SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid To: July 31, 2022 Certificate Number: 3606.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations[1, 7]:

I. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 4, 8] (±)	Comments
DC Voltage[3] – Measure	Up 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 (1 to 20) kV	0.69 % 0.07 % 0.015 % 0.001 % 0.001 % 0.001 % 0.002 % 1.6 %	Agilent 3458A Oscilloscope and probe
DC Voltage[3] – 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

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Parameter/Equipment	Range	CMC[2, 4, 8] (±)	Comments
DC Current[3] – Measure	(1 to 10) µA (10 to 100) µA 100 µA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 3) A (3 to 10) A	0.043 % 0.012 % 0.009 % 0.009 % 0.01 % 0.021 % 0.13 % 0.20 %	Agilent 3458A Digital multimeter
DC Current[3] – 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	0.0093 % 0.012 % 0.012 % 0.012 % 0.043 % 0.018 % 0.015 % 0.069 % 0.016 % 0.017 %	Calibrator
DC Resistance[3] – Measure	(0.1 to 1) Ω (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 1GΩ	0.018 % 0.008 % 0.006 % 0.001 % 0.001 % 0.001 % 0.003 % 0.015 % 0.067 % 0.59 %	Digital multimeter Agilent 3458A

Parameter/Equipment	Range	CMC[2, 4, 8] (±)	Comments
DC Resistance[3] – Generate	1 Ω 10 Ω 50 Ω 100 Ω 190 Ω 500 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 0.01 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 1 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 % 0.28 % 0.03% 0.004 % 1 % 1 % 1 % 3 %	Decade resistor RS925A decade resistor Decade resistor
AC Resistance[3] – 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[3] – 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 meter Impedance/gain-phase analyzer; 4 wire method

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

Parameter/Range	Frequency	CMC[2, 4, 8] (±)	Comments
AC Voltage[3] – 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 %	Oscilloscope & differential probe

Parameter/Range	Frequency	CMC[2, 4, 8] (±)	Comments
AC Voltage[3] – Generate			
(0 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
(0.2 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 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 to 202) V	(10 to 44) Hz (45 to 999) Hz (1 to 20) kHz	0.12 % 0.11 % 0.16 %	
(200 to 1020) V	10 to 44) Hz (45 to 999) Hz (1 to 20) 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[2, 4, 8] (±)	Comments
Harmonics Distortion[3] – Measure	10 Hz to 110 kHz	0.01 %	Audio analyzer reference frequency
AC Current[3] – 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 (3 to 6.3) A	(16 to 850) Hz 850 Hz to 2 kHz	0.25 % 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[2, 4, 8] (±)	Comments
AC Current[3] – 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
(0.2 to 2.02) mA	(10 to 44) Hz (45 to 999) Hz (1 to 10) kHz	0.32 % 0.11 % 1.0 %	
(2 to 20.2) mA	(10 to 44) Hz (45 to 999) Hz (1 to 10) kHz	0.32 % 0.11 % 0.75 %	
(20 to 202) mA	(10 to 44) Hz (45 to 999) Hz (1 to 10) kHz	0.32 % 0.11 % 0.85 %	
(0.2 to 2.02) A	(10 to 44) Hz (45 to 999) Hz (1 to 5) kHz	0.38 % 0.24 % 0.87 %	
(2 to 10.0) A	(30 to 44) Hz (45 to 99) Hz 100Hz to 1 kHz	0.30 % 0.13 % 0.43 %	

Parameter/Range	Frequency	CMC[2, 4, 8] (±)	Comments
Magnetic Field[3] – 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
(1 to 110) µT (1 to 50) µT (1 to 30) µT	(50 to 120) kHz (120 to 300) kHz (300 to 400) kHz	0.8 % 0.9 % 1.4 %	6 turn

II. Electrical – RF/Microwave

Parameter/Equipment	Range	CMC[2, 8] (±)	Comments
Absolute Power[3] – 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	
Relative Power[3] – 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	Impedance/gain-phase analyzer Network analyzer
9 kHz to 18 GHz	(0 to 70) dB (70 to 100) dB	0.07 dB 0.13 dB	Network analyzer

Parameter/Equipment	Range	CMC[2, 4, 8] (±)	Comments
Attenuation[3] – Generate			
DC to 8 GHz	(0 to 30) dB (30 to 70) dB (70 to 100) dB	0.13 dB 0.13 dB 0.26 dB	Step attenuator
(8 to 18) GHz	(0 to 30) dB (30 to 70) dB (70 to 100) dB	0.16 dB 0.16 dB 0.27 dB	
Impedance[3] – Measure			50 ohm load
Γ / θ	(9 to 100) kHz 100 kHz to 10 MHz (10 to 100) MHz	Γ: 0.03 θ: 2.2° Γ: 0.025 θ: 1.4° Γ: 0.03 θ: 2.2°	Impedance/gain-phase analyzer
Γ / θ	9 kHz to 2 GHz (2 to 8) GHz (8 to 18) GHz	Γ: 0.023 θ: 0.6° Γ: 0.024 θ: 0.6° Γ: 0.028 θ: 0.6°	Network analyzer & calibration kit
LISN[3] –			ANSI C63.4, CISPR 25, CISPR 16-1-2, ISO7637-2, ISO 11452-1, MIL-STD 461E
Voltage Division Factor	9 kHz to 300 MHz	0.2 dB	Network analyzer
Impedance: Z, θ	9 kHz to 300 MHz	Z: 2.2 %, θ: 0.6°	
Isolation	9 kHz to 300 MHz	0.2 dB	
CDNs[3] –			IEC 61000-4-6
Coupling Factor	150 kHz to 300 MHz	0.2 dB	Network analyzer
Impedance: Z, θ	150 kHz to 300 MHz	Z: 1.8 %, θ: 0.6°	
Isolation	150 kHz to 300 MHz	0.2 dB	

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
ISN[3] –			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 < 65dB	100 kHz to 5 MHz (5 to 30) MHz	0.35 dB 0.55 dB	
LCL < 75dB	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[3] –			
Marker Readout Accuracy	9 kHz to 6 GHz (2 to 18) GHz	20 pHz/Hz +100 µHz 20 pHz/Hz	Signal generator
Span Accuracy Residual FM Noise Side Band	100 Hz to 10 MHz (-20 to -130) dBc	1.0 % 1.0 Hz 0.5 dB	
Level Accuracy 9 kHz to 6 GHz	 (0 to -60) dBm (-60 to -110) dBm	 0.23 dB 0.27 dB	
Input Attenuator: 9 kHz to 18 GHz	 (0 to 60) dB	 0.15 dB	 Step attenuator
Reference Level: (IF Attenuator) (0 to 70) dB	 100 MHz, 1GHz	 0.15 dB	 Step attenuator
Input Impedance: Γ	9 kHz to 2 GHz (2 to 8) GHz (8 to 18) GHz	Γ: 0.023 Γ: 0.024 Γ: 0.028	Network analyzer and calibration kit
Resolution Bandwidth	(10 to 128) MHz	2.2 %	Signal generator

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Spectrum Analyzer[3] – (cont)			
Cal. Output:			
Frequency Accuracy	9 kHz to 18 GHz	0.01 µHz/Hz + 100 µHz	Frequency counter
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 & 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	
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 –			
Contact & Air Discharge:			IEC61000-4-2:2008 Oscilloscope
Discharge Voltage			
Rise time (± Polarity)	(± 0 to 30) kV (0.2 to 20) ns	2.2 % 51 ps	& Tek P6015A & Target
Peak Current	(± 0 to 15) kA	3.6 %	

Parameter/Equipment	Range	CMC[2] (±)	Comments
EMI Receiver[3] –			CISPR16-1-1
Reference Frequency	(1 to 100) MHz	0.01 µHz/Hz	
Readout Accuracy	9 kHz to 6 GHz (2 to 18) 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	
(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	
Input Attenuator:			
9 kHz to 18 GHz	(0 to 60) dB	0.15 dB	Step Attenuator
Input Impedance: Γ	9 kHz to 2 GHz (2 to 8) GHz (8 to 18) GHz	Γ: 0.023 Γ: 0.024 Γ: 0.028	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	Repeat: < 10 Hz Repeat: > 10 Hz	0.40 dB 0.34 dB	
Band B: 150 kHz to 30 MHz	Repeat: < 10 Hz Repeat: > 10 Hz	0.40 dB 0.34 dB	
Band C/D: (30 to 200) MHz	Repeat: < 10 Hz Repeat: > 10 Hz	0.48 dB 0.43 dB	
(200 to 1000) MHz	Repeat: < 10 Hz Repeat: > 10 Hz	0.56 dB 0.52 dB	

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

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Signal Generator[3] –			
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
(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	
Output Impedance	9 kHz to 2 GHz (2 to 8) GHz (8 to 18) GHz	Γ: 0.023 Γ: 0.024 Γ: 0.028	Network analyzer
Residual FM:		1.5 %	
Amplitude Modulation	100 Hz to 20 kHz (30 to 100) %	2.1 %	AF modulation frequency CW: 1 MHz to 1 GHz
Frequency Modulation	Δ FM: (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	Tr / Tf	2.4 %	Oscilloscope

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Power Analyzer[3] –			IEC61000-3-2, 3, 11, 12 IEC 61000-4-15, 4-7
AC Power: (45 to 65) Hz, PF = 1	20 W to 4.6 kW	0.02 %	AC Voltage 45 Hz to 6 kHz
Power Factor[5]: (45 to 65) Hz	(0.3 to 1)	0.23 %	AC Current 45 Hz to 6 kHz
Harmonic Current: 100 Hz to 6 kHz	(0.01 to 2) A	0.065 %	Fluke 6105A 1φ, (3φ)
Frequency	(45 to 65) Hz	0.02 %	Fluke 6105A
Voltage THD	(16 to 850) Hz 850 Hz to 6 kHz	0.022 % 0.31 %	
Current THD	(16 to 850) Hz 850 Hz to 6 kHz	0.016 % 0.13 %	
Pst[6]: (45 to 65) Hz	(0.1 to 3)	0.34 %	
dc d_{max} d_t	(0.1 to 5) % (0.1 to 5) % (400 to 1200) ms	0.30 % 0.31 % 0.11 %	
Antenna Factor[3]–			
Horn Antenna: Radiation Pattern	(0.5 to 18) GHz	0.36 dB	ANSI C63.5 SSM with floor absorber, SAE ARP 958
POD Antenna: Radiation Pattern	(1 to 18) GHz	1.1 dB	
Mono Pole	30 Hz to 1 kHz 1 kHz to 50 MHz	0.32 dB 0.25 dB	Capacitive substitute standard magnetic field method
Loop Antenna	1 Hz to 10 MHz (10 to 30) MHz	0.4 dB 0.5 dB	IEEE Std. 291-1991
Loop Sensor	1 Hz to 500 kHz	0.35 dB	IEEE.EMC-7.1965

Parameter/Equipment	Range	CMC[2, 4, 8] (±)	Comments
Antenna Factor[3]– (cont)			
Broad Band Antenna: Bi-conical Log Periodic Bi-Log	 (24 to 300) MHz (200 to 1000) MHz (30 to 1000) MHz	 1.0 dB 0.74 dB 1.0 dB	CISPR 16-1-6 SAM method SAE ARP958
Network Analyzer[3] –			
Reference Frequency	9 kHz to 18 GHz	0.01 μHz/Hz	Frequency – measure
Port Impedance	DC to 2 GHz (2 to 18) GHz	0.004 dB 0.01 dB	Calibration kit
Output Level Accuracy	9 kHz to 6 GHz 50 MHz to 10 GHz (10 to 26.5) GHz	0.23 dB 0.28 dB 0.37 dB	Absolute power – measure
Attenuation (S_{12}, S_{21})	9 kHz to 8 GHz (0 to 70) dB (70 to 100) dB (8 to 18) GHz (0 to 70) dB (70 to 100) dB	 0.13 dB 0.26 dB 0.16 dB 0.27 dB	Attenuation – generate
Phase	(-150 to 150)°	0.64 %	
Return Loss (S_{11},S_{22})	ρ = 12 dB ρ = 24 dB	0.27 dB 0.34 dB	
Current/Injection Probe[3] –			
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 100 MHz to 1 GHz (1 to 2.1) GHz	0.2 dB 0.2 dB 1.1 dB 3.1 dB	Impedance/gain-phase analyzer 50 Ω current calibration fixture

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Surge Generator[3] –			IEC61000-4-5 IEC61000-4-12 IEC61000-4-18
Vpeak	(± 0.2 to 7) kV	1.7 %	Oscilloscope & differential probe
Ipeak	1 A to 10 kA	1.7 %	Oscilloscope & current monitor
Effective Output Impedance	2 Ω, 12 Ω	2.4 %	
Front Time	5 ns to 10 µs	2.4 %	Time Tr, Tf
Time to Half Value	(0.1 to 700) µs	2.4 %	
Phase Shift	(1 to 360)°	2.4 %	
EFT/Burst Generator –			IEC61000-4-4
Vpeak	(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 –			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 %	
Duration	(0.1 to 1000) ms	2.4 %	
Phase Angle	(0 to 360)°	2.4 %	No load / 100 Ω load
EM Clamp –			IEC 61000-4-6
Coupling Factor:			
EM Clamp	(0.15 to 230) MHz	0.7 dB	Jig method
Injection Clamp	10 kHz to 500 MHz	0.8 dB	Network analyzer
	500 MHz to 2.1 GHz	1.3 dB	
Decoupling Factor	150 kHz to 230 MHz	0.7 dB	

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
Voltage Probe Calibration[3] –			
Passive Probe:			
Attenuation: DC/1 kHz	(0.1 to 2000) V	0.33 %	Oscilloscope
-3 dB Bandwidth	DC to 4 GHz	4.0 %	Function generator
Rise Time	Tr > 0.7 ns	4.0 %	Signal generator
	Tr > 0.35 ns	5.3 %	Pulse generator
Differential Probe:			
Attenuation	(0.001 to 2.8) kV	0.33 %	Electrical power quality Calibrator
-3 dB Bandwidth	DC to 100 MHz	4.0 %	
Rise Time	Tr > 3 ns	4.0 %	Signal generator, pulse generator
Oscilloscope[3] –			
Vertical: V/Div	2 mV to 10 mV/div	0.22 %	Function generator
	0.02 V to 10 V/div	0.12 %	
Horizontal: Time/Div	10 s to 100 ns/div	0.1 %	Function generator & signal generator
	10 ns to 200 ps/div	0.2 %	
-3 dB Bandwidth	DC to 4 GHz	3.6 %	Signal generator
Rise Time (>144 ps)	fc: < 500 MHz	2.2 %	Pulse generator
	fc: < 2.5 GHz	3.6 %	
Input Impedance: DC	50 Ω, 1 MΩ	0.015 %	
Delay Time	(0.1 to 100) ms	0.000 02 %	Function generator
7637 Pulse Generator[3] –			ISO7637-2 (2004, 2011(E)) ISO7637-3 ISO16750-2
Pulse 1, Pulse 2a, 2b, Pulse 3a, 3b, Pulse 5a, 5b:			Load / No load
Voltage	(0.1 to 660) V	2.6 %	Oscilloscope & HV differential probe
Rise Time	1 ns to 5 µs	2.4 %	
Duration	100 ns to 3 s	2.4 %	

Parameter/Equipment	Range	CMC[2, 4, 8] (±)	Comments
Pulse Generator, Function Generator[3] –			Square voltage DC voltage – measure
Sine Wave Form:			
10 kHz to 100 MHz	(+20 to -60) dBm	0.23 dB	Power meter & power sensor
Rise Time / Fall Time	Tr >1 ns	2.4 %	Oscilloscope
Pulse Width	10 µs to 1 s	2.4 %	
Phase	(0 to 360)°	0.4°	Delay time measure

Parameter/Equipment	Frequency	CMC[2] (±)	Comments
RF Amp, Pre Amp[3] –			
Gain	9 kHz to 1 GHz (1 to 18) GHz	0.24 dB 0.28 dB	Network analyzer
Input /Output Impedance	9 kHz to 2 GHz (2 to 8) GHz (8 to 18) GHz	Γ: 0.023 Γ: 0.024 Γ: 0.028	
Power Amp:			
1 dB Compression Gain	9 kHz to 1 GHz	0.31 dB	Network analyzer & attenuation
Maximum OUT (0 to 1 kW)	(1 to 18) GHz	0.34 dB	
Harmonic Distortion	(1 to 18) GHz	0.34 dB	
Bipolar power / Amp:	9 kHz to 2.2 GHz	64 dBc	
Gain	10 Hz to 300 MHz	0.26 dB	Network analyzer

Parameter/Equipment	Frequency	CMC[2] (±)	Comments
NSA Validation Test[3] –			
Distance 10 m, Horizontal:			
Bi-Conical Antenna	(30 to 70) MHz (70 to 200) MHz	1.0 dB 0.69 dB	ANSI C63.5, CISPR 16-1-4 Horizontal: Tx = 1.0 m, 2.0 m
Log Periodic Antenna	(200 to 1000) MHz	0.71 dB	Vertical: Tx = 1.0 m, 1.5 m Standard antenna:
Distance 10 m, Vertical:			VHBB9124:
Bi-Conical Antenna	(30 to 70) MHz (70 to 200) MHz	1.1 dB 0.72 dB	(30 to 200) MHz VULP9118A:
Log Periodic Antenna	(200 to 1000) MHz	0.74 dB	200 MHz to 1 GHz Network analyzer
Distance 3 m, Horizontal:			
Bi-Conical Antenna	(30 to 70) MHz (30 to 200) MHz	1.0 dB 0.72 dB	
Log Periodic Antenna	(200 to 1000) MHz	0.72 dB	
Distance 3 m, Vertical:			
Bi-Conical Antenna	(30 to 70) MHz (30 to 200) MHz	1.1 dB 0.75 dB	
Log Periodic Antenna	(200 to 1000) MHz	0.76 dB	
3 m Method			
Biconical Antenna LPDA Antenna Small LPDA Antenna	(30 to 200) MHz (200 to 1000) MHz (1 to 18) GHz	0.86 dB 0.69 dB 0.59 dB	ETSI TR 102 273-2, 273-3

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
ALSE Validation Test			
Reference Site Measurement Method	(0.15 to 20) MHz (20 to 30) MHz (30 to 1000) MHz	0.79 dB 1.6 dB 1.2 dB	CISPR 25 Monopole(0.15 to 30) MHz Bicon(30 to 200) MHz LPD(200 to 1000) MHz
Modeling Long Wire Antenna Method	(0.15 to 30) MHz (30 to 1000) MHz	1.2 dB 1.2 dB	Network analyzer

Parameter/Equipment	Range	CMC[2] (±)	Comments
Broadband Antenna, NSA Factor[3] –			Standard antenna method Standard antenna VHBB9124: (30 to 300) MHz VULP9118A: 200 MHz to 1 GHz Network analyzer
Distance 10 m, Horizontal H = 1.0, 2.0 m	(30 to 200) MHz (200 to 1000) MHz	1.1 dB 0.7 dB	
Distance 10 m, Vertical H = 1.0, 1.5 m	(30 to 200) MHz (200 to 1000) MHz	1.1 dB 0.74 dB	
Distance 3 m, Horizontal H = 1.0, 2.0 m	(30 to 200) MHz (200 to 1000) MHz	1.1 dB 0.7 dB	
Distance 3 m, Vertical H = 1.0, 1.5 m	(30 to 200) MHz (200 to 1000) MHz	1.1 dB 0.76 dB	
SVSWR Validation Test[3] –			CISPR16-1-4, VCCI
POD16: (1 to 6) GHz POD618: (6 to 18) GHz	(0 to 20) dB (0 to 20) dB	0.43 dB 0.43 dB	Network analyzer
SAC/Shield Validation Test[3] –			IEEE 299-2006
Dynamic Range (69 to 145) dB	14 kHz to 18 GHz	2.9 dB	Spectrum analyzer, signal generators, reference antennas

III. Time & Frequency

Parameter/Equipment	Range	CMC[2, 4, 9] (±)	Comments
Frequency[3] – Measure	10 Hz to 18 GHz	0.01 µHz/Hz + 100 µHz	Rubidium standard & phase locked counter
Frequency[3] – Generate	10 MHz 10 Hz to 18 GHz	20 pHz/Hz 20 pHz/Hz + 100 µHz	Rubidium standard Rubidium standard with signal generators phase locked
Period, Time Interval[3] – Tr, Tf Td	10 ns to 10 s (10 to 1000) s (1000 to 100 000) s 50 ps to 1 ms 50 ps to 1 ms	0.003 % 0.003 % 0.003 % 2.4 % 2.4 %	Oscilloscope

[1] This laboratory offers commercial calibration service 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 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.

[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 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] Power factor is ratio of PF=Pa/VI and has no units, where Pa: active power, VI: apparent power.

[6] Pst is the flicker severity and has no units. It is regulated by IEC61000 -3-3.

[7] This scope meets A2LA's *P112 Flexible Scope Policy.*

[8] 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.

[9] 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 7th day of December 2020.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3606.01
Valid to July 31, 2022

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