



# CERTIFICATE OF ACCREDITATION

*This is to attest that*

## **FIELD CALIBRATIONS, INC**

9830 SOUTH 51ST STREET, SUITE B-111  
PHOENIX, ARIZONA 85044-5668, U.S.A.

### **Calibration Laboratory CL-112**

has met the requirements of AC204, *IAS Accreditation Criteria for Calibration Laboratories*, and has demonstrated compliance with ISO/IEC Standard 17025:2017, *General requirements for the competence of testing and calibration laboratories*. This organization is accredited to provide the services specified in the scope of accreditation.

Effective Date October 18, 2022

Expiration Date March 1, 2025



A handwritten signature in black ink, reading "Raj Nathan".

**President**

# SCOPE OF ACCREDITATION

International Accreditation Service, Inc.

3060 Saturn Street, Suite 100, Brea, California 92821, U.S.A. | [www.iasonline.org](http://www.iasonline.org)

## FIELD CALIBRATIONS, INC

[www.fieldcal.com](http://www.fieldcal.com)

**Contact Name** Jessica Werzyn

**Contact Phone** +1-480-756-8828

*Accredited to ISO/IEC 17025:2017*

*Effective Date October 18, 2022*

### CALIBRATION AND MEASUREMENT CAPABILITY (CMC)\*

MEASURED QUANTITY or DEVICE TYPE CALIBRATED	RANGE	UNCERTAINTY <sup>1,2</sup> ( $\pm$ )	CALIBRATION METHOD OR PROCEDURE, STANDARD EQUIPMENT (OPTIONAL)
<b>Dimensional</b>			
Micrometers	0.0625 in to 60 in	(20 + 7L) $\mu$ in (where L = length in inches)	Direct measurement method Gage blocks, and micrometer standards
Calipers	Up to 1 in 1 in to 60 in	280 $\mu$ in 320 $\mu$ in	Direct measurement method with gage blocks
<b>Mechanical</b>			
Speed – Generate <sup>3</sup> (Contact)	55 rpm to 5000 rpm 5000 rpm to 7000 rpm 7000 rpm to 46 000 rpm	0.001 rpm 0.0012 rpm 0.000018 %	Direct measurement method Quantum N-11-ECS/3A w/HP 53132A
Speed – Generate <sup>3</sup> (Non-contact)	1 rpm to 100 rpm 100 rpm to 1000 rpm 1000 rpm to 99999 rpm	0.0088 rpm 0.065 rpm 0.58 rpm	Direct measurement method HP 3325B
Speed – Measure <sup>4</sup> (Non-contact)	1 rpm to 99 999 rpm 0.3 ft/min to 6500 ft/min 4 in/min to 78 000 in/min 0.1 m/min to 1999 m/min	0.03 % 0.03 % 0.03 % 0.03 %	Direct measurement method Electromatic CDT2000
Speed – Measure <sup>4</sup> (Contact)	1 rpm to 99 999 rpm 0.3 ft/min to 6500 ft/min 4 in/min to 78 000 in/min 0.1 m/min to 1999 m/min	1.0 % 1.0 % 1.0 % 1.0 %	Direct measurement method Electromatic CDT2000
	0.1 ft/min to 999.99 ft/min 1000 ft/min to 9999.9 ft/min 10 000 ft/min to 25 000 ft/min	0.13% + 0.06 ft/min 0.13% + 0.6 ft/min 0.13% + 1 ft/min	Direct measurement method Shimpo DT-107A
Acceleration/ Vibration – Measure <sup>4</sup> (at 1 g) <sup>5</sup>	1 Hz to 10 Hz 10 Hz to 100 Hz 100 Hz to 10 kHz	2.9 % 2.4 % 2.3 %	Comparison measurement method Dytran 3120BK w/ Keithley 2002

\* If information in this CMC is presented in non-SI units, the conversion factors stated in NIST Special Publication 811 "Guide for the Use of the International System of Units (SI)" apply.

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Scales and Balances - (Linearity Test Only)	200 mg	0.070 mg	Direct measurement method Class 1 and Class 3 Weights
	1 g to 10 g	0.50 mg	
	10 g	0.059 mg	
	20 g	0.12 mg	
	30 g	0.087 mg	
	40 g	0.015 mg	
	50 g	0.14 mg	
	50 g to 100 g	0.22 mg	
	100 g	0.28 mg	
	100 g to 200 g	0.50 mg	
	200 g	0.58 mg	
	200 g to 300 g	0.80 mg	
	300 g	0.86 mg	
	300 to 400 g	1.1 mg	
	400 g	0.91 mg	
	400 g to 500 g	1.1 mg	
	500 g	1.2 mg	
	500 g to 800 g	2.1 mg	
	1 kg	2.9 mg	
	1 kg to 2.8 kg	7.7 mg	
	3 kg	8.8 mg	
	3 kg to 4.8 kg	14 mg	
	5 kg	14 mg	
	5 kg to 9.8 kg	28 mg	
	10 kg	120 mg	
	10 kg to 14.8 kg	130 mg	
	15 kg	130 mg	
	33 lb to 50 lb	0.014 lb	Direct measurement method Class 7 Weights
	50 lb	0.0058 lb	
	50 lb to 100 lb	0.019 lb	
	100 lb	0.011 lb	
	100 lb to 150 lb	0.025 lb	
	150 lb	0.017 lb	
	150 lb to 200 lb	0.031 lb	
	200 lb	0.023 lb	
	200 lb to 250 lb	0.037 lb	
	250 lb	0.029 lb	
	250 lb to 300 lb	0.044 lb	
	300 lb	0.037 lb	
	300 to 350 lb	0.050 lb	
	350 lb	0.042 lb	
	350 lb to 400 lb	0.055 lb	
	400 lb	0.048 lb	

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Pressure/Vacuum – Generate <sup>3</sup> and Measure <sup>4</sup>	0 inH <sub>2</sub> O to 10 inH <sub>2</sub> O	0.03 inH <sub>2</sub> O	Direct measurement method Fluke 700P01 w/719
	-12 psi to 30 psi	0.015 psi	Direct measurement method Fluke 717-30G
	0 psia to 30 psia	0.021 psi	Direct measurement method Fluke 700PA5 w/719
	30 psi to 100 psi	0.035 psi	Direct measurement method Fluke 719-100G
	100 psi to 300 psi	0.11 psi	Direct measurement method Fluke 719 Pro 300G
	300 psi to 500 psi	0.25 psi	Direct measurement method Fluke 700P07 w/719
	500 psi to 1000 psi	0.5 psi	Direct measurement method Fluke 700P08 w/719
	1000 psi to 3000 psi	1.5 psi	Direct measurement method Ametek XP2i 3000
	3000 psi to 5000 psi	4.0 psi	Direct measurement method Fluke 700P30 w/719
	5000 psi to 7000 psi	4 psi	Direct measurement method Ashcroft 7000
	7000 psi to 10 000 psi	8 psi	Direct measurement method Fluke 700P31 w/ 719
Force Gages	1 gf to 200 gf	0.028 gf	Direct measurement method Class 1 and Class 3 Weights
	0.5 lbf to 2 lbf	0.0012 lbf	Direct measurement method Class 7 Weights
	2 lbf to 5 lbf	0.0027 lbf	
	5 lbf to 10 lbf	0.0046 lbf	
	10 lbf to 20 lbf	0.0082 lbf	
	20 lbf to 30 lbf	0.012 lbf	
	30 lbf to 40 lbf	0.015 lbf	
	40 lbf to 50 lbf	0.019 lbf	
	50 lbf to 60 lbf	0.024 lbf	
	60 lbf to 70 lbf	0.027 lbf	
	70 lbf to 80 lbf	0.030 lbf	
	80 lbf to 90 lbf	0.033 lbf	
90 lbf to 100 lbf	0.038 lbf		
100 lbf to 110 lbf	0.043 lbf		
Force – Measure <sup>4</sup>	0 lbf to 10 000 lbf	0.005 % + 10 lbf	Direct measurement method Interface 1211 NE with Newport Infinity INFS
	0 lbf to 100 000 lbf	200 lbf	Direct measurement method Transcell TI-500E w/VMC VLC-120

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Force – Measure <sup>4</sup> continued	0 lbf to 225 000 lbf	0.55 % + 100 lbf	Direct measurement method Tetrahedron 300K Load Cell w/Precision Digital PD6000-6R0
<b>Thermal</b>			
Simulated Temperature - Thermocouples Generate & Measure			Direct measurement method Fluke 7526A
Type B	600 °C to 800 °C 800 °C to 1550 °C 1550 °C to 1820 °C	0.35 °C 0.28 °C 0.22 °C	
Type E	-250 °C to -200 °C -200 °C to -100 °C -100 °C to 0 °C 0 °C to 600 °C 600 °C to 1000 °C	0.25 °C 0.12 °C 0.09 °C 0.08 °C 0.10 °C	
Type J	-210 °C to -100 °C -100 °C to 800 °C 800 °C to 1200 °C	0.14 °C 0.09 °C 0.10 °C	
Type K	-250 °C to -200 °C -200 °C to -100 °C -100 °C to 500 °C 500 °C to 800 °C 800 °C to 1372 °C	0.46 °C 0.16 °C 0.10 °C 0.10 °C 0.13 °C	
Type N	-250 °C to -200 °C -200 °C to -100 °C -100 °C to 0 °C 0 °C to 100 °C 100 °C to 800 °C 800 °C to 1300 °C	0.73 °C 0.23 °C 0.12 °C 0.11 °C 0.10 °C 0.12 °C	
Type R	-50 °C to -25 °C -25 °C to 0 °C 0 °C to 100 °C 100 °C to 400 °C 400 °C to 600 °C 600 °C to 1000 °C 1000 °C to 1600 °C 1600 °C to 1767 °C	0.55 °C 0.45 °C 0.39 °C 0.28 °C 0.22 °C 0.21 °C 0.19 °C 0.23 °C	
Type S	-50 °C to -25 °C -25 °C to 0 °C 0 °C to 100 °C	0.51 °C 0.43 °C 0.38 °C	



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Simulated Temperature - Thermocouples Generate & Measure continued Type S	100 °C to 400 °C 400 °C to 600 °C 600 °C to 1000 °C 1000 °C to 1600 °C 1600 °C to 1767 °C	0.29 °C 0.23 °C 0.22 °C 0.22 °C 0.26 °C	Direct measurement method Fluke 7526A
Type T	-250 °C to -200 °C -200 °C to -100 °C -100 °C to 0 °C 0 °C to 200 °C 200 °C to 400 °C	0.35 °C 0.16 °C 0.11 °C 0.09 °C 0.09 °C	
Type U	-200 °C to 0 °C 0 °C to 200 °C 200 °C to 600 °C	0.16 °C 0.10 °C 0.10 °C	
Simulated Temperature RTD Generate & Measure Pt 385, 100 Ω	-200 °C to 800 °C	0.05 °C	Direct measurement method Fluke 7526A
Pt 385, 1000 Ω	-200 °C to 0 °C 0 °C to 100 °C 100 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C	0.014 °C 0.016 °C 0.020 °C 0.022 °C 0.027 °C	
Pt 3926, 100 Ω	-200 °C to 630 °C	0.05 °C	
Pt 3916, 100 Ω	-200 °C to 630 °C	0.05 °C	
Ni 120, 120 Ω	-80 °C to 260 °C	0.02 °C	
Temperature – Measure <sup>4</sup>	-200 °C to -39 °C -39 °C to 0.01 °C 0.01 °C to 232 °C 232 °C to 420 °C 420 °C to 660 °C	0.016 °C 0.017 °C 0.033 °C 0.042 °C 0.058 °C	
Temperature – Generate <sup>3</sup>	-200 °C to -39 °C -39 °C to 0.01 °C 0.01 °C to 200 °C 200 °C to 300 °C 300 °C to 400 °C 400 °C to 500 °C 500 °C to 600 °C 600 °C to 660 °C	0.016 °C 0.017 °C 0.033 °C 0.32 °C 0.42 °C 0.49 °C 0.56 °C 0.60 °C	

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Infrared Temperature – Measure <sup>4</sup>	20 °C to 100 °C 100 °C to 250 °C	2 °C 2 %	Direct measurement method Fluke 62 MAX+
Relative Humidity – Generate <sup>3</sup>	10 %RH to 30 %RH 30 %RH to 80 %RH 80 %RH to 95 %RH	0.52 %RH 0.58 %RH 0.69 %RH	Direct measurement method Thunder Scientific 1200
Relative Humidity – Measure <sup>4</sup>	0 %RH to 90 %RH 90 %RH to 97 %RH	1 %RH 1.7 %RH	Comparison measurement method Vaisala HM70
<b>Electrical – DC/LF</b>			
DC Voltage – Generate <sup>3</sup> and Measure <sup>4</sup>	0 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1050 V	5.0 µV/V + 100 nV 3.5 µV/V + 400 nV 3.5 µV/V + 4 µV 5.5 µV/V + 40 µV 5.5 µV/V + 500 µV	Direct measurement method Fluke 5720A w/Fluke 8508A
DC Voltage – Generate <sup>3</sup>	1050 V to 1100 V	6.5 µV/V + 400 µV	Direct measurement method Fluke 5720A
DC Voltage – Generate <sup>3</sup> and Measure <sup>4</sup>	1100 V to 2 kV 2 kV to 20 kV	0.04 % + 0.4 V 0.04 % + 4 V	Direct measurement method Glassman LG40, Vitrek 4620B
DC Voltage – Measure <sup>4</sup>	1050 V to 1100 V	22 µV/V + 700 µV	Direct measurement method Keithley 2002
	20 kV to 100 kV	0.0035 % + 0.10 kV	Indirect measurement method Spellman HVD-100-1 w/HP 34401A
DC Current Generate <sup>3</sup>	50 aA to 2 pA 2 pA to 20 pA 20 pA to 200 pA 200 pA to 2 nA	0.43 % + 10 fA 0.38 % + 10 fA 0.25 % + 30 fA 0.065 % + 100 fA	Direct measurement method Keithley 263
	0.1 A to 1 A 10 µA to 100 µA 0.1 mA to 1 mA 1 mA to 10 mA 10 mA to 100 mA	120 µA/A + 10 µA 25 µA/A + 0.8 nA 25 µA/A + 5 nA 25 µA/A + 50 nA 40 µA/A + 0.5 µA	Direct measurement method Fluke 5720A w/HP 3458A
	0.022 A to 0.220 A 0.22 A to 2.2 A	45 µA/A + 0.7 µA 80 µA/A + 12 µA	Direct measurement method Fluke 5720A
	2.2 A to 11 A	360 µA/A + 480 µA	Direct measurement method Fluke 5720A w/5725A
	11 A to 20.5 A	0.1 % + 750 µA	Direct measurement method Fluke 5520A
	20 A to 150 A 150 A to 550 A 550 A to 1000 A	0.26 % + 0.05 A 0.25 % + 0.06 A 0.27 % + 0.06 A	Indirect measurement method Fluke 5520A w/50 Turn Coil
	0 A to 100 A	0.11 % + 0.3 mA	Indirect measurement method EMS 5.5-150-1-D w/HP 3458A & LAB100-100

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DC Current Generate <sup>3</sup> continued	100 A to 120 A	0.12 % + 3 mA	Indirect measurement method EMS 5.5-150-1-D w/HP 3458A & LAB1000-100
DC Current – Measure <sup>4</sup>	10 fA to 2 nA	0.3 % + 500 fA	Direct measurement method Keithley 487
	2 nA to 20 nA	0.2 % + 3 pA	
	20 nA to 200 nA	0.15 % + 20 pA	
	200 nA to 2 µA	0.15 % + 200 pA	Direct measurement method HP 3458A
	2 µA to 20 µA	0.1 % + 2 nA	
	20 µA to 200 µA	0.1 % + 20 nA	
	200 µA to 2 mA	0.1 % + 200 nA	Direct measurement method Fluke 8508A
	0 nA to 100 nA	35 µA/A + 40 pA	
	0.1 µA to 1 µA	25 µA/A + 40 pA	
1 µA to 10 µA	25 µA/A + 100 pA	Direct measurement method HP 3458A	
10 µA to 200 µA	12 µA/A + 400 pA		
200 µA to 2 mA	12 µA/A + 4 nA		
2 mA to 20 mA	14 µA/A + 40 nA	Direct measurement method Fluke 8508A	
20 mA to 200 mA	48 µA/A + 800 nA		
10 mA to 100 mA	40 µA/A + 500 nA		
0.1 A to 1 A	120 µA/A + 10 µA	Direct measurement method Fluke 8508A	
0.2 A to 2 A	190 µA/A + 16 µA		
2 A to 20 A	400 µA/A + 400 µA		
1 A to 30 A	0.13 % + 0.3 mA	Indirect measurement method HP 3458A w/HP 34330A	
10 A to 100 A	0.11 % + 0.3 mA		
100 A to 1000 A	0.12 % + 3 mA		
DC Resistance – Generate <sup>3</sup>	1 mΩ	0.22 %	Direct measurement method HP 4203x series
	10 mΩ	0.22 %	
	100 mΩ	0.22 %	
	1 Ω	0.22 %	
	10 Ω	0.12 %	
	100 Ω	0.12 %	
	1 kΩ	0.12 %	
	10 kΩ	0.12 %	
	100 kΩ	0.12 %	
	0 Ω to 2 Ω	17 µΩ/Ω + 4 µΩ	Direct measurement method Fluke 5500A w/Fluke 8508A
	2 Ω to 20 Ω	9.5 µΩ/Ω + 14 µΩ	
	20 Ω to 200 Ω	8.0 µΩ/Ω + 50 µΩ	
190 Ω	10 µΩ/Ω	Direct measurement method Fluke 5720A	
1 kΩ	8.5 µΩ/Ω		
1.9 kΩ	8.5 µΩ/Ω		
10 kΩ	8.5 µΩ/Ω		
19 kΩ	8.5 µΩ/Ω		
100 kΩ	11 µΩ/Ω		
190 kΩ	11 µΩ/Ω		
1 MΩ	20 µΩ/Ω		



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DC Resistance – Generate <sup>3</sup> continued	1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	21 μΩ/Ω 40 μΩ/Ω 47 μΩ/Ω 100 μΩ/Ω	Direct measurement method Fluke 5720A	
	11 MΩ to 32.99999 MΩ 33 MΩ to 109.9999 MΩ 110 MΩ to 329.9999 MΩ 330 MΩ to 1100 MΩ	250 μΩ/Ω + 2.5 kΩ 500 μΩ/Ω + 3 kΩ 0.3 % + 100 kΩ 1.5 % + 500 kΩ	Direct measurement method Fluke 5520A	
	0.1 GΩ to 1 GΩ	0.1 %	Direct measurement method PPM R3-1, 110	
	1 GΩ to 10 GΩ 10 GΩ to 100 GΩ	0.5 % 1.0 %	Direct measurement method Biddle Megadek 72-6345-1	
	1 GΩ 10 GΩ 100 GΩ	0.1 % 0.23 % 0.4 %	Direct measurement method Keithley 263	
	1 TΩ	0.57 %	Direct measurement method Rohde & Schwarz CR504	
DC Resistance – Measure <sup>4</sup>	0 Ω to 2 Ω 2 Ω to 20 Ω 20 Ω to 200 Ω 200 Ω to 2 kΩ 2 kΩ to 20 kΩ 20 kΩ to 200 kΩ 200 kΩ to 2 MΩ 2 MΩ to 20 MΩ 20 MΩ to 200 MΩ 200 MΩ to 2 GΩ	17 μΩ/Ω + 4 μΩ 9.5 μΩ/Ω + 14 μΩ 8.0 μΩ/Ω + 50 μΩ 8.0 μΩ/Ω + 500 μΩ 8.0 μΩ/Ω + 5 mΩ 8.0 μΩ/Ω + 50 mΩ 9.0 μΩ/Ω + 1 Ω 20 μΩ/Ω + 100 Ω 120 μΩ/Ω + 10 kΩ 1500 μΩ/Ω + 1 MΩ	Direct measurement method Fluke 8508A (Normal Mode)	
	2 MΩ to 20 MΩ 20 MΩ to 200 MΩ 200 MΩ to 2 GΩ 2 GΩ to 20 GΩ	17 μΩ/Ω + 10 Ω 65 μΩ/Ω + 1 kΩ 180 μΩ/Ω + 100 kΩ 1500 μΩ/Ω + 10 MΩ	Direct measurement method Fluke 8508A (High Voltage Mode)	
	10 MΩ 100 MΩ 1 GΩ 10 GΩ	0.0050 % 0.0064 % 0.015 % 0.12 %	Indirect measurement method HP 3458A; Fluke 5720A	
	100 GΩ 1 TΩ	0.29 % 0.57 %	Indirect measurement method Keithley 487; Fluke 5720A	
	DC Power – Generate <sup>3</sup>	(33 mV to 1020 V) 330 μA to 329.99 mA 330 mA to 2.999 A 3 A to 20.5 A	(% of output in Watts) 0.023 % 0.022 % 0.07 %	Direct measurement method Fluke 5520A

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AC Voltage – Generate <sup>3</sup>	1 nV to 2.2 mV (10 Hz to 20 Hz)	240 µV/V + 4 µV	Direct measurement method Fluke 5520A
	(20 Hz to 40 Hz)	90 µV/V + 4 µV	
	(40 Hz to 20 kHz)	80 µV/V + 4 µV	
	(20 kHz to 50 kHz)	200 µV/V + 4 µV	
	(50 kHz to 100 kHz)	500 µV/V + 5 µV	
	(100 kHz to 300 kHz)	1100 µV/V + 10 µV	
	(300 kHz to 500 kHz)	1400 µV/V + 20 µV	
	(500 kHz to 1 MHz)	2700 µV/V + 20 µV	
	2.2 mV to 22 mV (10 Hz to 20 Hz)	240 µV/V + 4 µV	
	(20 Hz to 40 Hz)	90 µV/V + 4 µV	
	(40 Hz to 20 kHz)	80 µV/V + 4 µV	
	(20 kHz to 50 kHz)	200 µV/V + 4 µV	
	(50 kHz to 100 kHz)	500 µV/V + 5 µV	
	(100 kHz to 300 kHz)	1100 µV/V + 10 µV	
	(300 kHz to 500 kHz)	1400 µV/V + 20 µV	
	(500 kHz to 1 MHz)	2700 µV/V + 20 µV	
	22 mV to 220 mV (10 Hz to 20 Hz)	240 µV/V + 12 µV	
	(20 Hz to 40 Hz)	90 µV/V + 7 µV	
	(40 Hz to 20 kHz)	80 µV/V + 7 µV	
	(20 kHz to 50 kHz)	200 µV/V + 7 µV	
(50 kHz to 100 kHz)	460 µV/V + 17 µV		
(100 kHz to 300 kHz)	900 µV/V + 20 µV		
(300 kHz to 500 kHz)	1400 µV/V + 25 µV		
(500 kHz to 1 MHz)	2700 µV/V + 45 µV		
220 mV to 2.2 V (10 Hz to 20 Hz)	240 µV/V + 40 µV		
(20 Hz to 40 Hz)	90 µV/V + 15 µV		
(40 Hz to 20 kHz)	45 µV/V + 8 µV		
(20 kHz to 50 kHz)	75 µV/V + 10 µV		
(50 kHz to 100 kHz)	110 µV/V + 30 µV		
(100 kHz to 300 kHz)	420 µV/V + 8 µV		
(300 kHz to 500 kHz)	1000 µV/V + 200 µV		
(500 kHz to 1 MHz)	1700 µV/V + 300 µV		
2.2 V to 22 V (10 Hz to 20 Hz)	240 µV/V + 400 µV		
(20 Hz to 40 Hz)	90 µV/V + 150 µV		
(40 Hz to 20 kHz)	45 µV/V + 50 µV		
(20 kHz to 50 kHz)	75 µV/V + 100 µV		
(50 kHz to 100 kHz)	100 µV/V + 200 µV		
(100 kHz to 300 kHz)	275 µV/V + 600 µV		
(300 kHz to 500 kHz)	1000 µV/V + 2 mV		
(500 kHz to 1 MHz)	1500 µV/V + 3.2 mV		

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AC Voltage – Generate <sup>3</sup>	22 V to 220 V (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)	240 $\mu$ V/V + 4 mV 90 $\mu$ V/V + 1.5 mV 52 $\mu$ V/V + 0.6 mV 80 $\mu$ V/V + 1 mV 150 $\mu$ V/V + 2.5 mV 900 $\mu$ V/V + 16 mV 4400 $\mu$ V/V + 40 mV 8000 $\mu$ V/V + 80 mV	Direct measurement method Fluke 5520A
	220 V to 1100 V (15 Hz to 50 Hz) (50 Hz to 1 kHz)	300 $\mu$ V/V + 16 mV 70 $\mu$ V/V + 3.5 mV	
	220 V to 750 V (30 kHz to 50 kHz) (50 kHz to 500 kHz)	600 $\mu$ V/V + 11 mV 2300 $\mu$ V/V + 45 mV	
	220 V to 1100 V (40 Hz to 1 kHz) (1 kHz to 20 kHz) (20 kHz to 30 kHz)	90 $\mu$ V/V + 4 mV 165 $\mu$ V/V + 6 mV 600 $\mu$ V/V + 11 mV	
AC Voltage – Measure <sup>4</sup>	0 mV to 10 mV (1 Hz to 40 Hz) (40 Hz to 1 kHz) (1 kHz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz)	0.03 % + 3 $\mu$ V 0.02 % + 1.1 $\mu$ V 0.03 % + 1.1 $\mu$ V 0.1 % + 1.1 $\mu$ V 0.5 % + 1.1 $\mu$ V 4 % + 2 $\mu$ V	Direct measurement method HP 3458A
	10 mV to 100 mV (1 Hz to 40 Hz) (40 Hz to 1 kHz) (1 kHz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz) (300 kHz to 1 MHz) (1 MHz to 2 MHz)	0.007 % + 4 $\mu$ V 0.007 % + 2 $\mu$ V 0.014 % + 2 $\mu$ V 0.03 % + 2 $\mu$ V 0.08 % + 2 $\mu$ V 0.3 % + 10 $\mu$ V 1 % + 10 $\mu$ V 1.5 % + 10 $\mu$ V	
	100 mV to 1 V (1 Hz to 40 Hz) (40 Hz to 1 kHz) (1 kHz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz) (300 kHz to 1 MHz) (1 MHz to 2 MHz)	0.007 % + 40 $\mu$ V 0.007 % + 20 $\mu$ V 0.014 % + 20 $\mu$ V 0.03 % + 20 $\mu$ V 0.08 % + 20 $\mu$ V 0.3 % + 100 $\mu$ V 1 % + 100 $\mu$ V 1.5 % + 100 $\mu$ V	

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AC Voltage – Measure <sup>4</sup> continued	1 V to 10 V (1 Hz to 40 Hz) (40 Hz to 1 kHz) (1 kHz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz) (300 kHz to 1 MHz) (1 MHz to 2 MHz)	0.007 % + 400 µV 0.007 % + 200 µV 0.014 % + 200 µV 0.03 % + 200 µV 0.08 % + 200 µV 0.3 % + 1 mV 1 % + 1 mV 1.5 % + 1 mV	Direct measurement method HP 3458A
	10 V to 100 V (1 Hz to 40 Hz) (40 Hz to 1 kHz) (1 kHz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 300 kHz) (300 kHz to 1 MHz)	0.02 % + 4 mV 0.02 % + 2 mV 0.02 % + 2 mV 0.035 % + 2 mV 0.12 % + 2 mV 0.4 % + 10 mV 1.5 % + 10 mV	
	100 V to 700 V (1 Hz to 40 Hz) (40 Hz to 1 kHz) (1 kHz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz)	0.04 % + 28 mV 0.04 % + 14 mV 0.06 % + 14 mV 0.12 % + 14 mV 0.3 % + 14 mV	
	0 mV to 200 mV (1 Hz to 10 Hz) (10 Hz to 40 Hz) (40 Hz to 100 Hz) (100 Hz to 2 kHz) (2 kHz to 10 kHz) (10 kHz to 30 kHz) (30 kHz to 100 kHz)	165 µV/V + 14 µV 140 µV/V + 4 µV 120 µV/V + 4 µV 110 µV/V + 2 µV 140 µV/V + 4 µV 340 µV/V + 8 µV 770 µV/V + 20 µV	Direct measurement method Fluke 8508A
	200 mV to 2 V (1 Hz to 10 Hz) (10 Hz to 40 Hz) (40 Hz to 100 Hz) (100 Hz to 2 kHz) (2 kHz to 10 kHz) (10 kHz to 30 kHz) (30 kHz to 100 kHz) (100 kHz to 300 kHz) (300 kHz to 1 MHz)	150 µV/V + 120 µV 120 µV/V + 20 µV 90 µV/V + 20 µV 75 µV/V + 20 µV 110 µV/V + 20 µV 220 µV/V + 40 µV 570 µV/V + 200 µV 0.3 % + 2 mV 1 % + 20 mV	

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AC Voltage – Measure <sup>4</sup> continued	2 V to 20 V (1 Hz to 10 Hz) (10 Hz to 40 Hz) (40 Hz to 100 Hz) (100 Hz to 2 kHz) (2 kHz to 10 kHz) (10 kHz to 30 kHz) (30 kHz to 100 kHz) (100 kHz to 300 kHz) (300 kHz to 1 MHz)	150 µV/V + 1.2 mV 120 µV/V + 200 µV 90 µV/V + 200 µV 75 µV/V + 200 µV 110 µV/V + 200 µV 220 µV/V + 400 µV 570 µV/V + 2 mV 0.3 % + 20 mV % + 200 mV	Direct measurement method Fluke 8508A
	20 V to 200 V (1 Hz to 10 Hz) (10 Hz to 40 Hz) (40 Hz to 100 Hz) (100 Hz to 2 kHz) (2 kHz to 10 kHz) (10 kHz to 30 kHz) (30 kHz to 100 kHz) (100 kHz to 300 kHz) (300 kHz to 1 MHz)	150 µV/V + 12 mV 120 µV/V + 2 mV 90 µV/V + 2 mV 75 µV/V + 2 mV 110 µV/V + 2 mV 220 µV/V + 4 mV 570 µV/V + 20 mV 0.3 % + 200 mV 1 % + 2 V	
	200 V to 1050 V (1 Hz to 10 Hz) (10 Hz to 40 Hz) (40 Hz to 10 kHz) (10 kHz to 30 kHz) (30 kHz to 100 kHz)	150 µV/V + 70 mV 120 µV/V + 20 mV 115 µV/V + 20 mV 225 µV/V + 40 mV 580 µV/V + 200 mV	
AC Voltage – Measure <sup>4</sup> (AC Band >2 MHz)	0 kV to 2 kV (20 Hz to 100 Hz) (100 Hz to 400 Hz)	0.07 % + 2 V 0.4 % + 4 V	Direct measurement method Vitretek 4620B
	(2 kV to 20 kV) 20 Hz to 100 Hz	.2 % + 20 V	
AC Voltage – Measure <sup>4</sup> (AC Band >2 MHz)	0 to 10 mV (45 Hz to 100 kHz) (100 kHz to 1 MHz) (1 MHz to 4 MHz) (4 MHz to 8 MHz)	0.09 % + 6 µV 1.2 % + 5 µV 7 % + 7 µV 20 % + 8 µV	Direct measurement method HP 3458A
	10 mV to 100 mV (45 Hz to 100 kHz) (100 kHz to 1 MHz) (1 MHz to 4 MHz) (4 MHz to 8 MHz) (8 MHz to 10 MHz)	0.09 % + 60 µV 2 % + 50 µV 4 % + 70 µV 4 % + 80 µV 15 % + 100 µV	



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AC Voltage – Measure <sup>4</sup> (AC Band >2 MHz) continued	100 mV to 1 V (45 Hz to 100 kHz) (100 kHz to 1 MHz) (1 MHz to 4 MHz) (4 MHz to 8 MHz) (8 MHz to 10 MHz)	0.09 % + 600 μV 2 % + 500 μV 4 % + 700 μV 4 % + 800 μV 15 % + 1 mV	Direct measurement method HP 3458A
	1 V to 10 V (45 Hz to 100 kHz) (100 kHz to 1 MHz) (1 MHz to 4 MHz) (4 MHz to 8 MHz) (8 MHz to 10 MHz)	0.09 % + 6 mV 2 % + 5 mV 4 % + 7 mV 4 % + 8 mV 15 % + 10 m	
	10 V to 100 V (45 Hz to 100 kHz)	0.12 % + 2 mV	
	100 V to 700 V (45 Hz to 100 kHz)	0.3 % + 70 mV	
AC Voltage – Amplitude Flatness, Measure <sup>4</sup>	1 V to 2 V (10 Hz to 10 MHz) (10 MHz to 30 MHz) (30 MHz to 50 MHz) (50 MHz to 100 MHz)	0.08 % 0.16 % 0.4 % 0.8 %	Indirect measurement method HP 3458A w/Fluke A55
AC Current – Generate <sup>3</sup>	1 nA 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)	250 μA/A + 16 nA 160 μA/A + 10 nA 120 μA/A + 8 nA 280 μA/A + 12 nA 1100 μA/A + 65 nA	Direct measurement method Fluke 5720A
	220 μA 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)	250 μA/A + 40 nA 160 μA/A + 35 nA 120 μA/A + 35 nA 200 μA/A + 110 nA 1100 μA/A + 650 nA	
	2.2 mA to 22 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)	250 μA/A + 400 nA 160 μA/A + 350 nA 120 μA/A + 350 nA 200 μA/A + 550 nA 1100 μA/A + 5 μA	
	22 mA to 220 mA (10 Hz to 20 Hz) (20 Hz to 40 Hz) (40 Hz to 1 kHz)	250 μA/A + 4 μA 160 μA/A + 3.5 μA 120 μA/A + 2.5 μA	

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AC Current – Generate <sup>3</sup> continued	22 mA to 220 mA (kHz 1 to 5 kHz) (5 kHz to 10 kHz)	200 $\mu$ A/A + 3.5 $\mu$ A 1100 $\mu$ A/A + 10 $\mu$ A	Direct measurement method Fluke 5720A
	220 mA to 2.2 A (20 Hz to 1 kHz) (1 kHz to 5 kHz) (5 kHz to 10 kHz)	260 $\mu$ A/A + 35 $\mu$ A 450 $\mu$ A/A + 80 $\mu$ A 7000 $\mu$ A/A + 160 $\mu$ A	
	2.2 A to 11 A (40 Hz to 1 kHz) (1 kHz to 5 kHz) (5 kHz to 10 kHz)	460 $\mu$ A/A + 170 $\mu$ A 950 $\mu$ A/A + 380 $\mu$ A 600 $\mu$ A/A + 750 $\mu$ A	Direct measurement method Fluke 5720A with 5725A
	1 A to 20 A (1 Hz to 5 kHz)	0.025 + (0.012 F) % (where F is frequency in kHz)	Indirect measurement method Shepherd Scientific 100 w/Fluke Y5020
	20 A to 100 A (1 Hz to 1 kHz)	0.1 A	Indirect measurement method Shepherd Scientific 100 w/Valhalla 2575A
	11 A to 20.5 A (45 Hz to 100 Hz) (100 Hz to 1 kHz) (1 kHz to 5 kHz)	0.12 % + 5 mA 0.15 % + 5 mA 3 % + 5 mA	Direct measurement method Fluke 5520A
	0 A to 1000 A (45 Hz to 440 Hz)	0.28 % + 0.11 A	Indirect measurement method Fluke 5520A w/50 turn coil
AC Current – Measure <sup>4</sup>	0 $\mu$ A to 100 $\mu$ A (10 Hz to 20 Hz) (20 Hz to 45 Hz) (45 Hz to 5 kHz)	0.4 % + 30 nA 0.15 % + 30 nA 0.06 % + 30 nA	Direct measurement method HP 3458A
	100 $\mu$ A to 1 mA (10 Hz to 20 Hz) (20 Hz to 45 Hz) (45 Hz to 100 Hz) (100 Hz to 5 kHz) (5 kHz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz)	0.4 % + 200 nA 0.15 % + 200 nA 0.06 % + 200 nA 0.03 % + 200 nA 0.06 % + 200 nA 0.4 % + 400 nA 0.55 % + 1.5 $\mu$ A	
	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)	0.4 % + 2 $\mu$ A 0.15 % + 2 $\mu$ A 0.06 % + 2 $\mu$ A 0.03 % + 2 $\mu$ A	

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AC Current – Measure <sup>4</sup> continued	1 mA to 10 mA (5 kHz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz)	0.06 % + 2 µA 0.4 % + 4 µA 0.55 % + 15 µA	Direct measurement method HP 3458A
	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) (5 kHz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz)	0.4 % + 20 µA 0.15 % + 20 µA 0.06 % + 20 µA 0.03 % + 20 µA 0.06 % + 20 µA 0.4 % + 40 µA 0.55 % + 150 µA	
	100 mA to 1 A (10 Hz to 20 Hz) (20 Hz to 45 Hz) (45 Hz to 100 Hz) (100 Hz to 5 kHz) (5 kHz to 20 kHz) (20 kHz to 50 kHz)	0.4 % + 200 µA 0.16 % + 200 µA 0.08 % + 200 µA 0.1 % + 200 µA 0.3 % + 200 µA 1 % + 400 µA	Direct measurement method Fluke 8508A
	0 µA to 200 µA (1 Hz to 10 Hz) (10 Hz to 10 kHz) (10 kHz to 30 kHz) (30 kHz to 100 kHz)	310 µA/A + 20 nA 300 µA/A + 20 nA 710 µA/A + 20 nA 0.4 % + 20 nA	
	200 µA to 2 mA (1 Hz to 10 Hz) (10 Hz to 10 kHz) (10 kHz to 30 kHz) (30 kHz to 100 kHz)	310 µA/A + 200 nA 300 µA/A + 200 nA 710 µA/A + 200 nA 0.4 % + 200 nA	
	2 mA to 20 mA (1 Hz to 10 Hz) (10 Hz to 10 kHz) (10 kHz to 30 kHz) (30 kHz to 100 kHz)	310 µA/A + 2 µA 300 µA/A + 2 µA 710 µA/A + 2 µA 0.4 % + 2 µA	
	20 mA to 200 mA (1 Hz to 10 Hz) (10 Hz to 10 kHz) (10 kHz to 30 kHz)	310 µA/A + 20 µA 290 µA/A + 20 µA 630 µA/A + 20 µA	
200 mA to 2 A (10 Hz to 2 kHz) (2 kHz to 10 kHz) (10 kHz to 30 kHz)	620 µA/A + 200 µA 725 µA/A + 200 µA 0.3 % + 200 µA		

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AC Current – Measure <sup>4</sup> continued	2 A to 20 A (10 Hz to 2 kHz) (2 kHz to 10 kHz)	820 $\mu$ A/A + 2 mA 0.25 % + 2 mA	Direct measurement method Fluke 8508A
	1 A to 20 A (1 Hz to 5 kHz)	0.025 % + (0.012 %*F) of RDG where F is frequency in kHz	Indirect measurement method Fluke Y5020 w/ Fluke 8508A
	20 A to 100 A (1 Hz to 1 kHz)	0.1 A	Indirect measurement method Valhalla 2575A w/ Fluke 8508A
AC Resistance – Generate <sup>3</sup>	10 $\Omega$ (DC to 1 MHz) (1 MHz to 2 MHz) (2 MHz to 3 MHz) (3 MHz to 4 MHz) (4 MHz to 5 MHz) (5 MHz to 10 MHz) (10 MHz to 13 MHz)	0.13 % 0.14 % 0.16 % 0.17 % 0.2 % 0.5 % 0.7 %	Direct measurement method HP 42030 resistor set
	100 $\Omega$ (DC to 1 MHz) (1 MHz to 2 MHz) (2 MHz to 3 MHz) (3 MHz to 4 MHz) (4 MHz to 5 MHz) (5 MHz to 10 MHz) (10 MHz to 13 MHz)	0.13 % 0.14 % 0.15 % 0.15 % 0.15 % 0.3 % 0.4 %	
	1 k $\Omega$ (DC to 100 kHz) (100 kHz to 1 MHz) (1 MHz to 2 MHz) (2 MHz to 3 MHz) (3 MHz to 4 MHz) (4 MHz to 5 MHz) (5 MHz to 10 MHz) (10 MHz to 13 MHz)	0.13 % + 0.2 $\Omega$ 0.13 % + 0.2 $\Omega$ 0.13 % + 0.2 $\Omega$ 0.13 % + 0.2 $\Omega$ 0.14 % + 0.2 $\Omega$ 0.15 % + 0.2 $\Omega$ 0.3 % + 0.2 $\Omega$ 0.4 % + 0.2 $\Omega$	
	10 k $\Omega$ (DC to 100 kHz) (100 kHz to 1 MHz)	0.12 % + 2 $\Omega$ 0.13 % + 2 $\Omega$	
	100 k $\Omega$ (DC to 100 kHz) (100 kHz to 1 MHz)	0.13 % + 20 $\Omega$ 0.13 % + 20 $\Omega$	

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AC Resistance – Measure <sup>4</sup>	10 mΩ to 100 MΩ (20 Hz to 1 MHz)	0.05 %	Direct measurement method HP 4284A
AC Power – Generate <sup>3</sup> (45 Hz to 65 Hz)	33 mV to 330 mV (3.3 mA to 8.999 mA) (9 mA to 32.999 mA) (33 mA to 89.99 mA) (90 mA to 329.99 mA) (330 mA to 0.8999 A) (0.9 A to 2.1999 A) (2.2 A to 4.4999 A) (4.5 A to 20.5 A)	(% of output in Watts) 0.14 % 0.1 % 0.14 % 0.1 % 0.13 % 0.11 % 0.13 % 0.11 %	Direct measurement method Fluke 5520A
	330 mV to 1020 V (3.3 mA to 8.999 mA) (9 mA to 32.999 mA) (33 mA to 89.99 mA) (90 mA to 329.99 mA) (330 mA to 0.8999 A) (0.9 A to 2.1999 A) (2.2 A to 4.4999 A) (4.5 A to 20.5 A)	0.12 % 0.08 % 0.12 % 0.08 % 0.11 % 0.09 % 0.12 % 0.1 %	
Capacitance – Generate <sup>3</sup>	0.19 nF to 1.0999 nF (10 Hz to 10 kHz)	0.5 % + 0.01 nF	Direct measurement method Fluke 5520A
	1.1 nF to 3.2999 nF (10 Hz to 3 kHz)	0.5 % + 0.01 nF	
	3.3 nF to 10.9999 nF (10 Hz to 1 kHz)	0.25 % + 0.01 nF	
	11 nF to 109.999 nF (10 Hz to 1 kHz)	0.25 % + 0.1 nF	
	110 nF to 329.999 nF (10 Hz to 1 kHz)	0.25 % + 0.3 nF	
	330 nF to 1.09999 μF (10 Hz to 600 Hz)	0.25 % + 1 nF	
	1.1 μF to 3.29999 μF (10 Hz to 300 Hz)	0.25 % + 3 nF	
	3.3 μF to 10.9999 μF (10 Hz to 150 Hz)	0.25 % + 10 nF	
	11 μF to 32.9999 μF (10 Hz to 120 Hz)	0.4 % + 30 nF	



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Capacitance – Generate <sup>3</sup> continued	33 µF to 109.999 µF (10 Hz to 80 Hz)	0.45 % + 100 nF	Direct measurement method Fluke 5520A
	110 µF to 329.999 µF (0 Hz to 50 Hz)	0.45 % + 300 nF	
	330 µF to 1.09999 mF (0 Hz to 20 Hz)	0.45 % + 1 µF	
	1.1 mF to 3.2999 mF @ 0 Hz to 6 Hz	0.45 % + 3 µF	
	3.3 mF to 10.9999 mF (0 Hz to 2 Hz)	0.45 % + 10 µF	
	11 mF to 32.9999 mF (0 Hz to 0.6 Hz)	0.75 % + 30 µF	
	33 mF to 110 mF (0 Hz to 0.2 Hz)	1.1 % + 100 µF	
Capacitance – Generate <sup>3</sup> , Fixed Points	1 pF, 10 pF, 100 pF, 1000 pF (20 Hz to 1 MHz)	0.05 %	Direct measurement method HP 1638x series
	100 pF to 1 µF (100 Hz to 100 kHz)	0.05 %	Direct measurement method Arco SS32 set
	1 µF to 1 F (100 Hz to 1 kHz)	0.25 %	Direct measurement method GenRad 1417
Capacitance – Measure <sup>4</sup>	0.1 pF to 10 F (20 Hz to 1 MHz)	0.05 %	Direct measurement method HP 4284A
Inductance – Generate <sup>3</sup> , Fixed Values	100 µH to 10 H (100 Hz to 10 kHz)	0.05 %	Direct measurement method HP 1638x series
Inductance – Measure <sup>4</sup>	0.01 nH to 100 kH (20 Hz to 1 MHz)	0.05 %	Direct measurement method HP 4284A
Oscilloscopes - Voltage Function – DC Signal (50 Ω)	±1 mV to ±5 V	0.025 % + 25 µV	Direct measurement method Fluke 9500B w/9530
Oscilloscopes Voltage Function - DC Signal (1 MΩ)	±1 mV to ±200 V	0.025 % + 25 µV	
Oscilloscopes Square Wave Signal (<10 kHz) (50 Ω)	40 µV <sub>p-p</sub> to 5 V <sub>p-p</sub> ≥1 mV ≤1 mV	0.1 % + 10 µV 1.0 % + 10 µV	

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Oscilloscopes - Square Wave Signal (<10 kHz) (1 MΩ)	40 μV <sub>p-p</sub> to 200 V <sub>p-p</sub> ≥1 mV ≤1 mV	0.1 % + 10 μV 1.0 % + 10 μV	Direct measurement method Fluke 9500B w/9530
Oscilloscopes - Square Wave Frequency	10 Hz to 100 kHz	0.25 μHz/Hz	
Oscilloscopes - Edge Function - Rise/Fall Time	150 ps (Fast Edge) 500 ps (Edge)	15 ps 40 ps	
Oscilloscopes – Leveled Sine Function - Leveled Sine Amplitude (Single Ref Frequency 50 kHz to 10 MHz)	5 mV <sub>p-p</sub> to 5 V <sub>p-p</sub> (0.1 Hz to 550 MHz)	(@ single reference frequency) 1.5 %	
	5 mV <sub>p-p</sub> to 3 V <sub>p-p</sub> (550 MHz to 2.5 GHz)	1.5 %	
	5 mV <sub>p-p</sub> to 2 V <sub>p-p</sub> (2.5 GHz to 3.2 GHz)	1.5 %	
Oscilloscopes – Leveled Sine Flatness with reference to frequency	(into VSWR of 1.6:1) 0.1 Hz to 300 MHz 300 MHz to 550 MHz 550 MHz to 1.1 GHz 1.1 GHz to 3.2 GHz	4 % 4 % 5 % 5 %	
	(into VSWR of 1.2:1) 0.1 Hz to 300 MHz 300 MHz to 550 MHz 550 MHz to 1.1 GHz 1.1 GHz to 3.2 GHz	2 % 2.5 % 3.5 % 4 %	
Oscilloscopes – Timing Marker Function - Square  Pulse and Narrow Triangle  Sine	9.0091 ns to 55 s	0.25 μs/s	
	900.91 ns to 55 s	0.25 μs/s	
	450.5 ps to 9.009 ns	0.25 μs/s	
Oscilloscopes – Input Impedance Function - Resistance Measurement	10 Ω to 40 Ω	0.5 %	
	40 Ω to 90 Ω	0.1 %	
	90 Ω to 150 Ω	0.5 %	
	50 k Ω to 800 kΩ	0.5 %	
	800 kΩ to 1.2 MΩ 1.2 MΩ to 12 MΩ	0.1 % 0.5 %	
Oscilloscopes – Pulse Width Function	1 ns to 100 ns	5 % + 200 ps	

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<b>Time and Frequency</b>			
Timers/Stop Watches	0.001 s to 99999.999 s	0.001 %	Comparison measurement method VWR 62344-880
Frequency – Generate <sup>3</sup> / Measure <sup>4</sup>	0.1 MHz, 1 MHz, 5 MHz, 10 MHz	(5 x 10 <sup>-12</sup> F) Hz Where F is frequency in Hz	Direct measurement method Fluke 910R
	1 Hz to 26.5 GHz	(1.2 x 10 <sup>-10</sup> F) Hz Where F is frequency in Hz	Direct measurement method HP 3325, Fluke 910R as external time base
<b>RF/Microwave and Electromagnetics</b>			
Amplitude Modulation – Measure <sup>4</sup> (150 kHz to 10 MHz)  (10 MHz to 1300 MHz)  (1.3 GHz to 26.5 GHz)	Rate: 50 Hz to 10 kHz Depth: 5 % to 99 %	2 % + 1 digit	Direct measurement method HP 8902A w/HP 11793A (using peak detector)
	Rate: 20 Hz to 10 kHz Depth: 5 % to 99 %	3 % + 1 digit	
	Rate: 50 Hz to 50 kHz Depth: 5 % to 99 %	1 % + 1 digit	
	Rate: 20 Hz to 20 kHz Depth: 5 % to 99 %	3 % + 1 digit	
	Rate: 50 Hz to 50 kHz Depth: 5 % to 99 %	1.5 % + 1 digit	
	Rate: 20 Hz to 100 kHz Depth: 5 % to 99 %	3 % + 1 digit	
Frequency Modulation – Measure <sup>4</sup> (250 kHz to 10 MHz)  (10 MHz to 1.3 GHz)  (1.3 GHz to 26.5 GHz)	Rate: 20 Hz to 10 kHz Deviation: 40 kHz peak	2 % + 1 digit	
	Rate: 50 Hz to 100 kHz Deviation: 400 kHz peak	1 % + 1 digit	
	Rate: 20 Hz to 200 kHz Deviation: 400 kHz peak	5 % + 1 digit	
	Rate: 50 Hz to 100 kHz Deviation: 400 kHz peak	1 % + 1 digit	
	Rate: 20 Hz to 200 kHz Deviation: 40 kHz peak	5 % + 1 digit	
	Rate: 20 Hz to 200 kHz Deviation: 40 kHz peak	5 % + 1 digit	

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MEASURED QUANTITY or DEVICE TYPE CALIBRATED	RANGE	UNCERTAINTY <sup>1,2</sup> (±)	CALIBRATION METHOD OR PROCEDURE, STANDARD EQUIPMENT (OPTIONAL)
Amplitude Modulation – Flatness Measure <sup>4</sup> (10 MHz to 1.3 GHz Carrier Frequency)	Rate: 90 Hz to 10 kHz Depth: 20 % to 80 %	0.3 % + 1 digit	Direct measurement method HP 8902A w/HP 11793A (using peak detector)
Modulation Residual AM – Measure <sup>4</sup> 50 Hz to 3 kHz BW	0 % rms to 100 % rms	0.01 % rms	Direct measurement method HP 8902A
Modulation Residual FM – Measure <sup>4</sup> 50 Hz to 3 kHz BW	≤100 MHz 1300 MHz	1 Hz <sub>rms</sub> 8.1 Hz <sub>rms</sub>	
Phase Modulation – Measure <sup>4</sup>	(150 kHz to 10 MHz) 200 Hz to 10 kHz	4 % + 1 digit	Direct measurement method HP 8902A w/HP 11793A (using peak detector)
	(10 MHz to 1.3 GHz) 200 Hz to 20 kHz	3 % + 1 digit	
	(1.3 GHz to 26.5 GHz) 200 Hz to 20 kHz	3 % + 1 digit	
Noise Measurement <sup>4</sup> (Distortion Harmonics <330 kHz)	20 Hz to 20 kHz 20 kHz to 100 kHz	1 dB 2 dB	Direct measurement method HP 8903B
Single Side Band Phase Noise (SSB)	10 MHz to 1300 MHz	1 dB	Direct measurement method HP 8902A-030, 037
Attenuation – Generate <sup>3</sup>	(200 Hz to 80 MHz) 0 dB to 18 dB 20 dB to 58 dB 60 dB to 98 dB	0.04 dB 0.09 dB 0.20 dB	Direct measurement method HP 3335A
	(DC to 18 GHz) 1 dB 2 dB 3 dB to 6 dB 7 dB to 8 dB 9 dB 10 dB 11 dB	0.35 dB 0.45 dB 0.55 dB 0.60 dB 0.65 dB 0.70 dB 0.80 dB	Direct measurement method Agilent 84904K, APC 3.5 mm connector
	(18 GHz to 26.5 GHz) 1 dB 2 dB 3 dB to 6 dB 7 dB to 8 dB 9 dB 10 dB 11 dB	0.40 dB 0.50 dB 0.70 dB 0.80 dB 0.85 dB 0.90 dB 1.10 dB	

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Attenuation – Generate <sup>3</sup> continued	(DC to 6 GHz)		Direct measurement method HP 8497K, APC 3.5 mm Connector
	10 dB	0.3 dB	
	20 dB	0.5 dB	
	30 dB	0.6 dB	
	40 dB	0.7 dB	
	50 dB	0.8 dB	
	60 dB	1.0 dB	
	70 dB to 80 dB	1.1 dB	
	90 dB	1.2 dB	
	(6 GHz to 12.4 GHz)		
	10 dB	0.4 dB	
	20 dB	0.5 dB	
	30 dB	0.7 dB	
	40 dB	0.9 dB	
	50 dB	1.0 dB	
	60 dB	1.3 dB	
	70 dB	1.5 dB	
	80 dB	1.6 dB	
	90 dB	1.7 dB	
	20 dB	0.6 dB	
	30 dB	0.8 dB	
	40 dB	1.1 dB	
	50 dB	1.2 dB	
	60 dB	1.4 dB	
	70 dB	1.7 dB	
	80 dB	1.8 dB	
	90 dB	2.1 dB	
	(18 GHz to 26.5 GHz)		
	10 dB	0.7 dB	
	20 dB	0.8 dB	
30 dB	1.0 dB		
40 dB	1.5 dB		
50 dB	1.6 dB		
60 dB	1.9 dB		
70 dB	2.3 dB		
80 dB	2.5 dB		
90 dB	2.8 dB		



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Attenuation – Measure <sup>4</sup>	(100 kHz to 26.5 GHz) 0 dB to -20 dB -20 dB to -40 dB -40 dB to -60 dB -60 dB to -80 dB -80 dB to -100 dB -100 dB to -127 dB	0.05 dB + M 0.18 dB + M 0.20 dB + M 0.24 dB + M 0.28 dB + M 0.35 dB + M Where M is the mismatch uncertainty, which has the following best-case values: 100 kHz to 6 GHz— 0.02 dB, 6 GHz to 26.5 GHz-- 0.07 dB	Direct measurement method HP 8902A w/11722A and 11793A
Power – Generate <sup>3</sup> (into 50 Ω)	(0.001 Hz to 100 kHz) -56.02 dBm to 13.52 dBm 13.52 dBm to 23.98 dBm  (100 kHz to 10 MHz) -56.02 dBm to +13.52 dBm  (10 MHz to 20 MHz) -56.02 dBm to -16.02 dBm -16.02 dBm to +13.52 dBm  (100 kHz to 20 MHz) 13.52 dBm to 23.98 dBm	0.2 dB 0.1 dB  0.6 dB  0.9 dB 0.6 dB  0.4 dB	Direct measurement method HP 3325B (sinewave 0 dB attenuation, BNC connector)
	(0.01 GHz to 3 GHz) +10 dBm to -9.95 dBm -10 dBm to -19.95 dBm -20 dBm to -49.95 dBm -50 dBm to -79.95 dBm -80 dBm to -100 dBm  (2.3 GHz to 20 GHz) +18 dBm to +10 dBm +10 dBm to -9.95 dBm -10 dBm to -19.95 dBm -20 dBm to -49.95 dBm -50 dBm to -79.95 dBm -80 dBm to -100 dBm  (20 GHz to 26.5 GHz) +18 dBm to +10 dBm +10 dBm to -9.95 dBm -10 dBm to -19.95 dBm	0.9 dBm 1.2 dBm 1.5 dBm 1.8 dBm 2.1 dBm  1.8 dBm 1.5 dBm 2.0 dBm 2.3 dBm 2.6 dBm 2.9 dBm  2.3 dBm 2.0 dBm 2.5 dBm	Direct measurement method HP 8340B, internally leveled Type N connector

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Power – Generate <sup>3</sup> (into 50 Ω) continued	-20 dBm to -49.95 dBm -50 dBm to -79.95 dBm -80 dBm to -100 dBm	2.8 dBm 3.1 dBm 3.4 dBm	Direct measurement method HP 8340B, internally leveled Type N connector
Power – Measure <sup>3</sup>	0.0001 to 18 GHz -20 to -15 dBm -15 to -10 dBm -10 to 10 dBm 10 to 20 dBm	0.34 dBm 0.15 dBm 0.12 dBm 0.19 dBm	Direct measurement method HP 437B with 8482A
	18 to 26.5 GHz -20 to -15 dBm -15 to -10 dBm -10 to 10 dBm 10 to 20 dBm	0.35 dBm 0.17 dBm 0.14 dBm 0.21 dBm	Direct measurement method HP 437B with 8485A
Return Loss – Measure <sup>4</sup> (into 50 Ω)	(10 MHz to 8.4 GHz) 10 dB 20 dB 30 dB 40 dB	1.3 dB 1.5 dB 1.5 dB 1.5 dB	Direct measurement method HP 85021B w/8755C and 8340B
	(8.4 GHz to 12.4 GHz) 10 dB 20 dB 30 dB 40 dB	1.3 dB 1.5 dB 1.5 dB 1.5 dB	
	(12.4 GHz to 20 GHz) 10 dB 20 dB 30 dB 40 dB	1.3 dB 1.5 dB 1.6 dB 1.6 dB	
	(20 GHz to 26.5 GHz) 10 dB 20 dB 30 dB 40 dB	1.5 dB 1.6 dB 1.7 dB 1.7 dB	
Harmonic and Non-Harmonic Amplitude Measure <sup>4</sup> (0.02 Hz to 25.5 kHz)	+30 dBV to -120 dBV	0.6 dB	Direct measurement method HP 3582A
Harmonic and Non-Harmonic Amplitude Measure <sup>4</sup> (9 kHz to 25 GHz)	0 dB to 60 dB Reference Level (Log Scale) (Linear Scale)	0.75 dB 3%	Direct measurement method HP 8592B

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Harmonic and Non-Harmonic Amplitude Measure <sup>4</sup> (9 kHz to 25 GHz) continued	-60 dB to -70 dB Reference Level (Log Scale) (Linear Scale)	1 dB 3%	Direct measurement method HP 8592B
<b>Chemical/Gas</b>			
pH - Generate <sup>3</sup>	4 units 7 units 10 units	0.054 units 0.037 units 0.066 units	Direct measurement method Solutions

<sup>1</sup>The uncertainty covered by the Calibration and Measurement Capability (CMC) is expressed as the expanded uncertainty having a coverage probability of approximately 95 %. It is the smallest measurement uncertainty that a laboratory can achieve within its scope of accreditation when performing calibrations of a best existing device. The measurement uncertainty reported on a calibration certificate may be greater than that provided in the CMC due to the behavior of the calibration item and other factors that may contribute to the uncertainty of a specific calibration.

<sup>2</sup>When uncertainty is stated in relative terms (such as percent, a multiplier expressed as a decimal fraction or in scientific notation), it is in relation to instrument reading or instrument output, as appropriate, unless otherwise indicated.

<sup>3</sup>Capability is suitable for the calibration of measuring devices in the stated ranges.

<sup>4</sup>Capability is suitable for the calibration of devices intended to generate the indicated quantity in the stated ranges.

<sup>5</sup>g = acceleration due to gravity

RDG = reading

BW = bandwidth

p-p = peak to peak

HV = high voltage

VSWR = voltage standing wave ratio