



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017,  
ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3-2006

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CALIBRATION

Valid To: August 31, 2021

Certificate Number: 2357.27

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1,5</sup>:

I. Electrical – DC/Low Frequency

| Parameter/Equipment                | Range                                                                                                                                                                                      | CMC <sup>2,4</sup> (±)                                                                                                                                                                                                 | Comments                                                                               |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| DC Voltage – Generate <sup>3</sup> | (0 to 220) mV<br>220 mV to 2.2 V<br>(2.2 to 11) V<br>(11 to 22) V<br>(22 to 220) V<br>(220 to 1100) V                                                                                      | 8.3 μV/V + 0.39 μV<br>5.3 μV/V + 0.62 μV<br>3.9 μV/V + 2.3 μV<br>3.9 μV/V + 3.9 μV<br>5.2 μV/V + 39 μV<br>6.7 μV/V + 0.39 mV                                                                                           | Fluke 5720A                                                                            |
| DC Current – Generate <sup>3</sup> | Up to 220 μA<br>220 mA to 2.2 mA<br>(2.2 to 22) mA<br>(22 to 220) mA<br>220 mA to 2.2 A<br><br>(2.2 to 3) A<br>(3 to 11) A<br>(11 to 20.5) A<br><br>(16.5 to 149.999) A<br>(150 to 1025) A | 39 μA/A + 5.4 nA<br>31 μA/A + 6.2 nA<br>32 μA/A + 39 nA<br>39 μA/A + 0.62 μA<br>70 μA/A + 12 μA<br><br>0.30 mA/A + 31 μA<br>0.40 mA/A + 0.39 mA<br>0.78 mA/A + 0.58 mA<br><br>4.4 mA/A + 0.11 mA<br>5.1 mA/A + 0.39 mA | Fluke 5720A<br><br><br><br><br><br>Fluke 5522A<br><br><br>Fluke 5522A w/<br>5500A coil |

| Parameter/Equipment                      | Range                  | CMC <sup>2,4</sup> (±) | Comments       |
|------------------------------------------|------------------------|------------------------|----------------|
| DC Resistance –<br>Generate <sup>3</sup> | (0 to 10.9999) Ω       | 38 μΩ/Ω + 0.78 mΩ      | Fluke 5522A    |
|                                          | (11 to 32.9999) Ω      | 27 μΩ/Ω + 1.2 mΩ       |                |
|                                          | (33 to 109.9999) Ω     | 23 μΩ/Ω + 1.1 mΩ       |                |
|                                          | (110 to 329.9999) Ω    | 23 μΩ/Ω + 1.6 mΩ       |                |
|                                          | (0.33 to 1.099999) kΩ  | 22 μΩ/Ω + 1.6 mΩ       |                |
|                                          | (1.1 to 3.2 99999) kΩ  | 22 μΩ/Ω + 16 mΩ        |                |
|                                          | (3.3 to 10.99999) kΩ   | 22 μΩ/Ω + 16 mΩ        |                |
|                                          | (11 to 32.99999) kΩ    | 24 μΩ/Ω + 0.16 Ω       |                |
|                                          | (33 to 109.9999) kΩ    | 23 μΩ/Ω + 0.16 Ω       |                |
|                                          | (110 to 329.9999) kΩ   | 27 μΩ/Ω + 1.6 Ω        |                |
|                                          | (0.33 to 1.09 9999) MΩ | 27 μΩ/Ω + 1.6 Ω        |                |
|                                          | (1.1 to 3.2 99999) MΩ  | 59 μΩ/Ω + 23 Ω         |                |
|                                          | (3.3 to 10.99999) MΩ   | 0.10 mΩ/Ω + 39 Ω       |                |
|                                          | (11 to 32.99999) MΩ    | 0.20 mΩ/Ω + 1.9 kΩ     |                |
|                                          | (33 to 109.9999) MΩ    | 0.40 mΩ/Ω + 2.3 kΩ     |                |
|                                          | (110 to 329.9999) MΩ   | 2.4 mΩ/Ω + 78 kΩ       |                |
|                                          | (330 to 1100) MΩ       | 12 mΩ/Ω + 0.39 MΩ      |                |
| Fixed Points <sup>3</sup>                | 1 Ω                    | 0.13 mΩ                | Fluke 5720A    |
|                                          | 1.9 Ω                  | 0.18 mΩ                |                |
|                                          | 10 Ω                   | 0.22 mΩ                |                |
|                                          | 19 Ω                   | 0.43 mΩ                |                |
|                                          | 100 Ω                  | 1.1 mΩ                 |                |
|                                          | 190 Ω                  | 2.0 mΩ                 |                |
|                                          | 1 kΩ                   | 8.3 mΩ                 |                |
|                                          | 1.9 kΩ                 | 16 mΩ                  |                |
|                                          | 10 kΩ                  | 80 mΩ                  |                |
|                                          | 19 kΩ                  | 0.15 Ω                 |                |
|                                          | 100 kΩ                 | 1.2 Ω                  |                |
|                                          | 190 kΩ                 | 2.9 Ω                  |                |
|                                          | 1 MΩ                   | 50 Ω                   |                |
|                                          | 1.9 MΩ                 | 62 Ω                   |                |
|                                          | 10 MΩ                  | 4.0 kΩ                 |                |
|                                          | 19 MΩ                  | 8.5 kΩ                 |                |
| 100 MΩ                                   | 26 kΩ                  |                        |                |
| DC Voltage –<br>Measure <sup>3</sup>     | 100 mV Range           | 8.0 μV/V + 0.23 μV     | Keysight 3458A |
|                                          | 1 V Range              | 4.7 μV/V + 2.3 μV      |                |
|                                          | 10 V Range             | 4.7 μV/V + 23 μV       |                |
|                                          | 100 V Range            | 6.2 μV/V + 0.23 mV     |                |
|                                          | 1000 V Range           | 6.4 μV/V + 2.3 mV      |                |

| Parameter/Equipment                  | Range                                                                                                                                                  | CMC <sup>2,4</sup> (±)                                                                                                                                                            | Comments       |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| DC Current – Measure <sup>3</sup>    | Up to 100 nA<br>(0.1 to 1) μA<br>(1 to 10) μA<br>(10 to 100) μA<br>(0.1 to 1) mA<br>(1 to 10) mA<br>(10 to 100) mA<br>(0.1 to 1) A                     | 0.24 mA/A<br>40 μA/A<br>17 μA/A<br>20 μA/A<br>18 μA/A<br>18 μA/A<br>30 μA/A<br>87 μA/A                                                                                            | Keysight 3458A |
| DC Resistance – Measure <sup>3</sup> | (0 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>(0.1 to 1) MΩ<br>(1 to 10) MΩ<br>(10 to 100) MΩ<br>(100 to 1200) MΩ | 14 μΩ/Ω + 39 μΩ<br>12 μΩ/Ω + 0.39 mΩ<br>10 μΩ/Ω + 0.39 mΩ<br>10 μΩ/Ω + 3.9 mΩ<br>11 μΩ/Ω + 39 mΩ<br>16 μΩ/Ω + 1.6 Ω<br>53 μΩ/Ω + 78 Ω<br>0.40 mΩ/Ω + 0.78 kΩ<br>4.8 mΩ/Ω + 7.8 kΩ | Keysight 3458A |

| Parameter/Range                    | Equipment                                                                                                                                        | CMC <sup>2,4</sup> (±)                                                                                                                                                  | Comments    |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| AC Voltage – Generate <sup>3</sup> |                                                                                                                                                  |                                                                                                                                                                         |             |
| Up to 2.2 mV                       | (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>(0.5 to 1) MHz | 0.55 mV/V + 3.9 μV<br>0.48 mV/V + 3.9 μV<br>0.51 mV/V + 3.9 μV<br>0.5 mV/V + 3.9 μV<br>2.3 mV/V + 4.7 μV<br>1.2 mV/V + 9.3 μV<br>1.7 mV/V + 19 μV<br>3.3 mV/V + 19 μV   | Fluke 5720A |
| (2.2 to 22) mV                     | (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>(0.5 to 1) MHz | 0.25 mV/V + 3.9 μV<br>0.12 mV/V + 3.9 μV<br>0.12 mV/V + 3.9 μV<br>0.22 mV/V + 3.9 μV<br>0.49 mV/V + 4.7 μV<br>1.0 mV/V + 9.3 μV<br>1.4 mV/V + 19 μV<br>2.7 mV/V + 19 μV |             |

| Parameter/Range                              | Frequency                                                                                                                                        | CMC <sup>2,4</sup> (±)                                                                                                                                                | Comments    |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| AC Voltage – Generate <sup>3</sup><br>(cont) |                                                                                                                                                  |                                                                                                                                                                       |             |
| (22 to 220) mV                               | (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>(0.5 to 1) MHz | 0.41 mV/V + 12 µV<br>130 µV/V + 6.2 µV<br>83 µV/V + 6.2 µV<br>0.20 mV/V + 6.2 µV<br>0.47 mV/V + 16 µV<br>0.86 mV/V + 19 µV<br>1.3 mV/V + 23 µV<br>2.6 mV/V + 47 µV    | Fluke 5720A |
| (0.22 to 2.2) V                              | (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>(0.5 to 1) MHz | 0.50 mV/V + 39 µV<br>86 µV/V + 16 µV<br>42 µV/V + 7.8 µV<br>71 µV/V + 9.3 µV<br>0.13 mV/V + 31 µV<br>0.39 mV/V + 78 µV<br>0.93 mV/V + 0.19 mV<br>1.6 mV/V + 0.31 mV   |             |
| (2.2 to 22) V                                | (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>(0.5 to 1) MHz | 0.38 mV/V + 0.39 mV<br>91 µV/V + 0.16 mV<br>42 µV/V + 54 µV<br>71 µV/V + 93 µV<br>94 µV/V + 0.19 mV<br>0.25 mV/V + 0.62 mV<br>0.93 mV/V + 1.9 mV<br>1.4 mV/V + 3.1 mV |             |
| (22 to 220) V                                | (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>(0.5 to 1) MHz | 0.44 mV/V + 3.9 mV<br>87 µV/V + 1.6 mV<br>52 µV/V + 0.54 mV<br>79 µV/V + 0.93 mV<br>0.14 mV/V + 2.3 mV<br>0.85 mV/V + 16 mV<br>4.2 mV/V + 39 mV<br>7.8 mV/V + 78 mV   | Fluke 5522A |
| (220 to 1100) V                              | (15 to 50) Hz<br>50 Hz to 1 kHz                                                                                                                  | 0.28 mV/V + 16 mV<br>71 µV/V + 3.1 mV                                                                                                                                 |             |
| (330 to 1020) V                              | (1 to 5) kHz<br>(50 to 10) kHz                                                                                                                   | 0.20 mV/V + 7.8 mV<br>0.24 mV/V + 7.8 mV                                                                                                                              |             |

| Parameter/Range                   | Frequency                                                                                                                                                                     | CMC <sup>2,4</sup> (±)                                                                                                                                                                                                 | Comments       |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| AC Voltage – Measure <sup>3</sup> |                                                                                                                                                                               |                                                                                                                                                                                                                        |                |
| (0 to 10) mV                      | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>100 kHz to 1 MHz<br>(1 to 4) MHz<br>(4 to 8) MHz                                      | 0.27 μV/V + 2.3 μV<br>0.18 μV/V + 0.85 μV<br>0.25 μV/V + 0.85 μV<br>0.78 μV/V + 0.85 μV<br>3.9 μV/V + 0.85 μV<br>31 μV/V + 3.9 μV<br>54 μV/V + 5.4 μV<br>0.16 mV/V + 6.2 μV                                            | Keysight 3458A |
| (10 to 100) mV                    | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz<br>(1 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz | 0.13 mV/V + 3.1 μV<br>71 μV/V + 1.6 μV<br>0.11 μV/V + 1.6 μV<br>0.23 μV/V + 1.6 μV<br>0.62 μV/V + 1.6 μV<br>2.3 μV/V + 7.8 μV<br>7.8 μV/V + 7.8 μV<br>31 μV/V + 54 μV<br>31 μV/V + 62 μV<br>0.12 V/V + 78 μV           |                |
| (0.1 to 1) V                      | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz<br>(1 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz | 0.28 mV/V + 31 μV<br>98 μV/V + 16 μV<br>0.14 mV/V + 16 μV<br>0.25 mV/V + 16 μV<br>0.63 mV/V + 16 μV<br>2.9 mV/V + 78 μV<br>7.9 mV/V + 78 μV<br>31 mV/V + 0.54 mV<br>31 mV/V + 0.62 mV<br>0.12 V/V + 0.78 mV            |                |
| (1 to 10) V                       | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz<br>(1 to 4) MHz<br>(4 to 8) MHz<br>(8 to 10) MHz | 0.28 mV/V + 0.31 mV<br>97 μV/V + 0.16 mV<br>0.13 mV/V + 0.16 mV<br>0.25 mV/V + 0.16 mV<br>0.63 mV/V + 0.16 mV<br>2.9 mV/V + 0.78 mV<br>7.9 mV/V + 0.78 mV<br>31 mV/V + 5.4 mV<br>31 mV/V + 6.2 mV<br>0.12 V/V + 7.8 mV |                |

| Parameter/Range                             | Frequency                                                                                                                    | CMC <sup>2,4</sup> (±)                                                                                                                              | Comments       |
|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| AC Voltage <sup>3</sup> – Measure<br>(cont) |                                                                                                                              |                                                                                                                                                     |                |
| (10 to 100) V                               | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz<br>(100 to 300) kHz<br>300 kHz to 1 MHz | 0.31 mV/V + 3.1 mV<br>0.17 mV/V + 1.6 mV<br>0.17 mV/V + 1.6 mV<br>0.28 mV/V + 1.6 mV<br>0.93 mV/V + 1.6 mV<br>3.5 mV/V + 7.8 mV<br>12 mV/V + 7.8 mV | Keysight 3458A |
| (100 to 700) V                              | (1 to 40) Hz<br>40 Hz to 1 kHz<br>(1 to 20) kHz<br>(20 to 50) kHz<br>(50 to 100) kHz                                         | 0.42 mV/V + 31 mV<br>0.32 mV/V + 16 mV<br>0.47 mV/V + 16 mV<br>0.93 mV/V + 16 mV<br>2.3 mV/V + 16 mV                                                |                |
| AC Current – Generate <sup>3</sup>          |                                                                                                                              |                                                                                                                                                     |                |
| Up to 220 µA                                | (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                                            | 0.39 mA/A + 16 nA<br>0.17 mA/A + 10 nA<br>0.12 mA/A + 8.0 nA<br>0.28 mA/A + 12 nA<br>1.0 mA/A + 65 nA                                               | Fluke 5720A    |
| (0.22 to 2.2) mA                            | (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 + 40 nA<br>0.19 mA/A + 35 nA<br>0.16 mA/A + 35 nA<br>0.23 mA/A + 0.11 µA<br>1.0 mA/A + 0.65 µA                                            |                |
| (2.2 to 22) mA                              | (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                                            | 0.34 mA/A + 0.40 µA<br>0.17 mA/A + 0.35 µA<br>0.13 mA/A + 0.35 µA<br>0.20 mA/A + 0.55 µA<br>1.0 mA/A + 5.0 µA                                       |                |
| (22 to 220) mA                              | (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 + 4.0 µA<br>0.17 mA/A + 3.5 µA<br>0.12 mA/A + 2.5 µA<br>0.20 mA/A + 3.5 µA<br>1.0 mA/A + 10 µA                                            |                |
| (0.22 to 2.2) A                             | 20 Hz to 1 kHz<br>(1 to 5) kHz<br>(5 to 10) kHz                                                                              | 0.27 mA/A + 35 µA<br>0.41 mA/A + 80 µA<br>6.0 mA/A + 0.16 mA                                                                                        |                |

| Parameter/Range                                                                     | Frequency                                                            | CMC <sup>2,4</sup> (±)                                                                 | Comments                    |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------|
| AC Current – Generate <sup>3</sup><br>(cont)                                        |                                                                      |                                                                                        |                             |
| (29 to 329.99) µA<br>(0.33 to 3.2999) mA<br>(3.3 to 32.999) mA<br>(33 to 329.99) mA | (10 to 30) kHz<br>(10 to 30) kHz<br>(10 to 30) kHz<br>(10 to 30) kHz | 12 mA/A + 0.31 µA<br>7.8 mA/A + 0.47 µA<br>3.4 mA/A + 3.1 µA<br>3.1 mA/A + 0.16 mA     | Fluke 5522A                 |
| (2.2 to 10.9999) A                                                                  | (45 to 100) Hz<br>100 Hz to 1 kHz<br>(1 to 5) kHz                    | 0.48 mA/A + 1.6 mA<br>0.78 mA/A + 1.6 mA<br>23 mA/A + 1.6 mA                           |                             |
| (11 to 20.5) A                                                                      | (45 to 100) Hz<br>100 Hz to 1 kHz<br>(1 to 5) kHz                    | 0.95 mA/A + 3.9 mA<br>1.2 mA/A + 3.9 mA<br>23 mA/A + 3.9 mA                            |                             |
| Clamp-On Meters:<br>(16.5 to 149.999) A                                             | (45 to 65) Hz<br>(65 to 440) Hz                                      | 0.41 %<br>0.85 %                                                                       | Fluke 5522A w/<br>5500 coil |
| (150 to 1025) A                                                                     | (45 to 65) Hz<br>(65 to 440) Hz                                      | 0.41 %<br>0.85 %                                                                       |                             |
| AC Current – Measure <sup>3</sup>                                                   |                                                                      |                                                                                        |                             |
| 100 µA Range                                                                        | (10 to 20) Hz<br>(20 to 45) Hz<br>45 Hz to 5 kHz                     | 3.2 mA/A + 23 nA<br>1.2 mA/A + 23 nA<br>0.47 mA/A + 23 nA                              | Keysight 3458A              |
| 1 mA Range                                                                          | (10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz  | 3.4 mA/A + 0.16 µA<br>1.3 mA/A + 0.16 µA<br>0.53 mA/A + 0.16 µA<br>0.25 mA/A + 0.16 µA |                             |
| 10 mA Range                                                                         | (10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz  | 3.4 mA/A + 1.6 µA<br>1.3 mA/A + 1.6 µA<br>0.52 mA/A + 1.6 µA<br>0.26 mA/A + 1.6 µA     |                             |
| 100 mA Range                                                                        | (10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz  | 3.5 mA/A + 16 µA<br>1.3 mA/A + 16 µA<br>0.52 mA/A + 16 µA<br>0.26 mA/A + 16 µA         |                             |
| 1 A Range                                                                           | (10 to 20) Hz<br>(20 to 45) Hz<br>(45 to 100) Hz<br>100 Hz to 5 kHz  | 3.5 mA/A + 0.16 mA<br>1.3 mA/A + 0.16 mA<br>0.66 mA/A + 0.16 mA<br>0.80 mA/A + 0.16 mA |                             |

| Parameter/Equipment                                                         | Range                                                                                             | CMC <sup>2</sup> (±)                                   | Comments    |
|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|--------------------------------------------------------|-------------|
| Electrical Calibration of Thermocouples <sup>3</sup> – Generate and Measure |                                                                                                   |                                                        |             |
| Type B                                                                      | (600 to 800) °C<br>(800 to 1000) °C<br>(1000 to 1550) °C<br>(1550 to 1820) °C                     | 0.33 °C<br>0.27 °C<br>0.24 °C<br>0.21 °C               | Fluke 5522A |
| Type C                                                                      | (0 to 150) °C<br>(150 to 650) °C<br>(650 to 1000) °C<br>(1000C to 1800) °C<br>(1800 to 2316) °C   | 0.19 °C<br>0.15 °C<br>0.19 °C<br>0.30 °C<br>0.49 °C    |             |
| Type E                                                                      | (-250 to -100) °C<br>(-100 to -25) °C<br>(-25 to 350) °C<br>(350 to 650) °C<br>(650 to 1000) °C   | 0.30 °C<br>0.099 °C<br>0.085 °C<br>0.099 °C<br>0.13 °C |             |
| Type J                                                                      | (-210 to -100) °C<br>(-100 to -30) °C<br>(-30 to 150) °C<br>(150 to 760) °C<br>(760 to 1200) °C   | 0.21 °C<br>0.11 °C<br>0.091 °C<br>0.11 °C<br>0.15 °C   |             |
| Type K                                                                      | (-200 to -100) °C<br>(-100 to -25) °C<br>(-25 to 120) °C<br>(120 to 1000) °C<br>(1000 to 1372) °C | 0.20 °C<br>0.12 °C<br>0.10 °C<br>0.15 °C<br>0.24 °C    |             |
| Type N                                                                      | (-200 to -100) °C<br>(-100 to -25) °C<br>(-25 to 120) °C<br>(120 to 410) °C<br>(410 to 1300) °C   | 0.24 °C<br>0.14 °C<br>0.12 °C<br>0.11 °C<br>0.17 °C    |             |
| Type R                                                                      | (0 to 250) °C<br>(250 to 400) °C<br>(400 to 1000) °C<br>(1000 to 1767) °C                         | 0.38 °C<br>0.22 °C<br>0.21 °C<br>0.24 °C               |             |



| Parameter/Equipment                                                                | Range                                                                                                                                                                  | CMC <sup>2</sup> (±)                                                                                  | Comments    |
|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-------------|
| Electrical Calibration of Thermocouples <sup>3</sup> – Generate and Measure (cont) |                                                                                                                                                                        |                                                                                                       |             |
| Type S                                                                             | (0 to 250) °C<br>(250 to 1000) °C<br>(1000 to 1400) °C<br>(1400 to 1767) °C                                                                                            | 0.38 °C<br>0.24 °C<br>0.22 °C<br>0.27 °C                                                              | Fluke 5522A |
| Type T                                                                             | (-250 to -150) °C<br>(-150 to 0) °C<br>(0 to 120) °C<br>(120 to 400) °C                                                                                                | 0.38 °C<br>0.14 °C<br>0.099 °C<br>0.085 °C                                                            |             |
| Type U                                                                             | (-200 to 0) °C<br>(0 to 600) °C                                                                                                                                        | 0.44 °C<br>0.21 °C                                                                                    |             |
| Electrical Calibration of RTD Indicators <sup>3</sup>                              |                                                                                                                                                                        |                                                                                                       |             |
| Pt 385, 100 Ω                                                                      | (-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                                         | 0.082 °C<br>0.12 °C<br>0.12 °C<br>0.10 °C<br>0.091 °C<br>0.10 °C<br>0.18 °C                           | Fluke 5522A |
| Pt 3926, 100 Ω                                                                     | (-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                                                            | 0.060 °C<br>0.076 °C<br>0.075 °C<br>0.083 °C<br>0.089 °C<br>0.16 °C                                   |             |
| Pt 3916, 100 Ω                                                                     | (-200 to -190) °C<br>(-190 to -80) °C<br>(-80 to 0) °C<br>(0 to 100) °C<br>(100 to 260) °C<br>(260 to 300) °C<br>(300 to 400) °C<br>(400 to 600) °C<br>(600 to 630) °C | 0.21 °C<br>0.060 °C<br>0.068 °C<br>0.070 °C<br>0.072 °C<br>0.078 °C<br>0.085 °C<br>0.13 °C<br>0.17 °C |             |

| Parameter/Equipment                                             | Range            | CMC <sup>2</sup> (±) | Comments    |
|-----------------------------------------------------------------|------------------|----------------------|-------------|
| Electrical Calibration of<br>RTD Indicators <sup>3</sup> (cont) |                  |                      |             |
| Pt 385, 200 Ω                                                   | (-200 to -80) °C | 0.035 °C             | Fluke 5522A |
|                                                                 | (-80 to 0) °C    | 0.038 °C             |             |
|                                                                 | (0 to 100) °C    | 0.044 °C             |             |
|                                                                 | (100 to 260) °C  | 0.045 °C             |             |
|                                                                 | (260 to 300) °C  | 0.090 °C             |             |
|                                                                 | (300 to 400) °C  | 0.098 °C             |             |
|                                                                 | (400 to 600) °C  | 0.10 °C              |             |
|                                                                 | (600 to 630) °C  | 0.11 °C              |             |
| Pt 385, 500 Ω                                                   | (-200 to -80) °C | 0.030 °C             |             |
|                                                                 | (-80 to 0) °C    | 0.037 °C             |             |
|                                                                 | (0 to 100) °C    | 0.044 °C             |             |
|                                                                 | (100 to 260) °C  | 0.051 °C             |             |
|                                                                 | (260 to 300) °C  | 0.058 °C             |             |
|                                                                 | (300 to 400) °C  | 0.058 °C             |             |
|                                                                 | (400 to 600) °C  | 0.066 °C             |             |
|                                                                 | (600 to 630) °C  | 0.073 °C             |             |
| Pt 385, 1000 Ω                                                  | (-200 to -80) °C | 0.029 °C             |             |
|                                                                 | (-80 to 0) °C    | 0.029 °C             |             |
|                                                                 | (0 to 100) °C    | 0.029 °C             |             |
|                                                                 | (100 to 260) °C  | 0.035 °C             |             |
|                                                                 | (260 to 300) °C  | 0.042 °C             |             |
|                                                                 | (300 to 400) °C  | 0.18 °C              |             |
|                                                                 | (400 to 600) °C  | 0.050 °C             |             |
|                                                                 | (600 to 630) °C  | 0.17 °C              |             |
| PtNi 385, 120 Ω                                                 | (-80 to 0) °C    | 0.070 °C             |             |
|                                                                 | (0 to 100) °C    | 0.10 °C              |             |
|                                                                 | (100 to 260) °C  | 0.10 °C              |             |
| Cu 427, 10 Ω                                                    | (-100 to 260) °C | 0.69 °C              |             |

| Parameter/Equipment                 | Range                                                                                                                                                                                                                                                                                                  | CMC <sup>2,4</sup> (±)                                                                                                                                                                                                                                                                                                                      | Comments    |
|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Capacitance – Generate <sup>3</sup> | (0.19 to 1.1) nF<br>(1.1 to 3.3) nF<br>(3.3 to 11) nF<br>(11 to 110) nF<br>(110 to 330) nF<br>(0.33 to 1.1) μF<br>(1.1 to 3.29) μF<br>(3.3 to 11) μF<br>(11 to 33) μF<br>(33 to 110) μF<br>(110 to 330) μF<br>(0.33 to 1.1) mF<br>(1.1 to 3.3) mF<br>(3.3 to 11) mF<br>(11 to 33) mF<br>(33 to 110) mF | 4.0 mF/F + 7.8 pF<br>4.0 mF/F + 7.8 pF<br>2.0 mF/F + 7.8 pF<br>2.1 mF/F + 78 pF<br>2.0 mF/F + 0.23 nF<br>2.1 mF/F + 0.78 nF<br>2.1 mF/F + 2.3 nF<br>2.1 mF/F + 7.8 nF<br>3.2 mF/F + 23 nF<br>3.6 mF/F + 78 nF<br>3.5 mF/F + 0.23 μF<br>3.5 mF/F + 0.78 μF<br>3.5 mF/F + 2.3 μF<br>3.5 mF/F + 7.8 μF<br>5.8 mF/F + 23 μF<br>8.5 mF/F + 78 μF | Fluke 5522A |

### III. Time & Frequency

| Parameter/Range                                 | Frequency                                                                     | CMC <sup>2,6</sup> (±)                                  | Comments                                                   |
|-------------------------------------------------|-------------------------------------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------|
| Frequency – Measure <sup>3</sup>                | 0.001 Hz to 1 kHz<br>(1 to 1000) kHz<br>(1 to 225) MHz<br>(0.225 to 12.4) GHz | 0.24 mHz/Hz<br>2.1 μHz/Hz<br>0.21 μHz/Hz<br>0.21 μHz/Hz | Keysight /<br>Agilent / HP<br>53132A                       |
| Frequency – Measuring<br>Equipment <sup>3</sup> | (0.001 to 1000) Hz<br>1000 Hz to 20 MHz<br><br>0.1 Hz to 20 MHz               | 0.12 mHz/Hz<br>2.3 μHz/Hz<br><br>0.11 μHz/Hz            | HP 3325A<br><br>HP 3325A w/<br>Keysight 53132A<br>timebase |

<sup>1</sup> This laboratory offers commercial and field calibration service.

- <sup>2</sup> Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of  $k = 2$ . The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.
- <sup>3</sup> Field calibration service is available for this calibration and this laboratory meets A2LA *R104 – General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.
- <sup>4</sup> The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMC's are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.
- <sup>5</sup> This scope meets A2LA's *P112 Flexible Scope Policy*.
- <sup>6</sup> The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.



## Accredited Laboratory

A2LA has accredited

**TEKTRONIX, INC.**

*Chaska, MN*

for technical competence in the field of

**Calibration**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSLI Z540-1-1994, the requirements of ANSI/NCSLI Z540.3-2006 and R205 – Specific Requirements: Calibration Laboratory Accreditation Program. 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*).



Presented this 17<sup>th</sup> day of October 2019.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 2357.27  
Valid to August 31, 2021

*For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.*