National Voluntary Laboratory Accreditation Program

CALIBRATION LABORATORIES **NVLAP LAB CODE 200893-0**

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

Transcat – Los Angeles	**Fields of Calibration**
1503 E. Orangethorpe Ave., Unit A Fullerton, CA 92831 Mr. Tony Kutch Phone: 714-447-4445 Fax: 714-447-4453 E-mail: tkutch@transcat.com URL: www.transcat.com	Dimensional Electromagnetics – DC/Low Frequency Time and Frequency Mechanical Electromagnetics – RF/Microwave Thermodynamic This laboratory is compliant to ANSI/NCSL Z540-1-1994; Part 1. (20/A01)

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	**Range**	**Uncertainty (*k*=2)** Note 3	**Remarks**
DIMENSIONAL			
LENGTH & DIAMETER; STEP GAGES (20/D05)			
Micrometers and Calipers–Outside, Inside, Depth Note 4	0 in to 8 in 8 in to 42 in	15 µin + 3 µin/in 10 µin + 4 µin/in	Comparison to Gage Blocks
Anvil Flatness Field calibrations available Note 4	0 in to 1 in	6.0 µin	Optical Flats
Anvil Parallelism Field calibrations available Note 4	0 in to 1 in	6.0 µin	Optical Parallel
Dial Indicators Field calibrations available Note 4	0 in to 0.1 in 0.1 in to 6 in	4.5 µin 4 µin + 4 µin/in	Gage Blocks
Length – Single Axis Inner Dimensions Outer Dimensions	 0.06 in to 4.7 in 0 in to 3.5 in 3.5 in to 10 in	 3 µin + 4 µin/in 3 µin + 4 µin/in 10 µin + 4 µin/in	 Horizontal Comparator Super Micrometer
Height Measuring Equipment	0 in to 8 in 8 in to 26 in	6 µin + 4 µin/in 12 µin + 4 µin/in	Gage Blocks with Surface Plate

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Measured Parameter or Device Calibrated	Range	Uncertainty (*k*=2) Note 3	Remarks
THREADED PLUGS & RING GAGES (20/D14)			
Threaded Plugs – Inner Diameter Outer Pitch Diameter	 0 in to 6 in 0 in to 6 in	 150 µin 83 µin	 Comparison to Set Plugs Super Micrometer/ Thread Wires

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (*k*=2) Note 3, 5	Remarks
ELECTROMAGNETICS – DC/LOW FREQUENCY				
VOLTAGE/CURRENT CONVERTERS to 100 MHz (20/E01)				
Sine Wave Flatness	0 V to 3 V	10 Hz to 1 MHz 1 MHz to 10 MHz 10 MHz to 30 MHz 30 MHz to 50 MHz 50 MHz to 80 MHz 80 MHz to 100 MHz	0.059 % 0.099 % 0.18 % 0.41 % 0.71 % 0.84 %	Thermal Voltage Converters
AC RESISTORS AND CURRENT (20/E02)				
AC Current – Measuring Equipment Field calibrations available Note 4	0 µA to 220 µA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	0.026 % + 16 nA 0.016 % + 10 nA 0.012 % + 8.2 nA 0.029 % + 12 nA 0.11 % + 66 nA	Fluke 5700A-EP
	0.22 mA to 2.2 mA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	0.026 % + 41 nA 0.016 % + 36 nA 0.012 % + 36 nA 0.020 % + 0.11 µA 0.11 % + 0.66 µA	
	2.2 mA to 22 mA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz	0.026 % + 0.41 µA 0.016 % + 0.36 µA 0.012 % + 0.36 µA	

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) Note 3, 5	Remarks
		1 kHz to 5 kHz	0.020 % + 0.56 µA	
		5 kHz to 10 kHz	0.11 % + 5.1 µA	
AC Current – Generate Field calibrations available Note 4	22 mA to 220 mA	10 Hz to 20 Hz	0.026 % + 4.1 µA	Fluke 5700A-EP
		20 Hz to 40 Hz	0.016 % + 3.6 µA	
		40 Hz to 1 kHz	0.012 % + 2.6 µA	
		1 kHz to 5 kHz	0.020 % + 3.6 µA	
		5 kHz to 10 kHz	0.11 % + 10 µA	
	0.22 A to 2.2 A	20 Hz to 1 kHz	0.027 % + 36 µA	
		1 kHz to 5 kHz	0.046 % + 82 µA	
		5 kHz to 10 kHz	0.70 % + 160 µA	
	2.2 A to 11 A	40 Hz to 1 kHz	0.047 % + 0.17 mA	Fluke 5700A-EP with 5725A
		1 kHz to 5 kHz	0.097 % + 0.39 mA	
		5 kHz to 10 kHz	0.37 % + 0.77 mA	
	11 A to 20.5 A	45 Hz to 100 Hz	0.097 % + 3.9 mA	Fluke 5520A
		100 Hz to 1 kHz	0.12 % + 3.9 mA	
		1 kHz to 5 kHz	2.3 % + 3.9 mA	Valhalla 2575A with Agilent 3458A
Extended Frequency Ranges Field calibrations available Note 4	29 µA to 329.99 µA	10 kHz to 30 kHz	1.2 % + 0.31 µA	
	330 µA to 3.299 mA	10 kHz to 30 kHz	0.78 % + 0.47 µA	
	3.3 mA to 32.99 mA	10 kHz to 30 kHz	0.31 % + 3.1 µA	
	33 mA to 329.99 mA	10 kHz to 30 kHz	0.31 % + 0.16 mA	
Clamp-on Ammeter Toroidal Type Field calibrations available Note 4	20 A to 150 A	45 Hz to 65 Hz	0.30 % + 26 mA	Fluke 5520A with 5500A/Coil
		65 Hz to 440 Hz	0.83 % + 47 mA	
	150 A to 1000 A	45 Hz to 65 Hz	0.35 % + 0.12 A	
		65 Hz to 440 Hz	1.1 % + 0.22 A	
Clamp-on Ammeter Non-Toroidal Type Field calibrations available Note 4	20 A to 150 A	45 Hz to 65 Hz	0.57 % + 0.25 A	Fluke 5520A with 5500A/Coil
		65 Hz to 440 Hz	1.0 % + 0.25 A	
	150 A to 1000 A	45 Hz to 65 Hz	0.60 % + 0.90 A	
		65 Hz to 440 Hz	1.3 % + 0.92 A	

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (*k*=2) Note 3, 5	Remarks
AC Current – Measure Field calibrations available Note 4	0 µA to 100 µA	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz	0.46 % + 35 nA 0.17 % + 35 nA 0.072 % + 35 nA 0.072 % + 35 nA	Agilent 3458A
	100 µA to 1 mA	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz	0.46 % + 230 nA 0.17 % + 230 nA 0.071 % + 230 nA 0.038 % + 230 nA	
	1 mA to 10 mA	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz	0.46 % + 2.3 µA 0.17 % + 2.3 µA 0.071 % + 2.3 µA 0.038 % + 2.3 µA	
	10 mA to 100 mA	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz	0.46 % + 23 µA 0.17 % + 23 µA 0.071 % + 23 µA 0.037 % + 23 µA	
	100 mA to 1 A	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 1 kHz	0.46 % + 0.23 mA 0.19 % + 0.23 mA 0.097 % + 0.23 mA 0.12 % + 0.23 mA	
	1 A to 10 A 10 A to 20 A	50 Hz to 60 Hz	0.081 % 0.12%	Characterized shunt & Agilent 3458A

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty (*k*=2) Note 3, 5	Remarks
DC RESISTANCE AND CURRENT (20/E05)			
DC Resistance – Measuring Equipment and Measure Field calibrations available Note 4	0 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 1 kΩ	18 µΩ/Ω + 58 µΩ 15 µΩ/Ω + 0.58 mΩ 12 µΩ/Ω + 0.58 mΩ	Agilent 3458A with Decade Resistor

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Measured Parameter or Device Calibrated	Range	Uncertainty (*k*=2) Note 3, 5	Remarks
DC Resistance – Measuring Equipment Field calibrations available Note 4	1 kΩ to 10 kΩ 10 kΩ to 100 kΩ 100 kΩ to 1 MΩ 1 MΩ to 10 MΩ 10 MΩ to 100 MΩ 100 MΩ to 1 GΩ	12 µΩ/Ω + 5.8 mΩ 12 µΩ/Ω + 58 mΩ 19 µΩ/Ω + 2.3 Ω 62 µΩ/Ω + 120 Ω 0.059 % + 1.2 kΩ 0.58 % + 12 kΩ	
	1 mΩ 10 mΩ 100 mΩ 2 GΩ to 10 GΩ 20 GΩ to 100 GΩ 200 GΩ to 1 TΩ	18 µΩ/Ω 18 µΩ/Ω 22 µΩ/Ω 0.59 % 1.2 % 2.6 %	L&N 4221B L&N 4222B L&N 4223B IET HRRS-B-3-1G-5KV
DC Current – Measuring Equipment and Measure Field calibrations available Note 4	0 µA to 100 µA 100 µA to 1 mA 1 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A	26 µA/A + 0.92 nA 26 µA/A + 5.8 nA 26 µA/A + 58 nA 43 µA/A + 0.58 µA 0.013 % + 12 µA	Agilent 3458A with Current Source
	1 A to 300 A	0.047 %	Shunts with DVM & Source
Clamp-on Ammeter Non-Toroidal Type Field calibrations available Note 4	20 A to 150 A 150 A to 1000 A	0.50 % + 0.14 A 0.52 % + 0.50 A	Fluke 5520A with5500A/Coil
DC VOLTAGE (20/E06)			
DC Voltage – Measure and Measuring Equipment Field calibrations available Note 4	0 mV to 100 mV 0.1 V to 10 V 10 V to 100 V 100 V to 500 V 500 V to 800 V 800 V to 1 kV	7.1 µV/V + 0.58 µV 5.1 µV/V + 0.58 µV 7.6 µV/V + 35 µV 11 µV/V + 0.12 mV 16 µV/V + 0.12 mV 21 µV/V + 0.12 mV	Agilent 3458A opt 2 with Fluke 5700A-EP
	1 kV to 100 kV	0.16 %	Hipotronics KVM100-DO with Agilent 34401A

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) Note 3, 5	Remarks
LF AC VOLTAGE (20/E09)				
AC Voltage – Measure Field calibrations available Note 4	0 to 1 mV	100 kHz to 1MHz	1.8 % + 2.4 µV	R&S URE3
		1 MHz to 3 MHz	3.5 % + 2.4 µV	
		3 MHz to 10 MHz	9.3 % + 2.4 µV	
		10 MHz to 20 MHz	23 % + 2.4 µV	
	1 mV to 3 mV	100 kHz to 1MHz	0.97 % + 2 µV	
		1 MHz to 3 MHz	3.5 % + 2 µV	
		3 MHz to 10 MHz	9.3 % + 2 µV	
		10 MHz to 20 MHz	23 % + 2 µV	
	3 mV to 100 mV	100 kHz to 1MHz	0.91 % + 3 µV	
		1 MHz to 3 MHz	1.8 % + 3 µV	
		3 MHz to 10 MHz	2.9 % + 3 µV	
		10 MHz to 20 MHz	7.0 % + 3 µV	
		20 MHz to 30 MHZ	14 % + 3 µV	
	0 mV to 10 mV	1 Hz to 40 Hz	0.039 % + 3.5 µV	Agilent 3458A
		40 Hz to 1 kHz	0.028 % + 1.2 µV	
		1 kHz to 20 kHz	0.038 % + 1.2 µV	
		20 kHz to 50 kHz	0.15 % + 1.2 µV	
		50 kHz to 100 kHz	0.59 % + 1.2 µV	
		100 kHz to 300 kHz	4.6 % + 2.3 µV	
		300 kHz to 1 MHz	1.5 % + 5.8 µV	
		1 MHz to 4 MHz	8.1 % + 8.1 µV	
	10 mV to 100 mV	1 Hz to 40 Hz	0.013 % + 4.6 µV	
		40 Hz to 1 kHz	0.0094 % + 2.3 µV	
		1 kHz to 20 kHz	0.017 % + 2.3 µV	
		20 kHz to 50 kHz	0.037 % + 2.3 µV	
		50 kHz to 100 kHz	0.093 % + 2.3 µV	
		100 kHz to 300 kHz	0.36 % + 12 µV	
		300 kHz to 1 MHz	1.2 % + 12 µV	
		1 MHz to 2 MHz	1.9 % + 12 µV	
		2 MHz to 4 MHz	4.7 % + 81 µV	

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) Note 3, 5	Remarks
		4 MHz to 8 MHz	4.7 % + 92 µV	
		8 MHz to 10 MHz	17 % + 120 µV	
	100 mV to 1 V	1 Hz to 40 Hz	0.0098 % + 46 µV	
		40 Hz to 1 kHz	0.0094 % + 23 µV	
		1 kHz to 20 kHz	0.017 % + 23 µV	
		20 kHz to 50 kHz	0.036 % + 23 µV	
		50 kHz to 100 kHz	0.093 % + 23 µV	
		100 kHz to 300 kHz	0.35 % + 0.12 mV	
		300 kHz to 1 MHz	1.2 % + 0.12 mV	
		1 MHz to 2 MHz	1.9 % + 0.12 mV	
		2 MHz to 4 MHz	4.7 % + 0.81 mV	
		4 MHz to 8 MHz	4.7 % + 0.92 mV	
		8 MHz to 10 MHz	17 % + 1.2 mV	
	1 V to 10 V	1 Hz to 40 Hz	0.015 % + 0.46 mV	
		40 Hz to 1 kHz	0.0095 % + 0.23 mV	
		1 kHz to 20 kHz	0.017 % + 0.23 mV	
		20 kHz to 50 kHz	0.036 % + 0.23 mV	
		50 kHz to 100 kHz	0.093 % + 0.23 mV	
		100 kHz to 300 kHz	0.35 % + 1.2 mV	
		300 kHz to 1 MHz	1.2 % + 1.2 mV	
		1 MHz to 2 MHz	1.8 % + 1.2 mV	
		2 MHz to 4 MHz	4.7 % + 8.1 mV	
		4 MHz to 8 MHz	4.7 % + 9.2 mV	
		8 MHz to 10 MHz	17 % + 12 mV	
	10 V to 100 V	1 Hz to 40 Hz	0.024 % + 4.6 mV	
		40 Hz to 1 kHz	0.024 % + 2.3 mV	
		1 kHz to 20 kHz	0.024 % + 2.3 mV	
		20 kHz to 50 kHz	0.041 % + 2.3 mV	
		50 kHz to 100 kHz	0.14 % + 2.3 mV	
		100 kHz to 300 kHz	0.46 % + 12 mV	
		300 kHz to 1 MHz	1.7 % + 12 mV	
	100 V to 700 V	1 Hz to 40 Hz	0.047 % + 46 mV	

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) Note 3, 5	Remarks
AC Voltage – Measuring Equipment Field calibrations available Note 4	700 V to 70 kV	40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 60 Hz	0.047 % + 23 mV 0.071 % + 23 mV 0.14 % + 23 mV 0.35 % + 23 mV 0.22 %	Hipotronics KVM100-DO with Agilent 34401A
	0 mV to 2.2 mV	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	0.036 % + 4.1 µV 0.033 % + 4.1 µV 0.033 % + 4.1 µV 0.033 % + 4.1 µV 0.057 % + 5.1 µV 0.13 % + 10 µV 0.20 % + 20 µV 0.31 % + 20 µV	Fluke 5700A-EP
	2.2 mV to 22 mV	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	0.037 % + 4.1 µV 0.026 % + 4.1 µV 0.0099 % + 4.1 µV 0.024 % + 4.1 µV 0.053 % + 5.1 µV 0.11 % + 10 µV 0.14 % + 20 µV 0.28 % + 20 µV	
	22 mV to 220 mV	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	0.025 % + 12 µV 0.0093 % + 7.1 µV 0.0082 % + 7.1 µV 0.021 % + 7.1 µV 0.047 % + 17 µV 0.092 % + 20 µV 0.14 % + 26 µV 0.28 % + 46 µV	
	220 mV to 2.2 V	10 Hz to 20 Hz	0.025 % + 41 µV	

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) Note 3, 5	Remarks
		20 Hz to 40 Hz	0.0093 % + 15 µV	
		40 Hz to 20 kHz	0.0046 % + 8.2 µV	
		20 kHz to 50 kHz	0.0077 % + 10 µV	
		50 kHz to 100 kHz	0.011 % + 31 µV	
		100 kHz to 300 kHz	0.043 % + 82 µV	
		300 kHz to 500 kHz	0.10 % + 0.20 mV	
		500 kHz to 1 MHz	0.17 % + 0.31 mV	
	2.2 V to 22 V	10 Hz to 20 Hz	0.025 % + 0.41 mV	
		20 Hz to 40 Hz	0.0092 % + 0.15 mV	
		40 Hz to 20 kHz	0.0046 % + 51 µV	
		20 kHz to 50 kHz	0.0078 % + 0.10 mV	
		50 kHz to 100 kHz	0.010 % + 0.20 mV	
		100 kHz to 300 kHz	0.028 % + 0.61 mV	
		300 kHz to 500 kHz	0.10 % + 2.0 mV	
		500 kHz to 1 MHz	0.15 % + 3.3 mV	
	22 V to 220 V	10 Hz to 20 Hz	0.025 % + 4.1 mV	
		20 Hz to 40 Hz	0.0092 % + 1.5 mV	
		40 Hz to 20 kHz	0.0053 % + 0.61 mV	
		20 kHz to 50 kHz	0.0082 % + 1.0 mV	
		50 kHz to 100 kHz	0.015 % + 2.5 mV	
		100 kHz to 300 kHz	0.092 % + 16 mV	
		300 kHz to 500 kHz	0.45 % + 41 mV	
		500 kHz to 1 MHz	0.82 % + 82 mV	
	220 V to 750 V	30 kHz to 50 kHz	0.061 % + 11 mV	Fluke 5700A-EP with 5725A
		50 kHz to 100 kHz	0.24 % + 46 mV	
	220 V to 1100 V	40 Hz to 1 kHz	0.011 % + 4.1 mV	Fluke 5700A-EP with 5725A
		1 kHz to 20 kHz	0.017 % + 6.1 mV	
		20 kHz to 30 kHz	0.061 % + 11 mV	

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Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) Note 3, 5	Remarks
LOW FREQUENCY CAPACITANCE (20/E10)				
Capacitance – Measure Field calibrations available Note 4	0 pF to 10 pF	1 kHz	0.47 % + 0.05 pF	GenRad 1689-9700
	10 pF to 100 pF		0.058 % + 0.05 pF	
	100 pF to 25 µF		0.024 % + 0.05 pF	
	25 µF to 100 µF		0.035 %	
	100 µF to 1000 µF		0.24 %	
Capacitance – Measuring Equipment Field calibrations available Note 4				GenRad 1409 Series Capacitors
	1 nF	1 kHz	0.017 %	
	2 nF		0.017 %	
	5 nF		0.017 %	
	10 nF		0.017 %	
	20 nF		0.017 %	
	50 nF		0.017 %	
	0.1 µF		0.017 %	
	0.2 µF		0.017 %	
	0.5 µF		0.017 %	
	1 µF		0.017 %	
	0.19 nF to < 1.1 nF	10 Hz to 10 kHz	0.39 % + 7.8 pF	Fluke 5520A
	1.1 nF to < 3.3 nF	10 Hz to 3 kHz	0.39 % + 7.8 pF	
	3.3 nF to < 11 nF	10 Hz to 1 kHz	0.20 % + 7.8 pF	
	11 nF to < 110 nF	10 Hz to 1 kHz	0.20 % + 78 pF	
	110 nF to < 330 nF	10 Hz to 1 kHz	0.20 % + 0.23 nF	
	0.33 µF to < 1.1 µF	10 Hz to 600 Hz	0.20 % + 0.78 nF	
	1.1 µF to < 3.3 µF	10 Hz to 300 Hz	0.20 % + 2.3 nF	
	3.3 µF to < 11 µF	10 Hz to 150 Hz	0.20 % + 7.8 nF	
	11 µF to < 33 µF	10 Hz to 120 Hz	0.31 % + 23 nF	
	33 µF to < 110 µF	10 Hz to 80 Hz	0.35 % + 78 nF	
	110 µF to < 330 µF	DC to 50 Hz	0.35 % + 0.23 µF	
	0.33 mF to < 1.1 mF	DC to 20 Hz	0.35 % + 0.78 µF	
	1.1 mF to < 3.3 mF	DC to 6 Hz	0.35 % + 2.3 µF	
	3.3 mF to < 11 mF	DC to 2 Hz	0.35 % + 7.8 µF	
	11 mF to < 33 mF	DC to 0.6 Hz	0.58 % + 23 µF	
	33 mF to < 110 mF	DC to 0.2 Hz	0.86 % + 78 µF	

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LF INDUCTANCE (20/E11)				
Measure Field calibrations available Note 4	1 mH to 10 H	1 kHz	0.025 %	GenRad 1689-9700
Measuring Equipment Field calibrations available Note 4	100 µH 1 mH 10 mH 100 mH 1 H 10 H	1 kHz	0.025 % 0.025 % 0.025 % 0.025 % 0.025 % 0.025 %	GenRad 1689-9700 with fixed sources
LF POWER/ENERGY (20/E12)				
Power – Measuring Equipment				Fluke 5520A
DC Power				
0.33 mA to 3.3 mA	11 µW to 3.4 W	DC	0.024 %	
3.3 mA to 33 mA	0.11W to 34 W		0.012 %	
33 mA to 330 mA	1.1 mW to 340 W		0.0093 %	
330 mA to 1.1 A	11 mW to 3.4 kW		0.026 %	
1.1 A to 3 A	36 mW to 3.1 kW		0.033 %	
3 to 11 A	0.99 W to 11 kW		0.064 %	
11 to 20.5 A	360 mW to 21 kW		0.089 %	
AC Power Note 8 (PF = 1)				
3.3 mA to 9 mA	0.11 mW to 9.2 W	45 Hz to 65 Hz	0.089 %	
9 mA to 33 mA	3 mW to 34W		0.061 %	
33 mA to 90 mA	1.1 mW to 92 W		0.089 %	
90 mA to 330 mA	3.0 mW to 340W		0.061 %	
0.33 A to 1.1 A	11 mW to 1.1 kW		0.071 %	
1.1 A to 3.0 A	36 mW to 3.1 kW		0.064 %	
3.0 A to 5.4 A	99 mW to 5.5 kW		0.11 %	
5.4 A to 11 A	180 mW to 11 kW		0.084 %	
11 A to 15 A	360 mW to 15 kW	45 Hz to 100 Hz	0.14 %	
11 A to 15 A	360 mW to 15 kW	100 Hz to 1 kHz	0.16 %	
15 A to 20.5 A	500 mW to 21 kW	45 Hz to 100 Hz	0.13 %	
15 A to 20.5 A	500 mW to 21 kW	100 Hz to 1 kHz	0.13 %	

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Measuring Equipment Field calibrations available Note 4	0° to 90°	10 Hz to 65 Hz 65 Hz to 500 Hz 500 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz 10 kHz to 30 kHz	0.11° 0.20° 0.39° 1.9° 3.9° 7.8°	Fluke 5520A

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Measured Parameter or Device Calibrated	Range	Uncertainty (k=2) Note 3	Remarks
TIME AND FREQUENCY			
FREQUENCY DISSEMINATION (20/F01)			
Frequency – Measuring Equipment and Measure Note 9			
In Lab	10 MHz	1.6×10^{-10}	GPS/Datum
Field Service Note 4	10 MHz	3.1×10^{-9}	Agilent 53131A (010)

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter	Range	Frequency Range	Uncertainty (k=2) Note 3, 5	Remarks
OSCILLATOR CHARACHTERIZATION (20/F03)				
AM Depth – Measure Field calibrations available Note 4		Where *AM* is the amplitude modulation depth of the measured signal. Uncertainty is listed in % of AM depth. Modulation rate shown in range column.		
50 Hz to 10 kHz	5 % to < 40 % 40 % to 99 %	150 kHz to 10 MHz	(0.024*AM* + 0.014) % (0.024*AM* + 0.14) %	Agilent 8902A With 11722A
20 Hz to < 50 Hz	5 % to < 40 % 40 % to 99 %	150 kHz to 10 MHz	(0.035*AM* + 0.014) % (0.035*AM* + 0.14) %	
50 Hz to 50 kHz	5 % to < 40 % 40 % to 99 %	10 MHz to 1.3 GHz	(0.013*AM* + 0.014) % (0.013*AM* + 0.14) %	
50 Hz to 50 kHz	5 % to < 40 %	1.3 GHz to 26.5 GHz	(0.018*AM* + 0.014) %	Agilent 8902A w/ 11722A, 11792A, &11793A

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter	Range	Frequency Range	Uncertainty (k=2) Note 3, 5	Remarks
	40 % to 99 %		(0.018*AM* + 0.14) %	
(20 Hz to 50 Hz) or	5 % to < 40 %	10 MHz to 26.5 GHz	(0.035*AM* + 0.014) %	
(50 kHz to 100 kHz)	40 % to 99 %	10 MHz to 26.5 GHz	(0.035*AM* + 0.14) %	
FM Modulation – Measure Field calibrations available Note 4		Where *FM* is the frequency modulation peak deviation of the measured signal. Modulation rate shown in range column.		
20 Hz to 10 kHz	0 kHz to < 4 kHz	250 kHz to 10 MHz	(0.023*FM* + 20) Hz	Agilent 8902A With 11722A
	4 kHz to 40 kHz		(0.023*FM* + 22) Hz	
	40 kHz to 400 kHz		(0.023*FM* + 100) Hz	
50 Hz to 100 kHz	0 kHz to < 4 kHz	10 MHz to 26.5 GHz	(0.012*FM* + 20) Hz	Agilent 8902A w/ 11722A, 11792A, &11793A
	4 kHz to < 40 kHz		(0.012*FM* + 22) Hz	
	40 kHz to 400 kHz		(0.012*FM* + 100) Hz	
20 Hz to <50 Hz	0 kHz to < 4 kHz		(0.058*FM* + 20) Hz	
	4 kHz to < 40 kHz		(0.058*FM* + 22) Hz	
	40 kHz to 400 kHz		(0.058*FM* + 100) Hz	
>100 kHz to 200 kHz	0 kHz to < 4 kHz		(0.058*FM* + 20) Hz	
	4 kHz to < 40 kHz		(0.058*FM* + 22) Hz	
	40 kHz to 400 kHz		(0.058*FM* + 100) Hz	
Phase Modulation – Measure Field calibrations available Note 4		Where *PM* is the phase modulation peak phase deviation of the measured signal. Modulation rate shown in range column.		
200 Hz to 10 kHz	0 rad to < 4 rad	150 kHz to 10 MHz	(0.047*PM* + 0.030) rad	Agilent 8902A with 11722A
	4 rad to < 40 rad		(0.047*PM* + 0.030) rad	
	40 rad to 400 rad		(0.047*PM* + 0.10) rad	
200 Hz to 20 kHz	0 rad to < 4 rad	10 MHz to 26.5 GHz	(0.040*PM* + 0.030) rad	Agilent 8902A w/ 11722A, 11792A, &11793A
	4 rad to < 40 rad		(0.040*PM* + 0.030) rad	
	40 rad to 400 rad		(0.040*PM* + 0.10) rad	
Harmonic Distortion Field calibrations available Note 4	0 dBc to -80 dBc	30 Hz to 6.5 GHz	1.7 dB	Agilent 8563E

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter	Range	Frequency Range	Uncertainty (k=2) Note 3, 5	Remarks
		6.5 GHz to 22 GHz 22 GHz to 26.5 GHz	2.6 dB 3.4 dB	
Total Harmonic Distortion Field calibrations available Note 4	0 dB to -100 dB	20 Hz to 20 kHz 20 kHz to 100 kHz	1.2 dB 2.3 dB	Agilent 8903B
AM Total Harmonic Distortion Field calibrations available Note 4	0 dB to -100 dB	20 Hz to 100 kHz	2.3 dB	
Total Harmonic Distortion 5 Hz to 600 kHz Field calibrations available Note 4				
Voltage Range < 30 V	100 % to 0.3 %	10 Hz to 1 MHz 1 MHz to 3 MHz	3 % 6 %	Agilent 334A
	0.1 %	10 Hz to 20 Hz 20 Hz to 30 Hz 30 Hz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1.2 MHz	12 % 6 % 3 % 6 % 12 %	
Voltage Range > 30 V	100 % to 0.3 %	10 Hz to 300 kHz 300 kHz to 500 kHz 500 kHz to 3 MHz	3 % 6 % 12 %	
	0.1 %	20 Hz to 30 Hz 30 Hz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1.2 MHz	12 % 3 % 6 % 12 %	

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) [Notes 1,2]

Measured Parameter or Device Calibrated	Range	Uncertainty (k=2) [Note 3, 5]	Remarks
PULSE WAVEFORM (20/F04)			
Rise Time – Measuring Equipment	≥ 25 ps	6.3 ps	Pulser
Rise Time – Measure	25 ps to 250 ps > 250 ps	11 % 3.9 %	Sampling System
MECHANICAL			
FORCE (20/M06)			
Force/Tension Field calibrations available [Note 4]	0.03 lbf to 300 lbf	0.016 %	Deadweights
MASS DETERMINATION (20/M08)			
Mass – Metric	30 kg 25 kg 20 kg 10 kg 5 kg 2 kg 1 kg 500 g 200 g 100 g 50 g 20 g 10 g 5 g 2 g 1 g	24 mg 24 mg 24 mg 8.5 mg 3.9 mg 1.6 mg 0.64 mg 0.28 mg 0.14 mg 0.11 mg 48 µg 42 µg 37 µg 12 µg 12 µg 13 µg	Echelon III
Mass – Avoirdupois	50 lb 30 lb 20 lb 10 lb 5 lb 3 lb	24 mg 9.3 mg 8.5 mg 3.9 mg 1.7 mg 0.70 mg	Echelon III

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty (*k*=2) Note 3, 5	Remarks
	2 lb 1 lb 8 oz 4 oz 2 oz 1 oz 0.5 oz	0.64 mg 0.28 mg 0.15 mg 0.12 mg 60 µg 56 µg 39 µg	
TORQUE (20/M15)			
Torque – Measure Field calibrations available Note 4	4 lbf-in to 250 lbf-in 250 lbf-in to 250 lbf-ft 250 lbf-ft to 600 lbf-ft	0.39 % 0.56 % 0.56 %	CDI 2000-400-02 with Loader CDI 2000-12-02 with Loader
Torque – Measuring Equipment	5 ozf-in to 250 lbf-ft	0.058 %	Torque Wheels with Weights
WEIGHING INSTRUMENTS (20/M16)			
Balances Field calibrations available Note 4	5 kg 2 kg 1 kg 500 g 300 g 200 g 100 g 50 g 30 g 20 g 10 g 5 g 3 g 2 g 1 g 500 mg 200 mg	12 mg 10 mg 5.2 mg 2.7 mg 1.9 mg 1.0 mg 0.52 mg 0.24 mg 0.15 mg 0.15 mg 0.10 mg 69 µg 69 µg 69 µg 69 µg 23 µg 23 µg	ASTM Class 1 Weights

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty (*k*=2) Note 3, 5	Remarks
	100 mg	23 µg	
	50 mg	23 µg	
	20 mg	23 µg	
	10 mg	23 µg	
	5 mg	23 µg	
	1 mg	23 µg	
Balances – Avoirdupois Field calibrations available Note 4	50 lb	2.3 g	Class F Weights
	30 lb	1.4 g	
	20 lb	0.91 g	
	10 lb	0.45 g	
	5 lb	0.23 g	
	3 lb	0.14 g	
	2 lb	91 mg	
	1 lb	45 mg	
	8 oz	23 mg	
	4 oz	12 mg	
	2 oz	5.7 mg	
	1 oz	2.8 mg	
	0.5 oz	1.4 mg	

CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (*k*=2) Note 3, 5	Remarks
ELECTROMAGNETICS – RF/MICROWAVE				
RF/MICROWAVE POWER METERS (20/R17)				
Absolute RF Power Field calibrations available Note 4	1 mW Reference	50 MHz	0.32 %	Agilent 478A- H75, 432A, and 3458A
Absolute RF Power Field calibrations available Note 4	+30 dBm to -20 dBm	100 kHz to 2.6 GHz	2.0 %	Agilent 8902A with 11722A
		2.6 GHz to 12 GHz	3.3 %	8902A with 1722A, 11792A, and 11793A
		12 GHz to 19 GHz	4.0 %	

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty (k=2) Note 3, 5	Remarks
		19 GHz to 26.5 GHz	4.4 %	
SCATTERING PARAMETERS (20/R18)				
Reflection – Magnitude	> 0.005 to 0.40	5 MHz to 2 GHz	0.012 rho	Agilent 8563E with Wiltron 60N50 and 87A50 VSWR bridges
		2 GHz to 18 GHz	0.021 rho	
Relative Power Measure	0 dB to -10 dB	100 kHz to 1.3 GHz	0.026 dB	Agilent 8902A with 11722A
	-10 dB to -20 dB		0.042 dB	
	-20 dB to -30 dB		0.053 dB	
	-30 dB to -40 dB		0.062 dB	
	-40 dB to -50 dB		0.084 dB	
	-50 dB to -60 dB		0.090 dB	
	-60 dB to -70 dB		0.096 dB	
	-70 dB to -80 dB		0.10 dB	
	-80 dB to -90 dB		0.12 dB	
	-90 dB to -100 dB		0.12 dB	
	-100 dB to -110 dB		0.12 dB	
	-110 dB to -127 dB		0.25 dB	
	0 dB to -10 dB	1.3 GHz to 26.5 GHz	0.053 dB	Agilent 8902A with 11792A and 11793A
	-10 dB to -20 dB		0.062 dB	
	-20 dB to -30 dB		0.070 dB	
	-30 dB to -40 dB		0.077 dB	
	-40 dB to -50 dB		0.095 dB	
	-50 dB to -60 dB		0.10 dB	
	-60 dB to -70 dB		0.11 dB	
	-70 dB to -80 dB		0.11 dB	
	-80 dB to -90 dB		0.12 dB	
	-90 dB to -100 dB		0.24 dB	
	-100 dB to -110 dB		0.24 dB	
	-110 dB to -127 dB		0.25 dB	

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty (*k*=2) Note 3, 5	Remarks
THERMODYNAMIC			
HUMIDITY (20/T02)			
Relative Humidity Field calibrations available Note 4	20 % to 90 %	1.3 %	Vaisala HMI41 with HMP46
LABORTORY THERMOMETERS (20/T03)			
Measure Field calibrations available Note 4	-195 °C to 660 °C	0.0087 °C + 0.003 %	Hart 5628 w/Black Stack
Measuring Equipment Field calibrations available Note 4	-80 °C to 0 °C 0 °C to 100 °C 100 °C to 200 °C 200 °C to 300 °C 300 °C to 425 ºC 425 °C to 660 °C	0.014 ºC + 0.003 % 0.017 ºC + 0.003 % 0.025 ºC + 0.003 % 0.035 ºC + 0.003 % 0.043 ºC + 0.003 % 0.060 ºC + 0.003 %	Hart 5628 w/Black Stack and Fluke 7381, 7321, and 6331 Baths Hart 5628 w/Black Stack and Fluke 9173 Dry Well
PRESSURE (20/T05)			
Absolute Pressure – Source	0 psia to 25 psia 25 psia to 500 psia	0.0019 psia 0.0065 % + 0.001 psia	Ruska 7250xi
Gage Pressure Measuring Equipment – Pneumatic Field calibrations available Note 4	-2 in H_2O to 2 in H_2O -14.7 psig to -0.5 psig 0.5 psig to 3 psig 3 psig to 500 psig	0.0012 in H_2O 0.0068 % 0.0068 % 0.0059 %	Dwyer 1430 Pressurements T3500
Pressure Measuring Equipment – Hydraulic Field calibrations available Note 4	5 psig to 1500 psig 1500 psig to 15 000 psig	0.0080 % 0.0080 %	Ametek T-150

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Measured Parameter or Device Calibrated	Range	Uncertainty (*k*=2) Note 3, 5	Remarks
TEMPERATURE INDICATORS (20/T08)			
Electrical Calibration of Thermocouple Devices Field calibrations available Note 4			
Type B	250 °C to 350 °C	1.1 °C	Ectron 1140A
	350 °C to 445 °C	0.87 °C	
	445 °C to 580 °C	0.68 °C	
	580 °C to 750 °C	0.53 °C	
	750 °C to 1000 °C	0.44 °C	
	1000 °C to 1820 °C	0.34 °C	
Type C	0 °C to 250 °C	0.23 °C	
	250 °C to 1000 °C	0.19 °C	
	1000 °C to 1500 °C	0.21 °C	
	1500 °C to 1800 °C	0.25 °C	
	1800 °C to 2000 °C	0.27 °C	
	2000 °C to 2250 °C	0.34 °C	
	2250 °C to 2315 °C	0.37 °C	
Type E	-270 °C to -245 °C	2.2 °C	
	-245 °C to -195 °C	0.23 °C	
	-195 °C to -155 °C	0.10 °C	
	-155 °C to -90 °C	0.10 °C	
	-90 °C to 0 °C	0.092 °C	
	0 °C to 15 °C	0.091 °C	
	15 °C to 890 °C	0.081 °C	
	890 °C to 1000 °C	0.091 °C	
Type J	-210 °C to -180 °C	0.15 °C	
	-180 °C to -120 °C	0.13 °C	
	-120 °C to -50 °C	0.10 °C	
	-50 °C to 0 °C	0.092 °C	
	0 °C to 1200 °C	0.091 °C	
Type K	-270 °C to -255 °C	2.6 °C	
	-255 °C to -195 °C	0.84 °C	

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty (*k*=2) Note 3, 5	Remarks
	-195 °C to -115 °C	0.15 °C	
	-115 °C to -55 °C	0.11 °C	
	-55 °C to 0 °C	0.093 °C	
	0 °C to 1000 °C	0.092 °C	
	1000 °C to 1372 °C	0.10 °C	
Type N	-270 °C to -260 °C	6.0 °C	
	-260 °C to -200 °C	1.2 °C	
	-200 °C to -140 °C	0.27 °C	
	-140 °C to -70 °C	0.18 °C	
	-70 °C to 0 °C	0.15 °C	
	0 °C to 25 °C	0.14 °C	
	25 °C to 160 °C	0.12 °C	
	160 °C to 1300 °C	0.11 °C	
Type R	-50 °C to -30 °C	0.75 °C	
	-30 °C to 0 °C	0.64 °C	
	0 °C to 45 °C	0.64 °C	
	45 °C to 160 °C	0.46 °C	
	160 °C to 380 °C	0.35 °C	
	380 °C to 775 °C	0.30 °C	
	775 °C to 1768 °C	0.26 °C	
Type S	-50 °C to -30 °C	0.72 °C	
	-30 °C to 0 °C	0.65 °C	
	0 °C to 45 °C	0.65 °C	
	45 °C to 105 °C	0.46 °C	
	105 °C to 310 °C	0.38 °C	
	310 °C to 615 °C	0.34 °C	
	615 °C to 1768 °C	0.30 °C	
Type T	-270 °C to -255 °C	2.1 °C	
	-255 °C to -240 °C	0.59 °C	
	-240 °C to -210 °C	0.36 °C	
	-210 °C to -150 °C	0.22 °C	
	-150 °C to -40 °C	0.15 °C	

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CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) [Notes 1,2]

Measured Parameter or Device Calibrated	Range	Uncertainty (*k*=2) [Note 3, 5]	Remarks
	-40 °C to 100 °C 100 °C to 400 °C	0.10 °C 0.091 °C	

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Notes
Note 1: A Calibration and Measurement Capability (CMC) is a description of the best result of a calibration or measurement (result with the smallest uncertainty of measurement) that is available to the laboratory's customers under normal conditions, when performing more or less routine calibrations of nearly ideal measurement standards or instruments. The CMC is described in the laboratory's scope of accreditation by: the measurement parameter/device being calibrated, the measurement range, the uncertainty associated with that range (see note 3), and remarks on additional parameters, if applicable.
Note 2: Calibration and Measurement Capabilities are traceable to the national measurement standards of the U.S. or to the national measurement standards of other countries and are thus traceable to the internationally accepted representation of the appropriate SI (Système International) unit.
Note 3: The uncertainty associated with a measurement in a CMC is an expanded uncertainty with a level of confidence of approximately 95 %, typically using a coverage factor of $k = 2$. However, laboratories may report a coverage factor different than $k = 2$ to achieve the 95 % level of confidence. Units for the measurand and its uncertainty are to match. Exceptions to this occur when marketplace practice employs mixed units, such as when the artifact to be measured is labeled in non-SI units and the uncertainty is given in SI units (Example: 5 lb weight with uncertainty given in mg). **Note 3a:** The uncertainty of a specific calibration by the laboratory may be greater than the uncertainty in the CMC due to the condition and behavior of the customer's device and specific circumstances of the calibration. The uncertainties quoted do not include possible effects on the calibrated device of transportation, long term stability, or intended use. **Note 3b:** As the CMC represents the best measurement results achievable under normal conditions, the accredited calibration laboratory shall not report smaller uncertainty of measurement than that given in a CMC for calibrations or measurements covered by that CMC. **Note 3c:** As described in Note 1, CMCs cover calibrations and measurements that are available to the laboratory's customers under *normal conditions.* However, the laboratory may have the capability to offer special tests, employing special conditions, which yield calibration or measurement results with lower uncertainties. Such special tests are not covered by the CMCs and are outside the laboratory's scope of accreditation. In this case, NVLAP requirements for the labeling, on calibration reports, of results outside the laboratory's scope of accreditation apply. These requirements are set out in Annex A.1.h. of NIST Handbook 150, Procedures and General Requirements.
Note 4: Uncertainties associated with field service calibration may be greater as they incorporate on-site environmental contributions, transportation effects, or other factors that affect the measurements. (This note applies only if marked in the body of the scope.)
Note 5: Values listed with percent (%) are percent of reading or generated value unless otherwise noted.
Note 6: NVLAP accreditation is the formal recognition of specific calibration capabilities. Neither NVLAP nor NIST guarantee the accuracy of individual calibrations made by accredited laboratories.
Note 7: See NIST Handbook 150 for further explanation of these notes.
Note 8: The uncertainties shown are for the most favorable conditions. There is an increase in uncertainty that corresponds to the laboratory's AC voltage and current uncertainties at different frequencies other than the ones shown. Power factors (PF) other than the one shown contribute to the power uncertainty. PF is related to the cosine of phase. Therefore, uncertainties track the laboratory's phase uncertainty closely at PF near one, but are magnified heavily as PF approaches zero. The lab may also report reactive power, apparent power, and power factor under this accreditation. If needed, contact laboratory for more information regarding uncertainties at frequency and power factor combinations other than the ones shown.
Note 9: Uncertainty values of derivatives of 10 MHz will differ due to resolution, noise and gating errors.

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