



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005
& ANSI/NCSL Z540-1-1994

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CALIBRATION

Valid To: February 29, 2012

Certificate Number: 2353.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Electrical – DC/Low Frequency

| Parameter/Equipment | Range | CMC ^{2,4,5,9} (±) | Comments |
|---------------------------------------|--|--|---|
| DC Voltage ³ – Generate | 220 mV 2.2 V 11 V 22 V 220 V 1100 V (1 to 45) kV | 12 µV/V + 0.5 µV 7 µV/V + 0.8 µV 4.7 µV/V + 10 ⁶ + 3 µV 4.7 µV/V + 5 µV 7 µV/V + 50 µV 9.3 µV/V + 500 µV 0.11 % | Fluke 5720A Ross divider w/ supply |
| DC Voltage – Generate Fixed Values | 1.0 V 1.018 V 10.0 V | 12 µV/V 6.1 µV/V 12 µV/V | Fluke 732A |
| DC Voltage ³ – Measure | (1 to 45) kV | 0.11 % | Ross divider |
| DC Voltage – Measure | (0 to 0.1) V (0.1 to 1.0) V (1.0V to 10.0) V (10.0 to 100.0) V (100.0 to 1100.0) V | 16 µV/V 6.3 µV/V 6.1 µV/V 8.3 µV/V 15 µV/V | Agilent 3458A, Opt 002 |

| Parameter/Equipment | Range | CMC ^{2, 4, 5} (±) | Comments |
|---------------------------------------|--|---|------------------------|
| DC Current ³ – Generate | 220 µA 2.2 mA 22 mA 220 mA 2.2 A | 50 µA/A + 9 nA 36 µA/A + 2 nA 47 µA/A + 50 nA 48 µA/A + 800 nA 89 µA/A + 15 µA | Fluke 5720A |
| | (0 to 10.9999) A (11 to 20.5) A | 0.050 % + 500 µA 0.10 % + 750 µA | Fluke 5520A |
| | (20 to 150) A (150 to 1000) A | 0.28 % + 100 µA 0.28 % + 100 µA | Fluke 5500 Coil |
| DC Current – Measure | (0 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A | 35 µA/A 30 µA/A 30 µA/A 32 µA/A 0.013 % | Agilent 3458A, Opt 002 |
| DC Resistance ³ – Generate | 0.9997251 Ω 9.999586 Ω 100.00886 Ω 1.0000202 kΩ 10.000064 kΩ 100.00033 kΩ 0.9999802 MΩ 9.999051 MΩ 99.99446 MΩ | 0.011 % 26 µΩ/Ω 0.014 % 9.3 µΩ/Ω 8.8 µΩ/Ω 12 µΩ/Ω 21 µΩ/Ω 42 µΩ/Ω 0.014 % | Fluke 5720A |
| | (33 to 109.9999) MΩ (110 to 329.9999) MΩ (330 to 1100) MΩ | 0.05 % + 3000 Ω 0.30 % + 100 kΩ 1.5 % + 500 kΩ | Fluke 5520A |
| | Fixed Points 1 MΩ 10 MΩ 100 MΩ | 0.10 % per decade 0.10 % per decade 0.20 % per decade | IET HRRS-B-3-1M |
| DC Resistance – Measure | 100 mΩ to 10 Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ (0.1 to 1) GΩ | 26 µΩ/Ω 23 µΩ/Ω 14 µΩ/Ω 14 µΩ/Ω 18 µΩ/Ω 20 µΩ/Ω 63 µΩ/Ω 0.051 % 0.50 % | Agilent 3458A, Opt 002 |

| Parameter/Range | Frequency | CMC ^{2,5,9} (±) | Comments |
|--|--|---|--|
| AC Voltage – Measure | | | |
| 3 μV to 10 mV | (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz | 0.04 % 0.03 % 0.04 % 0.11 % 0.51 % 4 % | Agilent 3458A synchronous sample mode, filter on |
| (10 to 100) mV, 1 V | (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz | 0.011 % 93 parts in 10 ⁶ 0.016 % 0.032 % 0.082 % 0.31 % 1.0 % 1.5 % | |
| (10 to 100) V | (1 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 KHz to 1 MHz | 0.024 % 0.022 % 0.037 % 0.013 % 0.041 % 1.6 % | |
| (100 to 1000) V | (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz | 0.046 % 0.044 % 0.063 % 0.12 % 0.30 % | |
| AC Voltage ³ – Measure | | | |
| (1 to 30) kV | (45 to 400) Hz | 0.57 % | Ross divider |
| AC Current – Measure, Fixed Points: | | | |
| 100 μA | (10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz | 0.43 % 0.18 % 0.092 % | Agilent 3458A synchronous sample mode, filter on |
| (1, 10, 100) mA | (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz | 0.42 % 0.17 % 0.082 % 0.052 % 0.082 % 0.44 % 0.71 % | |

| Parameter/Range | Frequency | CMC ^{2, 4, 9} (±) | Comments |
|--|---|---|------------------------|
| AC Voltage ³ – Generate (cont) | | | |
| 22V | (10 to 20) Hz (20 Hz to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 KHz to 1MHz | 0.028 % + 500 μV 97 μV/V + 200 μV 46 μV/V + 70 μV 95 μV/V + 120 μV 0.013 % + 250 μV 0.034 % + 800 μV 0.11 % + 2500 μV 0.18 % + 4000 μV | Fluke 5720A |
| 220 V | (10 to 20) Hz (20 Hz to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 KHz to 1 MHz | 0.028 % + 5 mV 0.011 % + 2 mV 46 μV/V + 0.7 mV 0.012 % + 1.2 mV 0.019 % + 3 mV 0.097 % + 20 mV 0.47 % + 50 mV 0.88 % + 100 mV | |
| 1100 V | (15 to 50) Hz 50 Hz to 1 kHz | 0.032 % + 20 mV 79 μV/V + 4 mV | |
| (1 to 45) kV | 60 Hz | 0.57 % | Ross divider w/ supply |
| AC Current ³ – Generate | | | |
| 220 μA | (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz | 0.03 % + 20 μA 0.02 % + 12 μA 0.016 % + 10 μA 0.042 % + 15 μA 0.12 % + 80 μA | Fluke 5720A |
| (29 to 330) μA | (10 to 30) kHz | 1.6 % + 0.4 μA | Fluke 5520A |
| 2.2 mA | (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz | 0.03 % + 50 μA 0.02 % + 40 μA 0.015 % + 40 μA 0.025 % + 130 μA 0.12 % + 800 μA | Fluke 5720A |
| 330 μA to 3.3 mA | (10 to 30) kHz | 1.0 % + 0.60 μA | Fluke 5520A |
| 22 mA | (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz | 0.03 % + 20 μA 0.02 % + 12 μA 0.016 % + 10 μA 0.042 % + 15 μA 0.12 % + 80 μA | Fluke 5720A |

| Parameter/Range | Frequency | CMC ^{2, 4, 9} (±) | Comments |
|--|--|--|------------------------------|
| AC Current ³ – Generate (cont) | | | |
| (3.3 to 33) mA | (10 to 30) kHz | 0.40 % + 4 μA | Fluke 5520A |
| 220 mA | (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz | 0.029 % + 5 μA 0.020 % + 4 μA 0.015 % + 3 μA 0.024 % + 4 μA 0.12 % + 12 μA | Fluke 5720A |
| (33 to 330) mA | (10 to 30) kHz | 0.40 % + 200 μA | Fluke 5520A |
| 2.2 A | 20 to 1 kHz (1 to 5) kHz (5 to 10) kHz | 0.031 % + 40 μA 0.046 % + 100 μA 0.71 % + 200 μA | Fluke 5720A |
| (3 to 10.99999) A | (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz | 0.06 % + 2000 μA 0.10 % + 2000 μA 3.0 % + 2000 μA | Fluke 5520A |
| (11 to 20.5) A | (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz | 0.12 % + 5 mA 0.15 % + 5 mA 3.0 % + 5 mA | Fluke 5520A |
| (20 to 1000) A | (45 to 100) Hz | 0.52 % + 250 mA | Fluke 5500 Coil/5520A |
| Shunt – AC/DC | 5.011 mΩ | 0.03 % | ITT HA0511 100A, 5 mΩ |
| Ground Bond Test – AC/DC | 0.0993190 Ω | 10 x 10 ⁻⁴ Ω | Ground bond test resistor |
| Power Measuring Equipment DC Power ³ – Generate | | | |
| PF = 1: (33 to 329.99) mV (45 to 65) Hz | (3.3 to 8.999) mA (9 to 32.999) mA (33 to 89.999) mA (90 to 329.99) mA (0.33 to 0.8999) A (0.9 to 2.1999) A (2.2 to 4.4999) A (4.5 to 20.5) A | 0.14 % 0.10 % 0.14 % 0.10 % 0.13 % 0.11 % 0.13 % 0.11 % | Fluke 5520A |

| Parameter/Range | Frequency | CMC ^{2,4} (±) | Comments |
|---|--|--|-------------|
| Power Measuring Equipment DC Power ³ – Generate (cont) 330 mV to 1020 V | (3.3 to 8.999) mA (9 to 32.999) mA (33 to 89.999) mA (90 to 329.99) mA (0.33 to 0.8999) A (0.9 to 2.1999) A (2.2 to 4.4999) A (4.5 to 20.5) A | 0.12 % 0.081 % 0.12 % 0.081 % 0.11 % 0.091 % 0.012 % 0.10 % | Fluke 5520A |
| Phase/Power Factor ³ – (10 to 65) Hz PF 0 to 1 | 0Φ / PF 1 10Φ / PF 0.985 20Φ / PF 0.940 30Φ / PF 0.866 40Φ / PF 0.766 50Φ / PF 0.643 60Φ / PF 0.500 70Φ / PF 0.342 80Φ / PF 0.174 | 0.03 % 0.06 % 0.10 % 0.15 % 0.21 % 0.30 % 0.48 % 0.99 % | Fluke 5520A |

| Parameter/Range | Frequency | CMC ^{2,4} (±) | Comments |
|---|---|---|-------------|
| Capacitance – Generate (0.19 to 0.3999) nF (0.4 to 1.0999) nF (1.1 to 3.2999) nF (3.3 to 10.9999) nF (11 to 32.9999) nF (33 to 109.999) nF (110 to 329.999) nF (0.33 to 1.09999) μF (1.1 to 3.29) μF (3.3 to 10.99) μF (11 to 32.99) μF (33 to 109.999) μF (110 to 329.999) μF | 10 Hz to 10 kHz 10 Hz to 10 KHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (0 to 50) Hz | 0.50 % + 0.01 nF 0.50 % + 0.01 nF 0.50 % + 0.01 nF 0.25 % + 0.01 nF 0.25 % + 0.1 nF 0.25 % + 0.1 nF 0.25 % + 0.3 nF 0.25 % + 1 nF 0.25 % + 3 nF 0.25 % + 10 nF 0.40 % + 30 nF 0.45 % + 100 nF 0.45 % + 300 nF | Fluke 5520A |

| Parameter/Range | Frequency | CMC ^{2,4} (±) | Comments |
|-------------------------------|---------------|------------------------|-------------|
| Capacitance – Generate (cont) | | | |
| (0.33 to 1.09999) mF | (0 to 20) Hz | 0.45 % + 1 µF | Fluke 5520A |
| (1.1 to 3.2999) mF | (0 to 6) Hz | 0.45 % + 3 µF | |
| (3.3 to 10.9999) mF | (0 to 2) Hz | 0.45 % + 10 µF | |
| (11 to 32.9999) mF | (0 to 0.6) Hz | 0.45 % + 30 µF | |
| (33 to 110) mF | (0 to 0.2) Hz | 1.1 % + 100 µF | |

| Parameter/Equipment | Range | CMC ^{2,6,8} (±) | Comments |
|--|---|---|-------------|
| Electrical Calibration of Thermocouple Indicators ³ – | | | |
| Type B | (600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C | 0.34 °C 0.26 °C 0.23 °C 0.26 °C | Fluke 5520A |
| Type C | (0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C | 0.23 °C 0.20 °C 0.24 °C 0.39 °C 0.65 °C | |
| Type E | (-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C | 0.39 °C 0.13 °C 0.11 °C 0.13 °C 0.16 °C | |
| Type J | (-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C | 0.22 °C 0.13 °C 0.11 °C 0.13 °C 0.18 °C | |
| Type K | (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C | 0.26 °C 0.14 °C 0.13 °C 0.20 °C 0.31 °C | |

| Parameter/Equipment | Range | CMC ^{2,6,8} (±) | Comments |
|---|---|--|-------------|
| Electrical Calibration of Thermocouple Indicators ³ – (cont) | | | |
| Type N | (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C | 0.31 °C 0.17 °C 0.15 °C 0.14 °C 0.22 °C | Fluke 5520A |
| Type R | (0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C | 0.44 °C 0.27 °C 0.29 °C 0.31 °C | |
| Type S | (0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C | 0.37 °C 0.28 °C 0.29 °C 0.36 °C | |
| Type T | (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C | 0.49 °C 0.19 °C 0.13 °C 0.11 °C | |
| Electrical Calibration of RTD Indicators ³ – | | | |
| Pt 385, 100 Ω | (-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C | 0.04 °C 0.04 °C 0.05 °C 0.07 °C 0.08 °C 0.09 °C 0.18 °C | Fluke 5520A |
| Pt 385, 200 Ω | (-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C | 0.03 °C 0.03 °C 0.03 °C 0.04 °C 0.09 °C 0.10 °C 0.11 °C 0.12 °C | |

| Parameter/Equipment | Range | CMC ^{2, 6, 8} (±) | Comments |
|---|---|--|-------------|
| Electrical Calibration of RTD Indicators ³ – (cont) | | | |
| Pt 385, 500 Ω | (-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C | 0.03 °C 0.04 °C 0.04 °C 0.05 °C 0.06 °C 0.06 °C 0.07 °C 0.09 °C | Fluke 5520A |
| Pt 385, 1 k Ω | (-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) v | 0.02 °C 0.02 °C 0.03 °C 0.04 °C 0.05 °C 0.05 °C 0.05 °C 0.18 °C | |
| Ni1 20, 120 Ω | (-80 to 0) °C (0 to 100) °C (100 to 260) °C | 0.06 °C 0.06 °C 0.11 °C | |
| Cu 427, 10 Ω | (-100 to 260) °C | 0.30 °C | |

| Parameter/Range | Frequency | CMC ^{2, 9} (±) | Comments |
|---|--|-------------------------|-----------------------|
| Oscilloscopes ³ – | | | |
| Square Wave Signal 50 Ω 1 MΩ | (1 to 100) kHz | 0.28 % + 1 μV | Tektronix CG5001 |
| Time Maker | 10 ns to 5 s | 0.012 % | |
| Edge – Generate | ≤ 200 ps | (+0) ps, (-100) ps | Tektronix 015-0311-01 |
| Leveled Sine Wave Amplitude – | | | |
| X 1 (5.5 V _{pp}) | 50 kHz (Reference) | 3 % | Tektronix SG503 |
| X 0.01 (5.5 mV _{pp}) | 50 kHz (Reference) | 4 % | |
| X 0.1 (550 mV _{pp}) | 50 kHz (Reference) | 4 % | |
| Flatness Amplitude 5.5 mV _{pp} to 5.5 V _{pp} | 250 KHz to 50 MHz 50 MHz to 250 MHz | 1 % 3 % | Tektronix SG503 |

| Parameter/Range | Frequency | CMC ^{2,9} (±) | Comments |
|--|------------------------------|-----------------------------|--|
| Oscilloscopes ³ – (cont) | | | |
| Leveled Sine Wave Amplitude – 0.5 V _{PP} to 4.0 V _{PP} | 50 KHz, 6 MHz (Reference) | 3 % | Tektronix SG504 ^{1, 2, 3} |
| Flatness Amplitude 0.5 V _{PP} to 4.0 V _{PP} | (245 to 1050) MHz | 4 % | Tektronix SG504 ^{1, 2, 3} |
| Frequency Source | 10 MHz | 13 part in 10 ¹¹ | Fluke 910R/171 ² (Hold off mode) |
| RF Power Generation, (+13 to -127) dBm | 100 kHz to 2000 MHz | 1.8 dBm | HP 8648B |

II. Thermodynamics

| Parameter/Equipment | Range | CMC ² (±) | Comments |
|-----------------------------|-----------------|----------------------|-------------------|
| Relative Humidity – Measure | (10 to 90) % RH | 1.2 % RH | Vaisala 141/HMP46 |
| Temperature – Measure | (-20 to 60) °C | 0.23 °C | Vaisala 141/HMP46 |

III. Time and Frequency

| Parameter/Range | Frequency | CMC ² (±) | Comments |
|--------------------------------------|----------------|------------------------------|--------------------------------|
| Frequency – Generate, Fixed Point | 10 MHz | 13 parts in 10 ¹¹ | Fluke 910R/171 (hold off mode) |
| Measure | (0 to 100) MHz | 5.8 x 10 ⁻¹⁰ | Agilent 5335A, Fluke 910R |

¹ This laboratory offers commercial calibration service and field calibration service.

- ² Calibration and Measurement Capability (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. Calibration and Measurement Capabilities 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.
- ³ 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.
- ⁴ The measurands stated are generated with the Fluke 5500A and 5700A series of instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a fraction of the reading/output plus a fixed (one-year) floor specification.
- ⁵ The measurands stated are measured with the Agilent 3458A. This capability is suitable for the calibration of the devices intended to generate the measurand in the ranges indicated. CMCs are expressed as either a specific value that covers the full range or as a combination of the fraction of the reading/output plus a range specification.
- ⁶ Temperature and capacitance values are calculated from volts and resistance Fluke's temperature specifications are used for comparison only.
- ⁷ Ohms zero cal performed daily +/- 1°C of TCAL
- ⁸ Specified TC simulated temperature CMCs are calibrator's values without thermocouple leads. External thermocouples have additional CMC values that are determined to be a very small error in addition to calibrators TC output plus one-year floor specification.
- ⁹ In the statement of CMC, percentages are to be read as percent of reading unless indicated otherwise.



The American Association for Laboratory Accreditation

World Class Accreditation

Accredited Laboratory

A2LA has accredited

GENERAL CALIBRATION, INC.

Boonton, NJ

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration. 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 8 January 2009*).

Presented this 9th day of March 2010.





Peter Abney

President & CEO
For the Accreditation Council
Certificate Number 2353.01
Valid to February 29, 2012
Revised January 30, 2012

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