



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid To: July 31, 2026

Certificate Number: 3606.01

In recognition of the successful completion of the A2LA evaluation process (including an assessment of the organization's compliance with A2LA's Calibration Program Requirements), accreditation is granted to this laboratory to perform the following calibrations<sup>1,7</sup>:

I. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,4,8</sup> (±)	Comments
DC Voltage <sup>3</sup> – Measure	(0.10 to 1) mV (1 to 10) mV (10 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V	0.69 % 0.07 % 0.015 % 0.001 % 0.001 % 0.001 % 0.002 %	Digital multimeter
	(1 to 20) kV	1.6 %	Oscilloscope & probe
DC Voltage <sup>3</sup> – Generate	Up to 12 mV (12 to 120) mV (0.120 to 1.2) V (1.2 to 12) V (12 to 32) V (32 to 45) V (45 to 180) V (180 to 504) V	0.065 % 0.023 % 0.009 % 0.009 % 0.024 % 0.092 % 0.094 % 0.077 %	Calibrator

Parameter/Equipment	Range	CMC <sup>2,4,8</sup> (±)	Comments
DC Current <sup>3</sup> – Measure	(1 to 10) $\mu$ A (10 to 100) $\mu$ A 100 $\mu$ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 3) A (3 to 10) A (10 to 20) A	0.043 % 0.012 % 0.009 % 0.009 % 0.01 % 0.021 % 0.13 % 0.20 % 0.24 %	Digital multimeter
DC Current <sup>3</sup> – Generate	(0.1 to 1.2) mA (1.2 to 12) mA (12 to 32) mA (32 to 120) mA (0.12 to 0.125) A (0.125 to 0.5) A (0.5 to 1) A (1 to 2.5) A (2.5 to 5) A (5 to 10) A (10 to 20) A  (10 to 16.4999) A (16.5 to 149.999) A (150 to 1000) A	0.0093 % 0.012 % 0.012 % 0.012 % 0.043 % 0.018 % 0.015 % 0.069 % 0.016 % 0.017 % 0.20 %  0.58 % 0.58 % 0.62 %	Calibrator            Calibrator & 50 turns coil
DC Resistance <sup>3</sup> – Measure	(0.1 to 1) $\Omega$  (1 to 10) $\Omega$ (10 to 100) $\Omega$ 100 $\Omega$ to 1 k $\Omega$ (1 to 10) k $\Omega$ (10 to 100) k $\Omega$ 100 k $\Omega$ to 1 M $\Omega$ (1 to 10) M $\Omega$ (10 to 100) M $\Omega$ 100 M $\Omega$ to 1 G $\Omega$	0.018 %  0.008 % 0.006 % 0.001 % 0.001 % 0.001 % 0.003 % 0.015 % 0.067 % 0.59 %	Digital multimeter  Agilent digital multimeter

Parameter/Equipment	Range	CMC <sup>2,4,8</sup> (±)	Comments
DC Resistance <sup>3</sup> – Generate			
Fixed Resistance	1 Ω 10 Ω 50 Ω 100 Ω 190 Ω 500 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ 10 GΩ 100 GΩ 500 GΩ	0.019 % 0.006 % 0.008 % 0.001 % 0.005 % 0.005 % 0.001 % 0.001 % 0.001 % 0.003 % 0.023 % 0.13 % 1 % 1 % 1 % 3 %	Resistance box
Variable Resistance	(0.01 to 10) Ω (10 to 100) Ω 100 Ω to 1 MΩ	0.28 % 0.03 % 0.004 %	Decade resistor
AC Resistance <sup>3</sup> – Generate			
1 kHz	10 Ω 50 Ω 100 Ω 1 kΩ 10 kΩ	0.1 % 0.15 % 0.1 % 0.1 % 0.1 %	Decade resistor
AC Resistance <sup>3</sup> – Measure			
1 kHz	(10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ 10 Ω to 10 kΩ	2.8 % 0.55 % 0.61 % 0.03 %	LCR/impedance analyzer, 4 wire method

Parameter/Range	Frequency	CMC <sup>2,4,8</sup> (±)	Comments
Capacitance <sup>3</sup> – Measure (10 to 100) nF 100 nF to 1 μF 1 μF to 1 mF 10 pF to 100 μF	(40 to 100) Hz  100 Hz to 1 MHz	0.95 % 0.93 % 0.93 % 0.23 %	LCR/impedance analyzer
Capacitance <sup>3</sup> – Generate 1 μF 100 nF 10 nF 1 nF 100 pF	1 kHz	0.2 % 0.2 % 0.1 % 0.1 % 0.1 %	Decade capacitor
Inductance <sup>3</sup> – Measure (1 to 10) mH 10 mH to 1 H (1 to 10) H (10 to 100) nH 100 nH to 10 H	(40 to 100) Hz  100 Hz to 1 MHz	0.98 % 0.93 % 1.3 % 0.10 % 0.03 %	LCR/impedance analyzer
Inductance <sup>3</sup> – Generate 100 μH 1 mH 10 mH 100 mH	1 kHz	2 % 1 % 1 % 0.5 %	Decade inductor

Parameter/Range	Frequency	CMC <sup>2,4,8</sup> (±)	Comments
AC Voltage <sup>3</sup> – Measure			
(1 to 10) mV	40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.16 % 0.71 % 4.9 %	Digital multimeter
(10 to 100) mV	1 Hz to 20 kHz (20 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.02 % 0.12 % 0.44 % 1.2 %	
100 mV to 1 V	1 Hz to 20 kHz (20 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.02 % 0.12 % 0.44 % 1.2 %	
(1 to 10) V	1 Hz to 20 kHz (20 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.02 % 0.12 % 0.44 % 1.2 %	
(10 to 100) V	1 Hz to 20 kHz (20 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.06 % 0.16 % 0.55 % 1.8 %	
(100 to 750) V	1 Hz to 20 kHz (20 to 100) kHz	0.09 % 0.37 %	
(0.2 to 7) kV	10 Hz to 50 MHz	1.6 %	

Parameter/Range	Frequency	CMC <sup>2,4,8</sup> (±)	Comments
AC Voltage <sup>3</sup> – Generate			
Up to 0.202 V	(10 to 44) Hz (45 to 999) Hz (1 to 19.999) kHz (20 to 99.999) kHz (100 to 500) kHz	0.31 % 0.061 % 0.13 % 0.47 % 1.2 %	Calibrator
(0.202 to 2.02) V	(10 to 44) Hz (45 to 999) Hz (1 to 19.999) kHz (20 to 99.999) kHz (100 to 500) kHz	0.30 % 0.052 % 0.10 % 0.49 % 0.92 %	
(2.02 to 20.2) V	(10 to 44) Hz (45 to 999) Hz (1 to 19.999) kHz (20 to 100) kHz	0.29 % 0.051 % 0.086 % 0.54 %	
(20.2 to 202) V	(30 to 44) Hz (45 to 999) Hz (1 to 20) kHz	0.12 % 0.11 % 0.16 %	
(202 to 1020) V	(30 to 44) Hz (45 to 999) Hz (1 to 10) kHz	0.52 % 0.51 % 0.44 %	
(1 to 23) V (23 to 90) V (90 to 180) V (180 to 1008) V	(16 to 850) Hz	0.031 % 0.012 % 0.011 % 0.014 %	Electrical power quality calibrator
(1 to 6.9) V (6.9 to 27) V (27 to 54) V (54 to 302) V	850 Hz to 6 kHz	0.17 % 0.089 % 0.071 % 0.12 %	

Parameter/Range	Frequency	CMC <sup>2, 4, 8</sup> (±)	Comments
Total Harmonics Distortion <sup>3</sup> – Measure	10 Hz to 110 kHz	0.01 %	Audio analyzer /power analyzer
AC Current <sup>3</sup> – Measure			
(1 to 10) mA	10 Hz to 5 kHz (5 to 10) kHz	0.19 % 0.5 %	Digital multimeter
(10 to 100) mA	10 Hz to 5 kHz (5 to 10) kHz	0.16 % 0.52 %	
100 mA to 1 A	10 Hz to 5 kHz (5 to 10) kHz	0.16 % 0.5 %	
(1 to 3) A	16 Hz to 5 kHz (5 to 6) kHz	0.19 % 1.2 %	
(3 to 10) A	(16 to 850) Hz	0.25 %	
(3 to 6.3) A	850 Hz to 2 kHz	0.29 %	
(10 to 100) μA	45 Hz to 1 kHz	0.42 %	
100 μA to 1 mA	45 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.23 % 0.26 % 0.85 % 2.1 %	
(1 to 10) mA	45 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.23 % 0.26 % 0.85 % 2.1 %	
(10 to 100) mA	45 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.23 % 0.26 % 0.85 % 2.1 %	
100 mA to 1 A	45 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	0.31 % 0.42 % 1.5 %	
(10 to 1000) A	1 Hz to 10 MHz	1.6 %	Current probe & oscilloscope

Parameter/Range	Frequency	CMC <sup>2,4,8</sup> (±)	Comments	
AC Current <sup>3</sup> – Generate				
(0.01 to 0.25) A	(16 to 850) Hz 850 Hz to 6 kHz	0.065 % 0.11 %	Electrical power quality calibrator	
(0.25 to 0.5) A	(16 to 850) Hz 850 Hz to 6 kHz	0.013 % 0.063 %		
(0.5 to 1) A	(16 to 850) Hz 850 Hz to 6 kHz	0.014 % 0.062 %		
(1 to 2) A	(16 to 850) Hz 850 Hz to 6 kHz	0.02 % 0.065 %		
(2 to 5) A	(16 to 850) Hz	0.014 %		
(2 to 4.2) A	850 Hz to 6 kHz	0.067 %		
(5 to 10) A	(16 to 850) Hz	0.018 %		
(10 to 21) A	(16 to 850) Hz	0.014 %		
(20 to 202) µA	(10 to 44) Hz (45 to 999) Hz (1 to 10) kHz	0.50 % 0.34 % 1.2 %		Calibrator
(0.202 to 2.02) mA	(10 to 44) Hz (45 to 999) Hz (1 to 10) kHz	0.32 % 0.11 % 1.0 %		
(2.02 to 20.2) mA	(10 to 44) Hz (45 to 999) Hz (1 to 10) kHz	0.32 % 0.11 % 0.75 %		
(20.2 to 202) mA	(10 to 44) Hz (45 to 999) Hz (1 to 10) kHz	0.32 % 0.11 % 0.85 %		
(0.202 to 2.02) A	(10 to 44) Hz (45 to 999) Hz (1 to 5) kHz	0.38 % 0.24 % 0.87 %		
(2.02 to 10.0) A	(30 to 44) Hz (45 to 99) Hz 100 Hz to 1 kHz	0.30 % 0.13 % 0.43 %		



Parameter/Range	Frequency	CMC <sup>2, 4, 8</sup> (±)	Comments
AC Current <sup>3</sup> – Generate (cont.)			
Toroidal-type Clamps			
(10 to 16.4999) A	(45 to 100) Hz (100 to 440) Hz	0.34 % 0.94 %	Calibrator & 50 turns coil
(16.5 to 149.999) A (150 to 1000) A	(45 to 100) Hz	0.35 % 0.47 %	
Non-toroidal-type Clamps			
(10 to 16.4999) A	(45 to 100) Hz (100 to 440) Hz	0.65 % 1.2 %	
(16.5 to 149.999) A (150 to 1000) A	(45 to 100) Hz	0.66 % 0.73 %	
Magnetic Field <sup>3</sup> – Generate			Helmholtz coil electrical power quality calibrator digital multimeter & resistor
(0.1 to 220) μT (200 to 350) μT (0.1 to 20) μT	DC to 850 Hz DC (1 to 20) kHz	0.7 % 0.7 % 0.8 %	Coil size: r = 0.15 m 14 turn
(1 to 1200) μT (1000 to 12 000) μT (1 to 700) μT	DC to 850 Hz DC (1 to 20) kHz	1.3 % 1.3 % 1.3 %	Coil size: r = 0.05 m 50 turn
(1 to 3200) μT (3000 to 32 000) μT (1 to 1800) μT	DC to 850 Hz DC (1 to 20) kHz	1.4 % 1.4 % 1.5 %	Coil size: r = 0.02 m 50 turn
(1 to 2600) μT (1 to 2100) μT (1 to 1100) μT (1 to 750) μT	(10 to 50) Hz (50 to 300) Hz (300 to 600) Hz (600 to 1000) Hz	0.8 % 0.8 % 0.8 % 0.8 %	Digital multimeter & resistor Helmholtz coil 300 turn
(1 to 450) μT (1 to 200) μT (1 to 110) μT	(1 to 5) kHz (5 to 20) kHz (20 to 50) kHz	0.8 % 0.8 % 0.8 %	Helmholtz coil electrical power quality calibrator digital multimeter & resistor 30 turn

Parameter/Range	Frequency	CMC <sup>2, 4, 8</sup> ( $\pm$ )	Comments
Magnetic Field <sup>3</sup> – Generate (cont)			Helmholtz coil electrical power quality calibrator digital multimeter & resistor 6 turn
(1 to 110) $\mu$ T	(50 to 120) kHz	0.8 %	
(1 to 50) $\mu$ T	(120 to 300) kHz	0.9 %	
(1 to 30) $\mu$ T	(300 to 400) kHz	1.4 %	

## II. Electrical – RF/Microwave

Parameter/Equipment	Range	CMC <sup>2, 8</sup> ( $\pm$ )	Comments
Absolute Power <sup>3</sup> – Measure			
10 Hz to 20 kHz	(+30 to -20) dBm	0.07 dB	Digital multimeter
9 kHz to 6 GHz	(+20 to -60) dBm	0.23 dB	Power meter & power sensor
50 MHz to 10 GHz	(+20 to -70) dBm	0.28 dB	
(10 to 26.5) GHz	(+20 to -70) dBm	0.37 dB	
(26.5 to 44) GHz	(+10 to -50) dBm	0.26 dB	
50 MHz, 64 MHz, 1 GHz	0 dBm	0.10 dB	
128 MHz	0 dBm	0.08 dB	
Transmission Coefficient (Mag) <sup>3</sup> – Measure (Attenuation)			
10 Hz to 100 MHz	(0 to 30) dB (30 to 70) dB (70 to 100) dB	0.13 dB 0.22 dB 0.52 dB	Network analyzer
9 kHz to 18 GHz	(0 to 70) dB (70 to 100) dB	0.07 dB 0.13 dB	
(18 to 26.5) GHz	(0 to 60) dB	0.11 dB	
(26.5 to 44) GHz	(0 to 40) dB (40 to 60) dB	0.25 dB 0.35 dB	

Parameter/Equipment	Range	CMC <sup>2,4,8</sup> (±)	Comments
Impedance (Reflection Coefficient) <sup>3</sup> – Measure			50 ohm load
Magnitude (0 to 1)	(9 to 100) kHz 100 kHz to 10 MHz (10 to 100) MHz	0.03 0.025 0.03	Impedance/gain-phase analyzer
Phase $\Theta$ (0 to 180) °	(9 to 100) kHz 100 kHz to 10 MHz (10 to 100) MHz	2.2° 1.4° 2.2°	
Magnitude (0 to 1)	9 kHz to 2 GHz (2 to 8) GHz (8 to 18) GHz (18 to 26.5) GHz (26.5 to 44) GHz	0.023 0.024 0.028 0.043 0.04	Network analyzer & calibration kit
Phase $\Theta$ (0 to 180) °	9 kHz to 2 GHz (2 to 18) GHz (18 to 26.5) GHz	0.6° 1.4° 2.0°	
LISN <sup>3</sup> –			ANSI C63.4, CISPR 25, CISPR 16-1-2, ISO7637-2, ISO 11452-1, MIL-STD 461
Voltage Division Factor	9 kHz to 300 MHz	0.2 dB	Network analyzer
Impedance: Z, $\theta$	9 kHz to 300 MHz	Z: 2.2 % , $\theta$ : 0.6°	
Isolation	9 kHz to 300 MHz	0.2 dB	
CDNs <sup>3</sup> –			IEC 61000-4-6 CISPR 16-1-2 Network analyzer
Coupling Factor	150 kHz to 300 MHz	0.2 dB	
Impedance: Z, $\theta$	150 kHz to 300 MHz	Z: 1.8 % , $\theta$ : 0.6°	
Isolation	150 kHz to 300 MHz	0.2 dB	

Parameter/Equipment	Range	CMC <sup>2,4,8</sup> (±)	Comments
ISN <sup>3</sup> –			CISPR 16-1-2
Voltage Division Factor	150 kHz to 30 MHz	0.2 dB	Network analyzer
Impedance: Z, θ	9 kHz to 30 MHz	Z: 1.8 % , θ: 0.6°	
LCL < 65 dB	100 kHz to 5 MHz (5 to 30) MHz	0.35 dB 0.55 dB	LCL: longitudinal conversion loss.
LCL < 75 dB	100 kHz to 5 MHz (5 to 30) MHz	0.35 dB 0.73 dB	
Insertion Loss	150 kHz to 200 MHz	0.27 dB	
Decoupling Factor	150 kHz to 30 MHz	0.2 dB	
Spectrum Analyzer <sup>3</sup> –			
Marker Readout Accuracy	9 kHz to 6 GHz (2 to 18) GHz (18 to 43.5) GHz	50 pHz/Hz + 100 μHz 50 pHz/Hz	Signal generator
Span Accuracy	100 Hz to 10 MHz	1.0 %	
Residual FM	100 Hz to 2 GHz	1.0 Hz	
Noise Side Band	(-20 to -130) dBc/Hz Offset Frequency: 100 Hz to 10 MHz	0.5 dB	
Level Accuracy	(0 to -60) dBm	0.23 dB	Power meter & power sensor
9 kHz to 6 GHz	(-60 to -110) dBm	0.27 dB	
50 MHz, 1 GHz	0 dBm	0.10 dB	
128 MHz	0 dBm	0.08 dB	
Input Attenuator:			Step attenuator
9 kHz to 18 GHz	(0 to 60) dB	0.15 dB	
(18 to 26.5) GHz	(0 to 60) dB	0.42 dB	
(26.5 to 40) GHz	(0 to 60) dB	0.52 dB	
(40 to 44) GHz	(0 to 60) dB	1.2 dB	
Reference Level: (IF Attenuator)			Step attenuator
100 MHz, 1 GHz	(0 to 70) dB	0.15 dB	

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Spectrum Analyzer <sup>3</sup> – (cont)			
Input Impedance: Reflection Coefficient Magnitude (0 to 1)	9 kHz to 2 GHz (2 to 8) GHz (8 to 18) GHz (18 to 26.5) GHz (26.5 to 44) GHz	0.023 0.024 0.028 0.043 0.04	Network analyzer & calibration kit
Resolution Bandwidth	(10 to 128) MHz	2.2 %	Signal generator
Cal. Output: Frequency Accuracy	9 kHz to 46 GHz	0.01 μHz/Hz + 100 μHz	Frequency counter
Sine-Wave level Accuracy: 1 Hz to 9 kHz	(0 to -20) dBm	0.085 dB	Signal generator & digital multimeter
9 kHz to 6 GHz	(+10 to -60) dBm (-60 to -110) dBm	0.23 dB 0.27 dB	Power meter & power sensor & spectrum analyzer
(6 to 10) GHz	(+10 to -70) dBm (-70 to -90) dBm	0.28 dB 0.31 dB	
(10 to 26.5) GHz	(+10 to -70) dBm	0.37 dB	
(26.5 to 43.5) GHz	(+10 to -50) dBm	0.26 dB	
Tracking Generator: Output Level Accuracy			
9 kHz to 6 GHz	(+10 to -50) dBm	0.23 dB	Power meter & power sensor
(6 to 18) GHz	(+10 to -50) dBm	0.37 dB	
ESD Generators –			ISO10605:2008 IEC61000-4-2:2008
Contact Discharge: Discharge Voltage Rise Time & Fall Time Peak Current	(0 to ±30) kV (0.2 to 20) ns (0 to ±15) kA	2.2 % 51 ps 3.6 %	Oscilloscope, high voltage probe & target

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
EMI Receiver <sup>3</sup> –			CISPR16-1-1
Reference Frequency	(1 to 100) MHz	0.01 µHz/Hz	
Readout Accuracy	9 kHz to 6 GHz (2 to 18) GHz (18 to 43.5) GHz	20 pHz/Hz + 100 µHz 20 pHz/Hz	Signal generator
Limitation of Intermodulation Effects	(-60 to -110) dBm	0.85 dB	
Sine-Wave Level Accuracy:			
9 kHz to 6 GHz	(+10 to -60) dBm (-60 to -110) dBm	0.23 dB 0.27 dB	Power meter & power sensor
(6 to 10) GHz	(+10 to -70) dBm (-70 to -90) dBm	0.28 dB 0.31 dB	
(10 to 26.5) GHz	(+10 to -70) dBm	0.37 dB	
(26.5 to 44) GHz	(+10 to -50) dBm	0.26 dB	
Input Attenuator:			
9 kHz to 18 GHz	(0 to 60) dB	0.15 dB	Step attenuator
(18 to 26.5) GHz	(0 to 60) dB	0.42 dB	
(26.5 to 40) GHz	(0 to 60) dB	0.52 dB	
(40 to 44) GHz	(0 to 60) dB	1.2 dB	
Input Impedance: Reflection Coefficient Magnitude (0 to 1)	9 kHz to 2 GHz (2 to 8) GHz (8 to 18) GHz (18 to 26.5) GHz (26.5 to 44) GHz	0.023 0.024 0.028 0.043 0.04	Network analyzer
QP Pulse Response:			
Band A	(9 to 150) kHz	0.34 dB	Pulse generator
Band B	150 kHz to 30 MHz	0.34 dB	
Band C/D	(30 to 200) MHz (200 to 1000) MHz	0.43 dB 0.52 dB	
QP Pulse Rate Response:			
Band A:			
(9 to 150) kHz	Repetition Rate < 10 Hz ≥ 10 Hz	0.40 dB 0.34 dB	

Parameter/Range	Frequency	CMC <sup>2,4</sup> (±)	Comments
EMI Receiver <sup>3</sup> – (cont)			CISPR16-1-1
QP Pulse Rate Response: Band B: 150 kHz to 30 MHz	Repetition Rate < 10 Hz ≥ 10 Hz	0.40 dB 0.34 dB	Pulse generator
Band C/D: (30 to 200) MHz	Repetition Rate < 10 Hz ≥ 10 Hz	0.48 dB 0.43 dB	
(200 to 1000) MHz	Repetition Rate < 10 Hz ≥ 10 Hz	0.56 dB 0.52 dB	
Relative Pulse Response QP vs. AV, PK: Band A Band B Band C/D	(9 to 150) kHz 150 kHz to 30 MHz (30 to 200) MHz (200 to 1000) MHz	0.34 dB 0.34 dB 0.43 dB 0.52 dB	
RMS – Average Pulse Rate: Band A Band B Band C/D	(9 to 150) kHz 150 kHz to 30 MHz (30 to 200) MHz (200 to 1000) MHz	0.34 dB 0.34 dB 0.43 dB 0.52 dB	Signal generator
Band E	(1 to 18) GHz	0.52 dB	
Selectivity: 6 dB BW	200 Hz 9 kHz 120 kHz 1 MHz	1.4 % 1.4 % 1.4 % 1.4 %	
Impulse Bandwidth	1 MHz	0.8 dB	
Pulse-Modulated Sine Wave Input:			
Band A/B	9 kHz to 30 MHz (30 to 300) MHz	0.8 dB 0.8 dB	

Parameter/Equipment	Range	CMC <sup>2,4</sup> ( $\pm$ )	Comments
Signal Generator <sup>3</sup> –			
Output Level Accuracy & Flatness:			
9 kHz to 6 GHz	(+20 to -60) dBm (-60 to -110) dBm	0.23 dB 0.27 dB	Power meter, power sensor & spectrum analyzer
(6 to 10) GHz	(+20 to -70) dBm (-70 to -90) dBm	0.28 dB 0.31 dB	
(10 to 26.5) GHz	(+20 to -70) dBm	0.37 dB	
(26.5 to 44) GHz	(+10 to -50) dBm	0.26 dB	
Output Impedance	9 kHz to 2 GHz (2 to 8) GHz (8 to 18) GHz (18 to 26.5) GHz	$\Gamma$ : 0.023 $\Gamma$ : 0.024 $\Gamma$ : 0.028 $\Gamma$ : 0.043	Network analyzer
Residual FM:	10 MHz to 2 GHz	1.5 %	Audio frequency modulation
Amplitude Modulation	Rate: 100 Hz to 20 kHz Depth: (30 to 100) %	2.1 %	CW: 1 MHz to 1 GHz
Frequency Modulation	Deviation: (10 to 50) kHz	0.13 %	CW: 1 MHz to 1 GHz
Phase Modulation	2.405/5.520/8.654 rad	0.01 rad	CW: 200 MHz to 3 GHz
Pulse Modulation	T <sub>r</sub> / T <sub>f</sub> : 50 ps to 1 ms	2.4 %	Oscilloscope



Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Power Analyzer <sup>3</sup> – AC Power: (45 to 65) Hz, PF = 1 Power Factor <sup>5</sup> : (45 to 65) Hz Harmonic Current: 100 Hz to 6 kHz Frequency Voltage THD (100 to 230) V Current THD Up to 10 A Pst <sup>6</sup> : (45 to 65) Hz dc d <sub>max</sub> d <sub>t</sub>	20 W to 4.6 kW (0.3 to 1) (0.01 to 2) A (45 to 65) Hz (16 to 850) Hz 850 Hz to 6 kHz (16 to 850) Hz 850 Hz to 6 kHz (0.1 to 3) (0.1 to 5) % (0.1 to 5) % (400 to 1200) ms	0.02 % 0.23 % 0.065 % 0.02 % 0.022 % 0.31 % 0.016 % 0.13 % 0.34 % 0.30 % 0.31 % 0.11 %	IEC61000-3-2, 3, 11, 12 IEC 61000-4-15, 4-7 AC Voltage 45 Hz to 6 kHz AC Current 45 Hz to 6 kHz Power quality calibrator 1φ, (3φ) Power quality calibrator
Antenna Factor <sup>3</sup> – Horn Antenna & POD Antenna Radiation Pattern Monopole Loop Antenna Loop Sensor	(0.5 to 18) GHz (1 to 18) GHz 30 Hz to 1 kHz 1 kHz to 50 MHz 1 Hz to 10 MHz (10 to 30) MHz 1 Hz to 500 kHz	0.36 dB 1.1 dB 0.32 dB 0.25 dB 0.4 dB 0.5 dB 0.35 dB	10 m Semi-Anechoic Chamber (SAC) ANSI C63.5 SSM with floor absorber, SAE ARP 958 Rev. D/E ANSI C63.5, SAE ARP958 Rev D/E, CISPR16-1-4:2007/2010, CISPR16-1-6 IEEE Std. 291-1991, CISPR 16-1-6 SAE ARP 958 Rev. D/E

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Antenna Factor <sup>3</sup> – (cont)			10 m Semi-Anechoic Chamber (SAC)
Broad Band Antenna:			
Bi-conical	(24 to 300) MHz	1.0 dB	CISPR 16-1-6 SAM method SAE ARP958 Rev. D/E
Log Periodic/Horn	(200 to 1000) MHz	0.74 dB	
Hybrid (bicon-log)	(30 to 1000) MHz	1.0 dB	
Network Analyzer <sup>3</sup> –			Spectrum analyzer, calibration kit, power meter, power sensor.
Reference Frequency	9 kHz to 18 GHz (18 to 46) GHz	0.34 µHz/Hz	
Port Impedance	DC to 2 GHz (2 to 18) GHz (18 to 26.5) GHz (26 to 44) GHz	0.22 dB 0.027 dB 0.051 dB 0.85 dB	
Output Level Accuracy	9 kHz to 6 GHz 50 MHz to 10 GHz (10 to 26.5) GHz (26.5 to 44) GHz	0.23 dB 0.28 dB 0.37 dB 0.26 dB	
Dynamic Accuracy			
DC to 8 GHz	(0 to 70) dB (70 to 100) dB	0.13 dB 0.26 dB	Step attenuator
(8 to 18) GHz	(0 to 70) dB (70 to 100) dB	0.16 dB 0.27 dB	
(18 to 26.5) GHz	(0 to 60) dB	0.42 dB	
(26.5 to 40) GHz	(0 to 60) dB	0.52 dB	
(40 to 44) GHz	(0 to 60) dB	1.20 dB	
Load Match	9 kHz to 18 GHz (18 to 26.5) GHz (26.5 to 44) GHz	0.13 dB 0.74 dB 0.47 dB	Calibration Kit

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Current/Injection Probe <sup>3</sup> –			
LF Sensitivity Factor	(10 to 850) Hz 10 mA to 20 A	1.0 %	Calibrator
Transfer Impedance: dBΩ	(1 to 30) Hz 10 Hz to 100 MHz	0.2 dB 0.2 dB	Impedance/gain-phase analyzer
	100 MHz to 1 GHz (1 to 2.1) GHz	1.1 dB 3.1 dB	50 Ω current calibration fixture
Surge Generator <sup>3</sup> –			IEC61000-4-5:2005/2017 IEC61000-4-12 IEC61000-4-18
V <sub>peak</sub>	±(0.2 to 7) kV	1.7 %	Oscilloscope & differential probe
I <sub>peak</sub>	1 A to 10 kA	1.7 %	Oscilloscope & current monitor
Effective Output Impedance	2 Ω, 12 Ω	2.4 %	
Front Time (T <sub>f</sub> /T <sub>1</sub> ) Time to Half Value (T <sub>d</sub> /T <sub>2</sub> )	5 ns to 10 μs (0.1 to 700) μs	2.4 % 2.4 %	
Phase Shift	(1 to 360) °	2.4 %	
EFT/Burst Generator <sup>3</sup> – Coupling clamp			IEC61000-4-4
V <sub>peak</sub>	(0.1 to 10) kV	2.9 %	Oscilloscope & attenuators
Pulse Duration	1 μs to 500 ms	2.4 %	
Rise Time / Fall Time	(1 to 10) ns	2.4 %	
Pulse Width	(10 to 100) ns	2.4 %	
Voltage Dip Generator <sup>3</sup> –			IEC 61000-4-11
Nominal Voltage	(90 to 264) V	1.8 %	Oscilloscope & differential probe, current monitor
Dip Voltage	(0.01 to 264) V	1.8 %	
Rise Time / Fall time	(0.01 to 20) μs	2.4 %	No load / 100 Ω load
Duration	(0.1 to 1000) ms	2.4 %	
Phase Angle	(0 to 360) °	2.4 %	

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
EM Clamp/Injection Clamp <sup>3</sup> –  Coupling Factor:  Decoupling Factor	  (0.15 to 230) MHz 10 kHz to 500 MHz 500 MHz to 2.1 GHz  150 kHz to 230 MHz	  0.7 dB 0.8 dB 1.3 dB  0.7 dB	IEC 61000-4-6  Jig method, network analyzer
Voltage Probe Calibration <sup>3</sup> –  Passive Probe: Attenuation: DC/1 kHz -3 dB Bandwidth Rise Time  Differential Probe: Attenuation -3 dB Bandwidth  Rise Time	  (0.1 to 2000) V DC to 4 GHz Tr > 0.7 ns Tr > 0.35 ns  (0.001 to 2.8) kV DC to 100 MHz  Tr > 3 ns	  0.33 % 4.0 % 4.0 % 5.3 %  0.33 % 4.0 %  4.0 %	Oscilloscope, Function generator, Signal generator, Pulse generator  Electrical power quality calibrator  Signal generator, pulse generator
Oscilloscope <sup>3</sup> –  Vertical: V/Div  Horizontal: Time/Div  -3 dB Bandwidth  Rise Time (144 ps to 1 μs)  Input Impedance: DC  Delay Time	  (2 to 10) mV (0.02 to 10) V  (10 s to 100 ns) 10 ns to 200 ps  DC to 4 GHz  fc: ≤ 500 MHz fc: ≤ 2.5 GHz  50 Ω, 1 MΩ  (0.1 to 100) ms	  0.22 % 0.12 %  0.1 % 0.2 %  3.6 %  2.2 % 3.6 %  0.015 %  0.000 02 %	Function generator  Function generator & signal generator  Signal generator  Pulse generator  Digital multimeter  Function generator

Parameter/Equipment	Range	CMC <sup>2,4,8</sup> ( $\pm$ )	Comments
7637 Pulse Generator <sup>3</sup> – Pulse 1, Pulse 2a, 2b, Pulse 3a, 3b, Pulse 5a, 5b: Voltage Rise Time Duration	(0.1 to 660) V 1 ns to 5 $\mu$ s 100 ns to 3 s	2.6 % 2.4 % 2.4 %	ISO7637-2 (2004, 2011(E)) ISO7637-3 ISO16750-2 Load / No load, Oscilloscope, & HV differential probe
Pulse Generator, Function Generator <sup>3</sup> – Square Wave Voltage  Sine Waveform: 10 Hz to 10 kHz 10 kHz to 100 MHz  Rise Time / Fall Time Pulse Width  Phase	(10 to 100) mVpp (100 mVpp to 20 Vpp)  (+10 to -20) dBm (+20 to -60) dBm  $T_r > 1$ ns, $T_f > 1$ ns 10 $\mu$ s to 1 s  (0 to 360) $^\circ$	0.015 % 0.001 %  0.07 dB 0.23 dB  2.4 % 2.4 %  0.4 $^\circ$	Digital multimeter  Digital multimeter, power meter & power sensor  Oscilloscope  Delay time measure

Parameter/Equipment	Frequency	CMC <sup>2</sup> ( $\pm$ )	Comments
RF Amp, Pre Amp <sup>3</sup> –  Gain  Input /Output Impedance  Power Amp: 1 dB Compression Gain Maximum OUT (0 to 1 kW)	9 kHz to 1 GHz (1 to 18) GHz  9 kHz to 2 GHz (2 to 8) GHz (8 to 18) GHz (18 to 26.5) GHz  9 kHz to 1 GHz  (1 to 18) GHz	0.24 dB 0.28 dB  $\Gamma$ : 0.023 $\Gamma$ : 0.024 $\Gamma$ : 0.028 $\Gamma$ : 0.043  0.31 dB  0.34 dB	Network analyzer  Network analyzer & attenuation

Harmonic Distortion	(1 to 18) GHz	0.34 dB	
Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
RF Amp, Pre Amp <sup>3</sup> – (cont) Bipolar Power / Amp: Gain (Up to 53 dB)	10 Hz to 300 MHz	0.26 dB	Network analyzer
Electric Field Probe –  Correction Factor  Linearity	10 kHz to 6 GHz (1 to 6) GHz  10 kHz to 6 GHz	1.9 dB 1.9 dB 1.9 dB	IEEE Std 1309 Transfer Standard  using GTEM-CELL using SAC with floor absorber Reference field probe Power Meter/Sensor
NSA Validation Test <sup>3</sup> –  Distance 10 m, Horizontal: Bi-Conical Antenna Log Periodic Antenna  Distance 10 m, Vertical: Bi-Conical Antenna Log Periodic Antenna  Distance 3 m, Horizontal: Bi-Conical Antenna Log Periodic Antenna  Distance 3 m, Vertical: Bi-Conical Antenna Log Periodic Antenna  3 m Method  Biconical Antenna LPDA Antenna Small LPDA Antenna	(30 to 70) MHz (70 to 200) MHz (200 to 1000) MHz  (30 to 70) MHz (70 to 200) MHz (200 to 1000) MHz  (30 to 70) MHz (30 to 200) MHz (200 to 1000) MHz  (30 to 70) MHz (30 to 200) MHz (200 to 1000) MHz    (30 to 200) MHz (200 to 1000) MHz (1 to 18) GHz	1.0 dB 0.69 dB 0.71 dB  1.1 dB 0.72 dB 0.74 dB  1.0 dB 0.72 dB 0.72 dB  1.1 dB 0.75 dB 0.76 dB   0.86 dB 0.69 dB 0.59 dB	ANSI C63.5, ANSI C63.5a, CISPR 16-1-4, CISPR 16-1-4:2010-04  horizontal: Tx = 1.0 m, 2.0 m, (2.5 to 4.0) m vertical: Tx = 1.0 m, 1.5 m, (2.0 to 3.5) m standard antenna: VHBB9124: (30 to 200) MHz VULP9118A: 200 MHz to 1 GHz Network analyzer   ETSI TR 102 273-2, 273-3

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
ALSE Validation Test <sup>3</sup> – Reference Site Measurement Method Modeling Long Wire Antenna Method	(0.15 to 20) MHz (20 to 30) MHz (30 to 1000) MHz (0.15 to 30) MHz (30 to 1000) MHz	0.79 dB 1.6 dB 1.2 dB 1.2 dB 1.2 dB	CISPR 25 Monopole (0.15 to 30) MHz Bicon (30 to 200) MHz LPD (200 to 1000) MHz Network analyzer
SVSWR Validation Test <sup>3</sup> – (1 to 6) GHz (6 to 18) GHz	(0 to 20) dB (0 to 20) dB	0.43 dB 0.43 dB	CISPR16-1-4, VCCI ANSI C63.4 Network analyzer, transmit antenna
SAC/Shield Validation Test <sup>3</sup> – Dynamic Range (69 to 145) dB	10 kHz to 18 GHz	2.9 dB	IEEE 299-2006 Spectrum analyzer, signal generators, reference antennas
NSIL Validation Test <sup>3</sup> – Distance 3 m Distance 5 m Distance 10 m	9 kHz to 30 MHz 9 kHz to 30 MHz 9 kHz to 30 MHz	1.1 dB 1.1 dB 1.8 dB	CISPR16-1-4 Network analyzer Loop antenna
Directional Coupler <sup>3</sup> – Coupling Factor/Loss (0 to 60) dB Directivity	10 Hz to 9 kHz 9 kHz to 18 GHz (18 to 44) GHz 10 Hz to 9 kHz 9 kHz to 18 GHz (18 to 44) GHz	0.22 dB 0.07 dB 0.35 dB 0.52 dB 0.69 dB 1.0 dB	Network analyzer

### III. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2,4,9</sup> (±)	Comments
Frequency <sup>3</sup> – Measure	10 Hz to 43.5 GHz	0.01 μHz/Hz + 100 μHz	Rubidium standard & phase locked counter
Frequency <sup>3</sup> – Generate	10 MHz	50 pHz/Hz (24 h)	Rubidium standard
	10 Hz to 43.5 GHz	50 pHz/Hz + 100 μHz	Rubidium standard with signal generators phase locked
Period, Time Interval <sup>3</sup> –	10 ns to 10 s (10 to 1000) s (1000 to 100 000) s	0.003 % 0.003 % 0.003 %	Oscilloscope
T <sub>r</sub> (Rise Time), T <sub>f</sub> (Fall Time)	50 ps to 1 ms	2.4 %	
T <sub>d</sub> (Duration Time)	50 ps to 1 ms	2.4 %	



Satellite location

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I. Electrical – RF/Microwave

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Antenna Factor--  Broad Band Antenna:  Bi-conical Log Periodic/Horn Hybrid (bicon-log)  Bi-conical Log Periodic Hybrid (bicon-log)	(24 to 300) MHz (200 to 1000) MHz (30 to 1000) MHz  (24 to 300) MHz (180 to 1000) MHz (30 to 2000) MHz	1.0 dB 0.74 dB 1.0 dB  0.64 dB 0.62 dB 0.62 dB	Network analyzer  10 m OATS  CISPR 16-1-6 SAM method SAE ARP958 Rev. D/E  ANSI C63.5- 1998/2006/2017, CISPR 16-1-6 SSM method including NSA & GSCF capabilities
Antenna Symmetry	(30 to 2000) MHz	0.21 dB	Network analyzer ANSI C63.5 ANSI C63.4

<sup>1</sup> This laboratory offers commercial calibration service and field calibration service.

<sup>2</sup> 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 of 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.

<sup>3</sup> Field calibration service is available for this calibration. 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 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.

<sup>4</sup> In the statement of CMC, the value is defined as the percentage of reading unless otherwise noted.

<sup>5</sup> Power factor is ratio of  $PF=Pa/VI$  and has no units, where Pa: active power, VI: apparent power.

<sup>6</sup> Pst is the flicker severity and has no units. It is regulated by IEC61000 -3-3.

<sup>7</sup> This scope meets A2LA's *P112 Flexible Scope Policy*.

<sup>8</sup> 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. CMCs 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.

<sup>9</sup> 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.



## Accredited Laboratory

A2LA has accredited

**OHTAMA CALIBRATION SERVICE CO., LTD.**

*Kanagawa, JAPAN*

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 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 26<sup>th</sup> day of June 2024.

A blue ink signature of Trace McInturff, written over a horizontal line.

Mr. Trace McInturff, Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 3606.01  
Valid to July 31, 2026

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