



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

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CALIBRATION

Valid To: June 30, 2019

Certificate Number: 2067.01

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 ^{2,5,9} (±)	Comments
DC Voltage ³ – Measure	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V	64 μV/V + 3.5 μV 51 μV/V + 7 μV 46 μV/V + 50 μV 56 μV/V + 0.6 mV 56 μV/V + 10 mV	Agilent 34401A
DC Voltage ³ – Generate	(0 to 320) mV (0.32 to 3.2) V (3.2 to 33) V (33 to 330) V (330 to 1020) V	72 μV/V + 3 μV 61 μV/V + 5 μV 61 μV/V + 50 μV 67 μV/V + 500 μV 67 μV/V + 1.5 mV	Fluke 5500A
DC Current ³ – Measure	(1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 3) A (3 to 10) A	0.06 % + 2 μA 0.06 % + 5 μA 0.12 % + 0.1 mA 0.14 % + 0.6 mA 2 %	Agilent 34401A 0.1 Ω shunt

Parameter/Equipment	Range	CMC ^{2,5,9} (±)	Comments
DC Current ³ – Generate	(0 to 3.3) mA (3.3 to 33) mA (33 to 330) mA (0.33 to 2.2) A (2.2 to 11) A	0.06 % + 0.05 μA 0.06 % + 0.25 μA 0.06 % + 3.3 μA 0.07 % + 44 μA 0.09 % + 330 μA	Fluke 5500A

Parameter/Range	Frequency	CMC ^{2,5,9} (±)	Comments
AC Voltage ³ – Measure			
(10 to 100) mV	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.07 % + 40 μV 0.14 % + 50 μV 0.7 % + 80 μV	Agilent 34401A
100 mV to 1.0 V	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.07 % + 0.3 mV 0.14 % + 0.5 mV 0.7 % + 0.8 mV	
(1 to 10) V	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.07 % + 3 mV 0.14 % + 5 mV 0.7 % + 8 mV	
(10 to 100) V	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.07 % + 30 mV 0.14 % + 50 mV 0.7 % + 80 mV	
(100 to 750) V	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.07 % + 230 mV 0.14 % + 380 mV 0.7 % + 600 mV	
10 mV to 100 V	DC to 1.5 GHz	2.4 %	Tek TDS 7254B
(0.1 to 20) kV _{RMS} (0.1 to 40) kV _{peak}	10 Hz to 50 MHz 10 Hz to 50 MHz	3.8 % 3.8 %	Oscilloscope w/ probe P6015

Parameter/Range	Frequency	CMC ^{2, 5, 9} (±)	Comments
AC Voltage ³ – Generate			
(1.0 to 33) mV	45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz	0.21 % + 20 μV 0.26 % + 20 μV 0.31 % + 20 μV	Fluke 5500A
(33 to 330) mV	45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz	0.06 % + 20 μV 0.12 % + 20 μV 0.19 % + 40 μV	
(0.33 to 3.3) V	45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz	0.04 % + 60 μV 0.09 % + 60 μV 0.16 % + 0.3 mV	
(3.3 to 33) V	45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz	0.05 % + 0.6 mV 0.09 % + 2.6 mV 0.22 % + 5 mV	
(33 to 330) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz	0.06 % + 6.6 mV 0.09 % + 15 mV 0.09 % + 33 mV	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.06 % + 80 mV 0.23 % + 100 mV 0.23 % + 500 mV	
AC Current ³ – Measure			
(0 to 1) A	10 Hz to 5 kHz	0.13 % + 0.4 mA	Agilent 34401A
(1 to 3) A	10 Hz to 5 kHz	0.2 % + 1.8 mA	
(3 to 10) A	10 Hz to 500 Hz	2.0 %	0.1 Ω shunt
(1 to 5000) A _{peak}	1 Hz to 20 MHz	3.2 %	Oscilloscope w/ Pearson 110 current monitor coil

Parameter/Range	Frequency	CMC ^{2, 5, 9} (±)	Comments
AC Current ³ – Generate			
(0.03 to 0.33) mA	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.15 % + 0.25 μA 0.46 % + 0.15 μA 1.5 % + 0.15 μA	Fluke 5500A
(0.33 to 3.3) mA	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.12 % + 0.3 μA 0.23 % + 0.3 μA 0.69 % + 0.3 μA	
(3.3 to 33) mA	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.11 % + 3 μA 0.23 % + 3 μA 0.69 % + 3 μA	
(33 to 330) mA	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.11 % + 30 μA 0.23 % + 30 μA 0.69 % + 30 μA	
(0.33 to 2.2) A	45 Hz to 1 kHz (1 to 5) kHz	0.12 % + 0.3 mA 0.87 % + 0.3 mA	
(2.2 to 11) A	45 Hz to 65 Hz (65 to 500) Hz (0.5 to 1) kHz	0.08 % + 2 mA 0.12 % + 2 mA 0.38 % + 2 mA	
Distortion ³	20 Hz to 20 kHz	2.4 % of reading	Texio VA2230
Inductance ³ – Measure			
32 μH to 1 H	1 kHz	0.76 %	NF ZM2371 LCR meter

Parameter/Equipment	Range	CMC ^{2, 5, 9} (±)	Comments
Resistance ³ – Measure	(0 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	0.04 % + 4 mΩ 0.04 % + 10 mΩ 0.04 % + 100 mΩ 0.04 % + 1 Ω 0.04 % + 10 Ω 0.06 % + 100 Ω 0.93 % + 10 kΩ	Agilent 34401A
Resistance ³ – Generate	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (0.33 to 1.1) kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) 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	0.03 % + 0.008 Ω 0.03 % + 0.01 Ω 0.03 % + 0.01 Ω 0.03 % + 0.01 Ω 0.03 % + 0.06 Ω 0.03 % + 0.06 Ω 0.03 % + 0.6 Ω 0.03 % + 0.6 Ω 0.03 % + 6 Ω 0.03 % + 6 Ω 0.03 % + 55 Ω 0.03 % + 55 Ω 0.07 % + 0.55 kΩ 0.12 % + 0.55 kΩ 0.6 % + 5.5 kΩ 0.6 % + 17 kΩ	Fluke 5500A
Capacitance ³ – Measure 8 pF to 3 mF	 1 kHz	 0.2 %	 NF ZM2371 LCR meter

Parameter/Equipment	Range	CMC ^{2, 5, 9} (±)	Comments
Reference Impedance Networks ³ –			
Resistance: DC	(0.05 to 1) Ω	0.2 %	NF ZM2371 LCR meter
Inductance Measure: 1 kHz	32 μH to 1 H	0.76 %	NF ZM2371 LCR meter
AC Stabilization Power Supplies (CVCF) ³ –			
AC Voltage: (50 to 400) Hz	(100 to 750) V	0.13 % + 230 mV	Agilent 34401A, oscilloscope, Pearson current monitor, AC voltage divider, audio analyzer
Frequency	(50 to 400) Hz	0.04 %	
Phase Angle	(0 to 360) ^o	0.7 %	
Distortion: 2 nd to 10 th	(0 to 80) %	2.7 %	
Regulation	(1 to 50) A	2.7 %	
AC Current: (50 to 400) Hz	(1 to 100) A	2.2 %	

II. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2, 6, 7} (±)	Comments
RF Power, Relative ³ – Measure			
(0 to 50) dB	5 Hz to 500 MHz	0.3 dB	Network analyzer HP 8751A
(50 to 60) dB	5 Hz to 500 MHz	0.5 dB	
(60 to 70) dB	5 Hz to 500 MHz	1.1 dB	

Parameter/Range	Frequency	CMC ^{2, 4, 6, 7, 9} (\pm)	Comments
RF Power, Relative ³ – Measure (cont)			
(0 to 50) dB	30 kHz to 3 GHz	0.3 dB	Network analyzer HP 8753ES
(50 to 60) dB	30 kHz to 3 GHz	0.4 dB	
(60 to 70) dB	30 kHz to 3 GHz	0.5 dB	
(0 to 40) dB	300 kHz to 6 GHz (6 to 20) GHz	0.5 dB 0.5 dB	Network analyzer Advantest R3770
(40 to 50) dB	300 kHz to 20 GHz (6 to 20) GHz	0.5 dB 0.6 dB	
(50 to 70) dB	300 kHz to 20 GHz (6 to 20) GHz	0.6 dB 0.6 dB	
(0 to 50) dB	45 MHz to 40 GHz	0.5 dB	Network analyzer Agilent N5230A
(50 to 60) dB	45 MHz to 40 GHz	0.7 dB	
(60 to 70) dB	45 MHz to 40 GHz	1.0 dB	
VSWR ³ –			
(-10 to 0) dBm	5 Hz to 500 MHz	1.7 %	Network analyzer HP 8751A with calibration kit
	500 MHz to 3 GHz (3 to 20) GHz	2.1 % 3.7 %	Network analyzer Advantest R3770 with calibration kit
	(20 to 40) GHz	5.6 %	Network analyzer Advantest N5230A with calibration kit
RF Power, Absolute ³ – Measure			
(-60 to 20) dBm	9 kHz to 6 GHz	0.26 dB + <i>M</i>	Power meter and power sensor
(-70 to 20) dBm	50 MHz to 50 GHz	0.32 dB + <i>M</i>	

Parameter/Range	Frequency	CMC ^{2, 4, 6, 7} (\pm)	Comments
RF Power ³ – Generate (-37 to 30) dBm (-37 to 10) dBm (-10 to 10) dBm (-27 to -5) dBm	5 Hz to 15 MHz 15 MHz to 1 GHz (1 to 4) GHz (4 to 40) GHz	0.21 dB + <i>M</i> 0.55 dB + <i>M</i> 0.59 dB + <i>M</i> 0.73 dB + <i>M</i>	Signal generators, power dividers, and power meter/sensor
Attenuation ³ – Generate (0 to 80) dB, 10 dB Steps	DC to 6 GHz (6 to 12.4) GHz (12.4 to 18) GHz (18 to 26.5) GHz (26.5 to 40) GHz	0.4 dB 0.5 dB 0.6 dB 0.6 dB 0.7 dB	Step attenuators
Broadband NSA Measurements ³	(30 to 300) MHz (200 to 1000) MHz (30 to 300) MHz (300 to 1000) MHz (1 to 40) GHz	1.0 dB 1.0 dB 1.1 dB 1.1 dB 1.4 dB	ANSI C63.4, ANSI C63.4a-2017, CISPR 16-1-4, network analyzer ETSI TS 102 321
Dipole NSA Measurements ³	(30 to 1000) MHz	1.1 dB	ANSI C63.4, ANSI C63.4a-2017, CISPR 16-1-4, network analyzer
SVSWR Validation ³	(1 to 18) GHz	1.3 dB	ANSI C63.4, CISPR 16-1-4, network analyzer

Parameter/Range	Frequency	CMC ^{2, 6, 7} (\pm)	Comments	
EM Field Uniformity ³	(80 to 1000) MHz (1 to 18) GHz	1.2 dB 1.8 dB	IEC 61000-4-3	
Shield Effectiveness ³	10 kHz to 18 GHz	2.0 dB	EN 50147-1	
Electric Field Probes ⁸	10 kHz to 1 GHz 100 kHz to 1 GHz	1.0 dB 1.0 dB	IEEE1309 G-TEM using substitution method with transfer standard	
	(1 to 4) GHz (4 to 18) GHz	1.3 dB 1.4 dB	Anechoic chamber using substitution method with transfer standard	
Antenna Factor ^{3, 8} –	Broad Band Antennas, Bi-conical, LPD, Hybrid	(25 to 2000) MHz	0.7 dB	SSM per ANSI C63.5 (1988, 1998, 2006, 2017)
		(25 to 2000) MHz	1.2 dB	SAE ARP 958
		(30 to 1000) MHz	0.7 dB	CISPR16-1-6
	Dipole Antennas	(30 to 1000) MHz	1.0 dB	RAM per ANSI C63.5 (1988, 1998, 2006, 2017)
	Horn Antennas	800 MHz to 18 GHz (18 to 40) GHz	1.1 dB 1.1 dB	SSM per ANSI C63.5 (1988, 1998, 2006, 2017) TAM per CISPR 16-1-6
		800 MHz to 18 GHz (18 to 40) GHz	1.2 dB 1.4 dB	SAE ARP 958

Parameter/Range	Frequency	CMC ^{2, 4, 6, 7} (±)	Comments
Antenna Factor ^{3, 8} – (cont)			
Antenna Pattern Measurement	800 MHz to 18 GHz (18 to 40) GHz	0.7 dB 1.0 dB	Network analyzer
Loop Antenna/Loop Sensor	10 Hz to 10 MHz (10 to 30) MHz	0.9 dB 1.0 dB	IEEE 291-1991
Rod Antenna	10 Hz to 60 MHz	0.7 dB	Equivalent capacitance substitution method (ECSM) per CISPR 16-1-6, ANSI C63.5 (1988, 1998, 2006, 2017)
Ambient Noise ³	150 kHz to 30 MHz (30 to 1000) MHz (1 to 26.5) GHz	1.1 dB 1.6 dB 3.5 dB	CISPR 22 Sec. 8.1, FCC Part 15
Antenna Symmetry ³	30 MHz to 20 GHz	0.4 dB	ANSI C63.5 (1988, 1998, 2006, 2017) CISPR 16-1-6
LISN ³ –			
Insertion Loss	9 kHz to 100 MHz (100 to 300) MHz	0.6 dB 1.3 dB	CISPR 16-1-2, ANSI C63.5 (1988, 1998, 2006, 2017)
Isolation	9 kHz to 100 MHz (100 to 300) MHz	0.6 dB 1.4 dB	
Impedance – Magnitude	9 kHz to 100 MHz (100 to 300) MHz	0.6 dB 1.2 dB	
Impedance – Phase (0 to +/- 180)°	9 kHz to 100 MHz (100 to 300) MHz	3.5° 6.2°	

Parameter/Range	Frequency	CMC ^{2, 4, 6, 7, 9} (\pm)	Comments
ISN ³ – Voltage Division Factor Decoupling Factor LCL	150 kHz to 30 MHz 150 kHz to 30 MHz LCL 55 dB LCL 65 dB LCL 75 dB	0.5 dB 0.5 dB 0.8 dB 1.1 dB 1.4 dB	CISPR 16-1-2
CDN's and Adapters ³ – (50 to 150) Ω Adapter Insertion Loss Coupling Factor Impedance	10 kHz to 230 MHz 10 kHz to 230 MHz 10 kHz to 230 MHz	0.5 dB 0.7 dB 4.1 %	IEC 61000-4-6 Network analyzer and calibration kits
Absorbing Clamp ³ – Clamp Factor Decoupling Factor	(30 to 300) MHz 300 MHz to 1 GHz 30 MHz to 1 GHz	3.1 dB 3.6 dB 0.9 dB	CISPR 16-1-3 Original method Network analyzer
Current Probes and Bulk Current Injection Probes ³ – Transfer Impedance	5 Hz to 500 MHz 500 MHz to 1 GHz	0.5 dB + <i>M</i> 0.6 dB + <i>M</i>	CISPR 16-1-2 HP 8751A with BNC calibration standards, Agilent 8753ES with type N calibration standards

Parameter/Range	Frequency	CMC ^{2, 6, 7, 9} (±)	Comments
ESD Simulators ³ – Contact Voltage (+ and –) Current Rise/Fall Time Air Discharge (+ and –) Rise/Fall Time RC time Constant Generated Voltage ESD Target ³	(0.15 to 74) A (0.6 to 20) ns (0.6 to 20) ns (220 to 740) ns (0 to 30) kV Transfer Impedance DC Resistance	3.0 % 28 ps 28 ps 1.6 % 2.0 % 0.22 % 0.28 % + 4 mΩ	IEC 61000-4-2, ISO 10605, SAE J 1113-13 Oscilloscope ESD target and 1.3 m x 1.3 m plate Electro-Static volt meter Fluke 5500A, Agilent 34401A
EFT/Burst Generator ³ – (50 and 1000) Ω: Voltage (+ and –) Rise Time / Duration Repetition Rate Capacitive Clamp: Voltage (+ and –) Rise Time / Duration	125 V to 6 kV 1 ns to 360 ms Up to 500 kHz 125 V to 6 kV 1 ns to 360 ms	3.9 % 1.6 % 1.6 % 3.9 % 1.6 %	IEC 61000-4-4 (2004, 2007, 2010, 2012) Oscilloscope IEC 61000-4-4

Parameter/Range	Frequency	CMC ^{2, 6, 7, 9} (±)	Comments
Surge Generator ³ –			
Ring Wave Frequency	Up to 100 kHz	1.6 %	IEC 61000-4-5(2005, 2014) Oscilloscope
Front Time/Duration Time (+ and –)	(0.7 to 840) μs	1.6 %	
Voltage (+ and –)	250 V to 6 kV	3.1 %	
Current (+ and –)	(0.125 to 3) kA	3.6 %	
Phase Shift	(0 to 360)°	5.8°	
Voltage Dip/Interruption Generator ³ (PQF) –			
Voltage	(0 to 500) V	1.9 %	IEC 61000-4-11 Oscilloscope
Current	(0 to 1000) A	2.2 %	
Phase	(0 to 360)°	5.4°	
Time	0.5 μs to 100 ms	1.7 %	
In-Rush Current	(0 to 1000) A	4.1 %	

Parameter/Equipment	Range	CMC ^{2, 6, 7, 9} (±)	Comments
Pulse Generator ³ – Voltage Without Load With Load Time Power Energy	(1 to 1000) V (1 to 1000) V 1 ns to 1 s	2.0 % 2.1 % 1.7 %	ISO 7637-1, 2 (2004, 2011), 3 JASO D-001-94
Magnetic Field ³ – Measure Current Magnetic Field Distortion Coil factor	(0 to 100) A (0.1 to 1999) mG (0 to 10) mG	1.9 % 1.8 % 2.4 % 2.6 %	IEC 61000-4-8 (2001) IEC 61000-4-9 (2001)
Large Loop Antenna System ³	9 kHz to 30 MHz	0.9 dB	CISPR16-1-4 (2010) S4.7
Span Readout Accuracy ³	10 Hz to 18 GHz	0.9 %	EIP 535B/EIP 575B NF WF1946B R&S SMY02, SMR20
Amplitude Modulation ³ – Carrier Frequency	9 kHz to 1 GHz Modulation Frequency 400 Hz to 10 kHz Modulation Index (10 to 99) %	1.8 %	Oscilloscope

Parameter/Range	Frequency	CMC ^{2,6,7,9} (\pm)	Comments
Frequency Modulation ³ – Carrier Frequency	10 MHz to 2 GHz Modulation Frequency (0.3 to 10) kHz FM Deviation (1 to 200) kHz	1.2 %	Spectrum analyzer
Harmonic Measurement ³	9 kHz to 3.1 GHz (3.1 to 8) GHz (8 to 14.5) GHz (14.5 to 28) GHz	2.8 dB 3.0 dB 5.0 dB 5.8 dB	Spectrum analyzer
Oscilloscope ³ – Voltage Accuracy Frequency Bandwidth Rise Time CAL Out, Frequency Input Impedance Time Accuracy	2 mV/div to 10 V/div 9 kHz to 6 GHz 1 kHz 50 Ω 1 M Ω 10 ns to 1 s	0.9 % 0.7 dB 15 % 1.2 x 10 ⁻⁶ % 0.04 % + 4 m Ω 0.04 % + 10 Ω 0.33 %	Function generator Signal generator Pulse generator Function generator Agilent 34401A Function generator Pulse generator
Power Analyzer ³ – AC Voltage: (45 to 500) Hz AC Current: (45 to 500) Hz AC Power: (45 to 65) Hz at Unity Power Factor	(10 to 1000) V (0.33 to 2.2) A (2.2 to 11) A 0.1 W to 11 kW	0.15 % 0.19 % 0.15 % 0.2 %	Fluke 5500A

Parameter/Range	Frequency	CMC ^{2, 5, 6, 7, 9} (±)	Comments
Power Analyzer ³ – (cont)			
Power Factor	0 W to 1.0 kW	0.17 %	Fluke 5500A
Frequency	10 Hz to 2.4 kHz	0.02 Hz	
Harmonics Current	50 Hz to 2.4 kHz	0.3 %	Waveform generator and PSU
Harmonics Distortion	50 Hz to 2.4 kHz	0.12 %	Waveform generator and PSU
Pst	(0.4 to 3.0) kHz	0.3 %	Waveform generator and PSU
EMI Receiver ³ –			CISPR 16-1-1
Reference Frequency	10 Hz to 20 GHz	1.2 x 10 ⁻⁶ %	Frequency counter and Rubidium oscillator
Input Impedance, SWR	5 Hz to 500 MHz 500 MHz to 3 GHz (3 to 20) GHz (20 to 40) GHz	0.2 dB 0.2 dB 0.4 dB 0.5 dB	Network analyzer w/ calibration kit
Sine-Wave Accuracy (110 to 0) dB μV	9 kHz to 1 GHz (1 to 4) GHz (4 to 6) GHz (6 to 10) GHz (10 to 18) GHz	0.42 dB 0.96 dB 1.1 dB 1.1 dB 1.3 dB	Signal generator, power meter/sensor

Parameter/Range	Frequency	CMC ^{2, 6, 7, 9} (±)	Comments
EMI Receiver ³ – (cont)			CISPR 16-1-1
Pulse Response: Absolute Calibration	Band A and B Band C and D > 1 GHz	0.8 dB 1.3 dB 1.5 dB	Schwarzbeck IGUU 2916
QP Pulse Rate Response: Relative Calibration	Band A and B Band C and D > 1 GHz	1.0 dB 1.4 dB 1.5 dB	Schwarzbeck IGUU 2916
Relative Pulse Response/QP and Peak	Band A and B Band C and D > 1 GHz	1.0 dB 1.4 dB 1.5 dB	Schwarzbeck IGUU 2916
Relative Pulse Response/QP and Average	Band A and B Band C and D > 1 GHz	1.0 dB 1.4 dB 1.5 dB	Schwarzbeck IGUU 2916
Relative Pulse Response/QP and RMS/	Band A and B Band C and D > 1 GHz	1.0 dB 1.4 dB 1.5 dB	Schwarzbeck IGUU 2916
Selectivity, 6 dB Bandwidth	9 kHz to 1 GHz (1 to 4) GHz (4 to 10) GHz (10 to 18) GHz	0.42 dB 0.96 dB 1.1 dB 1.3 dB	Signal generator, power meter/sensor
IF Rejection Ratio Image Rejection Ratio Spurious Responses	9 kHz to 1 GHz (1 to 4) GHz (4 to 10) GHz (10 to 18) GHz	0.6 dB 1.4 dB 1.6 dB 1.8 dB	Signal generator, power meter/sensor

Parameter/Range	Frequency	CMC ^{2, 6, 9} (±)	Comments
Signal Generator ³ –			
Output:			
Frequency Accuracy	10 Hz to 18 GHz	1.2 x 10 ⁻⁶ %	Frequency counter
Level Accuracy			
(20 to -50) dBm	1 kHz to 6 GHz	0.4 dB	Power meter/sensors
(20 to -50) dBm	(6 to 40) GHz	0.5 dB	
(-50 to -120) dBm	9 kHz to 3.1 GHz (3.1 to 8) GHz	1.0 dB	Spectrum analyzer
(-50 to -120) dBm	(8 to 14.5) GHz	1.2 dB	
(-50 to -120) dBm	(14.5 to 28) GHz	3.5 dB	
(-50 to -120) dBm	(28 to 40) GHz	4.1 dB	
(-50 to -120) dBm		5.2 dB	
Flatness	1 kHz to 40 GHz	0.5 dB	Power meter/sensors
Impedance, SWR			
	5 Hz to 500 MHz	0.2 dB	Network analyzer w/ calibration kit
	500 MHz to 3 GHz	0.2 dB	
	(3 to 20) GHz	0.4 dB	
	(20 to 40) GHz	0.5 dB	
Harmonics			
	10 MHz to 3.1 GHz	2.8 dB	Spectrum analyzer
	(3.1 to 8) GHz	3.0 dB	
	(8 to 14.5) GHz	5.0 dB	
	(14.5 to 28) GHz	5.8 dB	
Amplitude Modulation	500 kHz to 1 GHz	1.8 %	Oscilloscope
	Index: (10 to 99) %		
	Modulation Frequency		
	400 Hz to 10 kHz		
Frequency Modulation	10 MHz to 1 GHz	1.2 %	Spectrum analyzer
	Modulation Index		
	(1 to 100) kHz		
	Modulation Frequency		
	400 Hz to 10 kHz		
Phase Modulation	10 MHz to 1 GHz	1.2 %	Spectrum analyzer
	Modulation Index		
	(0.01 to 10) rad		
	Modulation Frequency		
	400 Hz to 10 kHz		



Parameter/Range	Frequency	CMC ^{2,6,9} (±)	Comments
Spectrum Analyzer ³ –			
Calibration Output: Frequency	10 MHz	1.2 x 10 ⁻⁶ %	Frequency counter power meter/sensor
Span Readout Accuracy	9 kHz to 18 GHz	0.9 %	Signal generator, frequency counter
Frequency Readout Accuracy (Including Maker Frequency)	9 kHz to 18 GHz	1.2 x 10 ⁻⁶ %	Signal generator, frequency counter
Level Accuracy	5 Hz to 15 MHz 15 MHz to 1 GHz (1 to 4) GHz (4 to 40) GHz	0.21 dB 0.55 dB 0.59 dB 0.73 dB	Signal generators, power dividers, and power meter/sensor
Input Attenuator	5 Hz to 20 kHz 20 kHz to 1 GHz (1 to 4) GHz (4 to 40) GHz	0.21 dB 0.55 dB 0.59 dB 0.73 dB	Signal generators, power dividers, and power meter/sensor
Reference Level (IF Attenuator)	5 Hz to 20 kHz 20 kHz to 1 GHz (1 to 4) GHz (4 to 40) GHz	0.21 dB 0.55 dB 0.59 dB 0.73 dB	Signal generators, power dividers, and power meter/sensor
Input Impedance, SWR	5 Hz to 500 MHz 500 MHz to 3 GHz (3 to 20) GHz (20 to 40) GHz	0.2 dB 0.2 dB 0.4 dB 0.5 dB	Network analyzer with calibration kit
Resolution Bandwidth	9 kHz to 1 GHz (1 to 4) GHz (4 to 10) GHz (10 to 18) GHz	0.42 dB 0.96 dB 1.1 dB 1.3 dB	Signal generator, power meter/sensor, frequency counter
Spurious Response	20 kHz to 1 GHz (1 to 4) GHz (4 to 40) GHz	0.77 dB 0.83 dB 1.00 dB	Signal generator, power meter/sensor

Parameter/Range	Frequency	CMC ^{2, 4, 6, 9} (\pm)	Comments
Spectrum Analyzer ³ – (cont)			
Tracking Generator ⁴ :			
Absolute Output	1 kHz to 40 GHz	0.5 dB	Power meter/sensor
Output Level Flatness	1 kHz to 40 GHz	0.5 dB	Power meter/sensor
Network Analyzer ³ –			
Frequency	1 kHz to 40 GHz	$1.2 \times 10^{-6} \%$	Frequency counter
VSWR	5 Hz to 500 MHz 500 MHz to 3 GHz (3 to 20) GHz (20 to 40) GHz	0.2 dB 0.2 dB 0.4 dB 0.5 dB	Network analyzer
Output Level Accuracy	9 kHz to 6 GHz (6 to 50) GHz	0.26 dB + <i>M</i> 0.32 dB + <i>M</i>	Power meter/sensor
Output Level Flatness	9 kHz to 6 GHz (6 to 50) GHz	0.26 dB + <i>M</i> 0.32 dB + <i>M</i>	Power meter/sensor
S ₂₁ , S ₁₂ – Attenuation:			
(0 to -50) dB	1 kHz to 18 GHz (18 to 40) GHz	0.3 dB 0.5 dB	Precision attenuators
(-60 to -100) dB	1 kHz to 18 GHz (18 to 40) GHz	0.7 dB 0.8 dB	
S ₁₁ , S ₂₂ – Return Loss:	1 kHz to 40 GHz	0.9 dB for 12 dB 2.1 dB for 24 dB	Precision attenuators and calibration kit

III. Time & Frequency

Parameter/Equipment	Frequency	CMC ^{2,9} (±)	Comments
Frequency ³ – Measuring Equipment	(5 to 100) Hz	0.04 %	NF WF1946B
	100 Hz to 1 MHz	0.01 %	
Frequency ³ – Measure	1 MHz to 2 GHz	0.0004 %	Rhode & Schwarz SMY 02 Rhode & Schwarz SMR 20
	(2 to 20) GHz	0.0007 %	
Frequency ³ – Measure	10 Hz to 20 GHz	1.2 x 10 ⁻⁶ %	EIP 535B and Rubidium oscillator

¹ This laboratory offers commercial and field 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 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 In the statement of CMC, M is the source of the mismatch uncertainty due to connections of the device to other devices in actual use.

⁵ Agilent 34401A or Fluke 5500A CMCs are to be read as percent of reading plus a floor value when % is used as part of the CMC.

⁶ Instruments are calibrated against manufacturer's specifications. These calibrations may also, at customer request, be based on conformance to the calibration requirements of various standards such as CISPR 16-1-1, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-11, EN 61000-4-5, IEC 61000-4-2, IEC 61000-3-2, IEC 61000-3-3, IEC 61000-4-7, IEC 61000-4-8, IEC 61000-4-9, IEC 61000-4-10, IEC 61000-4-11, IEC 61000-4-12, IEC 61000-4-13, IEC 61000-4-14, IEC 61000-4-15, ANSI 62.41:1991, ANSI C63.16, ANSI C62-41, UL 864, UL 1449, ISO 7637-2, ISO 17069, ITU Rec K.17, ITU Rec K.20, ITU Rec K.21, SBC-TP-76200, GR1089CORE and SAE J1113-13. Other standards may apply and the customer should contact the lab for further information.

⁷ Some of the types of instruments calibrated under these parameters are: EMI Receivers, EFT/Burst Generators, ESD Guns and Targets, Surge Generators, Generators for Voltage Dips, Short Interrupts and Variations, Ring Wave Generators, Network Analyzers, Click Analyzers, Impulse Generators, Power Meters, Power Sensors, Signal Generators, Spectrum Analyzers, Attenuators, Terminations, Power Analyzers, Reference Impedance Network (RIN) and CVCF power supply.

⁸ These calibrations are performed (as applicable to the normative requirements) at *Liberty Labs Asia, Inc.*, the *Fujitsu General EMC Laboratory*, located at 1116 Suenaga, Takatsu-ku, Kawasaki, 213-8502, JAPAN; at *UL Japan Kashima EMC*, 1614 Mushihata, Katori-shi, Chiba-ken, 289-0341, JAPAN where Standard Site Methods (SSM) is required; and at customer's location meeting standard antenna calibration site requirements.

⁹ In the statement of CMC, percentages are to be read as percent of reading unless otherwise noted.



Accredited Laboratory

A2LA has accredited

LIBERTY LABS ASIA, INC., SAMOTO & ASSOCIATES, LTD.

Yokohama, Kanagawa, JAPAN

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 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 8 January 2009*).



Presented this 9th day of November 2017.

A handwritten signature in black ink, written over a horizontal line.

President and CEO
For the Accreditation Council
Certificate Number 2067.01
Valid to June 30, 2019
Revised on July 19, 2018

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