

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid to: **June 26, 2022**

Certificate Number: **AC-1336**

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure	Up to 200 μ A 200 μ A to 2 mA (2 to 20) mA (20 to 200) mA 200 mA to 2 A (2 to 20) A	12 μ A/A + 0.4 nA 12 μ A/A + 4 nA 14 μ A/A + 40 nA 48 μ A/A + 0.8 μ A 185 μ A/A + 16 μ A 0.4 mA/A + 0.4 mA	Fluke 8508A Reference Multimeter
DC Voltage – Measure	Up to 200 mV 200 mV to 2 V (2 to 20) V (20 to 200) V 200 V to 1.05 kV	7.9 μ V + 0.1 μ V 8.6 μ V/V + 0.5 μ V 5.5 μ V/V + 5 μ V 14 μ V/V + 50 μ V 0.13 mV/V + 0.6 mV	Fluke 8508A Reference Multimeter
AC Voltage – Measure	Up to 200 mV (1 to 10) Hz (10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.17 mV/V + 14 μ V 0.14 mV/V + 4 μ V 0.12 mV/V + 4 μ V 0.11 mV/V + 2 μ V 0.14 mV/V + 4 μ V 0.34 mV/V + 8 μ V 0.77 mV/V + 20 μ V	Fluke 8508A Reference Multimeter

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AC Voltage – Measure	(0.2 to 2) V		Fluke 8508A Reference Multimeter
	(1 to 10) Hz	0.15 mV/V + 0.12 mV	
	(10 to 40) Hz	0.12 mV/V + 20 μV	
	(40 to 100) Hz	90 μV/V + 20 μV	
	100 Hz to 2 kHz	75 μV/V + 20 μV	
	(2 to 10) kHz	0.11 mV/V + 20 μV	
	(10 to 30) kHz	0.22 mV/V + 40 μV	
	(30 to 100) kHz	0.57 mV/V + 0.2 mV	
	(100 to 300) kHz	3 mV/V + 2 mV	
	300 kHz to 1MHz	10 mV/V + 20 mV	
	(2 to 20) V		
	(1 to 10) Hz	0.15 mV/V + 1.2 mV	
	(10 to 40) Hz	0.12 mV/V + 0.2 mV	
	(40 to 100) Hz	90 μV/V + 0.2 mV	
	100 Hz to 2 kHz	75 μV/V + 0.2 mV	
	(2 to 10) kHz	0.11 mV/V + 0.2 mV	
	(10 to 30) kHz	0.22 mV/V + 0.4 mV	
	(30 to 100) kHz	0.57 mV/V + 2 mV	
	(100 to 300) kHz	3 mV/V + 20 mV	
	300 kHz to 1MHz	10 mV/V + 0.2 V	
	(20 to 200) V		
	(1 to 10) Hz	0.15 mV/V + 12 mV	
	(10 to 40) Hz	0.12 mV/V + 2 mV	
	(40 to 100) Hz	90 μV/V + 2 mV	
	100 Hz to 2 kHz	75 μV/V + 2 mV	
	(2 to 10) kHz	0.11 mV/V + 2 mV	
	(10 to 30) kHz	0.22 mV/V + 4 mV	
	(30 to 100) kHz	0.57 mV/V + 20 mV	
(100 to 300) kHz	3 mV/V + 0.2 V		
300 kHz to 1MHz	10 mV/V + 2 V		
(200 to 1 000) V			
(1 to 10) Hz	0.15 mV/V + 70 mV		
(10 to 40) Hz	0.12 mV/V + 20 mV		
40 Hz to 10 kHz	0.12 mV/V + 20 mV		
(10 to 30) kHz	0.23 mV/V + 40 mV		
(30 to 100) kHz	0.58 mV/V + 0.2 V		

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure	Up to 200 mA (1 to 10) Hz	0.31 mA/A + 20 nA	Fluke 8508A Reference Multimeter
	10 Hz to 10 kHz (10 to 30) kHz	0.3 mA/A + 20 nA 0.71 mA/A + 20 nA	
	(30 to 100) kHz	4 mA/A + 20 nA	
	(0.2 to 2) mA (1 to 10) Hz	0.31 mA/A + 0.2 mA	
	10 Hz to 10 kHz (10 to 30) kHz	0.3 mA/A + 0.2 mA 0.71 mA/A + 0.2 mA	
	(30 to 100) kHz	4 mA/A + 0.2 mA	
	(2 to 20) mA (1 to 10) Hz	0.31 mA/A + 2 mA	
	10 Hz to 10 kHz (10 to 30) kHz	0.3 mA/A + 2 mA 0.71 mA/A + 2 mA	
	(30 to 100) kHz	4 mA/A + 2 mA	
	(20 to 200) mA (1 to 10) Hz	0.31 mA/A + 20 μA	
	10 Hz to 10 kHz (10 to 30) kHz	0.29 mA/A + 20 μA 0.63 mA/A + 20 μA	
	(0.2 to 2) A 10 Hz to 2 kHz (2 to 10) kHz	0.62 mA/A + 0.2 mA 0.73 mA/A + 0.2 mA	
	(10 to 30) kHz	3 mA/A + 0.2 mA	
	(2 to 20) A 10 Hz to 2 kHz (2 to 10) kHz	0.82 mA/A + 2 mA 2.5 mA/A + 2 mA	
Capacitance – Source Fixed (1 kHz)	1 nF	0.55 pF	GenRad 1409-F Capacitor GenRad 1409-L Capacitor GenRad 1409-T Capacitor GenRad 1409-Y Capacitor
	10 nF	5.1 pF	
	100 nF	55 pF	
	1 μF	0.51 nF	
Capacitance – Measure (1 kHz)	1 pF to 10 mF	0.25 mF/F + 30 aF	GenRad 1689 Digibridge
Resistance – Source	0 Ω	40 μΩ	Fluke 5720A Multiproduct Calibrator monitored with Fluke 8508A Reference Multimeter
	1 Ω	95 μΩ	
	1.9 Ω	0.18 mΩ	
	10 Ω	0.23 mΩ	
	19 Ω	0.44 mΩ	
	100 Ω	1 mΩ	
	190 Ω	1.9 mΩ	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance - Source	1 k Ω 1.9 k Ω 10 k Ω 19 k Ω 100 k Ω 190 k Ω 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω 100 M Ω	8.5 m Ω 16 m Ω 85 m Ω 0.16 m Ω 1.1 Ω 2.1 Ω 20 Ω 40 Ω 0.4 k Ω 0.89 k Ω 10 k Ω	Fluke 5720A Multiproduct Calibrator monitored with Fluke 8508A Reference Multimeter
Resistance - Source Fixed Values	1 Ω 10 k Ω	0.19 m Ω 11 m Ω	Fluke 742-1 Resistance Standard Fluke 742-10k Resistance Standard
Resistance – Measure	Up to 2 Ω (2 to 20) Ω (20 to 200) Ω (0.2 to 2) k Ω (2 to 20) k Ω (20 to 200) k Ω (0.2 to 2) M Ω (2 to 20) M Ω (20 to 200) M Ω (0.2 to 2) G Ω	17 $\mu\Omega/\Omega$ + 4 $\mu\Omega$ 9.5 $\mu\Omega/\Omega$ + 14 $\mu\Omega$ 8 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 8 $\mu\Omega/\Omega$ + 0.5 m Ω 8 $\mu\Omega/\Omega$ + 5 m Ω 8 $\mu\Omega/\Omega$ + 50 m Ω 9 $\mu\Omega/\Omega$ + 1 Ω 20 $\mu\Omega/\Omega$ + 0.1 k Ω 0.12 m Ω/Ω + 10 k Ω 1.5 m Ω/Ω + 1 M Ω	Fluke 8508A Reference Multimeter
Inductance – Source Fixed Values (1 kHz)	50 μ H 200 μ H 1 mH 5 mH 10 mH 50 mH 200 mH	0.25 μ H 0.5 μ H 1.1 μ H 5.1 μ H 10 μ H 50 μ H 0.2 mH	GenRad 1482-A Inductor GenRad 1482-C Inductor GenRad 1482-E Inductor GenRad 1482-G Inductor GenRad 1482-H Inductor GenRad 1482-K Inductor GenRad 1482-M Inductor
Inductance – Measure (1 kHz)	10 μ H to 1 000 H	0.25 mH/H	GenRad 1689 Digibridge

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes			
Amplitude – DC into 50 Ω load	0 V 888 μV to 5.56 V -888 μV to -5.56 V	0.6 mV 25 μV 25 μV	Wavetek 9500A Oscilloscope Calibrator w/ Wavetek 9520 Active Head
into 1 MΩ load	888 μV to 222.4 V -888 μV to -222.4 V	27 μV 27 μV	
Amplitude – Square Wave into 50 Ω load ≤10 kHz	(1 to 21) mV (21 to 556) mV 556 mV to 5.56 V 0 V	20 μV 0.13 mV 8.5 mV 15 μV	
into 1 MΩ load ≤10 kHz	(1 to 22) mV (22 to 556) mV 556 mV to 210 V 0 V	22 μV 0.13 mV 13 mV 15 μV	
Amplitude – Leveled Sine Wave (into 50 Ω)	4.44 mV to 5.56 V p-p 50 kHz to 10 MHz	15 mV/V	
Time Markers	450 ps to 55 s	6.4 ps	
Rise Time into 50 Ω load	150 ps	19 ps	
Leveled Sine Flatness (into 50 Ω and 1 MΩ load)	4.44 mV to 3.336 V p-p 0.1 Hz to 100 MHz (100 to 550) MHz 550 MHz to 1.1 GHz	15 mV/V 30 mV/V 40 mV/V	

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Absolute RF Power – Measure ² Power Reference 1 mW, Type-N(f), 50 Ω Relative to 1 mW	(-30 to +20) dBm 50 MHz 10 MHz to 18 GHz	7.8 μW 21 mW/W	HP 432B Power Meter w/ Power Sensor HP 436A Power Meter w/ Power Sensor

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Phase Modulation – Source ² (1 kHz)	100 kHz to 2.12 MHz	2.6 rad	HP 8642B Signal Generator
Phase Modulation – Measure ²	10 MHz to 1.3 GHz 200 Hz to 20 kHz rate	3 % of reading	HP 8901A Modulation Analyzer
Amplitude Modulation – Measure ²	10 MHz to 1.3 GHz 50 Hz to 50 kHz rate	1 % of reading	HP 8901A Modulation Analyzer
Frequency Modulation – Source ²	100 kHz to 2.12 MHz (20 to 100) kHz rate	5 % of reading + 10 Hz	HP 8642B Signal Generator
Frequency Modulation – Measure ²	10 MHz to 1.3 GHz 50 Hz to 100 kHz rate	1 % of reading	HP 8901A Modulation Analyzer

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure Devices	(-14 to 20) psig	0.000 42 psi	Ruska 7250XI Pressure Controller
	Up to 2 500 psig	0.05 psi	
	Up to 10 000 psig	0.11 % of reading	Comparison to Crystal XP21 Digital Pressure Gage

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Measure	(-55 to 140) °C	0.03 °C	Hart Scientific PRT, Fluke 8508A Reference Multimeter
Humidity – Source	(10 to 90) %RH	0.54 %RH	Thunder Scientific 2500 Humidity Generator

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Measure	20 kHz to 10 MHz	0.14 mHz/Hz	Kenometrics 60-TF Frequency Comparator WWVB
Rotational Speed – Measure	(5 to 99 999) rpm	0.18 % of reading	Extech 461825 Photo Tachometer/ Stroboscope
Rotational Speed – Source	(55 to 40 000) rpm	0.52 rpm	GEC H224-837837 Motor w/ Digital RPM Meter

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. The uncertainties listed for Electrical - RF/Microwave do not include uncertainties induced by mismatch.
3. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1336.



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