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.

Jason Stine, Vice President

Expiry Date: 29 October 2024

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, LLC

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Services performed at satellite locations as indicated
46782 Lakeview Blvd. Fremont, CA 94538
6120 Hanging Moss Rd. Orlando, FL 32807

CALIBRATION, DIMENSIONAL MEASUREMENT AND TESTING

Valid to: **October 29, 2024** Certificate Number: **AC-1736**

CALIBRATION

Acoustics and Vibration

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 2 500) 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	Vibration Calibrator System Fremont, CA
Sound Level Meters	(94, 114) dB @1 kHz	0.28 dB	Sound Calibrator Vista, CA

Chemical Quantities

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
pH - Source	4.01 pH 7.00 PH 10.00 pH	0.017 pH 0.018 pH 0.031 pH	Standard Solutions Vista, CA Fremont, CA Orlando, FL
Conductivity - Source	(100 to 10 000) µS/cm	1 % of calibrated value	Standard Solutions Vista, CA Fremont, CA Orlando, FL

Electrical – DC/Low Frequency

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	High Performance Multifunction Calibrator Vista, CA Orlando, FL
DC Voltage – Source	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 + 1 µV 3.5 µV/V + 3.1 µV 3.5 µV/V + 8.1 µV 5 µV/V + 83 µV 6.5 µV/V + 0.68 mV	High Performance Multifunction Calibrator Fremont, CA
DC Voltage – Source [1] Fixed Points	1 V 1.018 V 10 V	14 µV 17 µV 35 µV	DC Reference Standard Vista, CA
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	Precision 8.5 Digit Multimeter Fremont, CA Orlando, FL
	(2 to 200) mV 200 mV to 2 V (2 to 20) V (20 to 200) V 200 V to 1 kV	6.7 µV/V + 0.2 µV 4.3 µV/V + 0.5 µV 4.3 µV/V + 4.8 µV 6.7 µV/V + 98 µV 6.7 µV + 0.63 mV	Precision 8.5 Digit Multimeter Vista CA

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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	High Voltage Meter Vista, CA Fremont, CA Orlando, FL
DC Current – Source [1]	Up to 220 µA 220 µA 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 µA 72 µA/A + 14 µA 0.023 % of reading + 0.47 mA	High Performance Multifunction Calibrator w/ Transconductance Amplifier Vista, CA Orlando, FL
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 µA/A + 6 nA 35 µA/A + 7.6 nA 35 µA/A + 48 nA 55 µA/A + 0.74 µA 0.13 mA/A + 13 µA	High Performance Multifunction Calibrator Fremont, CA
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 µA 0.27 mA/A + 0.13 mA 0.39 mA/A + 0.41 mA 0.79 mA/A + 0.41 mA	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
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	Multi Product Calibrator w/ Current Coil Vista, CA Fremont, CA Orlando, FL
DC Power – Source [1] 33 mV to 1 020 V 329.99 mA range 2.999 9 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	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
DC Power - Measure	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	Precision Power Analyzer Vista, CA

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 µA/A + 93 pA 18 µA/A + 0.1 nA 28 µA/A + 0.14 nA 30 µA/A + 0.98 nA 30 µA/A + 6.5 nA 30 µA/A + 63 nA 44 µA/A + 1 µA 0.14 mA/A + 12 µA	Precision 8.5 Digit Multimeter Fremont, CA Orlando, FL
DC Current – Measure [1]	(2 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	15 µA/A + 0.49 nA 15 µA/A + 4.8 nA 17 µA/A + 48 nA 59 µA/A + 0.96 µA 0.23 mA/A + 25 µA 0.49 mA/A + 0.36 mA	Precision 8.5 DigitMultimeter Vista, CA
DC Current – Measure [1]	(1 to 100) A (100 to 600) A (600 to 2 000) A	85 µA/A 127 µA/A 0.29 % of reading + 0.02 A	Precision 8.5 Digit Multimeter w/ Current Shunts Vista, CA Fremont, CA Orlando, FL
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	 0.013 % of reading + 7.2 µV 0.008 3 % of reading + 4.2 µV 0.007 2 % of reading + 4.2 µV 0.016 % of reading + 4.6 µV 0.042 % of reading + 5.3 µV 0.095 % of reading + 10 µV 0.13 % of reading + 20 µV 0.25 % of reading + 21 µV 0.021 % of reading + 4.9 µV 0.008 3 % of reading + 4.3 µV 0.007 % of reading + 4.4 µV 0.017 % of reading + 4.8 µV 0.042 % of reading + 6.1 µV 0.092 % of reading + 12 µV 0.13 % of reading + 22 µV 0.22 % of reading + 33 µV	High Performance Multifunction Calibrator w/ Transconductance Amplifier Vista, CA Orlando, FL

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1]	(22 to 220) mV		High Performance Multifunction Calibrator w/ Transconductance Amplifier Vista, CA Orlando, FL
	(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	
	(2.2 to 22) V		
	(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	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1]	(220 to 1 100) V 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	 50 µV/V + 27 mV 0.1 mV/V + 31 mV 0.41 mV/V + 70 mV 0.45 mV/V + 12 mV 1.8 mV/V + 21 mV	High Performance Multifunction Calibrator w/ Transconductance Amplifier Vista, CA Orlando, FL
AC Voltage – Source	(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	 0.55 mV/V + 4.5 µV 0.21 mV/V + 4.5 µV 0.11 mV/V + 4.5 µV 0.37 mV/V + 4.5 µV 0.85 mV/V + 7 µV 1.1 mV/V + 13 µV 1.7 mV/V + 25 µV 3.4 mV/V + 25 µV 0.55 mV/V + 5 µV 0.21 mV/V + 5 µV 0.11 mV/V + 5 µV 0.37 mV/V + 5 µV 0.85 mV/V + 7 µV 1.1 mV/V + 12 µV 1.7 mV/V + 25 µV 3.4 mV/V + 25 µV 0.55 mV/V + 13 µV 0.21 mV/V + 8 µV 0.11 mV/V + 8 µV 0.32 mV/V + 8 µV 0.85 mV/V + 25 µV 1.1 mV/V + 25 µV 1.7 mV/V + 35 µV 3.4 mV/V + 80 µV	High Performance Multifunction Calibrator w/ Transconductance Amplifier Fremont, CA

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source	220 mV to 2.2 V		High Performance Multifunction Calibrator w/ Transconductance Amplifier Fremont, CA
	(10 to 20) Hz	0.24 mV/V + 45 µV	
	(20 to 40) Hz	90 µV/V + 25 µV	
	40 Hz to 20 kHz	45 µV/V + 21 µV	
	(20 to 50) kHz	75 µV/V + 22 µV	
	(50 to 100) kHz	0.11 mV/V + 82 µV	
	(100 to 300) kHz	0.42 mV/V + 0.11 mV	
	(300 to 500) kHz	1 mV/V + 0.22 mV	
	500 kHz to 1 MHz	1.7 mV/V + 0.31 mV	
	(2.2 to 22) V		
	(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

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure [1]	(1 to 10) mV		Precision 8.5 Digit Multimeter Fremont, CA Orlando, FL
	(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 to 1 000) V		
	(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		High Voltage Meter Vista, CA Fremont, CA Orlando, FL
	(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

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure [1]	Up to 200 mV		Precision 8.5 Digit Multimeter Vista, CA
	(1 to 10) Hz	0.2 mV/V + 29 µV	
	(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

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	Precision 8.5 Digit Multimeter Vista, CA
AC Voltage Flatness - Source (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	High Performance Multifunction Calibrator (Wideband) Vista, CA Fremont, CA Orlando, FL
AC Voltage Flatness - Measure	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	Precision 8.5 Digit Multimeter w/ Thermal Converters Vista, CA Fremont, CA Orlando, FL

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure [1]	Up to 2.2 mV		AC Measurement Standard Vista, CA Orlando, FL
	(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

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure [1]	(70 to 220) mV		AC Measurement Standard Vista, CA Orlando, FL
	(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 + 4.7 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

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure [1]	(7 to 22) V		AC Measurement Standard Vista, CA Orlando, FL
	(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

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Measure	Up to 10 mV		Precision 8.5 Digit Multimeter ACBAND < 2 MHz Vista, CA Fremont, CA Orlando, FL
	(1 to 40) Hz	3.5 µV/V + 4.6 µV	
	40 Hz to 1 kHz	2.4 µV/V + 3.2 µV	
	(1 to 20) kHz	3.5 µV/V + 4.6 µV	
	(20 to 50) kHz	12 µV/V + 3.2 µV	
	(50 to 100) kHz	58 µV/V + 3.2 µV	
	(100 to 300) kHz	0.47 mV/V + 3.8 µV	
	(10 to 100) mV		
	(1 to 40) Hz	86 µV/V + 4.6 µV	
	40 Hz to 1 kHz	86 µV/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 µV/V + 50 µV	
	40 Hz to 1 kHz	92 µV/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 µV/V + 0.14 mV	
	40 Hz to 1 kHz	91 µV/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

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Measure	(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	Precision 8.5 Digit Multimeter ACBAND < 2 MHz Vista, CA Fremont, CA Orlando, FL
AC Voltage - Measure	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	Precision 8.5 Digit Multimeter ACBAND > 2 MHz Vista, CA Fremont, CA Orlando, FL
AC Current – Source [1]	(9 to 220) µA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz 220 µA to 2.2 mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.02 % of reading + 26 nA 0.01 % of reading + 30 nA 0.01 % of reading + 8.3 nA 0.02 % of reading + 36 nA 0.1 % of reading + 63 nA 0.004 8 % of reading + 1.4 µA 0.006 1 % of reading + 0.44 µA 0.007 2 % of reading + 95 nA 0.016 % of reading + 0.18 µA 0.1 % of reading + 0.65 µA	High Performance Multifunction Calibrator Vista, CA Orlando, FL

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source [1]	(2.2 to 22) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (22 to 220 mA) (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz 220 mA to 2.2 A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.003 4 % of reading + 20 µA 0.002 5 % of reading + 12 µA 0.007 2 % of reading + 0.95 µA 0.015 % of reading + 1.5 µA 0.1 % of reading + 5.1 µA 0.004 6 % of reading + 0.15 mA 0.003 5 % of reading + 85 µA 0.006 2 % of reading + 12 µA 0.014 % of reading + 16 µA 0.089 % of reading + 38 µA 0.18 mA/A + 0.17 mA 0.32 mA/A + 0.27 mA 5.1 mA/A + 2.8 mA 0.3 mA/A + 1.1 mA 0.74 mA/A + 53 µA 2.8 mA/A + 200 µA	High Performance Multifunction Calibrator Vista, CA Orlando, FL
AC Current – Source [1]	(11 to 20) A (45 to 100) Hz 100 Hz to 1kHz (1 to 5) kHz	 1.2 mA/A + 5 mA 1.5 mA/A + 5 mA 30 mA/A + 5 mA	Multi Product Calibrator Vista, CA Orlando, FL
AC Current – Source [1] Clamp-On Meters	(10 to 16.5) A (45 to 65) Hz (65 to 440) Hz (16.5 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 025) A (45 to 65) Hz (65 to 440) Hz	 0.28 % of reading + 0.16 A 0.79 % of reading + 0.13 A 0.28 % of reading + 0.31 A 0.79 % of reading + 0.16 A 0.29 % of reading + 1.3 A 0.8 % of reading + 1.2 A	Multi Product Calibrator w/ Current Coil Vista, CA Fremont, CA Orlando, FL

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source	Up to 220 µA		High Performance Multifunction Calibrator Fremont, CA
	(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 µA 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 µA	
	(5 to 10) kHz	1.1 mA/A + 0.65 µA	
	(2.2 to 22) mA		
	(10 to 20 Hz	0.25 mA/A + 0.41 µA	
	(20 to 40) Hz	0.16 mA/A + 0.36 µA	
	40 Hz to 1 kHz	0.12 mA/A + 0.36 µA	
	(1 to 5) kHz	0.2 mA/A + 0.56 µA	
	(5 to 10) kHz	1.1 mA/A + 5.1 µA	
	(22 to 220) mA		
	(10 to 20) Hz	0.25 mA/A + 4.1 µA	
	(20 to 40) Hz	0.16 mA/A + 3.6 µA	
	40 Hz to 1 kHz	0.12 mA/A + 2.6 µA	
	(1 to 5) kHz	0.2 mA/A + 3.6 µA	
	(5 to 10) kHz	1.1 mA/A + 11 µA	
	220 mA to 2.2 A		
	20 Hz to 1 kHz	0.25 mA/A + 36 µA	
	(1 to 5) kHz	0.45 mA/A + 81 µA	
	(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

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Power – Source [1] PF = 1 (10 to 45) Hz 33 mV to 32.9999 V (3.3 mA to 2.99999 A) (45 to 65) Hz 33 mV to 1020 V (3.3 mA to 20.5 A)	110 µW to 99 W 110 µW to 21 kW	0.19 % of reading 0.15 % of reading	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
AC Power - Measure	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	 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	Precision Power Analyzer Vista, CA
AC Power - Measure	(>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 + 0.45 W 0.068 % of reading + 1.2 W 0.1 % of reading + 0.81 W 0.068 % of reading + 2.4 W	Precision Power Analyzer Vista, CA

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase – Source [1] (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	+/- 179.99 (ΔΦ°)	0.09° 0.2° 0.39° 1.9° 3.9° 7.8°	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
Phase – Measure	(0 to 360)° 10 Hz to 50 kHz (50 to 100) kHz	 0.084° 0.41°	Phase Meter Vista, CA
AC Current – Measure [1]	Up to 100 µA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz 100 µA 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 µA 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 µA 1.8 mA/A + 24 µA 0.71 mA/A + 24 µA 0.36 mA/A + 23 µA 0.71 mA/A + 24 µA 4.7 mA/A + 47 µA 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	Precision 8.5 Digit Multimeter Fremont, CA Orlando, FL
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	Precision 8.5 Digit Multimeter / Shunts Vista, CA Fremont, CA Orlando, FL

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Measure	Up to 200 µA 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz 200 µA 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 µA 0.86 mA/A + 0.24 µA 4.8 mA/A + 0.24 µA 0.37 mA/A + 2.4 µA 0.86 mA/A + 2.4 µA 4.8 mA/A + 2.4 µA 0.35 mA/A + 24 µA 0.75 mA/A + 24 µA 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	Precision 8.5 Digit Multimeter Vista CA
AC High Current - Measure	(50 to 400) H z (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 1 100) A (1 100 to 1 500) A	 0.59 % of reading + 0.029 A 0.59 % of reading + 0.37 A 0.6 % of reading + 1.6 A 0.6 % of reading + 2 A 0.6 % of reading + 3.8 A 0.6 % of reading + 4.1 A 0.6 % of reading + 4.9 A	Precision 8.5 Digit Multimeter and Current Transducers Orlando, FL
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	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	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL

Electrical – DC/Low Frequency

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	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
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	High Performance Multifunction Calibrator Vista, CA Orlando, FL
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	High Performance Multifunction Calibrator Fremont, CA

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source [1] Fixed Points	1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	47 Ω 0.47 kΩ 1.3 kΩ 12 kΩ	High Performance Multifunction Calibrator Fremont, CA
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	Four Terminal Pair Resistor Set Vista, CA Fremont, CA Orlando, FL
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	Precision 8.5 Digit Multimeter Fremont, CA Orlando, FL
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	Precision 8.5 Digit Multimeter Vista, CA
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	 (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	 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	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source [1] (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	 (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	 0.29 % 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	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
Fixed Capacitance @ 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	Capacitance Standard Set Vista, CA Fremont, CA Orlando, FL
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	Standard Air Capacitor Set Vista, CA Fremont, CA Orlando, FL
Capacitance - Measure	(1 to 10) nF (10 to 100) nF (0.1to 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	Digit Multimeter/LCR Meter Vista, CA Fremont, CA Orlando, FL

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inductance - Source 0.1 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	Standard Value Inductors Vista, CA Fremont, CA Orlando, FL
Inductance - Measure	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	Precision LCR Meter Vista, CA Fremont, CA Orlando, FL
Electrical Simulation of Thermocouple Indicating Devices – Source and Measure [1]	Type C (0 to 150) °C (150 to 650) °C (650 to 1 000) °C (1 000 to 1 800) °C (1 800 to 2 316) °C Type E (-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1 000) °C Type J (-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1 200) °C Type K (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1 000) °C (1 000 to 1 372) °C Type N (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1 300) °C	 0.29 °C 0.32 °C 0.28 °C 0.48 °C 0.71 °C 0.43 °C 0.21 °C 0.17 °C 0.14 °C 0.19 °C 0.35 °C 0.2 °C 0.14 °C 0.19 °C 0.26 °C 0.28 °C 0.21 °C 0.23 °C 0.25 °C 0.33 °C 0.39 °C 0.27 °C 0.23 °C 0.18 °C 0.27 °C	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Source and Measure [1]	Type R (0 to 250) °C (250 to 400) °C (400 to 1 000) °C (1 000 to 1 767) °C Type S (0 to 250) °C (250 to 1 000) °C (1 000 to 1 400) °C (1 400 to 1 767) °C Type T (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	 0.83 °C 0.42 °C 0.31 °C 0.38 °C 0.55 °C 0.34 °C 0.32 °C 0.41 °C 0.63 °C 0.35 °C 0.26 °C 0.22 °C	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
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	 0.05 °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	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL

Electrical – DC/Low Frequency

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 (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 Pt 385 (500 Ω) (-200 to -80) °C (-80 to 100) °C (100 to 260) °C (260 to 400) °C (400 to 600) °C (600 to 630) °C Pt 385 (1 000 Ω) (-200 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 600) °C (600 to 630) °C PtNi 385 (120 Ω) (Ni 120) (-80 to 100) °C (100 to 260) °C CU 427 (10 Ω) (100 to 260) °C	 0.04 °C 0.05 °C 0.12 °C 0.13 °C 0.14 °C 0.16 °C 0.04 °C 0.05 °C 0.06 °C 0.08 °C 0.09 °C 0.11 °C 0.03 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.23 °C 0.08 °C 0.14 °C 0.3 °C	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
Oscilloscopes [1] - DC Voltage Into 50 Ω Into 1 MΩ Square Wave Into 50 Ω 10 Hz to 10 kHz Into 1 MΩ 10 Hz to 1 kHz (1 to 10) kHz Leveled Sine Amplitude Reference @ 50 kHz	 (0 to +/-6.6) V (0 to +/-130) V 1 mVpp to 6.6 Vpp 1 mVpp to 130 Vpp 1 mVpp to 130 Vpp 5 mV to 5.5 V	 0.2 % + 36 µV 0.039 % of reading + 37 µV 0.2 % of reading + 65 µV 0.078 % of reading + 36 µV 0.19 % of reading + 39 µV 15 mV/V + 0.49 mV	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL

Electrical – DC/Low Frequency

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 Edge Transition Time (Rise Time)	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1 100) 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	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
Oscilloscopes - Square Wave Signal 10 Hz to 10 kHz 50 Ω 1 M Ω DC Signal Into 50Ω Into 1MΩ	1 mVpp to 6.6 V p-p 1 mVpp to 130 V p-p 1 mVpp to 6.6 V p-p 1 mVpp 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	Oscilloscope Calibrator Vista, CA
Oscilloscopes - Leveled Sine Wave Square Wave Signal Leveled Sine Wave Flatness referenced to 50 kHz reference Time Markers (5-2-1 sequence) into a 50 Ω load Fast Edge Mode Programmable Rise Time	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 5 mV to 5.5 V 10 MHz Reference 600 MHz to 1.6 GHz (1.6 to 2.1) GHz (1 to 50) ns 100 ns to 20 ms 50 ms to 5 s 5 s to 50 ms 20 ms to 500 ps (1 to 100) kHz	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 20 mV/V + 0.3 mV 70 mV/V + 0.3 mV 80 mV/V + 0.3 mV 0.001 1 % of reading + 0.048 ps 0.000 2 % of reading + 7 ps 0.4 % of reading 2.5 µs/s + 5 µHz 0.33 µs/s < 0.15 ns/s +/- 25 ps	Oscilloscope Calibrator Vista, CA

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rise Time (measurement)	20 ps to 100 µs	81 ns	Oscilloscope Vista, CA Fremont, CA Orlando, FL
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	Multimeters, ESD Target, Attenuator and Oscilloscope Vista, CA Fremont, CA Orlando, FL
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	Multimeters, ESD Target, Attenuator and Oscilloscope Vista, CA Fremont, CA Orlando, FL
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	Fast Rise Oscilloscope w/ EFT Verification Set Vista, CA Fremont, CA Orlando, FL
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	Fast Rise Oscilloscope, Current Probes, Oscilloscope Probes Vista, CA Fremont, CA Orlando, FL

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gauss Meter [1]	100 Gauss 200 Gauss 500 Gauss 1 000 Gauss	1.4 Gauss 2.5 Gauss 6.4 Gauss 7.7 Gauss	Reference Magnetic Field Block Vista, CA

Electrical – RF/Microwave

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	Standard Piston Attenuator Vista, CA Fremont, CA Orlando, FL
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	Standard Electronic Programmable Attenuator Fremont, CA Orlando, FL Vista, CA
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	Standard Electronic Programmable Attenuator Fremont, CA Orlando, FL Vista, CA
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	Standard Electronic Programmable Attenuator Fremont, CA Orlando, FL Vista, CA

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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) Vpp 1 mVpp to 3Vpp (3 to 10) Vpp 1 mVpp to 3 Vpp 100 mVpp to 3 Vpp (1 to 100) mVpp	0.13 dB 0.22 dB 0.41 dB 0.61 dB 0.61 dB 0.91 dB	Synthesized Signal Sources Vista, CA Fremont, CA Orlando, FL
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	Synthesized Level Generator Vista, CA
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	Synthesized Level Generator Vista, CA Fremont, CA Orlando, FL
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	Synthesized Level Generator Vista, CA Fremont, CA Orlando, FL

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power Source Into 50 Ω			Synthesized Level Generator Vista, CA Fremont, CA Orlando, FL
SWR ≤ 1.6:1	(+10 to - 10) dBm		
	10 MHz to 2 GHz	1.5 dB	
	(2 to 20) GHz	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	0.96 dB	
	(20 to 40) GHz	1.2 dB	
SWR ≤ 2.0:1	(+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 ≤ 2.0:1	(20 to 40) GHz	1.6 dB	
	(40 to 50) GHz	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 ≤ 2.0:1	(20 to 40) GHz	2.2 dB	
	(40 to 50) GHz	3.3 dB	
RF Absolute Power Source Into 50 Ω	(+24 to -48) dBm		Synthesized Low Phase Noise Level Generator Vista, CA
	Up to 300 MHz	0.06 dB	
	(+14 to -48) dBm		
	300 MHz to 3GHz	0.08 dB	
	(3 to 4) GHz	0.52 dB	
	(-48 to -84) dBm		
	100 kHz to 10 MHz	0.52 dB	
	(10 to 300) MHz	0.32 dB	
	300 MHz to 1.4 GHz	0.53 dB	
	(-48 to -74) dBm		
	(1.4 to 4) GHz	0.53 dB	
	(-74 to -84) dBm		
	(1.4 to 4) GHz	1 dB	
	(-84 to -94) dBm		
	100 kHz to 300 MHz	0.53 dB	
	300 MHz to 4 GHz	1 dB	
	(-94 to -130) dBm		
	(10 to 128) MHz	0.73 dB	
	300 MHz to 4 GHz	1.6 dB	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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	Synthesized Low Phase Noise Level Generator Vista, CA
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	Measuring Receiver System Vista, CA Fremont, CA Orlando, FL

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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	Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
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°	Vector Signal Analyzer Vista, CA Fremont, CA Orlando, FL
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	Vector Signal Analyzer Vista, CA Fremont, CA Orlando, FL
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	AM/FM Test Source, Analog Modulation Sources Vista, CA Fremont, CA Orlando, FL

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Amplitude Modulation - Source DC to 100 kHz	Rate:250 kHz to 50 GHz (0 to 99) % Depth	1.2 % of reading + 0.07 AM	AM/FM Test Source, Analog Modulation Sources Vista, CA Fremont, CA
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	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
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	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
Amplitude Modulation - Measure (26.5 to 31.15) GHz (31.15 to 50) GHz	50 Hz to 100kHz, (5 to 20) % Depth (20 to 99) % Depth 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 0.3 % of reading + 0.000 05 AM 0.07 % of reading + 0.000 046 AM	Microwave Measuring Receiver System Vista, CA

Electrical – RF/Microwave

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	0.023 AM + 0.01 % of reading 0.023 AM + 0.06 % of reading 0.035 AM + 0.01 % of reading 0.035 AM + 0.06 % of reading 0.012 AM + 0.01 % of reading 0.012 AM + 0.06 % of reading 0.035 AM + 0.01 % of reading 0.035 AM + 0.06 % of reading 0.018 AM + 0.03 % of reading 0.018 AM + 0.07 % of reading 0.035 AM + 0.03 % of reading 0.035 AM + 0.07 % of reading	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
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	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
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 + 3.8Hz 1.2 % of reading + 7.6 Hz	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
Frequency Modulation - Measure (26.5 to 50.0) GHz	Rate: 20 Hz to 10 kHz Dev:20 Hz to 40 kHz pk	10 % of reading + 4.2 Hz 1 % of reading + 12 Hz	Microwave Measuring Receiver System Vista, CA
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	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL

Electrical – RF/Microwave

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	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
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	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
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	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
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	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL

Electrical – RF/Microwave

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	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
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	AM/FM Test Source Vista, CA Fremont, CA Orlando, FL
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	Analog Modulation Sources Vista, CA Fremont, CA Orlando, FL

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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	Analog Modulation Sources Vista, CA Fremont, CA Orlando, FL
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 + 0.0071 rad 1.2 % of reading + 0.0071 rad 1.2 % of reading + 0.0073 rad	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
Phase Modulation - Measure >1.3 Rad Dev. >2.4 Rad Dev.	(26.5 to 31.5 GHz (31.5 to 50) GHz	1 % of reading + 0.0073 rad 1 % of reading + 0.008 rad	Microwave Measuring Receiver System Vista, CA
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	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
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	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL

Electrical – RF/Microwave

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	 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	Analog Modulation Sources Vista, CA Fremont, CA Orlando, FL
Distortion – Measure	(0.01 to 100) % Distortion 250 kHz to 50 GHz	0.065 % of reading	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
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	Distortion Analyzer Vista, CA Fremont, CA Orlando, FL
Power Reference- Measure 50 MHz	1 mW	5.5 µW	Primary Standards Lab (H75) Thermistor Mount, Power Meter, Precision 8.5-digit Multimeter Vista, CA Fremont, CA Orlando, FL

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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	RF Power Meters/Sensors Vista, CA Fremont, CA Orlando, FL
Power Meter – Range Calibration	3 µW 10 µW 30 µW 100 µW 300 µW 1 mW 3 mW 10 mW 30 mW 100 mW	21 nW 19 nW 21 nW 77 nW 0.11 µW 0.29 µW 0.64 µW 6.4 µW 13 µW 0.10 mW	Power Meter Range Calibrator w/ Precision DC Voltage Source Vista, CA Fremont, CA Orlando, FL
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	Primary Standards Lab Noise Source Vista, CA
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	Noise Source Fremont, CA Orlando, FL
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	Noise Figure Measurement System w/ Standard Noise Sources Vista, CA Fremont, CA Orlando, FL

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Single Sideband Phase Noise - Measure	1 MHz to 26.5 GHz	1.8 dB	Phase Noise Measurement System Vista, CA Fremont, CA Orlando, FL
Single Sideband Phase Noise - Measure	(26.5 to 50) GHz	1.8 dB	Phase Noise Measurement System Vista, CA
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	Signal Sources, Precision Level Source and Tegam System Vista, CA
Current Probes and Bulk Current Injection Probes Insertion Loss Transfer Impedance	(0 to 1) dB 20 Hz to 300 kHz 300 kHz to 400 MHz (0 to 1) dB 20 Hz to 300 kHz 300 kHz to 400 MHz	 0.09 dB 0.09 dB 0.02 dB 0.02 dB	Network/RF Impedance Analyzers Vista, CA Fremont, CA Orlando, FL

Electrical – RF/Microwave

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°)	LF Vector Network Analyzer, Calibration Kits Vista, CA Fremont, CA Orlando, FL
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°)	Vector Network Analyzer w/ Calibration Kits Vista, CA Fremont, CA Orlando, FL

Electrical – RF/Microwave

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° (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°) 0.17 dB (1.1°) 0.18 dB (1.2°) 0.2 dB (1.3°) 0.22 dB (1.4°) 0.24 dB (1.6°) 0.32 dB (2.1°) 0.6 dB (4.1°) 1.6 dB (8.7°) 4.2 dB (11°) 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°)	Vector Network Analyzer w/ Calibration Kits Vista, CA Fremont, CA Orlando, FL
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°	Vector Network Analyzer w/ Calibration Kits Vista, CA

Electrical – RF/Microwave

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

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Reflection S_{11}/S_{22} – Measure Phase and Magnitude [2,3]	(20 to 50) GHz (-180 to 180)° (<0.03) Γ (<0.2) Γ (<0.4) Γ (<0.6) Γ (<0.8) Γ (<1) Γ	 0.06 (19°) 0.066 (11°) 0.079 (11°) 0.097 (9.3°) 0.12 (8.8°) 0.15 (8.8°)	Vector Network Analyzer w/ Calibration Kits Vista, CA Fremont, CA Orlando, FL
Reflection S_{11}/S_{22} – Measure Magnitude [2,3] Phase	(<0.03 to <1) Γ (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	 0.011 Γ 0.011 Γ 0.018 Γ 0.023 Γ 0.023° 0.013° 0.064° 0.017°	Vector Network Analyzer w/ Calibration Kits Vista, CA
Network Analyzer System Verification (Corrected Performance) 7mm Test Ports Reflection S_{11}/S_{22} – Magnitude [2,3] Phase	 </= 0.1 to </= 1.0 Γ (0.0003 to 1) GHz (1 to 3) GHz (3 to 6) GHz </= 0 to </= 60° (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°	Mechanical Calibration Kits and RF Network Analyzer System Vista, CA Fremont, CA Orlando, FL
Network Analyzer System Verification (Corrected Performance) N-Type Test Ports Reflection S_{11}/S_{22} – Magnitude [2,3] Phase	 </= 0.1 to </= 1.0 Γ (0.0003 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz </= 0 to </= 60° (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°	Mechanical Calibration Kits and RF Network Analyzer System Vista, CA Fremont, CA Orlando, FL

Electrical – RF/Microwave

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]	<= 0.1 to <= 1.0 Γ (0.045 to 2) G Γ Hz (2 to 20) GHz (20 to 26.5) GHz	 0.000 76 Γ 0.001 Γ 0.003 Γ	Mechanical Calibration Kits and RF Network Analyzer System Vista, CA Fremont, CA Orlando, FL
Phase	<= 0 to <= 60° (0.045 to 2) GHz (2 to 20) GHz (20 to 26.5) GHz	 0.34° 0.36° 0.64°	
Network Analyzer System Verification (Corrected Performance) 2.4mm Test Ports Reflection S_{11}/S_{22} – Magnitude [2,3]	<= 0.1 to <= 1.0 Γ (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	Mechanical Calibration Kits and RF Network Analyzer System Vista, CA Fremont, CA Orlando, FL
Phase	<= 0 to <= 60° (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	 0.96° 1.3° 1.5° 2.3°	
Network Analyzer System Verification (Corrected Performance) 7mm Test Ports Transmission $S_{21}/S1_{22}$ – Magnitude	<= 0.1 to <= 1.0 dB (0.0003 to 1) GHz (1 to 3) GHz (3 to 6) GHz	 0.16 dB 0.16 dB 0.17 dB	Mechanical Calibration Kits and RF Network Analyzer System Vista, CA Fremont, CA Orlando, FL
Phase	<= 0 to <= 60° (0.0003 to 1) GHz (1 to 3) GHz (3 to 6) GHz	 1.4° 1.5° 2.2°	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) N-Type Test Ports Transmission $S_{21}/S1_{22}$ – Magnitude Phase	<= 0.1 to <= 1.0 dB (0.0003 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz <= 0 to <= 60° (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°	Mechanical Calibration Kits and RF Network Analyzer System Vista, CA Fremont, CA Orlando, FL
Network Analyzer System Verification (Corrected Performance) 3.5mm Test Ports Transmission $S_{21}/S1_{22}$ – Magnitude Phase	<= 0.1 to <= 1.0 dB (0.045 to 2) GHz (2 to 20) GHz (20 to 26.5) GHz <= 0 to <= 60° (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°	Mechanical Calibration Kits and RF Network Analyzer System Vista, CA Fremont, CA Orlando, FL
Network Analyzer System Verification (Corrected Performance) 2.4mm Test Ports Transmission $S_{21}/S1_{22}$– Magnitude Phase	<= 0.1 to <= 1.0 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	 0.023 dB 0.033dB 0.055 dB 0.068 dB 0.23° 0.41° 0.97° 1.8°	Mechanical Calibration Kits and RF Network Analyzer System Vista, CA Fremont, CA Orlando, FL
Scalar Network Analyzer Absolute Log Error Dynamic Accuracy	 21 dB (0 to 140) dB	 0.04 dB 0.02 dB	Scalar Network Analyzer Calibrator Vista, CA Fremont, CA Orlando, FL

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer Dynamic Accuracy	(0 to 140) dB	0.02 dB	Dynamic Accuracy Test Set Vista, CA Fremont, CA Orlando, FL
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	Pulse Generator Vista, CA Fremont, CA Orlando, FL
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 1000 MHz (-90 to 0) dB 10 Hz to 1 000 MHz 0.1 Ω to 1 kΩ 10 Hz to 1000 MHz (-180 to 180)° 10 Hz to 1 000 MHz	 0.25 dB 2.3 dB 2.4 % of reading 2.6°	RF Impedance/Network Analyzers, Calibration Kits Vista, CA Fremont, CA Orlando, FL

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
CDN (Coupling-Decoupling Network) & ISN (Impedance Stabilization Network)			RF Impedance/Network Analyzers, Calibration Kits Vista, CA Fremont, CA Orlando, FL
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 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

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Test, Dial Indicators & Thickness Gages [1]	Up to 4 in	0.26 µin/in + 57 µin	Gage Blocks Vista, CA Fremont, CA Orlando, FL
Calipers [1]	Up to 54 in	46 µin/in + 52 µin	Gage Blocks, Standard Rings, Rod Sets Vista, CA Fremont, CA Orlando, FL
Micrometers [1] (Linearity Only)	Up to 54 in	46 µin/in + 52 µin	Gage Blocks, Rod Sets Vista, CA Fremont, CA Orlando, FL

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pin and Plug Gages [1]	Up to 25 mm	5 µm	Micrometer Vista, CA Fremont, CA
Pin and Plug Gages	Up to 2.36 in	180 µin	Laser Micrometer & Pin Gages Vista, CA
Height Gages	Up to 12 in	(750 + 4.7*L*) µin	Gage Blocks Vista, CA Fremont, CA Orlando, FL
Depth Gages	Up to 12 in	(160 + 4.1*L*) µin	
Surface plates Overall Flatness Local Area Flatness	Up to 161 DL Up to 0.001 in	(77 + 0.18 DL) µin 29 µin	Leveling System Repeat-O-Meter Fremont, CA
Steel Rulers	Up to 48 in	0.036 in	Gage Blocks Vista, CA Fremont, CA Orlando, FL
Tape Measures	Up to 50 ft	0.036 in	Gage Blocks Vista, CA Fremont, CA Orlando, FL
Protractor/Angle	Up to 90°	0.069°	Angle Gage Blocks Vista, CA Fremont, CA Orlando, FL
Thread Plug Gage - Minor Diameter Major Diameter Pitch Diameter Flank Angle	 (0.04 to 5.9) in (0.04 to 5.9) in (0.04 to 5.9) in (≥ 27 to ≤ 80)°	 (76 + 5.8L) µin (76 + 5.8L) µin (40 + 7.7L) µin 0.11°	IAC MasterScanner Fremont, CA

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Thread Ring Gage - Minor Diameter Major Diameter Pitch Diameter Flank Angle	 (0.10 to 6.3) in (0.10 to 6.3) in (0.10 to 6.3) in (≥ 27 to ≤ 80)°	 (90 + 4.8L) µin (90 + 4.8L) µin (40 + 8.5L) µin 0.11°	IAC MasterScanner Fremont, CA

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Barometric Pressure Measurement	Up to 39 psia	0.014 psi	Digital Barometer/Precision Absolute Manometer Vista, CA Fremont, CA Orlando, FL
Force-Measuring Equipment Tension / Compression	(0.1 to 50) kgf	0.042 mgf/gf + 7.1 gf	NIST Class F Weights Vista, CA Fremont, CA Orlando, FL
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	5.8 lbf 59 lbf 71 lbf 88 lbf 110 lbf 130 lbf	Reference Load Cells Vista, CA Orlando, FL
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	Reference Load Cells Fremont, CA

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure – Source/Pressure gages and transducers [1]	(-12 to 300) psi (300 to 10 000) psi	0.2 psi 9.5 psi	Pressure Calibration System Vista, CA Fremont, CA Orlando, FL
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	0.03 lbf·in + 0.5 % of reading 0.008 7 lbf·in + 0.5 % of reading 0.067 lbf·in + 0.5 % of reading 0.002 9 lbf·ft + 0.6 % of reading 0.17 lbf·ft + 0.5 % of reading 0.15 lbf·ft + 0.6 % of reading	Torque Transducers Vista, CA Fremont, CA
Torque – Measure/Torque tools	(5 to 50) lbf·in (50 to 500) lbf·in (10 to 100) lbf·ft (100 to 750) lbf·ft	0.016 lbf·in + 0.003 lbf·in/lbf·in 0.068 lbf·in + 0.002 lbf·in/lbf·in 0.39 lbf·ft + 0.001 lbf·ft/lbf·ft 2.9 lbf·ft + 0.001 lbf·ft/lbf·ft	Torque Transducers Orlando, FL
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	Calibration Wheels Standard Weights Vista, CA Fremont, CA Orlando, FL
Scales & Balances [1]	1 mg to 10 g (10 to 500) g (0.5 to 1) kg (1 to 2) kg (2 to 20) kg (20 to 40) kg (40 to 50) kg	2.3 mg +0.6*R* 81 mg + 0.6*R* 1.5 mg + 0.6*R* 2.9 mg + 0.6*R* 2.3 g + 0.6*R* 4.6 g + 0.6*R* 5.8 g + 0.6*R*	NIST Class F Weights Vista, CA Fremont, CA
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 + 0.6*R* 0.000 18 lb + 0.6*R* 0.000 24 lb + 0.6*R* 0.000 6 lb + 0.6*R* 0.001 1 lb + 0.6*R* 0.002 4 lb + 0.6*R* 0.006 lb + 0.6*R*	NIST Class F Weights Vista, CA Fremont, CA

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales & Balances [4]	0.25 oz 0.5 oz 1 oz 2 oz 4 oz 8 oz 16 oz 1 kg 2 kg 5 lb (1 to 10) lb (10 to 50) lb (50 to 300) lb	0.000 71 oz 0.001 1 oz 0.000 27 oz 0.000 46 oz 0.001 oz 0.002 2 oz 0.002 9 oz 5.8 g 12 g 0.001 8 lb 0.002 6 lb 0.005 9 lb 0.041 lb	NIST Class F Weights Orlando, FL
Volumetric Recipients (Graduated Volumetric Containers)	(1 to 20) ml (>20 to 80) ml (>80 to 220) ml	0.06 ml 0.2 ml 0.23 ml	Analytical Balance Fremont, CA
Pipettes	(1 to 10) µL (>10 to 100) µL (>100 to 1 000) µL	0.051 µL 0.079 µL 0.17 µL	Pipette Calibration Balances Fremont, CA

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Radiation (Infrared) Thermometers	(50 to 100) °C (100 to 300) °C (300 to 500) °C	1.7 °C 5.3 °C 8.2 °C	Blackbody Source (Flat plate) $\varepsilon = 0.95$, $\lambda = (8 \text{ to } 14)$ µm Vista, CA Fremont, CA
Relative Humidity – Measure [1]	Up to 90 %RH (90 to 95) %RH	1.6 %RH 2.2 %RH	Humidity Probe Monitor Vista, CA Fremont, CA Orlando, FL
Relative Humidity – Measuring equipment	Up to 90 %RH (90 to 95) %RH	1.9 %RH 2.5 %RH	Humidity chamber, Humidity Probe Monitor Fremont, CA Orlando, FL

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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	Reference Thermometer w/ PRT Vista, CA Fremont, CA Orlando, FL
Temperature – Measuring equipment	(-70 to 0) °C (0 to 100) °C (100 to 175) °C	1.3 °C 1.5 °C 2.8 °C	Reference Chamber and Thermometer w/ PRT Fremont, CA Orlando, FL

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source [1]	1 µHz to 80 MHz	5.1×10^{-12} MHz	Frequency Synthesizer w/ GPS Reference Vista, CA Fremont, CA Orlando, FL
Frequency – Source [1]	10 MHz to 50 GHz	5.1×10^{-12} GHz	Synthesized Sweeper w/ GPS Reference Vista, CA Fremont, CA Orlando, FL
Frequency – Measure [1]	1 µHz to 12.4 GHz 1 Hz to 50 GHz	5.1×10^{-12} GHz 5.1×10^{-12} GHz	Electronic Counters, Analyzers w/ GPS Reference Vista, CA Fremont, CA Orlando, FL

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Time Interval	50 ns to 999 s	5 parts in 10^{12} s + 0.43 ns	Universal Counter w/ GPS Reference Vista, CA Fremont, CA Orlando, FL
Period	4.44 ns to 10 s	0.012 % of reading + 0.17 ns	Universal Counter w/ GPS Reference Vista, CA Fremont, CA Orlando, FL
Rise/Fall Time - Measure	> 2 ns	0.076 ns	Digital Oscilloscope Vista, CA Fremont, CA Orlando, FL
Pulse Width - Measure	> 5 ns	1.1 ns	Universal Counter w/ GPS Reference Vista, CA Fremont, CA Orlando, FL
Stop Watches – Totalize Method	1 s to 24 hr	0.000 6 % of reading + 0.044 s	Universal Counter and Synthesizer w/ GPS Reference Vista, CA Fremont, CA Orlando, FL

DIMENSIONAL MEASUREMENT

1 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Distance Measure [3]	Up to 500 in	0.053 in + 0.004 % of reading	Fluke 419D Laser Distance Meter Fremont, CA

1 Dimensional

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Distance/Linearity Measurement	Up to 610 mm	(19 + 0.7 L/600) µm	Linear Height Gage Fremont, CA

2 Dimensional

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 + 7.5 L/1 000) µm (14 + 7.5 L/1 000) µm	Vision System Fremont, CA

TESTING

Environmental

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 14644-4 ANSI/ASHRAE 110 IEST-RP-CC002.4	Flow hood Devices Test	Thermal Anemometer Aerosol Generator Digital Aerosol Photometer Vista, CA Fremont, CA Orlando, FL
Airborne Particle Count Survey Airflow Measurement Airflow Smoke Pattern Test HEPA/ULPA filter leak Test Biological Safety Cabinet Classification	ISO 14644-1 ISO 14644-4 IEST-RP-CC034.2 IEST-RP-CC006.3 NSF/ANSI49-2004 Annex	Biological Safety Cabinet Test	Particle Counter Balometer Aerosol Generator Digital Aerosol Photometer Thermal Anemometer Vista, CA Fremont, CA Orlando, FL

Environmental

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 14644-3 ISO 14644-4 IEST-RP-CC006.3 IEST-RP-CC034.2	Clean Room Test	Balometer Differential Pressure Meter Digital Aerosol Photometer, Aerosol Generator Particle Counter Light Level meter Sound meter Temperature & humidity meter Thermal anemometer. Vista, CA Fremont, CA Orlando, FL
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 14644-4 IEST-RP-CC002.4 IEST-RP-CC006.3 IEST-RP-CC034.2	Laminar Air Flow Workstation Test	Particle Counter Thermal Anemometer Aerosol Generator Digital Aerosol Photometer Light Level meter Sound meter Vista, CA Fremont, CA Orlando, FL
Oil Aerosol & Vapor Content [4]	ISO 8573-1 ISO 8573-2 ISO 8573-5	Compressed Air Purity Test	Oil Content Analyzer Air Sampler Vista, CA Fremont, CA Orlando, FL
Humidity / Dew Point Measurement	ISO 8573-3	Compressed Air Purity Test	Dew Point Meter & Diffuser Vista, CA Fremont, CA Orlando, FL
Pressurized Air Particle Content	ISO 8573-4	Compressed Air Purity Test	Particle Counter & Diffuser Vista, CA Fremont, CA Orlando, FL

Environmental

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
Viable Microbiological Contaminant [5]	ISO 8573-7	Compressed Air Purity Test	Microbiological Sampler Vista, CA Fremont, CA Orlando, FL

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
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. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1736.

Jason Stine, Vice President