

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

Oscilloscope Services, Inc.

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CALIBRATION

Valid to: **June 26, 2024**

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		



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AC Current – Measure	Up to 200 mA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.31 mA/A + 20 nA 0.3 mA/A + 20 nA 0.71 mA/A + 20 nA 4 mA/A + 20 nA	Fluke 8508A Reference Multimeter		
	(0.2 to 2) mA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.31 mA/A + 0.2 mA 0.3 mA/A + 0.2 mA 0.71 mA/A + 0.2 mA 4 mA/A + 0.2 mA			
	(2 to 20) mA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.31 mA/A + 2 mA 0.3 mA/A + 2 mA 0.71 mA/A + 2 mA 4 mA/A + 2 mA			
	(20 to 200) mA (1 to 10) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.31 mA/A + 20 μA 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 (10 to 30) kHz	0.62 mA/A + 0.2 mA 0.73 mA/A + 0.2 mA 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 ¹ (Fixed Artifact) (1 kHz)	1 nF 10 nF 100 nF 1 μF		0.55 pF 5.1 pF 55 pF 0.51 nF	GenRad 1409-F Capacitor GenRad 1409-L Capacitor GenRad 1409-T Capacitor GenRad 1409-Y Capacitor
	Capacitance – Measure ¹ (1 kHz)	1 pF to 10 mF		0.25 mF/F + 30 aF	GenRad 1689 Digibridge
	Resistance – Source ¹ (Simulated)	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			



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Resistance – Source ¹ (Simulated)	1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	8.5 mΩ 16 mΩ 85 mΩ 0.16 mΩ 1.1 Ω 2.1 Ω 20 Ω 40 Ω 0.4 kΩ 0.89 kΩ 10 kΩ	Fluke 5720A Multiproduct Calibrator monitored with Fluke 8508A Reference Multimeter
Resistance – Source ¹ (Fixed Artifact)	1 Ω 10 kΩ	0.19 mΩ 11 mΩ	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) kΩ (2 to 20) kΩ (20 to 200) kΩ (0.2 to 2) MΩ (2 to 20) MΩ (20 to 200) MΩ (0.2 to 2) GΩ	17 μΩ/Ω + 4 μΩ 9.5 μΩ/Ω + 14 μΩ 8 μΩ/Ω + 50 μΩ 8 μΩ/Ω + 0.5 mΩ 8 μΩ/Ω + 5 mΩ 8 μΩ/Ω + 50 mΩ 9 μΩ/Ω + 1 Ω 20 μΩ/Ω + 0.1 kΩ 0.12 mΩ/Ω + 10 kΩ 1.5 mΩ/Ω + 1 MΩ	Fluke 8508A Reference Multimeter
Inductance – Source ¹ (Fixed Artifact) (1 kHz)	50 μH 200 μH 1 mH 5 mH 10 mH 50 mH 200 mH	0.25 μH 0.5 μH 1.1 μH 5.1 μH 10 μH 50 μH 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 (1 kHz)	10 μH to 1 000 H	0.25 mH/H + 0.3 pH	GenRad 1689 Digibridge



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Oscilloscopes ¹			
Amplitude – DC into 50 Ω load	0 V 888 μV to 5.56 V -5.56 V to -888 μV	0.6 mV 0.25 mV/V + 25 μV 0.25 mV/V + 25 μV	
into 1 MΩ load	888 μV to 222.4 V -222.4 V to -888 μV	0.25 mV/V + 25 μV 0.25 mV/V + 25 μV	
Amplitude – Square Wave into 50 Ω load ≤ 10 kHz	35.52 μV to 1 mV (1 to 22) mV (22 to 556) mV 556 mV to 5.56 V 0 V	10 mV/V + 10 μV 1 mV/V + 15 μV 1 mV/V + 1 μV 0.5 mV/V + 1 μV 15 μV	
into 1 MΩ load ≤ 10 kHz	35.52 μV to 1 mV (1 to 22) mV (22 to 556) mV 556 mV to 210 V 0 V	10 mV/V + 10 μV 1 mV/V + 15 μV 1 mV/V + 1 μV 0.5 mV/V + 1 μV 15 μV	Wavetek 9500A Oscilloscope Calibrator w/ Wavetek 9520 Active Head
Amplitude – Leveled Sine Wave (into 50 Ω)	4.44 mVp-p to 5.56 Vp-p 50 kHz to 10 MHz	15 mV/V	
Time Markers	450 ps to 55 s	10 μs/s	
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 Vp-p 100 Hz to 100 MHz (100 to 550) MHz 550 MHz to 1.1 GHz	15 mV/V 30 mV/V 40 mV/V	



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Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Absolute RF Power – Measure ² Power Reference Type-N(f), 50 Ω	50 MHz 1 mW	7.8 μW	HP 432B Power Meter w/ Power Sensor
Absolute RF Power – Measure ²	(-30 to 20) dBm 10 MHz to 26.5 GHz	4.1 % of reading	HP 436A Power Meter w/ Power Sensor
Phase Modulation – Source ² (1 kHz Reference)	100 kHz to 2.12 MHz	2.6 rad	HP 8642B Signal Generator
Phase Modulation – Measure ² Rate: 200 Hz to 20 kHz	(1 to 90) rad 10 MHz to 1.3 GHz	3 % of reading	HP 8901A Modulation Analyzer
Amplitude Modulation – Measure ² Rate: 20 Hz to 10 kHz	(0.01 to 99) % Depth 150 kHz to 10 MHz	3 % of reading	HP 8901A Modulation Analyzer
Rate: 20 Hz to 100 kHz	(0.01 to 99) % Depth 150 kHz to 10 MHz	3 % of reading	
Rate: 50 Hz to 10 kHz	(5 to 99) % Depth 10 MHz to 1.3 GHz	2 % of reading	
Rate: 50 Hz to 50 kHz	(5 to 99) % Depth 10 MHz to 1.3 GHz	1 % of reading	
Frequency Modulation – Source ² Rate: (20 to 100) kHz	100 kHz to 2.12 MHz	5 % of reading + 10 Hz	HP 8642B Signal Generator
Frequency Modulation – Measure ² Rate: 20 Hz to 10 kHz	≤ 40 kHz peak 250 kHz to 10 MHz	2 % of reading	HP 8901A Modulation Analyzer
Rate: 50 Hz to 100 kHz	≤ 400 kHz peak 10 MHz to 1.3 GHz	1 % of reading	

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure Devices ¹	(-14 to 20) psig	0.009 % of reading + 0.000 1 psi	Ruska 7250XI Pressure Controller
	Up to 2 500 psig	0.01 % of reading + 0.005 psi	
Pressure Devices ¹	(1 to 10 000) psig	0.11 % of reading	Comparison to Crystal XP2i Digital Pressure Gage

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Measure ¹	(-55 to 140) °C	0.032 °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	150 kHz to 1.3 GHz	0.14 μHz/Hz + 6 Hz	HP 8901 Modulation Analyzer With HP Z3815A GPS Frequency/Time Receiver
Rotational Speed – Measure ^{1,3}	(5 to 99 999) rpm	0.18 % of reading + 0.06 rpm	Exttech 461825 Photo Tachometer/ Stroboscope
Rotational Speed – Source ^{1,3}	(55 to 40 000) rpm	0.011 % of reading + 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. rpm = revolutions per minute.
4. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1336.



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