



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017
& ANSI/NCSL Z540-1-1994

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CALIBRATION

Valid To: July 31, 2025

Certificate Number: 4201.02

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory at the location listed above, as well as the satellite laboratory location listed below, to perform the following calibrations^{1, 6}:

I. Acoustics & Vibrations

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
Microphones			
Sensitivity	(-50 to -20) dB (20 to 40) Hz (40 to 1300) Hz (1300 to 6300) Hz (6300 to 8000) Hz (8000 to 10 000) Hz (10 000 to 13 000) Hz (13 000 to 16 000) Hz	Reference to 1 V/Pa 0.14 dB 0.11 dB 0.12 dB 0.25 dB 0.27 dB 0.29 dB 0.41 dB	B&K 4180 Agilent 34401A Agilent 33220A G.R.A.S 12AQ 3-port coupler
Sound Calibrators – Multifunction, Pistonphone, Sound Calibrator	(94 to 134) dB (31.5 to 63) Hz (63 to 1000) Hz (1000 to 4000) Hz (4000 to 8000) Hz (8000 to 13 000) Hz	0.15 dB 0.14 dB 0.15 dB 0.27 dB 0.30 dB	B&K 4190 Agilent 34401A G.R.A.S 12AQ

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Sound Level Meters	(94 to 134) dB (125 to 2500) Hz (2500 to 6300) Hz (6300 to 8000) Hz	0.3 dB 0.4 dB 0.5 dB	B&K 4190 Agilent 33220A Agilent 34401A G.R.A.S 12AQ 3-port coupler
Vibration Transducers – Sensitivity Frequency Response	Reference @ 80 Hz (0.001 to 1000) mV/(m/s ²) (3 to 5) Hz (5 to 8) Hz (8 to 10) Hz (10 to 1300) Hz (1300 to 2500) Hz (2500 to 5000) Hz (5000 to 10 000) Hz	1.7 % 2.5 % 2.1 % 1.4 % 1.3 % 1.7 % 2.2 % 2.7 %	Spektra SE-20 with BN-09 Agilent 34401A Agilent 33220A B&K 2693-0I4 APS PA180DM
Vibration Measure & Measuring Equipment – Acceleration Displacement Frequency	(0.1 to 1000) m/s ² (3 to 5) Hz (5 to 8) Hz (8 to 10) Hz (10 to 20) Hz (20 to 1300) Hz (1300 to 3000) Hz (0.001 to 100) mm (3 to 5) Hz (5 to 8) Hz (8 to 10) Hz (10 to 80) Hz (80 to 100) Hz (100 to 160) Hz (160 to 320) Hz (3 to 8) Hz (8 to 3000) Hz	3.6 % 3.3 % 3.2 % 2.1 % 1.9 % 3.2 % 3.8 % 3.5 % 3.3 % 3.0 % 3.1 % 3.7 % 8.6 % 0.58 mHz 5.8 mHz	PCB 353B03 B&K 2693-0I4 Agilent 34401A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Vibration Meters –			
Acceleration	(1 to 500) m/s ²		
	(10 to 20) Hz	2.1 %	Spectra SE-20 (with BN-09) B&K 2693-0I4 Agilent 34401A APS PA180DM
	(20 to 630) Hz	1.8 %	
	(630 to 1250) Hz	2.0 %	
	(1250 to 2500) Hz	2.2 %	
Velocity	(1 to 500) mm/s		
	(10 to 20) Hz	2.1 %	
	(20 to 320) Hz	1.8 %	
	(320 to 630) Hz	1.9 %	
	(630 to 1300) Hz	2.3 %	
Displacement	(1 to 10 000) μm		
	(10 to 20) Hz	2.3 %	
	(20 to 160) Hz	1.8 %	
	(160 to 320) Hz	2.1 %	

II. Antennas

Parameter/Equipment	Range	CMC ² (±)	Comments
Loop Antenna – Antenna Factor	9 kHz to 30 MHz	1.1 dB	HP 34401A ANSI C63.5 SAE ARP958 CISPR 16-1-6
Monopole Antenna – Antenna Factor	9 kHz to 30 MHz	1.3 dB	Keysight E5061B Keysight 85032F ANSI C63.5 SAE ARP958 CISPR 16-1-6
Horn Antenna – Antenna Factor	(0.7 to 1) GHz (1 to 18) GHz (18 to 40) GHz	0.7 dB 0.89 dB 1.4 dB	Keysight E5063A/E5080B Keysight N5173B Keysight PXA
Symmetry, Balance, Cross Polarization	700 MHz to 1 GHz 1 GHz to 18 GHz 18 GHz to 40 GHz	0.33 dB 0.38 dB 0.33 dB	SAE/ARP 958D ANSI C63.5, ANSI C63.4, CISPR 16-1-6, CISPR 16-1-4
VSWR	700 MHz to 1 GHz 1 GHz to 18 GHz 18 GHz to 40 GHz	0.49 dB 0.54 dB 0.61 dB	

III. Dimensional

Parameter/Equipment	Range	CMC ² (±)	Comments
Angle Gauges/Bevel Protractors ³	Up to 360°	0.03°	Comparison to angle gauge blocks
Calipers/Caliper Gauges ³	Up to 1 in (1 to 12) in (12 to 24) in (24 to 40) in	100 μin 400 μin 0.0010 in 0.0014 in	Comparison to gauge blocks
Cylinder/Bore Gauges ³	Up to 32 in	0.092 in	Comparison to gauge blocks, dial gauge testers
Depth Gauges ³	Up to 0.5 in (0.5 to 4) in (4 to 12) in (12 to 24) in	67 μin 0.000 40 in 0.000 61 in 0.000 94 in	Comparison to gauge blocks
Dial/Test Indicators/Digital Indicators ³	Up to 0.2 in (0.2 to 1) in (1 to 4) in	10 μin 30 μin 110 μin	Comparison to gauge blocks
Feeler Gauges	Up to 0.2 in	24 μin	Bench micrometer
Height Gauges/Measuring Machines ³	Up to 4 in (4 to 12) in (12 to 24) in (24 to 40) in	140 μin 350 μin 670 μin 0.0011 in	Comparison to gauge blocks

Parameter/Equipment	Range	CMC ² (±)	Comments
Micrometers ³			
Outside	Up to 1 in (1 to 4) in (4 to 20) in	37 µin 160 µin 640 µin	Comparison to gauge blocks
Inside	(0.2 to 1.2) in (1.2 to 4) in (4 to 8) in (8 to 40) in	90 µin 170 µin 270 µin 0.0012 in	
Depth	Up to 2 in (2 to 6) in	110 µin 220 µin	

IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 7} (±)	Comments
DC Voltage – Generate ³	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1 000) V	1.4 x 10 ⁻⁵ V/V 6.7 x 10 ⁻⁶ V/V 4.4 x 10 ⁻⁶ V/V 6.3 x 10 ⁻⁶ V/V 8.1 x 10 ⁻⁶ V/V	Fluke 5730A
High Voltage	(1 to 3) kV (3 to 10) kV (10 to 20) kV (20 to 25) kV (25 to 30) kV	1.1 x 10 ⁻³ V/V 8.2 x 10 ⁻⁴ V/V 1.4 x 10 ⁻³ V/V 8.5 x 10 ⁻⁴ V/V 1.1 x 10 ⁻³ V/V	Matsusada AU-30P1-L Matsusada AU-30N1-L
DC Current – Generate ³	Up 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 10) A (10 to 20) A (20 to 100) A	7.4 x 10 ⁻⁴ A/A 1.2 x 10 ⁻⁴ A/A 5.1 x 10 ⁻⁵ A/A 4.9 x 10 ⁻⁵ A/A 6.1 x 10 ⁻⁵ A/A 1.1 x 10 ⁻⁴ A/A 2.0 x 10 ⁻⁴ A/A 1.6 x 10 ⁻⁴ A/A 7.0 x 10 ⁻⁴ A/A	Fluke 5730A Fluke 52120A

Parameter/Equipment	Range	CMC ^{2, 7} (±)	Comments
DC Current – Generate ³ (cont)	(100 to 200) A (200 to 900) A 900 A to 1 kA (1 to 1.5) kA (1.5 to 2) kA (2 to 2.5) kA	3.9 x 10 ⁻⁴ A/A 3.1 x 10 ⁻⁴ A/A 6.6 x 10 ⁻⁴ A/A 4.6 x 10 ⁻⁴ A/A 3.6 x 10 ⁻⁴ A/A 3.0 x 10 ⁻⁴ A/A	Fluke 5730A Fluke 52120A Fluke 25 Turn 3000A
Resistance – Generate ³	(0.1 to 1) Ω (1 to 10) Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ	1.2 × 10 ⁻⁴ Ω/Ω 8.6 x 10 ⁻⁵ Ω/Ω 7.1 x 10 ⁻⁵ Ω/Ω 7.1 x 10 ⁻⁵ Ω/Ω 6.9 x 10 ⁻⁵ Ω/Ω 7.1 x 10 ⁻⁵ Ω/Ω 7.1 x 10 ⁻⁵ Ω/Ω 7.3 x 10 ⁻⁵ Ω/Ω	IET HARS-X10-0.0001-K-H
Fixed Points	(10 to 100) MΩ (0.1 to 1) GΩ (1 to 10) GΩ (10 to 100) GΩ 1 mΩ 10 mΩ 100 mΩ 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ 10 GΩ 100 GΩ 1 TΩ	1.2 x 10 ⁻⁴ Ω/Ω 3.7 x 10 ⁻⁴ Ω/Ω 3.7 x 10 ⁻⁴ Ω/Ω 3.7 x 10 ⁻⁴ Ω/Ω 0.41 μΩ 2.1 × 10 ⁻⁴ Ω/Ω 1.3 × 10 ⁻⁴ Ω/Ω 3.2 × 10 ⁻⁵ Ω/Ω 2.7 × 10 ⁻⁵ Ω/Ω 2.5 × 10 ⁻⁵ Ω/Ω 2.5 × 10 ⁻⁵ Ω/Ω 2.5 × 10 ⁻⁶ Ω/Ω 2.5 × 10 ⁻⁵ Ω/Ω 2.8 × 10 ⁻⁵ Ω/Ω 3.2 × 10 ⁻⁵ Ω/Ω 3.2 × 10 ⁻⁵ Ω/Ω 1.2 × 10 ⁻³ Ω/Ω 1.2 × 10 ⁻³ Ω/Ω 4.1 × 10 ⁻³ Ω/Ω 4.1 × 10 ⁻² Ω/Ω	IET HARS-B-4-10M-5kV SARC-0.001 SARC-0.01 SARC-0.1 SARC-1 SARC-10 SARC-100 SARC-1K SARC-10K SARC-100K SARC-1M SARC-10M SAX-100M SAC-1G SAC-10G SAC-100G SAC-1T

Parameter/Equipment	Range	CMC ^{2, 7} (\pm)	Comments
DC Voltage – Measure ³	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	1.7 x 10 ⁻⁵ V/V 1.2 x 10 ⁻⁵ V/V 1.1 x 10 ⁻⁵ V/V 1.4 x 10 ⁻⁵ V/V 1.5 x 10 ⁻⁵ V/V	Agilent 3458A
	(1 to 4) kV (4 to 9) kV (9 to 10) kV (10 to 30) kV (30 to 50) kV (50 to 70) kV (70 to 90) kV	1.7 x 10 ⁻⁴ V/V 3.7 x 10 ⁻⁴ V/V 7.2 x 10 ⁻⁵ V/V 2.0 x 10 ⁻⁴ V/V 3.2 x 10 ⁻⁴ V/V 4.5 x 10 ⁻⁴ V/V 5.9 x 10 ⁻⁴ V/V	Vitretek 4700 & HVL-150
DC Current – Measure ³	100 nA to 1 μ A (1 to 100) μ A	1.7 x 10 ⁻⁴ A/A 1.4 x 10 ⁻⁴ A/A	Agilent 3458A
	100 μ A to 10 mA (10 to 100) mA	6.9 x 10 ⁻⁵ A/A 9.3 x 10 ⁻⁵ A/A	
	100 mA to 1 A	2.6 x 10 ⁻⁴ A/A	Ohmlabs CS-10 Ohmlabs CS-100 Guildline 9230A-500
	(1 to 10) A	2.2 x 10 ⁻⁴ A/A	
	(10 to 100) A (100 to 300) A (300 to 500) A	2.0 x 10 ⁻⁴ A/A 1.1 x 10 ⁻³ A/A 1.1 x 10 ⁻³ A/A	
(500 to 2000) A	2.0 x 10 ⁻² A/A	Fluke 353	

Parameter/Equipment	Range	CMC ^{2, 7} (±)	Comments
DC Resistance – Measure ³	(10 to 100) Ω	9.2 x 10 ⁻⁶ Ω/Ω	Agilent 3458A IET 1865+
	(0.1 to 1) kΩ	9.1 x 10 ⁻⁶ Ω/Ω	
	(1 to 10) kΩ	9.0 x 10 ⁻⁶ Ω/Ω	
	(10 to 100) kΩ	9.2 x 10 ⁻⁶ Ω/Ω	
	(0.1 to 1) MΩ	1.0 x 10 ⁻⁵ Ω/Ω	
	(1 to 10) MΩ	7.0 x 10 ⁻⁶ Ω/Ω	
	(10 to 100) MΩ	2.3 x 10 ⁻⁵ Ω/Ω	
	(0.1 to 1) GΩ	1.5 x 10 ⁻⁴ Ω/Ω	
	(1 to 10) GΩ	1.4 x 10 ⁻³ Ω/Ω	
	(10 to 100) GΩ	3.1 x 10 ⁻³ Ω/Ω	
	(0.1 to 1) TΩ	7.3 x 10 ⁻³ Ω/Ω	

Parameter/Range	Frequency	CMC ^{2, 7} (±)	Comments	
AC Voltage – Generate ³	(2 to 10) mV	(10 to 20) Hz	Fluke 5730A	
		(20 to 40) Hz		7.6 x 10 ⁻⁴ V/V
		40 Hz to 1 kHz		5.9 x 10 ⁻⁴ V/V
		(1 to 20) kHz		5.7 x 10 ⁻⁴ V/V
		(20 to 50) kHz		5.7 x 10 ⁻⁴ V/V
		(50 to 100) kHz		7.2 x 10 ⁻⁴ V/V
		(100 to 300) kHz		1.2 x 10 ⁻³ V/V
		(300 to 500) kHz		2.5 x 10 ⁻³ V/V
		500 kHz to 1 MHz		4.0 x 10 ⁻³ V/V
				5.7 x 10 ⁻³ V/V
		(10 to 100) mV		(10 to 20) Hz
	(20 to 40) Hz			1.9 x 10 ⁻⁴ V/V
	40 Hz to 1 kHz			1.6 x 10 ⁻⁴ V/V
	(1 to 20) kHz			1.6 x 10 ⁻⁴ V/V
	(20 to 50) kHz			2.3 x 10 ⁻⁴ V/V
	(50 to 100) kHz			5.7 x 10 ⁻⁴ V/V
		(100 to 300) kHz		1.1 x 10 ⁻³ V/V
	(300 to 500) kHz	2.0 x 10 ⁻³ V/V		
	500 kHz to 1 MHz	3.8 x 10 ⁻³ V/V		

Parameter/Range	Frequency	CMC ^{2, 7} (±)	Comments
AC Voltage – Generate ³ (cont)			
100 mV to 1 V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	3.3 x 10 ⁻⁴ V/V 1.3 x 10 ⁻⁴ V/V 6.2 x 10 ⁻⁵ V/V 6.2 x 10 ⁻⁵ V/V 1.0 x 10 ⁻⁴ V/V 1.4 x 10 ⁻⁴ V/V 4.9 x 10 ⁻⁴ V/V 1.4 x 10 ⁻³ V/V 2.4 x 10 ⁻³ V/V	Fluke 5730A
(1 to 10) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	3.3 x 10 ⁻⁴ V/V 1.3 x 10 ⁻⁴ V/V 5.9 x 10 ⁻⁵ V/V 5.8 x 10 ⁻⁵ V/V 1.0 x 10 ⁻⁴ V/V 1.3 x 10 ⁻⁴ V/V 3.9 x 10 ⁻⁴ V/V 1.5 x 10 ⁻³ V/V 2.3 x 10 ⁻³ V/V	
(10 to 100) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	3.3 x 10 ⁻⁴ V/V 1.3 x 10 ⁻⁴ V/V 7.2 x 10 ⁻⁵ V/V 8.0 x 10 ⁻⁵ V/V 1.1 x 10 ⁻⁴ V/V 2.2 x 10 ⁻⁴ V/V	
(100 to 500) V	50 Hz to 1 kHz	1.0 x 10 ⁻⁴ V/V	
(500 to 1000) V	50 Hz to 1 kHz	8.7 x 10 ⁻⁵ V/V	
AC Current – Generate ³			
20 μA	(1 to 10) kHz	5.1 x 10 ⁻³ A/A	Fluke 5730A Fluke 5522A
(20 to 100) μA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	4.9 x 10 ⁻⁴ A/A 3.1 x 10 ⁻⁴ A/A 2.3 x 10 ⁻⁴ A/A 5.4 x 10 ⁻⁴ A/A 2.3 x 10 ⁻³ A/A	
100 μA to 1 mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	3.5 x 10 ⁻⁴ A/A 2.4 x 10 ⁻⁴ A/A 1.8 x 10 ⁻⁴ A/A 3.9 x 10 ⁻⁴ A/A 2.1 x 10 ⁻³ A/A	

Parameter/Range	Frequency	CMC ^{2, 7} (±)	Comments
AC Current – Generate ³ (cont)			
(1 to 10) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	3.5×10^{-4} A/A 2.4×10^{-4} A/A 1.8×10^{-4} A/A 3.4×10^{-4} A/A 2.0×10^{-3} A/A	Fluke 5730A Fluke 5522A
(10 to 100) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	3.5×10^{-4} A/A 2.4×10^{-4} A/A 1.7×10^{-4} A/A 3.2×10^{-4} A/A 1.6×10^{-3} A/A	
100 mA to 1 A	(10 to 60) Hz (60 to 300) Hz 300 Hz to 1 kHz (1 to 3) kHz (3 to 6) kHz (6 to 10) kHz	1.4×10^{-3} A/A 1.6×10^{-3} A/A 2.2×10^{-3} A/A 1.4×10^{-2} A/A 3.8×10^{-2} A/A 9.0×10^{-2} A/A	
(1 to 20) A	(10 to 60) Hz (60 to 300) Hz 300 Hz to 1 kHz (1 to 3) kHz (3 to 6) kHz (6 to 10) kHz	6.9×10^{-4} A/A 8.2×10^{-4} A/A 1.5×10^{-3} A/A 4.5×10^{-3} A/A 1.3×10^{-2} A/A 3.3×10^{-2} A/A	Fluke 5730A Fluke 52120A Fluke 25 turn 3000A
(20 to 100) A	(50 to 60) Hz (60 to 400) Hz	3.0×10^{-3} A/A 3.7×10^{-3} A/A	
(100 to 200) A	(50 to 60) Hz (60 to 400) Hz	1.6×10^{-3} A/A 2.3×10^{-3} A/A	
(200 to 300) A	(50 to 60) Hz (60 to 400) Hz	1.1×10^{-3} A/A 1.9×10^{-3} A/A	
(300 to 400) A	(50 to 60) Hz (60 to 400) Hz	8.4×10^{-4} A/A 1.6×10^{-3} A/A	
(400 to 500) A	(50 to 60) Hz (60 to 400) Hz	7.0×10^{-4} A/A 1.5×10^{-3} A/A	
(500 to 750) A	(50 to 60) Hz (60 to 400) Hz	9.4×10^{-4} A/A 4.6×10^{-3} A/A	
(750 to 900) A	(50 to 60) Hz (60 to 400) Hz	8.0×10^{-4} A/A 4.0×10^{-3} A/A	

Parameter/Range	Frequency	CMC ^{2, 7} (±)	Comments
AC Current – Generate ³ (cont)			
(900 to 1000) mA	(50 to 60) Hz (60 to 400) Hz	9.6 x 10 ⁻⁴ A/A 3.7 x 10 ⁻³ A/A	Fluke 5730A Fluke 52120A Fluke 25 turn 3000A
(1000 to 1500) A	(50 to 60) Hz (60 to 400) Hz	6.7 x 10 ⁻⁴ A/A 2.8 x 10 ⁻³ A/A	
(1500 to 2000) A	(50 to 60) Hz (60 to 400) Hz	5.3 x 10 ⁻⁴ A/A 2.3 x 10 ⁻³ A/A	
(2000 to 2500) A	(50 to 60) Hz (60 to 400) Hz	4.5 x 10 ⁻⁴ A/A 2.1 x 10 ⁻³ A/A	
(2500 to 3000) A	(50 to 60) Hz (60 to 400) Hz	4.0 x 10 ⁻⁴ A/A 1.9 x 10 ⁻³ A/A	

Parameter/Range	Frequency	CMC ^{2, 7} (±)	Comments
AC Resistance – Generate ³			
100 mΩ 200 mΩ 300 mΩ 400 mΩ 500 mΩ	(50 Hz to 1 kHz)	1.3 mΩ 2.5 mΩ 3.6 mΩ 4.8 mΩ 5.9 mΩ	Rara IRH200 0.1 to 0.5
(1 to 10) Ω	1 kHz to 1 MHz (1 to 2) MHz (2 to 3) MHz (3 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	3.3 x 10 ⁻⁴ Ω/ Ω 5.2 x 10 ⁻⁴ Ω/ Ω 6.2 x 10 ⁻⁴ Ω/ Ω 7.2 x 10 ⁻⁴ Ω/ Ω 1.1 x 10 ⁻³ Ω/ Ω 4.1 x 10 ⁻³ Ω/ Ω 6.1 x 10 ⁻³ Ω/ Ω	Keysight 42030A
(10 to 100) Ω	1 kHz to 1 MHz (1 to 2) MHz (2 to 5) MHz (5 to 10) MHz (10 to 13) MHz	3.3 x 10 ⁻⁴ Ω/ Ω 4.3 x 10 ⁻⁴ Ω/ Ω 5.2 x 10 ⁻⁴ Ω/ Ω 2.1 x 10 ⁻³ Ω/ Ω 3.1 x 10 ⁻³ Ω/ Ω	

Parameter/Range	Frequency	CMC ^{2, 7} (\pm)	Comments
AC Resistance – Generate ³ (cont)			
100 Ω to 1 k Ω	1 kHz to 3 MHz (3 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	3.3 x 10 ⁻⁴ Ω/Ω 4.3 x 10 ⁻⁴ Ω/Ω 5.2 x 10 ⁻⁴ Ω/Ω 2.1 x 10 ⁻³ Ω/Ω 3.1 x 10 ⁻³ Ω/Ω	Keysight 42030A
(1 to 10) k Ω	(1 to 100) kHz 100 kHz to 1 MHz	2.4 x 10 ⁻⁴ Ω/Ω 3.3 x 10 ⁻⁴ Ω/Ω	
(10 to 100) k Ω	1 kHz to 1 MHz	3.3 x 10 ⁻⁴ Ω/Ω	
Capacitance – Generate ³			
1 pF 10 pF 100 pF 1 nF 10 μ F 100 μ F	@1 kHz	0.35 fF 3.5 fF 35 fF 0.35 pF 39 nF 0.39 μ F	Keysight 16380C
10 nF 10 nF 1 μ F	@120 Hz to 100 kHz	0.79 pF 7.9 pF 85 pF	
Inductance – Generate ³			
100 μ H to 10 H	100 Hz	1.2 x 10 ⁻³ H/H	IET 1482 series
100 μ H to 10 H	200 Hz	1.2 x 10 ⁻³ H/H	
100 μ H to 10 H	400 Hz	1.2 x 10 ⁻³ H/H	
100 μ H to 1 H (1 to 10) H	1 kHz	1.2 x 10 ⁻³ H/H 1.3 x 10 ⁻³ H/H	
100 μ H to 100 mH	10 kHz	1.2 x 10 ⁻³ H/H	

Parameter/Range	Frequency	CMC ^{2, 7} (±)	Comments
AC Voltage – Measure ³			
(10 to 100) mV	10 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	1.1 x 10 ⁻⁴ V/V 1.9 x 10 ⁻⁴ V/V 3.7 x 10 ⁻⁴ V/V 9.5 x 10 ⁻⁴ V/V 3.6 x 10 ⁻³ V/V 1.2 x 10 ⁻² V/V	Agilent 3458A
100 mV to 1 V	10 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	1.1 x 10 ⁻⁴ V/V 1.9 x 10 ⁻⁴ V/V 3.7 x 10 ⁻⁴ V/V 9.5 x 10 ⁻⁴ V/V 3.6 x 10 ⁻³ V/V 1.2 x 10 ⁻² V/V	
(1 to 10) V	10 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	1.1 x 10 ⁻⁴ V/V 1.9 x 10 ⁻⁴ V/V 3.7 x 10 ⁻⁴ V/V 9.5 x 10 ⁻⁴ V/V 3.6 x 10 ⁻³ V/V 1.2 x 10 ⁻² V/V	
(10 to 100) V	10 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	2.6 x 10 ⁻⁴ V/V 4.3 x 10 ⁻⁴ V/V 1.5 x 10 ⁻³ V/V	
(100 to 700) V	50 Hz to 1 kHz (1 to 10) kHz	4.9 x 10 ⁻⁴ V/V 7.2 x 10 ⁻⁴ V/V	
700 V to 1 kV	(50 to 60) Hz (60 to 400) Hz	1.6 x 10 ⁻³ V/V 4.8 x 10 ⁻³ V/V	
(1 to 9) kV	(50 to 60) Hz	1.5 x 10 ⁻³ V/V	
(9 to 10) kV	(50 to 60) Hz	6.0 x 10 ⁻³ V/V	
(10 to 70) kV	(50 to 60) Hz	5.9 x 10 ⁻³ V/V	

Parameter/Range	Frequency	CMC ^{2, 7} (\pm)	Comments
AC Current – Measure ³			
100 μ A to 1 mA	(10 to 40) Hz (40 to 100) Hz 100 Hz to 1 kHz (1 to 10) kHz	2.0×10^{-3} A/A 9.3×10^{-4} A/A 5.9×10^{-4} A/A 9.4×10^{-4} A/A	Agilent 3458A
(1 to 10) mA	(10 to 40) Hz (40 to 100) Hz 100 Hz to 1 kHz (1 to 10) kHz	2.0×10^{-3} A/A 9.3×10^{-4} A/A 5.9×10^{-4} A/A 9.4×10^{-4} A/A	
(10 to 100) mA	(10 to 40) Hz (40 to 100) Hz 100 Hz to 1 kHz (1 to 10) kHz	2.0×10^{-3} A/A 9.4×10^{-4} A/A 5.9×10^{-4} A/A 9.4×10^{-4} A/A	
100 mA to 1 A	(10 to 40) Hz (40 to 100) Hz 100 Hz to 1 kHz (1 to 10) kHz	2.1×10^{-3} A/A 1.2×10^{-3} A/A 1.5×10^{-3} A/A 3.8×10^{-3} A/A	
(1 to 10) A	(40 to 100) Hz 100 Hz to 1 kHz	7.6×10^{-4} A/A 2.1×10^{-3} A/A	Ohmlabs CS-10 Ohmlabs CS-100
(10 to 50) A	(40 to 100) Hz 100 Hz to 1 kHz	6.9×10^{-4} A/A 2.1×10^{-3} A/A	
(50 to 100) A	(40 to 100) Hz 100 Hz to 1 kHz	6.8×10^{-4} A/A 2.1×10^{-3} A/A	
(100 to 300) A (300 to 600) A (600 to 800) A (800 to 1000) A (1000 to 1400) A	60 Hz	2.0×10^{-4} A/A 1.0×10^{-4} A/A 7.3×10^{-5} A/A 5.8×10^{-4} A/A 2.9×10^{-2} A/A	Chauvin Arnoux A100 Fluke 353
AC Resistance – Measure ³			
100 m Ω 100 m Ω to 100 k Ω	1 kHz	30 m Ω 1.5×10^{-3} Ω / Ω	HP 4284A
Capacitance – Measure ³			
10 pF 10 nF to 1 μ F	1 kHz	35 fF 3.5×10^{-3} F/F	HP 4284A

Parameter/Range	Frequency	CMC ^{2, 7} (±)	Comments
Power – Generate ³ (cont) Total Harmonic Distortion THD-V (0.5 to 20) % THD-I (0.5 to 20) %	(50 to 60) Hz	0.50 % 0.48 %	Fluke 6105A
Power – Measure ³ AC Power: 18 mW (18 to 36) mW (36 to 180) mW (180 to 360) mW (360 to 750) mW 750 mW to 1.2 W (1.2 to 3.6) W (3.6 to 12) W (12 to 600) W 600 W to 1.2 kW (1.2 to 2.4) kW	(50 to 60) Hz	17 μW 5.7 × 10 ⁻⁴ W/W 4.0 × 10 ⁻⁴ W/W 4.3 × 10 ⁻⁴ W/W 4.0 × 10 ⁻⁴ W/W 7.0 × 10 ⁻⁴ W/W 4.0 × 10 ⁻⁴ W/W 3.9 × 10 ⁻⁴ W/W 3.5 × 10 ⁻⁴ W/W 7.0 × 10 ⁻⁴ W/W 4.6 × 10 ⁻⁴ W/W	Zimmer LMG 611

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
Perceptual Flicker	P_{st} Range (1 to 4 000) cpm: (16 to 10) %	0.52 %	Fluke 6105A Zimmer LMG 611 P_{st} : percent short-term cpm: rectangular changes per minute

Parameter/Equipment	Range	CMC ^{2,4,7} (±)	Comments
Electrical Simulation of Thermocouples ³			
Type E	(-250 to -100) °C (-100 to 650) °C (650 to 1000) °C	0.17 °C 0.20 °C 0.20 °C	Fluke 5522A
Type J	(-210 to -100) °C (-100 to 760) °C (760 to 1200) °C	0.17 °C 0.21 °C 0.21 °C	
Type K	(-200 to -100) °C (-100 to 1000) °C (1000 to 1372) °C	0.18 °C 0.33 °C 0.33 °C	
Type S	(0 to 250) °C (250 to 1400) °C (1400 to 1767) °C	0.30 °C 0.38 °C 0.38 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 400) °C	0.22 °C 0.17 °C 0.16 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Stimulation of RTDs ³			
PT385, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 200) °C (200 to 300) °C (300 to 400) °C (400 to 500) °C (500 to 600) °C (700 to 800) °C	0.041 °C 0.056 °C 0.064 °C 0.066 °C 0.073 °C 0.081 °C 0.16 °C 0.16 °C	Fluke 5522A

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Oscilloscope ³ – (cont)			
3 dB Bandwidth	(0.06 to 3) V 50 kHz to 550 MHz 550 MHz to 40 GHz	3.4 x 10 ⁻² V/V 2.4 x 10 ⁻² V/V	Keysight E8257D Keysight N1914A Keysight N8487A H.P 11667Cw
Time Marker	(0.5 to 1) ns (1 to 2) ns (2 to 5) ns (5 to 10) ns (10 to 20) ns (20 to 50) ns (50 to 100) ns (100 to 200) ns (200 to 500) ns (0.5 to 1) µs (1 to 2) µs (2 to 5) µs (5 to 10) µs (10 to 20) µs (20 to 50) µs (50 to 100) µs (100 to 200) µs (200 to 500) µs (0.5 to 1) ms (1 to 2) ms (2 to 5) ms (5 to 10) ms (10 to 20) ms (20 to 500) ms (0.5 to 5) s	6.2 x 10 ⁻⁶ s/s 3.1 x 10 ⁻⁶ s/s 1.3 x 10 ⁻⁶ s/s 6.2 x 10 ⁻⁶ s/s 3.1 x 10 ⁻⁶ s/s 1.3 x 10 ⁻⁶ s/s 6.2 x 10 ⁻⁶ s/s 3.1 x 10 ⁻⁶ s/s 1.3 x 10 ⁻⁶ s/s 6.2 x 10 ⁻⁶ s/s 3.1 x 10 ⁻⁶ s/s 1.3 x 10 ⁻⁶ s/s 6.2 x 10 ⁻⁶ s/s 3.1 x 10 ⁻⁶ s/s 1.3 x 10 ⁻⁶ s/s 7.1 x 10 ⁻⁶ s/s 4.7 x 10 ⁻⁶ s/s 3.7 x 10 ⁻⁶ s/s 7.1 x 10 ⁻⁶ s/s 4.7 x 10 ⁻⁶ s/s 3.7 x 10 ⁻⁶ s/s 7.1 x 10 ⁻⁶ s/s 4.3 x 10 ⁻⁶ s/s 8.7 x 10 ⁻⁵ s/s 1.2 x 10 ⁻³ s/s	
Frequency	(100 to 200) mHz (200 to 500) mHz (0.5 to 1) Hz (1 to 2) Hz (2 to 5) Hz (5 to 10) Hz (10 to 20) Hz (20 to 50) Hz (50 to 100) Hz (100 to 200) Hz (200 to 500) Hz (0.5 to 1) kHz (1 to 2) kHz	8.4 x 10 ⁻⁶ Hz/Hz 6.5 x 10 ⁻⁶ Hz/Hz 8.7 x 10 ⁻⁶ Hz/Hz 6.8 x 10 ⁻⁶ Hz/Hz 6.2 x 10 ⁻⁶ Hz/Hz 8.6 x 10 ⁻⁶ Hz/Hz 6.8 x 10 ⁻⁶ Hz/Hz 6.2 x 10 ⁻⁶ Hz/Hz 8.6 x 10 ⁻⁶ Hz/Hz 6.8 x 10 ⁻⁶ Hz/Hz 6.2 x 10 ⁻⁶ Hz/Hz 8.6 x 10 ⁻⁶ Hz/Hz 6.8 x 10 ⁻⁶ Hz/Hz 8.4 x 10 ⁻⁶ Hz/Hz	Agilent 33250A Fluke 9500B

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Oscilloscope ³ – (cont)			
Frequency	(2 to 5) kHz (5 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 200) kHz (200 to 500) kHz (0.5 to 1) MHz (1 to 2) MHz (2 to 5) MHz (5 to 10) MHz (10 to 20) MHz (20 to 50) MHz (50 to 100) MHz (100 to 200) MHz (200 to 500) MHz (0.5 to 1) GHz (1 to 2) GHz	6.5 x 10 ⁻⁶ Hz/Hz 8.7 x 10 ⁻⁶ Hz/Hz 6.8 x 10 ⁻⁶ Hz/Hz 6.2 x 10 ⁻⁶ Hz/Hz 8.6 x 10 ⁻⁶ Hz/Hz 6.8 x 10 ⁻⁶ Hz/Hz 6.2 x 10 ⁻⁶ Hz/Hz 6.2 x 10 ⁻⁶ Hz/Hz 3.1 x 10 ⁻⁶ Hz/Hz 1.4 x 10 ⁻⁶ Hz/Hz 6.2 x 10 ⁻⁶ Hz/Hz 3.1 x 10 ⁻⁶ Hz/Hz 1.4 x 10 ⁻⁶ Hz/Hz 6.2 x 10 ⁻⁶ Hz/Hz 3.1 x 10 ⁻⁶ Hz/Hz 1.4 x 10 ⁻⁶ Hz/Hz 6.2 x 10 ⁻⁶ Hz/Hz 3.1 x 10 ⁻⁶ Hz/Hz	Fluke 9500B

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
Leakage Current Network ³			
Input Voltage to Output Voltage Ratio 1 to 1384	20 Hz to 1 MHz	4.2 × 10 ⁻³	Fluke 5730A Agilent 3458A
Input Voltage to Output Current Ratio 0.5 to 689	20 Hz to 1 MHz	4.8 × 10 ⁻³	Agilent 3458A

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
Probes ³ – Bandwidth			
(100 to 300) mV	(0.05 to 100) MHz (100 to 300) MHz (300 to 500) MHz	4.2×10^{-2} V/V 5.9×10^{-2} V/V 6.1×10^{-2} V/V	Fluke 9500B Tektronix DPO 4054
(0.3 to 3) V	(0.05 to 100) MHz (100 to 300) MHz (300 to 500) MHz	6.0×10^{-2} V/V 7.3×10^{-2} V/V 7.4×10^{-2} V/V	
Current Shunts ³			
DC:			
(0.001 to 0.01) Ω		4.0×10^{-4} Ω/Ω	Fluke 5730A Fluke 52120A Agilent 3458A
(0.01 to 0.1) Ω		1.2×10^{-4} Ω/Ω	
(0.1 to 1) Ω		6.2×10^{-5} Ω/Ω	
(1 to 10) Ω		5.0×10^{-5} Ω/Ω	
(10 to 100) Ω		5.3×10^{-5} Ω/Ω	
(100 to 1000) Ω		1.2×10^{-4} Ω/Ω	
AC:			
(0.001 to 0.01) Ω	40 Hz	2.0×10^{-3} Ω/Ω	
(0.01 to 0.1) Ω		3.8×10^{-4} Ω/Ω	
(0.1 to 1) Ω		2.2×10^{-4} Ω/Ω	
(1 to 10) Ω		2.4×10^{-4} Ω/Ω	
(10 to 100) Ω		2.4×10^{-4} Ω/Ω	
(100 to 1000) Ω		2.8×10^{-4} Ω/Ω	
(0.001 to 0.01) Ω	40 Hz to 100 Hz	1.3×10^{-3} Ω/Ω	
(0.01 to 0.1) Ω		4.0×10^{-4} Ω/Ω	
(0.1 to 1) Ω		2.7×10^{-4} Ω/Ω	
(1 to 10) Ω		3.0×10^{-4} Ω/Ω	
(10 to 100) Ω		3.0×10^{-4} Ω/Ω	
(100 to 1000) Ω		3.6×10^{-4} Ω/Ω	
(0.001 to 0.01) Ω	100 Hz to 1 kHz	2.0×10^{-3} Ω/Ω	
(0.01 to 0.1) Ω		3.7×10^{-4} Ω/Ω	
(0.1 to 1) Ω		2.0×10^{-4} Ω/Ω	
(1 to 10) Ω		2.3×10^{-4} Ω/Ω	
(10 to 100) Ω		2.3×10^{-4} Ω/Ω	
(100 to 1000) Ω		2.7×10^{-4} Ω/Ω	

VI. Electrical – RF/EMC Equipment

Parameter/Equipment	Range	CMC ^{2,4,7} (±)	Comments
RF Power Meters ³ – Instrument Accuracy	3 μW to 100 mW	2.9 mW/W	HP 11683A
Display Linearity ³ – Measuring Equipment	(0 to 40) dB (40 to 96) dB	0.16 dB 0.19 dB	Keysight E8257D Keysight J7211C
Spectrum Analyzer ³ – Frequency Readout Marker Frequency Counter Span	5 Hz to 50 GHz 5 Hz to 50 GHz 5 Hz to 50 GHz	9. 6× 10 ⁻⁴ ·SPAN 0.06 Hz 1.4 × 10 ⁻³ ·SPAN	SRS FS740 Agilent 33250A Keysight E8257D
Input Attenuator Accuracy ³ – Measuring Equipment	(0 to 30) dB (30 to 70) dB	0.16 dB 0.17 dB	Keysight E8257D Keysight J7211C
Displayed Average Noise Level ³ – Measuring Equipment	3 Hz to 50 GHz	1.7 dB	Terminations in the calibration kits
Sinewave Response ³ – Measuring Equipment	10 Hz to 50 MHz 50 MHz to 7 GHz (7 to 12) GHz (12 to 26) GHz (26 to 32) GHz (32 to 40) GHz (45 to 50) GHz	0.06 dB 0.07 dB 0.08 dB 0.09 dB 0.11 dB 0.12 dB 0.19 dB	Agilent 33250A, Keysight E8257D, HP 83650B, Keysight N1914A, Keysight E9304A, Keysight E4412A, Keysight E4413A, Keysight N8487A
Spurious Response ³ – Measuring Equipment	9 kHz to 50 GHz	0.45 dB	Keysight N5173B Keysight E8257D HP 83650B

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Pulse Response ³ – Measuring Equipment			
Pulse Response	9 kHz to 40 GHz	0.70 dB	Keysight N5173B Keysight E8257D Schwarzbeck IGUU 2918 CISPR 16-1-1 ANSI C63.5
Repetition Frequency Response	9 kHz to 1 GHz	0.05 dB	
ISN ³ –			
Impedance	9 kHz to 1 GHz	3.2 Ω	Keysight E5061B Keysight 85032F calibration fixture CISPR 22, CISPR 32, CISPR 16-1-2
Phase Angle	9 kHz to 1 GHz	0.8°	
Voltage Division Factor	9 kHz to 1 GHz	0.12 dB	
Longitudinal Conversion Loss	9 kHz to 1 GHz	0.27 dB	
LISN ³ –			
Impedance	10 Hz to 1 GHz	0.5 Ω	Keysight E5061B Keysight 85032F calibration fixture ANSI C63.4, CISPR 25, CISPR 16-1-2, MIL-STD- 461F, ISO 7637-2
Phase Angle	10 Hz to 1 GHz	1.2°	
Voltage Division Factor	10 Hz to 1 GHz	0.12 dB	
CDN ³ –			
Impedance	10 Hz to 1 GHz	3.7 Ω	Keysight E5061B Keysight 85032F calibration fixture IEC/EN 61000-4-6 CISPR 16-1-2
Phase Angle	10 Hz to 1 GHz	1.4°	
Voltage Division Factor	10 Hz to 1 GHz	0.12 dB	

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
EM Clamps – Coupling Factor	9 kHz to 1 GHz	0.30 dB	Keysight E5061B Keysight 85032F IEC 61000-4-6
Decoupling Factor	9 kHz to 1 GHz	0.30 dB	
Impedance	9 kHz to 1 GHz	1.8×10^{-2} lin	
RF Current Probe ³ – Transfer Impedance	5 Hz to 500 MHz 500 MHz to 3 GHz	0.54 dB 1.1 dB	Keysight E5061B Keysight 85032F calibration fixture CISPR 16-1-2, IEC/EN 61000-4-6
Absorbing Clamps Reflection Coefficient (Mag)	5 Hz to 3 GHz	5.9×10^{-3} lin	Keysight E5061B Keysight 85032F CISPR 16-1-3 CISPR 16-1-4
Insertion Loss	30 MHz to 1 GHz	1.8 dB	
Noise Impulse Simulators ³ – Output Voltage	(100 to 200) V (200 to 500) V (0.5 to 1) kV (1 to 2) kV (2 to 3) kV (3 to 4) kV (4 to 5) kV	28 mV/V 27 mV/V 28 mV/V 57 mV/V 51 mV/V 46 mV/V 45 mV/V	Tektronix DPO 7354 Tektronix P6015A Tektronix P5100A
Pulse Width	(0.08 to 1) μs	12 ms/s	
Surge Generators ³ – Output Voltage Voltage	(1 to 500) V (0.5 to 1) kV (1 to 2) kV (2 to 4) kV (4 to 6) kV (6 to 20) kV	28 mV/V 28 mV/V 57 mV/V 40 mV/V 37 mV/V 41 mV/V	Tektronix DPO 7354 Tektronix P6015A Tektronix P5100A Pearson 110 Weinschel 24-40-34-LIM IEC 61000-4-5 IEC 61000-4-12 ISO 7637-2 MIL-STD-461F
Undershoot	Up to 150 V (150 to 600) V (0.6 to 1.2) kV	33 mV/V 30 mV/V 92 mV/V	

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Surge Generators ³ – Output Voltage (cont)			
Undershoot	(1.2 to 1.8) kV (1.8 to 2.4) kV (2.4 to 3.0) kV (3.0 to 4.5) kV (4.5 to 5.4) kV (5.4 to 6.0) kV	67 mV/V 58 mV/V 53 mV/V 47 mV/V 46 mV/V 45 mV/V	Tektronix DPO 7354 Tektronix P6015A Tektronix P5100A Pearson 110 Weinschel 24-40-34-LIM IEC 61000-4-5 IEC 61000-4-12
Front Time	(0.1 to 1.6) µs (1.6 to 5) µs (5 to 30) µs	10 ms/s 6.7 ms/s 11 ms/s	ISO 7637-2 MIL-STD-461F
Time to Half Value Time	(10 to 50) µs (50 to 700) µs (0.7 to 1) ms (1 to 2) ms (2 to 10) ms (10 to 40) ms 40 ms to 1 s (1 to 3) s	10 ms/s 7.1 ms/s 5.0 ms/s 10 ms/s 3.0 ms/s 5.0 ms/s 3.0 ms/s 6.7 ms/s	
Output Current: Current	(1 to 20) A (20 to 50) A (50 to 100) A (100 to 500) A (0.5 to 2) kA (2 to 3) kA	38 mA/A 37 mA/A 38 mA/A 37 mA/A 38 mA/A 37 mA/A	
Undershoot	Up to 300 A (300 to 900) A	40 mA/A 38 mA/A	
Output Current: Front Time	(1 to 5) µs (5 to 10) µs	10 ms/s 7.8 ms/s	
Time to Half Value Time	(10 to 25) µs (25 to 50) µs	12 ms/s 8.3 ms/s	
Phase (220 V / 60 Hz)	Up to 4.17 ms (4.17 to 8.33) ms (8.33 to 12.5) ms (12.5 to 16.67) ms	12 ms/s 6.0 ms/s 4.0 ms/s 3.0 ms/s	

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Surge Generators ³ – Output Voltage (cont)			
Phase (230 V / 50 Hz)	Up to 5 ms (5 to 10) ms (10 to 15) ms (15 to 20) ms	10 ms/s 5.0 ms/s 3.3 ms/s 2.3 ms/s	Tektronix DPO 7354 Tektronix P6015A Tektronix P5100A Pearson 110 Weinschel 24-40-34-LIM
(ISO 7637-2 only) Rise/Fall Time	(1 to 5) ms (5 to 10) ms	6.0 ms/s 3.0 ms/s	IEC 61000-4-5 IEC 61000-4-12 ISO 7637-2 MIL-STD-461F
Damped Time Constant	(1 to 2.5) µs (1 to 2) ms (20 to 26) ms (26 to 60) ms (60 to 400) ms	8.0 ms/s 15 ms/s 12 ms/s 17 ms/s 5.0 ms/s	
DC Cut Time	(5 to 10) ms (100 to 120) ms (120 to 200) ms (200 to 300) ms (0.3 to 1) s	3.0 ms/s 2.5 ms/s 5.0 ms/s 3.3 ms/s 3.0 ms/s	
Pulse Width	(2 to 2.82) µs (1 to 2) ms (50 to 100) ms (100 to 400) ms (0.4 to 1) s (1 to 2) s	7.1 ms/s 15 ms/s 3.0 ms/s 5.0 ms/s 3.0 ms/s 2.5 ms/s	
Oscillatory Wave Only			
Rise/Fall Time	(0.1 to 0.5) µs	20 ms/s	
Pulse Width	(1 to 6.4) µs (6.4 to 10) µs (10 to 70) µs (70 to 500) µs	7.8 ms/s 10 ms/s 4.3 ms/s 4.0 ms/s	
Frequency	1 kHz to 10 MHz (10 to 30) MHz (30 to 100) MHz	6.0 mHz/Hz 2.0 mHz/Hz 5.8 mHz/Hz	

Parameter/Equipment	Range	CMC ^{2,7} (\pm)	Comments
Burst Pulse Generators ³			
Output Voltage:			Tektronix DPO 7354 TESEQ INA265B
50 Ω	1 V to 4 kV	36 mV/V	
1 k Ω	1 V to 8 kV	50 mV/V	IEC 61000-4-4, MIL-STD-461F, ISO 7637-2
Rise/Fall Time	(1 to 10) ns (0.1 to 1) μ s	4.6 ms/s 5.8 ms/s	
Pulse Width	(10 to 100) ns (100 to 150) ns	2.3 ms/s 3.1 ms/s	
Repetition Frequency	(1 to 2.5) kHz (2.5 to 5) kHz 100 kHz	0.23 mHz/Hz 0.12 mHz/Hz 0.58 mHz/Hz	
Duration	(10 to 50) μ s (0.5 to 0.75) ms (0.75 to 2.0) ms (2.0 to 10) ms (10 to 20) ms	2.3 ms/s 7.7 ms/s 2.9 ms/s 2.3 ms/s 1.5 ms/s	
Burst Rate	(50 to 100) ms (100 to 200) ms (200 to 300) ms (0.3 to 1) s	2.3 ms/s 2.9 ms/s 1.9 ms/s 2.3 ms/s	
Damped Oscillatory Wave Rise/Fall Time	(1 to 5) ns	4.6 ms/s	
Oscillatory Frequency	(90 to 100) kHz (0.5 to 1) MHz (2 to 3) MHz (9 to 10) MHz (10 to 30) MHz (90 to 100) MHz	2.3 mHz/Hz 5.8 mHz/Hz 3.8 mHz/Hz 5.8 mHz/Hz 2.3 mHz/Hz 2.9 mHz/Hz	
Repetition Rate	(100 to 200) μ s	2.9 ms/s	
Duration	(40 to 50) ms	2.3 ms/s	
Burst Period	(200 to 300) ms	1.9 ms/s	

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
Electrostatic Discharge Simulators –			
Voltage	(0.2 to 0.5) kV (0.5 to 1) kV (1 to 2) kV (2 to 4) kV (4 to 6) kV (6 to 8) kV (8 to 10) kV (10 to 15) kV (15 to 20) kV (20 to 25) kV (25 to 30) kV	2.0 % 1.5 % 1.3 % 1.2 % 1.0 % 1.2 % 1.2 % 1.2 % 1.3 % 1.3 % 1.2 %	ESDEMC ES105-100
Current (Ip)	Up to 7.5 A (7.5 to 15) A (15 to 22.5) A (22.5 to 30) A (30 to 45) A (45 to 56) A (56 to 75) A (75 to 94) A (94 to 150) A	3.3 % 2.3 % 3.0 % 2.5 % 2.9 % 2.8 % 2.6 % 2.5 % 2.8 %	Tektronix DPO 7354 ESD target, V/A transducer IEC 61000-4-2 ISO 10605
T1	30 ns, 65 ns Up to 4 A (4 to 8) A (8 to 12) A (12 to 16) A (16 to 24) A (24 to 30) A (30 to 40) A (40 to 50) A (50 to 80) A	2.0 % 1.9 % 2.1 % 2.0 % 2.0 % 2.3 % 2.3 % 2.2 % 2.3 %	
T2	60 ns, 130 ns Up to 2 A (2 to 4) A (4 to 6) A (6 to 8) A (8 to 12) A (12 to 15) A (15 to 20) A (20 to 25) A (25 to 40) A	2.3 % 2.0 % 2.1 % 2.1 % 2.2 % 2.4 % 2.4 % 2.3 % 2.4 %	

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
Electrostatic Discharge Simulators – (cont)			
T3	180 ns, 400 ns Up to 0.55 A (0.55 to 1.1) A (1.10 to 1.7) A (1.7 to 2.2) A (2.2 to 3.3) A (3.3 to 4.1) A (4.1 to 5.5) A (5.5 to 7.0) A (7.0 to 11) A	5.5 % 3.2 % 5.6 % 3.5 % 4.7 % 3.8 % 3.9 % 2.9 % 4.0 %	Tektronix DPO 7354 ESD target, V/A transducer IEC 61000-4-2 ISO 10605
T4	360 ns, 800 ns Up to 0.30 A (0.30 to 0.60) A (0.60 to 0.90) A (0.90 to 1.2) A (1.2 to 1.8) A (1.8 to 2.3) A (2.3 to 3.0) A (3.0 to 4.0) A (4.0 to 6.0) A	9.6 % 5.1 % 10 % 5.7 % 8.1 % 6.0 % 6.2 % 4.0 % 6.6 %	
Rise/Fall Time	(0.5 to 1) ns	1.2 %	
Dip Simulators ³ –			
Output Voltage	Up to 100 V (100 to 220) V (220 to 230) V (230 to 400) V	1.1 mV/V 2.3 mV/V 2.2 mV/V 1.5 mV/V	Tektronix DPO 7354 HP 34401A Pintek DP-15K Pintek DP-30K IEC 61000-4-11
Line Frequency	(49 to 51) Hz (59 to 61) Hz	0.12 mHz/Hz 0.13 mHz/Hz	
Dip & Up Voltage	(50 to 60) Hz (1 to 120) V 0 % (1 to 10) V, (1 to 40) % (10 to 48) V, (40 to 70) % (48 to 84) V, (70 to 80) % (84 to 96) V,	0.52 V/V 0.12 V/V 69 mV/V 61 mV/V	

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Dip Simulators ³ – (cont) Dip & Up Voltage	(50 to 60) Hz	59 mV/V	Tektronix DPO 7354 HP 34401A Pintek DP-15K Pintek DP-30K IEC 61000-4-11
	(1 to 120) V		
	(80 to 120) %		
	(96 to 144) V		
	(120 to 220) V	0.52 V/V	
	0 %		
	(1 to 10) V		
	(1 to 40) %		
	(10 to 88) V	66 mV/V	
	(40 to 70) %		
	(88 to 154) V		
	(70 to 80) %		
	(154 to 176) V	39 mV/V	
	(80 to 120) %		
	(176 to 264) V		
	(220 to 230) V	0.52 V/V	
	0 %		
	(1 to 10) V		
	(1 to 40) %		
(10 to 92) V	64 mV/V		
(40 to 70) %			
(92 to 160) V			
(70 to 80) %			
(160 to 180) V	38 mV/V		
(80 to 120) %			
(180 to 300) V			
(230 to 380) V	1 V/V		
0 %			
(1 to 10) V			
(1 to 40) %			
(10 to 150) V	80 mV/V		
(40 to 70) %			
(150 to 270) V			
(70 to 80) %			
(270 to 300) V	44 mV/V		
(80 to 120) %			
(300 to 500) V			
Dip & Up Period	(5 to 20) ms	10 ms/s	
	(50 to 100) ms	3 ms/s	
	(100 to 200) ms	5 ms/s	
	(200 to 500) ms	4 ms/s	
	500 ms to 1 s	3 ms/s	
	(1 to 5) s	4 ms/s	
	(5 to 10) s	3 ms/s	

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Dip Simulators ³ – (cont)			
Dip & Up Period	(220 V, 60 Hz) (1 to 2.0) ms (2.0 to 4.2) ms (4.2 to 6.3) ms (6.3 to 8.3) ms (8.3 to 10) ms (10 to 13) ms (13 to 15) ms (15 to 17) ms	14 ms/s 7.2 ms/s 4.8 ms/s 3.6 ms/s 2.9 ms/s 2.4 ms/s 2.1 ms/s 1.8 ms/s	Tektronix DPO 7354 HP 34401A Pintek DP-15K Pintek DP-30K IEC 61000-4-11
Phase Shifting	(230 V, 50 Hz) (1 to 2.5) ms (2.5 to 5) ms (5 to 7.5) ms (7.5 to 10) ms (10 to 13) ms (13 to 15) ms (15 to 18) ms (18 to 20) ms	12 ms/s 6.0 ms/s 4.0 ms/s 3.0 ms/s 2.4 ms/s 2.0 ms/s 1.7 ms/s 1.5 ms/s	
Rise & Fall Time	(0.1 to 1.0) µs (1.0 to 5.0) µs (5.0 to 10) µs	10 ms/s 4.0 ms/s 2.0 ms/s	
Normalized Site Attenuation (NSA) Measurement ⁹	(30 to 200) MHz 200 MHz to 1 GHz	0.99 dB 0.95 dB	Keysight E5080B Keysight N5173B, standard antenna pair CISPR 16-1-4 ANSI C63.4
Site Voltage Standing Wave Ratio ⁹	(1 to 6) GHz (6 to 18) GHz	1.4 dB 1.5 dB	Keysight E5063A Keysight N5173B CISPR 16-1-4 ANSI C63.4
Shield Effectiveness ⁹	9 kHz to 30 MHz 30 MHz to 200 MHz 200 MHz to 1 GHz 1 GHz to 18 GHz	1.4 dB 1.1 dB 1.1 dB 1.0 dB	Keysight E5063A Keysight N5173B IEEE 299-2006 IEEE 299.1-2013 MIL-STD-285 EN 50147-1

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Field Uniformity - Measure ⁹	80 MHz to 6 GHz	1.1 dB	FL7006, Keysight N 5173B, IEC 61000-4-3

VII. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2,7,8} (±)	Comments
RF Absolute Power – Measure ³			
0 dBm	1 mW at 50 MHz	0.023 dB	R&S NRP40T
(-60 to 20) dBm	9 kHz to 6 GHz	0.12 dB	Agilent N1914A Agilent E9304A
(-70 to 20) dBm	10 MHz to 1 GHz	0.13 dB	Keysight E4412A
	(1 to 14) GHz	0.14 dB	
	(14 to 18) GHz	0.16 dB	
	50 MHz to 1 GHz	0.09 dB	Keysight E4413A
	(1 to 8) GHz	0.17 dB	
	(8 to 18) GHz	0.23 dB	
	(18 to 30) GHz	0.20 dB	
(-30 to 20) dBm	50 MHz to 1 GHz	0.10 dB	Keysight N8487A R&S NRP40T
	(1 to 13) GHz	0.13 dB	
	(13 to 17) GHz	0.13 dB	
	(17 to 25) GHz	0.29 dB	
	(25 to 32) GHz	0.29 dB	
	(32 to 39) GHz	0.34 dB	
	(39 to 45) GHz	0.35 dB	
	(45 to 50) GHz	0.35 dB	

Parameter/Range	Frequency	CMC ^{2, 7, 8} (±)	Comments
RF Relative Power – Measure ³			
(-60 to 20) dB	9 kHz to 6 GHz	0.06 dB	Agilent N1914A Agilent E9304A
(-70 to 20) dB	10 MHz to 18 GHz	0.06 dB	Agilent N1911A Agilent E9304A
	50 MHz to 26.5 GHz	0.06 dB	Keysight E4412A Keysight E4413A
(-30 to 20) dB	50 MHz to 50 GHz	0.06 dB	Keysight N8487A

Parameter/Range	Frequency	CMC ^{2, 7, 8} (±)	Comments
Tuned RF Level Absolute– Measure ³			
(20 to 30) dBm	50 MHz to 18 GHz	0.17 dB	Agilent N5531S Agilent N5532A
(10 to 20) dBm		0.17 dB	
(0 to 10) dBm		0.17 dB	
-(0 to 10) dBm		0.17 dB	
-(10 to 20) dBm		0.17 dB	
-(20 to 30) dBm		0.17 dB	
-(30 to 40) dBm		0.18 dB	
-(40 to 50) dBm		0.18 dB	
-(50 to 60) dBm		0.18 dB	
-(60 to 70) dBm		0.18 dB	
-(70 to 80) dBm		0.18 dB	
-(80 to 90) dBm		0.18 dB	
-(90 to 100) dBm		0.18 dB	
-(100 to 110) dBm		0.19 dB	
-(110 to 120) dBm		0.19 dB	

Parameter/Range	Frequency	CMC ^{2, 7, 8} (±)	Comments
Tuned RF Level Relative– Measure ³ -(0 to 10) dB -(10 to 20) dB -(20 to 30) dB -(30 to 40) dB -(40 to 50) dB -(50 to 60) dB -(60 to 70) dB -(70 to 80) dB -(80 to 90) dB -(90 to 100) dB -(100 to 110) dB -(110 to 120) dB -(120 to 130) dB	50 MHz to 26.5 GHz	0.026 dB 0.034 dB 0.036 dB 0.040 dB 0.047 dB 0.050 dB 0.058 dB 0.062 dB 0.069 dB 0.072 dB 0.078 dB 0.084 dB 0.084 dB	Agilent N5531S Agilent N5532A
RF Power Sensor – Calibration Factor ³	9 kHz to 10 MHz (10 to 100) MHz 100 MHz to 8 GHz (8 to 12) GHz (12 to 26.5) GHz (26.5 to 40) GHz (40 to 50) GHz	2.4 % 1.6 % 1.8 % 1.9 % 2.4 % 4.5 % 5.0 %	Agilent N1914A Keysight E9304A Keysight E4412A Keysight E4413A Keysight N8487A

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
Harmonics & Non-Harmonic Spurious – Measure ³ < 30 dBc	9 kHz to 3 GHz (3 to 13) GHz (13 to 20) GHz (20 to 40) GHz	0.36 dB 0.58 dB 0.81 dB 1.2 dB	Keysight E4448A
Amplitude Modulation – Measure ³ Rate: 50 Hz to 10 kHz Depth: (5 to 99) % Rate: 50 Hz to 100 kHz Depth: (5 to 20) % (20 to 99) % Rate: 50 Hz to 100 kHz Depth: (5 to 20) % (20 to 99) %	9 kHz to 10 MHz 10 MHz to 3 GHz (3 to 30) GHz	0.88 % 2.9 % 0.58 % 5.2 % 1.7 %	Agilent N5531S Agilent N5532A
Frequency Modulation – Measure ³ Rate: 20 Hz to 10 kHz Deviation: 200 Hz to 40 kHz Rate: 50 Hz to 200 kHz Deviation: 250 Hz to 400 kHz	9 kHz to 10 MHz $\beta > 0.2$ $\beta > 1.2$ 10 MHz to 6.6 GHz $\beta > 0.2$ $\beta > 0.45$ (6.6 to 13) GHz $\beta > 0.2$ $\beta > 8$ (13 to 30) GHz $\beta > 0.2$ $\beta > 32$	1.7 % Deviation 1.2 % Deviation 1.8 % Deviation 1.2 % Deviation 2.9 % Deviation 1.2 % Deviation 4.4 % Deviation 1.2 % Deviation	Agilent N5531S Agilent N5532A β is the ratio of frequency deviation to modulation rate (deviation/rate)

Parameter/Range	Frequency	CMC ^{2, 4, 7} (\pm)	Comments
Phase Modulation – Measure ³ > 0.7 rad > 0.3 rad > 2 rad > 0.6 rad > 4 rad > 1.2 rad	9 kHz to 6.6 GHz (6.6 to 13) GHz (13 to 30) GHz	1.2 % 3.5 % 1.2 % 3.5 % 1.2 % 3.5 %	Agilent N5531S Agilent N5532A
Resolution Bandwidth ³ – 3 dB Bandwidth 6 dB Bandwidth Switching Error	10 Hz to 100 MHz 10 Hz to 100 MHz 10 Hz to 100 MHz	3.1 x 10 ⁻³ RBW 5.0 x 10 ⁻⁴ RBW 0.042 dB	Keysight N5173B
Overall Selectivity ³ – Measuring Equipment	9 kHz to 40 GHz	0.08 dB	Keysight N5173B HP 83650B CISPR 16-1-1, ANSI C63.5

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments	
Reflection S11/S22 – Measure ³				
(0 to 0.1) lin (0 to 180) °	10 Hz to 2 GHz	0.010 (lin) 5.2°	Keysight E5061B Keysight E5063A Keysight E5080B Keysight 85032F Keysight 85054D Keysight 85052D Keysight 85056D Phase uncertainty is 180 ° when $\frac{\Delta mag}{mag} \geq 1$.	
(0.1 to 0.2) lin (0 to 180) °		0.019 (lin) 4.0°		
(0.2 to 0.3) lin (0 to 180) °		0.019 (lin) 3.4°		
(0.3 to 0.4) lin (0 to 180) °		0.019 (lin) 1.6°		
(0.4 to 0.5) lin (0 to 180) °		0.019 (lin) 1.4°		
(0.5 to 0.6) lin (0 to 180) °		0.020 (lin) 1.4°		
(0.6 to 0.7) lin (0 to 180) °		0.021 (lin) 1.4°		
(0.7 to 0.8) lin (0 to 180) °		0.022 (lin) 1.4°		
(0.8 to 0.9) lin (0 to 180) °		0.025 (lin) 1.4°		
(0.9 to 1) lin (0 to 180) °		0.026 (lin) 1.4°		
(0 to 0.1) lin (0 to 180) °		(2 to 20) GHz		0.011 (lin) 5.3°
(0.1 to 0.2) lin (0 to 180) °				0.019 (lin) 4.0°
(0.2 to 0.3) lin (0 to 180) °				0.018 (lin) 4.1°
(0.3 to 0.4) lin (0 to 180) °				0.021 (lin) 1.6°
(0.4 to 0.5) lin (0 to 180) °				0.02 (lin) 1.6°
(0.5 to 0.6) lin (0 to 180) °				0.023 (lin) 1.6°
(0.6 to 0.7) lin (0 to 180) °				0.025 (lin) 1.6°
(0.7 to 0.8) lin (0 to 180) °	0.027 (lin) 1.6°			
(0.8 to 0.9) lin (0 to 180) °	0.029 (lin) 1.6°			
(0.9 to 1) lin (0 to 180) °	0.029 (lin) 1.6°			

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments	
Reflection S11/S22 – Measure ³ (cont.)				
(0 to 0.1) lin (0 to 180) °	(20 to 40) GHz	0.018 (lin) 9.3°	Keysight E5061B Keysight E5063A Keysight E5080B Keysight 85032F Keysight 85054D Keysight 85052D Keysight 85056D Phase uncertainty is 180 ° when $\frac{\Delta mag}{mag} \geq 1$.	
(0.1 to 0.2) lin (0 to 180) °		0.023 (lin) 5.0°		
(0.2 to 0.3) lin (0 to 180) °		0.024 (lin) 5.0°		
(0.3 to 0.4) lin (0 to 180) °		0.027 (lin) 4.1°		
(0.4 to 0.5) lin (0 to 180) °		0.029 (lin) 3.9°		
(0.5 to 0.6) lin (0 to 180) °		0.032 (lin) 3.8°		
(0.6 to 0.7) lin (0 to 180) °		0.036 (lin) 3.8°		
(0.7 to 0.8) lin (0 to 180) °		0.040 (lin) 3.8°		
(0.8 to 0.9) lin (0 to 180) °		0.045 (lin) 3.8°		
(0.9 to 1) lin (0 to 180) °		0.049 (lin) 3.8°		
(0 to 0.1) lin (0 to 180) °		(40 to 50) GHz		0.026 (lin) 13°
(0.1 to 0.2) lin (0 to 180) °				0.059 (lin) 10°
(0.2 to 0.3) lin (0 to 180) °				0.059 (lin) 4.7°
(0.3 to 0.4) lin (0 to 180) °				0.060 (lin) 4.7°
(0.4 to 0.5) lin (0 to 180) °				0.062 (lin) 4.1°
(0.5 to 0.6) lin (0 to 180) °				0.066 (lin) 4.1°
(0.6 to 0.7) lin (0 to 180) °				0.071 (lin) 4.1°
(0.7 to 0.8) lin (0 to 180) °	0.079 (lin) 4.1°			
(0.8 to 0.9) lin (0 to 180) °	0.089 (lin) 4.1°			
(0.9 to 1) lin (0 to 180) °	0.10 (lin) 4.1°			

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments		
Transmission S12/S21 – Measure ³					
(0 to 10) dB (0 to 180) °	10 Hz to 2 GHz	0.12 dB 0.50°	Keysight E5061B Keysight E5063A Keysight E5080B Keysight 85032F Keysight 85054D Keysight 85052D Keysight 85056D		
(10 to 20) dB (0 to 180) °		0.12 dB 0.61°			
(20 to 30) dB (0 to 180) °		0.12 dB 0.71°			
(30 to 40) dB (0 to 180) °		0.21 dB 2.2°			
(40 to 50) dB (0 to 180) °		0.59 dB 3.5°			
(50 to 60) dB (0 to 180) °		1.8 dB 12°			
(0 to 10) dB (0 to 180) °		(2 to 20) GHz		0.14 dB 1.2°	
(10 to 20) dB (0 to 180) °				0.15 dB 2.2°	
(20 to 30) dB (0 to 180) °				0.16 dB 2.0°	
(30 to 40) dB (0 to 180) °				0.22 dB 4.0°	
(40 to 50) dB (0 to 180) °	0.23 dB 4.1°				
(50 to 60) dB (0 to 180) °	0.61 dB 4.3°				
(0 to 10) dB (0 to 180) °	0.21 dB 1.2°				
(10 to 20) dB (0 to 180) °	0.29 dB 2.0°				
(20 to 30) dB (0 to 180) °	0.28 dB 2.9°				
(30 to 40) dB (0 to 180) °	0.36 dB 8.3°				
(40 to 50) dB (0 to 180) °	0.47 dB 8.9°				
(50 to 60) dB (0 to 180) °	0.70 dB 10°				

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
Transmission S12/S21 – Measure (cont)	(2 to 20) GHz	0.33 dB	Keysight E5061B Keysight E5063A Keysight E5080B Keysight 85032F Keysight 85054D Keysight 85052D Keysight 85056D
(0 to 10) dB		2.1°	
(0 to 180) °		0.33 dB	
(10 to 20) dB		5.3°	
(0 to 180) °		0.76 dB	
(20 to 30) dB		5.3°	
(0 to 180) °		0.98 dB	
(30 to 40) dB		14°	
(0 to 180) °		1.3 dB	
(40 to 50) dB		15°	
(0 to 180) °		2.5 dB	
(50 to 60) dB	18°		
(0 to 180) °			

VIII. Mechanical

Parameter/Equipment	Range	CMC ^{2,4,5} (±)	Comments
Pressure & Vacuum ³	(-12 to < 0) psi	0.033 %	Pressure calibrators
	Up to 1 psi	0.065 %	
	Up to 30 psi	0.059 %	
	Up to 300 psi	0.023 %	
Torque – Measure	(0.1 to 1) N·m	0.99 %	Torque tool tester
	(1 to 2.5) N·m	0.57 %	
	(2.5 to 5) N·m	0.41 %	
	(5 to 10) N·m	0.46 %	
	(10 to 25) N·m	0.32 %	
	(25 to 50) N·m	0.31 %	
	(50 to 100) N·m	0.47 %	
	(100 to 250) N·m	0.26 %	
	(250 to 500) N·m	0.34 %	
	(500 to 1000) N·m	0.40 %	
	(1000 to 1500) N·m	0.31 %	
(1500 to 2500) N·m	0.27 %		

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
Scales and Balances ³	(0.001 to 20) g (20 to 200) g (200 to 400) g (400 to 600) g (600 to 1200) g (1.2 to 3) kg (3 to 5) kg (5 to 15) kg (15 to 30) kg (30 to 91) kg (91 to 140) kg (140 to 230) kg	0.033 mg 0.16 mg 0.25 mg 0.35 mg 6.1 mg 12 mg 18 mg 0.3 g 0.3 g 31 g 47 g 78 g	Standard weights

IX. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
Temperature – Measure & Measuring Equipment ³	-35 °C 0 °C (> 0 to 100) °C (100 to 250) °C (250 to 450) °C	0.45 °C 0.45 °C 0.46 °C 0.48 °C 0.65 °C	Fluke 1529 Fluke 5626 Sika TP17166S, TP17450S, TP17ZERO
Ovens & Chambers ³	(-40 to 250) °C	0.8 °C	Yokogawa GP10, thermocouple
Humidity – Measure & Measuring Equipment ³	(5 to 95) % RH	1.7 % RH	Environmental chamber Michell Optidew Vision, precision dewpoint meter

X. Time and Frequency

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
Frequency – Generate ³			
Frequency Accuracy	1 Hz to 50 GHz	1.3×10^{-10}	Keysight 33250A Agilent E4440A
Aging Rate	10 MHz	1.3×10^{-10} 24 h	GPS system with SRS FS740
Frequency – Measure ³	1 Hz to 26.5 GHz	6.8×10^{-10}	GPS system with SRS FS740, Agilent E4440A
Timer / Stopwatch ³	(1 to 3600) s	0.031 s	HS-3 (stopwatch)

SATELLITE

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I. Antenna Calibrations

Parameter/Equipment	Range	CMC ² (±)	Comments
Dipole Antennas – Antenna Factor	20 MHz to 18 GHz	0.8 dB	Keysight E5063A Keysight E5080B SAE/ARP 958D ANSI C63.5 CISPR 16-1-6
Biconical Antennas – Antenna Factor	20 MHz to 300 MHz (0.3 to 18) GHz	0.7 dB 0.89 dB	Keysight E5063A Keysight E5080B SAE/ARP 958D ANSI C63.5 CISPR 16-1-6
Log Periodic Antennas – Antenna Factor	20 MHz to 1 GHz 1 GHz to 6 GHz	0.82 dB	Keysight E5063A Keysight E5080B SAE/ARP 958D ANSI C63.5 CISPR 16-1-6
Hybrid Antennas – Antenna Factor	20 MHz to 1 GHz 1 GHz to 6 GHz	0.82 dB 0.82 dB	Keysight E5063A Keysight E5080B SAE/ARP 958D ANSI C63.5 CISPR 16-1-6 CISPR 16-1-4

Parameter/Equipment	Range	CMC ² (±)	Comments
Horn Antenna – Antenna Factor	(0.7 to 1) GHz (1 to 18) GHz (18 to 40) GHz	0.7 dB 0.89 dB 1.4 dB	Keysight E5063A Keysight N5173B SAE/ARP 958D ANSI C63.5 CISPR 16-1-6 CISPR 16-1-4
Dipole/Biconical/Hybrid/ Log Periodic/Horn Antenna			
Symmetry	20 MHz to 1 GHz (1 to 18) GHz (18 to 40) GHz	0.33 dB 0.38 dB 0.33 dB	ANSI C63.5 4.4 CISPR 16-1-6
Balance	20 MHz to 1 GHz (1 to 18) GHz (18 to 40) GHz	0.33 dB 0.38 dB 0.33 dB	CISPR 16-1-4 CISPR 16-1-6
Cross Polarization	20 MHz to 1 GHz (1 to 18) GHz (18 to 40) GHz	0.33 dB 0.38 dB 0.33 dB	ANSI C63.4, CISPR 16-1-4 CISPR 16-1-6
VSWR	20 MHz to 2 GHz (2 to 20) GHz (20 to 40) GHz	0.49 dB 0.54 dB 0.61 dB	ANSI C63.4 CISPR 16-1-4 CISPR 16-1-6

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. CMC's 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 CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

⁴ In the statement of CMC, % is the percent of reading.

⁵ 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.

⁶ This scope meets A2LA's *P112 Flexible Scope Policy*.

⁷ 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.

⁸ Mismatch uncertainty is not included in the expression of CMC for all microwave power measurement including Calibration Factor.

⁹ This Calibration is performed as a field service only.



Accredited Laboratory

A2LA has accredited

HYUNDAI C-TECH, INC. DBA HCT AMERICA, INC.

Morgan Hill, CA

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 the requirements of ANSI/NCSL Z540-1-1994 and R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).



Presented this 31st day of July 2023.

A blue ink signature of Mr. Trace McInturff.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 4201.02
Valid to July 31, 2025

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