



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid To: March 31, 2022

Certificate Number: 4727.01

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, 6, 9} (±)	Comments
DC Voltage – Generate	(0 to 329.9999) mV (0 to 3.299 999) V (1 to 30) V (30 to 329.9999) V (100 to 1000.000) V	15 µV/V + 1.4 µV 7.5 µV/V + 8.1 µV 8.2 µV/V + 81 µV 16 µV/V + 1.2 mV 16 µV/V + 5.4 mV	Calibrator
DC Current – Generate	(0 to 329.999) µA (0 to 3.299 99) mA (0 to 32.9999) mA (0 to 329.999) mA (0 to 1.099 99) A (1.1 to 2.999 99) A (0 to 10.099 99) A (11 to 20.5) A (10 to 16.4999) A (16.5 to 149.999) A (150 to 1000) A	0.1 mA/A + 0.022 µA 53 µA/A + 0.16 µA 49 µA/A + 1.6 µA 51 µA/A + 16 µA 23 µA/A + 0.78 mA 0.15 mA/A + 0.78 mA 0.12 mA/A + 7.8 mA 0.51 mA/A + 7.8 mA 0.0028 A/A 0.0042 A/A 0.0046 A/A	Calibrator 5520A and 50 turn coil

Parameter/Range	Frequency	CMC ^{2, 6, 9} (±)	Comments
AC Voltage – Generate			
(1.0 to 32.999) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.0013 V/V + 70 μV 0.000 29 V/V + 70 μV 0.000 48 V/V + 70 μV 0.0013 V/V + 70 μV 0.0029 V/V + 70 μV 0.0057 V/V + 70 μV	Calibrator
(33 to 329.999) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.0012 V/V + 70 μV 0.000 29 V/V + 70 μV 0.000 47 V/V + 70 μV 0.0012 V/V + 70 μV 0.0017 V/V + 74 μV 0.0022 V/V + 88 μV	
(0.33 to 3.299 99) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.0012 V/V + 0.16 mV 0.0003 V/V + 0.16 mV 0.000 49 V/V + 0.16 mV 0.0012 V/V + 0.16 mV 0.0017 V/V + 0.18 mV 0.0025 V/V + 0.49 mV	
(3.3 to 32.9999) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.0012 V/V + 1.6 mV 0.0003 V/V + 1.6 mV 0.000 51 V/V + 1.6 mV 0.0016 V/V + 1.6 mV 0.004 V/V + 2.0 mV	
(33 to 329.999) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.0012 V/V + 7.9 mV 0.000 42 V/V + 9.1 mV 0.0047 V/V + 9.1 mV 0.0062 V/V + 9.1 mV 0.0079 V/V + 40 mV	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.0012 V/V + 26 mV 0.000 58 V/V + 26 mV 0.000 59 V/V + 26 mV	

Parameter/Range	Frequency	CMC ^{2, 6, 9} (±)	Comments
AC Current – Generate			
(29.00 to 329.99) µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.038 A/A + 0.4 µA 0.038 A/A + 0.4 µA 0.001 A/A + 0.4 µA 0.024 A/A + 0.4 µA 0.026 A/A + 0.42 µA 0.16 A/A + 0.5 µA	Calibrator
(0.33 to 3.299 99) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.0019 A/A + 1.2 µA 0.000 95 A/A + 1.2 µA 0.000 62 A/A + 1.2 µA 0.0048 A/A + 1.2 µA 0.009 A/A + 1.2 µA 0.02 A/A + 0.61 µA	
(3.3 to 32.9999) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.0018 A/A + 4.2 µA 0.000 78 A/A + 4.2 µA 0.000 64 A/A + 4.2 µA 0.0024 A/A + 4.2 µA 0.0056 A/A + 4.5 µA 0.0084 A/A + 3.1 µA	
(33 to 3299.99) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.0018 A/A + 42 µA 0.000 78 A/A + 42 µA 0.000 34 A/A + 42 µA 0.0008 A/A + 55 µA 0.0018 A/A + 87 µA 0.0055 A/A + 0.16 mA	
(0.33 to 1.099 99) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.0021 A/A + 0.4 mA 0.000 65 A/A + 0.4 mA 0.0093 A/A + 0.87 mA 0.028 A/A + 3.9 mA	
(1.1 to 2.999 99) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.0021 A/A + 0.4 mA 0.000 75 A/A + 0.4 mA 0.0091 A/A + 0.87 mA 0.025 A/A + 3.9 mA	
(3 to 10.9999) A	(45 to 100) Hz 100 Hz to 1kHz (1 to 5) kHz	0.0016 A/A + 2.8 mA 0.0011 A/A + 2.8 mA 0.024 A/A + 2.8 mA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1kHz (1 to 5) kHz	0.0018 A/A + 4.5 mA 0.0014 A/A + 4.5 mA 0.024 A/A + 4.5 mA	

Parameter/Range	Frequency	CMC ^{2, 6, 9} (±)	Comments
AC Current – Generate (cont)			
(10 to 16.4999) A	(45 to 100) Hz	0.008 A/A	5520A and 50TURNS
(16.5 to 149.999) A	100 Hz to 1 kHz	0.007 A/A	
(150 to 1000) A	(1 to 5) kHz	0.012 A/A	

Parameter/Equipment	Range	CMC ^{2, 6, 9} (±)	Comments
Resistance – Generate	Up to 10.9999 Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω 330 Ω to 1.099 999 kΩ (1.1 to 3.299 999) kΩ (3.3 to 10.999 99) kΩ (11 to 32.999 99) kΩ (33 to 109.9999) kΩ (110 to 329.9999) kΩ 330 kΩ to 1.099 999 MΩ (1.1 to 3.299 999) MΩ (3.3 to 10.999 99) MΩ (11 to 32.999 99) MΩ (33 to 109.9999) MΩ (110 to 329.9999) MΩ (330 to 1100) MΩ	31 μΩ/Ω + 7.8 mΩ 25 μΩ/Ω + 12 mΩ 22 μΩ/Ω + 12 mΩ 22 μΩ/Ω + 16 mΩ 22 μΩ/Ω + 16 mΩ 23 μΩ/Ω + 0.16 Ω 23 μΩ/Ω + 78 mΩ 23 μΩ/Ω + 0.78 Ω 23 μΩ/Ω + 0.78 Ω 26 μΩ/Ω + 7.8 Ω 23 μΩ/Ω + 7.8 Ω 76 μΩ/Ω + 0.12 kΩ 0.000 11 Ω/Ω + 0.20 kΩ 0.000 22 Ω/Ω + 1.9 kΩ 0.000 45 Ω/Ω + 2.4 kΩ 0.003 Ω/Ω + 78 kΩ 0.0099 Ω/Ω + 0.39 MΩ	Calibrator
DC Voltage – Measure	(1 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	0.0043 % of reading + 0.0040 % of range 0.0029 % of reading + 0.0009 % of range 0.0028 % of reading + 0.0006 % of range 0.0044 % of reading + 0.0007 % of range 0.0049 % of reading + 0.0012 % of range	DMM

Parameter/Equipment	Range	CMC ^{2,4,6,9} (±)	Comments
LISN Series DC Voltage Drop	10 mV to 100 V	0.72 %	DMM
DC Voltage – Measure	1 mV to 80 V	3.2 %	Oscilloscope
ESD Simulator ³ Current (1 to 8) kV, Contact Discharge	(0.07 to 30) A	6.3 %	IEC/EN 61000-4-2, ISO 10605, oscilloscope using IEC ESD target
Voltage Indication	(1 to 30) kV	0.52 % + 0.002 kV	IEC/EN 61000-4-2, high voltage meter
EFT/Burst Generator (50, 1000) Ω Load Voltage	(0.1 to 5) kV	5.6 %	IEC/EN 61000-4-4, oscilloscope
Surge Generator Open and Short Circuit Voltage	(0.001 to 8) kV	4.1 %	IEC/EN 61000-4-5, IEC/EN 61000-4-5 (2005), oscilloscope
Current	(0.001 to 4) kA	4.1 %	IEC/EN 61000-4-5, IEC/EN 61000-4-5 (2005), oscilloscope
Transient Immunity Peak Voltage	(1 to 1000) V	3.2 %	ISO 7637-2, ISO 7637-2 (2004), ISO 16750-2, oscilloscope

Parameter/Equipment	Range	CMC ^{2, 6, 9} (\pm)	Comments
DC Current – Measure	(1 to 100) μ A	0.058 % of reading + 0.029 % of range	DMM
	(0.1 to 1) mA	0.058 % of reading + 0.0058 % of range	
	(1 to 10) mA	0.058 % of reading + 0.023 % of range	
	(10 to 100) mA	0.058 % of reading + 0.0058 % of range	
	(0.1 to 400) mA	0.058 % of reading + 0.0058 % of range	
	(0.4 to 1) A	0.058 % of reading + 0.023 % of range	
	(1 to 10) A	0.17 % of reading + 0.0093 % of range	
Resistance – Measure	(1 to 10) Ω	0.012 % of reading + 0.035 % of range	DMM 4-wire measurement
	(10 to 100) Ω	0.012 % of reading + 0.0046 % of range	
	(0.1 to 1) k Ω	0.012 % of reading + 0.0012 % of range	
	(1 to 10) k Ω	0.012 % of reading + 0.0012 % of range	
	(10 to 100) k Ω	0.012 % of reading + 0.0012 % of range	
	(0.1 to 1) M Ω	0.012 % of reading + 0.0012 % of range	
	(1 to 10) M Ω	0.046 % of reading + 0.0012 % of range	
	(10 to 100) M Ω	0.92 % of reading + 0.012 % of range	
	(0.1 to 1) G Ω	2.4 % of reading + 0.012 % of range	

Parameter/Range	Frequency	CMC ^{2, 6, 9} (±)	Comments
AC Voltage – Measure (cont)			DMM
(1 to 10) V	(10 to 50) Hz	0.4 % of reading + 0.035 % of range	
	(50 to 1000) Hz	0.069 % of reading + 0.035 % of range	
	(1 to 20) kHz	0.14 % of reading + 0.058 % of range	
	(20 to 50) kHz	0.69 % of reading + 0.093 % of range	
	(50 to 100) kHz	4.6 % of reading + 0.58 % of range	
	(100 to 300) kHz	4.6 % of reading + 0.58 % of range	
(10 to 100) V	(10 to 50) Hz	0.4 % of reading + 0.035 % of range	
	(50 to 1000) Hz	0.069 % of reading + 0.035 % of range	
	(1 to 20) kHz	0.14 % of reading + 0.058 % of range	
	(20 to 50) kHz	0.69 % of reading + 0.093 % of range	
	(50 to 100) kHz	4.6 % of reading + 0.58 % of range	
	(100 to 300) kHz	4.6 % of reading + 0.58 % of range	
(100 to 1000) V	(50 to 1000) Hz	0.07 % of reading + 0.026 % of range	
LISN Series AC Voltage Drop			
(10 to 250) V	(50 to 60) Hz	1.9 %	DMM

Parameter/Range	Frequency	CMC ^{2, 6, 9} (±)	Comments	
AC Current – Measure				
10 mA	10 Hz to 5 kHz	0.17 % of reading + 0.069 % of range	DMM	
	(5 to 10) kHz	0.4 % of reading + 0.81 % of range		
100 mA	10 Hz to 5 kHz	0.12 % of reading + 0.046 % of range		
	(5 to 10) kHz	0.23 % of reading + 0.29 % of range		
400 mA	10 Hz to 1 kHz	0.12 % of reading + 0.12 % of range		
	(1 to 10) kHz	0.23 % of reading + 0.81 % of range		
1 A	10 Hz to 5 kHz	0.12 % of reading + 0.046 % of range		
	(5 to 10) kHz	0.4 % of reading + 0.81 % of range		
3 A	10 Hz to 5 kHz	0.17 % of reading + 0.069 % of range		
	(5 to 10) kHz	0.4% of reading + 0.81 % of range		
10 A	45 Hz to 5 kHz	0.17 % of reading + 0.069 % of range		
(0.1 to 600) A	(40 to 60) Hz	2.2 % + 4 A		IEC/EN 61000-4-8, clamp-on tester

Parameter/Range	Frequency	CMC ^{2, 4, 6} (±)	Comments
Oscilloscope – Amplitude - DC Signal 50 Ω Load 1 MΩ Load	1 mV to 6.6 V 1 mV to 130 V	0.001 V/V + 47 μV 0.001 V/V + 48 μV	5520A/SC1100
Time Marker	1 ns to 20 ms	0.0031 %	
Frequency	50 Hz to 1 GHz	0.0031 %	
Bandwidth	5 mV to 5 V _{p-p} 50 kHz to 100 MHz	0.37 dB 0.42 dB	
	(100 to 300) MHz (300 to 600) MHz	0.63 dB	
	5 mV to 3.5 V _{p-p} (600 to 1000) MHz	0.74 dB	
	50 mV to 3 V _{p-p} 10 MHz to 4 GHz	0.28 dB	Signal generator, power sensor, power meter

II. Electrical – RF/Microwave

Parameter/ Range	Frequency	CMC ^{2, 6} (±)	Comments
RF Insertion Loss Attenuators, RF Cables	5 Hz to 3 GHz (3 to 18) GHz	0.11 dB 0.29 dB	Network analyzer with calibration kit power meter and power sensor, directional couplers measuring receiver
Directional Couplers	10 kHz to 3 GHz (3 to 18) GHz	0.11 dB 0.46 dB	Network analyzer with calibration kit power meter and power sensor, directional couplers

Parameter/ Range	Frequency	CMC ^{2, 3 6} (\pm)	Comments
RF Insertion Loss – (cont)			
CDNs (Voltage Division Factor)	150 kHz to 300 MHz	0.19 dB + <i>M</i>	CISPR 16-1-2, IEC/EN 61000-4-6, network analyzer with calibration kit
(50 to 150) Ω Adapters	150 kHz to 300 MHz	0.11 dB + <i>M</i>	IEC/EN 61000-4-6, network analyzer with calibration kit
Current Probes (Transfer Impedance)	10 kHz to 1 GHz	0.38 dB + <i>M</i>	CISPR 16-1-2, IEC/EN 61000-4-6, network analyzer with calibration kit
EM Clamps (Impedance)	9 kHz to 1 GHz	1.9 Ω	IEC/EN 61000-4-6 Network analyzer with calibration kit
(Coupling Factor)	9 kHz to 1 GHz	0.84 dB	
(Decoupling Factor)	9 kHz to 1 GHz	0.2 dB	
Decoupling Clamps (Impedance)	9 kHz to 1 GHz	1.9 Ω	IEC/EN 61000-4-6 Network analyzer with calibration kit
(Decoupling Factor)	9 kHz to 1 GHz	0.2 dB	
LISN, AN, AMN (Voltage Division Factor)	9 kHz to 200 MHz	0.1 dB + <i>M</i>	ANSI C63.4, ISO 7637-2 CISPR 16-1-2, network analyzer with calibration kit
LISN, AN, AMN (Isolation)	9 kHz to 200 MHz	6.4 dB + <i>M</i>	ANSI C63.4, ISO 7637-2 CISPR 16-1-2, network analyzer with calibration kit
ISNs (Voltage Division Factor)	9 kHz to 250 MHz	0.28 dB + <i>M</i>	CISPR 22 / EN55022, CISPR 32 / EN55032, CISPR16-1-2, network analyzer with calibration kit
ISNs (Transmission and Cross Talk)	9 kHz to 250 MHz	0.16 dB + <i>M</i>	CISPR 22 / EN 55022, CISPR 32 / EN55032, CISPR 16-1-2, network analyzer with calibration kit

Parameter/ Range	Frequency	CMC ^{2,3,6} (±)	Comments
RF Insertion Loss – (cont)			
ISNs (LCL)	9 kHz to 250 MHz	0.86 dB + <i>M</i>	CISPR 22 / EN 55022, CISPR 32 / EN55032, CISPR 16-1-2, network analyzer with calibration kit
Amplifiers (Gain)	9 kHz to 3 GHz (3 to 18) GHz	0.25 dB 0.55 dB	Network analyzer with calibration kit, power meter and power sensor, directional couplers
Impedance			
LISN, AN, AMN	9 kHz to 200 MHz	2.1 Ω	ANSI C63.4, CISPR 16-1-2, ISO 7637-2, network analyzer with calibration kit
CDNs	9 kHz to 300 MHz	2.1 Ω	IEC/EN 61000-4-6, network analyzer with calibration kit
ISN	9 kHz to 250 MHz	2.4 Ω	CISPR 22 / EN 55022, CISPR 32 / EN55032, CISPR 16-1-2, network analyzer with calibration kit
Terminators	9 kHz to 3 GHz (3 to 18) GHz	0.65 Ω 0.03 lin	Network analyzer with calibration kit Power meter and power sensor, directional couplers
Impedance - Phase Angle –			
LISN, AN, AMN	9 kHz to 200 MHz	1.6°	CISPR 16-1-2, network analyzer with calibration kit
ISN	9 kHz to 250 MHz	2.1°	CISPR 22 / EN 55022, CISPR 32 / EN55032, CISPR 16-1-2, network analyzer with calibration kit

Parameter/ Range	Frequency	CMC ^{2, 4, 6} (\pm)	Comments
Power Meter/Power Sensor –			
Power Sensor Correction Factor (0 dBm)	(0.1 to 0.3) MHz (0.3 to 1) MHz (1 to 50) MHz 50 MHz to 4 GHz (4 to 8) GHz (8 to 18) GHz	2.4 % 1.3 % 1.4 % 1.3 % 1.9 % 3.6 %	Power meter and power sensor
Power Meter Accuracy (-10 to 10) dBm	10 MHz to 4GHz (4 to 8) GHz (8 to 18) GHz	4 % 4 % 5.1 %	Power meter and power sensor
Power Meter Ref. Out	50 MHz, 0 dBm	1.2 %	
Spectrum Analyzer –			
Standard Frequency Accuracy	10 MHz	6.4 mHz	Rubidium standard and frequency counter
Displayed Frequency Accuracy	10 Hz to 1 GHz (1 to 10) GHz (10 to 18) GHz (18 to 26.5) GHz	0.7 Hz 7 Hz 12 Hz 17 Hz	Rubidium standard and signal generator
Span Accuracy	1 kHz to 26.5 GHz	0.023 % of Setting	Rubidium standard and signal generator
Frequency Response, Reference Level Accuracy, Absolute Amplitude Accuracy	100 kHz to 4 GHz (4 to 8) GHz (8 to 18) GHz (18 to 26.5) GHz	0.19 dB 0.35 dB 0.36 dB 0.36 dB	Power meter and power sensor
Reference Level Accuracy, Absolute Amplitude Accuracy	(-90 to -10) dBm (0.01 to 4) GHz (4 to 8) GHz (8 to 18) GHz	0.26 dB 0.29 dB 0.41 dB	Power meter and power sensor, step attenuator
	(-50 to -10) dBm (18 to 26.5) GHz	0.74 dB	
Attenuator Switching Accuracy	10 kHz to 26.5 GHz	0.94 dB	Power meter and power sensor, step attenuator
Bandwidth Switching Accuracy	10 kHz to 26.5 GHz	0.94 dB	Signal generator

Parameter/ Range	Frequency	CMC ^{2, 4, 6} (\pm)	Comments
Spectrum Analyzer – (cont)			
Bandwidth Accuracy	10 Hz to 50 MHz	2 %	Signal generator
Scale Fidelity	(0.01 to 18) GHz (1 to 80) dB (80 to 100) dB	0.15 dB 1.3 dB	Step Attenuator
	(18 to 26.5) GHz (10 to 90) dB	0.89 dB	
Noise Floor	10 kHz to 26.5 GHz	1.7 dB	50 Ω termination
EMI Test Receiver –			CISPR 16-1-1
Reference Frequency Accuracy	10 MHz	6.4 mHz	Rubidium standard and frequency counter
Attenuator Accuracy (0 to 70) dB	9 kHz to 26.5 GHz	0.15 dB	Signal generator
Sine Wave Accuracy	100 kHz to 4 GHz (4 to 8) GHz (8 to 18) GHz (18 to 26.5) GHz	0.23 dB 0.25 dB 0.35 dB 0.36 dB	Signal generator, frequency standard, power meter, power sensor, attenuator
Input Impedance (VSWR)	9 kHz to 3 GHz (3 to 18) GHz (18 to 26.5) GHz	0.01 lin 0.03 lin 0.04 lin	Network analyzer with calibration kit signal generator, power meter, power sensor, directional couplers
Bandwidth Accuracy	9 kHz to 26.5 GHz	2 %	Signal generator, frequency standard, attenuator
Bandwidth Switching Accuracy	9 kHz to 26.5 GHz	0.15 dB	Signal generator, frequency standard, attenuator
CISPR Amplitude Calibration (Bands A/B/C/D)	Pulse Repetitions	1 dB	CISPR pulse generator, signal generator, power meter, power sensor, function generator
	Relative Amplitude	1 dB	
	Amplitude Relationship	1 dB	

Parameter/ Range	Frequency	CMC ^{2,6} (±)	Comments
EMI Test Receiver – (cont)			
Noise Floor	10 kHz to 26.5 GHz	1.7 dB	CISPR 16-1-1 50 Ω termination
Absolute Amplitude Accuracy (-70 to +20) dBm	100 kHz to 4 GHz (4 to 8) GHz (8 to 18) GHz (18 to 26.5) GHz	0.23 dB 0.25 dB 0.35 dB 3.3 dB	Signal generator, frequency standard, power meter, power sensor, attenuator
Frequency Response	100 kHz to 4 GHz (4 to 8) GHz (8 to 18) GHz (18 to 26.5) GHz	0.23 dB 0.25 dB 0.35 dB 3.3 dB	Signal generator, frequency standard, power meter, power sensor, attenuator
Display Linearity 9 kHz to 4 GHz	(1 to 80) dB (80 to 100) dB	0.15 dB 1.3 dB	Signal generator, frequency standard, attenuator
(4 to 8) GHz	(1 to 80) dB	0.4 dB	
(8 to 18) GHz	(1 to 80) dB	0.5 dB	
(18 to 26.5) GHz	(1 to 90) dB	3.3 dB	
Signal Generator –			
Standard Frequency Accuracy	10 MHz	6.4 mHz	Rubidium standard and frequency counter
Frequency Accuracy	10 Hz to 1 MHz (1 to 10) MHz (10 to 100) MHz 100 MHz to 1 GHz (1 to 3) GHz (2 to 18) GHz (18 to 26.5) GHz	0.64 mHz 6.4 mHz 0.064 Hz 0.64 Hz 1.9 Hz 12 Hz 17 Hz	Rubidium standard and frequency counter
Linearity 100 kHz to 18 GHz (18 to 26.5) GHz	(-120 to 20) dBm (-120 to 20) dBm	0.4 dB 0.9 dB	Measuring receiver
Absolute Level Accuracy			
100 kHz to 1MHz	0 dBm	0.05 dB	Power meter and power sensor
1 MHz to 4.2 GHz	0 dBm	0.06 dB	
(4.2 to 18) GHz	0 dBm	0.08 dB	
(18 to 26.5) GHz	0 dBm	0.14 dB	

Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Signal Generator – (cont)			
Absolute Level Accuracy			
100 kHz to 1 MHz	(-10 to 10) dBm	0.05 dB	Measuring receiver and power sensor
1 MHz to 4.2 GHz	(-10 to 10) dBm	0.06 dB	
(4.2 to 18) GHz	(-10 to 10) dBm	0.08 dB	
(18 to 26.5) GHz	(-10 to 10) dBm	0.14 dB	
10 kHz to 4.2 GHz	(-10 to 20) dBm (-30 to -10) dBm (-90 to -30) dBm (-120 to -90) dBm	0.11 dB 0.16 dB 0.19 dB 0.66 dB	Measuring receiver and power sensor
(4.2 to 8) GHz	(-10 to 20) dBm (-30 to -10) dBm (-90 to -30) dBm (-120 to -90) dBm	0.13 dB 0.18 dB 0.21 dB 0.78 dB	
(8 to 12.4) GHz	(-10 to 20) dBm (-30 to -10) dBm (-90 to -30) dBm (-120 to -90) dBm	0.15 dB 0.2 dB 0.23 dB 0.79 dB	Power meter and power sensor, measuring receiver
(12.4 to 18) GHz	(-10 to 20) dBm (-30 to -10) dBm (-90 to -30) dBm (-120 to -90) dBm	0.18 dB 0.25 dB 0.27 dB 0.78 dB	
(18 to 26.5) GHz	(-10 to 20) dBm (-30 to -10) dBm (-90 to -30) dBm (-120 to -90) dBm	0.22 dB 0.31 dB 0.34 dB 0.95 dB	
Harmonics /Sub Harmonic			
(0.0001 to 4) GHz	(0 to -90) dBc	1.4 dB	Measuring receiver
(4 to 18) GHz	(0 to -90) dBc	1.8 dB	
(18 to 26.5) GHz	(0 to -90) dBc	2.6 dB	
FM Modulation Accuracy			
(0.2 to 10) MHz Mod. Frequency: 10 Hz to 10 kHz	Deviation: (0 to 50) kHz	1.2 % of reading	Measuring receiver
(10 to 18000) MHz Mod. Frequency: 10 Hz to 100 kHz	Deviation: (0 to 500) kHz	1.2 % of reading	

Parameter/Equipment	Range	CMC ^{2, 4, 6} (±)	Comments
<p>Signal Generator – (cont)</p> <p>FM Modulation Accuracy</p> <p>(10 to 18000) MHz Mod. Frequency: 100 kHz to 200 kHz</p> <p>AM Modulation Accuracy</p> <p>(0.1 to 10) MHz Rate: 10 Hz to 10 kHz</p> <p>(10 to 18000) MHz Rate: 10 Hz to 50 kHz</p> <p>(10 to 18000) MHz Rate: 50k Hz to 100 kHz</p>	<p>Deviation: (0 to 500) kHz</p> <p>Depth: (5 to 99) %</p> <p>Depth: (5 to 99) %</p> <p>Depth: (5 to 99) %</p>	<p>3.5 % of reading</p> <p>3.6 % of reading</p> <p>3.9 % of reading</p> <p>3.9 % of reading</p>	<p>Measuring receiver</p>
<p>Reflection S₁₁/S₂₂, Magnitude and Phase – (VSWR) Measure</p> <p>(0 to 0.2) lin (0.2 to 0.4) lin (0.4 to 0.6) lin (0.6 to 0.8) lin (0.8 to 1) lin</p> <p>(0 to 0.03) lin (0.03 to 0.04) lin (0.04 to 0.05) lin (0.05 to 0.08) lin (0.08 to 0.09) lin (0.09 to 0.1) lin (0.1 to 0.11) lin (0.11 to 0.12) lin (0.12 to 0.13) lin (0.13 to 0.15) lin (0.14 to 0.15) lin (0.15 to 0.17) lin (0.17 to 0.18) lin (0.18 to 0.19) lin (0.19 to 0.2) lin</p>	<p>5 Hz to 9 kHz</p>	<p>(0.0041 to 0.0068) lin (0.0068 to 0.0098) lin (0.0098 to 0.013) lin (0.013 to 0.018) lin (0.018 to 0.022) lin</p> <p>(180 to 8.7) deg (8.7 to 6.7) deg (6.7 to 5.5) deg (5.5 to 3.7) deg (3.7 to 3.4) deg (3.4 to 3.1) deg (3.1 to 2.9) deg (2.9 to 2.7) deg (2.7 to 2.6) deg (2.6 to 2.5) deg (2.5 to 2.3) deg (2.3 to 2.2) deg (2.2 to 2.1) deg (2.1 to 2.0) deg (2.0 to 1.9) deg</p>	<p>Network analyzer with calibration kit, one port device</p>

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Reflection S ₁₁ /S ₂₂ , Magnitude and Phase – (VSWR) Measure (cont)			
(0.2 to 0.3) lin (0.3 to 0.4) lin (0.4 to 0.46) lin (0.46 to 1) lin	5 Hz to 9 kHz	(1.9 to 1.6) deg (1.6 to 1.4) deg (1.4 to 1.3) deg 1.3 deg	Network analyzer with calibration kit, one port device
(0 to 0.2) lin (0.2 to 0.4) lin (0.4 to 0.6) lin (0.6 to 0.8) lin (0.8 to 1) lin	9 kHz to 10 MHz	(0.0041 to 0.0067) lin (0.0067 to 0.0098) lin (0.0098 to 0.013) lin (0.013 to 0.018) lin (0.018 to 0.022) lin	
(0 to 0.01) lin (0.01 to 0.1) lin (0.1 to 0.15) lin (0.15 to 0.17) lin (0.17 to 0.18) lin (0.18 to 0.2) lin (0.2 to 0.25) lin (0.25 to 0.3) lin (0.3 to 0.4) lin (0.4 to 0.5) lin (0.5 to 0.1) lin		(180 to 25) deg (25 to 3.1) deg (3.1 to 2.3) deg (2.3 to 2.2) deg (2.2 to 2.1) deg (2.1 to 1.9) deg (1.9 to 1.7) deg (1.7 to 1.6) deg (1.6 to 1.4) deg (1.4 to 1.3) deg 1.3 deg	
(0 to 0.2) lin (0.2 to 0.4) lin (0.4 to 0.6) lin (0.6 to 0.8) lin (0.8 to 1) lin	(10 to 1000) MHz	(0.0041 to 0.0068) lin (0.0068 to 0.0098) lin (0.0098 to 0.013) lin (0.013 to 0.018) lin (0.018 to 0.023) lin	
(0 to 0.01) lin (0.01 to 0.1) lin (0.1 to 0.15) lin (0.15 to 0.17) lin (0.17 to 0.18) lin (0.18 to 0.2) lin (0.2 to 0.25) lin (0.25 to 0.3) lin (0.3 to 0.4) lin (0.4 to 0.5) lin (0.5 to 1) lin		(180 to 25) deg (25 to 3.1) deg (3.1 to 2.3) deg (2.3 to 2.2) deg (2.2 to 2.1) deg (2.1 to 2.2) deg (2.2 to 1.9) deg (1.9 to 1.6) deg (1.6 to 1.4) deg (1.4 to 1.3) deg 1.3 deg	

Parameter/Equipment	Range	CMC ^{2,6} (\pm)	Comments
Reflection S ₁₁ /S ₂₂ , Magnitude and Phase – (VSWR) Measure (cont)	(1 to 3) GHz	(0.0056 to 0.0085) lin (0.0085 to 0.012) lin (0.012 to 0.016) lin (0.016 to 0.021) lin (0.021 to 0.026) lin (180 to 35) deg (35 to 4) deg (4 to 3) deg (3 to 2.7) deg (2.7 to 2.6) deg (2.6 to 2.4) deg (2.4 to 1.9) deg (1.9 to 1.7) deg (1.7 to 1.6) deg (1.6 to 1.5) deg 1.5 deg	Network analyzer with calibration kit, one port device
Transmission S ₁₂ /S ₂₁ , Magnitude and Phase – Measure	5 Hz to 9 kHz (10 to 0) dB (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB (-40 to -50) dB (-50 to -60) dB	(0.12 to 0.083) dB (0.77 to 0.55) deg (0.083 to 0.099) dB (0.55 to 0.65) deg (0.099 to 0.11) dB (0.65 to 0.75) deg (0.11 to 0.13) dB (0.75 to 0.85) deg (0.13 to 0.15) dB (0.85 to 0.98) deg (0.15 to 0.18) dB (0.98 to 1.2) deg (0.18 to 0.24) dB (1.2 to 1.6) deg	Network analyzer with calibration kit Non-reflecting device

Parameter/Frequency	Range	CMC ^{2, 5, 6} (\pm)	Comments
Transmission S ₁₂ /S ₂₁ , Magnitude and Phase – Measure (cont)	5 Hz to 9 kHz	(-60 to -70) dB (0.24 to 0.40) dB (1.6 to 3.2) deg	Network analyzer with calibration kit
		(-70 to -80) dB (0.40 to 1.2) dB (3.2 to 8.3) deg	Non-reflecting device
9 kHz to 10 MHz	(-80 to -90) dB (1.2 to 3.0) dB (8.3 to 25) deg		
	(10 to 0) dB (0.12 to 0.083) dB (0.77 to 0.55) deg		
	(0 to -10) dB (0.083 to 0.099) dB (0.55 to 0.65) deg		
	(-10 to -20) dB (0.099 to 0.11) dB (0.65 to 0.75) deg		
	(-20 to -30) dB (0.11 to 0.13) dB (0.75 to 0.85) deg		
	(-30 to -40) dB (0.13 to 0.15) dB (0.85 to 0.98) deg		
	(-40 to -50) dB (0.15 to 0.19) dB (0.79 to 1.3) deg		
	(-50 to -60) dB (0.19 to 0.36) dB (1.3 to 2.4) deg		
	(-60 to -70) dB (0.36 to 0.91) dB (2.4 to 6.3) deg		
	(-70 to -80) dB (0.91 to 2.5) dB (6.3 to 19) deg		
(-80 to -90) dB (2.5 to 6.2) dB (19 to 180) deg			

Parameter/Frequency	Range	CMC ^{2, 5, 6} (\pm)	Comments
Transmission S ₁₂ /S ₂₁ Magnitude and Phase – Measure (cont) (10 to 1000) MHz	(10 to 0) dB	(0.12 to 0.083) dB (0.77 to 0.55) deg	Network analyzer with calibration kit
	(0 to -10) dB	(0.083 to 0.099) dB (0.55 to 0.65) deg	
	(-10 to -20) dB	(0.099 to 0.11) dB (0.65 to 0.75) deg	Non-reflecting device
	(-20 to -30) dB	(0.11 to 0.13) dB (0.75 to 0.85) deg	
	(-30 to -40) dB	(0.13 to 0.15) dB (0.85 to 0.98) deg	
	(-40 to -50) dB	(0.15 to 0.18) dB (0.98 to 1.3) deg	
	(-50 to -60) dB	(0.18 to 0.26) dB (1.3 to 1.8) deg	
	(-60 to -70) dB	(0.26 to 0.49) dB (1.8 to 3.3) deg	
	(-70 to -80) dB	(0.49 to 1.2) dB (3.3 to 8.3) deg	
	(-80 to -90) dB	(1.2 to 3.1) dB (8.3 to 25) deg	

Parameter/Frequency	Range	CMC ^{2, 5, 6} (\pm)	Comments
Transmission S ₁₂ /S ₂₁ Magnitude and Phase – Measure (cont) (1 to 3) GHz	(10 to 0) dB	(0.13 to 0.096) dB (0.86 to 0.64) deg	Network analyzer with calibration kit
	(0 to -10) dB	(0.096 to 0.11) dB (0.64 to 0.74) deg	
	(-10 to -20) dB	(0.11 to 0.13) dB (0.74 to 0.84) deg	Non-reflecting device
	(-20 to -30) dB	(0.13 to 0.14) dB (0.84 to 0.94) deg	
	(-30 to -40) dB	(0.14 to 0.16) dB (0.94 to 1.1) deg	
	(-40 to -50) dB	(0.16 to 0.19) dB (1.1 to 1.3) deg	
	(-50 to -60) dB	(0.19 to 0.26) dB (0.71 to 1.07) deg	
	(-60 to -70) dB	(0.26 to 0.48) dB (1.3 to 3.3) deg	
	(-70 to -80) dB	(0.48 to 1.2) dB (3.3 to 8.3) deg	
	(-80 to -90) dB	(1.2 to 3.1) dB (8.3 to 25) deg	

III. Time & Frequency

Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Time Interval and Frequency –	0.5 ns to 60 s	2.8 %	Oscilloscope
ESD Simulator Contact Discharge - Rise Time, RC Time Constant	0.5 ns to 60 s	3.1 %	IEC/EN 61000-4-2, ISO 10605, ISO 10605 (2001), oscilloscope using IEC ESD target
EFT/Burst Generator (50, 1000) Ω Load			
Rise Time	(2 to 7) ns	2.3 %	IEC/EN 61000-4-4, oscilloscope
Pulse Width	(30 to 170) ns	2.9 %	IEC/EN 61000-4-4, oscilloscope
Burst Duration	(0.5 to 20) ms	0.25 %	IEC/EN 61000-4-4, oscilloscope
Burst Period	(200 to 400) ms	0.31 %	IEC/EN 61000-4-4, oscilloscope
Repetition Frequency	1 kHz to 1 MHz	0.37 %	IEC/EN 61000-4-4, oscilloscope
Surge Generator Open and Short Circuit			
Front Time, Rise Time	(0.3 to 13) μs	2.1 %	IEC/EN 61000-4-5, IEC/EN 61000-4-5 (2005), oscilloscope
Time to Half Value, Duration	(10 to 900) μs	0.99 %	IEC/EN 61000-4-5, IEC/EN 61000-4-5 (2005), oscilloscope
Open Circuit Phase Shifting	(0 to 20) ms	0.99 %	IEC/EN 61000-4-5, IEC/EN 61000-4-5 (2005), oscilloscope

Parameter/Equipment	Range	CMC ^{2, 4, 6, 8} (±)	Comments
Time Interval and Frequency (cont) –			
Transient Immunity Surge Pulse and Load Dump Pulse			
Rise Time	0.4 µs to 15 ms	2.1 %	ISO 7637-2, ISO 7637-2 (2004), ISO 16750-2, oscilloscope
Duration	0.1 µs to 700 ms	0.99 %	ISO 7637-2, ISO 7637-2 (2004), ISO 16750-2, oscilloscope
Transient Immunity Burst Pulse			
Rise Time	(3 to 7) ns	2.3 %	ISO 7637-2, ISO 7637-2 (2004), oscilloscope
Duration	(30 to 200) ns	2.9 %	ISO 7637-2, ISO 7637-2 (2004), oscilloscope
Frequency – Measure	(3 to 5) Hz (5 to 10) Hz (10 to 40) Hz 40 Hz to 300 kHz 40 Hz to 1 MHz 10 Hz to 1 MHz (1 to 10) MHz (10 to 100) MHz 100 MHz to 1 GHz (1 to 3) GHz (2 to 18) GHz (18 to 26.5) GHz	0.12 % 0.06 % 0.04 % 0.02 % 0.02 % 0.64 mHz 6.4 mHz 0.064 Hz 0.64 Hz 1.9 Hz 12 Hz 17 Hz	DMM Oscilloscope, HV differential probe Frequency counter, Phase locked to Rb oscillator

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 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 In the statement of CMC, M is the Mismatch error. Uncertainty does not include mismatch error due to connections of the device to other devices in actual use. Mismatch uncertainties, due to the reflection coefficient of the device to be calibrated, are to be included in the overall measurement uncertainty; the approach of determining expanded uncertainties at approximately the 95% level of confidence, (using a coverage factor of $k = 2$) is to be applied for this calculation as well.
- ⁴ In the statement of CMC, the value is defined as the percentage of reading unless otherwise noted.
- ⁵ CMC for intermediate values of measurand can be found by interpolation.
- ⁶ The contributions from the existing device are not include in the CMC claim.
- ⁷ This scope meets A2LA's P112 *Flexible Scope Policy*.
- ⁸ 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.
- ⁹ 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.



Accredited Laboratory

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Honjo-shi, Saitama-ken, 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 10th day of June 2020.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 4727.01
Valid to March 31, 2022

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