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

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CALIBRATION

Valid To: October 31, 2017 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 calibrations[1]:

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	63 µV/V + 3.5 µV 46 µV/V + 7 µV 40 µV/V + 50 µV 52 µV/V + 0.6 mV 52 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 58 µV/V + 5 µV 58 µV/V + 50 µV 64 µV/V + 500 µV 64 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 4 %	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	0.025 % + 0.05 μA 0.012 % + 0.25 μA 0.012 % + 3.3 μA 0.035 % + 44 μA 0.069 % + 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 0.69 % + 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 0.69 % + 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 0.69 % + 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 0.69 % + 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 0.69 % + 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	3.7 % 3.7 %	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	0.18 % + 20 µV 0.23 % + 20 µV 0.3 % + 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	0.03 % + 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	0.12 % + 0.4 mA	Agilent 34401A
(1 to 3) A	10 Hz to 5 kHz	0.17 % + 1.8 mA	
(3 to 10) A	10 Hz to 500 Hz	4 %	0.1 Ω shunt
(1 to 5000) A_{peak}	1 Hz to 20 MHz	2.8 %	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	0.27 % + 0.25 µA 0.57 % + 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	0.1 % + 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 0.24 % + 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 0.39 % + 2 mA	
Distortion[3]	20 Hz to 20 kHz	1.4 % of reading or 0.014 % distortion (whichever is greater)	Texio VA2230
Inductance[3] – Measure			
32 µH to 1 H	50 Hz 1 kHz	0.32 % 0.18 %	NF ZM2371 LCR meter

Parameter/Equipment	Range	CMC[2, 5, 9] (±)	Comments
Resistance[3] – Measure	(0 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) kΩ 100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) MΩ	0.01 % + 4 mΩ 0.01 % + 10 mΩ 0.01 % + 100 mΩ 0.01 % + 1 Ω 0.01 % + 10 Ω 0.05 % + 100 Ω 0.92 % + 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	0.027 % + 0.008 Ω 0.016 % + 0.01 Ω 0.011 % + 0.01 Ω 0.011 % + 0.01 Ω 0.01 % + 0.06 Ω 0.01 % + 0.06 Ω 0.01 % + 0.6 Ω 0.011 % + 0.6 Ω 0.013 % + 6 Ω 0.014% + 6 Ω 0.018 % + 55 Ω 0.03 % + 55 Ω 0.07 % + 0.55 kΩ 0.15 % + 0.55 kΩ 0.58 % + 5.5 kΩ 0.73 % + 17 kΩ	Fluke 5500A
Capacitance[3] – Measure 8 pF to 3 mF	 50 Hz 1 kHz	 0.52 % 0.45 %	 NF ZM2371 LCR meter

Parameter/Equipment	Range	CMC[2, 5, 9] (±)	Comments
Reference Impedance Networks[3] –			
Resistance	DC	0.07 %	Fluke 5500A Agilent 34401A
Inductance Measure:			
32 µH to 1 H	50 Hz 1 kHz	0.32 % 0.18 %	NF ZM2371 LCR meter
AC Stabilization Power Supplies (CVCF)[3] –			
AC Voltage: (50 to 400) Hz	(100 to 750) V	0.08 % + 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	0.65 %	
Distortion		2.8 %	
Regulation	(1 to 50) A	2.6 %	
AC Current: (50 to 400) Hz	(1 to 100) A	1.9 %	

II. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC[2, 6, 7] (±)	Comments
RF Power, Relative[3] – Measure			
(0 to 40) dB (40 to 50) dB (50 to 60) dB (60 to 70) dB	5 Hz to 500 MHz	0.26 dB 0.28 dB 0.43 dB 1.1 dB	Network analyzer HP 8751A

Parameter/Range	Frequency	CMC[2, 6, 7, 9] (±)	Comments
RF Power, Relative[3] – Measure			
(0 to 50) dB (50 to 60) dB (60 to 70) dB	30 kHz to 3 GHz	0.3 dB 0.36 dB 0.45 dB	Network analyzer HP 8753ES
(0 to 40) dB (40 to 50) dB (50 to 70) dB	300 kHz to 20 GHz	0.31 dB 0.32 dB 0.55 dB	Network analyzer Advantest R3770
(0 to 50) dB	45 MHz to 6 GHz (6 to 40) GHz	0.4 dB 0.44 dB	Network analyzer Agilent N5230A
(50 to 60) dB	45 MHz to 6 GHz (6 to 40) GHz	0.56 dB 0.6 dB	
(60 to 70) dB	45 MHz to 6 GHz (6 to 40) GHz	0.98 dB 1 dB	
Impedance[3] –			
50 Ω Load	5 Hz to 500 MHz	1.7 %	Network analyzer HP 8751A with calibration kit
	300 kHz to 3 GHz (3 to 20) GHz	1.8 % 3.5 %	Network analyzer Advantest R3770 with calibration kit
VSWR[3] – Γ			
(-10 to 0) dBm	1 kHz to 500 MHz 500 MHz to 3 GHz (3 to 18) GHz	2.1 % 3.8 % 6.4 %	HP 8751A, ADVANTEST R3770 & Agilent 8753ES with BNC & N calibration standard

Parameter/Range	Frequency	CMC[2, 4, 6, 7] (±)	Comments
RF Power, Absolute[3] – Measure (-60 to +20) dBm (-70 to +20) dBm	 9 kHz to 6 GHz 50 MHz to 50 GHz	 0.26 dB + *M* 0.32 dB + *M*	 Power meter and power sensor
RF Power[3]– Generate (-37 to +30) dBm (-37 to +10) dBm (-10 to +10) dBm (-27 to -5) dBm	 5 Hz to 20 kHz 20 kHz to 1 GHz (1 to 4) GHz (4 to 40) GHz	 0.25 dB 0.39 dB + *M* 0.43 dB + *M* 0.62 dB + *M*	 Signal generators, power dividers, and power meter/sensor
RF Phase[3] – Measure	9 kHz to 500 MHz 500 MHz to 3 GHz (3 to 20) GHz (20 to 40) GHz	0.4° 1.2° 1.8° 2.9°	Network analyzer
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	 0.33 dB 0.41 dB 0.48 dB 0.51 dB 0.68 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 dB 0.8 dB 1.4 dB 1.1 dB 1.5 dB	ANSI C63.4, CISPR 16-1-4, network analyzer ETSI TS 102 321
Dipole NSA Measurements[3]	(30 to 1000) MHz	1 dB	ANSI C63.4, CISPR 16-1-4, network analyzer
SVSWR Validation[3]	(1 to 18) GHz	1.2 dB	CISPR 16-1-4, network analyzer

Parameter/Range	Frequency	CMC[2, 6, 7] (±)	Comments
EM Field Uniformity[3]	80 MHz to 18 GHz	1.2 dB	IEC 61000-4-3
Shield Effectiveness[3]	10 kHz to 1 GHz (1 to 18) GHz	0.8 dB 0.85 dB	EN 50147-1
Electric Field Probes[8]	10 kHz to 1 GHz 100 kHz to 1 GHz (1 to 4) GHz (4 to 18) GHz	1 dB 1.2 dB 1.4 dB 1.5 dB	G-TEM using substitution method with transfer standard Anechoic chamber using substitution method with transfer standard
Antenna Factor[3, 8] –			
Broad Band Antennas, Bi-conical, LPD, Hybrid	(30 to 72.5) MHz (72.5 to 300) MHz (200 to 1000) MHz (1000 to 2000) MHz (25 to 2000) MHz (30 to 1000) MHz	1.1 dB 0.9 dB 0.9 dB 1 dB 0.7 dB 1.2 dB 1.1 dB	Substitution method/SAM (CISPR 16-1-6) SSM/TAM SAE/Identical Reference antenna method, ANSI C63.5 (1988, 1998, 2006)
Dipole Antennas	(30 to 80) MHz (80 to 1000) MHz	0.9 dB 1 dB	Reference antenna method, ANSI C63.5 (1988, 1998, 2006)
Horn Antennas	800 MHz to 18 GHz (18 to 40) GHz 800 MHz to 18 GHz (18 to 40) GHz 800 MHz to 18 GHz (18 to 40) GHz	1.1 dB 1.4 dB 1.1 dB 0.9 dB 1.1 dB 1.1 dB	Substitution method / SAM (CISPR 16-1-6) SSM/TAM ANSI C63.5/CISPR 16-1-6 SAE/Identical

Parameter/Range	Frequency	CMC[2, 4, 6, 7, 9] (±)	Comments
Antenna Factor[3, 8] – (cont)			
Antenna Pattern Measurement	800 MHz to 18 GHz (18 to 40) GHz	0.6 dB 0.7 dB	Network analyzer
Loop Antenna/Loop Sensor	10 Hz to 10 MHz (10 to 30) MHz	0.5 dB 0.7 dB	
	10 Hz to 10 MHz	0.7 dB	
Rod Antenna	10 Hz to 60 MHz	0.6 dB	Equivalent capacitance substitution method (ECSM) HP 8751A, 87512A w/BNC calibration standards
Ambient Noise[3]	150 kHz to 30 MHz (30 to 1000) MHz (1 to 26.5) GHz	2.1 dB 2.4 dB 3.9 dB	CISPR22
Antenna Symmetry[3]	30 MHz to 20 GHz	0.46 dB	ANSI 63.5
LISN[3] –			
Insertion Loss	9 kHz to 500 MHz	0.32 dB +*M*	HP 8751A with BNC calibration standards
Isolation Impedance Phase	9 kHz to 500 MHz 9 kHz to 500 MHz (0 to +/- 180)°	0.7 dB 3.8 % 6.5°	
ISN[3] –			
Voltage Division Factor Decoupling Factor LCL	150 kHz to 30 MHz 150 kHz to 30 MHz LCL 65 dB, 55 dB LCL 75 dB	0.3 dB 0.3 dB 0.7 dB 1.8 dB	CISPR 22, CISPR 16-1-2

Parameter/Range	Frequency	CMC[2, 4, 6, 7, 9] (±)	Comments
CDN's and Adapters[3] –			
(50 to 150) Ω			
Adapter Insertion Loss	10 kHz to 230 MHz	0.73 dB	IEC 61000-4-6
Coupling Factor	10 kHz to 230 MHz	0.72 dB	Network analyzer & calibration kits
Impedance	10 kHz to 230 MHz	4.4 %	
Absorbing Clamp[3] –			CISPR 16-1-3
Coupling Factor	30 MHz to 1 GHz	1 dB 2.6 dB	Jig method Original method
Decoupling Factor	30 MHz to 1 GHz	0.6 dB	Network analyzer
Current Probes & Bulk Current Injection Probes[3] –			
Transfer Impedance	5 Hz to 500 MHz	0.45 dB + *M*	HP 8751A with BNC calibration standards, Agilent 8753ES with type N calibration standards
	500 MHz to 1 GHz	0.53 dB + *M*	
ESD Simulators[3] –			IEC 61000-4-2, ISO 10605, SAE J 1113-13
Contact Voltage (+ and –)			
Current	(0.15 to 74) A	4.1 %	Oscilloscope
Rise/Fall Time	(0.6 to 20) ns	54 ps	ESD target and 1.3 m x 1.3 m Plate
Air Discharge (+ and –)			
Rise/Fall Time	(0.6 to 20) ns	54 ps	
RC time Constant	(220 to 740) ns	2.4 %	
Generated Voltage	(0 to 30) kV	2.6 %	Electro-Static volt meter
ESD Target[3]	Transfer Impedance	0.04 %	Fluke 5500A, Agilent 34401A
	DC Resistance	0.01 % + 4 mΩ	

Parameter/Range	Frequency	CMC[2, 4, 6, 7, 9] (±)	Comments
EFT/Burst Generator[3] –			
(50 and 1000) Ω:			
Voltage (+ and –)	125 V to 6 kV	3.6 %	Oscilloscope
Rise Time / Duration	1 ns to 360 ms	1.5 %	
Repetition Rate	Up to 500 kHz	1.5 %	
Capacitive Clamp:			
Voltage (+ and –)	125 V to 6 kV	3.6 %	IEC61000-4-4
Rise Time / Duration	1 ns to 360 ms	1.5 %	
Surge Generator[3] –			
Ring Wave Frequency	Up to 100 kHz	1.5 %	Oscilloscope
Front Time/Duration Time (+ and –)	(0.7 to 840) µs	1.5 %	
Voltage (+ and –)	250 V to 6 kV	4.2 %	
Current (+ and –)	(0.125 to 3) kA	2.8 %	
Phase Shift	(0 to 360)°	5.4°	
Voltage Dip/Interruption Generator[3] (PQF) –			
Voltage	(0 to 500) V	1.9 %	Oscilloscope
Current	(0 to 1000) A	2.2 %	
Phase	(0 to 360)°	5.4°	
Time	0.5 µs to 100 ms	1.5 %	
In-Rush Current	(0 to 1000) A	3.1 %	

Parameter/Equipment	Range	CMC[2, 4, 6, 7, 9] (±)	Comments
Pulse Generator[3] –			
Voltage	without load with load	1.9 % 2 %	ISO 7637-1, 2, 3 JASO D-001-94
Time		1.6 %	
Power Energy		4.5 %	
Magnetic Field[3] – Measure			
Current	(0 to 100) A	1.8 %	IEC 61000-4-8 IEC 61000-4-9
Magnetic Field	(0.1 to 1999) mG	1.5 %	
Distortion		1.4 %	
Coil factor	(0 to 10) mG	2.4 %	
Large Loop Antenna System[3]	9 kHz to 30 MHz	0.92 dB	CISPR16-1-4 (2010) S4.7
Span Readout Accuracy[3]	10 Hz to 18 GHz	0.8 %	EIP 535B/EIP 575B NF WF1946B R&S SMY02, SMR20
Amplitude Modulation[3] –			
Carrier Frequency	9 kHz to 1 GHz	2 %	Oscilloscope
Modulation Frequency 400 Hz to 10 kHz			
Modulation Index (10 to 99) %			

Parameter/Range	Frequency	CMC[2, 4, 6, 7, 9] (±)	Comments
Frequency Modulation[3] –			
Carrier Frequency	10 MHz to 2 GHz	1.2 %	Spectrum analyzer
Modulation Frequency (0.3 to 10) kHz			
FM Deviation (1 to 200) kHz			
Harmonic Measurement[3]	9 kHz to 6 GHz (6 to 43) GHz	0.47 dB 0.55 dB	Spectrum analyzer
Oscilloscope[3] –			
Voltage Accuracy	2 mV/div to 10 V/div	0.2 %	Function generator
Frequency Bandwidth	9 kHz to 6 GHz	0.5 dB	Signal generator
Rise Time	DC to 1 GHz (1 to 4) GHz	3.8 % 4.1 %	Pulse generator
CAL Out, Frequency	1 kHz	1.2 x 10^{-6} %	Function generator
Input Impedance	50 Ω 1 MΩ	0.01 % + 4 mΩ 0.01 % + 10 Ω	Agilent 34401A
Time Accuracy	10 ns to 1 s 200 ps to 10 ns	0.23 % 0.26 %	Function generator Pulse generator
Probe Rise Time	DC to 300 MHz	5.3 %	Pulse generator
Power Analyzer[3] –			
AC Voltage: (45 to 500) Hz	(10 to 1000) V	0.08 %	Fluke 5500A
AC Current: (45 to 500) Hz	(0.33 to 2.2) A (2.2 to 11) A	0.22 % 0.17 %	
AC Power: (45 to 65) Hz at Unity Power Factor	0.1 W to 11 kW	0.17 %	

Parameter/Range	Frequency	CMC[2, 5, 6, 7, 9] (±)	Comments
Power Analyzer[3] – (cont)			
Power Factor	0 W to 1.0 kW	0.14 %	Fluke 5500A
Frequency	10 Hz to 2.4 kHz	0.02 Hz	
Harmonics Current	50 Hz to 2.4 kHz	0.2 %	Waveform generator and PSU
Harmonics Distortion	50 Hz to 2.4 kHz	0.1 %	Waveform generator and PSU
Pst	(0.4 to 3.0) kHz	0.24 %	Waveform generator and PSU
EMI Receiver[3] –			
Reference Frequency	10 Hz to 20 GHz	1.2×10^{-6} %	Frequency counter & Rubidium oscillator
Input Impedance, SWR	10 kHz to 0.5 GHz (0.5 to 3) GHz (3 to 40) GHz	0.18 dB 0.34 dB 0.57 dB	Network analyzer w/ calibration kit
Sine-Wave Accuracy (110 to 0) dB µV	9 kHz to 6 GHz 50 MHz to 50 GHz	0.4 dB 0.6 dB	Signal generator, power meter/sensor
Pulse Response: QP Pulse Response	Band A and B Band C and D	0.5 dB 0.8 dB	Pulse generator
QP Pulse Rate Response	Band A and B Band C and D	0.5 dB 0.8 dB	Pulse generator
Relative Pulse Response/QP	Band A and B Band C and D	0.5 dB 0.8 dB	Pulse generator
Selectivity, 6 dB Bandwidth	Band A Band B Band C and D Band E	2.4 Hz 130 Hz 1.4 kHz 11 kHz	Pulse generator, frequency counter

Parameter/Range	Frequency	CMC[2, 6, 9] (±)	Comments
EMI Receiver[3] – (cont)			
IF Rejection Ratio	9 kHz to 6 GHz 50 MHz to 50 GHz	0.4 dB 0.6 dB	Signal generator, power meter/sensor
Image Rejection Ratio	9 kHz to 6 GHz 50 MHz to 50 GHz	0.4 dB 0.6 dB	Signal generator, power meter/sensor
Spurious Responses	9 kHz to 6 GHz 50 MHz to 50 GHz	0.4 dB 0.6 dB	Signal generator, power meter/sensor
Intermodulation Effects	9 kHz to 6 GHz 50 MHz to 50 GHz	0.4 dB 0.6 dB	Signal generator, power meter/sensor
Signal Generator[3] –			
Output:			
Frequency Accuracy	10 Hz to 18 GHz	1.2×10^{-6} %	Frequency counter
Level Accuracy			
1 kHz to 40 GHz	(+20 to -50) dBm	0.5 dB	Power meter/sensors
1 kHz to 26 GHz	(-50 to -110) dBm	0.7 dB	Spectrum analyzer
1 kHz to 40 GHz	(-50 to -110) dBm	1.2 dB	
Flatness	1 kHz to 26 GHz	0.37 dB	Power meter/sensors
Impedance, SWR	10 kHz to 0.5 GHz (0.5 to 3) GHz (3 to 40) GHz	0.18 dB 0.34 dB 0.57 dB	Network analyzer w/ calibration kit
Harmonics	9 kHz to 6 GHz (6 to 43) GHz	0.5 dB 0.55 dB	Spectrum analyzer
Amplitude Modulation: Index: (10 to 99) % Modulation Frequency 400 Hz to 10 kHz	500 kHz to 1 GHz	2 %	Oscilloscope
Frequency Modulation: Modulation Index (1 to 100) kHz Modulation Frequency 400 Hz to 10 kHz	10 MHz to 1 GHz	1.3 %	Spectrum analyzer

Parameter/Range	Frequency	CMC[2, 6, 9] (±)	Comments
Signal Generator[3] – (cont)			
Phase Modulation: Modulation Index (0.01 to 10) rad Modulation Frequency 400 Hz to 10 kHz	10 MHz to 1 GHz	1.2 %	Spectrum analyzer
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	0.8 %	Signal generator, frequency counter
Frequency Readout Accuracy (Including Maker Frequency)	9 kHz to 6 GHz (6 to 18) GHz	1.2 x 10^{-6} %	Frequency counter
Level Accuracy	5 Hz to 20 kHz 20 kHz to 1 GHz (1 to 4) GHz (4 to 40) GHz	0.25 dB 0.39 dB 0.43 dB 0.62 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	0.25 dB 0.39 dB 0.43 dB 0.62 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	0.25 dB 0.39 dB 0.43 dB 0.62 dB	Signal generators, power dividers, and power meter/sensor
Input Impedance, SWR	9 kHz to 0.5 GHz (0.5 to 3) GHz (3 to 40) GHz	0.18 dB 0.34 dB 0.57 dB	Network analyzer with calibration kit
Resolution Bandwidth	9 kHz to 6 GHz	2.3 %	Signal generator, power meter/sensor, frequency counter

Parameter/Range	Frequency	CMC[2, 4, 6, 9] (±)	Comments
Spectrum Analyzer[3] – (cont)			
Tracking Generator[4]:			
Absolute Output	9 kHz to 6 GHz (6 to 50) GHz	0.26 dB + *M* 0.32 dB + *M*	Power meter/sensor
Output Level Flatness	9 kHz to 6 GHz (6 to 50) GHz	0.26 dB + *M* 0.32 dB + *M*	Power meter/sensor
Network Analyzer[3] –			
Frequency	1 kHz to 40 GHz	1.2×10^{-6} %	Frequency counter
VSWR	1 kHz to 0.5 GHz (0.5 to 3) GHz (3 to 40) GHz	0.18 dB 0.34 dB 0.57 dB	Network analyzer
Output Level Accuracy	9 kHz to 6 GHz (6 to 50) GHz	0.26 dB + *M* 0.32 dB + *M*	Power meter/sensor
Output Level Flatness	9 kHz to 6 GHz (6 to 50) GHz	0.26 dB + *M* 0.32 dB + *M*	Power meter/sensor
S_{21}, S_{12} – Attenuation:			
(0 to -50) dB	1 kHz to 18 GHz (18 to 40) GHz	0.15 dB 0.39 dB	Precision attenuators
(-60 to -100) dB	1 kHz to 18 GHz (18 to 40) GHz	0.62 dB 0.71 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
Phase	DC to 4 GHz	0.16°	Precision BNC cable

III. Time & Frequency

Parameter/Equipment	Frequency	CMC[2, 9] (±)	Comments
Frequency[3] – Measuring Equipment	(5 to 100) Hz 100 Hz to 1 MHz 1 MHz to 2 GHz (2 to 20) GHz	0.024 % 0.0052 % 0.0003 % 0.0003 %	NF WF1946B Rhode & Schwarz SMY 02 Rhode & Schwarz SMR 20
Frequency[3] – Measure	10 Hz to 20 GHz	1.2×10^{-6} %	EIP 535B & 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 4th day of June 2015.

President and CEO
For the Accreditation Council
Certificate Number 2067.01
Valid to October 31, 2017
Revised on September 18, 2017

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