



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

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CALIBRATION

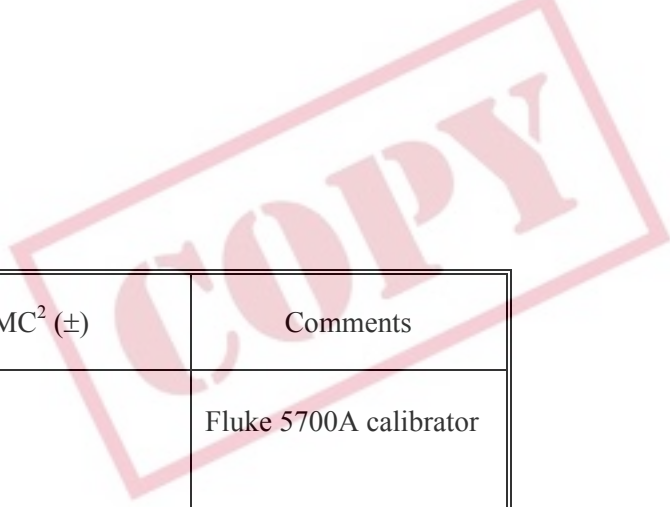
Valid until: September 30, 2015

Certificate Number: 2900.02

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 (±)	Comments
DC Voltage – Generate	(10 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1000) V	2.8 µV 0.017 mV 0.11 mV 0.17 mV 3.9 mV 9.6 mV	Fluke 5700A calibrator
DC Voltage – Measure	(1 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	2.1 µV 6.8 µV 54 µV 0.79 mV 7.2 mV	Agilent 3458A digital multimeter



Parameter/Equipment	Range	CMC ² (±)	Comments
DC Current – Generate	(10 to 220) µA	15 A	Fluke 5700A calibrator
	(0.22 to 2.2) mA	0.12 A	
DC Current – Measure	(2.2 to 22) mA	1.1 µA	Datron 9000 calibrator Yokogawa 2215 shunt resistor
	(22 to 220) mA	13 µA	
	(0.22 to 2.2) A	0.40 mA	
	(2 to 10) A	8.4 mA	
	(10 to 20) A	20 mA	
	(20 to 100) A	0.27 A	
DC Current – Measure	(1 to 100) µA	33 nA	Agilent 3458A digital multimeter
	(0.1 to 1) mA	30 nA	
	(1 to 10) mA	0.32 µA	
	(10 to 100) mA	4.7 µA	
	(0.1 to 1) A	0.14 mA	

Parameter/Range	Frequency	CMC ² (±)	Comments
AC Voltage – Generate (10 to 220) mV	(10 to 20) Hz	0.17 mV	Fluke 5700A calibrator
	(20 to 40) Hz	63 µV	
	40 Hz to 20 kHz	35 µV	
	(20 to 50) kHz	90 µV	
	(50 to 100) kHz	0.23 mV	
	(100 to 300) kHz	0.28 mV	
	(300 to 500) kHz	0.44 mV	
	500 kHz to 1 MHz	0.90 mV	
(0.22 to 2.2) V	(10 to 20) Hz	1.7 mV	
	(20 to 40) Hz	1.9 mV	
	40 Hz to 20 kHz	1.4 mV	
	(20 to 50) kHz	2.0 mV	
	(50 to 100) kHz	1.7 mV	
	(100 to 300) kHz	1.4 mV	
	(300 to 500) kHz	5.0 mV	
	500 kHz to 1 MHz	17 mV	

Peter Abney

Parameter/Range	Frequency	CMC ² (±)	Comments
AC Voltage – Generate (cont)			
(2.2 to 22) V	(10 to 20) Hz (20 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	13 mV 32 mV 1.8 mV 2.9 mV 5.9 mV 13 mV 51 mV 69 mV	Fluke 5700A calibrator
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz (40 to 20 k) Hz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz	0.12 mV 38 mV 19 mV 83 mV 0.12 V 0.43 V 0.44 V	
(220 to 700) V	(15 to 50) Hz 50 Hz to 1 kHz	0.30 V 60 mV	
AC Voltage – Measure			
(10 to 100) mV	(10 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	13 μV 11 μV 19 μV 38 μV 0.15 mV 0.37 mV 1.2 mV	Agilent 3458A digital multimeter

Parameter/Range	Frequency	CMC ² (±)	Comments
AC Voltage – Measure (cont)			
(0.1 to 1) V	(10 to 40) Hz	0.13 mV	Agilent 3458A digital multimeter
	40 Hz to 1 kHz	0.11 mV	
	(1 to 20) kHz	0.19 mV	
	(20 to 50) kHz	0.38 V	
	(50 to 100) kHz	1.0 mV	
	(100 to 300 kHz 300 kHz to 1 MHz	3.7 mV 12 V	
(1 to 10) V	(10 to 40) Hz	1.3 mV	
	40 Hz to 1 kHz	1.1 mV	
	(1 to 20) kHz	1.9 mV	
	(20 to 50) kHz	3.8 mV	
	(50 to 100) kHz	9.6 mV	
	(100 to 300 kHz 300 kHz to 1 MHz	37 mV 0.22 V	
(10 to 100) V	(10 to 40) Hz	28 mV	
	40 Hz to 1 kHz	26 mV	
	(1 to 20) kHz	26 mV	
	(20 to 50) kHz	43 mV	
	(50 to 100) kHz	0.15 V	
	(100 to 300 kHz 300 kHz to 1 MHz	0.48 V 1.8 V	
(100 to 700) V	(10 to 40) Hz	0.38 V	
	40 Hz to 1kHz	0.35 V	
	(1 to 20) kHz	0.52 V	
	(20 to 50 kHz)	1.1 V	
	(50 to 100) kHz	2.5 V	

Parameter/Range	Frequency	CMC ² (±)	Comments
AC Current – Generate			
(1 to 220) µA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz	0.19 µA 98 nA 48 nA 0.18 µA	Fluke 5700A calibrator
(0.22 to 2.2) mA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5k Hz	1.6 µA 0.80 µA 0.35 µA 1.8 µA	
(2.2 to 22) mA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz	16 µA 8.1 µA 3.5 µA 18 µA	
(22 to 220) mA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz	0.16 mA 82 µA 35 µA 0.18 mA	
(0.22 to 1) A	20 Hz to 1 kHz (1 to 5) kHz	0.69 mA 0.84 mA	
(1 to 10) A	50,60 Hz	28 mA	Yokogawa Datron 9000 calibrator
(10 to 20) A	60 Hz	65 mA	
(20 to 80) A	60 Hz	0.28 A	
(80 to 100) A	60 Hz	0.31 A	Tokyo Seiden CTL1-3-0.1 current transformer

Parameter/Range	Frequency	CMC ² (±)	Comments
AC Current – Measure			
(1 to 100) μA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz	0.51 μA 0.21 μA 0.11 μA	Agilent 3458A digital multimeter
(0.1 to 1) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.9 μA 1.0 μA 1.0 μA 0.59 μA	
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	50 μA 20 μA 9.4 μA 0.62 mA	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.50 mA 0.20 mA 94 μA 59 μA	
(0.1 to 1) A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.9 mA 2.1 mA 1.2 mA 1.5 mA	

Parameter/Equipment	Range	CMC ² (±)	Comments
Resistance Standard	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ	97 μ Ω 0.19 m Ω 0.29 m Ω 0.52 m Ω 1.7 m Ω 3.4 m Ω 14 m Ω	Fluke 5700A calibrator

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Resistance Standard (cont)	1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	26 m Ω 0.13 Ω 0.24 Ω 1.5 Ω 2.7 Ω 21 Ω 41 Ω 0.42 kΩ 0.93 kΩ 12 kΩ	Fluke 5700A calibrator
Resistance – Measure	(1 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	0.24 mΩ 2.1 mΩ 13 mΩ 0.30 Ω 1.3 Ω 20 Ω 0.72 kΩ 62 kΩ 6.2 MΩ	Agilent 3458A digital multimeter
AC Power – Measure			
Voltage: 100 V Current: 1 A Power Factor: 1	100 W	0.42 %	Yokogawa 7604 - 01 power meter
Voltage: 100 V Current: 10 A Power Factor: 1	1 kW	0.30 %	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Oscilloscope –			
DC Voltage	10 mV to 1000 V	0.028 %	Fluke 5700A Calibrator
AC Voltage	10 mV to 700 V, from 40 Hz to 20 kHz	0.64 %	
Frequency Response	10 Hz to 1 MHz, from .1V to 220 V	1.7 %	
Frequency	10 mHz to 15 MHz	0.16 %	

II. Electrical - Microwave/RF

Parameter/Equipment	Range	CMC ^{2,3} (±)	Comments
RF Power – Absolute Measure	9 kHz to 6 GHz 50 MHz to 26.5 GHz	0.16 dB 0.16 dB	Agilent E4418B power meter Agilent E9304A power sensor Agilent 8485A power sensor
RF Power – Relative Measure (General RF Insertion Loss/Gain)	9 kHz to 8.5 GHz	0.41 dB	Agilent E5071C network analyzer
RF Power – Absolute Generate			
(-60 to +10) dBm	9 kHz to 1000 MHz to 20 dB to 18 dB	1.2 dB	R&S SMB100A signal generator
(-60 to +10) dBm	(1 to 18) GHz	1.6 dBm	R&S SMR40 signal generator

Parameter/Equipment	Range	CMC ^{2,3,4} (±)	Comments
Impedance, VSWR – Measure			Agilent E5071C network analyzer
One Port Device	9 kHz to 1000 MHz, 20 dB to 18 dB	0.35 %	
Two Port Device	(1 to 18) GHz	0.5 %	
Signal Generator –	10 Hz to 10 MHz	0.051 Hz	Cosmos GCET frequency standard
Output Frequency	10 MHz to 1 GHz	16 Hz	Anritsu MF2414B frequency counter
	600 MHz to 40 GHz	4.2 kHz	
Output Level	(-60 to +10) dBm from 9 kHz to 6 GHz	0.16 dBm	Agilent E4418B power meter
	(-60 to +10) dBm from 50 MHz to 26.5 GHz	0.16 dBm	Agilent E9304A power sensor Agilent 8485A power sensor
Amplitude Modulation – Measure	150 kHz to 1300 MHz	1.2 %	HP 8901A modulation analyzer
Frequency Modulation – Measure	150 kHz to 1300 MHz	1.2 %	HP 8901A modulation analyzer
LISN –			
Insertion Loss	9 kHz to 3 GHz	0.28 dB	CISPR 16-1-2:2006
Impedance (Magnitude)	9 kHz to 3 GHz	4.0 %	Agilent E5071C network analyzer
Impedance (Phase)	9 kHz to 3 GHz	0.29 Degree	
Isolation	9 kHz to 3 GHz	0.34 dB	

Parameter/Equipment	Range	CMC ^{2,3,4} (±)	Comments
Antenna Factor (Calibration distance: 10 m)			ANSI C63.5 (1998) standard site method Agilent E5071C network analyzer
Log Periodic	(25 to 1000) MHz	1.2 dB	
Biconical	(25 to 1000) MHz	1.0 dB	
EMI Receiver - Input Impedance & VSWR	9 kHz to 8.5 GHz	0.35 %	CISPR 16-1-1 (2010) Agilent E5071C network analyzer
EMI Receiver – Absolute Pulse Response	9 kHz to 1 GHz	1.5 dB	R&S SMB100A signal generator R&S SMR40 signal generator Schwarzbeck IGUU2918 CISPR pulse generator
EMI Receiver – Relative Pulse Response	9 kHz to 1 GHz	1.5 dB	Schwarzbeck IGUU2918 CISPR pulse generator
EMI Receiver – Intermittent Response	9 kHz to 23.4375 MHz 23.4375 MHz to 1 GHz	2.2 % 6.0 %	R&S SMB100A signal generator
EMI Receiver – Sine-Wave Accuracy	9 kHz to 1 GHz (1 to 3) GHz	1.3 dB 1.3 dB	R&S SMB100A signal generator R&S SMR40 signal generator

Parameter/Equipment	Range	CMC ^{2,3,4} (±)	Comments
EMI Receiver – Selectivity	CISPR B and A band B band C band D band E band	15 Hz 0.18 kHz 2.6 kHz 2.7 kHz 49 KHz	R&S SMB100A signal generator R&S SMR40 signal generator
Adapters, Insertion Loss – (50 to 150) Ω	10 kHz to 230 MHz	0.082 dB	IEC 61000-4-6 (2008) Agilent E5071C network analyzer
CDN – Impedance	9 kHz to 230 MHz	4.0 %	IEC 61000-4-6 (2008) Agilent E5071C network analyzer
Bulk Current Injection Probe and Fixture – Insertion Loss VSWR	10 kHz to 400 MHz 10 kHz to 400 MHz	0.090 dB 3.0 %	Agilent E5071C network analyzer
Frequency – Measure	10 Hz to 10 MHz 10 MHz to 1 GHz 600 MHz to 40 GHz	0.051 Hz 16 Hz 4.2 kHz	Cosmos GCET frequency standard Anritsu MF2414B frequency counter

Parameter/Equipment	Range	CMC ^{2,3,4} (±)	Comments
Frequency – Generate	10 MHz GPS common view	1.4 x 10 ⁻⁶ Hz	Cosmos GCET frequency standard
	9 Hz to 1 GHz	0.0068 Hz	R&S SMB100A signal generator
	(1 to 18) GHz	1.2 kHz	R&S SMR40 signal generator
Spectrum Analyzer –			
Calibration Output Frequency	(10 to 50) MHz	1.8 Hz	Cosmos GCET frequency standard
Calibration Level	(10 to 50) MHz	0.16 dB	Anritsu MF2414B frequency counter
Frequency Readout Accuracy, Counter Accuracy	9 kHz to 1 GHz (1 to 3) GHz	0.012 Hz	Agilent E4418B power meter Agilent E9304A power sensor
Frequency Response	9 kHz to 1 GHz (1 to 3) GHz	0.8 dB 1.3 dB	Agilent 8485A power sensor R&S SMB100A signal generator
Resolution Bandwidth Accuracy	1 KHz to 3 MHz	2.4 %	R&S SMR 40 signal generator Agilent 8496 attenuator
Resolution Bandwidth Selectivity	300 Hz to 20 MHz	2.4 %	Agilent E5071C network analyzer
Reference Level Switching Accuracy	(0 to -60) dBm	0.16 dB	
VSWR	10 kHz to 3 GHz	1.9 %	

- ¹ This laboratory offers commercial 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 Uncertainty does not include mismatch error due to connections of the device to other devices in actual use. Mismatch uncertainties, due to the reflection coefficient of the device to be calibrated, are to be included in the overall measurement uncertainty, The approach of determining expanded uncertainties at approximately the 95% level of confidence, (using a coverage factor of $k = 2$) is to be applied for this calculation as well.
- ⁴ In the statement of CMC, the value is defined as the percentage of reading.



American Association for Laboratory Accreditation

Accredited Laboratory

A2LA has accredited

COSMOS CORPORATION

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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 21st day of March 2014.



President & CEO
For the Accreditation Council
Certificate Number 2900.02
Valid to September 30, 2015

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