



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

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CALIBRATION

Valid To: February 29, 2024

Certificate Number: 2626.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1, 7}:

I. Electrical – DC/Low Frequency

| Parameter/Equipment | Range | CMC ^{2, 3, 4, 5} (±) | Comments |
|--|---|--|---|
| DC Voltage – Generate | (0 to 220) mV 220 mV to 2.2 V (2.2 to 11) V | 7.8 μV/V + 0.40 μV 5.1 μV/V + 0.70 μV 3.7 μV/V + 2.5 μV | Fluke 5720A |
| DC Voltage – Measure | (0 to 100) mV 100 mV to 1 V (1 to 10) V | 13 μV/V + 0.70 μV 13 μV/V + 0.70 μV 13 μV/V + 0.90 μV | Agilent 3458A, opt 002 (2-year specifications) |
| DC Resistance – Measure | (0 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ | 29 μΩ/Ω + 0.14 mΩ 29 μΩ/Ω + 1.4 mΩ 24 μΩ/Ω + 1.4 mΩ 24 μΩ/Ω + 14 mΩ | Agilent 3458A, opt 002 (2-year specifications) |
| DC Resistance – Generate, Fixed Points | (1, 1.9) Ω (10, 19) Ω (100, 190) Ω (1, 1.9, 10, 19) kΩ | 96 μΩ/Ω 25 μΩ/Ω 11 μΩ/Ω 10 μΩ/Ω | Fluke 5720A |

| Parameter/Equipment | Range | CMC ^{2,3,4} (±) | Comments |
|-----------------------|--|---|-------------------------------------|
| DC Current – Measure | (1 to 10) μ A (10 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA | 39 μ A/A + 0.14 nA 39 μ A/A + 1.2 nA 39 μ A/A + 9.0 nA 39 μ A/A + 90 nA 56 μ A/A + 0.90 μ A | Agilent 3458A, opt 002 |
| DC Current – Generate | (10 to 100) μ A (0 to 220) μ A 220 μ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA | 0.58 mA/A + 20 nA 41 μ A/A + 6.0 nA 36 μ A/A + 7.0 nA 36 μ A/A + 40 nA 47 μ A/A + 0.70 μ A | Keithley 236/237 Fluke 5720A |

| Parameter/Range | Frequency | CMC ^{2,3,4,5} (±) | Comments |
|-----------------------|-------------------------------------|--|--|
| AC Voltage – Generate | | | |
| (0 to 2.2) mV | 10 Hz to 50 kHz 50 kHz to 1 MHz | 0.077 % + 4.0 μ V 0.28 % + 20 μ V | Fluke 5720A |
| (2.2 to 22) mV | 10 Hz to 50 kHz 50 kHz to 1 MHz | 0.026 % + 4.0 μ V 0.27 % + 20 μ V | |
| (22 to 220) mV | 10 Hz to 50 kHz 50 kHz to 1 MHz | 0.024 % + 12 μ V 0.28% + 45 μ V | |
| 220 mV to 2.2 V | 10 Hz to 50 kHz 50 kHz to 1 MHz | 0.024 % + 40 μ V 0.18 % + 300 μ V | |
| AC Voltage – Measure | | | |
| (0 to 10) mV | 1 Hz to 100 kHz (100 to 300) kHz | 0.59 % + 9.1 μ V 4.7 % + 10 μ V | Agilent 3458A, opt 002 (ACBAND \leq 2 MHz) |
| (10 to 100) mV | 1 Hz to 100 kHz 100 kHz to 2 MHz | 0.11 % + 2.4 μ V 1.8 % + 11 μ V | |
| 100 mV to 1 V | 1 Hz to 100 kHz 100 kHz to 2 MHz | 0.11 % + 24 μ V 1.8 % + 0.11 mV | |

| Parameter/Range | Frequency | CMC ^{2,3,4,5,6} (±) | Comments |
|--------------------------------|-------------------------------------|-------------------------------------|---|
| AC Voltage – Measure (cont) | | | |
| (1 to 10) V | 1 Hz to 100 kHz 100 kHz to 2 MHz | 0.11 % + 240 μV 1.8 % + 1.1 mV | Agilent 3458A, opt 002 (ACBAND ≤ 2 MHz) |
| (10 to 100) V | 1 Hz to 100 kHz 100 kHz to 1 MHz | 0.15 % + 2.4 mV 1.8 % + 11 mV | |
| (100 to 700) V | 1 Hz to 100 kHz | 0.36 % + 24 mV | |
| AC Current – Generate | | | |
| (9 to 220) μA | 10 Hz to 5 kHz (5 to 10) kHz | 0.032 % + 12 nA 0.11 % + 65 nA | Fluke 5720A |
| 220 μA to 2.2 mA | 10 Hz to 5 kHz (5 to 10) kHz | 0.026 % + 110 nA 0.11 % + 650 nA | |
| (2.2 to 22) mA | 10 Hz to 5 kHz (5 to 10) kHz | 0.027 % + 550 nA 0.11 % + 5 μA | |
| (22 to 220) mA | 10 Hz to 5 kHz (5 to 10) kHz | 0.028 % + 4.0 μA 0.11 % + 10 μA | |
| AC Current – Measure | | | |
| (5 to 100) μA | 1 kHz | 0.080 % + 30 nA | Agilent 3458A, opt 002 |
| 100 μA to 1 mA | 1 kHz | 0.080 % + 0.30 μA | |
| (1 to 10) mA | 1 kHz | 0.046 % + 2.0 μA | |
| (10 to 100) mA | 1 kHz | 0.046 % + 20 μA | |
| 100 mA to 1 A | 1 kHz | 0.13 % + 0.20 mA | |
| AC Power – Measure | | | |
| PF = 1 | | | Yokogawa WT3000E precision power analyzer |
| (1 to 60) W | (45 to 66) Hz | 0.052 % | |
| (60 to 200) W | (45 to 66) Hz | 0.050 % | |
| (200 to 750) W | (45 to 66) Hz | 0.048 % | |
| (750 to 3000) W | (45 to 66) Hz | 0.049 % | |

II. Electrical – RF/Microwave

| Parameter/Range | Frequency | CMC ^{2, 5, 6} (±) | Comments |
|---------------------------------------|---|---|---|
| RF Power – 1 mW Calibration Factor | 100 kHz to 50 MHz 50 MHz to 1 GHz (1 to 2) GHz (2 to 3) GHz (3 to 4) GHz (4 to 6) GHz (6 to 10) GHz (10 to 18) GHz | 0.62 % 0.61 % 0.59 % 0.61 % 0.63 % 0.68 % 0.80 % 1.7 % | Model F1130 transfer standard |
| RF Power – Generate & Measure | | | |
| 1 mW | 100 kHz to 50 MHz 50 MHz 50 MHz to 1 GHz (1 to 2) GHz (2 to 3) GHz (3 to 4) GHz (4 to 6) GHz (6 to 10) GHz (10 to 18) GHz | 0.62 % 0.58 % 0.61 % 0.59 % 0.61 % 0.63 % 0.68 % 0.80 % 1.7 % | F1130 transfer standard |
| (0.1 to 10) W | 100 kHz to 100 MHz 100 MHz to 1 GHz (1 to 6) GHz | 1.5 % 1.6 % 1.6 % | Directional coupler & N8482A |
| (10 to 100) W | 100 kHz to 100 MHz 100 MHz to 1 GHz (1 to 6) GHz | 1.6 % 1.7 % 1.7 % | |
| (100 to 1000) W | 100 kHz to 100 MHz 100 MHz to 1 GHz (1 to 6) GHz | 1.7 % 1.8 % 1.8 % | Directional coupler & N8482H |
| 1700 W | 250 kHz to 5 MHz (10 to 15) MHz (25 to 30) MHz (35 to 65) MHz (95 to 105) MHz (150 to 170) MHz | 0.39 % 0.39 % 0.39 % 0.39 % 0.39 % 0.39 % | Yokogawa WT3000 power analyzer PI 140ASX AC power supply (reference only) Bird 6080 calorimeter |
| 700 W | 250 kHz to 5 MHz (10 to 15) MHz (25 to 30) MHz (35 to 65) MHz (95 to 105) MHz (150 to 170) MHz | 0.42 % 0.42 % 0.42 % 0.42 % 0.42 % 0.42 % | Calorimeter |

| Parameter/Range | Frequency | CMC ^{2,5,6} (±) | Comments |
|--------------------------------------|--|--------------------------------------|---|
| RF Power – Generate & Measure (cont) | | | |
| 1700 Watts | (330 to 390) kHz (390 to 440) kHz (12.88 to 14.23) MHz (54 to 63) MHz | 0.38 % 0.20 % 0.22 % 0.23 % | Yokogawa 3000 power analyzer Pacific 160ASX AC power supply (reference only) Bird 6085B |
| RF Attenuation – | | | |
| (0 to 10) dB | 100 kHz to 100 MHz 100 MHz to 1 GHz (1 to 8.5) GHz | 0.022 dB 0.040 dB 0.030 dB | Rohde & Schwarz ZNB8 |
| (11 to 20) dB | 100 kHz to 100 MHz 100 MHz to 1 GHz (1 to 8.5) GHz | 0.025 dB 0.038 dB 0.033 dB | |
| (21 to 30) dB | 100 kHz to 100 MHz 100 MHz to 1 GHz (1 to 8.5) GHz | 0.029 dB 0.038 dB 0.036 dB | |
| (31 to 40) dB | 100 kHz to 100 MHz 100 MHz to 1 GHz (1 to 8.5) GHz | 0.034 dB 0.042 dB 0.040 dB | |
| (41 to 50) dB | 100 kHz to 100 MHz 100 MHz to 1 GHz (1 to 8.5) GHz | 0.039 dB 0.047 dB 0.047 dB | |
| (51 to 60) dB | 100 kHz to 100 MHz 100 MHz to 1 GHz (1 to 8.5) GHz | 0.064 dB 0.067 dB 0.064 dB | |

| Parameter/Range | Frequency | CMC ^{2,5,6} (±) | Comments |
|--|---|--|-------------------------|
| RF Impedance – Measure Reflection Coefficient | | | |
| 0.0 to < 0.2 | (0.1 to 1300) MHz (1.3 to 3) GHz (3 to 6) GHz (6 to 8.5) GHz | 0.0040 (linear, ratio) 0.0063 (linear, ratio) 0.0063 (linear, ratio) 0.0063 (linear, ratio) | Rohde & Schwarz ZNB8 |
| 0.2 to < 0.4 | (0.1 to 1300) MHz (1.3 to 3) GHz (3 to 6) GHz (6 to 8.5) GHz | 0.0068 (linear, ratio) 0.0091 (linear, ratio) 0.0091 (linear, ratio) 0.0091 (linear, ratio) | |
| 0.4 to < 0.6 | (0.1 to 1300) MHz (1.3 to 3) GHz (3 to 6) GHz (6 to 8.5) GHz | 0.012 (linear, ratio) 0.015 (linear, ratio) 0.015 (linear, ratio) 0.015 (linear, ratio) | |
| 0.6 to < 0.8 | (0.1 to 1300) MHz (1.3 to 3) GHz (3 to 6) GHz (6 to 8.5) GHz | 0.020 (linear, ratio) 0.022 (linear, ratio) 0.022 (linear, ratio) 0.022 (linear, ratio) | |
| 0.8 to < 1.0 | (0.1 to 1300) MHz (1.3 to 3) GHz (3 to 6) GHz (6 to 8.5) GHz | 0.030 (linear, ratio) 0.033 (linear, ratio) 0.033 (linear, ratio) 0.033 (linear, ratio) | |
| 1.0 | (0.1 to 1300) MHz (1.3 to 3) GHz (3 to 6) GHz (6 to 8.5) GHz | 0.043 (linear, ratio) 0.045 (linear, ratio) 0.045 (linear, ratio) 0.045 (linear, ratio) | |

III. Time & Frequency

| Parameter/Range | Frequency | CMC ^{2,6} (±) | Comments |
|--|---|---|---|
| Frequency – Measure & Measuring Equipment | 10 Hz to 100 kHz 100 kHz to 300 MHz 300 MHz to 1 GHz (1 to 5) GHz (5 to 15) GHz | 2.8 x 10 ⁻⁵ Hz 8.3 x 10 ⁻² Hz 7.0 Hz 35 Hz 110 Hz | Agilent 53230A counter, 910R GPS receiver, RF / function generator |
| Frequency – Time Base | 10 MHz | 4.2 x 10 ⁻¹² Hz/Hz | Wavetek 910R GPS receiver |

¹ This laboratory offers commercial calibration service.

² 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.

³ The measurands stated are generated with the Fluke 5720A series of instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. CMC are expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.

⁴ 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. CMC's 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.

⁵ In the statement of CMC, uncertainties expressed as a percent are to be read as percent of reading unless otherwise indicated.

⁶ 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.

⁷ This scope meets A2LA's *P112 Flexible Scope Policy*.



Accredited Laboratory

A2LA has accredited

BIRD SERVICE CENTER

Solon, OH

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/NCSL Z540-1-1994 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 15th day of February 2022.

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

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2626.01
Valid to February 29, 2024

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