



# CERTIFICATE OF ACCREDITATION

## ANSI-ASQ National Accreditation Board

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

**Wintronics, Inc.**  
**50 Division Ave**  
**Millington, NJ 07946**

has been assessed by ANAB  
and meets the requirements of international standard

**ISO/IEC 17025:2005**

while demonstrating technical competence in the field of

**CALIBRATION**

Refer to the accompanying Scope of Accreditation for information regarding the types of calibrations to which this accreditation applies.

AC-1656  
Certificate Number

  
ANAB Approval

Certificate Valid: 03/16/2018-04/26/2020  
Version No. 005 Issued: 03/16/2018



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005**

**Wintronics, Inc.**  
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**CALIBRATION**

Valid to: **April 26, 2020**

Certificate Number: **AC-1656**

**Electrical – DC/Low Frequency**

| Parameter/Equipment                   | Range                 | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment  |
|---------------------------------------|-----------------------|---|---|
| DC Voltage - Source                   | Up to 220 mV          | 9.1 $\mu$ V/V + 0.4 $\mu$ V               | Fluke 5720A Multiproduct Calibrator           |
|                                       | 220 mV to 2.2 V       | 5.9 $\mu$ V/V + 0.7 $\mu$ V               |   |
|                                       | (2 to 11) V           | 4.1 $\mu$ V/V + 2.5 $\mu$ V               |   |
|                                       | (11 to 22) V          | 4.1 $\mu$ V/V + 4 $\mu$ V                 |   |
|                                       | (22 to 220) V         | 5.9 $\mu$ V/V + 40 $\mu$ V                |   |
|                                       | 220 V to 1.1 kV       | 8.5 $\mu$ V/V + 0.4 mV                    |   |
| DC Voltage - Measure                  | Up to 100 mV          | 6.2 $\mu$ V/V + 1 $\mu$ V                 | Agilent 3458A Opt 002 Multimeter              |
|                                       | 100 mV to 1 V         | 4.6 $\mu$ V/V + 1 $\mu$ V                 |   |
|                                       | (1 to 10) V           | 4.6 $\mu$ V/V + 2 $\mu$ V                 |   |
|                                       | (10 to 100) V         | 7.2 $\mu$ V/V + 30 $\mu$ V                |   |
|                                       | 100 V to 1.1 kV       | 19 $\mu$ V/V + 0.1 mV                     |   |
| DC Current - Source                   | Up to 220 $\mu$ A     | 48 $\mu$ A/A + 6 nA                       | Fluke 5720A Multiproduct Calibrator           |
|                                       | 220 $\mu$ A to 2.2 mA | 42 $\mu$ A/A + 7 nA                       |   |
|                                       | (2.2 to 22) mA        | 42 $\mu$ A/A + 40 nA                      |   |
|                                       | (22 to 100) mA        | 55 $\mu$ A/A + 0.7 $\mu$ A                |   |
|                                       | (100 to 220) mA       | 65 $\mu$ A/A + 0.7 $\mu$ A                |   |
|                                       | 220 mA to 1A          | 0.14 mA/A + 1.2 $\mu$ A                   |   |
|                                       | (1 to 2.2) A          | 0.15 mA/A + 1.2 $\mu$ A                   |   |
|                                       | (2.2 to 11) A         | 7 mA/A + 0.33 mA                          | Fluke 5500A Multiproduct Calibrator           |
| DC Current - Source Clamp-on Ammeters | (10 to 500) A         | 18 mA/A + 0.52 A                          | Fluke 5500A Multiproduct Calibrator with Coil |



Electrical – DC/Low Frequency

| Parameter/Equipment  | Range   | Expanded Uncertainty of Measurement (+/-)  | Reference Standard, Method, and/or Equipment   |
|----------------------|---|--|--|
| DC Current - Measure | Up to 100 $\mu$ A<br>100 $\mu$ A to 1 mA<br>(1 to 10) mA<br>(10 to 100) mA<br>100 mA to 1 A   | 23 $\mu$ A/A + 0.8 nA<br>23 $\mu$ A/A + 5 nA<br>23 $\mu$ A/A + 50 nA<br>41 $\mu$ A/A + 0.5 $\mu$ A<br>0.13 mA/A + 10 $\mu$ A   | Agilent 3458A Multimeter                       |
|                      | (1 to 10) A   | 0.15 mA/A  | Agilent 3458A Multimeter,<br>Fluke Y5020 Shunt |
| AC Voltage - Source  | Up to 2.2 mV<br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1MHz<br>(2.2 to 22) mV<br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1MHz<br>(22 to 220) mV<br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 20 kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>(300 to 500) kHz<br>500 kHz to 1MHz | 1.1 mV/V + 4 $\mu$ V<br>0.89 mV/V + 4 $\mu$ V<br>0.91 mV/V + 4 $\mu$ V<br>0.94 mV/V + 4 $\mu$ V<br>1.6 mV/V + 5 $\mu$ V<br>2.5 mV/V + 10 $\mu$ V<br>3.6 mV/V + 20 $\mu$ V<br>6.3 mV/V + 20 $\mu$ V<br>0.33 mV/V + 4 $\mu$ V<br>0.21 mV/V + 4 $\mu$ V<br>0.21 mV/V + 4 $\mu$ V<br>0.27 mV/V + 4 $\mu$ V<br>0.55 mV/V + 5 $\mu$ V<br>1.3 mV/V + 10 $\mu$ V<br>1.7 mV/V + 20 $\mu$ V<br>3.2 mV/V + 20 $\mu$ V<br>0.28 mV/V + 12 $\mu$ V<br>0.12 mV/V + 7 $\mu$ V<br>99 $\mu$ V/V + 7 $\mu$ V<br>0.24 mV/V + 7 $\mu$ V<br>0.54 mV/V + 17 $\mu$ V<br>0.95 mV/V + 20 $\mu$ V<br>1.6 mV/V + 25 $\mu$ V<br>3.2 mV/V + 45 $\mu$ V | Fluke 5720A Multiproduct<br>Calibrator         |



Electrical – DC/Low Frequency

| Parameter/Equipment | Range                 | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|---------------------|-----------------------|---|--|
| AC Voltage - Source | 220 mV to 2.2 V       |   | Fluke 5720A Multiproduct Calibrator          |
|                     | (10 to 20) Hz         | 0.28 mV/V + 40 $\mu$ V                    |  |
|                     | (20 to 40) Hz         | 0.11 mV/V + 15 $\mu$ V                    |  |
|                     | 40 Hz to 20 kHz       | 59 $\mu$ V/V + 8 $\mu$ V                  |  |
|                     | (20 to 50) kHz        | 91 $\mu$ V/V + 10 $\mu$ V                 |  |
|                     | (50 to 100) kHz       | 0.13 mV/V + 30 $\mu$ V                    |  |
|                     | (100 to 300) kHz      | 0.49 mV/V + 80 $\mu$ V                    |  |
|                     | (300 to 500) kHz      | 1.2 mV/V + 0.2 mV                         |  |
|                     | 500 kHz to 1MHz       | 2 mV/V + 0.3 mV                           |  |
|                     | (2.2 to 22) V         |   |  |
|                     | (10 to 20) Hz         | 0.28 mV/V + 0.4 mV                        |  |
|                     | (20 to 40) Hz         | 0.11 mV/V + 0.15 mV                       |  |
|                     | 40 Hz to 20 kHz       | 59 $\mu$ V/V + 50 $\mu$ V                 |  |
|                     | (20 to 50) kHz        | 92 $\mu$ V/V + 0.1 mV                     |  |
|                     | (50 to 100) kHz       | 0.12 mV/V + 0.2 mV                        |  |
|                     | (100 to 300) kHz      | 0.32 mV/V + 0.6 mV                        |  |
|                     | (300 to 500) kHz      | 1.2 mV/V + 2 mV                           |  |
|                     | 500 kHz to 1MHz       | 1.7 mV/V + 3.2 mV                         |  |
|                     | (22 to 220) V         |   |  |
|                     | (10 to 20) Hz         | 0.28 mV/V + 4 mV                          |  |
|                     | (20 to 40) Hz         | 0.11 mV/V + 1.5 mV                        |  |
| 40 Hz to 20 kHz     | 67 $\mu$ V/V + 0.6 mV |   |  |
| (20 to 50) kHz      | 96 $\mu$ V/V + 1 mV   |   |  |
| (50 to 100) kHz     | 0.18 mV/V + 2.5 mV    |   |  |
| (100 to 300) kHz    | 1 mV/V + 16 mV        |   |  |
| (300 to 500) kHz    | 5.1 mV/V + 40 mV      |   |  |
| 500 kHz to 1MHz     | 8.4 mV/V + 80 mV      |   |  |
| (220 to 250) V      |                       |   |  |
| (15 to 50) Hz       | 0.37 mV/V + 16 mV     |   |  |
| 50 Hz to 1 kHz      | 96 $\mu$ V/V + 3.5 mV |   |  |
| 250 V to 1.1 kV     |                       |   |  |
| 50 Hz to 1 kHz      | 96 $\mu$ V/V + 3.5 mV |   |  |



Electrical – DC/Low Frequency

| Parameter/Equipment  | Range              | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|----------------------|--------------------|---|--|
| AC Voltage - Measure | (1 to 10) mV       |   | Agilent 3458A Multimeter                     |
|                      | (1 to 40) Hz       | 0.35 mV/V + 3 μV                          |  |
|                      | 40 Hz to 1 kHz     | 0.25 mV/V + 1.1 μV                        |  |
|                      | (1 to 20) kHz      | 0.4 mV/V + 1.1 μV                         |  |
|                      | (20 to 50) kHz     | 1.2 mV/V + 1.1 μV                         |  |
|                      | (50 to 100) kHz    | 6.3 mV/V + 1.1 μV                         |  |
|                      | (100 to 300) kHz   | 50 mV/V + 2 μV                            |  |
|                      | (10 to 100) mV     |   |  |
|                      | (1 to 40) Hz       | 0.1 mV/V + 4 μV                           |  |
|                      | 40 Hz to 1 kHz     | 0.1 mV/V + 2 μV                           |  |
|                      | (1 to 20) kHz      | 0.17 mV/V + 2 μV                          |  |
|                      | (20 to 50) kHz     | 0.35 mV/V + 2 μV                          |  |
|                      | (50 to 100) kHz    | 1.1 mV/V + 2 μV                           |  |
|                      | (100 to 300) kHz   | 4.6 mV/V + 10 μV                          |  |
|                      | 300 kHz to 1 MHz   | 13 mV/V + 10 μV                           |  |
|                      | 1MHz-2MHz          | 18 mV/V + 10 μV                           |  |
|                      | 100 mV to 1 V      |   |  |
|                      | (1 to 40) Hz       | 95 μV/V + 40 μV                           |  |
|                      | 40 Hz to 1 kHz     | 94 μV/V + 20 μV                           |  |
|                      | (1 to 20) kHz      | 0.17 mV/V + 20 μV                         |  |
|                      | (20 to 50) kHz     | 0.35 mV/V + 20 μV                         |  |
|                      | (50 to 100) kHz    | 0.93 mV/V + 20 μV                         |  |
|                      | (100 to 300) kHz   | 3.6 mV/V + 0.1 mV                         |  |
|                      | 300 kHz to 1 MHz   | 12 mV/V + 0.1 mV                          |  |
|                      | (1 to 2) MHz       | 18 mV/V + 0.1 mV                          |  |
|                      | (1 to 10) V        |   |  |
|                      | (1 to 40) Hz       | 95 μV/V + 0.4 mV                          |  |
| 40 Hz to 1 kHz       | 95 μV/V + 0.2 mV   |   |  |
| (1 to 20) kHz        | 0.17 mV/V + 0.2 mV |   |  |
| (20 to 50) kHz       | 0.35 mV/V + 0.2 mV |   |  |
| (50 to 100) kHz      | 1 mV/V + 0.2 mV    |   |  |
| (100 to 300) kHz     | 4 mV/V + 1 mV      |   |  |
| 300 kHz to 1 MHz     | 12 mV/V + 1 mV     |   |  |
| (1 to 2) MHz         | 18 mV/V + 1 mV     |   |  |



Electrical – DC/Low Frequency

| Parameter/Equipment                              | Range               | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--|---------------------|---|--|
| AC Voltage - Measure                             | (10 to 100) V       |   | Agilent 3458A Multimeter                     |
|  | (1 to 40) Hz        | 0.24 mV/V + 4 mV                          |  |
|  | 40 Hz to 1 kHz      | 0.24 mV/V + 2 mV                          |  |
|  | (1 to 20) kHz       | 0.23 mV/V + 2 mV                          |  |
|  | (20 to 50) kHz      | 0.41 mV/V + 2 mV                          |  |
|  | (50 to 100) kHz     | 1.4 mV/V + 2 mV                           |  |
|  | (100 to 300) kHz    | 4.6 mV/V + 10 mV                          |  |
|  | 300 kHz to 1 MHz    | 17 mV/V + 10 mV                           |  |
|  | (100 to 700) V      |   |  |
|  | (1 to 40) Hz        | 0.47 mV/V + 40 mV                         |  |
|  | 40 Hz to 1 kHz      | 0.47 mV/V + 20 mV                         |  |
|  | (1 to 20) kHz       | 0.7 mV/V + 20 mV                          |  |
|  | (20 to 50) kHz      | 0.14 mV/V + 20 mV                         |  |
|  | (50 to 100) kHz     | 0.35 mV/V + 20 mV                         |  |
| Electrical Simulation of Thermocouple Indicators | Type J              |   | Fluke 5500A-SC600 Multiproduct Calibrator    |
|  | (-210 to -100) °C   | 0.32 °C                                   |  |
|  | (-100 to -30) °C    | 0.19 °C                                   |  |
|  | (-30 to 150) °C     | 0.2 °C                                    |  |
|  | (150 to 760) °C     | 0.23 °C                                   |  |
|  | (760 to 1 200) °C   | 0.27 °C                                   |  |
|  | Type K              |   |  |
|  | (-200 to -100) °C   | 0.39 °C                                   |  |
|  | (-100 to -25) °C    | 0.22 °C                                   |  |
|  | (-25 to 120) °C     | 0.22 °C                                   |  |
|  | (120 to 1 000) °C   | 0.31 °C                                   |  |
|  | (1 000 to 1 372) °C | 0.47 °C                                   |  |
|  | Type T              |   |  |
|  | (-250 to -150) °C   | 0.73 °C                                   |  |
|  | (-150 to 0) °C      | 0.28 °C                                   |  |
|  | (0 to 120) °C       | 0.19 °C                                   |  |
|  | (120 to 400) °C     | 0.18 °C                                   |  |
|  | Type R              |   |  |
|  | (0 to 250) °C       | 0.88 °C                                   |  |
|  | (250 to 400) °C     | 0.71 °C                                   |  |
| (400 to 1 000) °C                                | 0.69 °C             |   |  |
| (1 000 to 1 767) °C                              | 0.74 °C             |   |  |



Electrical – DC/Low Frequency

| Parameter/Equipment                              | Range   | Expanded Uncertainty of Measurement (+/-)   | Reference Standard, Method, and/or Equipment |  |  |
|--|---|---|--|--|--|
| Electrical Simulation of Thermocouple Indicators | Type S<br>(0 to 250) °C<br>(250 to 1 000) °C<br>(1 000 to 1 400) °C<br>(1 400 to 1 767) °C            | 0.79 °C<br>0.71 °C<br>0.7 °C<br>0.79 °C   | Fluke 5500A-SC600<br>Multiproduct Calibrator |  |  |
| AC Current - Source                              | (22 to 220) µA<br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz   | 0.3 mA/A + 16 nA<br>0.19 mA/A + 10 nA<br>0.15 mA/A + 8 nA<br>0.38 mA/A + 12 nA<br>1.4 mA/A + 65 nA      | Fluke 5720A Multiproduct<br>Calibrator       |  |  |
|  | 220 µA to 2.2 mA<br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz | 0.35 mA/A + 50 nA<br>0.24 mA/A + 40 nA<br>0.17 mA/A + 40 nA<br>0.29 mA/A + 0.13 µA<br>1.5 mA/A + 0.8 µA |  |  |  |
|  | (2.2 to 22) mA<br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz   | 0.35 mA/A + 0.5 µA<br>0.24 mA/A + 0.4 µA<br>0.17 mA/A + 0.4 µA<br>0.29 mA/A + 0.7 µA<br>1.5 mA/A + 6 µA |  |  |  |
|  | (22 to 220) mA<br>(10 to 20) Hz<br>(20 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz   | 0.35 mA/A + 5 µA<br>0.24 mA/A + 4 µA<br>0.17 mA/A + 3 µA<br>0.28 mA/A + 4 µA<br>1.5 mA/A + 12 µA        |  |  |  |
|  | 220 mA to 2.2 A<br>20 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                    | 0.31 mA/A + 35 µA<br>0.6 mA/A + 0.1 mA<br>8.5 mA/A + 0.2 mA   |  |  |  |
|  | (2.2 to 11) A<br>(45 to 65) Hz<br>(65 to 500) Hz<br>500Hz-1kHz  | 0.72 mA/A + 2 mA<br>1.2 mA/A + 2 mA<br>3.8 mA/A + 2 mA  |  | Fluke 5500A Multiproduct<br>Calibrator |  |
|  | AC Current - Source<br>Clamp-on Ammeters  | (11 to 500) A<br>(45 to 65) Hz  |  | 14 mA/A + 0.8 A                        | Fluke 5500A Multiproduct<br>Calibrator with Coil |





Electrical – DC/Low Frequency

| Parameter/Equipment  | Range                  | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|----------------------|------------------------|---|--|
| AC Current - Measure | (10 to 100) $\mu$ A    |   | Agilent 3458A Multimeter                     |
|                      | (10 to 20) Hz          | 4.6 mA/A + 20 nA                          |  |
|                      | (20 to 45) Hz          | 1.8 mA/A + 20 nA                          |  |
|                      | 45 Hz to 1 kHz         | 0.74 mA/A + 20 nA                         |  |
|                      | 100 $\mu$ A to 1 mA    |   |  |
|                      | (10 to 20) Hz          | 4.6 mA/A + 0.2 $\mu$ A                    |  |
|                      | (20 to 45) Hz          | 1.7 mA/A + 0.2 $\mu$ A                    |  |
|                      | (45 to 100) Hz         | 0.72 mA/A + 0.2 $\mu$ A                   |  |
|                      | 100 Hz to 5 kHz        | 0.41 mA/A + 0.2 $\mu$ A                   |  |
|                      | (5 to 20) kHz          | 0.72 mA/A + 0.2 $\mu$ A                   |  |
|                      | (1 to 10) mA           |   |  |
|                      | (10 to 20) Hz          | 4.6 mA/A + 2 $\mu$ A                      |  |
|                      | (20 to 45) Hz          | 1.7 mA/A + 2 $\mu$ A                      |  |
|                      | (45 to 100) Hz         | 0.72 mA/A + 2 $\mu$ A                     |  |
|                      | 100 Hz to 5 kHz        | 0.4 mA/A + 2 $\mu$ A                      |  |
|                      | (5 to 20) kHz          | 0.72 mA/A + 2 $\mu$ A                     |  |
|                      | (10 to 100) mA         |   |  |
|                      | (10 to 20) Hz          | 4.6 mA/A + 20 $\mu$ A                     |  |
|                      | (20 to 45) Hz          | 1.7 mA/A + 20 $\mu$ A                     |  |
|                      | (45 to 100) Hz         | 0.74 mA/A + 20 $\mu$ A                    |  |
|                      | 100 Hz to 5 kHz        | 0.43 mA/A + 20 $\mu$ A                    |  |
| (5 to 20) kHz        | 0.74 mA/A + 20 $\mu$ A |   |  |
| 100 mA to 1 A        |                        |   |  |
| (10 to 20) Hz        | 4.6 mA/A + 0.2 mA      |   |  |
| (20 to 45) Hz        | 1.9 mA/A + 0.2 mA      |   |  |
| (45 to 100) Hz       | 0.94 mA/A + 0.2 mA     |   |  |
| 100 Hz to 5 kHz      | 1.2 mA/A + 0.2 mA      |   |  |
| (5 to 20) kHz        | 3.5 mA/A + 0.2 mA      |   |  |





Electrical – DC/Low Frequency

| Parameter/Equipment                 | Range            | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|-------------------------------------|------------------|---|--|
| Resistance - Source<br>Fixed Values | 1 Ω              | 0.12 mΩ/Ω                                 | Fluke 5720A Multiproduct<br>Calibrator       |
|                                     | 1.9 Ω            | 0.14 mΩ/Ω                                 |  |
|                                     | 10 Ω             | 31 μΩ/Ω                                   |  |
|                                     | 19 Ω             | 33 μΩ/Ω                                   |  |
|                                     | 100 Ω            | 13 μΩ/Ω                                   |  |
|                                     | 190 Ω            | 12 μΩ/Ω                                   |  |
|                                     | 1 kΩ             | 9.9 μΩ/Ω                                  |  |
|                                     | 1.9 kΩ           | 10 μΩ/Ω                                   |  |
|                                     | 10 kΩ            | 9.9 μΩ/Ω                                  |  |
|                                     | 19 kΩ            | 10 μΩ/Ω                                   |  |
|                                     | 100 kΩ           | 13 μΩ/Ω                                   |  |
|                                     | 190 kΩ           | 13 μΩ/Ω                                   |  |
|                                     | 1 MΩ             | 23 μΩ/Ω                                   |  |
|                                     | 1.9 MΩ           | 25 μΩ/Ω                                   |  |
|                                     | 10 MΩ            | 49 μΩ/Ω                                   |  |
| 19 MΩ                               | 0.11 mΩ/Ω        | Fluke 5500A Multiproduct<br>Calibrator    |  |
| 100 MΩ                              | 0.13 mΩ/Ω        |   |  |
| Resistance - Source                 | Up to 11Ω        |   | 0.18 mΩ/Ω + 8 mΩ                             |
|                                     | (11 to 33) Ω     |   | 0.14 mΩ/Ω + 15 mΩ                            |
|                                     | (33 to 110) Ω    |   | 0.11 mΩ/Ω + 15 mΩ                            |
|                                     | (110 to 330) Ω   |   | 0.1 mΩ/Ω + 15 mΩ                             |
|                                     | 330 to 1.1) kΩ   |   | 0.1 mΩ/Ω + 60 mΩ                             |
|                                     | (1.1 to 3.3) kΩ  |   | 0.11 mΩ/Ω + 60 mΩ                            |
|                                     | (3.3 to 11) kΩ   |   | 0.11 mΩ/Ω + 0.6 Ω                            |
|                                     | (11 to 33) kΩ    |   | 0.11 mΩ/Ω + 0.6 Ω                            |
|                                     | (33 to 110) kΩ   |   | 0.13 mΩ/Ω + 6 Ω                              |
|                                     | (110 to 330) kΩ  |   | 0.14 mΩ/Ω + 6 Ω                              |
|                                     | 330 to 1.1) MΩ   |   | 0.17 mΩ/Ω + 55 Ω                             |
|                                     | (1.1 to 3.3) MΩ  |   | 0.17 mΩ/Ω + 55 Ω                             |
|                                     | (3.3 to 11) MΩ   |   | 0.69 mΩ/Ω + 0.55 kΩ                          |
|                                     | (11 to 33) MΩ    | 1.2 mΩ/Ω + 0.55 kΩ                        |  |
|                                     | (33 to 110) MΩ   | 5.8 mΩ/Ω + 5.5 kΩ                         |  |
| (110 to 330) MΩ                     | 5.8 mΩ/Ω + 17 kΩ |   |  |



Electrical – DC/Low Frequency

| Parameter/Equipment                     | Range  | Expanded Uncertainty of Measurement (+/-)  | Reference Standard, Method, and/or Equipment |
|---|--|--|--|
| Resistance - Measure                    | 100 mΩ to 10 Ω<br>(10 to 100) Ω<br>100 Ω to 1 kΩ<br>(1 to 10) kΩ<br>(10 to 100) kΩ<br>100 kΩ to 1MΩ<br>(1 to 10) MΩ<br>(10 to 100) MΩ  | 17 μΩ/Ω + 50 μΩ<br>14 μΩ/Ω + 0.5 mΩ<br>12 μΩ/Ω + 0.5 mΩ<br>12 μΩ/Ω + 5 mΩ<br>12 μΩ/Ω + 50 mΩ<br>17 μΩ/Ω + 2 Ω<br>59 μΩ/Ω + 0.1 kΩ<br>0.59 mΩ/Ω + 1 kΩ  | Agilent 3458A Multimeter                     |
| Electrical Simulation of RTD Indicators | Pt 385, 100 Ω<br>(-200 to -80) °C<br>(-80 to 0) °C<br>(0 to 100) °C<br>(100 to 300) °C<br>(300 to 400) °C<br>(400 to 630) °C<br>(630 to 800) °C<br>Pt 3926, 100 Ω<br>(-200 to -80) °C<br>(-80 to 0) °C<br>(0 to 100) °C<br>(100 to 300) °C<br>(300 to 400) °C<br>(400 to 630) °C | 0.08 °C<br>0.08 °C<br>0.1 °C<br>0.12 °C<br>0.13 °C<br>0.15 °C<br>0.27 °C<br>0.08 °C<br>0.08 °C<br>0.1 °C<br>0.12 °C<br>0.12 °C<br>0.15 °C  | Fluke 5500A-SC600 Multiproduct Calibrator    |
| Capacitance - Source                    | (330 to 500) pF<br>500 pF to 1.1 nF<br>(1.1 to 3.3) nF<br>(3.3 to 11) nF<br>(11 to 33) nF<br>(33 to 110) nF<br>(110 to 330) nF<br>330 nF to 1.1 μF<br>(1.1 to 3.3) μF<br>(3.3 to 11) μF<br>(11 to 33) μF<br>(33 to 110) μF<br>(110 to 330) μF<br>330 μF to 1.1 mF                | 11 mF/F + 10 pF<br>6.5 mF/F + 10 pF<br>6.2 mF/F + 10 pF<br>5.9 mF/F + 10 pF<br>9.7 mF/F + 0.1 nF<br>3 mF/F + 0.1 nF<br>3.5 mF/F + 0.3 nF<br>3 mF/F + 1 nF<br>4.5 mF/F + 3 nF<br>4.2 mF/F + 10 nF<br>5.1 mF/F + 10 nF<br>5.9 mF/F + 0.1 μF<br>8.6 mF/F + 0.3 μF<br>13 mF/F + 0.3 μF | Fluke 5500A Multiproduct Calibrator          |



Electrical – DC/Low Frequency

| Parameter/Equipment  | Range   | Expanded Uncertainty of Measurement (+/-)   | Reference Standard, Method, and/or Equipment |
|--|---|---|--|
| AC Watts - Source<br>PF=1, (45 to 65) Hz<br>330 mV to 1.02 kV  | (33 to 90) mA<br>(90 to 330) mA<br>(330 to 900) mA<br>900 mA to 3 A<br>(3 to 4.5) A<br>(4.5 to 11) A  | 3.1 mW/W<br>1.8 mW/W<br>2.9 mW/W<br>1.7 mW/W<br>2.3 mW/W<br>1.7 mW/W  | Fluke 5500A Multiproduct Calibrator          |
| Oscilloscopes<br>DC Signal, 50 Ω<br>DC Signal, 1MΩ<br><br>Square Wave<br>50 Ω, 10Hz to 10kHz<br>1 MΩ, 10 Hz to 1kHz<br>1 MΩ, 1 kHz to 10kHz<br><br>Time Marker <sup>2</sup><br><br>Rise Time<br><br>Leveled Sine Wave<br>50kHz Reference<br><br>Flatness Amplitude<br>(5 mV to 5.5 V) p-p, relative to 50kHz | ± (0 to 6.6) V<br>± (0 to 130) V<br><br>± (1 mV to 6.6 V) p-p<br>± (1 mV to 130 V) p-p<br>± (1 mV to 130 V) p-p<br><br>2 ns to 20 ms<br>(cardinal points)<br><br>50 ms to 5 s<br>(cardinal points)<br><br>300 ps,<br>10 kHz to 2 MHz<br>350 ps<br>2 MHz to 10 MHz<br><br>(5 mV to 5.5 V) p-p<br><br>50 kHz to 100 MHz<br>(100 to 300) MHz<br>(300 to 600) MHz | 3.1 mV/V + 40 μV<br>1.3 mV/V + 40 μV<br><br>4.2 mV/V + 40 μV<br>1.6 mV/V + 40 μV<br>3 mV/V + 40 μV<br><br>12 μS/S<br><br>90 + 1 367 (t-0.05) μs/s<br><br>0.12 ns<br>0.12 ns<br><br>24 mV/V + 0.3 mV<br><br>20 mV/V + 0.1 mV<br>25 mV/V + 0.1 mV<br>47 mV/V + 0.1 mV | Fluke 5500A-SC600 Multiproduct Calibrator    |



**Length – Dimensional metrology**

| Parameter/Equipment      | Range      | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment |
|--------------------------|------------|---|--|
| Micrometers <sup>2</sup> | Up to 1 in | (60 + 4L) μin                             | Grade 2 Gage Blocks                          |
| Calipers <sup>2</sup>    | Up to 6 in | (530 + 8.1L) μin                          |  |

**Mass**

| Parameter/Equipment                | Range   | Expanded Uncertainty of Measurement (+/-)                                      | Reference Standard, Method, and/or Equipment  |
|------------------------------------|---|--|---|
| Pressure                           | Up to 9 psia/psig<br>(9 to 1 000) psia/psig   | 0.008 psi<br>0.009 % of reading  | DHI PPC3/A700K &<br>DHI PPC3/A7M Pressure<br>Controller and transducers                 |
| Torque Drivers                     | (10 to 100) ozf-in<br>(40 to 380) ozf-in<br>(20to 200) lbf-in                       | 1.7 % of reading<br>2.6 % of reading<br>1.2 % of reading                       | Torque transducers<br>CDI 1001-O-TTP<br>CDI T-400-0<br>CDI 2002-1-TTP                   |
| Torque - Click Style               | (10 to 100) ozf-in<br>(40 to 380) ozf-in<br>(20to 200) lbf-in<br>(20 to 250) lbf-ft | 2.1 % of reading<br>4.9 % of reading<br>0.91 % of reading<br>0.98 % of reading | Torque transducers<br>CDI 1001-O-TTP<br>CDI T-400-0<br>CDI 2002-1-TTP<br>CDI ASGT-250-F |
| Torque Tools –<br>Dial and Digital | (20 to 200) lbf-in<br>(20 to 250) lbf-ft  | 0.66 % of reading<br>1.2 % of reading  | Torque transducers<br>CDI 2002-1-TTP<br>CDI ASGT-250-F                                  |

**Thermodynamic**

| Parameter/Equipment  | Range           | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment                                    |
|--|-----------------|---|---|
| Temperature -<br>Source & Measure                                      | (0 to 100) °C   | 0.01 °C                                   | Hart 7040 Bath, 5610<br>Probe, 2563 Display                                     |
|  | (100 to 300) °C | 0.04 °C                                   | Hart 6330 Bath, 5612<br>Probe, 2560 Display                                     |
| Infrared Temperature - Source<br>& Measure<br>Wavelength: (8 to 14) μm | (0 to 100) °C   | 0.25 °C                                   | Heitronics TRT3 Infrared<br>Thermometer.82 TRT &<br>Mester ME20.02<br>Blackbody |

**Thermodynamic**

| Parameter/Equipment  | Range                                | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment                    |
|--|--------------------------------------|---|---|
| Infrared Temperature - Source & Measure<br>Wavelength: (8 to 14) $\mu\text{m}$ | (>100 to 600) $^{\circ}\text{C}$     | 1.1 $^{\circ}\text{C}$                    | Heitronics TRT3.82 TRT Infrared Thermometers & SW10B Blackbody  |
|  | (>600 to 1 000) $^{\circ}\text{C}$   | 1.2 $^{\circ}\text{C}$                    |   |
| Infrared Temperature - Source & Measure<br>Wavelength: 1.6 $\mu\text{m}$       | (>350 to 1 000) $^{\circ}\text{C}$   | 1.1 $^{\circ}\text{C}$                    | Heitronics CT18.04 Infrared Thermometer & SW11B Blackbody       |
|  | (>1 000 to 1 400) $^{\circ}\text{C}$ | 2.7 $^{\circ}\text{C}$                    | Heitronics CT18.04 Infrared Thermometer & Land R1500T Blackbody |
|  | (>1 400 to 1 450) $^{\circ}\text{C}$ | 3 $^{\circ}\text{C}$                      |   |

**Time and Frequency**

| Parameter/Equipment     | Range         | Expanded Uncertainty of Measurement (+/-) | Reference Standard, Method, and/or Equipment                                   |
|-------------------------|---------------|---|--|
| Frequency - Measure     | Up to 100 MHz | 1.6 x E <sup>-09</sup> Hz                 | HP 5335A Counter, Fluke 910R Frequency Standard                                |
| Frequency - Source      | 10 MHz        | 2.8 x E <sup>-12</sup> Hz                 |  |
| Timers and Stop Watches | Up to 24 hrs  | 0.03 s                                    | HP 5335A Counter, Fluke 910R Frequency Standard<br>HP 3325A Function Generator |

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.  $L$  = length in inches,  $t$  = time in seconds.
3. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1656.



Vice President