2.9 ns	Comparison to Oscilloscope
ESD Simulators Contact Voltage (Positive and Negative) Rise Time Peak Current 30 ns Current 60 ns Current	(1 to 8) kV (0.6 to 1) ns (3.75 to 33) A (2 to 20.8) A (1 to 10.4) A	1.2 % of reading 0.000 12 % Δ time reading + 11 ps 2.1 % of reading 3.4 % of reading 6.3 % of reading	Procedure IEC 61000-4-2 (Ed.2, 2008); Multimeters, ESD Target, Attenuator, Oscilloscope
ESD Simulators Air Discharge Voltage (Positive and Negative) Rise Time RC Time Constant (at ± 15 kV)	(0.7 to 1) ns (1 to 30) kV 600 ns ± 130 ns 330 pF probe 300 ns ± 60 ns 150 pF probe	1.2 % of reading 0.000 12 % Δ time reading + 11 ps 0.000 12 % Δ time reading + 11 ps	Procedure IEC 61000-4-2 (Ed.2, 2008); Multimeters, ESD Target, Attenuator, Oscilloscope

Electrical – DC/Low Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
EFT/Burst Generator Voltage (±)	10 V to 8 kV	2.7 % of reading	Procedure IEC 61000-4-4 (Ed.3, 2012); Fast Rise Oscilloscope w/ EFT Verification Set
Rise Time	5 ns ± 30 %	0.008 % Δ time reading	
Impulse Duration	50 ns ± 30 %	0.008 % Δ time reading	
Burst Duration	15 ns ± 20 %	0.008 % Δ time reading	
Burst Period	300 ms ± 20 %	0.008 % Δ time reading	
Surge Generator Front Time Rise Time Open Circuit (±)	(1.2 to 50) μs	0.008 % Δ time reading	Procedure IEC 61000-4-5 (Ed. 3.1, 2017), IEC 61000-4-11 (Ed 3.0, 2020), IEC 61000-4-18 (Ed. 2.0, 2019); Fast Rise Oscilloscope, Current Probes, Oscilloscope Probes
Short Circuit (±)	(1.2 to 50) μs	0.008 % Δ time reading	
Time to Half-Value (±)	(20 to 700) μs	0.008 % Δ time reading	
Open Circuit Voltage (±)	10 V to 12 kV	2.9 % of reading	
Short Circuit Voltage (±)	(0.125 to 3) kA	2.9 % of reading	
Ring Wave Voltage	1 kV ± 10 %	2.9 % of reading	
Ring Wave Rise Time	1.5 μs ± 0.5 μs	0.008 % Δ time reading	

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Attenuation – Source Coaxial, 10 dB Step	(0 to 120) dB 1 kHz 500 MHz 1 GHz	0.11 dB 0.28 dB 0.39 dB	Comparison to Standard Piston Attenuator
RF Attenuation – Source Coaxial, 1 dB Step	DC to 12.4 GHz (0 to 11) dB (12.4 to 18) GHz (0 to 11) dB	0.6 dB 0.8 dB	Comparison to Standard Electronic Programmable Attenuator

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Attenuation – Source Coaxial, 10 dB Step	DC to 12.4 GHz (0 to 10) dB 20 dB 30 dB 40 dB 50 dB 60 dB 70 dB (80 to 110) dB	0.51 dB 0.71 dB 0.91 dB 1.2 dB 1.5 dB 1.8 dB 2.1 dB 2.4 dB	Comparison to Standard Electronic Programmable Attenuator
RF Attenuation – Source Coaxial, 10 dB Step	(12.4 to 18) GHz (0 to 10) dB 20 dB 30 dB 40 dB 50 dB 60 dB 70 dB (80 to 110) dB	0.61 dB 0.81 dB 1.2 dB 1.6 dB 2 dB 2.4 dB 2.8 dB 3.2 dB	Comparison to Standard Electronic Programmable Attenuator
RF Absolute Power Source Into 50 Ω 0.001 Hz to 100 kHz SWR 1.2:1 100 kHz to 10 MHz SWR ≤ 1.2:1 (10 to 20) MHz SWR ≤ 1.2:1	(3 to 10) Vp-p 1 mVp-p to 3Vp-p (3 to 10) Vp-p 1 mVp-p to 3 Vp-p 100 mVp-p to 3 Vp-p (1 to 100) mVp-p	0.13 dB 0.22 dB 0.41 dB 0.61 dB 0.61 dB 0.91 dB	Comparison to Synthesized Signal Sources
RF Absolute Power Source Into 50 Ω Into 50 Ω/75 Ω	13.01 dBm 1 kHz to 25 MHz 200 Hz to 80 MHz	0.12 dB 0.18 dB	Comparison to Synthesized Level Generator
RF Absolute Power Into 50 Ω, In 2 dB steps Relative to Full Output	200 Hz to 80 MHz (0 to -38) dBm (-40 to -58) dBm (-60 to -98) dBm	0.21 dB 0.21 dB 0.27 dB	Comparison to Synthesized Level Generator

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power Into 75 Ω, In 2 dB steps Relative to Full Output	(0 to -38) dBm 200 Hz to 25 MHz	0.21 dB	Comparison to Synthesized Level Generator
	(25 to 80) MHz	0.36 dB	
	(-40 to -58) dBm 200 Hz to 25 MHz	0.28 dB	
	(25 to 80) MHz	0.54 dB	
	(-60 to -98) dBm 200 Hz to 25 MHz (25 to 80) MHz	0.45 dB 1.7 dB	
RF Absolute Power Source Into 50 Ω SWR ≤ 1.6:1 SWR ≤ 1.6:1 SWR ≤ 1.8:1 SWR ≤ 2:1 SWR ≤ 1.6:1 SWR ≤ 1.8:1 SWR ≤ 2:1 SWR ≤ 1.6:1 SWR ≤ 1.8:1 SWR ≤ 2:1	(+10 to -10) dBm 10 MHz to 2 GHz	1.5 dB	Comparison to Synthesized Level Generator
	(2 to 20) GHz	1.7 dB	
	(+5 to -10) dBm 10MHz to 2 GHz	0.82 dB	
	(2 to 20) GHz	0.96 dB	
	(20 to 40) GHz	1.2 dB	
	(+2.5 to -10) dBm (40 to 50) GHz	2.3 dB	
	(-10 to -60) dBm 10MHz to 2 GHz	1.2 dB	
	(2 to 20) GHz	1.3dB	
	(20 to 40) GHz	1.6 dB	
	(40 to 50) GHz	2.3 dB	
	(-60 to -110) dBm 10 MHz to 2 GHz	1.8 dB	
	(2 to 20) GHz	1.9 dB	
	(20 to 40) GHz	2.2 dB	
	(40 to 50) GHz	3.3 dB	

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Tuned Power – Measure (relative)	100 kHz to 4.2 GHz (+30 to 0) dB (0 to -30) dB (-30 to -60) dB (-60 to -90) dB (-90 to -129) dB (4.2 to 18) GHz (+30 to 0) dB (0 to -30) dB (-30 to -60) dB (-60 to -90) dB (-90 to -129) dB (18 to 26.5) GHz (+30 to 0) dB (0 to -30) dB (-30 to -60) dB (-60 to -90) dB (-90 to -129) dB	0.14 dB 0.16 dB 0.19 dB 0.21 dB 0.25 dB 0.18 dB 0.2 dB 0.22 dB 0.24 dB 0.28 dB 0.24 dB 0.25 dB 0.27 dB 0.29 dB 0.32 dB	Comparison to Measuring Receiver System
RF Tuned Power – Measure (relative)	(26.5 to 50) GHz (+30 to 0) dB (0 to -30) dB (-30 to -60) dB (-60 to -90) dB (-90 to -129) dB	0.2 dB 0.21 dB 0.23 dB 0.25 dB 0.29 dB	Comparison to Measuring Receiver System
Digital Modulation – Measure Carrier Frequency 2 MHz to 2.65 GHz Error Vector Magnitude for Modulation Types: MSK, GMSK, BPSK, DQPSK, $\Pi/4$ DQPSK, 8PSK, 16QAM, 32 QAM and QPSK Phase Error for Modulation Types: MSK, GMSK, BPSK, DQPSK, $\Pi/4$ DQPSK, 8PSK, 16QAM, 32 QAM and QPSK	(0 to 15) % (1 to 100) kHz 100 kHz to 1 MHz 1 MHz to 2.65 GHz (0 to 3) ^o (1 to 100) kHz (0.1 to 1) MHz 1 MHz to 2.65 GHz	0.33 % of reading 0.51 % of reading 1 % of reading 0.18 ^o 0.34 ^o 0.57 ^o	Comparison to Vector Signal Analyzer

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Digital Modulation – Measure Error Vector Magnitude for FSK Modulation	Modulation Frequency 3.2 kHz 1.152 kHz	0.54 % of reading 1.5 % of reading	Comparison to Vector Signal Analyzer
Amplitude Modulation – Source (11 to 13.5) MHz 20 Hz to 100 kHz DC to 15 kHz	Rate: 50 Hz to 50 kHz, (5 to 99) % Depth Rate: (20 to 50) Hz (5 to 99) % Depth Rate: 9 kHz to 3.2 GHz (0 to 100) % Depth	0.1 % of reading 0.25 % of reading 5 % of reading	Comparison to AM/FM Test Source, Analog Modulation Sources
Amplitude Modulation – Source DC to 100 kHz	Rate: 250 kHz to 50 GHz (0 to 99) % Depth	1.2 % of reading + 0.07 AM	Comparison to AM/FM Test Source, Analog Modulation Sources
Amplitude Modulation – Measure 100 kHz to 10 MHz 10 MHz to 3 GHz	Rate: 50 Hz to 10 kHz, (5 to 99) % Depth 50 Hz to 100 kHz, (20 to 99) % Depth	0.001 4 % of reading + 0.009 AM 0.001 % of reading + 0.007 AM	Comparison to Microwave Measuring Receiver System
Amplitude Modulation – Measure 10 MHz to 3 GHz (3 to 26.5) GHz (3 to 26.5) GHz	50 Hz to 100 kHz, (5 to 20) % Depth 50 Hz to 100 kHz, (5 to 20) % Depth 50 Hz to 100 kHz, (20 to 99) % Depth	0.001 % of reading + 0.029 AM 0.01 % of reading + 0.052 AM 0.01 % of reading + 0.018 AM	Comparison to Microwave Measuring Receiver System

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Amplitude Modulation – Measure 150 kHz to 10 MHz Rate: 50 Hz to 10 kHz, Depth: 5 % to 99 % Rate: 20 Hz to 10 kHz, Depth: to 99 % 10 MHz to 1.3 GHz Rate: 50 Hz to 50 kHz, Depth: 5 % to 99 % Rate: 20 Hz to 10 kHz, Depth: to 99 % (1.3 to 26.5) GHz Rate: 50 Hz to 10 kHz, Depth: 5 % to 99 % 10 MHz to 26.5 GHz Rate: 20 Hz to 10 kHz, Depth: to 99 %	(5 to < 10) % Depth (10 to 99) % Depth (5 to < 10) % Depth (10 to 99) % Depth (5 to < 10) % Depth (10 to 99) % Depth (5 to < 10) % Depth (10 to 99) % Depth (5 to < 10) % Depth (10 to 99) % Depth (5 to < 10) % Depth (10 to 99) % Depth	0.01 % of reading + 0.023 AM 0.06 % of reading + 0.023 AM 0.01 % of reading + 0.035 AM 0.06 % of reading + 0.035 AM 0.01 % of reading + 0.012 AM 0.06 % of reading + 0.012 AM 0.01 % of reading + 0.035 AM 0.06 % of reading + 0.035 AM 0.03 % of reading + 0.018 AM 0.07 % of reading + 0.018 AM 0.03 % of reading + 0.035 AM 0.07 % of reading + 0.035 AM	Comparison to Microwave Measuring Receiver System
Frequency Modulation – Measure 250 kHz to 10 MHz 10 MHz to 6.6 GHz	Rate: 20 Hz to 10 kHz Dev:20 Hz to 40 kHz pk Rate: 50 Hz to 200 kHz Dev:250 Hz to 400 kHz pk	1.7 % of reading + 5.7 Hz 1.1 % of reading + 6.6 Hz 1.8 % of reading + 5.1 Hz 1.2 % of reading + 6.1 Hz	Comparison to Microwave Measuring Receiver System
Frequency Modulation – Measure (6.6 to 13.2) GHz (13.2 to 26.5) GHz	Rate: 50 Hz to 200 kHz Dev:250 Hz to 400 kHz pk Rate: 50 Hz to 100 kHz Dev:250 Hz to 400 kHz pk	2.9 % of reading + 4 Hz 1.2 % of reading + 6.4 Hz 4.4 % of reading + 3.8 Hz 1.2 % of reading + 7.6 Hz	Comparison to Microwave Measuring Receiver System
Frequency Modulation – Measure 250 kHz to 10 MHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM 10 MHz to 26.5 GHz	Rate: 20 Hz to 10 kHz ≤ 40 kHz pk	0.024 FM + 2.4 Hz Pk 0.024 FM + 8 Hz Pk	Comparison to Microwave Measuring Receiver System

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation – Measure 10 MHz to 1.3 GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM	Rate: 50 Hz to 100 kHz ≤ 400 kHz pk	0.012 FM + 2.4 Hz Pk 0.012 FM + 14 Hz Pk 0.012 FM + 66 Hz Pk	Comparison to Microwave Measuring Receiver System
Frequency Modulation – Measure (> 1.3 to 6.2) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (> 6.2 to 12.4) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM	Rate: 50 Hz to 100 kHz ≤ 400 kHz pk	0.012 FM + 19 Hz Pk 0.012 FM + 23 Hz Pk 0.012 FM + 75 Hz Pk 0.012 FM + 35 Hz Pk 0.012 FM + 39 Hz Pk 0.012 FM + 91 Hz Pk	Comparison to Microwave Measuring Receiver System
Frequency Modulation – Measure (> 12.4 to 18.6) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (> 18.6 to 26.5) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM	Rate: 50 Hz to 100 kHz ≤ 400 kHz pk	0.012 FM + 51 Hz Pk 0.012 FM + 55 Hz Pk 0.012 FM + 110 Hz Pk 0.012 FM + 67 Hz Pk 0.012 FM + 71 Hz Pk 0.012 FM + 130 Hz Pk	Comparison to Microwave Measuring Receiver System
Frequency Modulation – Measure 10 MHz to 26.5 GHz 10 MHz to 1.3 GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (>1.3 to 6.2) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM	Rate: 50 Hz to 100 kHz ≤ 400 kHz pk	0.058 FM + 3.9 Hz Pk 0.058 FM + 8 Hz Pk 0.058 FM + 66 Hz Pk 0.058 FM + 19 Hz Pk 0.058 FM + 23 Hz Pk 0.058 FM + 75 Hz Pk	Comparison to Microwave Measuring Receiver System

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation – Measure (> 6.2 to 12.4) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (> 12.4 to 18.6) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (> 18.6 to 26.5) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM	Rate: 20 Hz to 200 kHz ≤ 400 kHz pk	0.058 FM + 35 Hz Pk 0.058 FM + 39 Hz Pk 0.058 FM + 91 Hz Pk 0.058 FM + 51 Hz Pk 0.058 FM + 55 Hz Pk 0.058 FM + 110 Hz Pk 0.058 FM + 67 Hz Pk 0.058 FM + 71 Hz Pk 0.058 FM + 130 Hz Pk	Comparison to Microwave Measuring Receiver System
Frequency Modulation – Source (11 to 13.5) MHz (11 to 13.5) MHz (88 to 108) MHz (88 to 108) MHz (352 to 432) MHz	Rate: DC to 10 kHz Dev.: ≤ 100 kHz peak Rate: DC to 10 kHz Dev.: ≤ 200 kHz peak Rate: DC to 100 kHz Dev.: ≤ 100 kHz peak Rate: DC to 100 kHz Dev.: ≤ 200 kHz peak Rate: DC to 100 kHz Dev.: ≤ 100 kHz peak	0.1 % of reading 0.25 % of reading 0.1 % of reading 0.25 % of reading 0.1 % of reading	Comparison to AM/FM Test Source

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation – Source (352 to 432) MHz 9 kHz to 1 GHz (1 to 2) GHz (2 to 3) GHz	Rate: DC to 100 kHz Dev.: ≤ 200 kHz peak Rate: DC to 150 kHz Dev.: ≤ 200 kHz peak Rate: DC to 150 kHz Dev.: ≤ 400 kHz peak Rate: DC to 150 kHz Dev.: ≤ 400 kHz peak	0.25 % of reading 3 % of reading + 30 Hz 3 % of reading + 60 Hz 3 % of reading + 120 Hz	Comparison to Analog Modulation Sources
Frequency Modulation – Source 1 kHz rate Max. Dev. 2 MHz Max. Dev. 4 MHz Max. Dev. 8 MHz Max. Dev. 16 MHz Max. Dev. 32 MHz Max. Dev. 64 MHz Max. Dev. 128 MHz	250 kHz to 1 GHz (1 to 2) GHz (2 to 3.2) GHz (3.2 to 10) GHz (10 to 20) GHz (20 to 40) GHz (40 to 50) GHz	40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz	Comparison to Analog Modulation Sources
Phase Modulation – Measure > 0.7 rad Dev. > 0.6 rad Dev. > 1.2 rad Dev.	100 kHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 26.5) GHz	1.2 % of reading + 0.007 1 rad 1.2 % of reading + 0.007 1 rad 1.2 % of reading + 0.007 3 rad	Comparison to Microwave Measuring Receiver System
Phase Modulation – Measure 150 kHz to 10 MHz (0 to < 4) rad pk PM (≥ 4 to < 40) rad pk PM 10 MHz to 1.3 GHz (0 to < 4) rad pk PM (≥ 4 to < 40) rad pk PM (≥ 40 to < 400) rad pk PM	200 Hz to 10 kHz Rate ≤ 40 rad pk 200 Hz to 20 kHz Rate ≤ 400 rad pk	4.7 % of reading + 0.001 rad 4.7 % of reading + 0.008 rad 3.5 % of reading + 0.001 rad 3.5 % of reading + 0.008 rad 3.5 % of reading + 0.09 rad	Comparison to Microwave Measuring Receiver System
Phase Modulation – Measure 1.3 to 26.5 GHz (0 to < 4) rad pk PM (≥ 4 to < 40) rad pk PM (≥ 40 to < 400) rad pk PM	200 Hz to 20 kHz Rate ≤ 400 rad pk	3.5 % of reading + 0.001 rad 3.5 % of reading + 0.008 rad 3.5 % of reading + 0.09 rad	Comparison to Microwave Measuring Receiver System

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase Modulation – Source Rate: 20 Hz to 10 kHz Carrier: 9 kHz to 1 GHz (1 to 2) GHz (2 to 3.2) GHz 250 kHz to 1 GHz (>1 to 2) GHz (>2 to 3.2) GHz (>3.2 to 10) GHz (>10 to 20) GHz (>20 to 40) GHz (>40 to 50) GHz	(0 to 10) rad (0 to 20) rad (0 to 40) rad Max. Dev. (0 to 20) rad (0 to 40) rad (0 to 80) rad (0 to 160) rad (0 to 320) rad (0 to 640) rad (0 to 1 280) rad	3 % of reading + 0.05 rad 3 % of reading + 0.1 rad 3 % of reading + 0.2 rad 6 % of reading + 0.012 rad 6 % of reading + 0.012 rad 6 % of reading + 0.012 rad 6 % of reading + 0.012 rad 6 % of reading + 0.012 rad 6 % of reading + 0.012 rad 6 % of reading + 0.012 rad	Comparison to Analog Modulation Sources
Distortion – Measure	(0.01 to 100) % Distortion 250 kHz to 50 GHz	0.065 % of reading	Comparison to Microwave Measuring Receiver System
Distortion – Measure Fundamental Frequency 20 Hz to 20 kHz (20 to 100) kHz	(-99 to 0) dB (-99 to 0) dB	1.2 dB 2.3 dB	Comparison to Distortion Analyzer
Power Reference – Measure 50 MHz	50 MHz 1 mW	5.5 μW	Indirect Method Primary Standards Lab (H75) Thermistor Mount, Power Meter, Precision 8.5 Digit Multimeter
Absolute Power – Measure	9 kHz to 4.2 GHz (+20 to -30) dBm 10 MHz to 18 GHz (-20 to -70) dBm 50 MHz to 26.5 GHz (+20 to -30) dBm (26.5 to 50) GHz (+20 to -30) dBm (-20 to -70) dBm	0.3 % of Reading + 0.65 dB 0.44 % of reading + 0.32 dB 0.24 % of reading + 0.86 dB 0.46 % of reading + 0.94 dB 1.6 % of reading + 0.67 dB	Comparison to RF Power Meters with Sensors

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Power Meter – Range Calibration	3 μ W 10 μ W 30 μ W 100 μ W 300 μ W 1 mW 3 mW 10 mW 30 mW 100 mW	21 nW 19 nW 21 nW 77 nW 0.11 μ W 0.29 μ W 0.64 μ W 6.4 μ W 13 μ W 0.1 mW	Comparison to Power Meter Range Calibrator w/ Precision DC Voltage Source
Noise Figure – Source	15 dB ENR 10 MHz to 4 GHz (> 4 to 10) GHz (> 10 to 18) GHz (> 18 to 26.5) GHz	0.22 dB 0.22 dB 0.22 dB 0.22 dB	Comparison to Noise Source
Noise Figure – Measure	100 kHz to 30 MHz >30 MHz to 3 GHz (>3 to 26.5) GHz	0.43 dB 0.42 dB 0.47 dB	Comparison to Noise Figure Measurement System w/ Standard Noise Sources
Single Sideband Phase Noise - Measure	1 MHz to 26.5 GHz	1.8 dB	Comparison to Phase Noise Measurement System
Current Probes/ Bulk Current Injection Probes Insertion Loss	(0 to 100) dB 20 Hz to 300 kHz 300 kHz to 1 MHz 1 MHz to 3 GHz	1.1 dB 1 dB 1.9 dB	Comparison to Network/RF Impedance Analyzers, Attenuator, Type N Calibration Kit
Transfer Impedance	(0 to 100) dB 20 Hz to 300 kHz 300 kHz to 1 MHz 1 MHz to 3 GHz	1.1 dB 1 dB 1.9 dB	

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Transmission S_{12}/S_{21} – Measure Phase and Magnitude	9 kHz to 1.3 GHz (-180 to 180)° (0 to 10) dB (-10 to 0) dB (-20 to -10) dB (-60 to -20) dB (-70 to -60) dB (-80 to -70) dB (-90 to -80) dB (1.3 to 3) GHz (0 to 10) dB (-10 to 0) dB (-20 to -10) dB (-60 to -20) dB (-70 to -60) dB (1.3 to 3) GHz (-80 to -70) dB (-90 to -80) dB	0.18 dB (1°) 0.057 dB (0.43°) 0.072 dB (0.8°) 0.086 dB (0.89°) 0.13 dB (1.2°) 0.3 dB (2.4°) 0.92 dB (6.9°) 0.12 dB (4.1°) 0.063 dB (0.48°) 0.077 dB (0.8°) 0.093 dB (0.94°) 0.13 dB (1.2°) 0.32 dB (2.6°) 0.92 dB (7.4°)	Comparison to LF Vector Network Analyzer, Calibration Kits
Transmission S_{12}/S_{21} – Measure Phase and Magnitude	50 MHz to 2 GHz (-180 to 180)° (0 to 10) dB (-10 to 0) dB (-20 to -10) dB (-30 to -20) dB (-40 to -30) dB (-50 to -40) dB (-60 to -50) dB (2 to 8) GHz (0 to 10) dB (-10 to 0) dB (-20 to -10) dB (-30 to -20) dB (-40 to -30) dB (-50 to -40) dB (-60 to -50) dB (-70 to -60) dB (-80 to -70) dB (-90 to -80) dB	0.07 dB (0.46°) 0.054 dB (0.36°) 0.075 dB (0.5°) 0.12 dB (0.83°) 0.29 dB (1.9°) 2.3 dB (5.5°) 5.9 dB (5.7°) 0.09 dB (0.59°) 0.07 dB (0.46°) 0.087 dB (0.57°) 0.1 dB (0.69°) 0.12 dB (0.81°) 0.15 dB (0.98°) 0.22 dB (1.4°) 0.45 dB (3.1°) 1.2 dB (8.7°) 3.4 dB (8.7°)	Comparison to Vector Network Analyzer w/ Calibration Kits

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Transmission S_{12}/S_{21} – Measure Phase and Magnitude	(8 to 20) GHz (-180 to 180) ^o (0 to 10) dB (-10 to 0) dB (-20 to -10) dB (-30 to -20) dB (-40 to -30) dB (-50 to -40) dB (-60 to -50) dB (-70 to -60) dB (-80 to -70) dB (-90 to -80) dB	0.19 dB (1.3 ^o) 0.17 dB (1.1 ^o) 0.18 dB (1.2 ^o) 0.2 dB (1.3 ^o) 0.22 dB (1.4 ^o) 0.24 dB (1.6 ^o) 0.32 dB (2.1 ^o) 0.6 dB (4.1 ^o) 1.6 dB (8.7 ^o) 4.2 dB (11 ^o)	Comparison to Vector Network Analyzer w/ Calibration Kits
	(20 to 50) GHz (0 to 10) dB (-10 to 0) dB (-20 to -10) dB (-30 to -20) dB (-40 to -30) dB (-50 to -40) dB (-60 to -50) dB (-70 to -60) dB (-80 to -70) dB (-90 to -80) dB	0.54 dB (3.7 ^o) 0.5 dB (3.4 ^o) 0.49 dB (3.3 ^o) 0.5 dB (3.4 ^o) 0.52 dB (3.5 ^o) 0.55 dB (3.7 ^o) 0.65 dB (4.4 ^o) 1.1 dB (7.6 ^o) 2.7 dB (8.9 ^o) 6.6 dB (11 ^o)	
Reflection S_{11}/S_{22} – Measure Phase and Magnitude ^{2,3}	9 kHz to 1.3 GHz (-180 to 180) ^o (< 0.03) Γ (< 0.2) Γ (< 0.4) Γ (< 0.6) Γ (< 0.8) Γ (< 1) Γ	0.002 3 (1.4 ^o) 0.003 5 (1.4 ^o) 0.006 1 (1.1 ^o) 0.008 3 (0.94 ^o) 0.01 (0.83 ^o) 0.012 (0.7 ^o)	Comparison to LF Vector Network Analyzer, Calibration Kits
	(1.3 to 3) GHz (< 0.03) Γ (< 0.2) Γ (< 0.4) Γ (< 0.6) Γ (< 0.8) Γ (< 1) Γ	0.005 6 (1.8 ^o) 0.003 5 (1.8 ^o) 0.008 (1.3 ^o) 0.011 (1.2 ^o) 0.013 (1 ^o) 0.016 (0.89 ^o)	

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Reflection S_{11}/S_{22} – Measure Phase and Magnitude ^{2,3}	50 MHz to 2 GHz (-180 to 180)°		Comparison to Vector Network Analyzer w/ Calibration Kits
	(< 0.03) Γ	0.01 (3.3°)	
	(< 0.2) Γ	0.012 (3.3°)	
	(< 0.4) Γ	0.014 (2°)	
	(< 0.6) Γ	0.017 (1.6°)	
	(< 0.8) Γ	0.021 (1.5°)	
	(< 1) Γ	0.026 (1.5°)	
	(2 to 8) GHz		
	(< 0.03) Γ	0.01 (3.5°)	
	(< 0.2) Γ	0.012 (3.5°)	
	(< 0.4) Γ	0.015 (2.2°)	
	(< 0.6) Γ	0.019 (1.8°)	
	(< 0.8) Γ	0.024 (1.7°)	
	(< 1) Γ	0.003 (1.7°)	
	(8 to 20) GHz		
	(< 0.03) Γ	0.002 4 (7.8°)	
	(< 0.2) Γ	0.002 7 (7.8°)	
	(< 0.4) Γ	0.003 3 (4.8°)	
	(< 0.6) Γ	0.004 2 (4°)	
	(< 0.8) Γ	0.053 (3.8°)	
	(< 1) Γ	0.067 (3.9°)	
	(20 to 50) GHz		
	(-180 to 180)°		
	(< 0.03) Γ	0.06 (19°)	
(< 0.2) Γ	0.066 (11°)		
(< 0.4) Γ	0.079 (11°)		
(< 0.6) Γ	0.097 (9.3°)		
(< 0.8) Γ	0.12 (8.8°)		
(< 1) Γ	0.15 (8.8°)		

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) 7mm Test Ports Reflection S_{11}/S_{22} ^{2,3} Magnitude Phase	≤ 0.1 to ≤ 1.0 Γ (0.0003 to 1) GHz (1 to 3) GHz (3 to 6) GHz ≤ 0 to $\leq 60^\circ$ (0.0003 to 1) GHz (1 to 3) GHz (3 to 6) GHz	0.003 8 Γ 0.003 9 Γ 0.005 1 Γ 2° 2.1° 2.7°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Network Analyzer System Verification (Corrected Performance) N-Type Test Ports Reflection S_{11}/S_{22} ^{2,3} Magnitude Phase	≤ 0.1 to ≤ 1 Γ (0.000 3 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz ≤ 0 to $\leq 60^\circ$ (0.000 3 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz	0.009 Γ 0.001 Γ 0.001 5 Γ 0.004 1 Γ 0.46° 0.64° 0.65° 1.3°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) 3.5mm Test Ports Reflection S_{11}/S_{22} ^{2,3} Magnitude Phase	≤ 0.1 to $\leq 1 \Gamma$ (0.045 to 2) G Γ Hz (2 to 20) GHz (20 to 26.5) GHz ≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 26.5) GHz	0.000 76 Γ 0.001 Γ 0.003 Γ 0.34° 0.36° 0.64°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Network Analyzer System Verification (Corrected Performance) 2.4mm Test Ports Reflection S_{11}/S_{22} ^{2,3} Magnitude ^{2,3} Phase	≤ 0.1 to $\leq 1.0 \Gamma$ (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz ≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.003 8 Γ 0.003 8 Γ 0.004 4 Γ 0.005 5 Γ 0.96° 1.3° 1.5° 2.3°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) 7mm Test Ports Transmission S_{21}/S_{12} Magnitude Phase	≤ 0.1 to ≤ 1.0 dB (0.000 3 to 1) GHz (1 to 3) GHz (3 to 6) GHz ≤ 0 to $\leq 60^\circ$ (0.000 3 to 1) GHz (1 to 3) GHz (3 to 6) GHz	0.16 dB 0.16 dB 0.17 dB 1.4° 1.5° 2.2°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Network Analyzer System Verification (Corrected Performance) N-Type Test Ports Transmission S_{21}/S_{12} Magnitude Phase	≤ 0.1 to ≤ 1 dB (0.000 3 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz ≤ 0 to $\leq 60^\circ$ (0.000 3 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz	0.018 dB 0.019 dB 0.02 dB 0.024 dB 0.18° 0.2° 0.23° 0.24°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) 3.5mm Test Ports Transmission S_{21}/S_{12} Magnitude Phase	≤ 0.1 to ≤ 1 dB (0.045 to 2) GHz (2 to 20) GHz (20 to 26.5) GHz ≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 26.5) GHz	0.018 dB 0.019 dB 0.032 dB 0.18° 0.18° 0.32°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Network Analyzer System Verification (Corrected Performance) 2.4mm Test Ports Transmission S_{21}/S_{12} Magnitude Phase	≤ 0.1 to ≤ 1 dB (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz ≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.023 dB 0.033 dB 0.055 dB 0.068 dB 0.23° 0.41° 0.97° 1.8°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Scalar Network Analyzer Absolute Log Error Dynamic Accuracy	21 dB (0 to 140) dB	0.04 dB 0.02 dB	Comparison to Scalar Network Analyzer Calibrator
Network Analyzer Dynamic Accuracy	(0 to 140) dB	0.02 dB	Comparison to Dynamic Accuracy Test Set

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Impulse Spectral Amplitude Source			Comparison to Pulse Generator
CISPR Band A	(10 to 150) kHz	0.82 dB	
CISPR Band B	150 kHz to 30 MHz	0.82 dB	
CISPR Band C and D	30 MHz to 1 GHz	1.1 dB	
CISPR Band E	(1 to 18) GHz	1.5 dB	
Sinewave Output for CISPR Checks Source @ 60 dB/ μ V	(0 to -70) dB 100 kHz (1, 10, and 100) MHz	0.35 dB 0.35 dB	
Peak and Average Detector Response	(0 to -70) dB CISPR Band A thru D	1.3 dB	
LISN (Line Impedance Stabilization Network) & AMN (Artificial Mains Network)			Comparison to RF Impedance/Network Analyzers, Calibration Kits
Insertion Loss	(-20 to 0) dB 10 Hz to 1000 MHz	0.25 dB	
Isolation (De-Coupling Factor)	(-90 to 0) dB 10 Hz to 1 000 MHz	2.3 dB	
Impedance (Magnitude)	0.1 Ω to 1 k Ω 10 Hz to 1000 MHz	2.4 % of reading	
Impedance (Phase)	(-180 to 180) $^{\circ}$ 10 Hz to 1 000 MHz	2.6 $^{\circ}$	

Electrical – RF/Microwave

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
CDN (Coupling-Decoupling Network) & ISN (Impedance Stabilization Network) Insertion Loss	(-20 to 0) dB 10 Hz to 1000 MHz	0.25 dB	Comparison to RF Impedance/Network Analyzers, Calibration Kits
Isolation (De-Coupling Factor)	(-90 to 0) dB 10 Hz to 1000 MHz	2.3 dB	
Impedance (Magnitude)	0.1 Ω to 1 kΩ 10 Hz to 1 000 MHz	2.4 % of reading	
Impedance (Phase)	(-180 to 180)° 10 Hz to 1 000 MHz	2.6°	
LCL (Longitudinal Conversion Loss)	(-20 to 0) dB 10 Hz to 1 000 MHz	2.3 dB	

Length – Dimensional Metrology

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Test, Dial Indicators, Thickness Gages ^{1,2}	Up to 4 in	$(57 + 0.26L) \mu\text{in}$	Comparison to Gage Blocks
Calipers ¹	Up to 54 in	$(52 + 46L) \mu\text{in}$	Comparison to Gage Blocks, Standard Rings, Rod Sets
Micrometers ¹ (Linearity Only)	Up to 54 in	$(52 + 46L) \mu\text{in}$	Comparison to Gage Blocks, Rod Sets
Pin and Plug Gages ¹	Up to 25 mm	5 μm	Comparison to Micrometer
Height Gages ²	Up to 12 in	$(750 + 4.7L) \mu\text{in}$	Comparison to Gage Blocks
Depth Gages ²	Up to 12 in	$(160 + 4.1L) \mu\text{in}$	Comparison to Gage Blocks

Length – Dimensional Metrology

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Surface Plates ^{1,2} Overall Flatness	Up to 161 inDL	(77 + 0.18DL) μin	Comparison to Leveling System
Local Area Flatness	Up to 0.001 in	29 μin	Repeat-O-Meter
Steel Rulers	Up to 48 in	0.036 in	Comparison to Gage Blocks
Tape Measures	Up to 50 ft	0.036 in	Comparison to Gage Blocks
Protractor/Angle	Up to 90°	0.069°	Comparison to Angle Gage Blocks
Thread Plug Gage ² Minor Diameter	(0.04 to 5.9) in	(76 + 5.8L) μin	Comparison to IAC MasterScanner
Major Diameter	(0.04 to 5.9) in	(76 + 5.8L) μin	
Pitch Diameter	(0.04 to 5.9) in	(40 + 7.7L) μin	
Flank Angle	(≥ 27 to ≤ 80)°	0.11°	
Thread Ring Gage ² Minor Diameter	(0.1 to 6.3) in	(90 + 4.8L) μin	Comparison to IAC MasterScanner
Major Diameter	(0.1 to 6.3) in	(90 + 4.8L) μin	
Pitch Diameter	(0.1 to 6.3) in	(40 + 8.5L) μin	
Flank Angle	(≥ 27 to ≤ 80)°	0.11°	

Mass and Mass Related

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Barometric Pressure Measurement	Up to 39 psia	0.014 psi	Comparison to Digital Barometer / Precision Absolute Manometer
Force-Measuring Equipment Tension / Compression	(0.1 to 50) kgf	0.042 mgf/gf + 7.1 gf	Comparison to NIST Class F Weights

Mass and Mass Related

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force-Measuring Standards/Transducers Tension / Compression	Up to 1 000 lbf (> 1 000 to 5 000) lbf (> 5 000 to 10 000) lbf (> 10 000 to 25 000) lbf (> 25 000 to 50 000) lbf (> 50 000 to 75 000) lbf (> 75 000 to 100 000) lbf	1.5 lbf 7.3 lbf 15 lbf 37 lbf 77 lbf 120 lbf 150 lbf	Comparison to Reference Load Cells
Pressure – Source/Pressure gages and transducers ¹	(-12 to 300) psi (300 to 10 000) psi	0.2 psi 1.4 psi	Comparison to Pressure Calibration System
Torque – Measure/Torque tools ¹	(2.5 to 25) lbf·in (5 to 10) lbf·in (10 to 100) lbf·in (5 to 50) lbf·ft (25 to 250) lbf·ft (250 to 600) lbf·ft	0.5 % of reading + 0.03 lbf·in 0.5 % of reading + 0.008 7 lbf·in 0.5 % of reading + 0.067 lbf·in 0.6 % of reading + 0.002 9 lbf·ft 0.5 % of reading + 0.17 lbf·ft 0.6 % of reading + 0.15 lbf·ft	Comparison to Torque Transducers
Torque – Source/Analyzers and measuring equipment	(1 to 10) lbf·in (10 to 25) lbf·in (25 to 50) lbf·in (50 to 100) lbf·in (100 to 150) lbf·in (150 to 250) lbf·in	0.021 % of reading + 0.009 lbf·in 0.017 % of reading + 0.011 lbf·in 0.033 % of reading + 0.022 lbf·in 0.035 % of reading + 0.040 lbf·in 0.038 % of reading + 0.042 lbf·in 0.04 % of reading + 0.045 lbf·in	Comparison to Calibration Wheels Standard Weights
Scales & Balances ^{1,10}	1 mg to 10 g (10 to 500) g (0.5 to 1) kg (1 to 2) kg	0.034 mg 0.7 mg 1.5 mg 2.9 mg	Comparison to ASTM E617 Class 0 weights and internal calibration procedure utilized in the calibration of the weighing system.
Scales & Balances ^{1,10}	(2 to 20) kg (20 to 40) kg (40 to 50) kg	2.3 g 4.6 g 5.8 g	Comparison to ASTM E617 Class 6 weights, NIST Class F weights, and internal calibration procedure utilized in the calibration of the weighing system.

Mass and Mass Related

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales & Balances ^{1,10}	(0.001 to 0.05) lb	0.000 012 lb	Comparison to NIST Class F weights and internal calibration procedure utilized in the calibration of the weighing system.
	(0.1 to 1) lb	0.000 18 lb	
	(1 to 2) lb	0.000 24 lb	
	(2 to 5) lb	0.000 6 lb	
	(5 to 10) lb	0.001 1 lb	
	(10 to 20) lb	0.002 4 lb	
Volumetric Recipients (Graduated Volumetric Containers)	(1 to 20) ml	0.06 ml	Comparison to Analytical Balance
	(> 20 to 80) ml	0.2 ml	
	(> 80 to 220) ml	0.23 ml	

Thermodynamic

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Radiation (Infrared) ¹ Thermometers	(50 to 100)°C	1.7°C	Comparison to Blackbody Source (Flat plate) $\epsilon = 0.95, \lambda = (8 \text{ to } 14)$
	(100 to 300)°C	5.3°C	
	(300 to 500)°C	8.2°C	
Relative Humidity – Measure ¹	Up to 90 %RH	1.6 % RH	Comparison to Humidity Probe Monitor
	(90 to 95) %RH	2.2 % RH	
Relative Humidity – Measuring equipment	Up to 90 %RH (90 to 95) %RH	1.9 %RH 2.5 %RH	Comparison to Humidity Chamber, Humidity Probe Monitor
Temperature – Measure ¹	(-200 to 0) °C	0.03 °C	Comparison to Reference Thermometer w/ PRT
	(0 to 100) °C	0.05 °C	
	(100 to 300) °C	0.07 °C	
	(300 to 420) °C	0.11 °C	
	(420 to 650) °C	0.14 °C	
Temperature – Measuring Equipment	(-70 to 0) °C	1.3 °C	Comparison to Reference Chamber and Thermometer w/ PRT
	(0 to 100) °C	1.5 °C	
	(100 to 175) °C	2.8 °C	

Time and Frequency

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source ¹	1 μHz to 80 MHz	5.8 x 10 ⁻⁹ MHz	Comparison to Frequency Synthesizer w/ GPS Reference Signal Generator
Frequency – Source ¹	1 Hz to 50 GHz	5.8 x 10 ⁻¹⁰ GHz	Comparison to Synthesized Sweeper w/ GPS Reference
Frequency – Measure ¹	1 μHz to 12.4 GHz 1 Hz to 50 GHz	5.8 x 10 ⁻¹⁰ GHz 5.8 x 10 ⁻¹¹ GHz	Comparison to Electronic Counters, Analyzers w/ GPS Reference
Time Interval	50 ns to 999 s	5 ps/s +0.43 ns	Comparison to Universal Counter w/ GPS Reference
Period ¹	4.44 ns to 10 s	0.012 % of reading + 0.17 ns	Comparison to Universal Counter w/ GPS Reference
Rise/Fall Time – Measure ¹	1 ns to 10 μs (10 to 100) μs	1.2 ns 2.9 ns	Comparison to Digital Oscilloscope Or Universal Counter w/ GPS Reference
Pulse Width – Measure ¹	> 5 ns	1.1 ns	Comparison to Universal Counter w/ GPS Reference
Stop Watches – Totalize Method	1s to 24 hr	0.06 % of reading + 44 ms	Comparison to Universal Counter and Synthesizer w/ GPS Reference

DIMENSIONAL MEASUREMENT

1 Dimensional

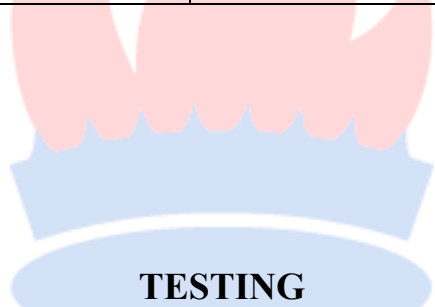
Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Distance Measure ³	Up to 500 in	0.004 % of reading + 0.053 in	Comparison to Laser Distance Meter
Distance/Linearity Measurement	Up to 610 mm	(19 + 0.7L/600) μm	Linear Height Gage

2 Dimensional

Santa Clara, CA

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dimensional (Non-Contact)	X axis to 100 mm Y axis to 80 mm	(14 + 7.5L/1 000) μm (14 + 7.5L/1 000) μm	Comparison to Vision System



Environmental

Santa Clara, CA

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
Face Velocity Test Airflow Smoke Pattern Test Leak/Backstreaming Test	ISO 14644-1 ISO 16644-2 ISO 14644-3 ISO 16644-7 ANSI/ASHRAE 110 IEST-RP-CC002.4	Flow hood Devices Test	Comparison to ThermalAnemometer Aerosol Generator Digital Aerosol Photometer
Airborne Particle Count Survey Airflow Measurement Airflow Smoke Pattern Test HEPA/ULPA filter leak Test Biological Safety Cabinet Classification	ISO 14644-1 ISO 16644-2 ISO 14644-3 ISO 16644-7 IEST-RP-CC034.2 IEST-RP-CC006.3 NSF/ANSI49-2004 Annex	Biological Safety Cabinet Test	Comparison to Particle Counter Balometer Aerosol Generator Digital Aerosol Photometer ThermalAnemometer

Environmental

Santa Clara, CA

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
Airflow Measurement Air Pressure Difference Test Airflow Smoke Pattern Test HEPA/ULPA filter leak Test Airborne Particle Count Survey Lighting Level Sound Level Test Temperature Test Humidity Test Temperature/Humidity Uniformity Test Recovery Test	ISO 14644-1 ISO 14644-2 ISO 14644-3 IEST-RP-CC006.3 IEST-RP-CC034.2 ISO/DIS 7726 In-house Method	Clean Room Test	Comparison to Balometer Differential Pressure Meter Digital Aerosol Photometer, Aerosol Generator Particle Counter Light meter Sound level meter Temperature & humidity meter Thermal Anemometer.
Airborne Particle Count Survey Airflow Velocity Laminar Hood HEPA/ULPA filter leak Test Induction Leak/Backstreaming Test Airflow Smoke Pattern Test Lighting Level Sound Level Test	ISO 14644-1 ISO 14644-2 ISO 14644-3 ISO 14644-7 IEST-RP-CC002.4 IEST-RP-CC006.3 IEST-RP-CC034.2 In-house Method	Laminar Air Flow Workstation Test	Comparison to Particle Counter Thermal Anemometer Aerosol Generator Digital Aerosol Photometer Light meter Sound level meter
Oil Aerosol & Vapor Content ⁴	ISO 8573-1 ISO 8573-2 ISO 8573-5	Compressed Air Purity Test	Comparison to Oil Content Analyzer Air Sampler
Humidity / Dew Point Measurement	ISO 8573-3	Compressed Air Purity Test	Comparison to Dew Point Meter & Diffuser
Pressurized Air Particle Content	ISO 8573-4	Compressed Air Purity Test	Comparison to Particle Counter & Diffuser
Viable Microbiological Contaminant ⁵	ISO 8573-7	Compressed Air Purity Test	Comparison to Microbiological Sampler

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Services performed at satellite laboratory

Techmaster Electronics, Inc.
 6120 Hanging Moss Rd.
 Orlando, FL 32807

CALIBRATION

Chemical Quantities

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH – Source ⁶	4.01 pH 7.00 PH 10.00 pH	0.017 pH 0.018 pH 0.031 pH	Comparison to Standard Solutions
Conductivity – Source ⁶	100 μS/cm 500 μS/cm 1 400 μS/cm 10 000 μS/cm	1.4 μS/cm 6.2 μS/cm 17 μS/cm 120 μS/cm	Comparison to Standard Solutions

**Electrical – DC/Low Frequency
 FL**

Orlando,

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source ¹	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V 220 V to 1.1 kV	6.8 μV/V + 0.48 μV 4.6 μV/V + 0.8 μV 3.2 μV/V + 3.2 μV 2.4 μV/V + 27 μV 4.7 μV/V + 43 μV 6 μV/V + 0.85 mV	Comparison to High Performance Multifunction Calibrator
DC Voltage – Measure ¹	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 V to 1 kV	7.2 μV/V + 0.55 μV 7 μV/V + 0.42 μV 6.9 μV/V + 0.86 μV 9.2 μV/V + 38 μV 9.3 μV/V + 0.13 mV	Comparison to Precision 8.5 Digit Multimeter
DC High Voltage – Measure ¹	Up to 10 kV (10 to 100) kV	0.35 mV/V + 0.09 V 0.63 mV/V + 4.1 V	Comparison to High Voltage Meter

Electrical – DC/Low Frequency
FL

Orlando,

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source ¹	Up to 220 μ A 220 μ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A	0.003 7 % of reading + 5.8 nA 0.003 1 % of reading + 7.4 nA 0.003 1 % of reading + 44 nA 0.004 % of reading + 0.69 μ A 72 μ A/A + 14 μ A 0.023 % of reading + 0.47 mA	Comparison to High Performance Multifunction Calibrator w/ Transconductance Amplifier
DC Current – Source ¹	330 mA to 1.1 A (1.1 to 3) A (3 to 11) A (11 to 20) A	0.15 mA/A + 44 μ A 0.27 mA/A + 0.13 mA 0.39 mA/A + 0.41 mA 0.79 mA/A + 0.41 mA	Comparison to Multi Product Calibrator
DC Current – Source ¹ Clamp-On Meters	(10 to 16.5) A (16.5 to 150) A (150 to 1 025) A	0.5 % of reading + 0.55 A 0.5 % of reading + 0.57 A 0.5 % of reading + 0.74 A	Comparison to Multi Product Calibrator w/ Current Coil
DC Power – Source ¹ 33 mV to 1 020 V 329.99 mA range 2.9999 A range 20.5 A range	10 μ W to 330 W 10 mW to 3 kW 100 mW to 21 kW	0.01 % of reading + 1.2 nW 0.04 % of reading 0.1 % of reading	Comparison to Multi Product Calibrator
DC Current – Measure ¹	Up to 100 nA 100 nA to 1 μ A (1 to 10) μ A (10 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	22 μ A/A + 93 pA 18 μ A/A + 0.1 nA 28 μ A/A + 0.14 nA 30 μ A/A + 0.98 nA 30 μ A/A + 6.5 nA 30 μ A/A + 63 nA 44 μ A/A + 1 μ A 0.14 mA/A + 12 μ A	Comparison to Precision 8.5 Digit Multimeter
DC Current – Measure ¹	(1 to 100) A (100 to 600) A (600 to 1 000) A	85 μ A/A 127 μ A/A 0.29 % of reading + 0.02 A	Indirect Method Precision 8.5 Digit Multimeter w/ Current Shunts

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(1 to 2.2) mV		Comparison to High Performance Multifunction Calibrator w/ Transconductance Amplifier
	(10 to 20) Hz	0.013 % of reading + 7.2 μV	
	(20 to 40) Hz	0.008 3 % of reading + 4.2 μV	
	40 Hz to 20 kHz	0.007 2 % of reading + 4.2 μV	
	(20 to 50) kHz	0.016 % of reading + 4.6 μV	
	(50 to 100) kHz	0.042 % of reading + 5.3 μV	
	(100 to 300) kHz	0.095 % of reading + 10 μV	
	(300 to 500) kHz	0.13 % of reading + 20 μV	
	500 kHz to 1 MHz	0.25 % of reading + 21 μV	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.021 % of reading + 4.9 μV	
	(20 to 40) Hz	0.008 3 % of reading + 4.3 μV	
	40 Hz to 20 kHz	0.007 % of reading + 4.4 μV	
	(20 to 50) kHz	0.017 % of reading + 4.8 μV	
	(50 to 100) kHz	0.042 % of reading + 6.1 μV	
	(100 to 300) kHz	0.092 % of reading + 12 μV	
	(300 to 500) kHz	0.13 % of reading + 22 μV	
	500 kHz to 1 MHz	0.22 % of reading + 33 μV	
	(22 to 220) mV		
	(10 to 20) Hz	0.022 % of reading + 16 μV	
	(20 to 40) Hz	0.006 4 % of reading + 15 μV	
	40 Hz to 20 kHz	0.004 4 % of reading + 10 μV	
	(20 to 50) kHz	0.009 % of reading + 14 μV	
	(50 to 100) kHz	0.028 % of reading + 23 μV	
	(100 to 300) kHz	0.056 % of reading + 35 μV	
	(300 to 500) kHz	0.13 % of reading + 39 μV	
	500 kHz to 1 MHz	0.23 % of reading + 0.12 mV	
	220 mV to 2.2 V		
(10 to 20) Hz	0.021 % of reading + 0.1 mV		
(20 to 40) Hz	82 μV/V + 32 μV		
40 Hz to 20 kHz	39 μV/V + 22 μV		
(20 to 50) kHz	44 μV/V + 62 μV		
(50 to 100) kHz	71 μV/V + 55 μV		
(100 to 300) kHz	0.3 mV/V + 0.12 mV		
(300 to 500) kHz	0.89 mV/V + 0.3 mV		
500 kHz to 1 MHz	1.5 mV/V + 0.6 mV		

Electrical – DC/Low Frequency
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Orlando,

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(2.2 to 22) V		Comparison to High Performance Multifunction Calibrator w/ Transconductance Amplifier
	(10 to 20) Hz	0.2 mV/V + 1.1 mV	
	(20 to 40) Hz	68 μ V/V + 0.63 mV	
	40 Hz to 20 kHz	19 μ V/V + 0.7 mV	
	(20 to 50) kHz	44 μ V/V + 0.61 mV	
	(50 to 100) kHz	0.006 1 % of reading + 0.65 mV	
	(100 to 300) kHz	0.19 mV/V + 1.9 mV	
	(300 to 500) kHz	0.9 mV/V + 2.8 mV	
	500 kHz to 1 MHz	1.1 mV/V + 11 mV	
	(22 to 220) V		
	(10 to 20) Hz	0.2 mV/V + 11 mV	
	(20 to 40) Hz	44 μ V/V + 17 mV	
	40 Hz to 20 kHz	38 μ V/V + 4.1 mV	
	(20 to 50) kHz	53 μ V/V + 8 mV	
	(50 to 100) kHz	0.11 mV/V + 10 mV	
	(100 to 300) kHz	0.84 mV/V + 19 mV	
	(300 to 500) kHz	4.2 mV/V + 45 mV	
	500 kHz to 1 MHz	7.7 mV/V + 90 mV	
	(220 to 1 100) V		
	40 Hz to 1 kHz	50 μ V/V + 27 mV	
(1 to 20) kHz	0.1 mV/V + 31 mV		
(20 to 30) kHz	0.41 mV/V + 70 mV		
(220 to 750) V			
(30 to 50) kHz	0.45 mV/V + 12 mV		
(50 to 100) kHz	1.8 mV/V + 21 mV		

Electrical – DC/Low Frequency
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Orlando,

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(1 to 10) mV		Comparison to Precision 8.5 Digit Multimeter
	(1 to 40) Hz	0.36 mV/V + 3.6 μV	
	40 Hz to 1 kHz	0.23 mV/V + 1.4 μV	
	(1 to 20) kHz	0.32 mV/V + 1.7 μV	
	(20 to 50) kHz	1.2 mV/V + 1.6 μV	
	(50 to 100) kHz	5.7 mV/V + 2 μV	
	(100 to 300) kHz	46 mV/V + 2.6 μV	
	(10 to 100) mV		
	(1 Hz to 40) Hz	72 μV/V + 0.85 mV	
	40 Hz to 1 kHz	84 μV/V + 0.26 mV	
	(1 to 20) kHz	0.17 mV/V + 0.26 mV	
	100 mV to 10 V		
	(1 Hz to 40) Hz	71 μV/V + 0.73 mV	
	40 Hz to 1 kHz	80 μV/V + 0.26 mV	
	(1 to 20) kHz	160 μV/V + 0.26 mV	
	(20 to 50) kHz	0.35 mV/V + 0.25 mV	
	(50 to 100) kHz	0.93 mV/V + 0.27 mV	
	(100 to 300) kHz	3.5 mV/V + 1.2 mV	
	300 kHz to 1 MHz	12 mV/V + 1.2 mV	
	(1 to 2) MHz	18 mV/V + 1.2 mV	
	(10 to 100) V		
	(1 to 40) Hz	0.24 mV/V + 4.7 mV	
	40 Hz to 1 kHz	0.15 mV/V + 16 mV	
	(1 to 20) kHz	0.15 mV/V + 17 mV	
	(20 to 50) kHz	0.36 mV/V + 8.6 mV	
	(50 to 100) kHz	1.4 mV/V + 3.9 mV	
	(100 to 300) kHz	4.8 mV/V + 12 mV	
	300 kHz to 1 MHz	18 mV/V + 12 mV	
100 V to 1 kV			
(1 to 40) Hz	0.46 mV/V + 50 mV		
40 Hz to 1 kHz	0.46 mV/V + 28 mV		
(1 to 20) kHz	0.69 mV/V + 29 mV		
(20 to 50) kHz	1.5 mV/V + 24 mV		
(50 to 100) kHz	3.6 mV/V + 24 mV		

Electrical – DC/Low Frequency
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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC High Voltage - Measure ¹	(Up to 10) kV (30 to 200) Hz (200 to 450) Hz (450 to 600) Hz (10 to 100) kV (30 to 70) Hz (70 to 200) Hz	1.4 mV/V + 0.14 V 4.6 mV/V + 0.14 V 8.7 mV/V + 0.14 V 1.4 mV/V + 0.7 V 17 % of reading + 0.7 V	Comparison to High Voltage Meter
AC Voltage Flatness - Source ¹ (Referenced to 1 kHz)	0.3 mV to 3.5 V (10 to 30) Hz 30 Hz to 120 kHz (0.3 to 1.1) mV 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz (1.1 to 3) mV 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz 3 mV to 3.5 V 120 kHz to 2 MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.35 % of reading 0.12 % of reading 0.24 % of reading + 3 μV 0.47 % of reading + 3 μV 0.7 % of reading + 3 μV 1.8 % of reading + 15 μV 0.12 % of reading + 3 μV 0.35 % of reading + 3 μV 0.58 % of reading + 3 μV 1.8 % of reading + 3 μV 0.12 % of reading + 3 μV 0.24 % of reading + 3 μV 0.47 % of reading + 3 μV 1.2 % of reading + 3 μV	Comparison to High Performance Multifunction Calibrator (Wideband)
AC Voltage Flatness – Measure ¹	Up to 3 V (10 to 100) Hz 100 Hz to 10 kHz (10 to 30) kHz 30 kHz to 1 MHz (1 to 10) MHz (10 to 30) MHz (30 to 50) MHz (50 to 70) MHz (70 to 80) MHz (80 to 100) MHz	0.2 % of reading 0.051% of reading 0.059 % of reading 0.13 % of reading 0.21% of reading 0.26% of reading 0.42 % of reading 0.65 % of reading 0.77% of reading 0.97 % of reading	Indirect Method Precision 8.5 Digit Multimeter w/ Thermal Converters

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	Up to 2.2 mV		Comparison to AC Measurement Standard
	(10 to 20) Hz	1.6 mV/V + 1.6 μV	
	(20 to 40) Hz	1.6 mV/V + 1.6 μV	
	40 Hz to 20 kHz	0.4 mV/V + 1.7 μV	
	(20 to 50) kHz	0.8 mV/V + 2.2 μV	
	(50 to 100) kHz	1.2 mV/V + 2.7 μV	
	(100 to 300) kHz	2.3 mV/V + 4.1 μV	
	(300 to 500) kHz	2.4 mV/V + 8.1 μV	
	500 kHz to 1 MHz	3.5 mV/V + 8.1 μV	
	(2.2 to 7) mV		
	(10 to 20) Hz	0.8 mV/V + 1.4 μV	
	(20 to 40) Hz	0.4 mV/V + 1.5 μV	
	40 Hz to 20 kHz	0.2 mV/V + 1.5 μV	
	(20 to 50) kHz	0.4 mV/V + 2.1 μV	
	(50 to 100) kHz	0.6 mV/V + 2.6 μV	
	(100 to 300) kHz	1.2 mV/V + 4.1 μV	
	(300 to 500) kHz	1.3 mV/V + 6 μV	
	500 kHz to 1 MHz	2 mV/V + 6 μV	
	(7 to 22) mV		
	(10 to 20) Hz	0.3 mV/V + 1.6 μV	
	(20 to 40) Hz	0.3 mV/V + 1.6 μV	
	40 Hz to 20 kHz	0.1 mV/V + 1.7 μV	
	(20 to 50) kHz	0.2 mV/V + 2.3 μV	
	(50 to 100) kHz	0.3 mV/V + 2.7 μV	
	(100 to 300) kHz	0.8 mV/V + 4.1 μV	
	(300 to 500) kHz	0.9 mV/V + 6.1 μV	
	500 kHz to 1 MHz	1.4 mV/V + 6.1 μV	
	(22 to 70) mV		
(10 to 20) Hz	2 mV/V + 5.3 μV		
(20 to 40) Hz	80 μV/V + 6.3 μV		
40 Hz to 20 kHz	40 μV/V + 6.8 μV		
(20 to 50) kHz	0.1 mV/V + 6.4 μV		
(50 to 100) kHz	0.23 mV/V + 5.8 μV		
(100 to 300) kHz	0.5 mV/V + 6 μV		
(300 to 500) kHz	0.7 mV/V + 9.4 μV		
500 kHz to 1 MHz	1.1 mV/V + 9 μV		

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(70 to 220) mV		Comparison to AC Measurement Standard
	(10 to 20) Hz	0.2 mV/V + 1.6 μV	
	(20 to 40) Hz	80 μV/V + 1.7 μV	
	40 Hz to 20 kHz	40 μV/V + 1.8 μV	
	(20 to 50) kHz	70 μV/V + 2.2 μV	
	(50 to 100) kHz	0.2 mV/V + 2.6 μV	
	(100 to 300) kHz	0.3 mV/V + 4.1 μV	
	(300 to 500) kHz	0.4 mV/V + 8 μV	
	500 kHz to 1 MHz	1 mV/V + 8 μV	
	(220 to 700) mV		
	(10 to 20) Hz	0.21 mV/V + 1.5 μV	
	(20 to 40) Hz	0.21 mV/V + 1.5 μV	
	40 Hz to 20 kHz	30 μV/V + 1.7 μV	
	(20 to 50) kHz	50 μV/V + 2.1 μV	
	(50 to 100) kHz	80 μV/V + 2.6 μV	
	(100 to 300) kHz	0.2 mV/V + 4 μV	
	(300 to 500) kHz	0.3 mV/V + 8 μV	
	500 kHz to 1 MHz	0.3 mV/V + 8 μV	
	700 mV to 2.2 V		
	(10 to 20) Hz	0.2 mV/V + 4.2 μV	
	(20 to 40) Hz	0.62 mV/V + 13 μV	
	40 Hz to 20 kHz	0.17 mV/V + 23 μV	
	(20 to 50) kHz	0.41 mV/V + 16 μV	
	(50 to 100) kHz	0.67 mV/V + 12 μV	
	(100 to 300) kHz	0.16 mV/V + 6 μV	
	(300 to 500) kHz	0.26 mV/V + 4 μV	
	500 kHz to 1 MHz	9 mV/V + 1.1 μV	
	(2.2 to 7) V		
(10 to 20) Hz	0.2 mV/V + 1.1 μV		
(20 to 40) Hz	0.7 mV/V + 3.2 μV		
40 Hz to 20 kHz	0.23 mV/V + 8.4 μV		
(20 to 50) kHz	0.5 mV/V + 4.4 μV		
(50 to 100) kHz	0.8 mV/V + 2.7 μV		
(100 to 300) kHz	0.19 mV/V + 1.1 μV		
(300 to 500) kHz	0.4 mV/V + 0.5 μV		
500 kHz to 1 MHz	1.2 mV/V + 0.2 μV		

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(7 to 22) V		Comparison to AC Measurement Standard
	(10 to 20) Hz	0.2 mV/V + 3.7 μV	
	(20 to 40) Hz	0.7 mV/V + 11 μV	
	40 Hz to 20 kHz	0.3 mV/V + 26 μV	
	(20 to 50) kHz	0.5 mV/V + 15 μV	
	(50 to 100) kHz	0.8 mV/V + 9.1 μV	
	(100 to 300) kHz	0.29 mV/V + 4 μV	
	(300 to 500) kHz	0.4 mV/V + 1.9 μV	
	500 kHz to 1 MHz	1.2 mV/V + 0.6 μV	
	(22 to 70) V		
	(10 to 20) Hz	0.2 mV/V + 9.1 μV	
	(20 to 40) Hz	70 μV/V + 27 μV	
	40 Hz to 20 kHz	30 μV/V + 55 μV	
	(20 to 50) kHz	60 μV/V + 32 μV	
	(50 to 100) kHz	90 μV/V + 19 μV	
	(100 to 300) kHz	0.2 mV/V + 9.1 μV	
	(300 to 500) kHz	0.4 mV/V + 4.4 μV	
	500 kHz to 1 MHz	1.2 mV/V + 1.5 μV	
	(70 to 220) V		
	(10 to 20) Hz	0.2 mV/V + 7.1 μV	
	(20 to 40) Hz	70 μV/V + 21 μV	
	40 Hz to 20 kHz	30 μV/V + 45 μV	
	(20 to 50) kHz	70 μV/V + 21 μV	
	(50 to 100) kHz	0.1 mV/V + 14 μV	
	(100 to 300) kHz	0.21 mV/V + 6.8 μV	
	(300 to 500) kHz	0.5 mV/V + 2.8 μV	
	(220 to 700) V		
	(10 to 20) Hz	0.2 mV/V + 77 μV	
(20 to 40) Hz	0.1 mV/V + 0.16 mV		
40 Hz to 20 kHz	40 μV/V + 0.37 mV		
(20 to 50) kHz	0.13 mV/V + 0.12 mV		
(50 to 100) kHz	0.5 mV/V + 31 μV		
700 V to 1 kV			
(10 to 20) Hz	0.2 mV/V + 31 μV		
(20 to 40) Hz	0.1 mV/V + 62 μV		
40 Hz to 20 kHz	40 μV/V + 0.16 mV		
(20 to 50) kHz	0.13 mV/V + 47 μV		
(50 to 100) kHz	0.5 mV/V + 12 μV		

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	Up to 10 mV		Comparison to Precision 8.5 Digit Multimeter AC BAND < 2 MHz
	(1 to 40) Hz	3.5 $\mu\text{V/V}$ + 4.6 μV	
	40 Hz to 1 kHz	2.4 $\mu\text{V/V}$ + 3.2 μV	
	(1 to 20) kHz	3.5 $\mu\text{V/V}$ + 4.6 μV	
	(20 to 50) kHz	12 $\mu\text{V/V}$ + 3.2 μV	
	(50 to 100) kHz	58 $\mu\text{V/V}$ + 3.2 μV	
	(100 to 300) kHz	0.47 mV/V + 3.8 μV	
	(10 to 100) mV		
	(1 to 40) Hz	86 $\mu\text{V/V}$ + 4.6 μV	
	40 Hz to 1 kHz	86 $\mu\text{V/V}$ + 2.3 μV	
	(1 to 20) kHz	0.17 mV/V + 2.3 μV	
	(20 to 50) kHz	0.35 mV/V + 2.3 μV	
	(50 to 100) kHz	0.93 mV/V + 2.3 μV	
	(100 to 300) kHz	3.5 mV/V + 12 μV	
	300 kHz to 1 MHz	12 mV/V + 12 μV	
	(1 to 2) MHz	18 mV/V + 12 μV	
	100 mV to 1 V		
	(1 to 40) Hz	92 $\mu\text{V/V}$ + 50 μV	
	40 Hz to 1 kHz	92 $\mu\text{V/V}$ + 31 μV	
	(1 to 10) V		
	(1 to 20) kHz	0.17 mV/V + 31 μV	
	(20 to 50) kHz	0.35 mV/V + 31 μV	
	(50 to 100) kHz	0.93 mV/V + 31 μV	
	(100 to 300) kHz	3.5 mV/V + 0.12 mV	
300 kHz to 1 MHz	12 mV/V + 0.12 mV		
(1 to 2) MHz	18 mV/V + 0.12 mV		
(10 to 100) V			
(1 to 40) Hz	91 $\mu\text{V/V}$ + 0.14 mV		
40 Hz to 1 kHz	91 $\mu\text{V/V}$ + 0.14 mV		
(1 to 20) kHz	0.17 mV/V + 0.14 mV		
(20 to 50) kHz	0.35 mV/V + 0.14 mV		
(50 to 100) kHz	0.93 mV/V + 0.14 mV		
(100 to 300) kHz	3.5 mV/V + 0.16 mV		
300 kHz to 1 MHz	1.2 mV/V + 0.16 mV		
(1 to 2) MHz	1.8 mV/V + 0.16 mV		

Electrical – DC/Low Frequency
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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(100 to 750) V (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	0.45 mV/V + 2.7 mV 0.45 mV/V + 2.7 mV 0.45 mV/V + 2.7 mV 0.56 mV/V + 2.7 mV 1.5 mV/V + 2.7 mV 4.7 mV/V + 2.7 mV 18 mV/V + 2.7 mV	Comparison to Precision 8.5 Digit Multimeter AC BAND < 2 MHz
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 11 mV to 10 V 45 Hz to 100 kHz 100 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (11 to 100) V 45 Hz to 100 kHz 100 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (8 to 10) MHz (100 to 750) V 45 Hz to 100 kHz	0.46 mV/V + 47 mV 0.46 mV/V + 24 mV 0.69 mV/V + 24 mV 1.4 mV/V + 24 mV 3.5 mV/V + 24 mV 1 mV/V + 7.5 μV 14 mV/V + 6.5 μV 81 mV/V + 8.6 μV 0.24 V + 9.7 μV 1 mV/V + 0.7 mV 24 mV/V + 0.58 mV 47 mV/V + 0.81 mV 47 mV/V + 0.93 mV 0.18 V + 1.2 mV 1.5 mV/V + 2.7 mV	Comparison to Precision 8.5 Digit Multimeter AC BAND > 2 MHz

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	(2.2 to 22) mA		Comparison to High Performance Multifunction Calibrator
	(10 to 20) Hz	0.003 4 % of reading + 20 μA	
	(20 to 40) Hz	0.002 5 % of reading + 12 μA	
	40 Hz to 1 kHz	0.007 2 % of reading + 0.95 μA	
	(1 to 5) kHz	0.015 % of reading + 1.5 μA	
	(5 to 10) kHz	0.1 % of reading + 5.1 μA	
	(22 to 220) mA		
	(10 to 20) Hz	0.004 6 % of reading + 0.15 mA	
	(20 to 40) Hz	0.003 5 % of reading + 85 μA	
	40 Hz to 1 kHz	0.006 2 % of reading + 12 μA	
	(1 to 5) kHz	0.014 % of reading + 16 μA	
	(5 to 10) kHz	0.089 % of reading + 38 μA	
	220 mA to 2.2 A		
	20 Hz to 1 kHz	0.18 mA/A + 0.17 mA	
(1 to 5) kHz	0.32 mA/A + 0.27 mA		
(5 to 10) kHz	5.1 mA/A + 2.8 mA		
AC Current – Source ¹	(2.2 to 11) A		Comparison to Multi Product Calibrator
	40 Hz to 1 kHz	0.3 mA/A + 1.1 mA	
	(1 to 5) kHz	0.74 mA/A + 53 μA	
	(5 to 10) kHz	2.8 mA/A + 200 μA	
AC Current – Source ¹	(11 to 20) A		Comparison to High Performance Multifunction Calibrator
	(45 to 100) Hz	1.2 mA/A + 5 mA	
	100 Hz to 1kHz	1.5 mA/A + 5 mA	
	(1 to 5) kHz	30 mA/A + 5 mA	
	(9 to 220) μA		
	(10 to 20) Hz	0.02 % of reading + 26 nA	
	(20 to 40) Hz	0.01 % of reading + 30 nA	
	40 Hz to 1 kHz	0.01 % of reading + 8.3 nA	
	(1 to 5) kHz	0.02 % of reading + 36 nA	
	(5 to 10) kHz	0.1 % of reading + 63 nA	
	220 μA to 2.2 mA		
	(10 to 20) Hz	0.004 8 % of reading + 1.4 μA	
	(20 to 40) Hz	0.006 1 % of reading + 0.44 μA	
	40 Hz to 1 kHz	0.007 2 % of reading + 95 nA	
(1 to 5) kHz	0.016 % of reading + 0.18 μA		
(5 to 10) kHz	0.1 % of reading + 0.65 μA		

Electrical – DC/Low Frequency
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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹ Clamp-On Meters	(10 to 16.5) A (45 to 65) Hz (65 to 440) Hz	0.28 % of reading + 0.16 A 0.79 % of reading + 0.13 A	Comparison to Multi Product Calibrator w/ Current Coil
	(16.5 to 150) A (45 to 65) Hz (65 to 440) Hz	0.28 % of reading + 0.31 A 0.79 % of reading + 0.16 A	
	(150 to 1 025) A (45 to 65) Hz (65 to 440) Hz	0.29 % of reading + 1.3 A 0.8 % of reading + 1.2 A	
AC Power – Source ¹ PF = 1 (10 to 45) Hz 33 mV to 32.9999 V (3.3 mA to 2.99999 A)	110 μW to 99 W	0.19 % of reading	Comparison to Multi Product Calibrator
	(45 to 65) Hz 33 mV to 1020 V (3.3 mA to 20.5 A)	110 μW to 21 kW 0.15 % of reading	
Phase – Source ¹	+/- 179.99 (ΔΦ°) (10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.09° 0.2° 0.39° 1.9° 3.9° 7.8°	Comparison to Multi Product Calibrator

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure ¹	Up to 100 μ A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz 100 μ A to 100 mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz 100 μ A to 100 mA (20 to 50) kHz (50 to 100) kHz 100 mA to 1 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	4.7 mA/A + 36 nA 1.8 mA/A + 35 nA 0.71 mA/A + 35 nA 0.7 mA/A + 35 nA 4.7 mA/A + 24 μ A 1.8 mA/A + 24 μ A 0.71 mA/A + 24 μ A 0.36 mA/A + 23 μ A 0.71 mA/A + 24 μ A 4.7 mA/A + 47 μ A 6.5 mA/A + 0.18 mA 4.7 mA/A + 0.24 mA 1.9 mA/A + 0.24 mA 0.95 mA/A + 0.24 mA 1.1 mA/A + 0.26 mA 3.5 mA/A + 0.24 mA 12 mA/A + 0.47 mA	Comparison to Precision 8.5 Digit Multimeter
AC Current – Measure ¹	(1 to 10) A (3 to 5) Hz (5 to 10) Hz 10 Hz to 5 kHz (5 to 10) kHz (10 to 100) A (50 to 60) Hz (100 to 300) A (50 to 60) Hz	20 mA/A + 6 mA 11 mA/A + 6 mA 1.5 mA/A + 6 mA 3.5 mA/A + 70 mA 0.6 A 0.8 A	Indirect Method Precision 8.5 Digit Multimeter / Shunts
AC High Current - Measure ¹	(50 to 400) Hz (0.25 to 10) A (10 to 100) A (100 to 400) A (400 to 600) A (50 to 60) Hz (600 to 900) A (900 to 1100) A (1100 to 1500) A	0.16 % of reading + 0.011 A 0.18 % of reading + 0.0045 A 0.21 % of reading + 0.016 A 0.21 % of reading + 0.036 A 0.29 % of reading + 0.032 A 0.29 % of reading + 0.048 A 0.29 % of reading + 0.17 A	Comparison to Precision 8.5 Digit Multimeter and Current Transformer

Electrical – DC/Low Frequency
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Orlando,

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source ¹	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω to 1.1 kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ 330 kΩ to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ 330 MΩ to 1.1 GΩ	1.7 mΩ/Ω + 35 μΩ 23 μΩ/Ω + 3.3 mΩ 31 μΩ/Ω + 1.9 mΩ 32 μΩ/Ω + 2.8 mΩ 33 μΩ/Ω + 2.3 mΩ 32 μΩ/Ω + 30 mΩ 5 μΩ/Ω + 1.4 Ω 32 μΩ/Ω + 0.3 Ω 33 μΩ/Ω + 0.34 Ω 37 μΩ/Ω + 3.1 Ω 38 μΩ/Ω + 2.6 Ω 71 μΩ/Ω + 36 Ω 0.13 mΩ/Ω + 0.38 kΩ 0.22 mΩ/Ω + 7.4 kΩ 0.42 mΩ/Ω + 32 kΩ 3.6 mΩ/Ω + 0.12 MΩ 18 mΩ/Ω + 0.59 MΩ	Comparison to Multi Product Calibrator
Resistance – Source ¹ Fixed Points	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	48 μΩ 0.15 mΩ 0.22 mΩ 0.28 mΩ 0.63 mΩ 1.2 mΩ 2.3 mΩ 7.8 mΩ 15 mΩ 77 mΩ 0.15 Ω 1 Ω 1.9 Ω 16 Ω 40 Ω 0.48 kΩ 1.1 kΩ 12 kΩ	Comparison to High Performance Multiproduct Calibrator

Electrical – DC/Low Frequency
FL

Orlando,

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
Resistance – Source ¹ Fixed Point (Four-Terminal Pair)	0.1 Ω 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ	0.56 mΩ 0.29 mΩ 2.3 mΩ 1.8 mΩ 35 mΩ 0.12 Ω 1.3 Ω	Comparison to Four Terminal Pair Resistor Set	
Resistance – Measure ¹	Up to 10 Ω (>10 to 100) Ω >100 Ω to 1 kΩ (>1 to 10) kΩ (>10 to 100) kΩ >100 kΩ to 1 MΩ (>1 to 10) MΩ (>10 to 100) MΩ >100 MΩ to 1 GΩ	21 μΩ/Ω + 62 μΩ 17 μΩ/Ω + 0.59 mΩ 15 μΩ/Ω + 0.67 mΩ 15 μΩ/Ω + 6.1 mΩ 15 μΩ/Ω + 62 mΩ 21 μΩ/Ω + 2.4 Ω 45 μΩ/Ω + 0.38 kΩ 0.58 mΩ/Ω + 1.2 kΩ 5.8 mΩ/Ω + 11 kΩ	Comparison to Precision 8.5 Digital Multimeter	
Capacitance – Source ¹	10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (0 to 50) Hz (0 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	(220 to 399.9) pF (0.4 to 1.099 9) nF (1.1 to 3.299 9) nF (3.3 to 10.999 9) nF (11 to 32.999 9) nF (33 to 109.999) nF (110 to 329.999) nF (0.33 to 1.099 99) μF (1.1 to 3.299 99) μF (3.3 to 10.999 9) μF (11 to 32.999 9) μF (33 to 109.999) μF (110 to 329.999) μF (0.33 to 1.099 99) mF (1.1 to 3.299 99) mF (3.3 to 10.999 9) mF (11 to 32.999 9) mF (33 to 110) mF	0.58 % of reading + 12 pF 0.57 % of reading + 12 pF 0.57 % of reading + 12 pF 0.22 % of reading + 27 pF 0.29 % of reading + 0.12 nF 0.29 % of reading + 0.13 nF 0.29 % of reading + 0.35 nF 0.28 % of reading + 1.5 nF 0.29 % of reading + 3.5 nF 0.29 % of reading + 1.3 nF 0.46 % of reading + 36 nF 0.53 % of reading + 0.12 μF 0.53 % of reading + 0.35 μF 0.5 % of reading + 1.5 μF 0.52 % of reading + 3.6 μF 0.51 % of reading + 13 μF 0.86 % of reading + 35 μF 1.3 % of reading + 0.13 mF	Comparison to Multi Product Calibrator

Electrical – DC/Low Frequency
FL

Orlando,

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Fixed Capacitance ¹ @ 1 kHz	(100 to 500) pF 500 pF to 5 nF (5 to 50) nF (50 to 100) nF (100 to 500) nF 500 nF to 1.5 μF	0.64 pF 3.7 pF 32 pF 63 pF 0.59 nF 0.63 nF	Comparison to Capacitance Standard Set
Capacitance – Source ¹	1 pF 1 kHz to 3 MHz 4 MHz 5 MHz 10 MHz 13 MHz 10 pF 1 kHz to 13 MHz 100 pF 1 kHz to 10 MHz 13 MHz 1 nF 1 kHz to 4 MHz 5 MHz 10 MHz 13 MHz	1.2 fF 1.3 fF 1.5 fF 2.8 fF 3.9 fF 12 fF 0.12 pF 0.13 pF 1.2 pF 1.3 pF 2.2 pF 3 pF	Comparison to Standard Air Capacitor Set
Capacitance – Measure ¹	(1 to 10) nF (10 to 100) nF (0.3 to 1) μF (1 to 10) μF (10 to 100) μF (100 to 1 000) μF (1 to 10) mF (10 to 100) mF	0.052 pF 0.041 pF 0.37 nF 0.018 μF 0.041 μF 0.56 μF 0.018 mF 0.059 mF	Comparison to Digit Multimeter/LCR Meter
Inductance – Source ¹	100 Hz to 1 kHz 200 μH 2 mH 20 mH 200 mH 2 H	0.58 μH 2.4 μH 24 μH 0.24 mH 2.4 mH	Comparison to Standard Value Inductors
Inductance – Measure ¹	0.001 nH to 99.999 999 H Up to 1 kHz 1 kHz to 1 MHz	0.062 % of reading + 0.007 mH 0.56 % of reading + 0.007 mH	Comparison to Precision LCR Meter



ANSI National Accreditation Board

Electrical Simulation of Thermocouple Indicating Devices – Source and Measure ¹	Type C			
	(0 to 150) °C		0.29 °C	
	(150 to 650) °C		0.32 °C	
	(650 to 1 000) °C		0.28 °C	
	(1 000 to 1 800) °C		0.48 °C	
	(1 800 to 2 316) °C		0.71 °C	
	Type E			
	(-250 to -100) °C		0.43 °C	
	(-100 to -25) °C		0.21 °C	
	(-25 to 350) °C		0.17 °C	
	(350 to 650) °C		0.14 °C	
	(650 to 1 000) °C		0.19 °C	
	Type J			
	(-210 to -100) °C		0.35 °C	
	(-100 to -30) °C		0.2 °C	
	(-30 to 150) °C		0.14 °C	
	(150 to 760) °C		0.19 °C	
	(760 to 1 200) °C		0.26 °C	
	Type K			
	(-200 to -100) °C		0.28 °C	
	(-100 to -25) °C		0.21 °C	
(-25 to 120) °C		0.23 °C		
(120 to 1 000) °C		0.25 °C		
(1 000 to 1 372) °C		0.33 °C		
Type N				
(-200 to -100) °C		0.39 °C		
(-100 to -25) °C		0.27 °C		
(-25 to 120) °C		0.23 °C		
(120 to 410) °C		0.18 °C		
(410 to 1 300) °C		0.27 °C		
Type R				
(0 to 250) °C		0.83 °C		
(250 to 400) °C		0.42 °C		
(400 to 1 000) °C		0.31 °C		
(1 000 to 1 767) °C		0.38 °C		
Type S				
(0 to 250) °C		0.55 °C		
(250 to 1 000) °C		0.34 °C		
(1 000 to 1 400) °C		0.32 °C		
(1 400 to 1 767) °C		0.41 °C		
Electrical Simulation of Thermocouple Indicating Devices – Source and Measure ¹	Type T			
	(-250 to -150) °C		0.63 °C	
	(-150 to 0) °C		0.35 °C	
	(0 to 120) °C		0.26 °C	
	(120 to 400) °C		0.22 °C	
			Comparison to Multi Product Calibrator	
			Comparison to Multi Product Calibrator	

Electrical – DC/Low Frequency
FL

Orlando,

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Temperature Indicating Devices – Source and Measure ¹	Pt 385 (100 Ω)		Comparison to Multi Product Calibrator
	(-200 to 0) °C	0.05 °C	
	(0 to 100) °C	0.07 °C	
	(100 to 300) °C	0.09 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 630) °C	0.12 °C	
	(630 to 800) °C	0.23 °C	
	Pt 3926 (100 Ω)		
	(-200 to 0) °C	0.05 °C	
	(0 to 100) °C	0.07 °C	
	(100 to 300) °C	0.09 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 630) °C	0.12 °C	
	Pt 3916 (100 Ω)		
	(-200 to -190) °C	0.25 °C	
	(-190 to -80) °C	0.04 °C	
	(-80 to 0) °C	0.05 °C	
	(0 to 100) °C	0.06 °C	
	(100 to 260) °C	0.07 °C	
	(260 to 300) °C	0.08 °C	
	(300 to 400) °C	0.09 °C	
(400 to 600) °C	0.1 °C		
(600 to 630) °C	0.23 °C		
Pt 385 (200 Ω)			
(-200 to 100) °C	0.04 °C		
(100 to 260) °C	0.05 °C		
(260 to 300) °C	0.12 °C		
(300 to 400) °C	0.13 °C		
(400 to 600) °C	0.14 °C		
(600 to 630) °C	0.16 °C		

Electrical – DC/Low Frequency
FL

Orlando,

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Temperature Indicating Devices – Source and Measure ¹	Pt 385 (500 Ω)		Comparison to Multi Product Calibrator
	(-200 to -80) °C	0.04 °C	
	(-80 to 100) °C	0.05 °C	
	(100 to 260) °C	0.06 °C	
	(260 to 400) °C	0.08 °C	
	(400 to 600) °C	0.09 °C	
	(600 to 630) °C	0.11 °C	
	Pt 385 (1000 Ω)		
	(-200 to 0) °C	0.03 °C	
	(0 to 100) °C	0.04 °C	
	(100 to 260) °C	0.05 °C	
	(260 to 300) °C	0.06 °C	
	(300 to 600) °C	0.07 °C	
(600 to 630) °C	0.23 °C		
PtNi 385 (120 Ω) (Ni 120)			
(-80 to 100) °C	0.08 °C		
(100 to 260) °C	0.14 °C		
CU 427 (10 Ω)			
(100 to 260) °C	0.3 °C		
Oscilloscopes ¹			Comparison to Multi Product Calibrator, FL
DC Voltage			
Into 50 Ω load	(0 to +/-6.6) V	0.2 % + 36 μV	
Into 1 MΩ load	(0 to +/-130) V	0.039 % of reading + 37 μV	
Square Wave			
Into 50 Ω load	10 Hz to 10 kHz		
Into 1 MΩ load	1 mVp-p to 6.6 Vp-p	0.2 % of reading + 65 μV	
	10 Hz to 1 kHz		
	1 mVp-p to 130 Vp-p	0.078 % of reading + 36 μV	
	(1 to 10) kHz		
	1 mVp-p to 130 Vp-p	0.19 % of reading + 39 μV	
Leveled Sine Amplitude Reference @ 50 kHz	5 mV to 5.5 V	15 mV/V + 0.49 mV	

Electrical – DC/Low Frequency
FL

Orlando,

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes ¹ Leveled Sine Amplitude (relative to 50 kHz) Time Markers (5-2-1 sequence) into 50 Ω load Edge Transition Time (Rise Time)	5 mV to 5.5 V 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz (1 to 50) ns 100 ns to 20 ms 50 ms to 5 s < 300 ps	14 mV/V + 0.12 mV 17 mV/V + 0.14 mV 32 mV/V + 0.15 mV 40 mV/V + 0.16 mV 0.001 1 % of reading + 0.048 ps 0.000 2 % of reading + 7 ps 0.4 % of reading 80 ps	Comparison to Multi Product Calibrator
Rise Time ¹ (measurement)	20 ps to 100 μs	81 ns	Comparison to Oscilloscope
Rise Time ¹ (measurement)	1 ns to 10 μs (10 to 100) μs	1.2 ns 2.9 ns	Comparison to Oscilloscope
ESD Simulators Contact Voltage (Positive and Negative) Rise Time Peak Current 30 ns Current 60 ns Current	(1 to 8) kV (0.6 to 1) ns (3.75 to 33) A (2 to 20.8) A (1 to 10.4) A	1.2 % of reading 0.000 12 % Δ time reading + 11 ps 2.1 % of reading 3.4 % of reading 6.3 % of reading	Procedure IEC 61000-4-2 (Ed.2, 2008); Multimeters, ESD Target, Attenuator,Oscilloscope
ESD Simulators Air Discharge Voltage (Positive and Negative) Rise Time RC Time Constant (at ± 15 kV)	(0.7 to 1) ns (1 to 30) kV 600 ns ± 130 ns 330 pF probe 300 ns ± 60 ns 150 pF probe	1.2 % of reading 0.000 12 % Δ time reading + 11 ps 0.000 12 % Δ time reading + 11 ps	Procedure IEC 61000-4-2 (Ed.2, 2008); Multimeters, ESD Target, Attenuator,Oscilloscope

Electrical – DC/Low Frequency
FL

Orlando,

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
EFT/Burst Generator Voltage (±)	10 V to 8 kV	2.7 % of reading	Procedure IEC 61000-4-4 (Ed.3, 2012); Fast Rise Oscilloscope w/ EFT Verification Set
Rise Time	5 ns ± 30 %	0.008 % Δ time reading	
Impulse Duration	50 ns ± 30 %	0.008 % Δ time reading	
Burst Duration	15 ns ± 20 %	0.008 % Δ time reading	
Burst Period	300 ms ± 20 %	0.008 % Δ time reading	
Surge Generator Front Time Rise Time Open Circuit (±)	(1.2 to 50) μs	0.008 % Δ time reading	Procedure IEC 61000-4-5 (Ed. 3.1, 2017), IEC 61000-4-11 (Ed 3.0, 2020), IEC 61000-4-18 (Ed. 2.0, 2019); Fast Rise Oscilloscope, Current Probes, Oscilloscope Probes
Short Circuit (±)	(1.2 to 50) μs	0.008 % Δ time reading	
Time to Half-Value (±)	(20 to 700) μs	0.008 % Δ time reading	
Open Circuit Voltage (±)	10 V to 12 kV	2.9 % of reading	
Short Circuit Voltage (±)	(0.125 to 3) kA	2.9 % of reading	
Ring Wave Voltage	1 kV ± 10 %	2.9 % of reading	
Ring Wave Rise Time	1.5 μs ± 0.5 μs	0.008 % Δ time reading	

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Attenuation – Source Coaxial, 10 dB Step	(0 to 120) dB 1 kHz 500 MHz 1 GHz	0.11 dB 0.28 dB 0.39 dB	Comparison to Standard Piston Attenuator

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Attenuation - Source Coaxial, 1 dB Step	DC to 12.4 GHz (0 to 11) dB	0.6 dB	Comparison to Standard Electronic Programmable Attenuator
	(12.4 to 18) GHz (0 to 11) dB	0.8 dB	
RF Attenuation Source Coaxial, 10 dB Step	DC to 12.4 GHz (0 to 10) dB	0.51 dB	Comparison to Standard Electronic Programmable Attenuator
	20 dB	0.71 dB	
	30 dB	0.91 dB	
	40 dB	1.2 dB	
	50 dB	1.5 dB	
	60 dB	1.8 dB	
	70 dB (80 to 110) dB	2.1 dB 2.4 dB	
RF Attenuation Source Coaxial, 10 dB Step	(12.4 to 18) GHz (0 to 10) dB	0.61 dB	Comparison to Standard Electronic Programmable Attenuator
	20 dB	0.81 dB	
	30 dB	1.2 dB	
	40 dB	1.6 dB	
	50 dB	2 dB	
	60 dB	2.4 dB	
	70 dB (80 to 110) dB	2.8 dB 3.2 dB	
RF Absolute Power – Source Into 50 Ω 1 mHz to 100 kHz SWR 1.2:1	(3 to 10) Vp-p	0.13 dB	Comparison to Synthesized Signal Sources
	1 mVp-p to 3Vp-p	0.22 dB	
	(3 to 10) Vp-p	0.41 dB	
	1 mVp-p to 3 Vp-p	0.61 dB	
100 kHz to 10 MHz SWR ≤ 1.2:1	(10 to 20) MHz	0.61 dB	
	(1 to 100) mVp-p	0.91 dB	
RF Absolute Power Into 50 Ω, In 2 dB steps Relative to Full Output	200 Hz to 80 MHz (0 to -38) dBm	0.21 dB	Comparison to Synthesized Level Generator
	(-40 to -58) dBm	0.21 dB	
	(-60 to -98) dBm	0.27 dB	

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power Into 75 Ω, In 2 dB steps Relative to Full Output	(0 to -38) dBm 200 Hz to 25 MHz (25 to 80) MHz	0.21 dB 0.36 dB	Comparison to Synthesized Level Generator
	(-40 to -58) dBm 200 Hz to 25 MHz (25 to 80) MHz	0.28 dB 0.54 dB	
	(-60 to -98) dBm 200 Hz to 25 MHz (25 to 80) MHz	0.45 dB 1.7 dB	
RF Absolute Power – Source Into 50 Ω			Comparison to Synthesized Level Generator
SWR ≤ 1.6:1	(+10 to -10) dBm 10 MHz to 2 GHz (2 to 20) GHz	1.5 dB 1.7 dB	
SWR ≤ 1.6:1	(+5 to -10) dBm 10MHz to 2 GHz	0.82 dB	
SWR ≤ 1.8:1	(2 to 20) GHz (20 to 40) GHz	0.96 dB 1.2 dB	
SWR ≤ 2:1	(+2.5 to -10) dBm (40 to 50) GHz	2.3 dB	
SWR ≤ 1.6:1	(-10 to -60) dBm 10MHz to 2 GHz	1.2 dB	
SWR ≤ 1.8:1	(2 to 20) GHz	1.3dB	
SWR ≤ 2:1	(20 to 40) GHz (40 to 50) GHz	1.6 dB 2.3 dB	
SWR ≤ 1.6:1	(-60 to -110) dBm 10 MHz to 2 GHz	1.8 dB	
SWR ≤ 1.8:1	(2 to 20) GHz	1.9 dB	
SWR ≤ 2:1	(20 to 40) GHz (40 to 50) GHz	2.2 dB 3.3 dB	

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Tuned Power – Measure (relative)	100 kHz to 4.2 GHz (+30 to 0) dB (0 to -30) dB (-30 to -60) dB (-60 to -90) dB (-90 to -129) dB (4.2 to 18) GHz (+30 to 0) dB (0 to -30) dB (-30 to -60) dB (-60 to -90) dB (-90 to -129) dB (18 to 26.5) GHz (+30 to 0) dB (0 to -30) dB (-30 to -60) dB (-60 to -90) dB (-90 to -129) dB	0.14 dB 0.16 dB 0.19 dB 0.21 dB 0.25 dB 0.18 dB 0.2 dB 0.22 dB 0.24 dB 0.28 dB 0.24 dB 0.25 dB 0.27 dB 0.29 dB 0.32 dB	Comparison to Measuring Receiver System
RF Tuned Power – Measure (relative)	(26.5 to 50) GHz (+30 to 0) dB (0 to -30) dB (-30 to -60) dB (-60 to -90) dB (-90 to -129) dB	0.2 dB 0.21 dB 0.23 dB 0.25 dB 0.29 dB	Comparison to Measuring Receiver System
Digital Modulation – Measure Carrier Frequency 2 MHz to 2.65 GHz Error Vector Magnitude for Modulation Types: MSK, GMSK, BPSK, DQPSK, $\Pi/4$ DQPSK, 8PSK, 16QAM, 32 QAM and QPSK Phase Error for Modulation Types: MSK, GMSK, BPSK, DQPSK, $\Pi/4$ DQPSK, 8PSK, 16QAM, 32 QAM and QPSK	(0 to 15) % (1 to 100) kHz 100 kHz to 1 MHz 1 MHz to 2.65 GHz (0 to 3) $^{\circ}$ (1 to 100) kHz (0.1 to 1) MHz 1 MHz to 2.65 GHz	0.33 % of reading 0.51 % of reading 1 % of reading 0.18 $^{\circ}$ 0.34 $^{\circ}$ 0.57 $^{\circ}$	Comparison to Vector Signal Analyzer

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Digital Modulation – Measure Error Vector Magnitude for FSK Modulation	Modulation Frequency 3.2 kHz 1.152 kHz	0.54 % of reading 1.5 % of reading	Comparison to Vector Signal Analyzer
Amplitude Modulation – Source (11 to 13.5) MHz 20 Hz to 100 kHz DC to 15 kHz	Rate: 50 Hz to 50 kHz, (5 to 99) % Depth Rate: (20 to 50) Hz (5 to 99) % Depth Rate: 9 kHz to 3.2 GHz (0 to 100) % Depth	0.1 % of reading 0.25 % of reading 5 % of reading	Comparison to AM/FM Test Source, Analog Modulation Sources
Amplitude Modulation – Measure 100 kHz to 10 MHz 10 MHz to 3 GHz	Rate: 50 Hz to 10 kHz, (5 to 99) % Depth 50 Hz to 100 kHz, (20 to 99) % Depth	0.001 4 % of reading + 0.009 AM 0.001 % of reading + 0.007 AM	Comparison to Microwave Measuring Receiver System
Amplitude Modulation – Measure 10 MHz to 3 GHz (3 to 26.5) GHz (3 to 26.5) GHz	50 Hz to 100 kHz, (5 to 20) % Depth 50 Hz to 100 kHz, (5 to 20) % Depth 50 Hz to 100 kHz, (20 to 99) % Depth	0.001 % of reading + 0.029 AM 0.01 % of reading + 0.052 AM 0.01 % of reading + 0.018 AM	Comparison to Microwave Measuring Receiver System



ANSI National Accreditation Board

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Amplitude Modulation – Measure 150 kHz to 10 MHz Rate: 50 Hz to 10 kHz, Depth: 5 % to 99 % Rate: 20 Hz to 10 kHz, Depth: to 99 % 10 MHz to 1.3 GHz Rate: 50 Hz to 50 kHz, Depth: 5 % to 99 % Rate: 20 Hz to 10 kHz, Depth: to 99 % (1.3 to 26.5) GHz Rate: 50 Hz to 10 kHz, Depth: 5 % to 99 % 10 MHz to 26.5 GHz Rate: 20 Hz to 10 kHz, Depth: to 99 %	(5 to < 10) % Depth (10 to 99) % Depth (5 to < 10) % Depth (10 to 99) % Depth (5 to < 10) % Depth (10 to 99) % Depth (5 to < 10) % Depth (10 to 99) % Depth (5 to < 10) % Depth (10 to 99) % Depth (5 to < 10) % Depth (10 to 99) % Depth	0.01 % of reading + 0.023 AM 0.06 % of reading + 0.023 AM 0.01 % of reading + 0.035 A 0.06 % of reading + 0.035 AM 0.01 % of reading + 0.012 AM 0.06 % of reading + 0.012 AM 0.01 % of reading + 0.035 AM 0.06 % of reading + 0.035 AM 0.03 % of reading + 0.018 AM 0.07 % of reading + 0.018 AM 0.03 % of reading + 0.035 AM 0.07 % of reading + 0.035 AM	Comparison to Microwave Measuring Receiver System
Frequency Modulation – Measure 250 kHz to 10 MHz 10 MHz to 6.6 GHz	Rate: 20 Hz to 10 kHz Dev: 20 Hz to 40 kHz pk Rate: 50 Hz to 200 kHz Dev: 250 Hz to 400 kHz pk	1.7 % of reading + 5.7 Hz 1.1 % of reading + 6.6 Hz 1.8 % of reading + 5.1 Hz 1.2 % of reading + 6.1 Hz	Comparison to Microwave Measuring Receiver System
Frequency Modulation – Measure (6.6 to 13.2) GHz (13.2 to 26.5) GHz	Rate: 50 Hz to 200 kHz Dev: 250 Hz to 400 kHz pk Rate: 50 Hz to 100 kHz Dev: 250 Hz to 400 kHz pk	2.9 % of reading + 4 Hz 1.2 % of reading + 6.4 Hz 4.4 % of reading + 3.8 Hz 1.2 % of reading + 7.6 Hz	Comparison to Microwave Measuring Receiver System

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation – Measure 250 kHz to 10 MHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM 10 MHz to 26.5 GHz	Rate: 20 Hz to 10 kHz ≤ 40 kHz pk	0.024 FM + 2.4 Hz Pk 0.024 FM + 8 Hz Pk	Comparison to Microwave Measuring Receiver System
Frequency Modulation – Measure 10 MHz to 1.3 GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM	Rate: 50 Hz to 100 kHz ≤ 400 kHz pk	0.012 FM + 2.4 Hz Pk 0.012 FM + 14 Hz Pk 0.012 FM + 66 Hz Pk	Comparison to Microwave Measuring Receiver System
Frequency Modulation – Measure (> 1.3 to 6.2) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (> 6.2 to 12.4) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM	Rate: 50 Hz to 100 kHz ≤ 400 kHz pk	0.012 FM + 19 Hz Pk 0.012 FM + 23 Hz Pk 0.012 FM + 75 Hz Pk 0.012 FM + 35 Hz Pk 0.012 FM + 39 Hz Pk 0.012 FM + 91 Hz Pk	Comparison to Microwave Measuring Receiver System
Frequency Modulation – Measure (> 12.4 to 18.6) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (> 18.6 to 26.5) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM	Rate: 50 Hz to 100 kHz ≤ 400 kHz pk	0.012 FM + 51 Hz Pk 0.012 FM + 55 Hz Pk 0.012 FM + 110 Hz Pk 0.012 FM + 67 Hz Pk 0.012 FM + 71 Hz Pk 0.012 FM + 130 Hz Pk	Comparison to Microwave Measuring Receiver System

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation – Measure 10 MHz to 26.5 GHz 10 MHz to 1.3 GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (>1.3 to 6.2) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM	Rate: 50 Hz to 100 kHz ≤ 400 kHz pk	0.058 FM + 3.9 Hz Pk 0.058 FM + 8 Hz Pk 0.058 FM + 66 Hz Pk 0.058 FM + 19 Hz Pk 0.058 FM + 23 Hz Pk 0.058 FM + 75 Hz Pk	Comparison to Microwave Measuring Receiver System
Frequency Modulation – Measure (> 6.2 to 12.4) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (> 12.4 to 18.6) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM (> 18.6 to 26.5) GHz (0 to < 4) kHz pk FM (≥ 4 to < 40) kHz pk FM (≥ 40 to < 400) kHz pk FM	Rate: 20 Hz to 200 kHz ≤ 400 kHz pk	0.058 FM + 35 Hz Pk 0.058 FM + 39 Hz Pk 0.058 FM + 91 Hz Pk 0.058 FM + 51 Hz Pk 0.058 FM + 55 Hz Pk 0.058 FM + 110 Hz Pk 0.058 FM + 67 Hz Pk 0.058 FM + 71 Hz Pk 0.058 FM + 130 Hz Pk	Comparison to Microwave Measuring Receiver System

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation – Source (11 to 13.5) MHz	Rate: DC to 10 kHz Dev.: ≤ 100 kHz peak	0.1 % of reading	Comparison to AM/FM Test Source
(11 to 13.5) MHz	Rate: DC to 10 kHz Dev.: ≤ 200 kHz peak	0.25 % of reading	
(88 to 108) MHz	Rate: DC to 100 kHz Dev.: ≤ 100 kHz peak	0.1 % of reading	
(88 to 108) MHz	Rate: DC to 100 kHz Dev.: ≤ 200 kHz peak	0.25 % of reading	
(352 to 432) MHz	Rate: DC to 100 kHz Dev.: ≤ 100 kHz peak	0.1 % of reading	
Frequency Modulation – Source (352 to 432) MHz	Rate: DC to 100 kHz Dev.: ≤ 200 kHz peak	0.25 % of reading	Comparison to Analog Modulation Sources
9 kHz to 1 GHz	Rate: DC to 150 kHz Dev.: ≤ 200 kHz peak	3 % of reading + 30 Hz	
(1 to 2) GHz	Rate: DC to 150 kHz Dev.: ≤ 400 kHz peak	3 % of reading + 60 Hz	
(2 to 3) GHz	Rate: DC to 150 kHz Dev.: ≤ 400 kHz peak	3 % of reading + 120 Hz	
Frequency Modulation – Source 1 kHz rate Max. Dev. 2 MHz Max. Dev. 4 MHz Max. Dev. 8 MHz Max. Dev. 16 MHz Max. Dev. 32 MHz Max. Dev. 64 MHz Max. Dev. 128 MHz	250 kHz to 1 GHz (1 to 2) GHz (2 to 3.2) GHz (3.2 to 10) GHz (10 to 20) GHz (20 to 40) GHz (40 to 50) GHz	40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz 40 mHz/Hz + 23 Hz	Comparison to Analog Modulation Sources

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase Modulation – Measure > 0.7 rad Dev. > 0.6 rad Dev. > 1.2 rad Dev.	100 kHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 26.5) GHz	1.2 % of reading + 0.007 1 rad 1.2 % of reading + 0.007 1 rad 1.2 % of reading + 0.007 3 rad	Comparison to Microwave Measuring Receiver System
Phase Modulation – Measure 150 kHz to 10 MHz (0 to < 4) rad pk PM (≥ 4 to < 40) rad pk PM 10 MHz to 1.3 GHz (0 to < 4) rad pk PM (≥ 4 to < 40) rad pk PM (≥ 40 to < 400) rad pk PM	200 Hz to 10 kHz Rate ≤ 40 rad pk 200 Hz to 20 kHz Rate ≤ 400 rad pk	4.7 % of reading + 0.001 rad 4.7 % of reading + 0.008 rad 3.5 % of reading + 0.001 rad 3.5 % of reading + 0.008 rad 3.5 % of reading + 0.09 rad	Comparison to Microwave Measuring Receiver System
Phase Modulation – Measure 1.3 to 26.5 GHz (0 to < 4) rad pk PM (≥ 4 to < 40) rad pk PM (≥ 40 to < 400) rad pk PM	200 Hz to 20 kHz Rate ≤ 400 rad pk	3.5 % of reading + 0.001 rad 3.5 % of reading + 0.008 rad 3.5 % of reading + 0.09 rad	Comparison to Microwave Measuring Receiver System
Phase Modulation – Source Rate: 20 Hz to 10 kHz Carrier: 9 kHz to 1 GHz (1 to 2) GHz (2 to 3.2) GHz 250 kHz to 1 GHz (> 1 to 2) GHz (> 2 to 3.2) GHz (> 3.2 to 10) GHz (> 10 to 20) GHz (> 20 to 40) GHz (> 40 to 50) GHz	(0 to 10) rad (0 to 20) rad (0 to 40) rad Max. Dev. (0 to 20) rad (0 to 40) rad (0 to 80) rad (0 to 160) rad (0 to 320) rad (0 to 640) rad (0 to 1 280) rad	3 % of reading + 0.05 rad 3 % of reading + 0.1 rad 3 % of reading + 0.2 rad 6 % of reading + 0.012 rad 6 % of reading + 0.012 rad 6 % of reading + 0.012 rad 6 % of reading + 0.012 rad 6 % of reading + 0.012 rad 6 % of reading + 0.012 rad 6 % of reading + 0.012 rad	Comparison to Analog Modulation Sources
Distortion – Measure	(0.01 to 100) % Distortion 250 kHz to 50 GHz	0.065 % of reading	Comparison to Microwave Measuring Receiver System

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Distortion – Measure Fundamental Frequency 20 Hz to 20 kHz (20 to 100) kHz	(-99 to 0) dB (-99 to 0) dB	1.2 dB 2.3 dB	Comparison to Distortion Analyzer
Power Reference – Measure	50 MHz 1 mW	5.5 μ W	Indirect Method Primary Standards Lab (H75) Thermistor Mount, Power Meter, Precision 8.5-digit Multimeter
Absolute Power – Measure	9 kHz to 4.2 GHz (+20 to -30) dBm 10 MHz to 18 GHz (-20 to -70) dBm 50 MHz to 26.5 GHz (+20 to -30) dBm (26.5 to 50) GHz (+20 to -30) dBm (-20 to -70) dBm	0.3 % of Reading + 0.65 dB 0.44 % of reading + 0.32 dB 0.24 % of reading + 0.86 dB 0.46 % of reading + 0.94 dB 1.6 % of reading + 0.67 dB	Comparison to RF Power Meters/Sensors
Power Meter – Range Calibration	3 μ W 10 μ W 30 μ W 100 μ W 300 μ W 1 mW 3 mW 10 mW 30 mW 100 mW	21 nW 19 nW 21 nW 77 nW 0.11 μ W 0.29 μ W 0.64 μ W 6.4 μ W 13 μ W 0.10 mW	Comparison to Power Meter Range Calibrator w/ Precision DC Voltage Source
Noise Figure – Source	15 dB ENR 10 MHz to 4 GHz (> 4 to 10) GHz (> 10 to 18) GHz (> 18 to 26.5) GHz	0.22 dB 0.22 dB 0.22 dB 0.22 dB	Comparison to Noise Source
Noise Figure – Measure	100 kHz to 30 MHz > 30 MHz to 3 GHz (> 3 to 26.5) GHz	0.43 dB 0.42 dB 0.47 dB	Comparison to Noise Figure Measurement System w/ Standard Noise Sources
Single Sideband Phase Noise – Measure	1 MHz to 26.5 GHz	1.8 dB	Comparison to Phase Noise Measurement System

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Current Probes/Bulk Current Injection Probes Insertion Loss Transfer Impedance	(0 to 100) dB 20 Hz to 300 kHz 300 kHz to 1 MHz 1 MHz to 3GHz (0 to 100) dB 20 Hz to 300 kHz 300 kHz to 1 MHz 1 MHz to 3 GHz	1.1 dB 1 dB 1.9 dB 1.1 dB 1 dB 1.9 dB	Comparison to Network/RF Impedance Analyzers, attenuator, type N calibration kit
Transmission S_{12}/S_{21} – Measure Phase and Magnitude (-180 to 180)°	9 kHz to 1.3 GHz (0 to 10) dB (-10 to 0) dB (-20 to -10) dB (-60 to -20) dB (-70 to -60) dB (-80 to -70) dB (-90 to -80) dB (1.3 to 3) GHz (0 to 10) dB (-10 to 0) dB (-20 to -10) dB (-60 to -20) dB (-70 to -60) dB (1.3 to 3) GHz (-80 to -70) dB (-90 to -80) dB	0.18 dB (1°) 0.057 dB (0.43°) 0.072 dB (0.8°) 0.086 dB (0.89°) 0.13 dB (1.2°) 0.3 dB (2.4°) 0.92 dB (6.9°) 0.12 dB (4.1°) 0.063 dB (0.48°) 0.077 dB (0.8°) 0.093 dB (0.94°) 0.13 dB (1.2°) 0.32 dB (2.6°) 0.92 dB (7.4°)	Comparison to LF Vector Network Analyzer, Calibration Kits

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Transmission S_{12}/S_{21} – Measure Phase and Magnitude (-180 to 180)°	50 MHz to 2 GHz		Comparison to Vector Network Analyzer w/ Calibration Kits
	(0 to 10) dB	0.07 dB (0.46°)	
	(-10 to 0) dB	0.054 dB (0.36°)	
	(-20 to -10) dB	0.075 dB (0.5°)	
	(-30 to -20) dB	0.12 dB (0.83°)	
	(-40 to -30) dB	0.29 dB (1.9°)	
	(-50 to -40) dB	2.3 dB (5.5°)	
	(-60 to -50) dB	5.9 dB (5.7°)	
	(2 to 8) GHz		
	(0 to 10) dB	0.09 dB (0.59°)	
	(-10 to 0) dB	0.07 dB (0.46°)	
	(-20 to -10) dB	0.087 dB (0.57°)	
	(-30 to -20) dB	0.1 dB (0.69°)	
	(-40 to -30) dB	0.12 dB (0.81°)	
	(-50 to -40) dB	0.15 dB (0.98°)	
	(-60 to -50) dB	0.22 dB (1.4°)	
	(-70 to -60) dB	0.45 dB (3.1°)	
(-80 to -70) dB	1.2 dB (8.7°)		
(-90 to -80) dB	3.4 dB (8.7°)		

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Transmission S_{12}/S_{21} – Measure Phase and Magnitude (-180 to 180) ^o	(8 to 20) GHz (0 to 10) dB (-10 to 0) dB (-20 to -10) dB (-30 to -20) dB (-40 to -30) dB (-50 to -40) dB (-60 to -50) dB (-70 to -60) dB (-80 to -70) dB (-90 to -80) dB (20 to 50) GHz (0 to 10) dB (-10 to 0) dB (-20 to -10) dB (-30 to -20) dB (-40 to -30) dB (-50 to -40) dB (-60 to -50) dB (-70 to -60) dB (-80 to -70) dB (-90 to -80) dB	0.19 dB (1.3 ^o) 0.17 dB (1.1 ^o) 0.18 dB (1.2 ^o) 0.2 dB (1.3 ^o) 0.22 dB (1.4 ^o) 0.24 dB (1.6 ^o) 0.32 dB (2.1 ^o) 0.6 dB (4.1 ^o) 1.6 dB (8.7 ^o) 4.2 dB (11 ^o) 0.54 dB (3.7 ^o) 0.5 dB (3.4 ^o) 0.49 dB (3.3 ^o) 0.5 dB (3.4 ^o) 0.52 dB (3.5 ^o) 0.55 dB (3.7 ^o) 0.65 dB (4.4 ^o) 1.1 dB (7.6 ^o) 2.7 dB (8.9 ^o) 6.6 dB (11 ^o)	Comparison to Vector Network Analyzer w/ Calibration Kits
Reflection S_{11}/S_{22} – Measure Phase and Magnitude ^{2,3} (-180 to 180) ^o	9 kHz to 1.3 GHz (< 0.03) Γ (< 0.2) Γ (< 0.4) Γ (< 0.6) Γ (< 0.8) Γ (< 1) Γ (1.3 to 3) GHz (< 0.03) Γ (< 0.2) Γ (< 0.4) Γ (< 0.6) Γ (< 0.8) Γ (< 1) Γ	0.002 3 (1.4 ^o) 0.003 5 (1.4 ^o) 0.006 1 (1.1 ^o) 0.008 3 (0.94 ^o) 0.01 (0.83 ^o) 0.012 (0.7 ^o) 0.005 6 (1.8 ^o) 0.003 5 (1.8 ^o) 0.008 (1.3 ^o) 0.011 (1.2 ^o) 0.013 (1 ^o) 0.016 (0.89 ^o)	Comparison to LF Vector Network Analyzer, Calibration Kits

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Reflection S_{11}/S_{22} – Measure Phase and Magnitude ^{2,3} (-180 to 180)°	50 MHz to 2 GHz		Comparison to Vector Network Analyzer w/ Calibration Kits
	(< 0.03) Γ	0.01 (3.3°)	
	(< 0.2) Γ	0.012 (3.3°)	
	(< 0.4) Γ	0.014 (2°)	
	(< 0.6) Γ	0.017 (1.6°)	
	(< 0.8) Γ	0.021 (1.5°)	
	(< 1) Γ	0.026 (1.5°)	
	(2 to 8) GHz		
	(< 0.03) Γ	0.01 (3.5°)	
	(< 0.2) Γ	0.012 (3.5°)	
	(< 0.4) Γ	0.015 (2.2°)	
	(< 0.6) Γ	0.019 (1.8°)	
	(< 0.8) Γ	0.024 (1.7°)	
	(< 1) Γ	0.003 (1.7°)	
	(8 to 20) GHz		
	(< 0.03) Γ	0.002 4 (7.8°)	
	(< 0.2) Γ	0.002 7 (7.8°)	
	(< 0.4) Γ	0.003 3 (4.8°)	
(< 0.6) Γ	0.004 2 (4°)		
(< 0.8) Γ	0.053 (3.8°)		
(< 1) Γ	0.067 (3.9°)		
Reflection S_{11}/S_{22} – Measure Phase and Magnitude ^{2,3} (-180 to 180)°	(20 to 50) GHz		Comparison to Vector Network Analyzer w/ Calibration Kits
	(< 0.03) Γ	0.06 (19°)	
	(< 0.2) Γ	0.066 (11°)	
	(< 0.4) Γ	0.079 (11°)	
	(< 0.6) Γ	0.097 (9.3°)	
	(< 0.8) Γ	0.12 (8.8°)	
	(< 1) Γ	0.15 (8.8°)	

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) 7mm Test Ports Reflection S_{11}/S_{22} ^{2,3} Magnitude Phase	≤ 0.1 to $\leq 1 \Gamma$ (0.000 3 to 1) GHz (1 to 3) GHz (3 to 6) GHz ≤ 0 to $\leq 60^\circ$ (0.000 3 to 1) GHz (1 to 3) GHz (3 to 6) GHz	0.003 8 Γ 0.003 9 Γ 0.005 1 Γ 2° 2.1° 2.7°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Network Analyzer System Verification (Corrected Performance) N-Type Test Ports Reflection S_{11}/S_{22} ^{2,3} Magnitude Phase	≤ 0.1 to $\leq 1 \Gamma$ (0.000 3 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz ≤ 0 to $\leq 60^\circ$ (0.000 3 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz	0.009 Γ 0.001 Γ 0.001 5 Γ 0.004 1 Γ 0.46° 0.64° 0.65° 1.3°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) 3.5mm Test Ports Reflection S ₁₁ /S ₂₂ ^{2,3} Magnitude Phase	≤ 0.1 to $\leq 1 \Gamma$ (0.045 to 2) G Γ Hz (2 to 20) GHz (20 to 26.5) GHz ≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 26.5) GHz	0.000 76 Γ 0.001 Γ 0.003 Γ 0.34° 0.36° 0.64°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Network Analyzer System Verification (Corrected Performance) 2.4mm Test Ports Reflection S ₁₁ /S ₂₂ ^{2,3} Magnitude Phase	≤ 0.1 to $\leq 1 \Gamma$ (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz ≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.003 8 Γ 0.003 8 Γ 0.004 4 Γ 0.005 5 Γ 0.96° 1.3° 1.5° 2.3°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) 7mm Test Ports Transmission S_{21}/S_{122} Magnitude Phase	≤ 0.1 to ≤ 1 dB (0.000 3 to 1) GHz (1 to 3) GHz (3 to 6) GHz ≤ 0 to $\leq 60^\circ$ (0.000 3 to 1) GHz (1 to 3) GHz (3 to 6) GHz	0.16 dB 0.16 dB 0.17 dB 1.4° 1.5° 2.2°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Network Analyzer System Verification (Corrected Performance) N-Type Test Ports Transmission S_{21}/S_{122} Magnitude Phase	≤ 0.1 to ≤ 1 dB (0.000 3 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz ≤ 0 to $\leq 60^\circ$ (0.000 3 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz	0.018 dB 0.019 dB 0.02 dB 0.024 dB 0.18° 0.2° 0.23° 0.24°	Comparison to Mechanical Calibration Kits and RF Network Analyzer System

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) 3.5mm Test Ports Transmission S_{21}/S_{12} Magnitude	≤ 0.1 to ≤ 1 dB (0.045 to 2) GHz (2 to 20) GHz (20 to 26.5) GHz	0.018 dB 0.019 dB 0.032 dB	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Phase	≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 26.5) GHz	0.18° 0.18° 0.32°	
Network Analyzer System Verification (Corrected Performance) 2.4mm Test Ports Transmission S_{21}/S_{12} Magnitude	≤ 0.1 to ≤ 1 dB (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.023 dB 0.033 dB 0.055 dB 0.068 dB	Comparison to Mechanical Calibration Kits and RF Network Analyzer System
Phase	≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.23° 0.41° 0.97° 1.8°	
Scalar Network Analyzer Absolute Log Error	21 dB	0.04 dB	Comparison to Scalar Network Analyzer Calibrator
Dynamic Accuracy	(0 to 140) dB	0.02 dB	
Network Analyzer Dynamic Accuracy	(0 to 140) dB	0.02 dB	Comparison to Dynamic Accuracy Test Set

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Impulse Spectral Amplitude – Source CISPR Band A CISPR Band B CISPR Band C and D CISPR Band E Sinewave Output for CISPR Checks Source @ 60 dB/μV Peak and Average Detector Response	(10 to 150) kHz 150 kHz to 30 MHz 30 MHz to 1 GHz (1 to 18) GHz (0 to -70) dB 100 kHz (1, 10, and 100) MHz (0 to -70) dB CISPR Band A thru D	0.82 dB 0.82 dB 1.1 dB 1.5 dB 0.35 dB 0.35 dB 1.3 dB	Comparison to Pulse Generator
LISN (Line Impedance Stabilization Network) & AMN (Artificial Mains Network) Insertion Loss Isolation (De-Coupling Factor) Impedance (Magnitude) Impedance (Phase)	(-20 to 0) dB 10 Hz to 1 000 MHz (-90 to 0) dB 10 Hz to 1 000 MHz 0.1 Ω to 1 kΩ 10 Hz to 1 000 MHz (-180 to 180)° 10 Hz to 1 000 MHz	0.25 dB 2.3 dB 2.4 % of reading 2.6°	Comparison to RF Impedance/Network Analyzers, Calibration Kits

Electrical – RF/Microwave

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
CDN (Coupling-Decoupling Network) & ISN (Impedance Stabilization Network) Insertion Loss	(-20 to 0) dB 10 Hz to 1 000 MHz	0.25 dB	Comparison to RF Impedance/Network Analyzers, Calibration Kits
Isolation (De-Coupling Factor)	(-90 to 0) dB 10 Hz to 1 000 MHz	2.3 dB	
Impedance (Magnitude)	0.1 Ω to 1 kΩ 10 Hz to 1 000 MHz	2.4 % of reading	
Impedance (Phase)	(-180 to 180)° 10 Hz to 1 000 MHz	2.6°	
LCL (Longitudinal Conversion Loss)	(-20 to 0) dB 10 Hz to 1 000 MHz	2.3 dB	

Length – Dimensional Metrology

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Test, Dial Indicators & Thickness Gages ^{1,2}	Up to 4 in	$(57 + 0.26L) \mu\text{in}$	Comparison to Gage Blocks
Calipers ^{1,2}	Up to 54 in	$(52 + 46L) \mu\text{in}$	Comparison to Gage Blocks, Standard Rings, Rod Sets
Micrometers ^{1,2} (Linearity Only)	Up to 54 in	$(52 + 46L) \mu\text{in}$	Comparison to Gage Blocks, Rod Sets
Height Gages ^{1,2}	Up to 12 in	$(750 + 4.7L) \mu\text{in}$	Comparison to Gage Blocks, Surface Plate
Depth Gages ^{1,2}	Up to 12 in	$(160 + 4.1L) \mu\text{in}$	Comparison to Gage Blocks
Steel Rulers	Up to 48 in	0.036 in	Comparison to Gage Blocks

Length – Dimensional Metrology

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tape Measures	Up to 50 ft	0.036 in	Comparison to Gage Blocks
Protractor/Angle	Up to 90°	0.069°	Comparison to Angle Gage Blocks

Mass and Mass Related

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Barometric Pressure Measurement	Up to 39 psia	0.014 psi	Comparison to Digital Barometer / Precision Absolute Manometer
Force-Measuring Equipment Tension / Compression	(0.1 to 50) kgf	0.042 mgf/gf + 7.1 gf	Comparison to NIST Class F Weights
Force-Measuring Equipment Tension / Compression	Up to 1 000 lbf (1 000 to 10 000) lbf (10 000 to 20 000) lbf (20 000 to 30 000) lbf (30 000 to 40 000) lbf (40 000 to 50 000) lbf	5.1 lbf 24 lbf 47 lbf 70 lbf 93 lbf 120 lbf	Comparison to Reference Load Cells
Pressure – Source/Pressure gages and transducers ¹	(-12 to 300) psi (300 to 10 000) psi	0.2 psi 1.4 psi	Comparison to Pressure Calibration System
Torque – Measure/Torque Tools	(8 to 80) ozf·in (5 to 50) lbf·in (50 to 500) lbf·in (25 to 250) lbf·ft	0.65 % of reading + 0.1 ozf·in 0.003 lbf·in/lbf·in + 0.016 lbf·in 0.002 lbf·in/lbf·in + 0.068 lbf·in 0.006 5 + lbf·ft/lbf·ft + 0.32 lbf·ft	Comparison to Torque Transducers

Mass and Mass Related

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales & Balances ⁴	0.25 oz	0.000 71 oz	Comparison to NIST Class F Weights And internal calibration procedure utilized in the calibration of the weighing system.
	0.5 oz	0.001 1 oz	
	1 oz	0.000 27 oz	
	2 oz	0.000 46 oz	
	4 oz	0.001 oz	
	8 oz	0.002 2 oz	
	16 oz	0.002 9 oz	
	1 kg	5.8 g	
	2 kg	12 g	
	5 lb	0.001 8 lb	
	(1 to 10) lb	0.002 6 lb	
	(10 to 50) lb	0.005 9 lb	
(50 to 300) lb	0.041 lb		

Thermodynamic

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity – Measure ¹	Up to 90 %RH	1.6 % RH	Comparison to Humidity Probe Monitor
	(90 to 95) %RH	2.2 % RH	
Relative Humidity – Measuring equipment	Up to 90 %RH	1.9 %RH	Comparison to Humidity chamber, Humidity Probe Monitor
	(90 to 95) %RH	2.5 %RH	
Temperature – Measure ¹	(-200 to 0) °C	0.03 °C	Comparison to Reference Thermometer w/ PRT
	(0 to 100) °C	0.05 °C	
	(100 to 300) °C	0.07 °C	
	(300 to 420) °C	0.11 °C	
	(420 to 650) °C	0.14 °C	
Temperature – Measuring equipment	(-70 to 0) °C	1.3 °C	Comparison to Reference Chamber and Thermometer w/ PRT
	(0 to 100) °C	1.5 °C	
	(100 to 175) °C	2.8 °C	

Time and Frequency

Orlando, FL

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source ¹	1 μHz to 80 MHz	5.8 x 10 ⁻⁹ MHz	Comparison to Frequency Synthesizer w/ GPS Reference Signal Generator
Frequency – Source ¹	1 Hz to 50 GHz	5.8 x 10 ⁻¹⁰ GHz	Comparison to Synthesized Sweeper w/ GPS Reference
Frequency – Measure ¹	1 μHz to 12.4 GHz 1 Hz to 50 GHz	5.8 x 10 ⁻¹⁰ GHz 5.8 x 10 ⁻¹¹ GHz	Comparison to Electronic Counters, Analyzers w/ GPS Reference
Time Interval	50 ns to 999 s	5 parts in 10 ¹² s+0.43 ns	Comparison to Universal Counter w/ GPS Reference
Period ¹	4.44 ns to 10 s	0.012 % of reading + 0.17 ns	Comparison to Universal Counter w/ GPS Reference
Rise/Fall Time – Measure ¹	1 ns to 10 μs (10 to 100) μs	1.2 ns 2.9 ns	Comparison to Digital Oscilloscope Or Universal Counter w/ GPS Reference
Pulse Width – Measure ¹	> 5 ns	1.1 ns	Comparison to Universal Counter w/ GPS Reference
Stop Watches – Totalize Method	1s to 24 hr	0.06 % of reading + 44 ms	Comparison to Universal Counter and Synthesizer w/ GPS Reference

TESTING

Environmental

Orlando, FL

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
Face Velocity Test Airflow Smoke Pattern Test Leak/Backstreaming Test	ISO 14644-1 ISO 16644-2 ISO 14644-3 ISO 16644-7 ANSI/ASHRAE 110 IEST-RP-CC002.4	Flow hood Devices Test	Comparison to Thermal Anemometer Aerosol Generator Digital Aerosol Photometer
Airborne Particle Count Survey Airflow Measurement Airflow Smoke Pattern Test HEPA/ULPA filter leak Test Biological Safety Cabinet Classification	ISO 14644-1 ISO 16644-2 ISO 14644-3 ISO 16644-7 IEST-RP-CC034.2 IEST-RP-CC006.3 NSF/ANSI49-2004 Annex	Biological Safety Cabinet Test	Comparison to Particle Counter Balometer Aerosol Generator Digital Aerosol Photometer Thermal Anemometer
Airflow Measurement Air Pressure Difference Test Airflow Smoke Pattern Test HEPA/ULPA filter leak Test Airborne Particle Count Survey Lighting Level Sound Level Test Temperature Test Humidity Test Temperature/Humidity Uniformity Test Recovery Test	ISO 14644-1 ISO 14644-2 ISO 14644-3 IEST-RP-CC006.3 IEST-RP-CC034.2 ISO/DIS 7726 In-house Method	Clean Room Test	Comparison to Balometer Differential Pressure Meter Digital Aerosol Photometer, Aerosol Generator Particle Counter Light meter Sound level meter Temperature & humidity meter Thermal Anemometer.
Airborne Particle Count Survey Airflow Velocity Laminar Hood HEPA/ULPA filter leak Test Induction Leak/Backstreaming Test Airflow Smoke Pattern Test Lighting Level Sound Level Test	ISO 14644-1 ISO 14644-2 ISO 14644-3 ISO 14644-7 IEST-RP-CC002.4 IEST-RP-CC006.3 IEST-RP-CC034.2 In-house Method	Laminar Air Flow Workstation Test	Comparison to Particle Counter Thermal Anemometer Aerosol Generator Digital Aerosol Photometer Light meter Sound level meter

Environmental

Orlando, FL

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
Oil Aerosol & Vapor Content ⁴	ISO 8573-1 ISO 8573-2 ISO 8573-5	Compressed Air Purity Test	Comparison to Oil Content Analyzer Air Sampler
Humidity / Dew Point Measurement	ISO 8573-3	Compressed Air Purity Test	Comparison to Dew Point Meter & Diffuser
Pressurized Air Particle Content	ISO 8573-4	Compressed Air Purity Test	Comparison to Particle Counter & Diffuser
Viable Microbiological Contaminant ⁵	ISO 8573-7	Compressed Air Purity Test	Comparison to Microbiological Sampler

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Services performed at satellite laboratory

Techmaster Electronics, Inc.

4614 Sinclair Rd.
San Antonio, TX 78222

CALIBRATION

Acoustics and Vibration

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Sound Level Meters ¹	125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz 74 dB, 84 dB, 94 dB, 104 dB, 114 dB	0.3 dB	Comparison to Sound Level Calibrator

Chemical Quantities

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH – Source ^{1,6}	4.01 pH 7 pH 10 pH	0.016 pH 0.019 pH 0.027 pH	Comparison to Standard Solutions
Conductivity – Source ⁶	25 μS/cm 84 μS/cm 500 μS/cm 1 400 μS/cm 12 800 μS/cm	0.38 μS/cm 0.9 μS/cm 4.9 μS/cm 8.3 μS/cm 77 μS/cm	Comparison to Standard Solutions

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source ¹	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V 220 V to 1.1 kV	7.5 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 6.5 μV/V + 0.4 mV	Comparison to Multiproduct Calibrator
DC Voltage – Source ¹ Fixed Point	10 V	20 μV	Comparison to DC Reference Standard
DC Voltage – Measure ¹	Up to 200 mV 200 mV to 2 V (2 to 20) V (20 to 200) V 200 V to 1 kV	5.0 μV/V + 0.1 μV 3.5 μV/V + 0.4 μV 3.5 μV/V + 4.0 μV 5.5 μV/V + 40 μV 5.5 μV + 1.0 mV	Comparison to Precision 8.5 Digit Multimeter
DC High Voltage – Measure ¹	Up to 10 kV (10 to 100) kV (100 to 150) kV	0.35 mV/V + 0.11 V 1.2 mV/V + 0.4 V 1.1 mV/V + 10 V	Comparison to High Voltage Meter Digital Multimeter
DC Current – Source ¹	Up to 220 μA 220 μA to 2.2 mA 2.2 mA to 22 mA 22 mA to 220 mA 220 mA to 2.2 A	40 μA/A + 6 nA 35 μA/A + 7 nA 35 μA/A + 40 nA 45 μA/A + 0.7 μA 80 μA/A + 12 μA	Comparison to Multiproduct Calibrator
DC Current – Source ¹	2.2 A to 11 A	0.36 mA/A + 0.48 mA	Comparison to Multiproduct Calibrator, Amplifier
DC Current – Source ¹	11 A to 20.5 A	0.78 mA/A + 1.2 mA	Comparison to Multiproduct Calibrator

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Source ¹ Clamp-On Meters	(10 to 16.5) A (16.5 to 150) A (150 to 1 025) A	0.54 % of reading + 0.03 A 0.57 % of reading + 0.17 A 0.59 % of reading + 0.61 A	Comparison to Multi Product Calibrator w/ Current Coil
DC Power – Source ¹ 33 mV to 1 020 V 329.99 mA range 2.9999 A range 20.5 A range	10 μW to 330 W 10 mW to 3 kW 100 mW to 21 kW	0.01 % of reading + 1.2 nW 0.04 % of reading 0.1 % of reading	Comparison to Multi Product Calibrator
DC Power – Source ¹ 33 mV to 1 020 V 329.99 mA range 2.9999 A range 20.5 A range	3.3 mA to 8.999 mA 9 mA to 32.999 mA 33 mA to 89.99 mA 90 mA to 329.99 mA 0.33 A to 0.899 9 A 0.9 A to 2.199 9 A 2.2 A to 4.499 9 A 4.5 A to 11 A	0.31 mW/W 0.23 mW/W 0.31 mW/W 0.23 mW/W 0.62 mW/W 0.47 mW/W 0.93 mW/W 0.7 mW/W	Comparison to Multi Product Calibrator
DC Current – Measure ¹	Up to 100 nA 100 nA to 1 μA (1 to 10) μA (10 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	35 μA/A + 47 pA 24 μA/A + 0.047 nA 24 μA/A + 0.12 nA 24 μA/A + 0.95 nA 24 μA/A + 0.005 9 μA 24 μA/A + 0.059 μA 41 μA/A + 0.59 μA 130 μA/A + 0.012 mA	Comparison to Precision 8.5 Digit Multimeter
DC Current – Measure ¹	Up to 200 μA (200 μA to 2) mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A	12 μA/A + 0.4 nA 12 μA/A + 4 nA 14 μA/A + 40 nA 48 μA/A + 0.8 μA 0.19 mA/A + 16 μA 0.4 mA/A + 0.4 mA	Comparison to Precision 8.5 Digit Multimeter
DC Current – Measure ¹	(20 to 100) A (100 to 600) A (600 to 1 000) A	38 μA/A + 5.9 μA 0.19 % + 0.012 mA 0.32 % + 1.4 mA	Indirect Method Precision 8.5 Digit Multimeter w/ Current Shunts
DC Power – Measure ¹	Up to 10 W (> 10 to 15) W (> 15 to 100) W (> 100 to 150) W	0.043% of reading + 0.074 W 0.043 % of reading + 0.015 W 0.043 % of reading + 0.098 W 0.043 % of reading + 0.15 W	Comparison to Precision Power Analyzer

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	Up to 2.2 mV		Comparison to Multiproduct Calibrator
	(10 to 20) Hz	0.24 mV/V + 4 μV	
	(20 to 40) Hz	90.0 μV/V + 4 μV	
	40 Hz to 20 kHz	80.0 μV/V + 4 μV	
	(20 to 50) kHz	0.2 mV/V + 4 μV	
	(50 to 100) kHz	0.5 mV/V + 5 μV	
	(100 to 300) kHz	1.1 mV/V + 10 μV	
	(300 to 500) kHz	1.4 mV/V + 20 μV	
	500 kHz to 1 MHz	2.7 mV/V + 20 μV	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.24 mV/V + 4 μV	
	(20 to 40) Hz	90 μV/V + 4 μV	
	40 Hz to 20 kHz	80 μV/V + 4 μV	
	(20 to 50) kHz	0.2 mV/V + 4 μV	
	(50 to 100) kHz	0.5 mV/V + 5 μV	
	(100 to 300) kHz	1.1 mV/V + 10 μV	
	(300 to 500) kHz	1.4 mV/V + 20 μV	
	500 kHz to 1 MHz	2.7 mV/V + 20 μV	
	(22 to 220) mV		
	(10 to 20) Hz	0.24 mV/V + 12 μV	
	(20 to 40) Hz	90.0 μV/V + 7 μV	
	40 Hz to 20 kHz	80.0 μV/V + 7 μV	
	(20 to 50) kHz	0.2 mV/V + 7 μV	
	(50 to 100) kHz	0.46 mV/V + 17 μV	
	(100 to 300) kHz	0.9 mV/V + 20 μV	
	(300 to 500) kHz	1.4 mV/V + 25 μV	
	500 kHz to 1 MHz	2.7 mV/V + 45 μV	
	220 mV to 2.2 V		
(10 to 20) Hz	0.24 mV/V + 40 μV		
(20 to 40) Hz	90 μV/V + 15 μV		
40 Hz to 20 kHz	45 μV/V + 8 μV		
(20 to 50) kHz	75 μV/V + 10 μV		
(50 to 100) kHz	0.11 mV/V + 30 μV		
(100 to 300) kHz	0.42 mV/V + 80 μV		
(300 to 500) kHz	1 mV/V + 0.2 mV		
500 kHz to 1 MHz	1.7 mV/V + 0.3 mV		

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source ¹	(2.2 to 22) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (22 to 220) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz 220 V to 1.1 kV (15 to 50) Hz 50 Hz to 1 kHz	0.24 mV/V + 0.4 mV 90 μV/V + 0.15 mV 45 μV/V + 50 μV 75 μV/V + 0.1 mV 0.1 mV/V + 0.2 mV 0.28 mV/V + 0.6 mV 1 mV/V + 2 mV 1.5 mV/V + 3.2 mV 0.24 mV/V + 4 mV 90 μV/V + 1.5 mV 52 μV/V + 0.6 mV 80 μV/V + 1 mV 0.15 mV/V + 2.5 mV 0.9 mV/V + 16 mV 4.4 mV/V + 40 mV 8 mV/V + 80 mV 0.3 mV/V + 16 mV 70 μV/V + 3.5 mV	Comparison to Multiproduct Calibrator
AC Voltage – Source ¹	220 V to 1.1 kV 40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz (220 to 750) V (30 to 50) kHz (50 to 100) kHz	90 μV/V + 4 mV 0.17 mV/V + 6 mV 0.6 mV/V + 11 mV 0.6 mV/V + 11 mV 2.3 mV/V + 45 mV	Comparison to High Performance Multifunction Calibrator w/ Amplifier
AC Voltage – Measure ¹	0 to 200 mV 1 Hz to 10 Hz 10 Hz to 40 Hz 40 Hz to 100 Hz 100 Hz to 2 kHz 2 kHz to 10 kHz 10 kHz to 30 kHz 30 kHz to 100 kHz	0.17 mV/V + 14 μV 0.14 mV/V + 4 μV 0.12 mV/V + 4 μV 0.11 mV/V + 2 μV 0.14 mV/V + 4 μV 0.34 mV/V + 8 μV 0.77 mV/V + 20 μV	Comparison to Precision 8.5 Digit Multimeter

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	200 mV to 2 V		Comparison to Precision 8.5 Digit Multimeter
	1 Hz to 10 Hz	0.15 mV/V + 0.12 mV	
	10 Hz to 40 Hz	0.12 mV/V + 20 μV	
	40 Hz to 100 Hz	90 μV/V + 20 μV	
	100 Hz to 2 kHz	75 μV/V + 20 μV	
	2 kHz to 10 kHz	0.11 mV/V + 20 μV	
	10 kHz to 30 kHz	0.22 mV/V + 40 μV	
	30 kHz to 100 kHz	0.57 mV/V + 0.2 mV	
	100 kHz to 300 kHz	3 mV/V + 2 mV	
	300 kHz to 1 MHz	10 mV/V + 20 mV	
	(2 to 20) V		
	1 Hz to 10 Hz	0.15 mV/V + 1.2 mV	
	10 Hz to 40 Hz	0.12 mV/V + 0.2 mV	
	40 Hz to 100 Hz	90 μV/V + 0.2 mV	
	100 Hz to 2 kHz	75 μV/V + 0.2 mV	
	2 kHz to 10 kHz	0.11 mV/V + 0.2 mV	
	10 kHz to 30 kHz	0.22 mV/V + 0.4 mV	
	30 kHz to 100 kHz	0.57 mV/V + 2 mV	
	100 kHz to 300 kHz	3 mV/V + 20 mV	
	300 kHz to 1 MHz	10 mV/V + 0.2 V	
	(20 to 200) V		
	1 Hz to 10 Hz	0.15 mV/V + 12 mV	
	10 Hz to 40 Hz	0.12 mV/V + 2 mV	
	40 Hz to 100 Hz	90 μV/V + 2 mV	
	100 Hz to 2 kHz	75 μV/V + 2 mV	
	2 kHz to 10 kHz	0.11 mV/V + 2 mV	
	10 kHz to 30 kHz	0.22 mV/V + 4 mV	
	30 kHz to 100 kHz	0.57 mV/V + 20 mV	
	100 kHz to 300 kHz	3 mV/V + 0.2 V	
	300 kHz to 1 MHz	10 mV/V + 2 V	
200 V to 1 kV			
1 Hz to 10 Hz	0.15 mV/V + 70 mV		
10 Hz to 40 Hz	0.12 mV/V + 20 mV		
40 Hz to 10 kHz	0.12 mV/V + 20 mV		
10 kHz to 30 kHz	0.23 mV/V + 40 mV		
30 kHz to 100 kHz	0.58 mV/V + 0.2 V		

Electrical – DC/Low Frequency

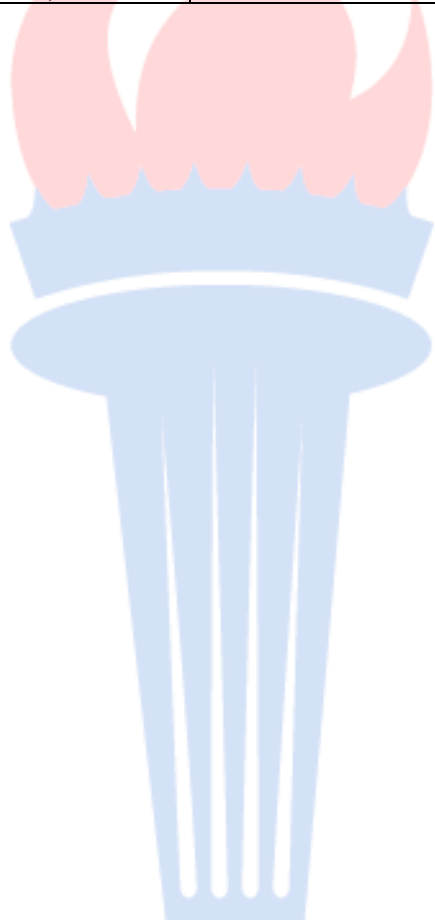
San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC High Voltage - Measure ¹	(Up to 10) kV (30 to 200) Hz (200 to 450) Hz (450 to 600) Hz	1.4 mV/V + 0.14 V 4.6 mV/V + 0.14V 8.7 mV/V + 0.14 V	Comparison to High Voltage Meter
	(10 to 100) kV (30 to 70) Hz (70 to 200) Hz	1.4 mV/V + 0.7 V 17 % of reading + 0.7 V	
AC High Voltage - Measure ¹	Up to 10 kV (30 to 200) Hz (200 to 450) Hz (450 to 600) Hz	1.4 mV/V + 0.14 V 4.6 mV/V + 0.14 V 8.7 mV/V + 0.14 V	Comparison to High Voltage Divider
	(10 to 100) kV (30 to 70) Hz (70 to 200) Hz	5.9 mV/V + 0.015 kV 8.2 mV/V + 0.011 kV	
	(100 to 150) kV (30 to 70) Hz	5.4 mV/V + 0.14 kV	
	(70 to 200) Hz	6.7 mV/V + 0.22 kV	
AC Voltage Flatness - Source ¹ (Referenced to 1 kHz)	0.3 mV to 3.5 V (10 to 30) Hz	0.35 % of reading	Comparison to High Performance Multifunction Calibrator (Wideband)
	30 Hz to 120 kHz	0.12 % of reading	
	(0.3 to 1.1) mV 120 kHz to 2 MHz	0.24 % of reading + 3 μV	
	(2 to 10) MHz	0.47 % of reading + 3 μV	
	(10 to 20) MHz	0.7 % of reading + 3 μV	
	(20 to 30) MHz	1.8 % of reading + 15 μV	
	(1.1 to 3) mV 120 kHz to 2 MHz	0.12 % of reading + 3 μV	
	(2 to 10) MHz	0.35 % of reading + 3 μV	
	(10 to 20) MHz	0.58 % of reading + 3 μV	
	(20 to 30) MHz	1.8 % of reading + 3 μV	
3 mV to 3.5 V 120 kHz to 2 MHz	0.12 % of reading + 3 μV		
(2 to 10) MHz	0.24 % of reading + 3 μV		
(10 to 20) MHz	0.47 % of reading + 3 μV		
(20 to 30) MHz	1.2 % of reading + 3 μV		

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage Flatness – Measure ¹	Up to 3 V		Indirect Method Precision 8.5 Digit Multimeter w/ Thermal Converters
	(10 to 100) Hz	0.2 % of reading	
	100 Hz to 10 kHz	0.051 % of reading	
	(10 to 30) kHz	0.059 % of reading	
	30 kHz to 1 MHz	0.13 % of reading	
	(1 to 10) MHz	0.21 % of reading	
	(10 to 30) MHz	0.26 % of reading	
	(30 to 50) MHz	0.42 % of reading	
	(50 to 70) MHz	0.65 % of reading	
	(70 to 80) MHz	0.77 % of reading	
(80 to 100) MHz	0.97 % of reading		



Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	Up to 2.2 mV		Comparison to AC Measurement Standard
	(10 to 20) Hz	1.6 mV/V + 1.6 μV	
	(20 to 40) Hz	1.6 mV/V + 1.6 μV	
	40 Hz to 20 kHz	0.4 mV/V + 1.7 μV	
	(20 to 50) kHz	0.8 mV/V + 2.2 μV	
	(50 to 100) kHz	1.2 mV/V + 2.7 μV	
	(100 to 300) kHz	2.3 mV/V + 4.1 μV	
	(300 to 500) kHz	2.4 mV/V + 8.1 μV	
	500 kHz to 1 MHz	3.5 mV/V + 8.1 μV	
	(2.2 to 7) mV		
	(10 to 20) Hz	0.8 mV/V + 1.4 μV	
	(20 to 40) Hz	0.4 mV/V + 1.5 μV	
	40 Hz to 20 kHz	0.2 mV/V + 1.5 μV	
	(20 to 50) kHz	0.4 mV/V + 2.1 μV	
	(50 to 100) kHz	0.6 mV/V + 2.6 μV	
	(100 to 300) kHz	1.2 mV/V + 4.1 μV	
	(300 to 500) kHz	1.3 mV/V + 6 μV	
	500 kHz to 1 MHz	2 mV/V + 6 μV	
	(7 to 22) mV		
	(10 to 20) Hz	0.3 mV/V + 1.6 μV	
	(20 to 40) Hz	0.3 mV/V + 1.6 μV	
	40 Hz to 20 kHz	0.1 mV/V + 1.7 μV	
	(20 to 50) kHz	0.2 mV/V + 2.3 μV	
	(50 to 100) kHz	0.3 mV/V + 2.7 μV	
	(100 to 300) kHz	0.8 mV/V + 4.1 μV	
	(300 to 500) kHz	0.9 mV/V + 6.1 μV	
	500 kHz to 1 MHz	1.4 mV/V + 6.1 μV	
	(22 to 70) mV		
	(10 to 20) Hz	2 mV/V + 5.3 μV	
	(20 to 40) Hz	80 μV/V + 6.3 μV	
40 Hz to 20 kHz	40 μV/V + 6.8 μV		
(20 to 50) kHz	0.1 mV/V + 6.4 μV		
(50 to 100) kHz	0.23 mV/V + 5.8 μV		
(100 to 300) kHz	0.5 mV/V + 6 μV		
(300 to 500) kHz	0.7 mV/V + 9.4 μV		
500 kHz to 1 MHz	1.1 mV/V + 9 μV		

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(70 to 220) mV		Comparison to AC Measurement Standard
	(10 to 20) Hz	0.2 mV/V + 1.6 μV	
	(20 to 40) Hz	80 μV/V + 1.7 μV	
	40 Hz to 20 kHz	40 μV/V + 1.8 μV	
	(20 to 50) kHz	70 μV/V + 2.2 μV	
	(50 to 100) kHz	0.2 mV/V + 2.6 μV	
	(100 to 300) kHz	0.3 mV/V + 4.1 μV	
	(300 to 500) kHz	0.4 mV/V + 8 μV	
	500 kHz to 1 MHz	1 mV/V + 8 μV	
	(220 to 700) mV		
	(10 to 20) Hz	0.21 mV/V + 1.5 μV	
	(20 to 40) Hz	0.21 mV/V + 1.5 μV	
	40 Hz to 20 kHz	30 μV/V + 1.7 μV	
	(20 to 50) kHz	50 μV/V + 2.1 μV	
	(50 to 100) kHz	80 μV/V + 2.6 μV	
	(100 to 300) kHz	0.2 mV/V + 4 μV	
	(300 to 500) kHz	0.3 mV/V + 8 μV	
	500 kHz to 1 MHz	0.3 mV/V + 8 μV	
	700 mV to 2.2 V		
	(10 to 20) Hz	0.2 mV/V + 4.2 μV	
	(20 to 40) Hz	0.62 mV/V + 13 μV	
	40 Hz to 20 kHz	0.17 mV/V + 23 μV	
	(20 to 50) kHz	0.41 mV/V + 16 μV	
	(50 to 100) kHz	0.67 mV/V + 12 μV	
	(100 to 300) kHz	0.16 mV/V + 6 μV	
	(300 to 500) kHz	0.26 mV/V + 4 μV	
	500 kHz to 1 MHz	9 mV/V + 1.1 μV	
	(2.2 to 7) V		
	(10 to 20) Hz	0.2 mV/V + 1.1 μV	
	(20 to 40) Hz	0.7 mV/V + 3.2 μV	
40 Hz to 20 kHz	0.23 mV/V + 8.4 μV		
(20 to 50) kHz	0.5 mV/V + 4.4 μV		
(50 to 100) kHz	0.8 mV/V + 2.7 μV		
(100 to 300) kHz	0.19 mV/V + 1.1 μV		
(300 to 500) kHz	0.4 mV/V + 0.5 μV		
500 kHz to 1 MHz	1.2 mV/V + 0.2 μV		

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(7 to 22) V		Comparison to AC Measurement Standard
	(10 to 20) Hz	0.2 mV/V + 3.7 μV	
	(20 to 40) Hz	0.7 mV/V + 11 μV	
	40 Hz to 20 kHz	0.3 mV/V + 26 μV	
	(20 to 50) kHz	0.5 mV/V + 15 μV	
	(50 to 100) kHz	0.8 mV/V + 9.1 μV	
	(100 to 300) kHz	0.29 mV/V + 4 μV	
	(300 to 500) kHz	0.4 mV/V + 1.9 μV	
	500 kHz to 1 MHz	1.2 mV/V + 0.6 μV	
	(22 to 70) V		
	(10 to 20) Hz	0.2 mV/V + 9.1 μV	
	(20 to 40) Hz	70 μV/V + 27 μV	
	40 Hz to 20 kHz	30 μV/V + 55 μV	
	(20 to 50) kHz	60 μV/V + 32 μV	
	(50 to 100) kHz	90 μV/V + 19 μV	
	(100 to 300) kHz	0.2 mV/V + 9.1 μV	
	(300 to 500) kHz	0.4 mV/V + 4.4 μV	
	500 kHz to 1 MHz	1.2 mV/V + 1.5 μV	
	(70 to 220) V		
	(10 to 20) Hz	0.20 mV/V + 7.1 μV	
	(20 to 40) Hz	70 μV/V + 21 μV	
	40 Hz to 20 kHz	30 μV/V + 45 μV	
	(20 to 50) kHz	70 μV/V + 21 μV	
	(50 to 100) kHz	0.1 mV/V + 14 μV	
	(100 to 300) kHz	0.21 mV/V + 6.8 μV	
	(300 to 500) kHz	0.5 mV/V + 2.8 μV	
	(220 to 700) V		
	(10 to 20) Hz	0.2 mV/V + 77 μV	
(20 to 40) Hz	0.1 mV/V + 0.16 mV		
40 Hz to 20 kHz	40 μV/V + 0.37 mV		
(20 to 50) kHz	0.13 mV/V + 0.12 mV		
(50 to 100) kHz	0.5 mV/V + 31 μV		
700 V to 1 kV			
(10 to 20) Hz	0.2 mV/V + 31 μV		
(20 to 40) Hz	0.1 mV/V + 62 μV		
40 Hz to 20 kHz	40 μV/V + 0.16 mV		
(20 to 50) kHz	0.13 mV/V + 47 μV		
(50 to 100) kHz	0.5 mV/V + 12 μV		

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	Up to 10 mV		Comparison to Precision 8.5 Digit Multimeter AC BAND < 2 MHz
	(1 to 40) Hz	3.5 μ V/V + 4.6 μ V	
	40 Hz to 1 kHz	2.4 μ V/V + 3.2 μ V	
	(1 to 20) kHz	3.5 μ V/V + 4.6 μ V	
	(20 to 50) kHz	12 μ V/V + 3.2 μ V	
	(50 to 100) kHz	58 μ V/V + 3.2 μ V	
	(100 to 300) kHz	0.47 mV/V + 3.8 μ V	
	(10 to 100) mV		
	(1 to 40) Hz	86 μ V/V + 4.6 μ V	
	40 Hz to 1 kHz	86 μ V/V + 2.3 μ V	
	(1 to 20) kHz	0.17 mV/V + 2.3 μ V	
	(20 to 50) kHz	0.35 mV/V + 2.3 μ V	
	(50 to 100) kHz	0.93 mV/V + 2.3 μ V	
	(100 to 300) kHz	3.5 mV/V + 12 μ V	
	300 kHz to 1 MHz	12 mV/V + 12 μ V	
	(1 to 2) MHz	18 mV/V + 12 μ V	
	100 mV to 1 V		
	(1 to 40) Hz	92 μ V/V + 50 μ V	
	40 Hz to 1 kHz	92 μ V/V + 31 μ V	
	(1 to 10) V		
	(1 to 20) kHz	0.17 mV/V + 31 μ V	
	(20 to 50) kHz	0.35 mV/V + 31 μ V	
	(50 to 100) kHz	0.93 mV/V + 31 μ V	
	(100 to 300) kHz	3.5 mV/V + 0.12 mV	
300 kHz to 1 MHz	12 mV/V + 0.12 mV		
(1 to 2) MHz	18 mV/V + 0.12 mV		
(10 to 100) V			
(1 to 40) Hz	91 μ V/V + 0.14 mV		
40 Hz to 1 kHz	91 μ V/V + 0.14 mV		
(1 to 20) kHz	0.17 mV/V + 0.14 mV		
(20 to 50) kHz	0.35 mV/V + 0.14 mV		
(50 to 100) kHz	0.93 mV/V + 0.14 mV		
(100 to 300) kHz	3.5 mV/V + 0.16 mV		
300 kHz to 1 MHz	1.2 mV/V + 0.16 mV		
(1 to 2) MHz	1.8 mV/V + 0.16 mV		

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure ¹	(100 to 750) V (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	0.45 mV/V + 2.7 mV 0.45 mV/V + 2.7 mV 0.45 mV/V + 2.7 mV 0.56 mV/V + 2.7 mV 1.5 mV/V + 2.7 mV 4.7 mV/V + 2.7 mV 18 mV/V + 2.7 mV	Comparison to Precision 8.5 Digit Multimeter AC BAND < 2 MHz
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 11 mV to 10 V 45 Hz to 100 kHz 100 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (11 to 100) V 45 Hz to 100 kHz 100 kHz to 1 MHz (1 to 4) MHz (4 to 8) MHz (8 to 10) MHz (100 to 750) V 45 Hz to 100 kHz	0.46 mV/V + 47 mV 0.46 mV/V + 24 mV 0.69 mV/V + 24 mV 1.4 mV/V + 24 mV 3.5 mV/V + 24 mV 1 mV/V + 7.5 μV 14 mV/V + 6.5 μV 81 mV/V + 8.6 μV 0.24 V + 9.7 μV 1 mV/V + 0.7 mV 24 mV/V + 0.58 mV 47 mV/V + 0.81 mV 47 mV/V + 0.93 mV 0.18 V + 1.2 mV 1.5 mV/V + 2.7 mV	Comparison to Precision 8.5 Digit Multimeter AC BAND > 2 MHz

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹	(9 to 220) μ A		Comparison to High Performance Multifunction Calibrator
	10 Hz to 20 Hz	0.25 mA/A + 16 nA	
	20 Hz to 40 Hz	0.16 mA/A + 10 nA	
	40 Hz to 1 kHz	0.12 mA/A + 8 nA	
	1 kHz to 5 kHz	0.28 mA/A + 12 nA	
	5 kHz to 10 kHz	1.1 mA/A + 65 nA	
	220 μ A to 2.2 mA		
	10 Hz to 20 Hz	0.25 mA/A + 40 nA	
	20 Hz to 40 Hz	0.16 mA/A + 35 nA	
	40 Hz to 1 kHz	0.12 mA/A + 35 nA	
	1 kHz to 5 kHz	0.2 mA/A + 0.11 μ A	
	5 kHz to 10 kHz	1.1 mA/A + 0.65 μ A	
	(2.2 to 22) mA		
	10 Hz to 20 Hz	0.25 mA/A + 0.4 μ A	
	20 Hz to 40 Hz	0.16 mA/A + 0.35 μ A	
40 Hz to 1 kHz	0.12 mA/A + 0.35 μ A		
1 kHz to 5 kHz	0.2 mA/A + 0.55 μ A		
5 kHz to 10 kHz	1.1 mA/A + 5 μ A		
(22 to 220) mA			
10 Hz to 20 Hz	0.25 mA/A + 4 μ A		
20 Hz to 40 Hz	0.16 mA/A + 3.5 μ A		
40 Hz to 1 kHz	0.12 mA/A + 2.5 μ A		
1 kHz to 5 kHz	0.2 mA/A + 3.5 μ A		
5 kHz to 10 kHz	1.1 mA/A + 10 μ A		
220 mA to 2.2 A			
20 Hz to 1 kHz	0.26 mA/A + 35 μ A		
1 kHz to 5 kHz	0.45 mA/A + 80 μ A		
5 kHz to 10 kHz	7 mA/A + 0.16 mA		
AC Current – Source ¹	(2.2 to 11) A		Comparison to High Performance Multifunction Calibrator Amplifier
	40 Hz to 1 kHz	0.46 mA/A + 0.17 mA	
	1 kHz to 5 kHz	0.95 mA/A + 0.38 mA	
	5 kHz to 10 kHz	3.6 mA/A + 0.75 mA	
AC Current – Source ¹	(11 to 20.5) A		Comparison to Multifunction Calibrator
	45 Hz to 100 Hz	0.93 mA/A + 3.9 mA	
	100 Hz to 1 kHz	1.2 mA/A + 3.9 mA	
	1 kHz to 5 kHz	23 mA/A + 3.9 mA	

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source ¹ Clamp-On Meters	(10 to 16.5) A (45 to 65) Hz (65 to 440) Hz	0.35 % of reading + 0.001 7 A 0.89 % of reading + 0.008 3 A	Comparison to Multi Product Calibrator w/ Current Coil
	(16.5 to 150) A (45 to 65) Hz (65 to 440) Hz	0.34 % of reading + 0.043 A 0.93 % of reading + 0.043 A	
	(150 to 1 025) A (45 to 65) Hz (65 to 440) Hz	0.33 % of reading + 0.3 A 0.91 % of reading + 0.25 A	
	(33 to 330) mV (3.3 to 9) mA (9 to 33) mA (33 to 90) mA (90 to 330) mA (330 to 900) mA 900 mA to 2.2 A (2.2 to 4.5) A (4.5 to 11) A 330 mV to 1.02 kV (3.3 to 9) mA (9 to 33) mA (33 to 90) mA (90 to 330) mA (330 to 900) mA 900 mA to 2.2 A (2.2 to 4.5) A (4.5 to 11) A (11 to 20.5) A	3.1 mW/W 1.9 mW/W 2.7 mW/W 1.9 mW/W 2.7 mW/W 1.9 mW/W 2.7 mW/W 1.9 mW/W 1.9 mW/W 1.9 mW/W 1.9 mW/W 1.9 mW/W 1.9 mW/W 1.9 mW/W 1.6 mW/W 1.2 mW/W 1.2 mW/W 1.2 mW/W 1.2 mW/W 1.2 mW/W 1.2 mW/W 1.5 mW/W	
AC Power – Source ¹ (45 to 65) Hz			Comparison to Multi Product Calibrator

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power - Measure ¹	Up to 15 W (0.1 to 66) Hz 66 Hz to 1 kHz (>15 to 30) W (0.1 to 66) Hz 66 Hz to 1 kHz (>30 to 60) W (0.1 to 66) Hz 66 Hz to 1 kHz (>60 to 100) W (0.1 to 66) Hz 66 Hz to 1 kHz (>100 to 150) W (0.1 to 66) Hz 66 Hz to 1 kHz (>150 to 300) W (0.1 to 66) Hz 66 Hz to 1 kHz (>300 to 600) W (0.1 to 66) Hz 66 Hz to 1 kHz (>600 to 1 000) W (0.1 to 66) Hz 66 Hz to 1 kHz (>1 000 to 2 000) W (0.1 to 66) Hz 66 Hz to 1 kHz	0.1 % of reading + 0.012 W 0.068 % of reading + 0.018 W 0.1 % of reading + 0.023 W 0.068 % of reading + 0.035 W 0.1 % of reading + 0.046 W 0.068 % of reading + 0.071 W 0.1 % of reading + 0.076 W 0.068 % of reading + 0.12 W 0.1 % of reading + 0.12 W 0.068 % of reading + 0.18 W 0.1 % of reading + 0.24 W 0.068 % of reading + 0.36 W 0.1 % of reading + 0.43 W 0.068 % of reading + 0.71 W 0.1 % of reading + 0.45 W 0.068 % of reading + 1.2 W 0.1 % of reading + 0.81 W 0.068 % of reading + 2.4 W	Comparison to Precision Power Analyzer
Phase – Source ¹	+/- 179.99 ($\Delta\Phi^\circ$) (10 to 45) Hz (45 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.09° 0.08° 0.2° 0.39° 1.9° 3.9° 7.8°	Comparison to Multi Product Calibrator
Phase – Measure ¹	(0 to 360)° 10 Hz to 50 kHz (50 to 100) kHz	0.084° 0.41°	Comparison to Phase Meter

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure ¹	Up to 200 μ A		Comparison to Precision 8.5 Digit Multimeter
	1 Hz to 10 Hz	0.31 mA/A + 20 nA	
	10 Hz to 10 kHz	0.3 mA/A + 20 nA	
	10 kHz to 30 kHz	0.71 mA/A + 20 nA	
	30 kHz to 100 kHz	4 mA/A + 20 nA	
	200 μ A to 2 mA		
	1 Hz to 10 Hz	0.31 mA/A + 0.2 μ A	
	10 Hz to 10 kHz	0.3 m μ A/A + 0.2 μ A	
	10 kHz to 30 kHz	0.71 mA/A + 0.2 μ A	
	30 kHz to 100 kHz	4 mA/A + 0.2 μ A	
	(2 to 20) mA		
	1 Hz to 10 Hz	0.31 mA/A + 2 μ A	
	10 Hz to 10 kHz	0.3 mA/A + 2 μ A	
	10 kHz to 30 kHz	0.71 mA/A + 2 μ A	
	30 kHz to 100 kHz	4 mA/A + 2 μ A	
(20 to 200) mA			
1 Hz to 10 Hz	0.31 mA/A + 20 μ A		
10 Hz to 10 kHz	0.29 mA/A + 20 μ A		
10 kHz to 30 kHz	0.63 mA/A + 20 μ A		
200 mA to 2 A			
10 Hz to 2 kHz	0.62 mA/A + 0.2 mA		
2 kHz to 10 kHz	0.73 mA/A + 0.2 mA		
10 kHz to 30 kHz	3 mA/A + 0.2 mA		
(2 to 20) A			
10 Hz to 2 kHz	0.82 mA/A + 2 mA		
(2 to 10) kHz	2.5 mA/A + 2 mA		
AC High Current – Measure ¹	(50 to 400) Hz		Comparison to Precision 8.5 Digit Multimeter and Current Shunt
	(10 to 60) A	0.12 % of reading + 0.0029 A	
	(60 to 600) A	0.12 % of reading + 0.0032 A	
	(50 to 60) Hz		
	(600 to 1500) A	0.23 % of reading + 0.02 A	



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Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source ¹ (Simulated Fixed Points)	1 Ω	95 μΩ/Ω	Comparison to Multiproduct Calibrator
	1.9 Ω	95 μΩ/Ω	
	10 Ω	23 μΩ/Ω	
	19 Ω	23 μΩ/Ω	
	100 Ω	10 μΩ/Ω	
	190 Ω	10 μΩ/Ω	
	1k Ω	8.5 μΩ/Ω	
	1.9 k Ω	8.5 μΩ/Ω	
	10 k Ω	8.5 μΩ/Ω	
	19 k Ω	8.5 μΩ/Ω	
	100 k Ω	11 μΩ/Ω	
	190 k Ω	11 μΩ/Ω	
	1 M Ω	20 μΩ/Ω	
	1.9 M Ω	21 μΩ/Ω	
	10 M Ω	40 μΩ/Ω	
19 M Ω	47 μΩ/Ω		
100 M Ω	100 μΩ/Ω		
Resistance – Source ¹ (Simulation)	(100 to 330) MΩ 330 M Ω to 1.1 GΩ	2.3 mΩ/Ω + 78 kΩ 11.6 mΩ/Ω + 0.4 MΩ	Comparison to Multifunction Calibrator
Resistance – Source ¹ (Simulation)	Up to 11 Ω	1.7 mΩ/Ω + 35 μΩ	Comparison to Multifunction Calibrator
	(11 to 33) Ω	23 μΩ/Ω + 3.3 mΩ	
	(33 to 110) Ω	31 μΩ/Ω + 1.9 mΩ	
	(110 to 330) Ω	32 μΩ/Ω + 2.8 mΩ	
	330 Ω to 1.1 kΩ	33 μΩ/Ω + 2.3 mΩ	
	(1.1 to 3.3) kΩ	32 μΩ/Ω + 30 mΩ	
	(3.3 to 11) kΩ	5 μΩ/Ω + 1.4 Ω	
	(11 to 33) kΩ	32 μΩ/Ω + 0.3 Ω	
	(33 to 110) kΩ	33 μΩ/Ω + 0.34 Ω	
	(110 to 330) kΩ	37 μΩ/Ω + 3.1 Ω	
	330 kΩ to 1.1 MΩ	38 μΩ/Ω + 2.6 Ω	
	(1.1 to 3.3) MΩ	71 μΩ/Ω + 36 Ω	
	(3.3 to 11) MΩ	0.13 mΩ/Ω + 0.38 kΩ	
	(11 to 33) MΩ	0.22 mΩ/Ω + 7.4 kΩ	
	(33 to 110) MΩ	0.42 mΩ/Ω + 32 kΩ	
(110 to 330) MΩ	3.6 mΩ/Ω + 0.12 MΩ		
330 MΩ to 1.1 GΩ	18 mΩ/Ω + 0.59 MΩ		
Resistance – Source ¹ (Fixed Artifacts)	1 Ω	8 μΩ/ Ω	Comparison to Resistance Standards
	10 kΩ	4 μΩ/ Ω	

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source ¹ Fixed Point (Four-Terminal Pair)	0.1 Ω	0.56 mΩ	Comparison to Four Terminal Pair Resistor Set
	1 Ω	0.29 mΩ	
	10 Ω	2.3 mΩ	
	100 Ω	1.8 mΩ	
	1 kΩ	35 mΩ	
	10 kΩ	0.12 Ω	
	100 kΩ	1.3 Ω	
Resistance – Measure ¹	Up to 2Ω	17 μΩ/Ω + 4 μΩ	Comparison to Precision 8.5 Digit Multimeter
	(2 to 20) Ω	9.5 μΩ/Ω + 14 μΩ	
	(20 to 200) Ω	8 μΩ/Ω + 50 μΩ	
	200 Ω to 2 kΩ	8 μΩ/Ω + 0.5 mΩ	
	(2 to 20) kΩ	8 μΩ/Ω + 5 mΩ	
	(20 to 200) kΩ	8 μΩ/Ω + 50 mΩ	
	200 kΩ to 2 MΩ	9 μΩ/Ω + 1.0 Ω	
	(2 to 20) MΩ	17 μΩ/Ω + 10 Ω	
	(20 to 200) MΩ	65 μΩ/Ω + 1 kΩ	
200 MΩ to 2 GΩ	0.18 mΩ/Ω + 100 kΩ		
(2 to 20) GΩ	1.5 mΩ/Ω + 10 MΩ		
High Resistance – Measure ¹	100 MΩ to 1GΩ	0.059 % of reading	Comparison to Tera-Ohmmeter
	1 GΩ to 10 GΩ	0.084 % of reading	
	10 G Ω to 100 GΩ	0.13 % of reading	
	100 G Ω to 1 TΩ	0.25 % of reading	
	1 TΩ to 10 TΩ	0.36 % of reading	
	10 TΩ to 100 TΩ	0.61 % of reading	
	100 TΩ to 1 PΩ	1.2 % of reading	
1 PΩ to 10 PΩ	1.3 % of reading		

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
LCR Impedance – Source ¹	0.1 Ω		Comparison to Impedance Calibrator
	20 Hz to 2 kHz	0.22 % of reading	
	2 kHz to 4 kHz	0.32 % of reading	
	4 kHz to 7.5 kHz	0.52 % of reading	
	7.5 kHz to 10 kHz	1.1 % of reading	
	1 Ω		
	20 Hz to 40 kHz	0.12 % of reading	
	40 kHz to 100 kHz	0.22 % of reading	
	10 Ω		
	20 Hz to 100 kHz	0.06 % of reading	
LCR Impedance – Source ¹	100 Ω		Comparison to Impedance Calibrator
	20 Hz to 100 kHz	0.03 % of reading	
	1 kΩ		
	20 Hz to 100 kHz	0.07 % of reading	
	10 kΩ		
	20 Hz to 100 kHz	0.04 % of reading	
	100 kΩ		
	20 Hz to 20 kHz	0.04 % of reading	
	20 kHz to 75 kHz	0.07 % of reading	
	75 kHz to 100 kHz	0.13 % of reading	
	1 MΩ		
	20 Hz to 7.5 kHz	0.05 % of reading	
	7.5 kHz to 20 kHz	0.07 % of reading	
	20 kHz to 75 kHz	0.22 % of reading	
	75 kHz to 100 kHz	0.53 % of reading	
	10 MΩ		
20 Hz to 7.5 kHz	0.07 % of reading		
7.5 Hz to 10 kHz	0.26 % of reading		
100 MΩ			
20 Hz to 400 Hz	0.12 % of reading		
400 Hz to 750 Hz	0.22 % of reading		
750 Hz to 2 kHz	0.52 % of reading		
2 kHz to 4 kHz	1.1 % of reading		
4 kHz to 5 kHz	2.1 % of reading		

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
LCR Impedance – Source ¹	1 pF		Comparison to Impedance Calibrator, Standard Air Capacitor Set
	1 kHz to 1 MHz	0.043 % of reading	
	1 MHz to 5 MHz	0.11 % of reading	
	5 MHz to 13 MHz	0.41 % of reading	
	10 pF		
	20 Hz to 1 kHz	0.52 % of reading	
	1 kHz to 5 MHz	0.043 % of reading	
	5 MHz to 13 MHz	0.046 % of reading	
	100 pF		
	20 Hz to 1 kHz	0.32 % of reading	
	1 kHz to 5 MHz	0.043 % of reading	
	(5 to 13) MHz	0.066 % of reading	
	1 nF		
	20 Hz to 1 kHz	0.32 % of reading	
	1 kHz to 5 MHz	0.11 % of reading	
	(5 to 13) MHz	0.31 % of reading	
	10 nF		
	20 Hz to 100 kHz	0.11 % of reading	
	100 nF		
	20 Hz to 100 kHz	0.14 % of reading	
	1 μF		
	20 Hz to 100 kHz	0.14 % of reading	
	10 μF		
	20 Hz to 10 kHz	0.14 % of reading	
	100 μF		
	20 Hz to 10 kHz	0.23 % of reading	
	10 μH		
	20 Hz to 100 kHz	0.53 % of reading	
100 μH			
20 Hz to 100 kHz	0.53 % of reading		
1 mH			
20 Hz to 100 kHz	0.2 % of reading		
10 mH			
20 Hz to 100 kHz	0.2 % of reading		
100 mH			
20 Hz to 100 kHz	0.2 % of reading		
1 H			
20 Hz to 10 kHz	0.24 % of reading		
10 H			
20 Hz to 10 kHz	0.24 % of reading		

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Impedance – Measure ¹	(10 to 100) mΩ		Precision LCR Meter
	20 Hz to 1 kHz	0.03 % of reading + 0.77 μΩ	
	1 kHz to 1 MHz	0.12 % of reading + 0.31 μΩ	
	(1 to 10) Ω		
	20 Hz to 30 Hz	0.30 % of reading + 13 μΩ	
	30 Hz to 1 MHz	0.16 % of reading + 13 μΩ	
	10 Ω to 1 kΩ		
	20 Hz to 30 Hz	0.30 % of reading + 0.69 mΩ	
	30 Hz to 100 Hz	0.12 % of reading + 0.28 mΩ	
	100 Hz to 1 MHz	0.06 % of reading + 0.13 mΩ	
	(1 to 300) kΩ		
	20 Hz to 30 Hz	0.30 % of reading + 0.69 Ω	
	30 Hz to 100 Hz	0.12 % of reading + 0.28 Ω	
	100 Hz to 1 MHz	0.06 % of reading + 0.13 Ω	
	300 kΩ to 10 MΩ		
	20 Hz to 30 Hz	0.30 % of reading + 0.08 kΩ	
30 Hz to 1 MHz	0.12 % of reading + 0.03 kΩ		
10 MΩ to 100 MΩ			
20 Hz to 1 kHz	0.30 % of reading + 0.76 kΩ		
1kHz to 1 MHz	0.12 % of reading + 0.3 kΩ		
Capacitance – Source ¹ (Simulation)			Comparison to Multi Product Calibrator
10 Hz to 10 kHz	(220 to 399.9) pF	0.58 % of reading + 12 pF	
10 Hz to 10 kHz	(0.4 to 1.099 9) nF	0.57 % of reading + 12 pF	
10 Hz to 3 kHz	(1.1 to 3.299 9) nF	0.57 % of reading + 12 pF	
10 Hz to 1 kHz	(3.3 to 10.999 9) nF	0.22 % of reading + 27 pF	
10 Hz to 1 kHz	(11 to 32.999 9) nF	0.29 % of reading + 0.12 nF	
10 Hz to 1 kHz	(33 to 109.999) nF	0.29 % of reading + 0.13 nF	
10 Hz to 1 kHz	(110 to 329.999) nF	0.29 % of reading + 0.35 nF	
(10 to 600) Hz	(0.33 to 1.099 99) μF	0.28 % of reading + 1.5 nF	
(10 to 300) Hz	(1.1 to 3.299 99) μF	0.29 % of reading + 3.5 nF	
(10 to 150) Hz	(3.3 to 10.999 9) μF	0.29 % of reading + 1.3 nF	
(10 to 120) Hz	(11 to 32.999 9) μF	0.46 % of reading + 36 nF	
(10 to 80) Hz	(33 to 109.999) μF	0.53 % of reading + 0.12 μF	
(0 to 50) Hz	(110 to 329.999) μF	0.53 % of reading + 0.35 μF	
(0 to 20) Hz	(0.33 to 1.099 99) mF	0.5 % of reading + 1.5 μF	
(0 to 6) Hz	(1.1 to 3.299 99) mF	0.52 % of reading + 3.6 μF	
(0 to 2) Hz	(3.3 to 10.999 9) mF	0.51 % of reading + 13 μF	
(0 to 0.6) Hz	(11 to 32.999 9) mF	0.86 % of reading + 35 μF	
(0 to 0.2) Hz	(33 to 110) mF	1.3 % of reading + 0.13 mF	

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source ¹ (Simulation)			Comparison to Multi Product Calibrator
50 Hz to 1 kHz	(330 to 500) pF	3.9 mF/F + 7.8 pF	
50 Hz to 1 kHz	500 pF to 1.1 nF	3.9 mF/F + 7.8 pF	
50 Hz to 1 kHz	(1.1 to 3.3) nF	3.9 mF/F + 7.8 pF	
50 Hz to 1 kHz	(3.3 to 11) nF	3.9 mF/F + 7.8 pF	
50 Hz to 1 kHz	(11 to 33) nF	1.9 mF/F + 78 pF	
50 Hz to 1 kHz	(33 to 110) nF	1.9 mF/F + 78 pF	
50 Hz to 1 kHz	(110 to 330) nF	1.9 mF/F + 0.23 nF	
50 Hz to 1 kHz	330 nF to 1.1 μF	1.9 mF/F + 0.8 nF	
50 Hz to 1 kHz	(1.1 to 3.3) μF	2.7 mF/F + 2.3 nF	
(50 to 400) Hz	(3.3 to 11) μF	2.7 mF/F + 7.8 nF	
(50 to 400) Hz	(11 to 33) μF	3.1 mF/F + 23 nF	
(50 to 200) Hz	(33 to 110) μF	3.9 mF/F + 78 nF	
(50 to 100) Hz	(110 to 330) μF	5.4 mF/F + 0.23 μF	
(50 to 100) Hz	330 μF to 1.1 mF	7.8 mF/F + 0.23 μF	
Fixed Capacitance ¹ @ 1 kHz (Artifacts)	(100 to 500) pF	0.64 pF	Comparison to Capacitance Standard Set
	500 pF to 5 nF	3.7 pF	
	(5 to 50) nF	32 pF	
	(50 to 100) nF	63 pF	
	(100 to 500) nF	0.59 nF	
	500 nF to 1.5 μF	0.63 nF	
Capacitance – Measure ¹	up to 100 pF	0.12 % of reading + 0.002 pF	Comparison to Digit Multimeter LCR Meter
	(100 to 1 000) pF	0.12 % of reading + 0.006 pF	
	(1 to 100) nF	0.06 % of reading + 0.05pF	
	(100 to 1 000) nF	0.06 % of reading + 0.02 nF	
	(1 to 100) μF	0.06 % of reading + 0.07 nF	
	(100 to 1 000) μF	0.06 % of reading + 3.4 nF	
	(1 to 110) mF	0.12 % of reading + 0.48 μF	
Inductance – Source ¹ (Fixed Artifacts)	100 Hz to 1 kHz		Comparison to Standard Value Inductors
	200 μH	0.58 μH	
	2 mH	2.4 μH	
	20 mH	24 μH	
	200 mH	0.24 mH	
	2 H	2.4 mH	
Inductance – Measure ¹	Up to 100 μH	0.08 % of reading + 0.000 02 μH	Comparison to Precision LCR Meter
	(100 to 1 000) μH	0.08 % of reading + 0.002 3 μH	
	(1 to 100) mH	0.13 % of reading + 0.000 03 mH	
	(0.1 to 1) H	0.12 % of reading + 0.000 059 H	
	(1 to 10) H	0.13% of reading + 0.000 28 H	

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Source and Measure ¹	Type B		Comparison to Multi Product Calibrator
	(600 to 800) °C	0.34 °C	
	(800 to 1 000) °C	0.26 °C	
	(1 000 to 1 550) °C	0.23 °C	
	(1 550 to 1 820) °C	0.26 °C	
	Type C		
	(0 to 150) °C	0.23 °C	
	(150 to 650) °C	0.2 °C	
	(650 to 1 000) °C	0.24 °C	
	(1 000 to 1 800) °C	0.39 °C	
	(1 800 to 2 316) °C	0.65 °C	
	Type E		
	(-250 to -100) °C	0.21 °C	
	(-100 to -25) °C	0.12 °C	
	(-25 to 350) °C	0.11 °C	
	(350 to 650) °C	0.13 °C	
	(650 to 1 000) °C	0.18 °C	
	Type J		
	(-210 to -100) °C	0.21 °C	
	(-100 to -30) °C	0.12 °C	
	(-30 to 150) °C	0.11 °C	
	(150 to 760) °C	0.13 °C	
	(760 to 1 200) °C	0.18 °C	
	Type K		
	(-200 to -100) °C	0.26 °C	
	(-100 to -25) °C	0.14 °C	
	(-25 to 120) °C	0.12 °C	
	(120 to 1 000) °C	0.20 °C	
(1 000 to 1 372) °C	0.31 °C		
Type L			
(-200 to -100) °C	0.29 °C		
(-100 to 800) °C	0.2 °C		
(800 to 900) °C	0.13 °C		
Type N			
(-200 to -100) °C	0.31 °C		
(-100 to -25) °C	0.17 °C		
(-25 to 120) °C	0.15 °C		
(120 to 410) °C	0.14 °C		
(410 to 1 300) °C	0.21 °C		

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Temperature Indicating Devices – Source and Measure ¹	Type R		Comparison to Multi Product Calibrator
	(0 to 250) °C	0.44 °C	
	(250 to 400) °C	0.27 °C	
	(400 to 1 000) °C	0.26 °C	
	(1 000 to 1 767) °C	0.31 °C	
	Type S		
	(0 to 250) °C	0.36 °C	
	(250 to 1 000) °C	0.28 °C	
	(1 000 to 1 400) °C	0.29 °C	
	(1 400 to 1 767) °C	0.36 °C	
	Type T		
	(-250 to -150) °C	0.49 °C	
	(-150 to 0) °C	0.19 °C	
(0 to 120) °C	0.12 °C		
(120 to 400) °C	0.11 °C		
Type U			
(-200 to 0) °C	0.43 °C		
(0 to 600) °C	0.21 °C		

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Temperature Indicating Devices – Source and Measure ¹	Pt 385, 100 Ω (-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C Pt 3926, 100 Ω (-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C Pt 3916, 100 Ω (-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.04 °C 0.05 °C 0.07 °C 0.08 °C 0.09 °C 0.18 °C 0.04 °C 0.05 °C 0.05 °C 0.08 °C 0.09 °C 0.19 °C 0.03 °C 0.04 °C 0.05 °C 0.05 °C 0.06 °C 0.15 °C 0.08 °C 0.18 °C	Comparison to Multi Product Calibrator
Oscilloscopes ¹ DC Voltage Into 50 Ω load Into 1 MΩ load	(-6.6 to 6.6) V (-130 to 130) V	1.9 mV/V + 31 μV 0.39 mV/V + 31 μV	Comparison to Multi Product Calibrator
Oscilloscopes ¹ Square Wave Into 50 Ω load Into 1 MΩ load	10 Hz to 10 kHz 1 mVp-p to 6.6 Vp-p 1 mVp-p to 130 Vp-p	1.9 mV/V + 31 μV 0.77 mV/V + 31 μV	Comparison to Multi Product Calibrator
Oscilloscopes ¹ Wave Generator Square, Sine, Triangle Into 50 Ω load Into 1 MΩ load	1.8 mVp-p to 2.5 Vp-p 1.8 mVp-p to 55 Vp-p	23 mV/V + 78 μV 23 mV/V + 78 μV	Comparison to Multi Product Calibrator

Electrical – DC/Low Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes ^{1,8} Leveled Sine Wave Source Into 50 Ω load	5 mVp-p to 5.5 Vp-p 50 kHz 50 kHz to 100 MHz 100 to 300 MHz 300 to 600 MHz	16 mV/V + 0.24 mV 27 mV/V + 0.24 mV 31 mV/V + 0.24 mV 47 mV/V + 0.24 mV	Comparison to Oscilloscope Calibrator
Flatness Relative to 50 kHz	50 kHz to 100 MHz 100 to 300 MHz 300 to 600 MHz	12 mV/V + 78 μV 16 mV/V + 78 μV 31 mV/V + 78 μV	
Oscilloscopes ^{1,8,9} Time Marker Source Into 50 Ω load	5 s to 50 ms 20 ms to 2 ns	1.9 μs/s + 775t 1.9 μs/s	Comparison to Multiproduct Calibrator
Oscilloscopes ^{1,8} Square Wave Frequency Source	10 Hz to 10 kHz	1.9 μHz/Hz	Comparison to Multiproduct Calibrator
Oscilloscopes ^{1,8} Leveled Sine Wave Frequency Source	50 kHz to 600 MHz	1.9 μHz/Hz	Comparison to Multiproduct Calibrator
Oscilloscopes ^{1,8} Wave Generator Frequency Source	10 Hz to 100 kHz	19 μHz/Hz + 12 mHz	Comparison to Multiproduct Calibrator
Rise Time ¹ (measurement)	1 ns to 10 μs 10 μs to 100 μs	1.2 ns 2.9 ns	Comparison to Oscilloscope

Length – Dimensional Metrology

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Test, Dial Indicators & Thickness Gages ^{1,2}	Up to 1 in (1 to 4) in	52 μin (47 + 8.7L) μin	Comparison to Gage Blocks
Gauge Blocks ²	Up to 0.05 in (0.05 to 4) in (4 to 12) in	4.7 μin (2.1 + 3.8L) μin (1 + 4.3L) μIN	Comparison to Gage Blocks, P&W LabMaster®

Length – Dimensional Metrology

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Calipers ^{1,2}	Up to 20 in (20 to 54) in	380 μin (310 + 4.2L) μin	Comparison to Gage Blocks, Standard Rings, Rod Sets
Micrometers ^{1,2} (Linearity Only)	Up to 1 in (1 to 4) in (4 to 20) in (20 to 36) in (36 to 54) in	35 μin (34 + 2L) μin (67 + 2.7L) μin (56 + 3.8L) μin 790 μin	Comparison to Gage Blocks, Rod Sets
Pin and Plug Gages ²	Up to 6 in	(5 + 5.3L) μin	Comparison to P&W LabMaster®
Ring Gages ²	Up to 1 in (1 to 6.4) in	(13 + 16L) μin (24 + 4.3L) μin	Comparison to P&W LabMaster®
Height Gages ¹	Up to 24 in	410 μin	Comparison to Gage Blocks
Depth Micrometers ^{1,2}	Up to 6 in (6 to 12) in	(42 + 2.3L) μin (34 + 5L) μin	Comparison to Gage Blocks
Protractor/Angle ^{1,2}	Up to 90°	1.6'	Comparison to Angle Gage Blocks
Roughness Testers ¹	118 μin	3.9 μin	Comparison to Roughness Standard
Roughness Specimens ¹	Up to 118 μin	4.1 μin	Comparison to Surface Roughness Meter
Coating Thickness Gauge ¹	Up to 100 μm Over 100 to 1500 μm	2.6 μm 2.6 μm + 0.07% of reading	Comparison to Plastic Shims

Mass and Mass Related

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force-Measuring Equipment Tension / Compression ¹	Up to 1 kgf	0.000 19 kgf	Comparison to NIST Class F Weights
	(1 to 2.5) kgf	0.000 45 kgf	
	(2.5 to 5) kgf	0.000 93 kgf	
	(5 to 10) kgf	0.002 kgf	
	(10 to 25) kgf	0.004 8 kgf	
	(25 to 50) kgf	0.01 kgf	
	(50 to 100) kgf (100 to 150) kgf	0.018 kgf 0.047 kgf	
Force-Measuring Equipment Tension / Compression ¹	Up to 2 lbf	0.000 46 lbf	Comparison to Standard weight
	(2 to 5) lbf	0.000 96 lbf	
	(5 to 10) lbf	0.002 lbf	
	(10 to 20) lbf	0.005 lbf	
	(20 to 50) lbf	0.01 lbf	
	(50 to 100) lbf	0.017 lbf	
	(100 to 200) lbf (200 to 300) lbf	0.045 lbf 0.093 lbf	
Pressure – Source/Pressure Gages and Transducers ¹	(-14 to 20) psi	0.005 psi	Comparison to Pressure Calibration System
	(20 to 100) psi	0.02 psi	
	(10 to 300) psi	0.04 psi	
	(300 to 1 000) psi	0.2 psi	
	(1 000 to 10 000) psi (10 000 to 15 000) psi	6 psi 9 psi	
Torque – Measure/Torque Tools ¹	(20 to 200) ozf·in	0.57 % of reading + 0.12 ozf·in	Comparison to Torque Transducers
	(5 to 50) lbf·in	0.61 % of reading + 0.004 lbf·in	
	(40 to 400) lbf·in	0.33 % of reading + 0.06 lbf·in	
	(100 to 1 000) lbf·in	0.27 % of reading + 0.8 lbf·in	
	(25 to 250) lbf·ft	0.32 % of reading + 0.05 lbf·ft	
	(60 to 600) lbf·ft (600 to 1 000) lbf·ft	0.29 % of reading + 0.58 lbf·ft 0.35 % of reading + 0.74 lbf·ft	
Torque – Source/Analyzers and Measuring equipment	(1 to 10) lbf·in	0.04 % of reading + 0.003 lbf·in	Comparison to Calibration Wheels, Standard Weights
	(10 to 25) lbf·in	0.049 % of reading + 0.005 lbf·in	
	(25 to 50) lbf·in	0.058 % of reading + 0.003 lbf·in	
	(50 to 100) lbf·in	0.06 % of reading + 0.003 lbf·in	
	(100 to 150) lbf·in	0.059 % of reading + 0.006 lbf·in	
	(150 to 250) lbf·in	0.061 % of reading + 0.004 lbf·in	
	(25 to 250) lbf·ft (250 to 600) lbf·ft (600 to 1 000) lbf·ft	0.046 % of reading + 0.011 lbf·ft 0.052 % of reading + 0.1 lbf·ft 0.042 % of reading + 1.1 lbf·ft	

Mass and Mass Related

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales & Balances ^{1,10}	(1 to 500) mg	0.014 mg	Comparison to ASTM E617 Class 0 weights and internal calibration procedure utilized in the calibration of the weighing system.
	(0.5 to 5) g	0.026 mg	
	(5 to 10) g	0.037 mg	
	(10 to 20) g	0.058 mg	
	(20 to 50) g	0.12 mg	
	(50 to 100) g	0.24 mg	
	(100 to 200) g	0.47 mg	
	(200 to 500) g	1.2 mg	
	(0.5 to 1) kg	3.0 mg	
(1 to 2) kg	5.3 mg		
Scales & Balances ^{1,10}	(2 to 10) kg	1.2 g	Comparison to ASTM E617 Class 6 weights, NIST Class F weights, and internal calibration procedure utilized in the calibration of the weighing system.
	(10 to 20) kg	2.8 g	
	(20 to 40) kg	4.9 g	
	(40 to 50) kg	6.2 g	
Scales & Balances ^{1,10}	(0.001 to 0.05) lb	0.000 012 lb	Comparison to NIST Class F Weights and internal calibration procedure utilized in the calibration of the weighing system.
	(0.1 to 1) lb	0.000 18 lb	
	(1 to 2) lb	0.000 24 lb	
	(2 to 5) lb	0.000 6 lb	
	(5 to 10) lb	0.001 1 lb	
	(10 to 20) lb	0.002 4 lb	
	(20 to 50) lb	0.006 lb	

Thermodynamic

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity – Measure ¹	Up to 90 %RH	1.6 % RH	Comparison to Humidity Probe Monitor
	(90 to 95) %RH	2.2 % RH	
Temperature – Measure ¹	(-200 to 0) °C	0.033 °C	Comparison to Reference Thermometer w/ PRT
	(0 to 100) °C	0.058 °C	
	(100 to 300) °C	0.077 °C	
	(300 to 420) °C	0.12 °C	

Thermodynamic

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Measuring Equipment ¹	(-200 to 0) °C (0 to 100) °C (100 to 420) °C	0.069 °C 0.084 °C 0.43 °C	Comparison to Reference Thermometer w/ PRT and Temperature Dry Block, Micro Bath
Radiation (Infrared) ¹ Thermometers	(50 to 100)°C (100 to 300)°C (300 to 500)°C	1.7°C 5.3°C 8.2°C	Comparison to Blackbody Source (Flat plate) ε = 0.95, λ = (8 to 14) μm

Time and Frequency

San Antonio, TX

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source ¹	10 MHz	1.0 x 10 ⁻¹⁰ Hz	Comparison to Frequency Standard
Frequency – Source ¹	10 mHz to 2 MHz	1.9 μHz/Hz + 3.8 μHz	Comparison to Multiproduct Calibrator
Frequency – Source ¹	(2 to 80) MHz	5.8 x 10 ⁻⁹ MHz	Comparison to Frequency Synthesizer w/ GPS Reference Signal Generator
Time Interval ¹	50 ns to 999 s	1.3 x 10 ⁻⁹ + 0.14 ns	Comparison to Universal Counter w/ GPS Reference
Period ¹	4.44 ns to 10 s	0.012 % of reading + 0.17 ns	Comparison to Universal Counter w/ GPS Reference
Rise/Fall Time – Measure ¹	1 ns to 10 μs (10 to 100) μs	1.2 ns 2.9 ns	Comparison to Digital Oscilloscope Or Universal Counter w/ GPS Reference
Pulse Width – Measure ¹	> 5 ns	1.1 ns	Comparison to Universal Counter w/ GPS Reference

Time and Frequency

San Antonio, TX

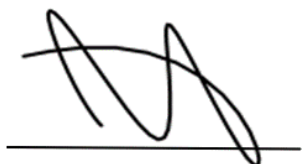
Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Stop Watches – Totalize Method ¹	1s to 24 hr	40 ms	Comparison to Universal Counter and Synthesizer w/ GPS Reference

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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. Γ = rho; L = length in inches; DL = diagonal length in inches; ' = arc-minute.
3. Unitless linear measure.
4. Portions of ISO 8573-5 requiring analysis using gas chromatography are contracted to another accredited laboratory.
5. This analysis is intended to be used in conjunction with the testing per ISO 8573-4 when there is a need to identify solid particles that are also viable, colony-forming units and is contracted to another accredited laboratory.
6. The nominal values listed are approximate.
7. Scope uncertainties do not include estimated contributions to uncertainty from a “best available” unit under test.
8. t = time in seconds
9. The methods used by the laboratory are adopted from OEM-Sourced, MET-CAL, DOD MIDAS, GIDEP-Sourced, CP, TSA and Customer Specific.
10. $0.6R$, where R is the resolution of the unit under calibration, will be added to the Measurement Uncertainty (MU) at the time of calibration.



Jason Stine, Vice President