



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Techmaster Electronics, Inc.
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

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.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 29 October 2020
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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Services performed at satellite locations as indicated
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CALIBRATION

Valid to: **October 29, 2020**

Certificate Number: **AC-1736**

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 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	Vibration Calibrator System Orlando, FL

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	0.014 pH 0.027 pH 0.024 pH	Standard Solutions Vista, CA Fremont, CA Orlando, FL
Conductivity - Source	(445 to 3 900) μ S	1 % of calibrated value	Standard Solutions Vista, CA Fremont, CA Orlando, FL



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage - Source ¹	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	0.65 % of reading + 0.58 μ V 4.6 μ V/V + 0.8 μ V 3.2 μ V/V + 3.2 μ V 2.4 μ V/V + 27 μ V 4.7 μ V/V + 43 μ V 6 μ V/V + 0.85 mV	High Performance Multifunction Calibrator Vista, CA
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 μ V/V + 0.4 μ V 5 μ V/V + 1 μ V 3.5 μ V/V + 3.1 μ V 3.5 μ V/V + 8.1 μ V 5 μ V/V + 83 μ V 6.5 μ V/V + 0.68 mV	High Performance Multifunction Calibrator Fremont, CA Orlando, FL
DC Voltage - Source ¹ Fixed Points	1 V 1.018 V 10 V	14 μ V 17 μ V 35 μ V	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 μ V/V + 0.55 μ V 7 μ V/V + 0.42 μ V 6.9 μ V/V + 0.86 μ V 9.2 μ V/V + 38 μ V 9.3 μ V/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 μ V/V + 0.20 μ V 4.3 μ V/V + 0.50 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	Precision 8.5 DigitMultimeter Vista CA
	(1 to 40) kV	5 mV/V	High Voltage Probe with Digital Multimeter Vista, CA Fremont, CA Orlando, FL
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	High Performance Multifunction Calibrator w/ Transconductance Amplifier Vista, CA



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
	Up to 220 μ A 220 μ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	40 μ A/A + 6 nA 35 μ A/A + 7.6 nA 35 μ A/A + 48 nA 55 μ A/A + 0.74 μ A 0.13 mA/A + 13 μ A	High Performance Multifunction Calibrator Fremont, CA Orlando, FL
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	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
DC Current - Source ¹ Clamp-On Ammeters	(20 to 150) A (150 to 1 025) A	0.05 % of reading + 3.1 mA 0.1 % of reading	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 2.9999 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	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
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	Precision 8.5 Digit Multimeter Fremont, CA Orlando, FL
	(2 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	Precision 8.5 Digit Multimeter Vista, CA



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
	(1 to 100) A (100 to 600) A	85 μ A/A 127 μ A/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 (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 (22 to 220) mV (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.013 % of reading + 7.2 μ V 0.008 3 % of reading + 4.2 μ V 0.007 2 % of reading + 4.2 μ V 0.016 % of reading + 4.6 μ V 0.042 % of reading + 5.3 μ V 0.095 % of reading + 10 μ V 0.13 % of reading + 20 μ V 0.25 % of reading + 21 μ V 0.021 % of reading + 4.9 μ V 0.008 3 % of reading + 4.3 μ V 0.007 % of reading + 4.4 μ V 0.017 % of reading + 4.8 μ V 0.042 % of reading + 6.1 μ V 0.092 % of reading + 12 μ V 0.13 % of reading + 22 μ V 0.22 % of reading + 33 μ V 0.022 % of reading + 16 μ V 0.006 4 % of reading + 15 μ V 0.004 4 % of reading + 10 μ V 0.009 % of reading + 14 μ V 0.028 % of reading + 23 μ V 0.056 % of reading + 35 μ V 0.13 % of reading + 39 μ V 0.23 % of reading + 0.12 mV	High Performance Multifunction Calibrator w/ Transconductance Amplifier Vista, CA



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Source ¹	220 mV to 2.2 V	0.021 % of reading + 0.1 mV 82 μV/V + 32 μV 39 μV/V + 22 μV 44 μV/V + 62 μV 71 μV/V + 55 μV 0.3 mV/V + 0.12 mV 0.89 mV/V + 0.3 mV 1.5 mV/V + 0.6 mV 0.2 mV/V + 1.1 mV 68 μV/V + 0.63 mV 19 μV/V + 0.7 mV 44 μV/V + 0.61 mV 0.006 1 % + 0.65 mV 0.19 mV/V + 1.9 mV 0.9 mV/V + 2.8 mV 1.1 mV/V + 11 mV 0.2 mV/V + 11 mV 44 μV/V + 17 mV 38 μV/V + 4.1 mV 53 μV/V + 8 mV 0.11 mV/V + 10 mV 0.84 mV/V + 19 mV 4.2 mV/V + 45 mV 7.7 mV/V + 90 mV 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
	(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) 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 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			



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source	(1 to 2.2) mV		High Performance Multifunction Calibrator w/ Transconductance Amplifier Fremont, CA Orlando, FL
	(10 to 20) Hz	0.55 mV/V + 4.5 μV	
	(20 to 40) Hz	0.21 mV/V + 4.5 μV	
	40 Hz to 20 kHz	0.11 mV/V + 4.5 μV	
	(20 to 50) kHz	0.37 mV/V + 4.5 μV	
	(50 to 100) kHz	0.85 mV/V + 7 μV	
	(100 to 300) kHz	1.1 mV/V + 13 μV	
	(300 to 500) kHz	1.7 mV/V + 25 μV	
	500 kHz to 1 MHz	3.4 mV/V + 25 μV	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.55 mV/V + 5 μV	
	(20 to 40) Hz	0.21 mV/V + 5 μV	
	40 Hz to 20 kHz	0.11 mV/V + 5 μV	
	(20 to 50) kHz	0.37 mV/V + 5 μV	
	(50 to 100) kHz	0.85 mV/V + 7 μV	
	(100 to 300) kHz	1.1 mV/V + 12 μV	
	(300 to 500) kHz	1.7 mV/V + 25 μV	
	500 kHz to 1 MHz	3.4 mV/V + 25 μV	
	(22 to 220) mV		
	(10 to 20) Hz	0.55 mV/V + 13 μV	
	(20 to 40) Hz	0.21 mV/V + 8 μV	
	40 Hz to 20 kHz	0.11 mV/V + 8 μV	
	(20 to 50) kHz	0.32 mV/V + 8 μV	
	(50 to 100) kHz	0.85 mV/V + 25 μV	
	(100 to 300) kHz	1.1 mV/V + 25 μV	
	(300 to 500) kHz	1.7 mV/V + 35 μV	
	500 kHz to 1 MHz	3.4 mV/V + 80 μV	
	220 mV to 2.2 V		
(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		



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Electrical – DC/Low Frequency

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



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Measure ¹	(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		
	(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 Voltage - Measure ¹	(1 to 40) kV 60 Hz	77 mV /V	High Voltage Probe with Digital Multimeter Vista, CA Fremont, CA Orlando, FL



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Measure ¹	Up to 200 mV		Precision 8.5 Digit Multimeter w/ Current Shunts 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		
AC Voltage - Measure ¹	200 V to 1 kV		Precision 8.5 Digit Multimeter w/ Current Shunts Vista, CA
	(1 to 10) Hz	0.19 mV/V + 84 mV	
	(10 to 40) Hz	0.16 mV/V + 24 mV	
	40 Hz to 10 kHz	0.29 mV/V + 24 mV	
	(10 to 30) kHz	0.28 mV/V + 48 mV	
(30 to 100) kHz	0.72 mV/V + 0.24 V		



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage Flatness - Source (Referenced to 1 kHz)	0.3 mV to 3.5 V (10 to 30) Hz	0.35 % of reading	High Performance Multifunction Calibrator (Wideband) Vista, CA Fremont, CA Orlando, FL
	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	Up to 3 V (10 to 100) Hz	0.2 % of reading	Precision 8.5 Digit Multimeter w/ Thermal Converters Vista, CA Fremont, CA Orlando, FL
	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	



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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		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Measure ¹	(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		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Measure ¹	(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		



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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 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		



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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



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Source ¹	(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	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	High Performance Multifunction Calibrator Vista, CA
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
AC Current - Source ¹	(20 to 150) A (10 to 100) Hz (100 to 440) Hz (150 to 1 025) A (45 to 100) Hz (100 to 440) Hz	0.1 % of reading + 8.2 mA 0.24 % of reading + 39 mA 0.11 % of reading + 78 mA 0.78 % of reading + 0.2 A	Multi Product Calibrator w/ Current Coil Vista, CA Fremont, CA Orlando, FL
AC Current – Source	Up to 220 μA (10 to 20 Hz) (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz 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	0.25 mA/A + 16 nA 0.16 mA/A + 10 nA 0.12 mA/A + 8 nA 0.28 mA/A + 12 nA 1.1 mA/A + 65 nA 0.25 mA/A + 40 nA 0.16 mA/A + 36 nA 0.12 mA/A + 36 nA 0.2 mA/A + 0.11 μA 1.1 mA/A + 0.65 μA	High Performance Multifunction Calibrator Fremont, CA Orlando, FL



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment		
AC Current – Source	(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	0.25 mA/A + 0.41 μ A 0.16 mA/A + 0.36 μ A 0.12 mA/A + 0.36 μ A 0.2 mA/A + 0.56 μ A 1.1 mA/A + 5.1 μ A	High Performance Multifunction Calibrator Fremont, CA Orlando, FL		
	(22 to 220) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.25 mA/A + 4.1 μ A 0.16 mA/A + 3.6 μ A 0.12 mA/A + 2.6 μ A 0.2 mA/A + 3.6 μ A 1.1 mA/A + 11 μ A			
	220 mA to 2.2 A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.25 mA/A + 36 μ A 0.45 mA/A + 81 μ A 7 mA/A + 0.18 mA			
	(2.2 to 11) A 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.46 mA/A + 0.21 mA 0.95 mA/A + 0.4 mA 3.6 mA/A + 0.76 mA			
	(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			
	AC Power - Source ¹ PF = 1 (10 to 45) Hz 33 mV to 32.9999 V (3.3 mA to 2.99999 A)	110 μ W to 99 W		0.19 % of reading	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
		(45 to 65) Hz 33 mV to 1020 V (3.3 mA to 20.5 A)		110 μ W to 99 W 0.15 % of reading	
	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) ($\Delta\Phi^\circ$)		0.09 $^\circ$	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
				0.2 $^\circ$	
				0.39 $^\circ$	
				1.9 $^\circ$	
				3.9 $^\circ$	
7.8 $^\circ$					



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase – Measure 10 mV to 630 Vrms	(0 to 360) ° 5 Hz to 2 kHz 2 kHz to 5kHz 5 kHz to 10 kHz 10 kHz to 50 kHz	0.023 ° 0.036 ° 0.045 ° 0.058 °	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 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



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Measure	Up to 200 μ A		Precision 8.5 DigitMultimeter Vista CA
	10 Hz to 10 kHz	0.42 mA/A + 24 nA	
	(10 to 30) kHz	0.88 mA/A + 24 nA	
	(30 to 100) kHz	4.8 mA/A + 24 nA	
	200 μ A to 2 mA		
	10 Hz to 10 kHz	0.36 mA/A + 0.24 μ A	
	(10 to 30) kHz	0.86 mA/A + 0.24 μ A	
	(30 to 100) kHz	4.8 mA/A + 0.24 μ A	
	2 to 20 mA		
	10 Hz to 10 kHz	0.37 mA/A + 2.4 μ A	
	(10 to 30) kHz	0.86 mA/A + 2.4 μ A	
	(30 to 100) kHz	4.8 mA/A + 2.4 μ A	
	20 to 200 mA		
	10 Hz to 10 kHz	0.35 mA/A + 24 μ A	
(10 to 30) kHz	0.75 mA/A + 24 μ A		
200 mA to 2 A			
10 Hz to 2 kHz	0.75 mA/A + 0.25 mA		
(2 to 10) kHz	0.87 mA/A + 0.27 mA		
(10 to 30) kHz	3.6 mA/A + 0.26 mA		
2 to 20 A			
10 Hz to 2 kHz	0.99 mA/A + 2.4 mA		
(2 to 10) kHz	3.1 mA/A + 2.4 mA		
Resistance - Source ¹	Up to 11 Ω	1.7 m Ω / Ω + 35 $\mu\Omega$	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
	(11 to 33) Ω	23 $\mu\Omega$ / Ω + 3.3 m Ω	
	(33 to 110) Ω	31 $\mu\Omega$ / Ω + 1.9 m Ω	
	(110 to 330) Ω	32 $\mu\Omega$ / Ω + 2.8 m Ω	
	330 Ω to 1.1 k Ω	33 $\mu\Omega$ / Ω + 2.3 m Ω	
	(1.1 to 3.3) k Ω	32 $\mu\Omega$ / Ω + 30 m Ω	
	(3.3 to 11) k Ω	5 $\mu\Omega$ / Ω + 1.4 Ω	
	(11 to 33) k Ω	32 $\mu\Omega$ / Ω + 0.3 Ω	
	(33 to 110) k Ω	33 $\mu\Omega$ / Ω + 0.34 Ω	
	(110 to 330) k Ω	37 $\mu\Omega$ / Ω + 3.1 Ω	
	330 k Ω to 1.1 M Ω	38 $\mu\Omega$ / Ω + 2.6 Ω	
	(1.1 to 3.3) M Ω	71 $\mu\Omega$ / Ω + 36 Ω	
	(3.3 to 11) M Ω	0.13 m Ω / Ω + 0.38 k Ω	
	(11 to 33) M Ω	0.22 m Ω / Ω + 7.4 k Ω	
	(33 to 110) M Ω	0.42 m Ω / Ω + 32 k Ω	
	(110 to 330) M Ω	3.6 m Ω / Ω + 0.12 M Ω	
330 M Ω to 1.1 G Ω	18 m Ω / Ω + 0.59 M Ω		



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance - Source ¹ Fixed Points	0 Ω	48 μΩ	High Performance Multifunction Calibrator Vista, CA
	1 Ω	0.15 mΩ	
	1.9 Ω	0.22 mΩ	
	10 Ω	0.28 mΩ	
	19 Ω	0.63 mΩ	
	100 Ω	1.2 mΩ	
	190 Ω	2.3 mΩ	
	1 kΩ	7.8 mΩ	
	1.9 kΩ	15 mΩ	
	10 kΩ	77 mΩ	
	19 kΩ	0.15 Ω	
	100 kΩ	1 Ω	
	190 kΩ	1.9 Ω	
	1 MΩ	16 Ω	
	1.9 MΩ	40 Ω	
Resistance - Source ¹ Fixed Points	10 MΩ	0.48 kΩ	High Performance Multifunction Calibrator Vista, CA
	19 MΩ	1.1 kΩ	
	100 MΩ	12 kΩ	
Resistance - Source ¹ Fixed Points	1 Ω	0.12 mΩ	High Performance Multifunction Calibrator Fremont, CA Orlando, FL
	1.9 Ω	0.22 mΩ	
	10 Ω	0.28 mΩ	
	19 Ω	0.58 mΩ	
	100 Ω	1.3 mΩ	
	190 Ω	2.4 mΩ	
	1 kΩ	10 mΩ	
	1.9 kΩ	20 mΩ	
	10 kΩ	90 mΩ	
	19 kΩ	0.19 Ω	
	100 kΩ	1.3 Ω	
	190 kΩ	2.5 Ω	
	1 MΩ	24 Ω	
	1.9 MΩ	47 Ω	
	10 MΩ	0.47 kΩ	
19 MΩ	1.3 kΩ		
100 MΩ	12 kΩ		



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Electrical – DC/Low Frequency

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	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	22 μΩ/Ω + 62 μΩ 18 μΩ/Ω + 0.61 mΩ 16 μΩ/Ω + 0.73 mΩ 15 μΩ/Ω + 13 mΩ 15 μΩ/Ω + 67 mΩ 21 μΩ/Ω + 2.7 Ω 46 μΩ/Ω + 0.39 kΩ 0.56 mΩ/Ω + 1.2 kΩ 6 mΩ/Ω + 12 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 DigitMultimeter 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 (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (0 to 50) 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	0.58 % 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	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance - Source ¹ (0 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	(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	0.5 % 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	(100 to 500) pF @ 1 kHz 500 pF to 5 nF @ 1 kHz (5 to 50) nF @ 1 kHz (50 to 100) nF @ 1 kHz (100 to 500) nF @ 1 kHz 500 nF to 1.5 μF @ 1 kHz	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 10 pF 100 pF 1 nF	1.2 fF 12 fF 0.12 pF 1.2 pF	Standard Air Capacitor Set Vista, CA Fremont, CA Orlando, FL
Capacitance - Source ¹	1 pF (1 to 3) MHz 4 MHz 5 MHz 10 MHz 13 MHz 10 pF (1 to 13) MHz 100 pF (1 to 10) MHz 13 MHz 1 nF (1 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 (0.1 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	Digit Multimeter/LCR Meter Vista, CA Fremont, CA Orlando, FL



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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 μ H 2 mH 20 mH 200 mH 2 H	0.58 μ H 2.4 uH 24 uH 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



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Source and Measure ¹	Type R		Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
	(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 Simulation of RTD Temperature Indicating Devices – Source and Measure ¹	Pt 385 (100 Ω)		Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
	(-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		



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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)		Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
	(-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	
	Pt 385 (1 000 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 - DC Voltage Into 50 Ω Into 1 MΩ	(0 to +/-6.6) V	0.2 % + 36 μV	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
	(0 to +/-130) V	0.039 % of reading + 37 μV	
	Square Wave Into 50 Ω 10 Hz to 10 kHz	1 mV to 6.6 Vpp	
Into 1 MΩ 10 Hz to 1 kHz (1 to 10) kHz	1 mV to 130 Vpp	0.078 % of reading + 36 μV	
	1 mV to 130 Vpp	0.19 % of reading + 39 μV	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes ¹ - Leveled Sine Amplitude Reference @ 50 kHz	5 mV to 5.5 V	15 mV/V + 0.49 mV	Multi Product Calibrator Vista, CA Fremont, CA Orlando, FL
Leveled Sine Amplitude (relative to 50 kHz) 5 mV to 5.5 V	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1 100) MHz	14 mV/V + 0.12 mV 17 mV/V + 0.14 mV 32 mV/V + 0.15 mV 40 mV/V + 0.16 mV	
Time Markers (5-2-1 sequence) into 50 Ω	(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	
Edge Transition Time (Rise Time)	<300 ps	80 ps	
Oscilloscopes - Square Wave Signal 10 Hz to 10 kHz 50 Ω 1 MΩ DC Signal Into 50Ω Into 1MΩ	1 mV to 6.6 V p-p 1 mV to 130 V p-p	2.5 mV/V + 40 μV 0.5 mV/V + 5 μV	Oscilloscope Calibrator Fremont, CA
Leveled Sine Wave	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	2.5 mV/V + 40 μV 0.5 mV/V + 5 μV Absolute Amplitude 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	
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 a 50 Ω load	(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	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes - Fast Edge Mode	5 s to 50 ms 20 ms to 500 ps	2.5 μ s/s + 5 μ Hz 0.33 μ s/s	Oscilloscope Calibrator Fremont, CA
Programmable Rise Time	(1 to 100) kHz	< 0.15 ns/s +/- 25 ps	
Rise Time (measurement)	20 ps to 100 μ s	81 ns	Oscilloscope Vista, CA Fremont, CA Orlando, FL

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



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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
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 Fremont, CA Orlando, FL
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	
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



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Absolute Power Source Into 50 Ω SWR ≤ 1.6:1	(+10 to - 10) dBm 10 MHz to 2 GHz	1.5 dB	Synthesized Level Generator Vista, CA Fremont, CA Orlando, FL
	(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	Synthesized Low Phase Noise Level Generator Vista, CA
	(2 to 20) GHz	1.9 dB	
	(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 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	
RF Absolute Power Source Into 50 Ω	(-74 to -84) dBm (1.4 to 4) GHz	1 dB	Synthesized Low Phase Noise Level Generator Vista, CA
	(-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	



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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		Synthesized Low Phase Noise Level Generator Vista, CA
	Up to 125 MHz	0.07 dB	
	(125 to 300) MHz	0.16 dB	
	300 MHz to 1.4 GHz	0.26 dB	
	(1.4 to 3) GHz	0.33 dB	
	(3 to 4) GHz	0.52 dB	
	(-23 dBm to -54) dBm		
	Up to 300 MHz	0.16 dB	
	300 MHz to 4 GHz	0.52 dB	
	(-54 to -80) dBm		
	100 kHz to 300 MHz	0.23 dB	
	300 MHz to 4 GHz	0.54 dB	
	(-80 to -90) dBm		
	100 kHz to 300 MHz	0.7 dB	
300 MHz to 4 GHz	1 dB		
(-90 to -100) dBm			
100 kHz to 300 MHz	0.76 dB		
300 MHz to 4 GHz	1 dB		
(-100 to 120) dBm			
10 MHz to 4GHz	1.6 dB		
RF Tuned Power – Measure (relative)	Up to 4.2 GHz		Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
	30 to -90 dB	0.4 % of reading + 0.22 dB	
	-90 to -114 dB	0.38 % of reading + 0.62 dB	
	-106 to -129 dB	0.28 % of reading + 1 dB	
	4GHz to 26.5 GHz		
	30 to -90 dB	2 % of reading + 0.97 dB	
	-90 to -114 dB	0.83 % of reading + 2.9 dB	
	-106 to -129 dB	0.8 % of reading + 3.6 dB	
	26.5 GHz to 50 GHz		
	30 to -90 dB	2.2 % of reading + 1.1 dB	
	-90 to -114 dB	0.93 % of reading + 3.4 dB	
	-106 to -129 dB	0.88 % of reading + 4 dB	



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 Error Vector Magnitude for FSK Modulation	(1 to 100) kHz 100 kHz to 1 MHz 1 MHz to 2.65 GHz (1 to 100) kHz (0.1 to 1) MHz 1 MHz to 2.65 GHz Modulation Frequency 3.2 kHz 1.152 kHz	0.33 % of reading 0.51 % of reading 1 % of reading 0.18 ° 0.34 ° 0.57 ° 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) % Rate: (20 to 50) Hz (5 to 99) % Rate:9 kHz to 3.2 GHz (0 to 100) %	0.1 % of reading 0.25 % of reading 5 % of reading	AM/FM Test Source, Analog Modulation Sources Vista, CA Fremont, CA Orlando, FL
Amplitude Modulation - Source DC to 100 kHz	Rate:250 kHz to 50 GHz (0 to 99) %	1.2 % of reading + 0.07 AM	AM/FM Test Source, Analog Modulation Sources Vista, CA Fremont, CA
Amplitude Modulation - Measure ³ 100 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



Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Amplitude Modulation - Measure ³ 10 MHz to 3 GHz	50 Hz to 100 kHz, (5 to 20) % Depth	0.001 % of reading + 0.029 AM	Microwave Measuring Receiver System Vista, CA Fremont, CA Orlando, FL
(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	
Amplitude Modulation - Measure (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	Microwave Measuring Receiver System Vista, CA
(31.15 to 50) GHz	50 Hz to 100kHz, (5 to 20) % Depth (20 to 99) % Depth	0.3 % of reading + 0.000 05 AM 0.07 % of reading + 0.000 046 AM	
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



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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
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



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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
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



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Electrical – RF/Microwave

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	AM/FM Test Source Vista, CA Fremont, CA Orlando, FL
(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	Analog Modulation Sources Vista, CA Fremont, CA Orlando, FL
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	Analog Modulation Sources Vista, CA Fremont, CA Orlando, FL



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Electrical – RF/Microwave

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 + 0.0071 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
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 1280) 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

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase - Measure	(0 to 360) ° 10 Hz to 50 kHz (50 to 100) kHz	0.084 ° 0.41 °	Phase Meter Vista, CA
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	(0 to -99) dB (0 to -99) 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
Absolute Power - Measure	100 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



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Noise Figure - Source	15 dB ENR 10 MHz to 4 GHz (>4 to 10) GHz (>10 to 18) GHz (>18 to 26.5) GHz	0.11 dB 0.14 dB 0.18 dB 0.17 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
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 20) dB (9 to 100) kHz 100 kHz to 10 MHz 10 MHz to 4.2 GHz 50MHz to 10 GHz (10 to 18) GHz (18 to 26.5) GHz (26.5 to 30) GHz (30 to 40) GHz (40 to 50) GHz	0.42 dB 0.22 dB 0.54 dB 0.91 dB 0.93 dB 1 dB 1.2 dB 2.1 dB 2.5 dB	Bolometric Mounts, Gold Standard Power Sensors, AC Measurement Standard, Signal Sources and Precision Level Source Vista, CA



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
ESD Simulators Contact Voltage (Positive and Negative)	(1 to 8) kV	1.2 % of reading	Multimeters, ESD Target, Attenuator and Oscilloscope Vista, CA Fremont, CA Orlando, FL
Rise Time	(0.6 to 1) ns	0.000 12 % Δ time rdg + 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	
ESD Simulators Air Discharge Voltage (Positive and Negative) Rise Time	(1 to 30) kV	1.2 % of reading	Multimeters, ESD Target, Attenuator and Oscilloscope Vista, CA Fremont, CA Orlando, FL
RC Time Constant (at ± 15 kV)	(0.7 to 1) ns	0.00012 % Δ time reading + 11 ps	
	600 ns \pm 130 ns for 330 pF probe 300 ns \pm 60 ns for 150 pF probe	0.00012 % Δ time reading + 11 ps 0.00012 % Δ time reading + 11 ps	
EFT/Burst Generator Voltage (\pm) Rise Time Impulse Duration Burst Duration Burst Period	10 V to 8 kV 5 ns \pm 30 % 50 ns \pm 30 % 15 ns \pm 20 % 300 ms \pm 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
Current Probes and Bulk Current Injection Probes Insertion Loss	(0 to 1) dB 20 Hz to 300 kHz 300 kHz to 400 MHz	0.09 dB 0.09 dB	Network/RF Impedance Analyzers Vista, CA Fremont, CA Orlando, FL
Transfer Impedance	(0 to 1) dB 20 Hz to 300 kHz 300 kHz to 400 MHz	0.02 dB 0.02 dB	



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Surge Generator Front Time Rise Time Open Circuit (\pm) Short Circuit (\pm) Time to Half-Value (\pm) Open Circuit Voltage (\pm) Short Circuit Voltage (\pm) Ring Wave Voltage Ring Wave Rise Time	(1.2 to 50) μ s (1.2 to 50) μ s (20 to 700) μ s 10 V to 12 kV (0.125 to 3) kA 1 kV \pm 10 % 1.5 μ s \pm 0.5 μ s	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
Transmission S_{12}/S_{21} - Measure Phase and Magnitude	10 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	0.18 dB (1 $^\circ$) 0.057 dB (0.43 $^\circ$) 0.072 dB (0.8 $^\circ$) 0.086 dB (0.89 $^\circ$) 0.13 dB (1.2 $^\circ$) 0.3 dB (2.4 $^\circ$) 0.92 dB (6.9 $^\circ$)	LF Vector Network Analyzer, Calibration Kits Vista, CA Fremont, CA Orlando, FL
Transmission S_{12}/S_{21} - Measure Phase and Magnitude	(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	0.12 dB (4.1 $^\circ$) 0.063 dB (0.48 $^\circ$) 0.077 dB (0.8 $^\circ$) 0.093 dB (0.94 $^\circ$) 0.13 dB (1.2 $^\circ$) 0.32 dB (2.6 $^\circ$) 0.92 dB (7.4 $^\circ$)	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 (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	0.07 dB (0.46 $^\circ$) 0.054 dB (0.36 $^\circ$) 0.075 dB (0.5 $^\circ$) 0.12 dB (0.83 $^\circ$) 0.29 dB (1.9 $^\circ$) 2.3 dB (5.5 $^\circ$) 5.9 dB (5.7 $^\circ$)	Vector Network Analyzer w/ Calibration Kits Vista, CA Fremont, CA Orlando, FL



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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	(2 to 8) GHz		Vector Network Analyzer w/ Calibration Kits Vista, CA Fremont, CA Orlando, FL
	(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		
	(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 °)	
	(20 to 40) GHz		
	(0 to 10) dB	0.54 dB (3.7 °)	
	(-10 to 0) dB	0.5 dB (3.4 °)	
	(-20 to -10) dB	0.49 dB (3.3 °)	
	(-30 to -20) dB	0.5 dB (3.4 °)	
	(-40 to -30) dB	0.52 dB (3.5 °)	
	(-50 to -40) dB	0.55 dB (3.7 °)	
	(-60 to -50) dB	0.65 dB (4.4 °)	
(-70 to -60) dB	1.1 dB (7.6 °)		
(-80 to -70) dB	2.7 dB (8.9 °)		
(-90 to -80) dB	6.6 dB (11 °)		



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 $<+ 60^\circ$ 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
Reflection S_{11}/S_{22} - Measure Phase and Magnitude ²	10 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 lin (1.4 deg) 0.003 5 lin (1.4 deg) 0.006 1 lin (1.1 deg) 0.008 3 lin (0.94 deg) 0.01 lin (0.83 deg) 0.012 lin (0.7 deg) 0.005 6 lin (1.8 deg) 0.003 5 lin (1.8 deg) 0.008 lin (1.3 deg) 0.011 lin (1.2 deg) 0.013 lin (1 deg) 0.016 lin (0.89 deg)	LF Vector Network Analyzer, Calibration Kits Vista, CA Fremont, CA Orlando, FL
Reflection S_{11}/S_{22} – Measure Phase and Magnitude ²	50 MHz to 2 GHz (<0.03) Γ (<0.2) Γ (<0.4) Γ (<0.6) Γ (<0.8) Γ (<1) Γ	0.01 lin (3.3 deg) 0.012 lin (3.3 deg) 0.014 lin (2 deg) 0.017 lin (1.6 deg) 0.021 lin (1.5 deg) 0.026 lin (1.5 deg)	Vector Network Analyzer w/ Calibration Kits Vista, CA Fremont, CA Orlando, FL
Reflection S_{11}/S_{22} – Measure Phase and Magnitude ²	(2 to 8) GHz (<0.03) Γ (<0.2) Γ (<0.4) Γ (<0.6) Γ (<0.8) Γ (<1) Γ	0.01 lin (3.5 deg) 0.012 lin (3.5 deg) 0.015 lin (2.2 deg) 0.019 lin (1.8 deg) 0.024 lin (1.7 deg) 0.003 lin (1.7 deg)	Vector Network Analyzer w/ Calibration Kits Vista, CA Fremont, CA Orlando, FL



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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	(8 to 20) GHz (<0.03) Γ (<0.2) Γ (<0.4) Γ (<0.6) Γ (<0.8) Γ (<1) Γ	0.0024 lin (7.8 deg) 0.0027 lin (7.8 deg) 0.0033 lin (4.8 deg) 0.0042 lin (4 deg) 0.053 lin (3.8 deg) 0.067 lin (3.9 deg)	Vector Network Analyzer w/ Calibration Kits Vista, CA Fremont, CA Orlando, FL
	(20 to 40) GHz (<0.03) Γ (<0.2) Γ (<0.4) Γ (<0.6) Γ (<0.8) Γ (<1) Γ	0.06 lin (19 deg) 0.066 lin (11 deg) 0.079 lin (11 deg) 0.097 lin (9.3 deg) 0.12 lin (8.8 deg) 0.15 lin (8.8 deg)	
Reflection S_{11}/S_{22} – Measure Magnitude ⁴	(<0.03 to <1) Γ (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	Vector Network Analyzer w/ Calibration Kits Vista, CA
Phase	≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.023 $^\circ$ 0.013 $^\circ$ 0.064 $^\circ$ 0.017 $^\circ$	
Network Analyzer System Verification (Corrected Performance) 7mm Test Ports Reflection S_{11}/S_{22} – Magnitude ⁴	≤ 0.1 to ≤ 1.0 Γ (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	Mechanical Calibration Kits and RF Network Analyzer System Verification Kits Vista, CA Fremont, CA Orlando, FL
Phase	≤ 0 to $\leq 60^\circ$ (0.0003 to 1) GHz (1 to 3) GHz (3 to 6) GHz	1.97 $^\circ$ 2.1 $^\circ$ 2.7 $^\circ$	



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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 Reflection S_{11}/S_{22} –Magnitude ⁴ 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 $\leq 60^\circ$ (0.0003 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 $^\circ$ 0.64 $^\circ$ 0.65 $^\circ$ 1.3 $^\circ$	Mechanical Calibration Kits and RF Network Analyzer System Verification Kits Vista, CA Fremont, CA Orlando, FL
Network Analyzer System Verification (Corrected Performance) 3.5mm Test Ports Reflection S_{11}/S_{22} –Magnitude ⁴ Phase	≤ 0.1 to ≤ 1.0 (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 $^\circ$ 0.36 $^\circ$ 0.64 $^\circ$	Mechanical Calibration Kits and RF Network Analyzer System Verification Kits Vista, CA Fremont, CA Orlando, FL
Network Analyzer System Verification (Corrected Performance) 2.4mm Test Ports Reflection S_{11}/S_{22} –Magnitude ⁴ Phase	≤ 0.1 to ≤ 1.0 Γ (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 $^\circ$ 1.3 $^\circ$ 1.5 $^\circ$ 2.3 $^\circ$	Mechanical Calibration Kits and RF Network Analyzer System Verification Kits Vista, CA Fremont, CA Orlando, FL



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Electrical – RF/Microwave

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 ≤ 1.0 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 1.43 ° 1.5 ° 2.2 °	Mechanical Calibration Kits and RF Network Analyzer System Verification Kits Vista, CA Fremont, CA Orlando, FL
Network Analyzer System Verification (Corrected Performance) N-Type Test Ports Transmission S_{21}/S_{122} – 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 $\leq 60^\circ$ (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 °	Mechanical Calibration Kits and RF Network Analyzer System Verification Kits Vista, CA Fremont, CA Orlando, FL
Network Analyzer System Verification (Corrected Performance) 3.5mm Test Ports Transmission S_{21}/S_{122} – Magnitude Phase	≤ 0.1 to ≤ 1.0 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 °	Mechanical Calibration Kits and RF Network Analyzer System Verification Kits Vista, CA Fremont, CA Orlando, FL



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) 2.4mm Test Ports Transmission S_{21}/S_{12} – 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 $\leq 60^\circ$ (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 °	Mechanical Calibration Kits and RF Network Analyzer System Verification Kits 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
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/ μ V 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	CISPR Pulse Generator Vista, CA Fremont, CA Orlando, FL



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
LISN (Line Impedance Stabilization Network) & AMN (Artificial Mains Network) Insertion Loss	(-20 to 0) dB 10 Hz to 1000 MHz	0.25 dB	RF Impedance/Network Analyzers, Calibration Kits, Calibration Fixtures Vista, CA Fremont, CA Orlando, FL
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 1000 MHz	2.4 %	
Impedance (Phase)	(-180 to 180) ° 10 Hz to 1 000 MHz	2.6 °	
CDN (Coupling-Decoupling Network) & ISN (Impedance Stabilization Network) Insertion Loss	(-20 to 0) dB 10 Hz to 1000 MHz	0.25 dB	RF Impedance/Network Analyzers, Calibration Kits, Calibration Fixtures Vista, CA Fremont, CA Orlando, FL
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	
Biconical Antennas ³ – 1 Meter Distance 3 Meter Distance 10 Meter Distance	(-135 to 21) dB (25 to 300) MHz	0.94 dB	Standard Site Method, Horizontal Polarization, Vertical Polarization, Swept Frequency Analyzer and Source Fremont, CA
Log Periodic Antennas ³ – 1 Meter Distance 3 Meter Distance 10 Meter Distance	(-135 to 21) dB 80 MHz to 6 GHz	0.83 dB	Standard Site Method, Horizontal Polarization, Vertical Polarization, Swept Frequency Analyzer and Source Fremont, CA



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Hybrid Antennas ³ – 1 Meter Distance 3 Meter Distance 10 Meter Distance	(-135 to 21) dB 20 MHz to 6 GHz	1.1 dB	Standard Site Method, Horizontal Polarization, Vertical Polarization, Swept Frequency Analyzer and Source Fremont, CA
Horn Antennas ³ 1 Meter Distance 3 Meter Distance	(-135 to 21) dB 170 MHz to 3 GHz 700 MHz to 18 GHz (-135 to 21) dB (1 to 18) GHz (18 to 26.5) GHz (26.5 to 40) GHz	0.58 dB 0.9 dB 1.1 dB 1.2 dB 1.3 dB	Standard Site Method, Horizontal Polarization, Vertical Polarization, Network Analyzer and Calibration Kit Fremont, CA
Antenna VSWR ³	(-135 to 21) dB 20 MHz to 1 GHz (1 to 20) GHz (20 to 40) GHz	0.77 dB 0.89 dB 1.1 dB	Network Analyzer with Calibration Kit Fremont, CA
NSA Measurement ³	(-135 to 21) dB (30 to 200) MHz 200 MHz to 1 GHz	0.99 dB 0.95 dB	Swept Frequency Analyzer and Source, Standard Antenna Pair Fremont, CA
Antenna Symmetry ³	(-1 to 1) dB 30 MHz to 6 GHz @ (-110 to 20) dB	0.26 dB + 0.012 % of reading	Agilent E4440A Spectrum Analyzer, Agilent E8257D Signal Generator, Sunol Sciences JB6 Antenna Fremont, CA

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Calipers ¹	(0 to 54) in	46 μin/in + 52 μin	Gage Blocks, Standard Rings, Rod Sets Vista, CA Fremont, CA Orlando, FL
Micrometers and Thickness Gages ¹ (Linearity Only)	(0 to 54) in	46 μin/in + 52 μin	Gage Blocks, Rod Sets Vista, CA Fremont, CA
Indicators ¹	(0 to 4) in	0.26 μin/in + 57 μin	Gage Blocks Vista, CA Fremont, CA
Pin and Plug Gages ¹	(0.3 to 30) mm	5 μm	Micrometer Vista, CA Fremont, CA
Micrometers and Thickness Gages	Up to 7 in	(58 + 10L) μin	Grade 1 Gage Block Set Orlando, FL
Calipers - External Diameter Internal Diameter	Up to 12 in	(68 + 24.2L) μin	Grade 1 Gage Block Set Vista, CA Fremont, CA
Height Gages	Up to 12 in	(750 + 4.7L) μin	Gage Blocks
Depth Gages	Up to 12 in	(160 + 4.1L) μin	Vista, CA Fremont, CA Orlando, FL
Dial Indicators	Up to 2 in	(1 100 + 18L) μin	Gage Blocks Vista, CA Fremont, CA Orlando, FL
Surface Flatness	(12 X 12) in to (72 X 144) in	(250 + 0.21L) μin	Leveling System Orlando, FL



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Length – Dimensional Metrology

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

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force	(0 to 20) kgf	0.024 kgf/kgf	NIST Class F Weights Vista, CA Fremont, CA Orlando, FL
Pressure - Source 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 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	(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 0.068 lbf·in + 0.002 lbf·in 0.39 lbf·ft + 0.001 lbf·ft 2.9 lbf·ft + 0.001 lbf·ft	Torque Transducers Orlando, FL



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Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales & Balances ¹	10 mg to 100 g 1 kg 2 kg (5 to 10) lb (10 to 20) lb (20 to 100) lb (100 to 356) lb	0.15 g 0.23 g 0.3 g 0.15 lb 0.14 lb 0.18 lb 0.12 lb	NIST Class F Weights Vista, CA Fremont, CA
Scales & Balances	0.25 oz 0.5 oz 1 oz 2 oz 4 oz 8 oz 16 oz 1 kg 2 kg 5 lbs (1 to 10) lbs (10 to 50) lbs (50 to 300) lbs	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

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity - Measure ¹	(0 to 80) %RH	2 %RH	Humidity Probe Monitor Vista, CA Fremont, CA Orlando, FL
Temperature - Measure	(-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



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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 x 10 ⁻¹² MHz	Frequency Synthesizer w/ GPS Reference Vista, CA Fremont, CA Orlando, FL
Frequency - Source ¹	10 MHz to 50 GHz	5.1 x 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 x 10 ⁻¹² GHz 5.1 x 10 ⁻¹² GHz	Electronic Counters, Analyzers w/ GPS Reference Vista, CA Fremont, CA Orlando, FL
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

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pulse Width - Measure	> 5 ns	1.1 ns	Universal Counter w/ GPS Reference Vista, CA Fremont, CA Orlando, FL
Stop Watches – Totalize Method	1s to 24 hrs	0.000 6 % of reading + 0.044 s	Universal Counter and Synthesizer w/ GPS Reference 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. $\Gamma = \rho$
3. Performed at Open Area Test Site (OATS) in Morgan, CA.
4. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1736.



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