SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid To: March 31, 2026 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, 8]:

I. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 7, 10] (±)	Comments
DC Voltage[3] – Generate	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1000) V	6.8 µV/V + 0.57 µV 4.6 µV/V + 1.2 µV 3.2 µV/V + 3.9 µV 3.3 µV/V + 6.9 µV 4.7 µV/V + 65 µV 6.4 µV/V + 0.51 mV	Calibrator 5520A/5522A /5730A
DC Current[3] – Generate	(0 to 220) µA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A (2.2 to 2.999 99) A (3 to 10.9999) A (11 to 20.5) A (10 to 16.4999) A (16.5 to 149.999) A (150 to 1000) A	40 µA /A + 5.5 nA 32 µA/A + 7.1 nA 32 µA/A + 60 nA 39 µA/A + 1.3 µA 74 µA/A + 13 µA 0.000 31A/A + 21 µA 0.0004 A/A + 0.43mA 0.0008 A/A + 0.43 mA 0.0028 A/A + 0.074 A 0.0042 A/A + 0.12 A 0.0046 A/A + 0.2 A	Calibrator 5520A/5522A /5730A 5520A/5522A & 50 turn coil

Parameter/Range	Frequency	CMC[2, 7, 10] (±)	Comments
AC Voltage[3] – Generate			
(1.0 to 2.2) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.17 mV/V + 5.6 µV 64 µV/V + 5.6 µV 68 µV/V + 4.5 µV 0.18 mV/V + 4.3 µV 0.42 mV/V + 5.3 µV 0.98 mV/V + 9.8 µV 1 mV/V + 21 µV 2.6 mV/V + 21 µV	Calibrator 5520A/5522A /5730A
(2.2 to 22) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.19 mV/V + 6 µV 67 µV/V + 5.8 µV 68 µV/V + 4.7 µV 0.19 mV/V + 4.5 µV 0.44 mV/V + 5.7 µV 0.96 mV/V + 11 µV 1.3 mV/V + 22 µV 2.2 mV/V + 36 µV	
(22 to 220) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.25 mV/V + 22 µV 0.11 mV/V + 15 µV 47 µV/V + 9.5 µV 0.11 mV/V + 11 µV 0.29 mV/V + 24 µV 0.56 mV/V + 36 µV 1.3 mV/V + 41 µV 2.2 mV/V + 0.16 mV	
(0.22 to 2.2) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.23 mV/V + 0.13 mV 94 µV/V + 46 µV 28 µV/V + 37 µV 54 µV/V + 34 µV 71 µV/V + 51 µV 0.26 mV/V + 0.21 mV 0.89 mV/V + 0.31 mV 1.3 mV/V + 0.98 mV	
(2.2 to 22) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.25 mV/V + 0.73 mV 85 µV/V + 0.63 mV 25 µV/V + 0.43 mV 56 µV/V + 0.26 mV 69 µV/V + 0.43 mV 0.19 mV/V + 1.9 mV 0.9 mV/V + 2.8 mV 0.91 mV/V + 18 mV	

Parameter/Range	Frequency	CMC[2, 7, 10] (±)	Comments
AC Voltage[3] – Generate (cont)			
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.24 mV/V + 9.9 mV 87 µV/V + 5.5 mV 33 µV/V + 5.5 mV 66 µV/V + 4 mV 0.11 mV/V + 11 mV 0.81 mV/V + 19 mV 4.2 mV/V + 42 mV 7.4 mV/V + 0.09 V	Calibrator 5520A/5522A /5730A
(220 to 1000) V	(15 to 50) Hz (0.05 to 1) kHz	0.21 mV/V + 54 mV 79 µV/V + 44 mV	
AC Current[3] – Generate			
(10 to 220) µA	(10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.24 mA/A + 0.023 µA 0.15 mA/A + 0.017 µA 79 µA/A + 0.014 µA 0.2 mA/A + 0.04 µA 0.96 mA/A + 0.12 µA	Calibrator 5520A/5522A /5730A
(0.22 to 2.2) mA	(10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.21 mA/A + 0.17 µA 0.14 mA/A + 0.12 µA 75 µA/A + 0.1 µA 0.17 mA/A + 0.19 µA 1.1 mA/A + 0.66 µA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.18 mA/A + 2.6 µA 0.13 mA/A + 1.4 µA 74 µA/A + 0.98 µA 0.16 mA/A + 1.6 µA 1.1 mA/A + 5.2 µA	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.18 mA/A + 27 µA 0.13 mA/A + 14 µA 64 µA/A + 13 µA 0.14 mA/A + 17 µA 0.93 mA/A + 39 µA	
(0.22 to 2.2) A	(0.02 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.2 mA/A + 0.16 mA 0.4 mA/A + 0.26 mA 10 mA/A + 2 mA	

Parameter/Range	Frequency	CMC[2, 7, 10] (±)	Comments
AC Current[3] – Generate (cont)			
(2.2 to 2.999 99) A	(10 to 45) Hz (0.045 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.0017 A/A + 1.1 mA 0.000 41 A/A + 0.92 mA 0.0067 A/A + 1.4 mA 0.029 A/A + 4.4 mA	Calibrator 5520A/5522A /5730A
(3 to 10.9999) A	(45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.0021 A/A + 3.1 mA 0.0037 A/A + 3.1 mA 0.13 A/A + 4 mA	
(11 to 20.5) A	(45 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.0085 A/A + 6.1 mA 0.011 A/A + 6.1 mA 0.24 A/A + 7.6 mA	
(10 to 16.4999) A	(45 to 65) Hz (65 to 440) Hz	0.0048 A/A + 0.022 A 0.008 A/A + 0.023 A	5520A/5522A & 50TURNS
(16.5 to 149.999) A	(45 to 65) Hz (65 to 440) Hz	0.005 A/A + 0.19 A 0.0073 A/A + 0.23 A	
(150 to 1000) A	(45 to 65) Hz (65 to 440) Hz	0.0049 A/A + 0.68 A 0.012 A/A + 0.63 A	

Parameter/Equipment	Range	CMC[2, 7, 10] (±)	Comments
DC Resistance[3] – Generate, Fixed Points	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ	0.000 092 Ω 0.000 24 Ω 0.000 98 Ω 0.0067 Ω 0.067 Ω 0.83 Ω 13 Ω 0.39 kΩ 12 kΩ	Calibrator 5520A/5522A /5730A

Parameter/Equipment	Range	CMC[2, 7, 10] (±)	Comments
DC Resistance[3] – Generate (cont)	(0 to 10.9999) Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω (0.33 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 (0.33 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 28 μΩ/Ω + 7.8 Ω 26 μΩ/Ω + 7.8 Ω 76 μΩ/Ω + 0.12 kΩ 0.000 11 Ω/Ω + 0.2 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 5520A/5522A
DC Voltage[3] – Measure	(0 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	6.7 μV/V of reading + 3.6 μV/V of range 5.4 μV/V of reading + 0.37 μV/V of range 5.3 μV/V of reading + 0.082 μV/V of range 8 μV/V of reading + 0.37 μV/V of range 17 μV/V of reading + 0.13 μV/V of range	DMM 3458A/8846A
Series DC Voltage Drop[3] – LISN or AMN	10 mV to 100 V	0.72 %	CISPR16-1-2 DMM

Parameter/Equipment	Range	CMC[2, 7, 10] (±)	Comments
DC Voltage[3] – 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	0.62 %	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 & 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, 7, 10] (±)	Comments
DC Current[3] – Measure	(0 to 100) µA	28 µA/A of reading + 9.3 µA/A of range	DMM 3458A/8846A
	(0.1 to 1) mA	26 µA/A of reading + 5.8 µA/A of range	
	(1 to 10) mA	27 µA/A of reading + 5.8 µA/A of range	
	(10 to 100) mA	47 µA/A of reading + 5.8 µA/A of range	
	(0.1 to 1) A	0.014 % of reading + 0.0012 % of range	
	(1 to 3) A	0.12 % of reading + 0.023 % of range	DMM 8846A
	(3 to 10) A	0.18 % of reading + 0.0093 % of range	
DC Resistance[3] – Measure	1 mΩ 10 mΩ 100 mΩ	0.000 24 mΩ 0.0016 mΩ 0.0085 mΩ	Standard resistors 2792A & DMM measurement
	(0 to 10) Ω	20 µΩ/Ω of reading + 5.8 µΩ/Ω of range	DMM 4-wire measurement 3458A/8846A
	(10 to 100) Ω	17 µΩ/Ω of reading + 5.8 µΩ/Ω of range	
	(0.1 to1) kΩ	14 µΩ/Ω of reading + 0.58 µΩ/Ω of range	
	(1 to 10) kΩ	14 µΩ/Ω of reading + 0.58 µΩ/Ω of range	
	(10 to 100) kΩ	14 µΩ/Ω of reading + 0.58 µΩ/Ω of range	
	(0.1 to 1) MΩ	19 µΩ/Ω of reading + 2.4 µΩ/Ω of range	
	(1 to 10) MΩ	62 µΩ/Ω of reading + 12 µΩ/Ω of range	
	(10 to 100) MΩ	0.061 % of reading + 0.0012 % of range	

Parameter/Equipment	Range	CMC[2, 7, 10] (±)	Comments
DC Resistance[3] – Measure (cont)	(0.01 to 1) GΩ	2.4 % of reading + 0.012 % of range	DMM 8846A

Parameter/Range	Frequency	CMC[2, 7, 10] (±)	Comments
AC Voltage[3] – Measure			
(1 to 10) mV	(0.04 to 1) kHz	0.026 % of reading + 0.013 % of range	DMM 3458A/8846A
(10 to 100) mV	(10 to 40) Hz	0.077 % of reading + 0.047 % of range	
	(0.04 to 1) kHz	0.0094 % of reading + 0.0024 % of range	
	(1 to 20) kHz	0.077 % of reading + 0.047 % of range	
	(20 to 50) kHz	0.15 % of reading + 0.058 % of range	
	(50 to 100) kHz	0.7 % of reading + 0.093 % of range	
	(100 to 300) kHz	4.7 % of reading + 0.58 % of range	
(0.1 to 1) V	(10 to 40) Hz	0.074 % of reading + 0.035 % of range	
	(0.04 to 1) kHz	0.0091 % of reading + 0.0024 % of range	
	(1 to 20) kHz	0.074 % of reading + 0.035 % of range	
	(20 to 50) kHz	0.14 % of reading + 0.058 % of range	
	(50 to 100) kHz	0.7 % of reading + 0.093 % of range	
	(100 to 300) kHz	4.7 % of reading + 0.58 % of range	

Parameter/Range	Frequency	CMC[2, 7, 10] (±)	Comments
AC Voltage[3] – Measure (cont)			
(1 to 10) V	(1 to 40) Hz	0.011 % of reading + 0.0047 % of range	DMM 3458A/8846A
	(0.04 to 1) kHz	0.0094 % of reading + 0.0024 % of range	
	(1 to 20) kHz	0.018 % of reading + 0.0024 % of range	
	(20 to 50) kHz	0.037 % of reading + 0.0024 % of range	
	(50 to 100) kHz	0.094 % of reading + 0.0024 % of range	
	(100 to 300) kHz	0.36 % of reading + 0.012 % of range	
	(0.3 to 1) MHz	1.2 % of reading + 0.012 % of range	
(10 to 100) V	(10 to 40) Hz	0.07 % of reading + 0.035 % of range	
	(0.04 to 1) kHz	0.024 % of reading + 0.0024 % of range	
	(1 to 20) kHz	0.07 % of reading + 0.035 % of range	
	(20 to 50) kHz	0.14 % of reading + 0.058 % of range	
	(50 to 100) kHz	0.7 % of reading + 0.093 % of range	
(100 to 1000) V	(10 to 40) Hz	0.07 % of reading + 0.026 % of range	
	(0.04 to 1) kHz	0.047 % of reading + 0.0024 % of range	
	(1 to 20) kHz	0.07 % of reading + 0.026 % of range	
	(20 to 50) kHz	0.14 % of reading + 0.044 % of range	

Parameter/Range	Frequency	CMC[2, 7, 10] (±)	Comments
AC Voltage[3] – Measure (cont)			DMM 3458A/8846A
(100 to 1000) V	(50 to 100) kHz	0.69 % of reading + 0.093 % of range	

Parameter/Range	Frequency	CMC[2, 5, 7, 10] (±)	Comments
Series AC Voltage Drop[3] – LISN or AMN			
(10 to 250) V	(50 to 60) Hz	1.9 %	CISPR16-1-2 DMM
AC Current[3] – Measure			DMM 3458A/8846A
(0 to 100) µA	(10 to 20) Hz	0.47 % of reading + 0.035 % of range	
	(20 to 45) Hz	0.18 % of reading + 0.035 % of range	
	(0.045 to 5) kHz	0.18 % of reading + 0.035 % of range	
(0.1 to 1) mA	(10 to 20) Hz	0.47 % of reading + 0.024 % of range	
	(20 to 45) Hz	0.18 % of reading + 0.024 % of range	
	(45 to 100) Hz	0.071 % of reading + 0.024 % of range	
	(0.1 to 5) kHz	0.037 % of reading + 0.024 % of range	
	(5 to 20) kHz	0.071 % of reading + 0.024 % of range	
	(20 to 50) kHz	0.47 % of reading + 0.047 % of range	
	(50 to 100) kHz	0.64 % of reading + 0.18 % of range	

Parameter/Range	Frequency	CMC[2, 7, 10] (±)	Comments
AC Current[3] – Measure (cont)			
(1 to 10) mA	(10 to 20) Hz	0.47 % of reading + 0.024 % of range	DMM 3458A/8846A
	(20 to 45) Hz	0.18 % of reading + 0.024 % of range	
	(45 to 100) Hz	0.071 % of reading + 0.024 % of range	
(10 to 100) mA	(0.1 to 5) kHz	0.037 % of reading + 0.024 % of range	
	(5 to 20) kHz	0.071 % of reading + 0.024 % of range	
	(20 to 50) kHz	0.47 % of reading + 0.047 % of range	
	(50 to 100) kHz	0.64 % of reading + 0.18 % of range	
	(10 to 20) Hz	0.47 % of reading + 0.024 % of range	
	(20 to 45) Hz	0.18 % of reading + 0.024 % of range	
	(45 to 100) Hz	0.071 % of reading + 0.024 % of range	
(0.1 to 1) A	(0.1 to 5) kHz	0.037 % of reading + 0.024 % of range	
	(5 to 20) kHz	0.071 % of reading + 0.024 % of range	
	(20 to 50) kHz	0.47 % of reading + 0.047 % of range	
	(50 to 100) kHz	0.64 % of reading + 0.18 % of range	
	(10 to 20) Hz	0.47 % of reading + 0.024 % of range	
	(20 to 45) Hz	0.19 % of reading + 0.024 % of range	DMM 8846A
(1 to 3) A	(45 to 100) Hz	0.1 % of reading + 0.024 % of range	

Parameter/Range	Frequency	CMC[2, 7, 10] (±)	Comments
AC Current[3] – Measure (cont)			
(1 to 3) A	(0.1 to 5) kHz	0.12 % of reading + 0.024 % of range	
	(5 to 20) kHz	0.24 % of reading + 0.024 % of range	
	(20 to 50) kHz	1.2 % of reading + 0.047 % of range	IEC/EN 61000-4-8,clamp-on tester
	(0.01 to 5) kHz	0.18 % of reading + 0.069 % of range	
(3 to 10) A	(5 to 10) kHz	0.41 % of reading + 0.81 % of range	
(0.1 to 600) A	(0.01 to 5) kHz	0.18 % of reading + 0.07 % of range	
	(40 to 60) Hz	2.2 % + 4 A	

Parameter/Equipment	Range	CMC[2, 5, 7, 10] (±)	Comments
Capacitance[3] – Measure, Fixed Points			
1 pF	(0.001 to 1) MHz	0.3 %	Impedance meter
10 pF	(0.001 to 1) MHz	0.21 %	
100 pF	(0.001 to 1) MHz	0.21 %	
1000 pF	(0.001 to 1) MHz	0.11 %	
10 nF	(1 to 100) kHz	0.16 %	
100 nF	(1 to 100) kHz	0.1 %	
1000 nF	(1 to 100) kHz	0.1 %	

Parameter/Equipment	Range	CMC[2, 5, 7, 10] (±)	Comments
Inductance[3] – Measure, Fixed Points			
100 µH	1 kHz	1.1 %	Impedance meter
1 mH	1 kHz	0.19 %	
10 mH	1 kHz	0.11 %	
100 mH	1 kHz	0.11 %	
1 H	1 kHz	0.11 %	
10 H	1 kHz	0.12 %	
AC Resistance[3] – Measure, Fixed Points			
100 Ω	1 kHz	0.14 %	Impedance meter
1 kΩ	1 kHz	0.14 %	
10 kΩ	1 kHz	0.14 %	
100 kΩ	1 kHz	0.15 %	
AC Power[3] – Generate			
1 PF 1 mW to 20 kW	(45 to 65) Hz	0.11 %	Calibrator 5520A/5522A
Capacitance[3] – Generate, Fixed Points			
1 pF	1 kHz 1 MHz	0.04 % 0.036 %	Standard capacitors
10 pF	1 kHz 1MHz	0.036 % 0.036 %	
100 pF	1 kHz 1 MHz	0.036 % 0.036 %	
1000 pF	1 kHz 1 MHz	0.036 % 0.036 %	
10 nF	1 kHz 100 kHz	0.011 % 0.011 %	

Parameter/Equipment	Range	CMC[2, 5, 7, 10] (±)	Comments
Capacitance[3] – Generate, Fixed Points (cont.)			
100 nF	1 kHz 100 kHz	0.011 % 0.011 %	Standard capacitors
1000 nF	1 kHz 100 kHz	0.011 % 0.013 %	

Parameter/Range	Frequency	CMC[2, 5, 7, 10] (±)	Comments
Inductance[3] – Generate, Fixed Points			
100 µH	1 kHz	0.043 %	Standard inductors
1 mH	1 kHz	0.025 %	
10 mH	1 kHz	0.017 %	
100 mH	1 kHz	0.017 %	
1 H	1 kHz	0.018 %	
10 H	1 kHz	0.11 %	
AC Resistance[3] – Generate, Fixed Points			
100 Ω	1 kHz	0.012 %	Standard resistors
1 kΩ	1 kHz	0.012 %	
10 kΩ	1 kHz	0.012 %	
100 kΩ	1 kHz	0.012 %	

Parameter/Frequency	Range	CMC[2, 5, 7, 10] (±)	Comments
Oscilloscope[3] –			
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/5522A + 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 (100 to 300) MHz (300 to 600) MHz	 0.37 dB 0.42 dB 0.63 dB	
	5 mV to 3.5 V_{p-p} (600 to 1000) MHz	 0.74 dB	Signal generator, power sensor, power meter
	50 mV to 3 V_{p-p} 10 MHz to 4 GHz (4 to 20) GHz	 0.28 dB 0.94 dB	
Electrical Calibration of Strain Indicators[3] –	(100 000 to 200 000) × 10^{-6}	0.026 % of setting	Strain calibrator
	(10 000 to 100 000) × 10^{-6}	0.018 % of setting	
	(1000 to 10 000) × 10^{-6}	0.018 % of setting	
	(100 to 1000) × 10^{-6}	0.041 % of setting	
	(20.1 to 100) × 10^{-6}	0.33 % of setting	
	20.0 × 10^{-6}	1.6 % of setting	

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Electrical Calibration of Thermocouple Temperature Indicators[3] –			
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.59 °C 0.20 °C 0.18 °C 0.20 °C 0.25 °C	Calibrator
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.39 °C 0.22 °C 0.20 °C 0.31 °C 0.47 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.32 °C 0.20 °C 0.18 °C 0.21 °C 0.28 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.47 °C 0.27 °C 0.23 °C 0.23 °C 0.32 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.67 °C 0.43 °C 0.40 °C 0.48 °C	

Parameter/Equipment	Range	CMC[2, 7] (±)	Comments
Electrical Calibration of Thermocouple Temperature Indicators[3] – (cont)			
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.55 °C 0.43 °C 0.45 °C 0.54 °C	Calibrator
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.74 °C 0.29 °C 0.20 °C 0.18 °C	

II. Electrical – RF/Microwave

Parameter/Equipment	Frequency	CMC[2, 4, 7] (±)	Comments
RF Insertion Loss[3] –			
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 & 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 & power sensor, directional couplers
CDNs (Voltage Division Factor)	150 kHz to 300 MHz	0.19 dB + *M*	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 + *M*	IEC/EN 61000-4-6, network analyzer with calibration kit
Current Probes (Transfer Impedance)	10 Hz to 10 kHz 10 kHz to 2.1 GHz	1.4 dB + *M* 0.38 dB + *M*	CISPR 16-1-2, IEC/EN 61000-4-6, network analyzer with calibration kit

Parameter/Equipment	Frequency	CMC[2, 4, 7] (±)	Comments
RF Insertion Loss[3] – (cont)			
EM Clamps:			
Impedance	9 kHz to 1 GHz	1.9 Ω	IEC/EN 61000-4-6
Coupling Factor	9 kHz to 1 GHz	0.84 dB	Network analyzer with
Decoupling Factor	9 kHz to 1 GHz	0.2 dB	calibration kit
Decoupling Clamps:			
Impedance	9 kHz to 1 GHz	1.9 Ω	IEC/EN 61000-4-6
Decoupling Factor	9 kHz to 1 GHz	0.2 dB	Network analyzer with calibration kit
LISN, AN, AMN (Voltage Division Factor)	9 kHz to 200 MHz	0.1 dB + *M*	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 + *M*	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 + *M*	CISPR 22 / EN55022, CISPR 32 / EN55032, CISPR16-1-2, network analyzer with calibration kit
ISNs (Transmission & Cross Talk)	9 kHz to 250 MHz	0.16 dB + *M*	CISPR 22 / EN 55022, CISPR 32 / EN55032, CISPR 16-1-2, network analyzer with calibration kit
ISNs (LCL)	9 kHz to 250 MHz	0.86 dB + *M*	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 & power sensor, directional couplers

Parameter/Equipment	Frequency	CMC[2, 7] (±)	Comments
Impedance[3] –			
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	0.65 Ω	Network analyzer with calibration kit
	(3 to 18) GHz	0.03 Ω	Power meter & power sensor, directional couplers
Impedance - Phase Angle[3] –			
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/Equipment	Frequency	CMC[2, 5, 7] (±)	Comments
Power Meter/Power Sensor[3] –			
Power Sensor Correction Factor (0 dBm)	9 kHz to 50 MHz 50 MHz to 4 GHz (4 to 8) GHz (8 to 18) GHz	1.2 % 1.3 % 1.9 % 3.6 %	Power meter & power sensor
Power Meter Accuracy (-10 to 10) dBm	10 MHz to 4 GHz (4 to 8) GHz (8 to 18) GHz	4 % 4 % 5.1 %	Power meter & power sensor
Power Meter Ref. Out	50 MHz, 0 dBm	1.2 %	
Spectrum Analyzer[3] –			
Standard Frequency Accuracy	10 MHz	6.4 mHz	Rubidium standard & 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 & signal generator
Span Accuracy	1 kHz to 26.5 GHz	0.023 % of setting	Rubidium standard & signal generator
Frequency Response, Reference Level Accuracy	(9 to 100) kHz 100 kHz to 6 GHz (6 to 18) GHz (18 to 26.5) GHz	0.18 dB 0.19 dB 0.36 dB 0.36 dB	Power meter & 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 & power sensor, step attenuator
Attenuator Switching Accuracy	(-50 to -10) dBm (18 to 26.5) GHz	 0.74 dB	
Bandwidth Switching Accuracy	10 kHz to 26.5 GHz	0.94 dB	Power meter & power sensor, step attenuator
	10 kHz to 26.5 GHz	0.94 dB	Signal generator

Parameter/Range	Frequency	CMC[2, 5, 7] (±)	Comments
Spectrum Analyzer[3] – (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 (18 to 26.5) GHz (10 to 90) dB	 0.15 dB 1.3 dB 0.89 dB	Step attenuator
Noise Floor	10 kHz to 26.5 GHz	1.7 dB	50 Ω termination
EMI Test Receiver[3,11] –			CISPR 16-1-1
Reference Frequency Accuracy	10 MHz	6.4 mHz	Rubidium standard & frequency counter
Attenuator Accuracy (0 to 70) dB	9 kHz to 26.5 GHz	0.15 dB	Signal generator
Sine Wave Accuracy Frequency Response	(9 to 100) kHz 100 kHz to 6 GHz (6 to 18) GHz (18 to 26.5) GHz	0.18 dB 0.19 dB 0.36 dB 0.36 dB	Signal generator, frequency standard, power meter, power sensor
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 Overall Selectivity	10 Hz to 50 MHz	2 %	Signal generator, frequency standard, attenuator
Bandwidth Switching Accuracy	9 kHz to 26.5 GHz	0.15 dB	Signal generator, frequency standard, attenuator
CW – Pulse Amplitude Comparison	CISPR Bands A/B CISPR Bands C/D CISPR Band E	1.2 dB 1.2 dB 1.3 dB	CISPR pulse generator, signal generator, power meter, power sensor, function generator

Parameter/ Range	Frequency	CMC[2, 4, 7] (±)	Comments
EMI Test Receiver[3,11] – (cont)			CISPR 16-1-1
Noise Floor	10 kHz to 26.5 GHz	1.7 dB	50 Ω termination
Absolute Amplitude Accuracy, (-70 to +20) dBm	(9 to 100) kHz 100 kHz to 6 GHz (6 to 18) GHz (18 to 26.5) GHz	0.24 dB 0.25 dB 0.4 dB 0.59 dB	Signal generator, frequency standard, power meter, power sensor, attenuator
Display Linearity: (1 to 80) dB (80 to 100) dB	9 kHz to 4 GHz	0.15 dB 1.3 dB	Signal generator, frequency standard, attenuator
(1 to 80) dB	(4 to 8) GHz	0.4 dB	
(1 to 80) dB	(8 to 18) GHz	0.5 dB	
(1 to 90) dB	(18 to 26.5) GHz	3.3 dB	
Signal Generator[3] –			
Standard Frequency Accuracy	10 MHz	6.4 mHz	Rubidium standard & 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 & frequency counter
Linearity: (-120 to 20) dBm (-120 to 20) dBm	100 kHz to 18 GHz (18 to 26.5) GHz	0.4 dB 0.9 dB	Measuring receiver
Absolute Level Accuracy: 0 dBm 0 dBm 0 dBm 0 dBm	100 kHz to 1 MHz 1 MHz to 4.2 GHz (4.2 to 18) GHz (18 to 26.5) GHz	0.05 dB 0.06 dB 0.08 dB 0.14 dB	Power meter & power sensor

Parameter/Range	Frequency	CMC[2, 7] (±)	Comments
Signal Generator[3] – (cont)			
Level Accuracy:			
(-10 to 10) dBm	100 kHz to 1 MHz	0.05 dB	Measuring receiver & power sensor
(-10 to 10) dBm	1 MHz to 4.2 GHz	0.06 dB	
(-10 to 10) dBm	(4.2 to 18) GHz	0.08 dB	
(-10 to 10) dBm	(18 to 26.5) GHz	0.14 dB	
(-10 to 20) dBm	10 kHz to 4.2 GHz	0.11 dB	Measuring receiver & power sensor
(-30 to -10) dBm		0.16 dB	
(-90 to -30) dBm		0.19 dB	
(-120 to -90) dBm		0.66 dB	
(-10 to 20) dBm	(4.2 to 8) GHz	0.13 dB	
(-30 to -10) dBm		0.18 dB	
(-90 to -30) dBm		0.21 dB	
(-120 to -90) dBm		0.78 dB	
(-10 to 20) dBm	(8 to 12.4) GHz	0.15 dB	Power meter & power sensor, measuring receiver
(-30 to -10) dBm		0.2 dB	
(-90 to -30) dBm		0.23 dB	
(-120 to -90) dBm		0.79 dB	
(-10 to 20) dBm	(12.4 to 18) GHz	0.18 dB	
(-30 to -10) dBm		0.25 dB	
(-90 to -30) dBm		0.27 dB	
(-120 to -90) dBm		0.78 dB	
(-10 to 20) dBm	(18 to 26.5) GHz	0.22 dB	
(-30 to -10) dBm		0.31 dB	
(-90 to -30) dBm		0.34 dB	
(-120 to -90) dBm		0.95 dB	
Harmonics/Sub Harmonic:			
(0 to -90) dBc	(0.0001 to 4) GHz	1.4 dB	Measuring receiver
(0 to -90) dBc	(4 to 18) GHz	1.8 dB	
(0 to -90) dBc	(18 to 26.5) GHz	2.6 dB	
FM Modulation Accuracy:			
Deviation: (0 to 50) kHz	(0.2 to 10) MHz Mod. Frequency: 10 Hz to 10 kHz	1.2 % of reading	Measuring receiver

Parameter/Range	Frequency	CMC[2, 7, 9] (±)	Comments
Signal Generator[3] – (cont)			
FM Modulation Accuracy:			
(10 to 18 000) MHz Mod. Frequency: 10 Hz to 100 kHz	Deviation: (0 to 500) kHz	1.2 % of reading	Measuring receiver
(10 to 18 000) MHz Mod. Frequency: 100 kHz to 200 kHz	Deviation: (0 to 500) kHz	3.5 % of reading	
AM Modulation Accuracy:			
(0.1 to 10) MHz Rate: 10 Hz to 10 kHz	Depth: (5 to 99) %	3.6 % of reading	
(10 to 18 000) MHz Rate: 10 Hz to 50 kHz	Depth: (5 to 99) %	3.9 % of reading	
(10 to 18 000) MHz Rate: 50 kHz to 100 kHz	Depth: (5 to 99) %	3.9 % of reading	
Reflection S_{11}/S_{22}, Magnitude & Phase[3, 6] – (VSWR) Measure			
(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	5 Hz to 9 kHz	(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	Network analyzer with calibration kit, one port device
(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		(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	

Parameter/Range	Frequency	CMC[2, 7, 9] (±)	Comments
Reflection S_{11}/S_{22}, Magnitude & Phase[3, 6] – (VSWR) Measure (cont)			
(0.17 to 0.18) lin	5 Hz to 9 kHz	(2.2 to 2.1) deg	Network analyzer with calibration kit, one port device
(0.18 to 0.19) lin		(2.1 to 2.0) deg	
(0.19 to 0.2) lin		(2.0 to 1.9) deg	
(0.2 to 0.3) lin		(1.9 to 1.6) deg	
(0.3 to 0.4) lin		(1.6 to 1.4) deg	
(0.4 to 0.46) lin		(1.4 to 1.3) deg	
(0.46 to 1) lin		1.3 deg	
(0 to 0.2) lin	9 kHz to 10 MHz	(0.0041 to 0.0067) lin	
(0.2 to 0.4) lin		(0.0067 to 0.0098) lin	
(0.4 to 0.6) lin		(0.0098 to 0.013) lin	
(0.6 to 0.8) lin		(0.013 to 0.018) lin	
(0.8 to 1) lin		(0.018 to 0.022) lin	
(0 to 0.01) lin		(180 to 25) deg	
(0.01 to 0.1) lin		(25 to 3.1) deg	
(0.1 to 0.15) lin		(3.1 to 2.3) deg	
(0.15 to 0.17) lin		(2.3 to 2.2) deg	
(0.17 to 0.18) lin		(2.2 to 2.1) deg	
(0.18 to 0.2) lin		(2.1 to 1.9) deg	
(0.2 to 0.25) lin		(1.9 to 1.7) deg	
(0.25 to 0.3) lin		(1.7 to 1.6) deg	
(0.3 to 0.4) lin		(1.6 to 1.4) deg	
(0.4 to 0.5) lin		(1.4 to 1.3) deg	
(0.5 to 0.1) lin		1.3 deg	
(0 to 0.2) lin	(10 to 1000) MHz	(0.0041 to 0.0068) lin	
(0.2 to 0.4) lin		(0.0068 to 0.0098) lin	
(0.4 to 0.6) lin		(0.0098 to 0.013) lin	
(0.6 to 0.8) lin		(0.013 to 0.018) lin	
(0.8 to 1) lin		(0.018 to 0.023) lin	
(0 to 0.01) lin		(180 to 25) deg	
(0.01 to 0.1) lin		(25 to 3.1) deg	
(0.1 to 0.15) lin		(3.1 to 2.3) deg	
(0.15 to 0.17) lin		(2.3 to 2.2) deg	
(0.17 to 0.18) lin		(2.2 to 2.1) deg	
(0.18 to 0.2) lin		(2.1 to 2.2) deg	
(0.2 to 0.25) lin		(2.2 to 1.9) deg	
(0.25 to 0.3) lin		(1.9 to 1.6) deg	
(0.3 to 0.4) lin		(1.6 to 1.4) deg	
(0.4 to 0.5) lin		(1.4 to 1.3) deg	
(0.5 to 1) lin		1.3 deg	

Parameter/Range	Frequency	CMC[2, 7, 9] (±)	Comments
Reflection S_{11}/S_{22}, Magnitude & Phase[3, 6] – (VSWR) Measure (cont)			
(0 to 0.2) lin	(1 to 3) GHz	(0.0056 to 0.0085) lin	Network analyzer with calibration kit, one port device
(0.2 to 0.4) lin		(0.0085 to 0.012) lin	
(0.4 to 0.6) lin		(0.012 to 0.016) lin	
(0.6 to 0.8) lin		(0.016 to 0.021) lin	
(0.8 to 1) lin		(0.021 to 0.026) lin	
(0 to 0.01) lin		(180 to 35) deg	
(0.01 to 0.1) lin		(35 to 4) deg	
(0.1 to 0.15) lin		(4 to 3) deg	
(0.15 to 0.17) lin		(3 to 2.7) deg	
(0.17 to 0.18) lin		(2.7 to 2.6) deg	
(0.18 to 0.2) lin		(2.6 to 2.4) deg	
(0.2 to 0.25) lin		(2.4 to 1.9) deg	
(0.25 to 0.3) lin		(1.9 to 1.7) deg	
(0.3 to 0.4) lin		(1.7 to 1.6) deg	
(0.4 to 0.5) lin		(1.6 to 1.5) deg	
(0.5 to 1) lin		1.5 deg	
(0 to 0.2) lin	(3 to 20) GHz	(0.0037 to 0.0044) lin	
(0.2 to 0.4) lin		(0.0044 to 0.0054) lin	
(0.4 to 0.6) lin		(0.0054 to 0.065) lin	
(0.6 to 0.8) lin		(0.0065 to 0.008) lin	
(0.8 to 1) lin		(0.008 to 0.0097) lin	
(0 to 0.01) lin		(180 to 22) deg	
(0.01 to 0.1) lin		(22 to 2.3) deg	
(0.1 to 0.15) lin		(2.3 to 1.6) deg	
(0.15 to 0.17) lin		(1.6 to 1.5) deg	
(0.17 to 0.18) lin		(1.5 to 1.4) deg	
(0.18 to 0.2) lin		(1.4 to 1.3) deg	
(0.2 to 0.25) lin		(1.3 to 1.1) deg	
(0.25 to 0.3) lin		(1.1 to 0.9) deg	
(0.3 to 0.4) lin		(0.9 to 0.8) deg	
(0.4 to 0.5) lin		(0.8 to 0.7) deg	
(0.5 to 1) lin		0.6 deg	

Parameter/ Range	Frequency	CMC[2, 7, 9] (±)	Comments
Reflection S11/S22, Magnitude & Phase[3,6] – (VSWR) Measure (cont)			
(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	(20 to 26.5) GHz	(0.0042 to 0.005) lin (0.005 to 0.0062) lin (0.0062 to 0.0077) lin (0.0077 to 0.0094) lin (0.0094 to 0.011) lin	Network analyzer with calibration kit, one port device
(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 2.6) deg (2.6 to 1.8) deg (1.8 to 1.7) deg (1.7 to 1.6) deg (1.6 to 1.5) deg (1.5 to 1.2) deg (1.2 to 1.1) deg (1.1 to 0.9) deg (0.9 to 0.8) deg 0.7 deg	
Transmission S12/S21, Magnitude & Phase10[3,6] – Measure			
(10 to 0) dB	5 Hz to 9 kHz	(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 1.2) deg	
(-50 to -60) dB		(0.18 to 0.24) dB (1.2 to 1.6) deg	

Parameter/ Range	Frequency	CMC[2,7,9] (±)	Comments
Transmission S_{12}/S_{21}, Magnitude & Phase[3,6] – Measure (cont)			
(-60 to -70) dB	5 Hz to 9 kHz	(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
(-80 to -90) dB		(1.2 to 3.0) dB (8.3 to 25) deg	
(10 to 0) dB	9 kHz to 10 MHz	(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/ Range	Frequency	CMC[2, 7, 9] (±)	Comments
Transmission S_{12}/S_{21} Magnitude & Phase[3, 6] – Measure (cont)			
(10 to 0) dB	(10 to 1000) MHz	(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	
(10 to 0) dB	(1 to 3) GHz	(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	

Parameter/ Range	Frequency	CMC[2, 7, 9] (±)	Comments
Transmission S_{12}/S_{21} Magnitude & Phase[3, 6] – Measure (cont)			
(-30 to -40) dB	(1 to 3) GHz	(0.14 to 0.16) dB (0.94 to 1.1) deg	Network analyzer with calibration kit
(-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 1.1) 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	
(10 to 0) dB	(3 to 20) GHz	(0.057 to 0.036) dB (0.34 to 0.24) deg	
(0 to -10) dB		(0.036 to 0.041) dB (0.24 to 0.26) deg	
(-10 to -20) dB		(0.041 to 0.045) dB (0.26 to 0.28) deg	
(-20 to -30) dB		(0.045 to 0.048) dB (0.28 to 0.31) deg	
(-30 to -40) dB		(0.048 to 0.051) dB (0.31 to 0.33) deg	

Parameter/ Range	Frequency	CMC[2, 4, 7] (±)	Comments
Transmission S_{12}/S_{21} Magnitude & Phase[3, 6] – Measure (cont)			
(-40 to -50) dB	(3 to 20) GHz	(0.051 to 0.06) dB (0.33 to 0.38) deg	Network analyzer with calibration kit
(-50 to -60) dB		(0.06 to 0.1) dB (0.38 to 0.67) deg	
(-60 to -70) dB		(0.1 to 0.15) dB (0.67 to 0.98) deg	Non-reflecting device
(-70 to -80) dB		(0.15 to 0.2) dB (0.98 to 1.3) deg	
(-80 to -90) dB		(0.2 to 0.29) dB (1.3 to 2) deg	
(10 to 0) dB	(20 to 26.5) GHz	(0.065 to 0.044) dB (0.39 to 0.29) deg	
(0 to -10) dB		(0.044 to 0.049) dB (0.29 to 0.31) deg	
(-10 to -20) dB		(0.049 to 0.052) dB (0.31 to 0.34) deg	
(-20 to -30) dB		(0.052 to 0.056) dB (0.34 to 0.36) deg	
(-30 to -40) dB		(0.056 to 0.059) dB (0.36 to 0.38) deg	
(-40 to -50) dB		(0.059 to 0.068) dB (0.36 to 0.44) deg	
(-50 to -60) dB		(0.068 to 0.11) dB (0.44 to 0.73) deg	
(-60 to -70) dB		(0.11 to 0.16) dB (0.73 to 1.0) deg	
(-70 to -80) dB		(0.16 to 0.22) dB (1.04 to 1.5) deg	
(-80 to -90) dB		(0.22 to 0.35) dB (1.5 to 2.3) deg	

III. Mechanical

Parameter/ Range	Range	CMC[2, 7] (±)	Comments
Torque Tools - Torque Wrench	(2 to 500) N·m	1.5 % of measurement torque	Torque wrench tester

IV. Thermodynamics

Parameter/ Range	Range	CMC[2, 7] (±)	Comments
Temperature Controlled Chamber[3]	(-70 to 5) °C (5 to 85) °C (85 to 180) °C	0.58 °C 0.24 °C 0.61 °C	Humidity & temperature meter
Humidity Controlled Chamber[3]	(5 to 95) % RH	3.8 % RH	Humidity & temperature meter

V. Time & Frequency

Parameter/Equipment	Range	CMC [2, 5, 7] (±)	Comments[12]
Time Interval & Frequency[3] –	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

Parameter/Equipment	Range	CMC[2, 5, 7] (±)	Comments[12]
Time Interval & Frequency (cont)[3] –			
Surge Generator: Open & 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
Transient Immunity Surge Pulse & 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

Parameter/Equipment	Range	CMC[2, 5, 7, 9] (±)	Comments[12]
Frequency[3] – 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

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[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] 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 Calibration and Measurement Capability Uncertainty (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, *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.

[5] In the statement of CMC, the value is defined as the percentage of reading unless otherwise noted.

[6] CMC for intermediate values of measurand can be found by interpolation.

[7] The contributions from the existing device are not include in the CMC claim.

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

[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.

[10] 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.

[11] Instruments may be calibrated in accordance with various editions of applicable standards like CISPR 16-1-1 or ANSI C63.2

[12] When the date, revision or edition of a test method standard is not identified in the scope of accreditation, the laboratories is required to be using the current version within one year of the date of publication, per part C., Section 1 of the *R101 – General Requirements – Accreditation of ISO-IEC17025 Laboratories* . If a specifier/regulator imposes a different transition period, this will supersede the A2LA one year implementation period.

Accredited Laboratory

A2LA has accredited

OKI ENGINEERING CO., LTD.

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 22nd day of March 2024.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 4727.01
Valid to March 31, 2026

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