



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

HYUNDAI C-TECH, INC.
dba HCT AMERICA, INC.
1726 Ringwood Avenue
San Jose, CA 95131
Mr. Timothy Choi Phone: 510 933 8848

CALIBRATION

Valid To: July 31, 2023

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. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
DC Voltage – Generate ³	0 mV (0 to 10) mV (10 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 V to 1 kV	0.79 μV 0.94 μV 16 μV/V 8.0 μV/V 5.6 μV/V 8.6 μV/V 10 μV/V	Fluke 5522A Datron 4808
High Voltage ³	(1 to 10) kV (10 to 30) kV	0.10 % 0.22 %	Matsusada AU-30P/N1-L
Loop Antennas Antenna Factor	9 kHz to 30 MHz	1.1 dB	HCTA procedure HCT-TI-304 Standard Antenna Method ANSI C63.5, SAE ARP958, CISPR 16-1-6; Standard Loop Antenna, HP 34401A

Rod Antenna Antenna Factor	9 kHz to 30 MHz	1.3 dB	HCTA procedure HCT-TI-305 Network Analyzer Method ANSI C63.5, SAE ARP958, CISPR 16-1-6, Keysight E5061B, Keysight 85032F
DC Current – Generate ³	100 μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 2) A (2 to 10) A (10 to 20) A (1 to 1000) A	14 nA 67 μ A/A 67 μ A/A 67 μ A/A 0.014 % 0.018 % 0.030 % 0.081 % 0.081 %	Datron 4808 Fluke 5522A Fluke 5522A w/ 50 turn coil
Parameter/Equipment	Range	CMC ^{2, 4, 7} (\pm)	Comments

Resistance – Generate	1 mΩ (1 to 10) mΩ (10 to 100) mΩ (0.1 to 1) Ω (1 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ	0.20 mΩ 0.20 mΩ 0.20 mΩ 33 μΩ/Ω 25 μΩ/Ω 25 μΩ/Ω 25 μΩ/Ω 25 μΩ/Ω 29 μΩ/Ω 29 μΩ/Ω 29 μΩ/Ω	IET HARS-X-10-0.001-K-H
	(10 to 100) MΩ 100 MΩ to 1 GΩ (1 to 10) GΩ (10 to 100) GΩ	0.0066 % 0.024 % 0.18 % 0.60 %	IET HRRS-B-4-10M-5kV
Fixed Points	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	0.059 % 0.032 % 69 μΩ/Ω 40 μΩ/Ω 24 μΩ/Ω 23 μΩ/Ω 24 μΩ/Ω 25 μΩ/Ω 23 μΩ/Ω 26 μΩ/Ω 24 μΩ/Ω 27 μΩ/Ω 66 μΩ/Ω 57 μΩ/Ω 0.010 % 0.021 % 0.041 %	Fluke 5522A
DC Voltage – Measure ³	(10 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 V to 1 kV	21 μV/V 13 μV/V 12 μV/V 15 μV/V 16 μV/V	Agilent 3458A
High Voltage	(1 to 10) kV (10 to 15) kV (15 to 30) kV	0.64 % 1.2 % 1.2 %	Kikusui 149-10A ESD/EMC ES105-100

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
---------------------	-------	----------------------------	----------



DC Current – Measure ³	(10 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 10) A (10 to 100) A	0.014 % 60 μ A/A 55 μ A/A 77 μ A/A 0.019 % 0.012 % 0.012 %	Agilent 3458A Ohmlabs CS-10 & CS-100
DC Resistance – Measure ³	10 Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) M Ω	0.34 m Ω 24 $\mu\Omega/\Omega$ 16 $\mu\Omega/\Omega$ 16 $\mu\Omega/\Omega$ 17 $\mu\Omega/\Omega$ 25 $\mu\Omega/\Omega$ 84 $\mu\Omega/\Omega$ 0.062 %	Agilent 3458A

Parameter/Range	Frequency	CMC ^{2, 4, 7} (\pm)	Comments
AC Voltage – Generate ³ 100 mV	10 Hz (10 to 40) Hz (40 to 100) Hz (100 to 500) Hz 500 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 200) kHz (200 to 500) kHz 500 kHz to 1 MHz	0.034 % 0.019 % 0.019 % 0.018 % 0.018 % 0.019 % 0.019 % 0.046 % 0.14 % 0.14 % 0.37 % 0.40 %	Datron 4808

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
AC Voltage – Generate ³ (cont)			
Up to 1 V	10 Hz	0.027 %	Datron 4808
	(10 to 40) Hz	0.0090 %	
	(40 to 100) Hz	0.0087 %	
	(100 to 500) Hz	0.0066 %	
	500 Hz to 1 kHz	0.0066 %	
	(1 to 10) kHz	0.0066 %	
	(10 to 20) kHz	0.0066 %	
	(20 to 50) kHz	0.013 %	
	(50 to 100) kHz	0.015 %	
	(100 to 200) kHz	0.063 %	
(1 to 10) V	(200 to 500) kHz	0.33 %	
	500 kHz to 1 MHz	0.36 %	
	10 Hz	0.027 %	
	(10 to 40) Hz	0.0092 %	
	(40 to 100) Hz	0.0089 %	
	(100 to 500) Hz	0.0069 %	
	500 Hz to 1 kHz	0.0069 %	
	(1 to 10) kHz	0.0069 %	
	(10 to 20) kHz	0.0069 %	
	(20 to 50) kHz	0.014 %	
(10 to 100) V	(50 to 100) kHz	0.017 %	
	(100 to 200) kHz	0.047 %	
	(200 to 500) kHz	0.24 %	
	500 kHz to 1 MHz	0.29 %	
	10 Hz	0.028 %	
	(10 to 40) Hz	0.010 %	
	(40 to 100) Hz	0.010 %	
	(100 to 500) Hz	0.0083 %	
100 V to 1 kV	500 Hz to 1 kHz	0.0083 %	
	(1 to 10) kHz	0.0083 %	
	(10 to 20) kHz	0.0094 %	
	(20 to 50) kHz	0.024 %	
	(50 to 100) kHz	0.061 %	
100 V to 1 kV	50 Hz	0.020 %	
	(50 to 100) Hz	0.020 %	
	(100 to 500) Hz	0.015 %	
	500 Hz to 1 kHz	0.015 %	

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
AC Current – Generate ³			
100 µA	40 Hz (40 to 55) Hz (55 to 100) Hz (100 to 200) Hz (200 to 500) Hz 500 Hz to 1 kHz (1 to 2) kHz (2 to 5) kHz (5 to 10) kHz	0.22 µA 0.20 µA 0.20 µA 0.20 µA 0.20 µA 0.20 µA 0.36 µA 0.36 µA 0.78 µA	Fluke 5522A
(100 to 300) µA	40 Hz (40 to 55) Hz (55 to 100) Hz (100 to 200) Hz (200 to 500) Hz 500 Hz to 1 kHz (1 to 2) kHz (2 to 5) kHz (5 to 10) kHz	0.15 % 0.13 % 0.13 % 0.13 % 0.13 % 0.13 % 0.27 % 0.27 % 0.67 %	
300 µA to 1 mA	10 Hz (10 to 40) Hz (40 to 55) Hz (55 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.038 % 0.024 % 0.024 % 0.024 % 0.024 % 0.035 % 0.41 %	Datron 4808
(1 to 3) mA	40 Hz (40 to 55) Hz (55 to 100) Hz (100 to 200) Hz (200 to 500) Hz 500 Hz to 1 kHz (1 to 2) kHz (2 to 5) kHz (5 to 10) kHz	0.11 % 0.084 % 0.084 % 0.084 % 0.084 % 0.084 % 0.16 % 0.16 % 0.40 %	Fluke 5522A

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
AC Current – Generate ³ (cont)			
(3 to 10) mA	10 Hz	0.038 %	Datron 4808
	(10 to 40) Hz	0.024 %	
	(40 to 55) Hz	0.024 %	
	(55 to 500) Hz	0.024 %	
	500 Hz to 1 kHz	0.024 %	
	(1 to 5) kHz	0.035 %	
	(5 to 10) kHz	0.18 %	
(10 to 30) mA	40 Hz	0.085 %	Fluke 5522A
	(40 to 55) Hz	0.042 %	
	(55 to 100) Hz	0.042 %	
	(100 to 200) Hz	0.042 %	
	(200 to 500) Hz	0.042 %	
	500 Hz to 1 kHz	0.042 %	
	(1 to 2) kHz	0.070 %	
	(2 to 5) kHz	0.070 %	
	(5 to 10) kHz	0.16 %	
(30 to 100) mA	10 Hz	0.038 %	Datron 4808
	(10 to 40) Hz	0.024 %	
	(40 to 55) Hz	0.024 %	
	(55 to 500) Hz	0.024 %	
	500 Hz to 1 kHz	0.024 %	
	(1 to 5) kHz	0.035 %	
	(5 to 10) kHz	0.23 %	
(100 to 300) mA	40 Hz	0.085 %	Fluke 55220A
	(40 to 55) Hz	0.042 %	
	(55 to 100) Hz	0.042 %	
	(100 to 200) Hz	0.042 %	
	(200 to 500) Hz	0.042 %	
	500 Hz to 1 kHz	0.042 %	
	(1 to 2) kHz	0.093 %	
	(2 to 5) kHz	0.093 %	
	(5 to 10) kHz	0.18 %	
300 mA to 1 A	10 Hz	0.053 %	Datron 4808
	(10 to 40) Hz	0.053 %	
	(40 to 55) Hz	0.053 %	
	(55 to 500) Hz	0.046 %	
	500 Hz to 1 kHz	0.046 %	
	(1 to 5) kHz	0.073 %	

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
AC Current – Generate ³ (cont)			
(1 to 3) A	55 Hz (55 to 100) Hz (100 to 200) Hz (200 to 500) Hz 500 Hz to 1 kHz (1 to 2) kHz (2 to 5) kHz	0.14 % 0.053 % 0.053 % 0.053 % 0.053 % 0.49 % 0.49 %	Fluke 5522A
(3 to 10) A	40 Hz (40 to 55) Hz (55 to 100) Hz (100 to 200) Hz (200 to 500) Hz 500 Hz to 1 kHz (1 to 2) kHz (2 to 5) kHz	0.13 % 0.13 % 0.13 % 0.16 % 0.16 % 0.16 % 2.4 % 2.4 %	Datron 4808
(10 to 20) A	40 Hz (40 to 55) Hz (55 to 100) Hz (100 to 200) Hz (200 to 500) Hz 500 Hz to 1 kHz	0.11 % 0.11 % 0.11 % 0.14 % 0.14 % 0.14 %	Fluke 5522A
(1 to 1000) A	50 & 60 Hz 400 Hz	0.11 % 0.14 %	Fluke 5522A w/ Fluke 5500 - 50 turn coil
AC Voltage – Measure ³			
100 mV	(10 to 50) Hz (50 to 60) Hz (60 to 100) Hz 100 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.019 % 0.019 % 0.019 % 0.019 % 0.024 % 0.024 % 0.044 % 0.011 %	Agilent 3458A

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
AC Voltage – Measure ³ (cont)			
100 mV to 1 V	(10 to 50) Hz	0.012 %	Agilent 3458A
	(50 to 60) Hz	0.012 %	
	(60 to 100) Hz	0.012 %	
	100 Hz to 1 kHz	0.012 %	
	(1 to 10) kHz	0.019 %	
	(10 to 20) kHz	0.019 %	
	(20 to 50) kHz	0.038 %	
	(50 to 100) kHz	0.096 %	
(1 to 10) V	(10 to 50) Hz	0.011 %	Agilent 3458A
	(50 to 60) Hz	0.012 %	
	(60 to 100) Hz	0.012 %	
	100 Hz to 1 kHz	0.011 %	
	(1 to 10) kHz	0.019 %	
	(10 to 20) kHz	0.019 %	
	(20 to 50) kHz	0.038 %	
	(50 to 100) kHz	0.096 %	
(10 to 100) V	(10 to 50) Hz	0.026 %	Agilent 3458A
	(50 to 60) Hz	0.026 %	
	(60 to 100) Hz	0.026 %	
	100 Hz to 1 kHz	0.026 %	
	(1 to 10) kHz	0.026 %	
	(10 to 20) kHz	0.026 %	
	(20 to 50) kHz	0.044 %	
	(50 to 100) kHz	0.14 %	
(100 to 700) V	(10 to 50) Hz	0.062 %	Agilent 3458A
	(50 to 60) Hz	0.050 %	
	(60 to 100) Hz	0.050 %	
	100 Hz to 1 kHz	0.050 %	
	(1 to 10) kHz	0.075 %	
(0.7 to 10) kV	60 Hz	1.2 %	Kikusui 149-10A

Parameter/Range	Frequency	CMC ^{2,4,7} (±)	Comments
AC Current – Measure ³			
(10 to 100) μA	(10 to 50) Hz (50 to 60) Hz (60 to 100) Hz 100 Hz to 1 kHz (1 to 10) kHz	0.11 % 0.11 % 0.11 % 0.11 % 0.24 %	Agilent 3458A
100 μA to 1 mA	(10 to 50) Hz (50 to 60) Hz (60 to 100) Hz 100 Hz to 1 kHz (1 to 10) kHz	0.094 % 0.094 % 0.094 % 0.060 % 0.19 %	
(1 to 10) mA	(10 to 50) Hz (50 to 60) Hz (60 to 100) Hz 100 Hz to 1 kHz (1 to 10) kHz	0.094 % 0.094 % 0.094 % 0.061 % 0.21 %	
(10 to 100) mA	(10 to 50) Hz (50 to 60) Hz (60 to 100) Hz 100 Hz to 1 kHz (1 to 10) kHz	0.094 % 0.094 % 0.094 % 0.060 % 0.082 %	
100 mA to 1 A	(10 to 50) Hz (50 to 60) Hz (60 to 100) Hz 100 Hz to 1 kHz (1 to 10) kHz	0.12 % 0.12 % 0.12 % 0.14 % 0.84 %	
(1 to 10) A	(10 to 40) Hz (40 to 100) Hz 100 Hz to 1 kHz	0.047 % 0.048 % 0.11 %	Ohmlabs CS-10 & CS-100
(10 to 100) A	(10 to 40) Hz (40 to 100) Hz 100 Hz to 1 kHz	0.13 % 0.12 % 0.21 %	

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
AC Resistance – Measure ³ 10 Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ	1 kHz	0.10 % 0.10 % 0.10 % 0.10 % 0.10 %	Fluke PM 6304
Capacitance – Measure ³ 10 nF (10 to 100) nF 100 nF to 1 μF (1 to 10) μF	1 kHz	0.13 % 0.13 % 0.13 % 0.40 %	Fluke PM6304

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
Electrical Simulation of Thermocouples ³ –			
Type E	-250 °C (>-250 to -100) °C (-100 to 650) °C (650 to 1000) °C	0.41 °C 0.17 °C 0.20 °C 0.20 °C	Fluke 5522A
Type J	-210 °C (>-210 to -100) °C (-100 to 760) °C (760 to 1200) °C	0.24 °C 0.17 °C 0.21 °C 0.21 °C	
Type K	-200 °C (>-200 to -100) °C (-100 to 1000) °C (1000 to 1372) °C	0.28 °C 0.18 °C 0.33 °C 0.33 °C	
Type S	0 °C (>0 to 250) °C (250 to 1400) °C (1400 to 1767) °C	0.38 °C 0.30 °C 0.38 °C 0.38 °C	
Type T	-250 °C (>-250 to -150) °C (-150 to 0) °C (0 to 400) °C	0.50 °C 0.22 °C 0.17 °C 0.16 °C	

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
Electrical Stimulation of RTDs ³ PT385, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 630) °C (630 to 800) °C	0.059 °C 0.082 °C 0.11 °C 0.12 °C 0.24 °C	Fluke 5522A
Oscilloscope ³ – DC Voltage 50 Ω Load 1 MΩ Load Square Wave Signal at 1 kHz Leveled Sine Flatness at 50 Ω (1.2 to 3) V (0.06 to 1.2) V	10 mV to 6.5 V 10 mV to 130 V 10 mV to 5 V 10 mV to 130 V 10 MHz (10 to 100) MHz (100 to 300) MHz (300 to 500) MHz (500 to 1000) MHz (1000 to 4000) MHz 10 MHz (10 to 100) MHz (100 to 300) MHz (300 to 500) MHz (500 to 1000) MHz (1000 to 4000) MHz	0.75 % 0.52 % 0.75 % 0.58 % 8.6 % 8.2 % 8.3 % 8.4 % 8.5 % 4.8 % 8.7 % 8.8 % 8.9 % 9.0 % 9.2 % 5.0 %	Fluke 5522A/SC1100 Plus: HP 83732B Generator HP 437B Power Meter HP E4412 Sensor HP 11667A Splitter Fluke 5522A/SC110 Plus: Same equipment as for 3 V range

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
Oscilloscope ³ – (cont)			
Time Mark	10 ns (10 to 500) ns 500 ns to 1 µs (1 to 500) µs 500 µs to 1 ms (1 to 500) ms 500 ms to 1 s (1 to 5) s	31 fs 3.1 µs/s 6.6 µs/s 3.1 µs/s 6.6 µs/s 3.1 µs/s 29 µs/s 29 µs/s	Fluke 5522A/SC1100
Frequency	200 mHz (0.200 to 1) Hz (1 to 500) Hz (0.500 to 1) kHz (1 to 500) kHz (0.500 to 1) MHz	29 µHz/Hz 29 µHz/Hz 3.1 µHz/Hz 6.6 µHz/Hz 3.1 µHz/Hz 6.6 µHz/Hz	Fluke 5522A/SC1100
Flatness –			
50 Ω Load 10 Hz to 20 kHz (20 to 100) kHz	0 dB 0 dB	0.0065 dB 0.013 dB	Agilent 3458A
Power – Generate ³			
Active Power (0.01 to 0.24) W (0.24 to 0.48) W (0.48 to 0.6) W (0.6 to 1.2) W (1.2 to 2.4) W (2.4 to 6.0) W (6 to 12) W (12 to 24) W (24 to 60) W (60 to 120) W (120 to 240) W (240 to 600) W (0.6 to 1.2) kW (1.2 to 2.4) kW (2.4 to 4.8) kW	(50 to 60) Hz	0.10 % 0.10 % 0.10 % 0.069 % 0.069 % 0.10 % 0.069 % 0.069 % 0.091 % 0.076 % 0.076 % 0.084 % 0.084 % 0.084 %	Fluke 5522A

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
Power – Generate³ (cont)			
Apparent Power (0.01 to 0.12) V·A (0.12 to 0.24) V·A (0.24 to 0.6) V·A (0.6 to 1.2) V·A (1.2 to 2.4) V·A (2.4 to 4.8) V·A (4.8 to 6) V·A (6 to 12) V·A (12 to 24) V·A (24 to 60) V·A (60 to 120) V·A (120 to 240) V·A (240 to 480) V·A (480 to 600) V·A (0.6 to 1.2) kV·A (1.2 to 2.4) kV·A (2.4 to 4.8) kV·A (4.8 to 20) kV·A	(50 to 60) Hz	0.10 % 0.094 % 0.066 % 0.066 % 0.050 % 0.052 % 0.065 % 0.066 % 0.050 % 0.059 % 0.050 % 0.061 % 0.061 % 0.081 % 0.065 % 0.11 % 0.11 % 0.12 %	Fluke 5522A
Power Factor ³	± 1 ± 0.5 ± 0.3	0.059 % 0.26 % 0.36 %	
Capacitance – Generate³			
	(40 to 100) pF (0.1 to 1) nF (1 to 10) nF (10 to 100) nF 100 nF to 1 µF	3.8 % 0.68 % 0.40 % 0.38 % 0.30 %	HP 4440B

II. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
RF Absolute Power – Measure			Agilent N1911A Power Meter, RF/Microwave Power Sensors:
(-60 to 20) dBm	9 kHz to 6 GHz	0.12 dB	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	
(-70 to 20) dBm	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 26.5) GHz	0.20 dB	
(-30 to 20) dBm	50 MHz to 1 GHz	0.10 dB	Keysight N8487A,
	(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, 4, 7} (±)	Comments
RF Relative Power – Measure (-60 to 20) dBm (-70 to 20) dBm (-70 to 20) dBm (-30 to 20) dBm	9 kHz to 6 GHz 10 MHz to 18 GHz 50 MHz to 26.5 GHz 50 MHz to 50 GHz	0.06 dB 0.06 dB 0.06 dB 0.06 dB	Agilent N1911A Power Meter, RF/Microwave Power Sensors: Agilent E9304A, Keysight E4412A, Keysight E4413A, Keysight N8487A
Tuned RF Level Absolute – Measure ³ (20 to 30) dBm (10 to 20) dBm (0 to 10) dBm -(0 to 10) dBm -(10 to 20) dBm -(20 to 30) dBm -(30 to 40) dBm -(40 to 50) dBm -(50 to 60) dBm -(60 to 70) dBm -(70 to 80) dBm -(80 to 90) dBm -(90 to 100) dBm -(100 to 110) dBm -(110 to 120) dBm	10 MHz to 18 GHz	0.17 dB 0.17 dB 0.17 dB 0.17 dB 0.17 dB 0.17 dB 0.17 dB 0.18 dB 0.18 dB 0.18 dB 0.18 dB 0.18 dB 0.18 dB 0.18 dB 0.18 dB 0.19 dB 0.19 dB	Agilent N5531S measuring receiver, Agilent N5532A sensor module

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	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	9 kHz 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 measuring receiver, Agilent N5532A Sensor Module
RF Power Sensor – Calibration Factor	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 % CF 1.6 % CF 1.8 % CF 1.9 % CF 2.4 % CF 4.5 % CF 5.0 % CF	Agilent N1911A Power Meter, Keysight/ R&S Power Sensors: Keysight E9304A, Keysight E4412A, Keysight E4413A, R&S NRP40T, Keysight N8487A
Harmonics/Spurious – Measure ³	9 kHz to 3 GHz (3 to 13.2) GHz (13.2 to 20) GHz (20 to 40) GHz	0.36 dB 0.58 dB 0.81 dB 1.2 dB	Keysight N9030A signal analyzer

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
Amplitude Modulation – Measure ³			
9 kHz to 10 MHz	Rate: 50 Hz to 10 kHz Depth: (5 to 99) %	0.88 %	Agilent N5531S measuring receiver, Agilent N5532A sensor module
10 MHz to 3 GHz	Rate: 50 Hz to 100 kHz Depth: (5 to 20) % (20 to 99) %	2.9 % 0.58 %	
(3 to 26.5) GHz	Rate: 50 Hz to 100 kHz Depth: (5 to 20) % (20 to 99) %	5.2 % 1.7 %	
Frequency Modulation - Measure			
Rate: 20 Hz to 10 kHz Deviation: 200 Hz to 40 kHz	9 kHz to 10 MHz > 0.2 β > 1.2 β	1.7 % Deviation 1.2 % Deviation	Agilent N5531S Measuring Receiver, Agilent N5532A Sensor Module β is the ratio of frequency deviation to modulation rate (deviation/rate)
Rate: 50 Hz to 200 kHz Deviation: 250 Hz to 400 kHz	10 MHz to 6.6 GHz > 0.2 β > 0.45 β	1.8 % Deviation 1.2 % Deviation	
	(6.6 to 13.2) GHz > 0.2 β > 8 β	2.9 % Deviation 1.2 % Deviation	
	(13.2 to 26.5) GHz > 0.2 β > 32 β	4.4 % Deviation 1.2 % Deviation	
Phase Modulation – Measure ³			
> 0.7 rad > 0.3 rad	9 kHz to 6.6 GHz	1.2 % 3.5 %	Agilent N5531S measuring receiver, Agilent N5532A sensor module
> 2 rad > 0.6 rad	(6.6 to 13.2) GHz	1.2 % 3.5 %	
> 4 rad > 1.2 rad	(13.2 to 26.5) GHz	1.2 % 3.5 %	

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
Resolution Bandwidth – 3 dB Bandwidth 6 dB Bandwidth Switching Error	1 Hz to 100 MHz 1 Hz to 100 MHz 1 Hz to 100 MHz	3.1 x 10 ⁻³ RBW 5.0 x 10 ⁻⁴ RBW 0.042 dB	Keysight N5173B RF signal generator
Overall Selectivity ³ – Measuring Equipment	9 kHz to 40 GHz	0.08 dB	CISPR 16-1-1, ANSI C63.2 Keysight N5173B RF signal generator, HP 83650B RF signal generator
Reflection S11/S22 – Measure 10 Hz to 2 GHz	(0 to 0.1) lin (0.1 to 0.2) lin (0.2 to 0.3) lin (0.3 to 0.4) lin (0.4 to 0.5) lin (0.5 to 0.6) lin (0.6 to 0.7) lin (0.7 to 0.8) lin (0.8 to 0.9) lin (0.9 to 1) lin	0.0104 (lin) 5.2° 0.0185(lin) 4.0° 0.0192(lin) 3.4° 0.0192 (lin) 1.6° 0.0192(lin) 1.4° 0.0199 (lin) 1.4° 0.0206 (lin) 1.4° 0.022 (lin) 1.4° 0.025 (lin) 1.4° 0.026 (lin) 1.4°	HP 4395A network analyzer, HP 8510C network analyzer, Keysight 85032F calibration kit, Keysight 85054D calibration kit, HP 85052D calibration kit, Keysight 85056K02 calibration kit, HP 85056D calibration kit

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
Reflection S11/S22 – Measure (cont)	(2 to 20) GHz		HP 4395A Network Analyzer, HP 8510C network analyzer, Keysight 85032F calibration kit, Keysight 85054D calibration kit, HP 85052D calibration kit, Keysight 85056K02 calibration kit, HP 85056D calibration kit
	(0 to 0.1) lin	0.0106 (lin) 5.3°	
	(0.1 to 0.2) lin	0.0185 (lin) 4.0°	
	(0.2 to 0.3) lin	0.0177 (lin) 4.1°	
	(0.3 to 0.4) lin	0.0206 (lin) 1.6°	
	(0.4 to 0.5) lin	0.02 (lin) 1.6°	
	(0.5 to 0.6) lin	0.023 (lin) 1.6°	
	(0.6 to 0.7) lin	0.025 (lin) 1.6°	
	(0.7 to 0.8) lin	0.027 (lin) 1.6°	
	(0.8 to 0.9) lin	0.029 (lin) 1.6°	
	(0.9 to 1) lin	0.029 (lin) 1.6°	
	(20 to 40) GHz		
	(0 to 0.1) lin	0.018 (lin) 9.3°	
	(0.1 to 0.2) lin	0.023 (lin) 5.0°	
	(0.2 to 0.3) lin	0.024 (lin) 5.0°	
	(0.3 to 0.4) lin	0.027 (lin) 4.1°	
	(0.4 to 0.5) lin	0.029 (lin) 3.9°	
	(0.5 to 0.6) lin	0.032 (lin) 3.8°	
	(0.6 to 0.7) lin	0.036 (lin) 3.8°	
	(0.7 to 0.8) lin	0.040 (lin) 3.8°	
(0.8 to 0.9) lin	0.045 (lin) 3.8°		
(0.9 to 1) lin	0.049 (lin) 3.8°		

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
Reflection S11/S22 – Measure (cont)			HP 4395A Network Analyzer, HP 8510C network analyzer, Keysight 85032F calibration kit, Keysight 85054D calibration kit, HP 85052D calibration kit, Keysight 85056K02 calibration kit, HP 85056D calibration kit
(40 to 50) GHz	(0 to 0.1) lin	0.026 (lin) 12.7°	
	(0.1 to 0.2) lin	0.059 (lin) 10.2°	
	(0.2 to 0.3) lin	0.059 (lin) 4.7°	
	(0.3 to 0.4) lin	0.060 (lin) 4.7°	
	(0.4 to 0.5) lin	0.062 (lin) 4.1°	
	(0.5 to 0.6) lin	0.066 (lin) 4.1°	
	(0.6 to 0.7) lin	0.071 (lin) 4.1°	
	(0.7 to 0.8) lin	0.079 (lin) 4.1°	
	(0.8 to 0.9) lin	0.089 (lin) 4.1°	
	(0.9 to 1) lin	0.10 (lin) 4.1°	

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments	
Transmission S12/S21 Measure	10 Hz to 2 GHz	(0 to 10) dB	0.12 dB 0.50°	HP 4395A network analyzer, HP 8510C network analyzer, Keysight 85032F calibration kit, Keysight 85054D calibration kit, HP 85052D calibration kit, Keysight 85056K02 calibration kit, HP 85056D calibration kit
		(10 to 20) dB	0.12 dB 0.61°	
		(20 to 30) dB	0.12 dB 0.71°	
		(30 to 40) dB	0.21 dB 2.24°	
		(40 to 50) dB	0.59 dB 3.53°	
		(50 to 60) dB	1.75 dB 11.9°	
		(2 to 20) GHz	(0 to 10) dB	
	(10 to 20) dB		0.15 dB 2.23°	
	(20 to 30) dB		0.16 dB 2.02°	
	(30 to 40) dB		0.22 dB 4.00°	
	(40 to 50) dB		0.23 dB 4.07°	
	(50 to 60) dB		0.61 dB 4.3°	

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
Transmission S12/S21 Measure (cont)			
(20 to 40) GHz	(0 to 10) dB	0.21 dB 1.17°	HP 4395A network analyzer, HP 8510C network analyzer, Keysight 85032F calibration kit, Keysight 85054D calibration kit, HP 85052D calibration kit, Keysight 85056K02 calibration kit, HP 85056D calibration kit
	(10 to 20) dB	0.29 dB 2.00°	
	(20 to 30) dB	0.28 dB 2.9°	
	(30 to 40) dB	0.36 dB 8.3°	
	(40 to 50) dB	0.47 dB 8.9°	
	(50 to 60) dB	0.70 dB 10.4°	
(40 to 50) GHz	(0 to 10) dB	0.33 dB 2.1°	
	(10 to 20) dB	0.33 dB 5.3°	
	(20 to 30) dB	0.76 dB 5.3°	
	(30 to 40) dB	0.98 dB 13.9°	
	(40 to 50) dB	1.28 dB 14.5°	
	(50 to 60) dB	2.48 dB 17.9°	

III. Electrical – RF/EMC Equipment

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
RF power meters ³ – Instrument Accuracy	3 μW to 100 mW	2.9 mW/W	HP 11683A range calibrator
Display Linearity ³ – Measuring Equipment	(0 to 40) dB (40 to 96) dB	0.16 dB 0.19 dB	Keysight N5173B RF signal generator, HP 8494B + 8486B step attenuator
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 frequency standard, Keysight N5173B RF signal generator
Input Attenuator Accuracy ³ – Measuring Equipment	(0 to 30) dB (30 to 70 dB)	0.16 dB 0.17 dB	Keysight N5173B RF signal generator, HP 8494B + 8486B step attenuator
Displayed Average Noise Level ³ – Measuring Equipment	1 Hz to 50 GHz	1.7 dB	Terminations in the calibration kits
Noise impulse simulators ³ – Output Voltage Pulse Width	(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 (0.08 to 1) μs	28 mV/V 27 mV/V 28 mV/V 57 mV/V 51 mV/V 46 mV/V 45 mV/V 12 ms/s	Tektronix DPO 7354 digital oscilloscope, Tektronix P6015A High voltage probe, Tektronix P5100A high voltage probe

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
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	HP 3325B function generator, Keysight N5173B RF signal generator, HP 83650B RF signal generator, Agilent N1911A power meter, Keysight/ R&S power sensors, Agilent E9304A, Keysight E4412A, Keysight E4413A, Keysight N8487A
Pulse response ³ – Measuring Equipment Pulse Response Repetition Frequency Response	9 kHz to 40 GHz 9 kHz to 1 GHz	0.70 dB 0.05 dB	CISPR 16-1-1, ANSI C63.2 Schwarzbeck IGUU 2916 calibration pulse generator, pulse modulated RF generator
Spurious Response ³ – Measuring Equipment	9 kHz to 50 GHz	0.45 dB	Keysight N5173B RF signal generator, HP 83650B RF signal generator

Parameter/Equipment	Range	CMC ^{2,4,7} (±)	Comments
ISN ³ –			CISPR 22, CISPR 32, CISPR 16-1-2
Impedance	9 kHz to 1 GHz	3.2 Ω	HP 8510C, HP 4395A, Keysight 85032F, calibration fixture
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 –			ANSI C63.4, CISPR 25, CISPR 16-1-2, MIL- STD-461F, ISO 7637-2
Impedance	10 Hz to 1 GHz	0.5 Ω	HP 8510C, HP 4395A, Keysight 85032F, calibration fixture
Phase Angle	10 Hz to 1 GHz	1.2°	
Voltage Division Factor	10 Hz to 1 GHz	0.12 dB	
CDN ³ –			IEC/EN 61000-4-6, CISPR 16-1-2
Impedance	10 Hz to 1 GHz	3.7 Ω	HP 8510C, HP 4395A, Keysight 85032F, calibration fixture
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, 4, 7} (±)	Comments
Surge Generators ³ –			IEC 61000-4-5, IEC 61000-4-12, ISO 7637-2, MIL-STD-461F
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 digital oscilloscope, Tektronix P6015A high voltage probe, Tektronix P5100A high voltage Probe, Pearson 110 current monitor, Weinschel 24-40-34-LIM attenuator
Undershoot	(0 to 150) V (150 to 600) V (0.6 to 1.2) kV (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	33 mV/V 30 mV/V 92 mV/V 67 mV/V 58 mV/V 53 mV/V 47 mV/V 46 mV/V 45 mV/V	
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	
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	(0 to 300) A (300 to 900) A	40 mA/A 38 mA/A	

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
Surge generators ³ – (cont)			IEC 61000-4-5, IEC 61000-4-12, ISO 7637-2, MIL-STD-461F
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)	(0 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	
(230 V / 50 Hz)	(0 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	
Surge generators: (ISO 7637-2 only)			
Rise/Fall Time	(1 to 5) ms (5 to 10) ms	6.0 ms/s 3.0 ms/s	
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	

Parameter/Equipment	Range	CMC ^{2, 4, 7} (\pm)	Comments
Surge Generators ³ – (cont)			IEC 61000-4-5, IEC 61000-4-12, ISO 7637-2, MIL-STD-461F
Surge Generators: (Oscillatory Wave Only)			
Rise/Fall Time	(0.1 to 0.5) μ s	20 ms/s	Tektronix DPO 7354 digital oscilloscope, Tektronix P6015A high voltage probe, Tektronix P5100A high voltage probe, Pearson 110 current monitor, Weinschel 24-40-34-LIM attenuator
Pulse Width	(1 to 6.4) μ s (6.4 to 10) μ s (10 to 70) μ s (70 to 500) μ s	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	
Burst pulse generators ³ –			IEC 61000-4-4, MIL-STD-461F, ISO 7637-2
Output Voltage			Tektronix DPO 7354 digital oscilloscope, attenuators: Haefely/PAT 50 & 1000
50 Ω	1 V to 4 kV	36 mV/V	
1 k Ω	1 V to 8 kV	50 mV/V	
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 7.7ms/s 2.9 ms/s 2.3 ms/s 1.5 ms/s	

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
Burst pulse generators ³ – (cont)			IEC 61000-4-4, MIL-STD-461F, ISO 7637-2
Rise/Fall Time			Tektronix DPO 7354 digital oscilloscope, attenuators
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) µs	2.9 ms/s	
Duration	(40 to 50) ms	2.3 ms/s	
Burst period	(200 to 300) ms	1.9 ms/s	
Electrostatic Discharge Simulators ³ –			IEC 61000-4-2, ISO 10605
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

Parameter/Equipment	Range	CMC ^{2,4,7} (±)	Comments
Electrostatic Discharge Simulators ³ – (cont)			
Current (I _p)	(0 to 7.5) A	3.3 %	Tektronix DPO 7354 digital oscilloscope, ESD target, V/A transducer
	(7.5 to 15) A	2.3 %	
	(15 to 22.5) A	3.0 %	
	(22.5 to 30) A	2.5 %	
	(30 to 45.0) A	2.9 %	
	(45.0 to 56.3) A	2.8 %	
	(56.3 to 75) A	2.6 %	
	(75 to 93.8) A	2.5 %	
	(93.8 to 150) A	2.8 %	
T1	(0 to 4) A	2.0 %	
30 ns, 65 ns	(4 to 8) A	1.9 %	
	(8 to 12) A	2.1 %	
	(12 to 16) A	2.0 %	
	(16 to 24) A	2.0 %	
	(24 to 30) A	2.3 %	
	(30 to 40) A	2.3 %	
	(40 to 50) A	2.2 %	
	(50 to 80) A	2.3 %	
T2	(0 to 2) A	2.3 %	
60 ns, 130 ns	(2 to 4) A	2.0 %	
	(4 to 6) A	2.1 %	
	(6 to 8) A	2.1 %	
	(8 to 12) A	2.2 %	
	(12 to 15) A	2.4 %	
	(15 to 20) A	2.4 %	
	(20 to 25) A	2.3 %	
	(25 to 40) A	2.4 %	
T3	(0 to 0.55) A	5.5 %	
180 ns, 400 ns	(0.55 to 1.10) A	3.2 %	
	(1.10 to 1.65) A	5.6 %	
	(1.65 to 2.20) A	3.5 %	
	(2.20 to 3.30) A	4.7 %	
	(3.30 to 4.13) A	3.8 %	
	(4.13 to 5.50) A	3.9 %	
	(5.50 to 6.88) A	2.9 %	
	(6.88 to 10.6) A	4.0 %	
			IEC 61000-4-2, ISO 10605
			Tektronix DPO 7354 digital oscilloscope, ESD target, V/A transducer

Parameter/Equipment	Range	CMC ^{2,4,7} (±)	Comments
Electrostatic Discharge Simulators ³ – (cont)			
T4 360 ns, 800 ns	(0 to 0.30) A (0.30 to 0.60) A (0.60 to 0.90) A (0.90 to 1.20) A (1.20 to 1.80) A (1.80 to 2.25) A (2.25 to 3.00) A (3.00 to 3.75) A (3.75 to 5.90) A	9.6 % 5.1 % 10 % 5.7 % 8.1 % 6.0 % 6.2 % 4.0 % 6.6 %	Tektronix DPO 7354 digital oscilloscope, ESD target, V/A transducer
Rise/Fall Time	(0.5 to 1) ns	1.2 %	
RF Current Probe – Transfer Impedance	5 Hz to 500 MHz 500 MHz to 3 GHz	0.54 dB 1.1 dB	CISPR 16-1-2, IEC/EN 61000-4-6 HP 8510C, HP 4395A, Keysight 85032F, calibration fixture
Dip Simulators –			IEC 61000-4-11
Output Voltage	(0 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 digital oscilloscope, HP 34401A digital multimeter, Pintek DP-15K differential voltage probe, Pintek DP-30K differential voltage probe
Line Frequency	(49 to 51) Hz (59 to 61) Hz	0.12 mHz/Hz 0.13 mHz/Hz	
Dip & Up Voltage (50 Hz ~ 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, (80 to 120) %	0.52 V/V 0.12 V/V 69 mV/V 61 mV/V	

Parameter/Equipment	Range	CMC ^{2,4,7} (±)	Comments
Dip Simulators – (cont)			
Dip & Up Voltage (50 Hz ~ 60 Hz)	(96 to 144) V	59 mV/V	Tektronix DPO 7354 digital oscilloscope, HP 34401A digital multimeter, Pintek DP-15K differential voltage probe, Pintek DP-30K differential voltage probe
	(120 to 220) V		
	0 %		
	(1 to 10) V	0.52 V/V	
	(1 to 40) %		
	(10 to 88) V	66 mV/V	
	(40 to 70) %		
	(88 to 154) V	42 mV/V	
	(70 to 80) %		
	(154 to 176) V	39 mV/V	
	(80 to 120) %		
	(176 to 264) V	50 mV/V	
	(220 to 230) V		
	0 %		
	(1 to 10) V	0.52 V/V	
	(1 to 40) %		
	(10 to 92) V	64 mV/V	
	(40 to 70) %		
	(92 V to ~161) V	41 mV/V	
	(70 to 80) %		
(~161 to ~184) V	38 mV/V		
(80 to 120) %			
(~184 to ~276) V	48 mV/V		
(230 to 380) V	1 V/V		
0 %			
(1 to 10) V	80 mV/V		
(1 to 40) %			
(10 to 152) V	49 mV/V		
(40 to 70) %			
(152 to 266) V	44 mV/V		
(70 to 80) %			
(266 to 304) V	34 mV/V		
(80 to 120) %			
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 ^{2,4,7} (±)	Comments
Dip Simulators – (cont)			IEC 61000-4-11
Phase Shifting (220 V, 60 Hz)	(1 to 2.08) ms (2.08 to 4.17) ms (4.17 to 6.25) ms (6.25 to 8.33) ms (8.33 to 10.42) ms (10.42 to 12.5) ms (12.5 to 14.58) ms (14.58 to 16.67) 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 digital oscilloscope, HP 34401A digital multimeter, Pintek DP-15K differential voltage probe, Pintek DP-30K differential voltage probe
(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 12.5) ms (12.5 to 15) ms (15 to 17.5) ms (17.5 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 10.0) µs	10 ms/s 4.0 ms/s 2.0 ms/s	
Normalized Site Attenuation (NSA) Measurement ³	(30 to 200) MHz 200 MHz to 1 GHz	0.99 dB 0.95 dB	CISPR 16-1-4 ANSI C63.4 Keysight/N9030A, Keysight/N5173B, Standard antenna pair
Site Voltage Standing Wave Ratio ³	(1 to 6) GHz (6 to 18) GHz	1.4 dB 1.5 dB	CISPR 16-1-4 ANSI C63.4 R&S/ESU Keysight/N5173B

Parameter/Equipment	Range	CMC ^{2,4,7} (±)	Comments
Shield Effectiveness ³	9 kHz to 30 MHz (30 to 200) MHz 200 MHz to 1 GHz (1 to 18) GHz	1.4 dB 1.1 dB 1.1 dB 1.0 dB	IEEE 299-2006, IEEE 299.1-2013, MIL-STD-285, EN 50147-1 Keysight/N9030A Keysight/N5173B
Field Uniformity ³	80 MHz to 1 GHz (1 to 6) GHz	1.1 dB 1.1 dB	IEC 61000-4-3

IV. Antenna Calibrations

Parameter/Equipment	Range	CMC ^{2,4,7} (±)	Comments
Horn Antenna – 1 m, 3 m Antenna Factor VSWR	(0.2 to 1) GHz (1 to 18) GHz (18 to 40) GHz (0.2 to 40) GHz	0.7 dB 0.89 dB 1.4 dB 0.02 linear	Standard site method, horizontal polarization, vertical polarization Keysight E5063A Keysight N5173B, Keysight PXA, Agilent/8510C SAE/ARP 958D ANSI C63.5-2017 CISPR 16-1-6 CISPR 16-1-4

IV. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Temperature – Measure and 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 Thermometer readout, Fluke 5626 SPRT, Sika dry blocks TP17166S, TP17450S, TP17ZERO ice point
Humidity – Measure and Measuring Equipment ³	(5 to 95) %	1.7 % RH	Environmental chamber, Michell Optidew Vision precision dewpoint meter

V. Time & Frequency

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Frequency – Measuring Equipment ³	10 MHz	10 pHz/Hz	GPS System with SRS FS740

¹Accreditation is granted to this laboratory at the location listed above as well as the satellite laboratory location listed below:

HYUNDAI C-TECH, INC.
 dba HCT AMERICA, INC.
 1177 Comstock Road
 Hollister, CA 95023

I. Antenna Calibrations

Parameter/Equipment	Range	CMC ^{2,4,7} (±)	Comments
Biconical Antennas – 1 m, 3 m, 10 m Antenna Factor VSWR	 20 MHz to 1 GHz (1 to 18) GHz 20 MHz to 1 GHz (1 to 18) GHz	 0.7 dB 0.82 dB 0.02 linear 0.02 linear	Standard site method, horizontal polarization, vertical polarization Keysight E5063A SAE/ARP 958D ANSI C63.5-2017 CISPR 16-1-6 CISPR 16-1-4
Log Periodic Antennas – 1 m, 3 m, 10 m Antenna Factor VSWR	 20 MHz to 6 GHz 20 MHz to 6 GHz	 0.82 dB 0.02 linear unit	Standard site method, horizontal polarization, vertical polarization Keysight E5063A SAE/ARP 958D ANSI C63.5-2017 CISPR 16-1-6 CISPR 16-1-4
Hybrid Antennas – 1 m, 3 m, 10 m Antenna Factor VSWR	 30 MHz to 1 GHz 30 MHz to 1 GHz	 0.82 dB 0.02 linear	Standard site method, horizontal polarization, vertical polarization Keysight E5063A SAE/ARP 958D ANSI C63.5-2017 CISPR 16-1-6 CISPR 16-1-4

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. 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

A2LA has accredited

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

San Jose, 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 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 2021.

A blue ink signature of the Vice President of Accreditation Services, written over a horizontal line.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 4201.02
Valid to July 31, 2023

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