



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 2026

Certificate Number: AC-1736



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



**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017
AND
ANSI/NCSL Z540-1-1994 (R2002)**

Techmaster Electronics, LLC

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Services performed at satellite locations as indicated
2225 Martin Ave, Suite I, Santa Clara, CA 95050
6120 Hanging Moss Rd. Orlando, FL 32807

CALIBRATION, DIMENSIONAL MEASUREMENT AND TESTING

Valid to: **October 29, 2026**

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 Santa Clara, 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 ⁶	4.01 pH 7.00 PH 10.00 pH	0.017 pH 0.018 pH 0.031 pH	Standard Solutions Vista, CA Santa Clara CA Orlando, FL
Conductivity - Source ⁶	100 µS/cm 500 µS/cm 1 400 µS/cm 10 000 µS/cm	1.4 µS/cm 6.2 µS/cm 17 µS/cm 120 µS/cm	Standard Solutions Vista, CA Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Digit Multimeter Vista, CA
DC Current – Measure ¹	(1 to 100) A (100 to 600) A (600 to 1 000) A	85 µA/A 127 µA/A 0.29 % of reading + 0.02 A	Precision 8.5 Digit Multimeter w/ Current Shunts Vista, CA Santa Clara, 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



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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	(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	0.0064 % of reading + 15 μV	
	40 Hz to 20 kHz	0.0044 % 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	0.0061 % 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 μ V/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 μ V 0.21 mV/V + 4.5 μ V 0.11 mV/V + 4.5 μ V 0.37 mV/V + 4.5 μ V 0.85 mV/V + 7 μ V 1.1 mV/V + 13 μ V 1.7 mV/V + 25 μ V 3.4 mV/V + 25 μ V 0.55 mV/V + 5 μ V 0.21 mV/V + 5 μ V 0.11 mV/V + 5 μ V 0.37 mV/V + 5 μ V 0.85 mV/V + 7 μ V 1.1 mV/V + 12 μ V 1.7 mV/V + 25 μ V 3.4 mV/V + 25 μ V 0.55 mV/V + 13 μ V 0.21 mV/V + 8 μ V 0.11 mV/V + 8 μ V 0.32 mV/V + 8 μ V 0.85 mV/V + 25 μ V 1.1 mV/V + 25 μ V 1.7 mV/V + 35 μ V 3.4 mV/V + 80 μ V	High Performance Multifunction Calibrator w/ Transconductance Amplifier Santa Clara, 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 Santa Clara, 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		



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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 Santa Clara, CA Orlando, FL
	(1 to 40) Hz	0.36 mV/V + 3.6 μ V	
	40 Hz to 1 kHz	0.23 mV/V + 1.4 μ V	
	(1 to 20) kHz	0.32 mV/V + 1.7 μ V	
	(20 to 50) kHz	1.2 mV/V + 1.6 μ V	
	(50 to 100) kHz	5.7 mV/V + 2 μ V	
	(100 to 300) kHz	46 mV/V + 2.6 μ V	
	(10 to 100) mV		
	(1 Hz to 40) Hz	72 μ V/V + 0.85 mV	
	40 Hz to 1 kHz	84 μ V/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 μ V/V + 0.73 mV	
	40 Hz to 1 kHz	80 μ V/V + 0.26 mV	
	(1 to 20) kHz	160 μ V/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 Santa Clara, 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		



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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 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		



ANSI National Accreditation Board

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 Santa Clara, 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 Santa Clara, 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 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		



ANSI National Accreditation Board

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		



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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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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	Up to 220 μ A		High Performance Multifunction Calibrator Santa Clara, 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 μ A to 2.2 mA		
	(10 to 20) Hz	0.25 mA/A + 40 nA	
	(20 to 40) Hz	0.16 mA/A + 36 nA	
	40 Hz to 1 kHz	0.12 mA/A + 36 nA	
	(1 to 5) kHz	0.2 mA/A + 0.11 μ A	
	(5 to 10) kHz	1.1 mA/A + 0.65 μ A	
	(2.2 to 22) mA		
	(10 to 20) Hz	0.25 mA/A + 0.41 μ A	
	(20 to 40) Hz	0.16 mA/A + 0.36 μ A	
	40 Hz to 1 kHz	0.12 mA/A + 0.36 μ A	
	(1 to 5) kHz	0.2 mA/A + 0.56 μ A	
	(5 to 10) kHz	1.1 mA/A + 5.1 μ A	
	(22 to 220) mA		
	(10 to 20) Hz	0.25 mA/A + 4.1 μ A	
	(20 to 40) Hz	0.16 mA/A + 3.6 μ A	
40 Hz to 1 kHz	0.12 mA/A + 2.6 μ A		
(1 to 5) kHz	0.2 mA/A + 3.6 μ A		
(5 to 10) kHz	1.1 mA/A + 11 μ A		
220 mA to 2.2 A			
20 Hz to 1 kHz	0.25 mA/A + 36 μ A		
(1 to 5) kHz	0.45 mA/A + 81 μ A		
(5 to 10) kHz	7 mA/A + 0.18 mA		
(2.2 to 11) A			
40 Hz to 1 kHz	0.46 mA/A + 0.21 mA		
(1 to 5) kHz	0.95 mA/A + 0.4 mA		
(5 to 10) kHz	3.6 mA/A + 0.76 mA		
(11 to 20) A			
(45 to 100) Hz	1.2 mA/A + 5 mA		
100 Hz to 1kHz	1.5 mA/A + 5 mA		
(1 to 5) kHz	30 mA/A + 5 mA		

Electrical – DC/Low Frequency

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 Santa Clara, 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



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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 ($\Delta\Phi^\circ$)	0.09° 0.2° 0.39° 1.9° 3.9° 7.8°	Multi Product Calibrator Vista, CA Santa Clara, 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 μ A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz 100 μ A to 100 mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz 100 μ A to 100 mA (20 to 50) kHz (50 to 100) kHz 100 mA to 1 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	4.7 mA/A + 36 nA 1.8 mA/A + 35 nA 0.71 mA/A + 35 nA 0.7 mA/A + 35 nA 4.7 mA/A + 24 μ A 1.8 mA/A + 24 μ A 0.71 mA/A + 24 μ A 0.36 mA/A + 23 μ A 0.71 mA/A + 24 μ A 4.7 mA/A + 47 μ A 6.5 mA/A + 0.18 mA 4.7 mA/A + 0.24 mA 1.9 mA/A + 0.24 mA 0.95 mA/A + 0.24 mA 1.1 mA/A + 0.26 mA 3.5 mA/A + 0.24 mA 12 mA/A + 0.47 mA	Precision 8.5 Digit Multimeter Santa Clara, 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 Santa Clara, 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 μ A		Precision 8.5 Digit Multimeter 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		
AC High Current - Measure	(50 to 400) H z		Precision 8.5 Digit Multimeter and Current Transducers Orlando, FL
	(0.25 to 10) A	0.59 % of reading + 0.029 A	
	(10 to 100) A	0.59 % of reading + 0.37 A	
	(100 to 400) A	0.6 % of reading + 1.6 A	
	(400 to 600) A	0.6 % of reading + 2 A	
	(50 to 60) Hz		
	(600 to 900) A	0.6 % of reading + 3.8 A	
(900 to 1 100) A	0.6 % of reading + 4.1 A		
(1 100 to 1 500) A	0.6 % of reading + 4.9 A		
Resistance – Source ¹	Up to 11 Ω	1.7 m Ω / Ω + 35 $\mu\Omega$	Multi Product Calibrator Vista, CA Santa Clara, 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	

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 Santa Clara, 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 Santa Clara, CA



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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	1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	47 Ω 0.47 kΩ 1.3 kΩ 12 kΩ	High Performance Multifunction Calibrator Santa Clara, 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 Santa Clara, 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 Santa Clara, 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
LCR Impedance - Source	DC to 1 kHz 100 mΩ 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ	0.42 mΩ 1.3 mΩ 6.3 mΩ 33 mΩ 310 mΩ 3.1 Ω 32 Ω 460 Ω 13 kΩ 33 kΩ	Impedance Calibrator Vista, CA



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
LCR Impedance - Source	(0.1 to 1) kHz		Impedance Calibrator Vista, CA
	10 pF	0.062 pF	
	100 pF	0.12 pF	
	1 nF	0.0017 nF	
	10 nF	0.024 nF	
	100 nF	0.067 nF	
	1 μF	0.0015 μF	
	10 μF	0.0069 μF	
	100 μF	0.13 μF	
	(10 to 50) kHz		
	10 μH	0.12 μH	
	(1 to 10) kHz		
	100 μH	0.24 μH	
	(0.1 to 1) kHz		
	1 mH	0.0013 mH	
10 mH	0.012 mH		
100 mH	0.12 mH		
1 H	0.0012 H		
10 H	0.012 H		
Capacitance – Source ¹			Multi Product Calibrator Vista, CA Santa Clara, CA Orlando, FL
10 Hz to 10 kHz	(220 to 399.9) pF	0.58 % of reading + 12 pF	
10 Hz to 10 kHz	(0.4 to 1.099 9) nF	0.57 % of reading + 12 pF	
10 Hz to 3 kHz	(1.1 to 3.299 9) nF	0.57 % of reading + 12 pF	
10 Hz to 1 kHz	(3.3 to 10.999 9) nF	0.22 % of reading + 27 pF	
10 Hz to 1 kHz	(11 to 32.999 9) nF	0.29 % of reading + 0.12 nF	
10 Hz to 1 kHz	(33 to 109.999) nF	0.29 % of reading + 0.13 nF	
10 Hz to 1 kHz	(110 to 329.999) nF	0.29 % of reading + 0.35 nF	
(10 to 600) Hz	(0.33 to 1.099 99) μF	0.28 % of reading + 1.5 nF	
(10 to 300) Hz	(1.1 to 3.299 99) μF	0.29 % of reading + 3.5 nF	
Capacitance – Source ¹			Multi Product Calibrator Vista, CA Santa Clara, CA Orlando, FL
(10 to 150) Hz	(3.3 to 10.999 9) μF	0.29 % of reading + 1.3 nF	
(10 to 120) Hz	(11 to 32.999 9) μF	0.46 % of reading + 36 nF	
(10 to 80) Hz	(33 to 109.999) μF	0.53 % of reading + 0.12 μF	
(0 to 50) Hz	(110 to 329.999) μF	0.53 % of reading + 0.35 μF	
(0 to 20) Hz	(0.33 to 1.099 99) mF	0.5 % of reading + 1.5 μF	
(0 to 6) Hz	(1.1 to 3.299 99) mF	0.52 % of reading + 3.6 μF	
(0 to 2) Hz	(3.3 to 10.999 9) mF	0.51 % of reading + 13 μF	
(0 to 0.6) Hz	(11 to 32.999 9) mF	0.86 % of reading + 35 μF	
(0 to 0.2) Hz	(33 to 110) mF	1.3 % of reading + 0.13 mF	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 Santa Clara, 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 Santa Clara, 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 Santa Clara, CA Orlando, FL
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 Santa Clara, 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 Santa Clara, 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 C		Multi Product Calibrator Vista, CA Santa Clara, CA Orlando, FL
	(0 to 150) °C	0.29 °C	
	(150 to 650) °C	0.32 °C	
	(650 to 1 000) °C	0.28 °C	
	(1 000 to 1 800) °C	0.48 °C	
	(1 800 to 2 316) °C	0.71 °C	
	Type E		
	(-250 to -100) °C	0.43 °C	
	(-100 to -25) °C	0.21 °C	
	(-25 to 350) °C	0.17 °C	
	(350 to 650) °C	0.14 °C	
	(650 to 1 000) °C	0.19 °C	
	Type J		
	(-210 to -100) °C	0.35 °C	
	(-100 to -30) °C	0.2 °C	
	(-30 to 150) °C	0.14 °C	
	(150 to 760) °C	0.19 °C	
	(760 to 1 200) °C	0.26 °C	
	Type K		
	(-200 to -100) °C	0.28 °C	
	(-100 to -25) °C	0.21 °C	
(-25 to 120) °C	0.23 °C		
(120 to 1 000) °C	0.25 °C		
(1 000 to 1 372) °C	0.33 °C		
Type N			
(-200 to -100) °C	0.39 °C		
(-100 to -25) °C	0.27 °C		
(-25 to 120) °C	0.23 °C		
(120 to 410) °C	0.18 °C		
(410 to 1 300) °C	0.27 °C		



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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 Santa Clara, 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 Santa Clara, 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		

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 Santa Clara, 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 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	0.2 % + 36 μV	Multi Product Calibrator Vista, CA Santa Clara, CA Orlando, FL	
	(0 to +/-130) V	0.039 % of reading + 37 μV		
	1 mVpp to 6.6 Vpp	0.2 % of reading + 65 μV		
	1 mVpp to 130 Vpp	0.078 % of reading + 36 μV		
	5 mV to 5.5 V	15 mV/V + 0.49 mV		



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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 (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 Santa Clara, 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 μ s	81 ns	Oscilloscope Vista, CA Santa Clara, CA Orlando, FL
ESD Simulators Contact Voltage (Positive and Negative)	(1 to 8) kV	1.2 % of reading	Multimeters, ESD Target, Attenuator and Oscilloscope
Rise Time	(0.6 to 1) ns	0.000 12 % Δ time reading + 11 ps	Vista, CA Santa Clara, CA Orlando, FL
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)	(0.7 to 1) ns (1 to 30) kV	1.2 % of reading	Multimeters, ESD Target, Attenuator and Oscilloscope
Rise Time			
RC Time Constant (at \pm 15 kV)	600 ns \pm 130 ns 330 pF probe 300 ns \pm 60 ns 150 pF probe	0.000 12 % Δ time reading + 11 ps 0.000 12 % Δ time reading + 11 ps	Vista, CA Santa Clara, CA Orlando, FL
EFT/Burst Generator Voltage (\pm)	10 V to 8 kV	2.7 % of reading	Fast Rise Oscilloscope w/ EFT Verification Set
Rise Time	5 ns \pm 30 %	0.008 % Δ time reading	
Impulse Duration	50 ns \pm 30 %	0.008 % Δ time reading	
Burst Duration	15 ns \pm 20 %	0.008 % Δ time reading	
Burst Period	300 ms \pm 20 %	0.008 % Δ time reading	Vista, CA Santa Clara, CA Orlando, FL
Surge Generator Front Time			Fast Rise Oscilloscope, Current Probes, Oscilloscope Probes
Rise Time			
Open Circuit (\pm)	(1.2 to 50) μ s	0.008 % Δ time reading	
Short Circuit (\pm)	(1.2 to 50) μ s	0.008 % Δ time reading	
Time to Half-Value (\pm)	(20 to 700) μ s	0.008 % Δ time reading	
Open Circuit Voltage (\pm)	10 V to 12 kV	2.9 % of reading	Vista, CA Santa Clara, CA Orlando, FL
Short Circuit Voltage (\pm)	(0.125 to 3) kA	2.9 % of reading	
Ring Wave Voltage	1 kV \pm 10 %	2.9 % of reading	
Ring Wave Rise Time	1.5 μ s \pm 0.5 μ s	0.008 % Δ time reading	

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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Absolute Power Source Into 50 Ω 0.001 Hz to 100 kHz SWR 1.2:1	(3 to 10) V _{pp} 1 mV _{pp} to 3V _{pp}	0.13 dB 0.22 dB	Synthesized Signal Sources
100 kHz to 10 MHz SWR ≤ 1.2:1	(3 to 10) V _{pp} 1 mV _{pp} to 3 V _{pp}	0.41 dB 0.61 dB	Vista, CA Santa Clara, CA Orlando, FL
(10 to 20) MHz SWR ≤ 1.2:1	100 mV _{pp} to 3 V _{pp} (1 to 100) mV _{pp}	0.61 dB 0.91 dB	
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 Santa Clara, 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 Santa Clara, 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 SWR ≤ 1.6:1	(+10 to -10) dBm 10 MHz to 2 GHz (2 to 20) GHz	1.5 dB 1.7 dB	Synthesized Level Generator Vista, CA Santa Clara, CA Orlando, FL
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	
SWR ≤ 2.0:1	(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	
SWR ≤ 2.0:1	(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	Synthesized Low Phase Noise Level Generator Vista, CA
SWR ≤ 2.0:1	(20 to 40) GHz	2.2 dB	
SWR ≤ 2.0:1	(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 (3 to 4) GHz	0.08 dB 0.52 dB	
	(-48 to -84) dBm 100 kHz to 10 MHz (10 to 300) MHz	0.52 dB 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 300 MHz to 4 GHz	0.53 dB 1 dB	
	(-94 to -130) dBm (10 to 128) MHz 300 MHz to 4 GHz	0.73 dB 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)	100 kHz to 4.2 GHz		Measuring Receiver System Vista, CA Santa Clara, CA Orlando, FL
	(+30 to 0) dB	0.14 dB	
	(0 to -30) dB	0.16 dB	
	(-30 to -60) dB	0.19 dB	
	(-60 to -90) dB	0.21 dB	
	(-90 to -129) dB	0.25 dB	
	(4.2 to 18) GHz		
	(+30 to 0) dB	0.18 dB	
	(0 to -30) dB	0.2 dB	
	(-30 to -60) dB	0.22 dB	
	(-60 to -90) dB	0.24 dB	
	(-90 to -129) dB	0.28 dB	
	(18 to 26.5) GHz		
	(+30 to 0) dB	0.24 dB	
	(0 to -30) dB	0.25 dB	
	(-30 to -60) dB	0.27 dB	
	(-60 to -90) dB	0.29 dB	
	(-90 to -129) dB	0.32 dB	

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 Santa Clara, CA Orlando, FL
Digital Modulation - Measure Carrier Frequency 2 MHz to 2.65 GHz Error Vector Magnitude for Modulation Types: MSK, GMSK, BPSK, DQPSK, $\Pi/4$ DQPSK, 8PSK, 16QAM, 32 QAM and QPSK Phase Error for Modulation Types: MSK, GMSK, BPSK, DQPSK, $\Pi/4$ DQPSK, 8PSK, 16QAM, 32 QAM and QPSK	(0 to 15) % (1 to 100) kHz 100 kHz to 1 MHz 1 MHz to 2.65 GHz (0 to 3) $^{\circ}$ (1 to 100) kHz (0.1 to 1) MHz 1 MHz to 2.65 GHz	0.33 % of reading 0.51 % of reading 1 % of reading 0.18 $^{\circ}$ 0.34 $^{\circ}$ 0.57 $^{\circ}$	Vector Signal Analyzer Vista, CA Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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



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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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, 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 Santa Clara, CA Orlando, FL



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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 Santa Clara, 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 Santa Clara, 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 Santa Clara, CA Orlando, FL
Power Reference- Measure 50 MHz	1 mW	5.5 μ W	Primary Standards Lab (H75) Thermistor Mount, Power Meter, Precision 8.5-digit Multimeter Vista, CA Santa Clara, CA Orlando, FL



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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	0.3 % of Reading + 0.65 dB	RF Power Meters/Sensors Vista, CA Santa Clara, CA Orlando, FL
	10 MHz to 18 GHz (-20 to -70) dBm	0.44 % of reading + 0.32 dB	
	50 MHz to 26.5 GHz (+20 to -30) dBm	0.24 % of reading + 0.86 dB	
	(26.5 to 50) GHz (+20 to -30) dBm	0.46 % of reading + 0.94 dB	
	(-20 to -70) dBm	1.6 % of reading + 0.67 dB	
Power Meter – Range Calibration	3 μ W	21 nW	Power Meter Range Calibrator w/ Precision DC Voltage Source Vista, CA Santa Clara, CA Orlando, FL
	10 μ W	19 nW	
	30 μ W	21 nW	
	100 μ W	77 nW	
	300 μ W	0.11 μ W	
	1 mW	0.29 μ W	
	3 mW	0.64 μ W	
	10 mW	6.4 μ W	
	30 mW	13 μ W	
	100 mW	0.10 mW	
Noise Figure - Source	15 dB ENR		Primary Standards Lab Noise Source Vista, CA
	10 MHz to 1.5 GHz	0.29 dB	
	(1.5 to 3) GHz	0.25 dB	
	(3 to 7) GHz	0.26 dB	
	(7 to 18) GHz	0.37 dB	
Noise Figure - Source	15 dB ENR		Noise Source Santa Clara, CA Orlando, FL
	10 MHz to 4 GHz	0.22 dB	
	(>4 to 10) GHz		
	(>10 to 18) GHz		
	(>18 to 26.5) GHz		
Noise Figure - Measure	100 kHz to 30 MHz	0.43 dB	Noise Figure Measurement System w/ Standard Noise Sources Vista, CA Santa Clara, CA Orlando, FL
	>30 MHz to 3 GHz	0.42 dB	
	(>3 to 26.5) GHz	0.47 dB	

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 Santa Clara, 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	(0 to 100) dB 9 kHz to 300 kHz 300 kHz to 1 MHz 1 MHz to 3 GHz	1.1 dB 1 dB 1.9 dB	Network/RF Impedance Analyzers, attenuator, type N calibration kit Vista, CA Santa Clara, CA Orlando, FL
Transfer Impedance	(0 to 100) dB 9 kHz to 300 kHz 300 kHz to 1 MHz 1 MHz to 3 GHz	1.1 dB 1 dB 1.9 dB	



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



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



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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 ^{2,3}	9 kHz to 1.3 GHz (-180 to 180) ^o		LF Vector Network Analyzer, Calibration Kits Vista, CA Santa Clara, CA Orlando, FL
	(<0.03) Γ	0.002 3 (1.4 ^o)	
	(<0.2) Γ	0.003 5 (1.4 ^o)	
	(<0.4) Γ	0.006 1 (1.1 ^o)	
	(<0.6) Γ	0.008 3 (0.94 ^o)	
	(<0.8) Γ	0.01 (0.83 ^o)	
	(<1) Γ	0.012 (0.7 ^o)	
	(1.3 to 3) GHz		
	(<0.03) Γ	0.005 6 (1.8 ^o)	
	(<0.2) Γ	0.003 5 (1.8 ^o)	
	(<0.4) Γ	0.008 (1.3 ^o)	
	(<0.6) Γ	0.011 (1.2 ^o)	
	(<0.8) Γ	0.013 (1 ^o)	
	(<1) Γ	0.016 (0.89 ^o)	
Reflection S_{11}/S_{22} – Measure Phase and Magnitude ^{2,3}	50 MHz to 2 GHz (-180 to 180) ^o		Vector Network Analyzer w/ Calibration Kits Vista, CA Santa Clara, CA Orlando, FL
	(<0.03) Γ	0.01 (3.3 ^o)	
	(<0.2) Γ	0.012 (3.3 ^o)	
	(<0.4) Γ	0.014 (2 ^o)	
	(<0.6) Γ	0.017 (1.6 ^o)	
	(<0.8) Γ	0.021 (1.5 ^o)	
	(<1) Γ	0.026 (1.5 ^o)	
	(2 to 8) GHz		
	(<0.03) Γ	0.01 (3.5 ^o)	
	(<0.2) Γ	0.012 (3.5 ^o)	
	(<0.4) Γ	0.015 (2.2 ^o)	
	(<0.6) Γ	0.019 (1.8 ^o)	
	(<0.8) Γ	0.024 (1.7 ^o)	
	(<1) Γ	0.003 (1.7 ^o)	
	(8 to 20) GHz		
	(<0.03) Γ	0.002 4 (7.8 ^o)	
	(<0.2) Γ	0.002 7 (7.8 ^o)	
	(<0.4) Γ	0.003 3 (4.8 ^o)	
	(<0.6) Γ	0.004 2 (4 ^o)	
	(<0.8) Γ	0.053 (3.8 ^o)	
	(<1) Γ	0.067 (3.9 ^o)	

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 Santa Clara, 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 $\leq 60^\circ$ (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 $\leq 60^\circ$ (0.0003 to 1) GHz (1 to 3) GHz (3 to 6) GHz	0.003 8 Γ 0.003 9 Γ 0.005 1 Γ 2° 2.1° 2.7°	Mechanical Calibration Kits and RF Network Analyzer System Vista, CA Santa Clara, 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 $\leq 60^\circ$ (0.000 3 to 1) GHz (1 to 3) GHz (3 to 8) GHz (8 to 18) GHz	0.009 Γ 0.001 Γ 0.001 5 Γ 0.004 1 Γ 0.46° 0.64° 0.65° 1.3°	Mechanical Calibration Kits and RF Network Analyzer System Vista, CA Santa Clara, CA Orlando, FL



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Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Network Analyzer System Verification (Corrected Performance) 3.5mm Test Ports Reflection S_{11}/S_{22} – Magnitude ^{2,3} Phase	≤ 0.1 to $\leq 1.0 \Gamma$ (0.045 to 2) G Γ Hz (2 to 20) GHz (20 to 26.5) GHz ≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 26.5) GHz	0.000 76 Γ 0.001 Γ 0.003 Γ 0.34° 0.36° 0.64°	Mechanical Calibration Kits and RF Network Analyzer System Vista, CA Santa Clara, CA Orlando, FL
Network Analyzer System Verification (Corrected Performance) 2.4mm Test Ports Reflection S_{11}/S_{22} – Magnitude ^{2,3} Phase	≤ 0.1 to $\leq 1.0 \Gamma$ (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz ≤ 0 to $\leq 60^\circ$ (0.045 to 2) GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.003 8 Γ 0.003 8 Γ 0.004 4 Γ 0.005 5 Γ 0.96° 1.3° 1.5° 2.3°	Mechanical Calibration Kits and RF Network Analyzer System Vista, CA Santa Clara, CA Orlando, FL
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 1.4° 1.5° 2.2°	Mechanical Calibration Kits and RF Network Analyzer System Vista, CA Santa Clara, 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) 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 Vista, CA Santa Clara, 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 Vista, CA Santa Clara, CA Orlando, FL
Network Analyzer System Verification (Corrected Performance) 2.4mm 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 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 Vista, CA Santa Clara, 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 Santa Clara, CA Orlando, FL



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



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
CDN (Coupling-Decoupling Network) & ISN (Impedance Stabilization Network) Insertion Loss	(-20 to 0) dB 10 Hz to 1000 MHz	0.25 dB	RF Impedance/Network Analyzers, Calibration Kits Vista, CA Santa Clara, 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	

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 Santa Clara, CA Orlando, FL
Calipers ¹	Up to 54 in	46 μin/in + 52 μin	Gage Blocks, Standard Rings, Rod Sets Vista, CA Santa Clara, CA Orlando, FL
Micrometers ¹ (Linearity Only)	Up to 54 in	46 μin/in + 52 μin	Gage Blocks, Rod Sets Vista, CA Santa Clara, 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 Santa Clara, 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 + 4.7L) μin	Gage Blocks Vista, CA Santa Clara, CA Orlando, FL
Depth Gages	Up to 12 in	(160 + 4.1L) 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 Santa Clara, CA
Steel Rulers	Up to 48 in	0.036 in	Gage Blocks Vista, CA Santa Clara, CA Orlando, FL
Tape Measures	Up to 50 ft	0.036 in	Gage Blocks Vista, CA Santa Clara, CA Orlando, FL
Protractor/Angle	Up to 90°	0.069°	Angle Gage Blocks Vista, CA Santa Clara, 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 Santa Clara, 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) μ in (90 + 4.8L) μ in (40 + 8.5L) μ in 0.11°	IAC MasterScanner Santa Clara, CA
Roughness Testers ¹	118 min	3.8 min	Roughness Standard Vista, CA
Roughness Specimens ¹	Up to 118 μ in	4.2 min	Surface Roughness Meter Vista, CA
Coating Thickness Gauge ¹	49 μ m 117 μ m 281 μ m 404 μ m	2 μ m 5.6 μ m 9.2 μ m 19 μ m	Plastic Shims Vista, 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 Santa Clara, 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 Santa Clara, 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	5.1 lbf 24 lbf 47 lbf 70 lbf 93 lbf 120 lbf	Reference Load Cells Vista, CA Orlando, FL

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force-Measuring Standards/Transducers Tension / Compression	Up to 1 000 lbf (>1 000 to 5 000) lbf (>5 000 to 10 000) lbf (>10 000 to 25 000) lbf (>25 000 to 50 000) lbf (>50 000 to 75 000) lbf (>75 000 to 100 000) lbf	1.5 lbf 7.3 lbf 15 lbf 37 lbf 77 lbf 120 lbf 150 lbf	Reference Load Cells Santa Clara, CA
Pressure – Source/Pressure gages and transducers ¹	(-12 to 300) psi (300 to 10 000) psi	0.2 psi 1.4 psi	Pressure Calibration System Vista, CA Santa Clara, 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	0.36 ozf·in + 0.34 % of reading 0.042 lbf·in + 0.34 % of reading 0.24 lbf·in + 0.34 % of reading 0.54 lbf·in + 0.34 % of reading 0.15 lbf·ft + 0.34 % of reading 0.28 lbf·ft + 0.34 % of reading	Torque Transducers Vista, CA
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 Fremont Clara, CA
Torque – Measure/Torque tools	(8 to 80) ozf·in (5 to 50) lbf·in (50 to 500) lbf·in (25 to 250) lbf·ft	0.1 ozf·in + 0.65 % of reading 0.016 lbf·in + 0.003 lbf·in/lbf·in 0.068 lbf·in + 0.002 lbf·in/lbf·in 0.32 lbf·ft + 0.006 5 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 Santa Clara, CA
Scales & Balances ¹	1 mg to 10 g (10 to 500) g (0.5 to 1) kg (1 to 2) kg	0.034 mg + 0.6R 0.7 mg + 0.6R 1.5 mg + 0.6R 2.9 mg + 0.6R	ASTM Class 0 Weights Vista, CA Santa Clara, CA

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales & Balances ¹	(2 to 20) kg (20 to 40) kg (40 to 50) kg	2.3 g + 0.6R 4.6 g + 0.6R 5.8 g + 0.6R	NIST Class F Weights Vista, CA Santa Clara, 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 + 0.6R 0.000 18 lb + 0.6R 0.000 24 lb + 0.6R 0.000 6 lb + 0.6R 0.001 1 lb + 0.6R 0.002 4 lb + 0.6R 0.006 lb + 0.6R	NIST Class F Weights Vista, CA Santa Clara, CA
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 Santa Clara, 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 Vista, 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) $\epsilon = 0.95, \lambda = (8 \text{ to } 14) \mu\text{m}$ Vista, CA Santa Clara, CA
Relative Humidity – Measure ¹	Up to 90 %RH (90 to 95) %RH	1.6 %RH 2.2 %RH	Humidity Probe Monitor Vista, CA Santa Clara, 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 Santa Clara, CA Orlando, FL
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 Santa Clara, 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 Santa Clara, 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	5.8 x 10 ⁻⁹ MHz	Frequency Synthesizer w/ GPS Reference Vista, CA Santa Clara, CA Orlando, FL

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source ¹	10 MHz to 50 GHz	5.8×10^{-10} GHz	Synthesized Sweeper w/ GPS Reference Vista, CA Santa Clara, CA Orlando, FL
Frequency – Measure ¹	1 μ Hz to 12.4 GHz 1 Hz to 50 GHz	5.8×10^{-9} GHz 5.8×10^{-10} GHz	Electronic Counters, Analyzers w/ GPS Reference Vista, CA Santa Clara, 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 Santa Clara, CA Orlando, FL
Period	4.44 ns to 10 s	0.012 % of reading + 0.17 ns	Universal Counter w/ GPS Reference Vista, CA Santa Clara, CA Orlando, FL
Rise/Fall Time - Measure	> 2 ns	0.076 ns	Digital Oscilloscope Vista, CA Santa Clara, CA Orlando, FL
Pulse Width - Measure	> 5 ns	1.1 ns	Universal Counter w/ GPS Reference Vista, CA Santa Clara, CA Orlando, FL

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
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 Santa Clara, 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 Santa Clara, CA
Distance/Linearity Measurement	Up to 610 mm	(19 + 0.7 L/600) μm	Linear Height Gage Santa Clara, 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 Santa Clara, 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 14644-1 ISO 16644-2 ISO 14644-3 ISO 16644-7 ANSI/ASHRAE 110 IEST-RP-CC002.4	Flow hood Devices Test	Thermal Anemometer Aerosol Generator Digital Aerosol Photometer Vista, CA Santa Clara, 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 16644-2 ISO 14644-3 ISO 16644-7 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 Santa Clara, CA Orlando, FL
Airflow Measurement Air Pressure Difference Test Airflow Smoke Pattern Test HEPA/ULPA filter leak Test Airborne Particle Count Survey Lighting Level Sound Level Test Temperature Test Humidity Test Temperature/Humidity Uniformity Test Recovery Test	ISO 14644-1 ISO 14644-2 ISO 14644-3 IEST-RP-CC006.3 IEST-RP-CC034.2 ISO/DIS 7726 In-house Method	Clean Room Test	Balometer Differential Pressure Meter Digital Aerosol Photometer, Aerosol Generator Particle Counter Light meter Sound level meter Temperature & humidity meter Thermal anemometer. Vista, CA Santa Clara, 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 14644-2 ISO 14644-3 ISO 14644-7 IEST-RP-CC002.4 IEST-RP-CC006.3 IEST-RP-CC034.2 In-house Method	Laminar Air Flow Workstation Test	Particle Counter Thermal Anemometer Aerosol Generator Digital Aerosol Photometer Light meter Sound level meter Vista, CA Santa Clara, 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
Oil Aerosol & Vapor Content ⁴	ISO 8573-1 ISO 8573-2 ISO 8573-5	Compressed Air Purity Test	Oil Content Analyzer Air Sampler Santa Clara, CA Orlando, FL
Humidity / Dew Point Measurement	ISO 8573-3	Compressed Air Purity Test	Dew Point Meter & Diffuser Santa Clara, CA Orlando, FL
Pressurized Air Particle Content	ISO 8573-4	Compressed Air Purity Test	Particle Counter & Diffuser Santa Clara, CA Orlando, FL
Viable Microbiological Contaminant ⁵	ISO 8573-7	Compressed Air Purity Test	Microbiological Sampler Santa Clara, 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. Unitless linear measure.
4. Portions of ISO 8573-5 requiring analysis using gas chromatography are contracted to another accredited laboratory.
5. This analysis is intended to be used in conjunction with the testing per ISO 8573-4 when there is a need to identify solid particles that are also viable, colony-forming units and is contracted to another accredited laboratory.
6. The nominal values listed are approximate.
7. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1736.



Jason Stine, Vice President