



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005  
ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3

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CALIBRATION

Valid To: October 31, 2019

Certificate Number: 2123.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1</sup>:

I. Electrical – RF/Microwave

Parameter/Equipment	Frequency	CMC <sup>2</sup> (±)	Comments
ISN <sup>3</sup> –			CISPR 22, CISPR 32, CISPR 16-1-2
Phase	150 kHz to 80 MHz	3.0°	HP 8751A & HP 87512A E5071C, HP 4395A
Insertion Loss	150 kHz to 80 MHz	0.36 dB	
Impedance	150 kHz to 80 MHz	2.4 Ω	
Longitudinal Conversion Loss	150 kHz to 80 MHz	0.88 dB	
Decoupling Attenuation	150 kHz to 80 MHz	0.36 dB	

Parameter/Equipment	Frequency	CMC <sup>2, 4, 5</sup> ( $\pm$ )	Comments
LISN <sup>3</sup> –			ANSI C63.4, CISPR 25 & CISPR 16-1-2, ISO 7637-2
Insertion Loss	9 kHz to 108 MHz	0.66 dB + <i>M</i>	HP 8751A & HP 87512A, BNC & Type “N” calibration standards
	(108 to 400) MHz	0.86 dB + <i>M</i>	
	150 kHz to 100 MHz	0.38 dB	
	(100 to 200) MHz	0.61 dB	
	(200 to 400) MHz	1.4 dB	
	(400 to 600) MHz	1.3 dB	
	(600 to 800) MHz	1.4 dB	
Impedance – Magnitude	800 MHz to 1 GHz	2.3 dB	
	9 kHz to 100 MHz	0.2 $\Omega$	
	(100 to 200) MHz	0.7 $\Omega$	
	(200 to 400) MHz	1.2 $\Omega$	
	150 kHz to 100 MHz	0.35 $\Omega$	
	(100 to 200) MHz	1.3 $\Omega$	
	(200 to 400) MHz	2.3 $\Omega$	
Impedance – Phase	(400 to 600) MHz	2.2 $\Omega$	
	(600 to 800) MHz	1.9 $\Omega$	
	800 MHz to 1 GHz	2.2 $\Omega$	
	9 kHz to 100 MHz	3.6°	
Isolation	(100 to 200) MHz	3.4°	
	(200 to 400) MHz	3.2°	
	9 kHz to 100 MHz	0.36 dB	
RF Power, Absolute <sup>3</sup> – Measure	(-30 to 20) dBm		
	9 kHz to 50 MHz	1.8 %	E9304A
	50 MHz to 5.0 GHz	2.2 %	
	50 MHz to 7 GHz	1.6 %	HP 8487A
	(7 to 18) GHz	1.8 %	
	(18 to 26) GHz	2.0 %	
	(26 to 33) GHz	2.6 %	
	(33 to 40) GHz	3.4 %	
	(40 to 47) GHz	4.2 %	
	(47 to 50) GHz	4.4 %	

Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> ( $\pm$ )	Comments
RF Power, Absolute <sup>3</sup> – Measure (cont)  (-70 to -20) dBm	50 MHz to 7 GHz (7 to 18) GHz (18 to 26) GHz (26 to 33) GHz (33 to 40) GHz (40 to 48) GHz (48 to 50) GHz	2.0 % 2.3 % 2.4 % 2.3 % 4.1 % 4.0 % 4.1 %	HP 8487D
RF Power <sup>3</sup> – Generate	9 kHz to 2.5 GHz (2.5 to 3.2) GHz (3.2 to 4) GHz  1 Hz to 15 MHz  10 MHz to 2 GHz @ $\geq$ -10 dBm  (2 to 20) GHz (20 to 40) GHz	1 dB 1.5 dB 2 dB  0.1 dB  0.6 dBm  0.7 dBm 0.9 dBm	HP 8648D  HP 33120  HP 83640L  HP 83640L
Current Probes <sup>3</sup> & Bulk Current Injection Probes <sup>3</sup> –  Insertion Loss  Transfer Impedance	5 Hz to 500 MHz 500 MHz to 2.4 GHz  5 Hz to 500 MHz 500 MHz to 2.4 GHz	0.77 dB + <i>M</i> 1.1 dB + <i>M</i>  0.77 dB + <i>M</i> 1.1 dB + <i>M</i>	CISPR 16-1-2, IEC/EN 61000-4-6  HP 8751A & HP 87512A, BNC & Type “N” calibration standards
CDN's & Adapters <sup>3</sup> – (50 to 150) $\Omega$  Adapter Insertion Loss  Coupling Factor  Impedance  Voltage Division Factor	10 kHz to 230 MHz  10 kHz to 230 MHz  10 kHz to 230 MHz  10 kHz to 230 MHz	1.2 dB + <i>M</i>  1.1 dB + <i>M</i>  3.5 $\Omega$  0.25 dB	IEC/EN 61000-4-6 CISPR 16-1-2  HP 8751A & HP 87512A, BNC and Type “N” calibration standards  Agilent E5061B ENA network analyzer

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
Absorbing Clamps	30 MHz to 1 GHz	2.4 dB	CISPR 16-1-3 Annex B, Agilent E5061B
Injection Clamps <sup>3</sup>	(0.01 to 1000) MHz	1.6 dB	IEC/EN 61000-4-6, HP 8593E, CAL801A
NSA Measurements <sup>3</sup>	(30 to 1000) MHz	0.5 dB	ANSI C63.4: (2003, 2009, 2010, & 2014) EN 50147-2 (1997) CISPR 16-1-4, CISPR 16-1-5  Agilent E5061B & E5071C
	(30 to 1000) MHz	0.1 dB	HP 8753D, Agilent E8364C, Keysight N5225A
Shielding Effectiveness <sup>3</sup>	1 kHz to 1 GHz	0.5 dB	EN 50147-1, IEE 299, NSA 94-106  HP 8591E, HP 8593EM
	(1 to 18) GHz	0.6 dB	HP 8753D, Agilent E8364C, Keysight N5225A
Site VSWR Measurements <sup>3</sup>	(1 to 3) GHz	0.66 dB	CISPR 16-1-4, CISPR 16-1-5 Agilent E8364C, Keysight N5225A
	(3 to 18) GHz	0.84 dB	
Field Uniformity <sup>3</sup>	26 MHz to 18 GHz	1.2 dB	IEC/EN 61000-4-3
ESD Targets <sup>3</sup> –			IEC 61000-4-2, ISO 10605
Frequency Response	DC to 4.0 GHz	0.26 dB	Agilent ENA E5071C, Fluke 123 HP 3478A, Solar 7144-1.0
Low Frequency Transfer Function	(0 to 30) A	0.32 %	
Insertion Loss	Up to 300 kHz	0.072 dB	
	(0.30 to 10) MHz	0.076 dB	
	(0.010 to 3.0) GHz	0.080 dB	
	(3.0 to 4.0) GHz	0.092 dB	

Parameter/Equipment	Range	CMC <sup>2,5</sup> (±)	Comments
ESD Simulators <sup>3</sup> –			
Contact Voltage (Positive & Negative)	(0 to 2) kV (2 to 8) kV (8 to 15) kV (15 to 30) kV (30 to 40) kV	2.6 % 0.7 % 0.6 % 0.54 % 0.72 %	IEC/EN 61000-4-2; ISO 10605; SAE J1113-13, GR1089
Rise Time – Peak Current 30 ns Current 60 ns Current (0 to 800) ns Current	(0 to 2) ns (0 to 40) A (0 to 40) A (0 to 40) A	65 ps 5.0 % 5.6 % 6.1 %	TEK TDS 7404 IEC ESD target applied kilovolt 149-3
Air Discharge Voltage (Positive & Negative)	(0 to 2) kV (2 to 20) kV (20 to 40) kV	0.15 % 0.61 % 1.2 %	
Rise Time – RC Time Constant  (at ± 15 kV)	(0 to 2) ns  600 ns ± 130 ns (for 330 pF probe) 300 ns ± 60 ns (for 150 pF probe)	61 ps  7.2 ns 6.0 ns	
Magnetic Field Strength Meters –			
DC (15 to 19) mG (150 to 190) mG (60 to 700) mG	(5 to 20) Hz 20 Hz to 2 kHz (2 to 500) kHz	0.73 dB 0.73 dB 1.1 dB 1.1 dB	Standard field using Helmholtz coil
RF Isotropic E-Field Probe –			
Anechoic Chamber Frequency Response Linearity Isotropic	45 GHz	1.7 dB 0.54 dB 0.47 dB	Anechoic chamber FEP 7050 probes using substitution method
Anechoic Chamber Frequency Response Linearity Isotropic	60 GHz	1.8 dB 0.72 dB 0.47 dB	Anechoic chamber FEP 7060 probes using substitution method

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
RF Isotropic E-Field Probe – (cont)			
TEM Cell			
Frequency Response	9 kHz to 800 MHz	0.91 dB	TEM cell
Linearity		0.91 dB	calculated/ substitution
Isotropic		0.92 dB	
GTEM			
Frequency Response	10 kHz to 1000 MHz	0.97 dB	GTEM
Linearity		0.97 dB	calculated/ substitution
Isotropic		0.97 dB	
Tri-plate			
Linearity	10 kHz to 1000 MHz	0.89 dB	Tri-plate,
Isotropic		1.2 dB	calculated/ substitution
		1.2 dB	
Anechoic Chamber			
Linearity	(450 to 18 000) MHz	1.1 dB	Anechoic chamber,
Isotropic		1.2 dB	calculated/ substitution
		1.2 dB	
Anechoic Chamber			
Linearity	(18 000 to 40 000) MHz	2.0 dB	Anechoic chamber,
Isotropic		1.1 dB	calculated/ substitution
		1.1 dB	
RF Laser Isotropic E-Field Probe –			
TEM Cell			
Frequency Response	5 kHz to 800 MHz	0.73 dB	TEM cell,
Linearity	9 kHz to 800 MHz	0.91 dB	calculated/ substitution
Isotropic	9 kHz to 800 MHz	0.92 dB	
GTEM			
Frequency Response	10 kHz to 1000 MHz	0.81 dB	GTEM
Linearity		0.97 dB	
Isotropic		0.97 dB	
Anechoic Chamber			
Linearity	(450 to 18 000) MHz	0.91 dB	Anechoic chamber
Isotropic		1.1 dB	
		1.1 dB	

Parameter/Equipment	Range	CMC <sup>2,5</sup> ( $\pm$ )	Comments
RF Laser Isotropic E-Field Probe – (cont)			
Anechoic Chamber Linearity Isotropic	(18 000 to 40 000) MHz	1.7 dB 1.7 dB 1.7 dB	Anechoic chamber
Electronic E-Field Probes			IEEE 1309, IEC/EN 61000-4-3, substitution method
	10 kHz to 5000 MHz Correction Factor	1.3 dB	FP 5000 type probe
	10 kHz to 5000 MHz Linearity Factor	0.83 dB	FP 5000 type probe
	10 kHz to 5000 MHz Channel Match Factor	1 dB	FP 5000 type probe
	(200 to 1000) MHz Isotropic Response	0.83 dB	FP 5000 type probe
	80 MHz to 18 GHz Correction Factor	1.9 dB	FP 2080 type probe, calculated/substitution
	80 MHz to 18 GHz Linearity Factor	0.84 dB	FP 2080 type probe, calculated/substitution
	80 MHz to 18 GHz Channel Match Factor	1 dB	FP 2080 type probe, calculated/substitution
	(18 to 40) GHz Correction Factor Linearity Channel Match Isotropic: (400 & 1000) MHz	2.3 dB 1.3 dB 1.3 dB 1.2 dB	FP2080 type probe
RF Pre-Amplifiers, Amplifiers <sup>3</sup> –			IEEE 291
Gain	5 Hz to 18 GHz (18 to 50) GHz	0.97 dB 1 dB	Agilent E5061B, E5071C Agilent E8364C, Keysight N5225A

Parameter/Equipment	Range	CMC <sup>2, 4, 5</sup> ( $\pm$ )	Comments
RF Pre-Amplifiers, Amplifiers <sup>3</sup> – (cont)			IEEE 291
Output of Power Source DC Voltage	(0 to 200) V	0.023 % + 2.4 mV	Agilent 3478
DC Current	(0 to 3) A	1.2 % + 0.46 A	
Reflection $S_{11}/S_{22}$ – Magnitude <sup>3</sup>			
5 Hz to 300 kHz	(0 to 0.5) lin (0.5 to 1) lin	$M + 0.05$ (lin) $M + 0.1$ (lin)	Agilent E5061B, E5071C, Agilent E8364C, Keysight N5225A w/ electronic calibration kit
300 kHz to 6 GHz	(0 to 1) lin	$M + 0.1$ (lin)	
10 MHz to 50 GHz	(0 to 1) lin	$M + 0.1$ (lin)	
Reflection $S_{11}/S_{22}$ – Phase <sup>3</sup>			
5 Hz to 300 kHz	(0 to 180) $^{\circ}$	3.5 $^{\circ}$	Agilent E5061B, E5071C, E8364C Keysight N5225A
300 kHz to 6 GHz	(0 to 180) $^{\circ}$	3.3 $^{\circ}$	
10 MHz to 18 GHz	(0 to 180) $^{\circ}$	3.5 $^{\circ}$	
(18 to 50) GHz	(0 to 180) $^{\circ}$	4.1 $^{\circ}$	

Parameter/Range	Frequency	CMC <sup>2, 4</sup> ( $\pm$ )	Comments
Transmission $S_{12}/S_{21}$ – Magnitude <sup>3</sup>			
(0 to 70) dB	5 Hz to 500 MHz	0.15 dB	Agilent E8364C, Agilent E5061B, Agilent E5071C, Keysight N5225A
(0 to 70) dB	10 MHz to 50 GHz	0.15 dB	
(0 to 70) dB	10 Hz to 500 MHz	0.97 dB	
(0 to 70) dB	(0.5 to 18) GHz	0.97 dB	
(0 to 30) dB	300 kHz to 6 GHz	$M + 0.07$ dB	
(30 to 40) dB		$M + 0.08$ dB	
(40 to 50) dB		$M + 0.09$ dB	
(50 to 60) dB		$M + 0.1$ dB	
(60 to 70) dB		$M + 0.15$ dB	



Parameter/Equipment	Frequency	CMC <sup>2,4</sup> (±)	Comments
Transmission $S_{12}/S_{21}$ – Magnitude <sup>3</sup> (cont)  (0 to 12) dB (12 to 40) dB (40 to 60) dB (60 to 70) dB	10 MHz to 18 GHz	$M + 0.05$ dB $M + 0.07$ dB $M + 0.08$ dB $M + 0.15$ dB	Agilent E8364C, Agilent E5061B, Agilent E5071C, Keysight N5225A
Transmission $S_{12}/S_{21}$ – Phase <sup>3</sup>  (0 to 180)°    Antenna Symmetry 300 kHz to 1 GHz 10 MHz to 18 GHz	5 Hz to 500 MHz  10 MHz to 50 GHz  300 kHz to 6 GHz  10 MHz to 18 GHz  -- --	3.5°  3.2°  3.7°  3.9°  0.07 dB 0.05 dB	Agilent E8364C  Keysight N5225A  Agilent E5061B & E5071C  Agilent E8364C Keysight N5225A  ANSI C63.5 4.4, CISPR 16- 1-6
Antenna Pattern Measurements	(1 to 1000) MHz (1 to 40) GHz	0.87 dB 1 dB	Agilent E8364C Keysight N5225A
Antenna Cross – Polar Response	20 MHz to 40 GHz	0.5 dB	CISPR 16-1-4 CISPR 16-1-6  Agilent E5061B & E5071C Keysight N5225A
Antenna Balance	20 MHz to 40 GHz	0.5 dB	CISPR 16-1-4 CISPR 16-1-6  Agilent E5061B & E5071C Keysight N5225A
Antenna VSWR	(20 to 2000) MHz (1 to 40) GHz	0.6 dB 0.9 dB	IEEE 149-1979  Agilent E5061B & E5071C Keysight N5225A

Parameter/Equipment	Frequency	CMC <sup>2</sup> (±)	Comments
Rod Antennas <sup>3</sup> (ECSM) –  Antenna Factor	10 Hz to 60 MHz	0.23 dB	CISPR 25, ANSI C63.5 SAE ARP 958, CISPR 16-1-4, CISPR 16-1-6  Agilent E5061B and E5071C, E8364C & Keysight N5225A
Loop Antennas	1 kHz to 30 MHz  10 Hz to 2 MHz  10 Hz to 30 MHz	0.32 dB  0.34 dB  0.44 dB	Standard field using Vacuo junction  Standard field using loop current measurement  Substitution method using reference antenna
Conical Log Spiral Antennas –  1 Meter Distance	(200 to 400) MHz (400 to 1000) MHz (1000 to 10 000) MHz	2.2 dB 0.88 dB 1.7 dB	SAE ARP 958  Agilent E5061B, E5071C, E8364C, Keysight N5225A, OATS <sup>6</sup>
Dipole Antennas –  3 Meter Distance  3 Meter Distance  3 Meter Distance  3 Meter Distance	(30 to 60) MHz (50 to 150) MHz (140 to 400) MHz (400 to 1000) MHz  (30 to 60) MHz (50 to 150) MHz (140 to 400) MHz (400 to 1000) MHz  (30 to 60) MHz (50 to 150) MHz (140 to 400) MHz (400 to 1000) MHz  (30 to 1000) MHz	0.5 dB 0.48 dB 0.55 dB 0.60 dB  0.52 dB 0.55 dB 0.60 dB 0.62 dB  0.45 dB 0.52 dB 0.45 dB 0.58 dB  0.59 dB	ANSI C63.5, CISPR 16-1-6  Standard site method, horizontal/vertical polarization, OATS <sup>6</sup> , HP 8591E, HP 8593EM  Reference antenna method, horizontal/vertical polarization, OATS <sup>6</sup> , HP 8591E, HP 8593EM  Identical antenna method, horizontal/vertical polarization, OATS <sup>6</sup> , HP 8591E, HP 8593EM  Standard antenna method, horizontal/vertical

Parameter/Equipment	Frequency	CMC <sup>2</sup> (±)	Comments
Dipole Antennas – (cont)			ANSI C63.5, CISPR 16-1-6
3 Meter Distance	(30 to 1000) MHz	0.40 dB	Three antenna method, horizontal/vertical
10 Meter Distance	(30 to 60) MHz (50 to 150) MHz (140 to 400) MHz (400 to 1000) MHz	0.41 dB 0.45 dB 0.51 dB 0.55 dB	Standard site method, horizontal/vertical polarization, OATS <sup>6</sup> , HP 8591E, HP 8593EM
10 Meter Distance	(30 to 60) MHz (50 to 150) MHz (140 to 400) MHz (400 to 1000) MHz	0.35 dB 0.40 dB 0.45 dB 0.51 dB	Reference antenna method, horizontal/vertical polarization, OATS <sup>6</sup> , HP 8591E, HP 8593EM
10 Meter Distance	(30 to 60) MHz (50 to 150) MHz (140 to 400) MHz (400 to 1000) MHz	0.41 dB 0.38 dB 0.45 dB 0.50 dB	Identical antenna method, horizontal/vertical polarization, OATS <sup>6</sup> , HP 8591E, HP 8593EM
10 Meter Distance	(30 to 1000) MHz	0.63 dB	Standard antenna method, horizontal/vertical
10 Meter Distance	(30 to 1000) MHz	0.41 dB	Three antenna method, horizontal/vertical
Biconical Antenna –			
1 Meter Distance	(20 to 70) MHz (70 to 200) MHz (200 to 300) MHz	0.33 dB 0.34 dB 0.37 dB	SAE ARP 958, OATS, Agilent E5061B, E5071C, E8364C & Keysight N5225A
3 Meter Distance	(20 to 70) MHz (70 to 200) MHz (200 to 300) MHz	0.37 dB 0.48 dB 0.37 dB	SAE ARP 958, Appendix C, OATS, Agilent E5061B, E5071C, E8364C & Keysight N5225A
3 Meter Distance	(20 to 70) MHz (70 to 200) MHz (200 to 300) MHz	0.93 dB 0.54 dB 0.25 dB	ANSI C63.5, CISPR 16-1-6 Standard site method, horizontal/vertical polarization, OATS <sup>6</sup> , Agilent E5061B, E5071C, E8364C & Keysight N5225A

Parameter/Equipment	Frequency	CMC <sup>2</sup> (±)	Comments
Biconical Antennas – (cont)			
3 Meter Distance	(20 to 72.5) MHz (72.5 to 115) MHz (115 to 157.5) MHz (157.5 to 200) MHz (200 to 300) MHz	0.95 dB 0.55 dB 0.41 dB 0.50 dB 0.60 dB	ANSI C63.5, CISPR 16-1-6 Reference antenna method, horizontal/vertical polarization, OATS <sup>6</sup> , Agilent E5061B, E5071C, E8364C & Keysight N5225A
3 Meter Distance	(20 to 72.5) MHz (72.5 to 115) MHz (115 to 157.5) MHz (157.5 to 200) MHz (200 to 300) MHz	0.96 dB 0.6 dB 0.39 dB 0.47 dB 0.52 dB	ANSI C63.5, CISPR 16-1-6 Identical antenna method, horizontal/vertical polarization, OATS <sup>6</sup> , Agilent E5061B, E5071C, E8364C & Keysight N5225A
3 Meter Distance	(20 to 300) MHz	0.50 dB	Standard antenna method, horizontal/vertical
3 Meter Distance	(20 to 300) MHz	0.40 dB	Three antenna method, horizontal/vertical
10 Meter Distance	(20 to 72.5) MHz (72.5 to 115) MHz (115 to 157.5) MHz (157.5 to 200) MHz (200 to 300) MHz	0.93 dB 0.52 dB 0.24 dB 0.20 dB 0.25 dB	ANSI C63.5, CISPR 16-1-6 Standard site method, horizontal/vertical polarization, OATS <sup>6</sup> , Agilent E5061B, E5071C, E8364C & Keysight N5225A
10 Meter Distance	(20 to 72.5) MHz (72.5 to 115) MHz (115 to 157.5) MHz (157.5 to 200) MHz (200 to 300) MHz	0.97 dB 0.62 dB 0.41 dB 0.30 dB 0.31 dB	ANSI C63.5, CISPR 16-1-6 Reference antenna method, horizontal/vertical polarization, OATS <sup>6</sup> , Agilent E5061B, E5071C, E8364C & Keysight N5225A
10 Meter Distance	(20 to 72.5) MHz (72.5 to 115) MHz (115 to 157.5) MHz (157.5 to 200) MHz (200 to 300) MHz	0.96 dB 0.60 dB 0.38 dB 0.46 dB 0.52 dB	ANSI C63.5, CISPR 16-1-6 Identical antenna method, horizontal/vertical polarization, OATS <sup>6</sup> , Agilent E5061B, E5071C, E8364C & Keysight N5225A

Parameter/Equipment	Frequency	CMC <sup>2</sup> (±)	Comments
Biconical Antennas – (cont)			
10 Meter Distance	(20 to 300) MHz	0.52 dB	Standard antenna method, horizontal/vertical
10 Meter Distance	(20 to 300) MHz	0.43 dB	Three antenna method, horizontal/vertical
Log-Periodic Antennas –			
1 Meter Distance	(140 to 400) MHz (400 to 1000) MHz (1000 to 5000) MHz	0.32 dB 0.38 dB 0.52 dB	SAE ARP 958 OATS, Agilent E5061B, E5071C, E8364C & Keysight N5225A
3 Meter Distance	(140 to 400) MHz (400 to 1000) MHz (1000 to 5000) MHz	0.38 dB 0.45 dB 0.58 dB	SAE ARP 958, Appendix C, OATS, Agilent E5061B, E5071C, E8364C & Keysight N5225A
3 Meter Distance	(140 to 300) MHz (300 to 400) MHz (400 to 500) MHz (500 to 600) MHz (600 to 700) MHz (700 to 800) MHz (800 to 900) MHz (900 to 1000) MHz (1000 to 5000) MHz	0.3 dB 0.3 dB 0.4 dB 0.4 dB 0.4 dB 0.5 dB 0.5 dB 0.6 dB 0.7 dB	ANSI C63.5, CISPR 16-1-6 Standard site method, horizontal/vertical polarization, OATS <sup>6</sup> , Agilent E5061B, E5071C, E8364C & Keysight N5225A
3 Meter Distance	(140 to 300) MHz (300 to 400) MHz (400 to 500) MHz (500 to 600) MHz (600 to 700) MHz (700 to 800) MHz (800 to 900) MHz (900 to 1000) MHz (1000 to 5000) MHz	0.2 dB 0.2 dB 0.2 dB 0.25 dB 0.35 dB 0.45 dB 0.45 dB 0.5 dB 0.6 dB	ANSI C63.5, CISPR 16-1-6 Identical antenna method, horizontal/vertical polarization, OATS <sup>6</sup> , Agilent E5061B, E5071C, E8364C & Keysight N5225A
3 Meter Distance	(140 to 5000) MHz	0.65 dB	Standard antenna method, horizontal/vertical
3 Meter Distance	(140 to 5000) MHz	0.46 dB	Three antenna method, horizontal/vertical

Parameter/Equipment	Frequency	CMC <sup>2</sup> (±)	Comments
Log-Periodic Antennas – (cont)			
10 Meter Distance	(140 to 300) MHz (300 to 400) MHz (400 to 500) MHz (500 to 600) MHz (600 to 700) MHz (700 to 800) MHz (800 to 900) MHz (900 to 1000) MHz (1000 to 5000) MHz	0.3 dB 0.3 dB 0.4 dB 0.4 dB 0.4 dB 0.5 dB 0.5 dB 0.6 dB 0.7 dB	ANSI C63.5, CISPR 16-1-6 Standard site method, horizontal/vertical polarization, OATS <sup>6</sup> , Agilent E5061B, E5071C, E8364C & Keysight N5225A
10 Meter Distance	(140 to 300) MHz (300 to 400) MHz (400 to 500) MHz (500 to 600) MHz (600 to 700) MHz (700 to 800) MHz (800 to 900) MHz (900 to 1000) MHz (1000 to 5000) MHz	0.3 dB 0.3 dB 0.3 dB 0.3 dB 0.45 dB 0.45 dB 0.55 dB 0.6 dB 0.7 dB	ANSI C63.5, CISPR 16-1-6 Identical antenna method, horizontal/vertical polarization, OATS <sup>6</sup> , Agilent E5061B, E5071C, E8364C & Keysight N5225A
10 Meter Distance	(140 to 5000) MHz	0.69 dB	Standard antenna method, horizontal/vertical
10 Meter Distance	(140 to 5000) MHz	0.50 dB	Three antenna method, horizontal/vertical
Hybrid Antennas –			
1 Meter Distance	(20 to 70) MHz (70 to 200) MHz (200 to 400) MHz (400 to 1000) MHz (1000 to 6000) MHz	0.5 dB 0.76 dB 0.91 dB 0.74 dB 0.75 dB	SAE ARP 958 OATS, HP 8593EM w/ electronic calibration kit
3 Meter Distance	(20 to 70) MHz (70 to 200) MHz (200 to 400) MHz (400 to 1000) MHz (1000 to 6000) MHz	0.11 dB 0.11 dB 0.19 dB 0.26 dB 0.41 dB	SAE ARP958, Appendix C OATS, Agilent E5061B and E5071C, E8364C and Keysight N5225A

Parameter/Equipment	Frequency	CMC <sup>2</sup> (±)	Comments
Hybrid Antennas – (cont)			
3 Meter Distance	(20 to 1000) MHz (1000 to 6000) MHz	0.58 dB 0.75 dB	ANSI C63.5, CISPR 16-1-6 Standard site method, horizontal/vertical polarization, OATS <sup>6</sup> , Agilent E5061B, E5071C, E8364C & Keysight N5225A
3 Meter Distance	(20 to 6000) MHz	0.74 dB	Standard antenna method
3 Meter Distance	(20 to 6000) MHz	0.46 dB	Three antenna method
10 Meter Distance	(20 to 1000) MHz (1000 to 6000) MHz	0.58 dB 0.75 dB	ANSI C63.5, CISPR 16-1-6 Standard site method, horizontal/vertical polarization, OATS, Agilent E5061B, E5071C, E8364C & Keysight N5225A
10 Meter Distance	(20 to 1000) MHz (1000 to 6000) MHz	0.68 dB 0.89 dB	ANSI C63.5, CISPR 16-1-6 Identical antenna method, horizontal/vertical polarization, OATS <sup>6</sup> , Agilent E5061B, E5071C, E8364C & Keysight N5225A
10 Meter Distance	(20 to 6000) MHz	0.77 dB	Standard antenna method
10 Meter Distance	(20 to 6000) MHz	0.50 dB	Three antenna method
Horn Antennas <sup>7</sup> – LPA's			
1 Meter Distance	700 MHz to 50 GHz	0.45 dB	SAE ARP 958 Identical Agilent E8364C, Keysight N5225A
3 Meter Distance	700 MHz to 50 GHz	0.48 dB	SAE ARP958, Appendix C, Agilent E8364C, Keysight N5225A
1 & 3 Meter Distance	700 MHz to 18 GHz (18 to 26.5) GHz (26.5 to 50) GHz	0.37 dB 0.42 dB 0.47 dB	ANSI C63.5, CISPR 16-1-6 standard site method, three antenna method, horizontal/vertical polarization, Agilent E8364C, Keysight N5225A

Parameter/Equipment	Frequency	CMC <sup>2</sup> (±)	Comments
Horn Antennas <sup>7</sup> – LPA's (cont)			
3 Meter Distance	700 MHz to 50 GHz	0.50 dB	ANSI C63.5, CISPR 16-1-6 identical antenna method, horizontal/vertical polarization, three antenna method, Agilent E8364C, Keysight N5225A
Far Field	700 MHz to 50 GHz	0.44 dB	
Time Domain	700 MHz to 50 GHz	0.46 dB	ANSI C63.5, CISPR 16-1-6 identical antenna method, horizontal/vertical polarization, three antenna method, Agilent E8364C, Keysight N5225A

## II. Mechanical

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Pin Depth	(0.18 to 0.23) in	0.000 40 in	Maury Microwave A020D

<sup>1</sup> This laboratory offers commercial and field calibration service.

<sup>2</sup> 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.

<sup>3</sup> Field calibration service is available for this calibration and this laboratory meets *A2LA R104 – General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the 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.

<sup>4</sup> In the statement of CMC,  $M$  is the uncertainty contribution of the mismatch error caused by the impedance mismatch between the calibration system of the laboratory and the device under calibration.

<sup>5</sup> In the statement of CMC, all percentages are to be read as percent of reading unless noted otherwise.



<sup>6</sup> The ground plane of size of calibration site 2 is 50 × 80 square meters and does meet the stated requirements for antenna calibration test sites called out in CISPR 16-1-5. Keysight Technologies maintains multiple OATS, including a 50 meter x 80 meter ground plane meeting the requirements for CALTS called out in CISPR 16-1-4, CISPR 16-1-5, CISPR 16-1-6. In addition all Keysight Technologies OATS meet the +/-2dB NSA as described in ANSI C63.4 and C63.5 for calibration and qualification of antennas.

<sup>7</sup> Horns in the range of 700 MHz to 50 GHz are calibrated in a free space environment void of any conductive surfaces unless instructed otherwise.

<sup>8</sup> When listing equipment, Keysight, Agilent, and HP may be used interchangeably.



## Accredited Laboratory

A2LA has accredited

# KEYSIGHT TECHNOLOGIES, INC. SERVICE CENTERS

*Kimballton, IA*

for technical competence in the field of

## Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSLI Z540-1-1994, the requirements of ANSI/NCSLI Z540.3-2006 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 8 January 2009*).



Presented this 13<sup>th</sup> day of December 2017.

A handwritten signature in blue ink, appearing to read "L. J. ...", positioned above a horizontal line.

President and CEO  
For the Accreditation Council  
Certificate Number 2123.01  
Valid to October 31, 2019

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