ANSI-ASQ National Accreditation Board

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005 AND ANSI/NCSL Z540-1-1994 (R2002)

BC Group International

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CALIBRATION

Valid to: **September 19, 2020** Certificate Number: **L2299**

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Capacitance – Source			
50 Hz to 1 kHz	(0.33 to 11) nF	0.4% rdg + 0.01 nF	
50 Hz to 1 kHz	(11 to 110) nF	0.25% rdg + 0.1 nF	
50 Hz to 1 kHz	(110 to 330) nF	0.25% rdg + 0.3 nF	
50 Hz to 1 kHz	(0.33 to 1.1) µF	0.25% rdg + 1 nF	
50 Hz to 1 kHz	(1.1 to 3.3) µF	0.35% rdg + 3 nF	Fluke 5500A
(50 to 400) Hz	(3.3 to 11) µF	0.35% rdg + 10 nF	
(50 to 400) Hz	(11 to 33) µF	0.4% rdg + 30 nF	
(50 to 200) Hz	(33 to 110) µF	0.5% rdg + 100 nF	
(50 to 100) Hz	(110 to 330) µF	0.7% rdg + 300 nF	
(50 to 100) Hz	(0.33 to 1.1) mF	0.85% rdg + 300 nF	
DC Current – Source	(0 to 3.2) mA	0.11 mA/A + 0.05 µA	Fluke 5500A
	(0 to 32) mA	90 µA/A + 0.25 µA	
	(0 to 320) mA	90 µA/A + 3.35 µA	
	(0 to 2.1) A	0.28 mA/A + 44 µA	
	(0 to 11) A	0.55 mA/A + 330 µA	
DC Current – Measure	(1 to 10) µA	35 µA/A + 0.1 nA	HP 3458A
	(10 to 100) µA	35 µA/A + 0.8 nA	
	(0.1 to 1) mA	35 µA/A + 0.005 µA	
	(1 to 10) mA	35 µA/A + 0.05 µA	
	(10 to 100) mA	51 µA/A + 0.5 µA	
	(0.1 to 1) A	0.14 mA/A + 10 µA	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current – Source	(0.03 to 0.33) mA		Fluke 5500A
	(10 to 20) Hz	0.2% rdg + 0.15 µA	
	(20 to 45) Hz	0.1% rdg + 0.15 µA	
	45 Hz to 1 kHz	0.1% rdg + 0.15 µA	
	(1 to 5) kHz	0.3% rdg + 0.15 µA	
	(5 to 10) kHz	1% rdg + 0.15 µA	
	(0.33 to 3.3) mA		
	(10 to 20) Hz	0.2% rdg + 0.3 µA	
	(20 to 45) Hz	0.1% rdg + 0.3 µA	
	45 Hz to 1 kHz	0.1% rdg + 0.3 µA	
	(1 to 5) kHz	0.2% rdg + 0.3 µA	
	(5 to 10) kHz	0.6% rdg + 0.3 µA	
	(3.3 to 33) mA		
	(10 to 20) Hz	0.2% rdg + 3 µA	
	(20 to 45) Hz	0.1% rdg + 3 µA	
	45 Hz to 1 kHz	0.08% rdg + 3 µA	
	(1 to 5) kHz	0.2% rdg + 3 µA	
	(5 to 10) kHz	0.5% rdg + 3 µA	
AC Current – Source	(33 to 330) mA		Fluke 5500A
	(10 to 20) Hz	0.2% rdg + 30 µA	
	(20 to 45) Hz	0.1% rdg + 30 µA	
	45 Hz to 1 kHz	0.08% rdg + 30 µA	
	(1 to 5) kHz	0.2% rdg + 30 µA	
	(5 to 10) kHz	0.5% rdg + 30 µA	
	(0.33 to 2.2) A		
	(10 to 45) Hz	0.16% rdg + 300 µA	
	45 Hz to 1 kHz	0.08% rdg + 300 µA	
	(1 to 5) kHz	0.6% rdg + 300 µA	
	(2.2 to 11) A		
	(45 to 65) Hz	0.06% rdg + 2 mA	
	(65 to 500) Hz	0.1% rdg + 2 mA	
	500 Hz to 1 kHz	0.33% rdg + 2 mA	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current – Measure	(0 to 100) µA		HP 3458A
	(20 to 45) Hz	2.0 µA/mA + 0.03 µA	
	(45 to 100) Hz	1.1 µA/mA + 0.03 µA	
	100 Hz to 5 kHz	1.0 µA/mA + 0.03 µA	
	(0.1 to 1) mA		
	(20 to 45) Hz	2.0 µA/mA + 0.2 µA	
	(45 to 100) Hz	1.1 µA/mA + 0.2 µA	
	100 Hz to 5 kHz	0.7 µA/mA + 0.2 µA	
	(1 to 10) mA		
	(20 to 45) Hz	2.0 µA/mA + 2 µA	
	(45 to 100) Hz	1.1 µA/mA + 2 µA	
	100 Hz to 5 kHz	0.7 µA/mA + 2 µA	
	(10 to 100) mA		
	(20 to 45) Hz	2.0 µA/mA + 20 µA	
	(45 to 100) Hz	1.0 µA/mA + 20 µA	
	100 Hz to 5 kHz	0.7 µA/mA + 20 µA	
	(0.1 to 1) A		
	(20 to 45) Hz	2 µA/mA + 200 µA	
	(45 to 100) Hz	1 µA/mA + 200 µA	
	100 Hz to 5 kHz	1.3 µA/mA + 200 µA	
Resistance – Source	(0 to 11) Ω	0.01% rdg + 5 mΩ	Fluke 5500A
	(11 to 33) Ω	0.01% rdg + 0.01 Ω	
	(33 to 330) Ω	0.008% rdg + 0.01 Ω	
	330 Ω to 3.3 kΩ	0.008% rdg + 0.06 Ω	
	(3.3 to 33) kΩ	0.008% rdg + 0.6 Ω	
	(33 to 110) kΩ	0.009% rdg + 6 Ω	
	(110 to 330) kΩ	0.01% rdg + 6 Ω	
	330 kΩ to 3.3 MΩ	0.013% rdg + 55 Ω	
	(3.3 to 11) MΩ	0.05% rdg + 0.55 kΩ	
	(11 to 33) MΩ	0.09% rdg + 0.55 kΩ	
	(33 to 110) MΩ	0.4% rdg + 5.5 kΩ	
	(110 to 330) MΩ	0.4% rdg + 17 kΩ	
Resistance – Measure	(0 to 10) Ω	20 µΩ/Ω + 0.5 mΩ	HP 3458A
	(10 to 100) Ω	17 µΩ/Ω + 0.5 mΩ	
	(0.1 to 1) kΩ	15 µΩ/Ω + 0.5 mΩ	
	(1 to 10) kΩ	15 µΩ/Ω + 5 mΩ	
	(10 to 100) kΩ	16 µΩ/Ω + 0.05 Ω	
	(0.1 to 1) MΩ	21 Ω/MΩ + 2 Ω	
	(1 to 10) MΩ	57 Ω/MΩ + 100 Ω	
	(10 to 100) MΩ	600 Ω/MΩ + 1 kΩ	
	(0.1 to 1) GΩ	6 kΩ/MΩ + 10 kΩ	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
DC Voltage – Source	(0 to 330) mV (0 to 3.3) V (0 to 33) V (33 to 330) V (100 to 1 020) V	48 µV/V + 3 µV 40 µV/V + 5 µV 40 µV/V + 50 µV 48 µV/V + 0.5 mV 48 µV/V + 1.5 mV	Fluke 5500A
DC Voltage – Measure	(1 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1 000) V	16 µV/V + 0.3 µV 15 µV/V + 0.3 µV 15 µV/V + 0.5 µV 18 µV/V + 30 µV 15 µV/V + 0.1 mV	HP 3458A
	(0 to 2 000) V (2 000 to 40 000) V	0.7 mV/V + 0.4 V 1 mV/V + 8 V	Vitrek 4640A
AC Voltage – Source	(1 to 33) mV (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (33 to 330) mV (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (0.33 to 3.3) V (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (3.3 to 33) V (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	 0.32% rdg + 20 µV 0.11% rdg + 20 µV 0.18% rdg + 20 µV 0.19% rdg + 20 µV 0.3% rdg + 33 µV 0.9% rdg + 60 µV 0.25% rdg + 50 µV 0.05% rdg + 20 µV 0.1% rdg + 20 µV 0.16% rdg + 40 µV 0.24% rdg + 0.17 mV 0.7% rdg + 0.33 mV 0.15% rdg + 0.25 mV 0.03% rdg + 60 µV 0.08% rdg + 60 µV 0.14% rdg + 0.3 mV 0.24% rdg + 1.7 mV 0.5% rdg + 3.3 mV 0.12% rdg + 2.5 mV 0.04% rdg + 0.6 mV 0.08% rdg + 2.6 mV 0.15% rdg + 5 mV 0.24% rdg + 17 mV	Fluke 5500A

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Source	(33 to 330) V 45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (330 to 1 020) V 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.05% rdg + 6.6 mV 0.08% rdg + 15 mV 0.09% rdg + 33 mV 0.05% rdg + 80 mV 0.2% rdg + 0.1 V 0.2% rdg + 0.5 V	Fluke 5500A
AC Voltage – Measure	(0 to 10) mV 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (10 to 100) mV 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (0.1 to 1) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (1 to 10) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (10 to 100) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz	 365 µV/V + 1.1 µV 425 µV/V + 1.1 µV 1.5 µV/mV + 1.1 µV 200 µV/V + 2 µV 250 µV/V + 2 µV 450 µV/V + 2 µV 200 µV/V + 20 µV 230 µV/V + 20 µV 450 µV/V + 20 µV 200 µV/V + 0.2 mV 230 µV/V + 0.2 mV 450 µV/V + 0.2 mV 320 µV/V + 2 mV 320 µV/V + 2 mV 560 µV/V + 2 mV	HP 3458A
AC Voltage – Measure	(100 to 1 000) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz	 0.5 mV/V + 20 mV 0.8 mV/V + 20 mV 1.5 mV/V + 20 mV	HP 3458A
	(0 to 2 000) V (40 to 100) Hz (100 to 400) Hz (2 000 to 40 000) V (50 to 60) Hz	 11 mV/V + 2 V 14 mV/V + 4 V 8 mV/V + 60 V	Vitrek 4640A
	(0 to 1) V (0 to 10) MHz (10 to 100) MHz	 1.5 mV/V 16 mV/V	BL 1395B w/ HP 3458A

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Electrical Calibration of Thermocouple Indicating Systems-Source	Type E		Fluke 5500A
	(-250 to -100) °C	0.39 °C	
	(-100 to -25) °C	0.13 °C	
	(-25 to 350) °C	0.11 °C	
	(350 to 650) °C	0.13 °C	
	(650 to 1 000) °C	0.17 °C	
	Type J		
	(-210 to -100) °C	0.16 °C	
	(-100 to -30) °C	0.13 °C	
	(-30 to 150) °C	0.12 °C	
	(150 to 760) °C	0.14 °C	
	(760 to 1 200) °C	0.18 °C	
	Type K		
	(-200 to -100) °C	0.26 °C	
	(-100 to 125) °C	0.15 °C	
	(125 to 120) °C	0.13 °C	
	(120 to 1 000) °C	0.21 °C	
	(1 000 to 1 372) °C	0.32 °C	
	Type R		
	(0 to 250) °C	0.45 °C	
	(250 to 400) °C	0.29 °C	
	(400 to 1 000) °C	0.28 °C	
	(1 000 to 1 767) °C	0.31 °C	
	Type S		
	(0 to 250) °C	0.37 °C	
	(250 to 1 000) °C	0.3 °C	
	(1 000 to 1 400) °C	0.31 °C	
	(1 400 to 1 767) °C	0.31 °C	
	Type T		
	(-250 to -150) °C	0.5 °C	
	(-150 to 0) °C	0.2 °C	
	(0 to 120) °C	0.13 °C	
	(120 to 400) °C	0.12 °C	

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Amplitude – DC			Fluke 5500A w/ SC300
50 Ω	(-2.2 to 2.2) V	0.21% rdg + 0.1 mV	
1 MΩ	(-33 to 33) V	0.2% rdg + 0.1 mV	
Amplitude – Square Wave			
50 Ω	1.8 mV to 2.2 V (p-p)	0.23% rdg + 0.1 mV	
1 MΩ	1.8 mV to 105 V (p-p)	0.28% rdg + 0.1 mV	
Leveled Sine Wave	50 kHz reference	1.8% rdg + 0.2 mV	
Amplitude	50 kHz to 100 MHz	3.4% rdg + 0.3 mV	
	(100 to 300) MHz	3.6% rdg + 0.3 mV	
Flatness	50 kHz to 100 MHz	1.8% rdg + 0.1 mV	
	(100 to 300) MHz	2% rdg + 0.1 mV	
Time Marker [2]	5 s to 100 µs	(20 + 1 000*t*) µs/s	
	(50 to 2) µs	(20 + 15 000*t*) µs/s	
	1 µs to 2 ns	20 µs/s	

Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Force – Measure	(0 to 100) lbf	0.2 lbf	Chatillon DFS2-100
Pressure – Measure	(-0.3 to 0.3) psi	0.000 05 psi	Mensor APC600
	(-5 to 5) psi	0.000 59 psi	
	(-10 to 10) psi	0.001 2 psi	
	(-14.7 to 75) psi	0.008 8 psi	
	(-14.7 to 100) psi	0.012 psi	
Torque – Measure	(4 to 50) lbf·in	0.4 % of reading	Snap On Versatest w/ TTC400 Transducer
	(30 to 400) lbf·in	0.4 % of reading	
	(80 to 1 000) lbf·in	0.4 % of reading	
	(20 to 250) lbf·ft	0.4 % of reading	

Time and Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Frequency – Source	0.01 Hz to 12 kHz 12 kHz to 120 kHz 120 kHz to 1.2 MHz 1.2 MHz to 2 MHz	63 µHz/Hz + 1 mHz 70 µHz/Hz + 15 mHz 62 µHz/Hz + 15 mHz 290 µHz/Hz + 15 mHz	Fluke 5500A
Frequency – Measure	(1 to 40) Hz 40 Hz to 10 MHz	0.6 mHz/Hz 0.2 mHz/Hz	HP 3458A

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. This scope is formatted as part of a single document including Certificate of Accreditation No. L2299.

Vice President