

# Scope of Accreditation For BC Group International, Inc.

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In recognition of a successful assessment to ISO/IEC 17025:2005 and ANSI Z540-1:1994 (R2002) to the following Calibration and Measurement Capabilities, accreditation has been granted to **BC Group International, Inc.** for the following:

Accreditation granted through: **September 19, 2017**

## Calibration

### Electrical – Capacitance

Calibration Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Remarks
Capacitance – Source			Fluke 5500A
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) $\mu$ F	0.25% rdg + 1 nF	
50 Hz to 1 kHz	(1.1 to 3.3) $\mu$ F	0.35% rdg + 3 nF	
(50 to 400) Hz	(3.3 to 11) $\mu$ F	0.35% rdg + 10 nF	
(50 to 400) Hz	(11 to 33) $\mu$ F	0.4% rdg + 30 nF	
(50 to 200) Hz	(33 to 110) $\mu$ F	0.5% rdg + 100 nF	
(50 to 100) Hz	(110 to 330) $\mu$ F	0.7% rdg + 300 nF	
(50 to 100) Hz	(0.33 to 1.1) mF	0.85% rdg + 300 nF	

### Electrical – Current

Calibration Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Remarks
DC Current – Source	(0 to 3.2) mA	0.11 mA/A + 0.05 $\mu$ A	Fluke 5500A
	(0 to 32) mA	90 $\mu$ A/A + 0.25 $\mu$ A	
	(0 to 320) mA	90 $\mu$ A/A + 3.35 $\mu$ A	
	(0 to 2.1) A	0.28 mA/A + 44 $\mu$ A	
	(0 to 11) A	0.55 mA/A + 330 $\mu$ A	

Calibration Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Remarks		
DC Current – Measure	(1 to 10) $\mu$ A	35 $\mu$ A/A + 0.1 nA	HP 3458A		
	(10 to 100) $\mu$ A	35 $\mu$ A/A + 0.8 nA			
	(0.1 to 1) mA	35 $\mu$ A/A + 0.005 $\mu$ A			
	(1 to 10) mA	35 $\mu$ A/A + 0.05 $\mu$ A			
	(10 to 100) mA	51 $\mu$ A/A + 0.5 $\mu$ A			
	(0.1 to 1) A	0.14 mA/A + 10 $\mu$ A			
AC Current – Source	(0.03 to 0.33) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.2% rdg + 0.15 $\mu$ A 0.1% rdg + 0.15 $\mu$ A 0.1% rdg + 0.15 $\mu$ A 0.3% rdg + 0.15 $\mu$ A 1% rdg + 0.15 $\mu$ A	Fluke 5500A		
	(0.33 to 3.3) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.2% rdg + 0.3 $\mu$ A 0.1% rdg + 0.3 $\mu$ A 0.1% rdg + 0.3 $\mu$ A 0.2% rdg + 0.3 $\mu$ A 0.6% rdg + 0.3 $\mu$ A			
	(3.3 to 33) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.2% rdg + 3 $\mu$ A 0.1% rdg + 3 $\mu$ A 0.08% rdg + 3 $\mu$ A 0.2% rdg + 3 $\mu$ A 0.5% rdg + 3 $\mu$ A			
	(33 to 330) mA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.2% rdg + 30 $\mu$ A 0.1% rdg + 30 $\mu$ A 0.08% rdg + 30 $\mu$ A 0.2% rdg + 30 $\mu$ A 0.5% rdg + 30 $\mu$ A			
	(0.33 to 2.2) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz	0.16% rdg + 300 $\mu$ A 0.08% rdg + 300 $\mu$ A 0.6% rdg + 300 $\mu$ A			
	(2.2 to 11) A (45 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz	0.06% rdg + 2 mA 0.1% rdg + 2 mA 0.33% rdg + 2 mA			
	AC Current – Measure	(0 to 100) $\mu$ A (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz		1.9 $\mu$ A/mA + 0.03 $\mu$ A 1 $\mu$ A/mA + 0.03 $\mu$ A 0.9 $\mu$ A/mA + 0.03 $\mu$ A	HP 3458A
		(0.1 to 1) mA (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz		1.9 $\mu$ A/mA + 0.2 $\mu$ A 1 $\mu$ A/mA + 0.2 $\mu$ A 0.6 $\mu$ A/mA + 0.2 $\mu$ A	

Calibration Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Remarks
AC Current – Measure	(1 to 10) mA (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	1.9 $\mu$ A/mA + 2 $\mu$ A 1.0 $\mu$ A/mA + 2 $\mu$ A 0.6 $\mu$ A/mA + 2 $\mu$ A	HP 3458A
	(10 to 100) mA (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	1.9 $\mu$ A/mA + 20 $\mu$ A 0.9 $\mu$ A/mA + 20 $\mu$ A 0.6 $\mu$ A/mA + 20 $\mu$ A	
	(0.1 to 1) A (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	2 $\mu$ A/mA + 200 $\mu$ A 1 $\mu$ A/mA + 200 $\mu$ A 1.3 $\mu$ A/mA + 200 $\mu$ A	

**Electrical – Resistance**

Calibration Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Remarks
Resistance – Source	(0 to 11) $\Omega$	0.01% rdg + 5 m $\Omega$	Fluke 5500A
	(11 to 33) $\Omega$	0.01% rdg + 0.01 $\Omega$	
	(33 to 330) $\Omega$	0.008% rdg + 0.01 $\Omega$	
	330 $\Omega$ to 3.3 k $\Omega$	0.008% rdg + 0.06 $\Omega$	
	(3.3 to 33) k $\Omega$	0.008% rdg + 0.6 $\Omega$	
	(33 to 110) k $\Omega$	0.009% rdg + 6 $\Omega$	
	(110 to 330) k $\Omega$	0.01% rdg + 6 $\Omega$	
	330 k $\Omega$ to 3.3 M $\Omega$	0.013% rdg + 55 $\Omega$	
	(3.3 to 11) M $\Omega$	0.05% rdg + 0.55 k $\Omega$	
	(11 to 33) M $\Omega$	0.09% rdg + 0.55 k $\Omega$	
	(33 to 110) M $\Omega$	0.4% rdg + 5.5 k $\Omega$	
	(110 to 330) M $\Omega$	0.4% rdg + 17 k $\Omega$	
Resistance – Measure	(0 to 10) $\Omega$	20 $\mu\Omega/\Omega$ + 0.5 m $\Omega$	HP 3458A
	(10 to 100) $\Omega$	17 $\mu\Omega/\Omega$ + 0.5 m $\Omega$	
	(0.1 to 1) k $\Omega$	15 $\mu\Omega/\Omega$ + 0.5 m $\Omega$	
	(1 to 10) k $\Omega$	15 $\mu\Omega/\Omega$ + 5 m $\Omega$	
	(10 to 100) k $\Omega$	16 $\mu\Omega/\Omega$ + 0.05 $\Omega$	
	(0.1 to 1) M $\Omega$	21 $\Omega/M\Omega$ + 2 $\Omega$	
	(1 to 10) M $\Omega$	57 $\Omega/M\Omega$ + 100 $\Omega$	
	(10 to 100) M $\Omega$	600 $\Omega/M\Omega$ + 1 k $\Omega$	
(0.1 to 1) G $\Omega$	6 k $\Omega/M\Omega$ + 10 k $\Omega$		

**Electrical – Voltage**

Calibration Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Remarks
DC Voltage – Source	(0 to 330) mV	48 $\mu$ V/V + 3 $\mu$ V	Fluke 5500A
	(0 to 3.3) V	40 $\mu$ V/V + 5 $\mu$ V	
	(0 to 33) V	40 $\mu$ V/V + 50 $\mu$ V	
	(33 to 330) V	48 $\mu$ V/V + 0.5 mV	
	(100 to 1 020) V	48 $\mu$ V/V + 1.5 mV	
DC Voltage – Measure	(1 to 100) mV	15 $\mu$ V/V + 0.3 $\mu$ V	HP 3458A
	(0.1 to 1) V	14 $\mu$ V/V + 0.3 $\mu$ V	
	(1 to 10) V	14 $\mu$ V/V + 0.5 $\mu$ V	
	(10 to 100) V	17 $\mu$ V/V + 30 $\mu$ V	
	(100 to 1 000) V	15 $\mu$ V/V + 0.1 mV	
	(0 to 2 000) V	0.7 mV/V + 0.4 V	Vitretek 4640A
	(2 000 to 40 000) V	1 mV/V + 8 V	
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	0.32% rdg + 20 $\mu$ V 0.11% rdg + 20 $\mu$ V 0.18% rdg + 20 $\mu$ V 0.19% rdg + 20 $\mu$ V 0.3% rdg + 33 $\mu$ V 0.9% rdg + 60 $\mu$ V	Fluke 5500A
	(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	0.25% rdg + 50 $\mu$ V 0.05% rdg + 20 $\mu$ V 0.1% rdg + 20 $\mu$ V 0.16% rdg + 40 $\mu$ V 0.24% rdg + 0.17 mV 0.7% rdg + 0.33 mV	
	(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	0.15% rdg + 0.25 mV 0.03% rdg + 60 $\mu$ V 0.08% rdg + 60 $\mu$ V 0.14% rdg + 0.3 mV 0.24% rdg + 1.7 mV 0.5% rdg + 3.3 mV	
	(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	0.12% 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	
	(33 to 330) V 45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz	0.05% rdg + 6.6 mV 0.08% rdg + 15 mV 0.09% rdg + 33 mV	
	(330 to 1 020) V 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.05% rdg + 80 mV 0.2% rdg + 0.1 V 0.2% rdg + 0.5 V	

Calibration Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Remarks		
AC Voltage – Measure	(0 to 10) mV 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz	365 $\mu$ V/V + 1.1 $\mu$ V 425 $\mu$ V/V + 1.1 $\mu$ V 1.5 $\mu$ V/mV + 1.1 $\mu$ V	HP 3458A		
	(10 to 100) mV 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz	130 $\mu$ V/V + 2 $\mu$ V 220 $\mu$ V/V + 2 $\mu$ V 430 $\mu$ V/V + 2 $\mu$ V			
	(0.1 to 1) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz	130 $\mu$ V/V + 20 $\mu$ V 200 $\mu$ V/V + 20 $\mu$ V 430 $\mu$ V/V + 20 $\mu$ V			
	(1 to 10) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz	130 $\mu$ V/V + 0.2 mV 200 $\mu$ V/V + 0.2 mV 430 $\mu$ V/V + 0.2 mV			
	(10 to 100) V 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz	290 $\mu$ V/V + 2 mV 290 $\mu$ V/V + 2 mV 490 $\mu$ V/V + 2 mV			
	(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			
	(0 to 2 000) V (40 to 100) Hz (100 to 400) Hz	11 mV/V + 2 V 14 mV/V + 4 V		Vitretek 4640A	
	(2 000 to 40 000) V (50 to 60) Hz	8 mV/V + 60 V			
		(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 Calibration of Thermocouple Indicating Systems-Source			
Type E	(-250 to -100) °C	0.39 °C	Fluke 5500A		
	(-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			

Calibration Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Remarks
Type K	(-200 to -100) °C	0.26 °C	Fluke 5500A
	(-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	

**Mass – Force**

Calibration Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Remarks
Force – Measure	(0 to 100) lbf	0.2 lbf	Chatillon DFS2-100

**Mass – Pressure / Low Vacuum**

Calibration Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Remarks
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	

**Mass – Torque**

Calibration Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Remarks
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 – Frequency / Period**

Calibration Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Remarks
Frequency – Source	0.01 Hz to 12 kHz	63 $\mu$ Hz/Hz + 1 mHz	Fluke 5500A
	12 kHz to 120 kHz	70 $\mu$ Hz/Hz + 15 mHz	
	120 kHz to 1.2 MHz	62 $\mu$ Hz/Hz + 15 mHz	
	1.2 MHz to 2 MHz	290 $\mu$ Hz/Hz + 15 mHz	
Frequency – Measure	(1 to 40) Hz	0.6 mHz/Hz	HP 3458A
	40 Hz to 10 MHz	0.2 mHz/Hz	

**Time and Frequency – Oscilloscopes**

Calibration Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Remarks
Amplitude – DC 50 $\Omega$	(-2.2 to 2.2) V	0.21% rdg + 0.1 mV	Fluke 5500A w/ SC300
	1 M $\Omega$	(-33 to 33) V	
Amplitude – Square Wave 50 $\Omega$	1.8 mV to 2.2 V (p-p)	0.23% rdg + 0.1 mV	
	1 M $\Omega$	1.8 mV to 105 V (p-p)	
Leveled Sine Wave	50 kHz reference	1.8% rdg + 0.2 mV	Fluke 5500A w/ SC300
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 <sup>2</sup>	5 s to 100 $\mu$ s	(20 + 1 000t) $\mu$ s/s	
	(50 to 2) $\mu$ s	(20 + 15 000t) $\mu$ s/s	
	1 $\mu$ s to 2 ns	20 $\mu$ s/s	

Calibration and Measurement Capability (CMC) is expressed in terms of the measurement parameter, measurement range, expanded uncertainty of measurement and remarks. 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) Laboratory offers calibration services at the laboratory's own facilities and at the client or other agreed upon facilities.
- 2)  $t$  = time in seconds

Approved by:   
R. Douglas Leonard  
Chief Technical Officer

Date: September 21, 2016