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

NI HUNGARY KFT
NATIONAL INSTRUMENTS CALIBRATION
SERVICES DEBRECEN
Hatar ut 1/A
Debrecen, Hungary H4031
Tibor Bernath Phone: +36 52 515 400

CALIBRATION

Valid To: October 31, 2020 Certificate Number: 3634.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations[1]:

I. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 6] ±	Comments
DC Voltage[3] – Generate	0 V (0 to 2.2) V (2.2 to 11) V (22 to 220) V (220 to 1100) V	0.20 µV 3.5 µV/V + 0.70 µV 2.5 µV/V + 2.5 µV 3.5 µV/V + 40 µV 4.6 µV/V + 400 µV	Two wire short reference calibrator
DC Voltage[3, 5] – Measure	0 V (0 to 0.1) V (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	1.0 µV 7.3 µV/V + 0.2 µV 6.7 µV/V + 0.2 µV 6.7 µV/V + 0.33 µV 8.0 µV/V + 20 µV 16 µV/V + 67 µV	Reference digital multimeter

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
DC Current[3] – Generate	0 µA (2.2 to 22) mA (2.2 to 220) mA (0.22 to 2.2) A (2.2 to 5) A (0.9 to 1) µA (1 to 10) µA (10 to 100) µA (0.10 to 1.0) mA	4.9 pA 30 µA/A + 40 nA 40 µA/A + 0.70 µA 60 µA/A + 12 µA 0.05 % + 500 µA 25 µA/A + 40 pA 25 µA/A + 0.1 nA 20 µA/A + 0.62 nA 20 µA/A + 3.9 nA	Open Reference calibrator Reference calibrator, digital multimeter
DC Current[3] – Measure	(0 to 1) µA (1 to 10) µA (10 to 100) µA 100 µA to 1 mA (1 to 10) mA (10 to 100) mA (0.1to 1.0) A (1.0 to 2.0) A (2.0 to 3.0) A 9 nA (0.9 to 10) µA 1 A 3 A	13 µA/A + 27 pA 13 µA/A + 67 pA 13 µA/A + 530 pA 13 µA/A + 3.3 nA 13 µA/A + 33 nA 23 µA/A + 330 nA 73 µA/A + 6.7 µA 0.039 % + 90 µA 0.063 % + 90 µA 30uA/A 19 µA/A 65 µA/A 74 µA/A	Reference digital multimeter NI 4071 Current shunts
Resistance[3] – Generate, Fixed Points	0 Ω 0 Ω 1 Ω 10 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ	68 µΩ 150 µΩ 2.6 mΩ/Ω 47 µΩ/Ω 12 µΩ/Ω 20 µΩ/Ω 7.6 µΩ/Ω 17 µΩ/Ω 7.5 µΩ/Ω 23 µΩ/Ω 9.0 µΩ/Ω 15 µΩ/Ω 31 µΩ/Ω 98 µΩ/Ω	Two wire short Reference calibrator

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
Resistance[3] – Measure	(0 to 100) Ω (100 to 1000) Ω (1 to 10) kΩ (10 to 100) kΩ (100 to 1000) kΩ (1 to 10) MΩ (10 to 30) MΩ (30 to 100) MΩ	31 μΩ/Ω + 0.43 mΩ 26 μΩ/Ω + 0.50 mΩ 26 μΩ/Ω + 5.0 mΩ 28 μΩ/Ω + 0.10 Ω 30 μΩ/Ω + 1.0 Ω 70 μΩ/Ω + 100 Ω 0.024 % + 900 Ω 0.55 % + 1.0 kΩ	NI 4071
Resistance[3, 5] – Generate	Up to 10.9999 Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω (0.33 to 1.099 999) kΩ (1.1 to 3.299 999) kΩ (3.3 to 10.999 99) kΩ (11 to 32.999 99) kΩ (33 to 109.999) kΩ (110 to 329.999) kΩ (0.33 to 1.1) MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ (0.33 to 1) GΩ	31 μΩ/Ω + 0.7 mΩ 24 μΩ/Ω + 1.2 mΩ 22 μΩ/Ω + 1.1 mΩ 22 μΩ/Ω + 1.6 mΩ 22 μΩ/Ω + 2 mΩ 23 μΩ/Ω + 15 mΩ 23 μΩ/Ω + 15 mΩ 22 μΩ/Ω + 0.15 Ω 22 μΩ/Ω + 0.15 Ω 26 μΩ/Ω + 5.4 Ω 26 μΩ/Ω + 5.4 Ω 27 μΩ/Ω + 39 Ω 0.10 mΩ/Ω + 54 Ω 0.19 mΩ/Ω + 2.1 kΩ 0.39 mΩ/Ω + 2.5 kΩ 2.3 mΩ/Ω + 78 kΩ 12 mΩ/Ω + 0.39 MΩ	Reference calibrator

Parameter/Range	Frequency	CMC[2, 6] (±)	Comments
AC Voltage[3] – Generate			
(2.2 to 22) mV	(10 to 20) Hz	0.022 % + 4.0 µV	Reference calibrator
	(20 to 40) Hz	85 µV/V + 4.0 µV	
	40 Hz to 20 kHz	75 µV/V + 4.0 µV	
	(20 to 50) kHz	0.018 % + 4.0 µV	
	(50 to 100) kHz	0.046 % + 5.0 µV	
	(100 to 300) kHz	0.090 % + 10 µV	
	(300 to 500) kHz	0.12 % + 20 µV	
	500 kHz to 1 MHz	0.25 % + 20 µV	
(22 to 220) mV	(10 to 20) Hz	0.022 % + 12 µV	
	(20 to 40) Hz	85 µV/V + 7.0 µV	
	40 Hz to 20 kHz	75 µV/V + 7.0 µV	
	(20 to 50) kHz	0.018 % + 7.0 µV	
	(50 to 100) kHz	0.042 % + 17 µV	
	(100 to 300) kHz	0.075 % + 20 µV	
	(300 to 500) kHz	0.12 % + 25 µV	
	500 kHz to 1 MHz	0.25 % + 45 µV	
220 mV to 2.2 V	(10 to 20) Hz	0.023 % + 40 µV	
	(20 to 40) Hz	81 µV/V + 15 µV	
	40 Hz to 20 kHz	40 µV/V + 8.0 µV	
	(20 to 50) kHz	70 µV/V + 10 µV	
	(50 to 100) kHz	0.011 % + 30 µV	
	(100 to 300) kHz	0.034 % + 80 µV	
	(300 to 500) kHz	0.090 % + 200 µV	
	500 kHz to 1 MHz	0.15 % + 300 µV	
(2.2 to 22) V	(10 to 20) Hz	0.022 % + 400 µV	
	(20 to 40) Hz	80 µV/V + 150 µV	
	40 Hz to 20 kHz	40 µV/V + 50 µV	
	(20 to 50) kHz	70 µV/V + 100 µV	
	(50 to 100) kHz	98 µV/V + 200 µV	
	(100 to 300) kHz	0.031 % + 600 µV	
	(300 to 500) kHz	0.090 % + 2.0 mV	
	500 kHz to 1 MHz	0.13 % + 3.2 mV	
(22 to 220) V	(10 to 20) Hz	0.022 % + 4.0 mV	
	(20 to 40) Hz	80 µV/V + 1.5 mV	
	40 Hz to 20 kHz	47 µV/V + 0.60 mV	
	(20 to 50) kHz	78 µV/V + 1.0 mV	
	(50 to 100) kHz	0.013 % + 2.5 mV	
	(100 to 300) kHz	0.094 % + 16 mV	
	(300 to 500) kHz	0.42 % + 40 mV	
	500 kHz to 1 MHz	0.70 % + 80 mV	
(220 to 1100) V	(15 to 50) Hz	0.026 % + 16 mV	
	50 Hz to 1 kHz	60 µV/V + 3.5 mV	

Parameter/Range	Frequency	CMC[2, 6] (±)	Comments
AC Voltage[3] – Measure			
(1 to 50) mV	(1 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.10 % + 10 µV 0.050 % + 10 µV 0.070 % + 10 µV 0.30 % + 10 µV 0.70 % + 75 µV	NI 4071
(50 to 500) mV	(1 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.10 % + 25 µV 0.050 % + 25 µV 0.070 % + 25 µV 0.20 % + 25 µV 0.70 % + 750 µV	
500 mV to 5 V	(1 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.10 % + 250 µV 0.050 % + 250 µV 0.060 % + 250 µV 0.20 % + 250 µV 0.70 % + 7.5 mV	
(5 to 50) V	(1 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.10 % + 2.5 mV 0.060 % + 5.0 mV 0.12 % + 25 mV 0.60 % + 25 mV 3.0 % + 75 mV	
(50 to 700) V	(1 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.10 % + 35 mV 0.060 % + 70 mV 0.12 % + 0.35 V 0.60 % + 0.35 V 3.0 % + 1.1 V	

Parameter/Range	Frequency	CMC[2, 6] (±)	Comments
AC Current[3] – Generate			
(0 to 220) µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 16 nA 0.014 % + 10 nA 0.011 % + 8.0 nA 0.025 % + 12 nA 0.090 % + 65 nA	Reference calibrator
(0.22 to 2.2) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.23 % + 40 nA 0.014 % + 35 nA 0.011 % + 35 nA 0.018 % + 110 nA 0.090 % + 650 nA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 400 nA 0.014 % + 350 nA 0.011 % + 350 nA 0.018 % + 550 nA 0.090 % + 5.0 µA	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 4.0 µA 0.014 % + 3.5 µA 0.011 % + 2.5 µA 0.018 % + 5.5 µA 0.090 % + 10 µA	
(0.22 to 2.2) A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.024 % + 35 µA 0.039 % + 80 µA 0.60 % + 160 µA	
2.5 A	40 Hz	1.3 mA	Reference amplifier
5 A	40 Hz	2.5 mA	
AC Current[3] – Measure			
(9 to 100) µA	1 Hz to 1 kHz	0.030 % + 20 nA	NI 4071
(0.1 to 1.0) mA (1 to 10) mA (10 to 100) mA (0.1 to 1.0) A (1 to 3) A	1 Hz to 5 kHz	0.030 % + 0.20 µA 0.030 % + 2.0 µA 0.030 % + 20 µA 0.10 % + 200 µA 0.10 % + 600 µA	

Parameter/Range	Frequency	CMC[2, 4, 6] (±)	Comments
Inductance[3] – Generate, Fixed Point			
0 H	91 Hz to 3 kHz	10 x 10^{-9} H	Two wire short
Capacitance[3] – Generate, Fixed Points			
0 F	91 Hz to 3 kHz	350 x 10^{-15} F	Open test standard reference capacitors
270 pF	3 kHz	0.13 %	
1 nF	3 kHz	0.06 %	
100 nF	3 kHz	0.02 %	
100 nF	1 kHz	0.06 %	
10 µF	1 kHz	0.04 %	
10 µF	91 Hz	0.07 %	
1000 µF	91 Hz	0.16 %	

Parameter/Equipment	Range	CMC[2, 6] (±)	Comments
Thermocouple Simulation[3] –			
Type E	(18 to 28) °C	0.07 °C	Thermocouple simulator

Parameter/Equipment	Range	CMC[2, 4, 6] (±)	Comments
Oscilloscope Functions[3] –			
Amplitude – DC Voltage			
1 MΩ	1 mV to 200 V	0.019 % + 19 µV	Oscilloscope calibrator
50 Ω	1 mV to 5 V	0.019 % + 19 µV	
Bandwidth Reference to 50 kHz	(1.1 to 400.1) MHz 475.1 MHz 1500.1 MHz	0.13 dB 0.53 dB 0.25 dB	Generator with sensor/splitter
Sine Wave Amplitude – 50 kHz	(0.125 to 0.5) V_{p-p} (0.7 to 1.4) V_{p-p} (2.5 to 5) V_{p-p} (7 to 20) V_{p-p}	0.013 dB 0.012 dB 0.015 dB 0.023 dB	Generator/DMM as transfer standard
Input Impedance	50 Ω 1 MΩ	41 mΩ 0.80 kΩ	Oscilloscope calibrator
Capacitance	15 pF 20 pF	0.43 pF 0.52 pF	
Time Base Accuracy	(11 to 100) MHz	0.3 µHz/Hz	
RMS noise	(0 to 0.11) % (0.11 to 2.5) %	0.001 % of full scale 0.018 % of full scale	50 Ω termination

II. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC[2, 6] (±)	Comments
RF Absolute Power[3] – Generate & Measure			
-90 dBm	(85 to 2005) MHz	0.67 dB	Ratio measurement
-90 dBm	(2005 to 6600) MHZ	0.81 dB	
-60 dBm	(10 to 80) MHz	0.36 dB	Power meter, power sensor, power splitter, signal generator
(-70 to -60) dBm	(80 to 1800) MHz	0.21 dB	
(-70 to -60) dBm	(1800 to 4800) MHz	0.27 dB	
(-70 to -60) dBm	(4800 to 6000) MHz	0.30 dB	
-55.0 dBm	(10 to 6600) MHz	0.36 dB	
(-50 to -10) dBm	(10 to 8400) MHz	0.22 dB	
(-50 to -10) dBm	(8400 to 14000) MHz	0.26 dB	Spectrum analyzer
-5.0 dBm	(10 to 6600) MHz	0.41 dB	
0.0 dBm	(10 to 80) MHz	0.39 dB	
0.0 dBm	(80 to 6600) MHz	0.24 dB	
5.0 dBm	(10 to 6600) MHz	0.41 dB	
10.0 dBm	(10 to 80) MHz	0.41 dB	
10.0 dBm	(80 to 3800) MHz	0.25 dB	
10.0 dBm	(3800 to 6000) MHz	0.30 dB	
10.0 dBm	(6000 to 6600) MHz	0.41 dB	
15.0 dBm	(10 to 6600) MHz	0.41 dB	
(20 to 30) dBm	(80 to 3800) MHz	0.25 dB	
(20 to 30) dBm	(3800 to 6000) MHz	0.30 dB	
(1 to 10) dBm	(10 & 100) MHz	0.25 dB	
RF Absolute Power[3] – Measure			
10 dBm	(10 to 3000) MHz	0.19 dB	Spectrum analyzer, power meter, power sensor
9.5 dBm	(800 & 4000) MHz	0.12 dB	
7.5 dBm	(3200 to 8300) MHz	0.29 dB	
7 dBm	3300 MHz	0.20 dB	
(5 to -45) dBm	(0.5 to 10) MHz	0.10 dB	
(-45 to -50) dBm	(0.5 to 10) MHz	0.16 dB	
(5 to -50) dBm	(10 to 200) MHz	0.17 dB	
(5 to -45) dBm	(200 to 2500) MHz	0.10 dB	
(-45 to -50) dBm	(200 to 2500) MHz	0.20 dB	
(5 to -50) dBm	(2500 to 3600) MHz	0.20 dB	
0 dBm	(3300 to 6600) MHz	0.30 dB	
(-55 to -60) dBm	(0.5 to 3300) MHz	1.0 dB	
(-60 to -70) dBm	(0.5 to 3000) MHz	1.0 dB	
(-70 to -80) dBm	(0.5 to 2500) MHz	1.0 dB	

Parameter/Range	Frequency	CMC[2, 6] (±)	Comments
RF Absolute Power[3] – Measure (cont)			Spectrum analyzer, power meter, power sensor
(-80 to -90) dBm	(0.5 to 1500) MHz	1.0 dB	
(-90 to -100) dBm	(0.5 to 500.1) MHz	1.0 dB	
RF Relative Power[3] – Measure			
-36 dBm	100 MHz	3.2 dB	Spectrum analyzer
-36 dBm	(100 to 6000) MHz	2.4 dB	
(0 to -30) dBm	80 MHz	2.3 dB	
(0 and -30) dBm	(80 to 3600) MHz	0.90 dB	
(0 and -30) dBm	(3600 to 6000) MHz	2.3 dB	
(0 and -30) dBm	(6000 to 6600) MHz	2.5 dB	
(-20 to -10) dBm	(80 to 6000) MHz	2.3 dB	
-6 dBm	100 MHz	1.8 dB	
-6 dBm	(100 to 6000) MHz	1.4 dB	
Average Noise Level – Measure			
-60 dBm	(100 to 6000) MHz	1.1 dB	Vector signal analyzer NI 5663E spectrum analyzer
-50 dBm	(10 to 200) MHz	1.1 dB	
-50 dBm	(200 to 8400) MHz	0.92 dB	
-50 dBm	(8400 to 14 000) MHz	1.4 dB	
-30 dBm	(85 to 3600) MHz	0.55 dB	
-30 dBm	(3600 to 6600) MHz	2.1 dB	
-10 dBm	(10 to 20) MHz	2.5 dB	
-10 dBm	(85 to 4000) MHz	0.59 dB	
-10 dBm	(4000 to 6000) MHz	1.1 dB	
-10 dBm	(6000 to 6600) MHz	2.2 dB	
0 dBm	(85 to 3600) MHz	0.59 dB	
0 dBm	(3600 to 6000) MHz	1.2 dB	
0 dBm	(6000 to 6600) MHz	2.2 dB	
10 dBm	(85 to 3600) MHz	0.69 dB	
10 dBm	(3600 to 6000) MHz	1.2 dB	
10 dBm	(6000 to 6600) MHz	2.2 dB	

Parameter/Range	Frequency	CMC[2, 6] (±)	Comments
SSB Phase Noise[3] – Measure			
Carrier Frequency:	Offset:		Spectrum analyzer
800 MHz	100 Hz	3.2 dB	
800 MHz	1 kHz to 1 MHz	1.6 dB	
800 MHz	5 MHz	2.5 dB	
4000 MHz	100 Hz to 5 MHz	1.7 dB	
5412.5 MHz	100 Hz to 5 MHz	1.6 dB	
7812.5 MHz	100 Hz to 5 MHz	2.0 dB	
(500 to 3300) MHz	0 dBm	0.70 dB	
(3300 to 6600) MHz	0 dBm	2.2 dB	
Harmonics	(10 to 200) MHz	1.4 dB	
	(200 to 3600) MHz	0.62 dB	
	(3600 to 6000) MHz	1.5 dB	
Non-Harmonics	(35 to 3300) MHz	0.60 dB	
	(3300 to 6000) MHz	1.4 dB	
Spurious Response – Down to -95 dBm	10 MHz to 14 GHz	0.90 dB	
RMS EVM[3] –			
-10 dBm	(400 to 6000) MHz	0.05 dB	Spectrum analyzer
AC Relative Power – Measure[3]			
(-4 to 12) dBm	(1 to 20) MHz	0.062 dB	Power sensor, power meter

III. Time & Frequency

Parameter/Equipment	Range	CMC[2] (±)	Comments
Frequency[3] – Measuring Equipment	0.1 Hz to 80 MHz 10 MHz 2.2 GHz	3.9 µHz/Hz 0.5 nHz/Hz 39 nHz/Hz	Frequency generator Rubidium frequency standard
Frequency[3] – Measure	10 kHz 1 MHz 5 MHz 100 MHz 110 MHz 400 MHz	9.5 µHz/Hz 2.4 µHz/Hz 8.6 µHz/Hz 3.4 nHz/Hz 1.9 nHz/Hz 0.42 µHz/Hz	Frequency counter Spectrum analyzer
Time Interval[3]	Up to 120 ns	13 ps	Phase locked oscilloscope
Relative Phase Matching[3] 9 V, 1 kHz, Sine Wave 9 V, 20 kHz, Sine Wave	WITHDRAWN ± 0.045° ± 0.9°	WITHDRAWN 0.001° 0.008°	WITHDRAWN Voltage input module

[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] 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 Calibration and Measurement Capability Uncertainty (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 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] In the statement of CMC, the value is defined as the percentage of reading, unless otherwise noted.

[5] The contributions from the "best existing device" are not included in the CMC claim.

[6] 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.

WITHDRAWN

Accredited Laboratory

A2LA has accredited

NI HUNGARY KFT

Debrecen, HUNGARY

for technical competence in the field of

Calibration

WITHDRAWN

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 *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 11th day of September 2018.

President and CEO
For the Accreditation Council
Certificate Number 3634.01
Valid to October 31, 2020
Revised on October 4, 2018

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