National Voluntary Laboratory Accreditation Program

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

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CALIBRATION LABORATORIES **NVLAP LAB CODE 100290-0**

ELECTROMAGNETICS - RF MICROWAVE, DC/LF, FREQUENCY
(Capabilities listed by instrument type and/or method)

NVLAP Code: 20/R08
Microwave Antenna Parameters by Standard Site Method
Biconical, Logperiodic, Complex

ANSI C63.5: 1998, ANSI C63.5: 2004 (up to 3000 MHz) *note 4*
SAE ARP 958 Revision D (up to 3000 MHz) *note 4*

Range in MHz	*Uncertainty (±) in dB note 1*	*Polarization*	*Distance in m*	*Height in m*
20 to 25	1.4	Horizontal	1	1
25 to 1000	1.4	Horizontal	1	1
1000 to 3000	1.5	Horizontal	1	1
20 to 25	1.0	Vertical	1	1
25 to 1000	1.0	Vertical	1	1
1000 to 3000	1.0	Vertical	1	1
20 to 25	1.4	Horizontal	1	1.5
25 to 1000	1.4	Horizontal	1	1.5
1000 to 3000	1.4	Horizontal	1	1.5
20 to 25	1.0	Vertical	1	1.5
25 to 1000	1.0	Vertical	1	1.5

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1000 to 3000	0.95	Vertical	1	1.5
20 to 25	1.4	Horizontal	1	2
25 to 1000	1.4	Horizontal	1	2
1000 to 3000	1.4	Horizontal	1	2
20 to 25	1.0	Vertical	1	2
25 to 1000	1.0	Vertical	1	2
1000 to 3000	0.92	Vertical	1	2
20 to 25	1.4	Horizontal	1	3
25 to 1000	1.4	Horizontal	1	3
1000 to 3000	1.4	Horizontal	1	3
20 to 25	1.0	Vertical	1	3
25 to 1000	1.0	Vertical	1	3
1000 to 3000	1.1	Vertical	1	3
20 to 25	1.5	Horizontal	3	1
25 to 1000	0.85	Horizontal	3	1
1000 to 3000	0.91	Horizontal	3	1
20 to 25	0.95	Vertical	3	1
25 to 1000	0.96	Vertical	3	1
1000 to 3000	0.87	Vertical	3	1
20 to 25	1.1	Horizontal	3	1.5
25 to 1000	0.84	Horizontal	3	1.5
1000 to 3000	0.91	Horizontal	3	1.5
20 to 25	1.0	Vertical	3	1.5
25 to 1000	0.94	Vertical	3	1.5
1000 to 3000	0.82	Vertical	3	1.5
20 to 25	1.1	Horizontal	3	2
25 to 1000	0.85	Horizontal	3	2
1000 to 3000	0.87	Horizontal	3	2
20 to 25	1.05	Vertical	3	2
25 to 1000	0.98	Vertical	3	2
1000 to 3000	0.82	Vertical	3	2
20 to 25	1.0	Horizontal	10	1
25 to 1000	0.89	Horizontal	10	1
1000 to 3000	0.96	Horizontal	10	1

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20 to 25	0.90	Vertical	10	1
25 to 1000	0.90	Vertical	10	1
1000 to 3000	1.0	Vertical	10	1
20 to 25	1.4	Horizontal	10	1.5
25 to 1000	0.89	Horizontal	10	1.5
1000 to 3000	0.93	Horizontal	10	1.5
20 to 25	0.90	Vertical	10	1.5
25 to 1000	0.87	Vertical	10	1.5
1000 to 3000	0.95	Vertical	10	1.5
20 to 25	1.0	Horizontal	10	2
25 to 1000	0.89	Horizontal	10	2
1000 to 3000	1.0	Horizontal	10	2
20 to 25	0.89	Vertical	10	2
25 to 1000	0.87	Vertical	10	2
1000 to 3000	0.89	Vertical	10	2

Microwave Antenna Parameter by Reference Antenna Method

ANSI C63.5: 1998, ANSI 63.5:2004 (up to 1000 MHz) *note 4*

Range in MHz	***Best Uncertainty (±) in dB*** *note 1*	***Polarization***	***Distance in m***	***Height in m***
Biconical, Log-period Complex				
25 to 1000	0.85	Horizontal	10	2
Complex				
25 to 1000	0.86	Horizontal	10	2
Dipole				
25 to 1000	0.82	Horizontal	10	2
Shortened Dipole				
25 to 1000	0.82	Horizontal	10	2
Horn, Log-Periodic				
1000 to 2600	0.97	Free Space	10	Free Space

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2600 to 12000	1.4	Free Space	10	Free Space
12000 to 18000	2.0	Free Space	10	Free Space

Antenna Impedance, VSWR, Gamma, Return Loss

Frequency Range in MHz	***Best Uncertainty (±)*** [note 1]	***Value of k***
20 to 1000	0.50 %	2
1000 to 18000	0.31 %	2
18000 to 26500	0.28 %	2

NVLAP Codes: 20/F01, 20/R02, 20/R17

CISPR Receiver 50 ohm Nominal Impedance [note 3]

CISPR 16-1-1:2003, CISPR 16-1-1:2006 [note 4]

Input Impedance

Frequency Range	***Best Uncertainty (±)*** [note 1]	***Value of k***
9 kHz to 6 GHz	1.3 %	2
6 GHz to 26.5 GHz	1.2 %	2
Sine-wave Voltage Accuracy		
9 kHz to 4 GHz	0.39 dB	2
4 GHz to 18 GHz	1.3 dB	2
18 GHz to 40 GHz	2.3 dB	2
Overall Selectivity		
9 kHz to 4GHz	1.3 dB	2
Amplitude Relationship (Absolute)		
9 kHz to 1 GHz	0.4 dB	2
Amplitude Relationship (Relative)		
9 kHz to 1 GHz	0.35 dB	2

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Random Noise		
9 kHz to 4 GHz	0.31 dB	2
Response to intermittent, unsteady, and drifting narrowband		
9 kHz to 1 GHz	0.84 dB	2
Impulse Bandwidth		
Method 1, Bimp = 1 MHz	4.1 %	2
Method 2, Bimp = 1 MHz	4.3 %	2
Method 3, Bimp = 1 MHz	4.0 %	2
Disturbance Analyzer (Click Analyzer)		
Time/Frequency	1.2 E-07 %	2
Amplitude	0.56 dB	2

NVLAP Code: 20/R08

Monopole Antenna using Capacitance Substitution Method *note 3*

CISPR 16-1-4:2003 *note 4*, ANSI 63.5 2004 *note 4*, SAE ARP958 Revision D *note 4*

Frequency Range in MHz	***Best Uncertainty (±)*** *note 1*	***Value of k***
0.000020 to 50	0.72 dB	2

Loop Antenna by Standard Field Strength Method *note 3*

Standard Field using Shunt Resistor SAE ARP958 Revision D *note 4*		
0.000020 to 0.3	1.2 dB	2
Standard Field using Vacuo Junction		
0.009 to 0.1	0.52 dB	2
0.1 to 30	0.39 dB	2

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Current Probe, Injection Probe, Transfer Impedance *note 3*		
CISPR 16-1-2:2003 *note 4*		
0.000020 to 500	0.81 dB	2
Magnetic Field Meter, Standard H-Field Method, DC-200 Hz *note 3*		
DC to 200 Hz	1.6 %	2
Frequency Response *note 3*		
Gain		
0.000010 to 0.01	0.48 dB	2
0.01 to 1000	0.33 dB	2
1000 to 40 000	0.42 dB	2
Frequency Range in MHz	***Best Uncertainty (±)*** *note 1*	***Value of k***
Insertion Loss		
0.000010 to 0.01	0.27 dB	2
0.01 to 1000	0.12 dB	2
1000 to 40 000	0.20 dB	2
Impedance, VSWR, Gamma, Return Loss		
0.000010 to 1000	0.41 %	2
1000 to 6000	1.3 %	2
6000 to 26500	1.2 %	2

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Horn Antennas, Log – periodic

ANSI 63.5:2004 *note 4* SAE ARP958 Revision D *note 4*

Frequency Range in GHz	*Best Uncertainty (±) in dB note 1*	*Distance in m*
1 to 2.6	1.0	1
2.6 to 12	1.0	1
12 to 18	2.1	1
18 to 26.5	2.9	1
26.5 to 40	2.9	1
1 to 2.6	0.84	3
2.6 to 12	0.82	3
12 to 18	1.7	3
18 to 26.5	2.1	3
26.5 to 40	2.3	3
1 to 2.6	0.42	10
2.6 to 12	0.81	10
12 to 18	1.2	10

Microwave Antenna Parameters by Standard Site Method

Log Spiral Antennas, SAE ARP958 Revision D *note 4*

Frequency Range in GHz	*Best Uncertainty (±) in dB note 1*	*Distance in m*
0.2 to 1	0.97	1
1 to 10	1.05	1

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NVLAP Codes: 20/R02, 20/R13, 20/R14

LISNs – CDNs *note 3*

CISPR 16-1-2: 2003 *note 4* IEC 61000-4-6: 2003 *note 4*

Frequency Range in MHz	*Best Uncertainty (±) note 2*	*Value of k*
LISNs		
Insertion Loss		
0.009 to 30	0.30 dB	2
30 to 200	0.67 dB	2
Impedance		
0.009 to 30	1.3 %	2
30 to 200	7.2 %	2
Phase		
0.009 to 30	0.50 %	2
30 to 200	3.0 %	2
Isolation		
0.009 to 30	0.48 dB	2
30 to 200	1.4 dB	2
VSWR for RF Output Port		
0.009 to 200	0.41 %	2

NVLAP Codes: 20/F01, 20/R02, 20/R13

CDNs *note 3*

CISPR16-1-2:2003, IEC 61000-4-6:2003

Frequency Range in MHz	*Best Uncertainty (±) note 2*	*Value of k*
Insertion Loss		
0.009 to 80	0.82 dB	2
80 to 300	0.82 dB	2

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Impedance		
0.009 to 80	1.8 %	2
80 to 300	1.7 %	2
150 ohms Adapter *note 3*		
Insertion Loss		
0.009 to 80	0.56 dB	2
80 to 300	0.53 dB	2
Impedance		
0.009 to 80	0.60 %	2
80 to 300	4.5 %	2
Frequency		
0.0000001 to 18000	1.2 E-07 + 0.1 Hz	2
Voltage Probe *note 3*		
CISPR 16-1-2		
Insertion Loss, VDF		
0.009 to 30	0.49 dB	2
Impedance		
0.009 to 30	3.4 %	2
Capacitive Voltage Probes *note 3*		
CISPR 16-1-2		
Frequency Range in MHz	***Best Uncertainty (±) note 2***	***Value of k***
Insertion Loss, VDF		
0.009 to 30	0.56 dB	2
Insertion Loss w/ Influence of external electric field		
0.009 to 30	1.9 dB	2

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ISNs *note 3* CISPR 16-1-2		
Asymmetric Impedance 0.009 to 80	2.2 %	2
Asymmetric Impedance Phase 0.009 to 80	0.44 %	2
LCL ≤ 55 dB 0.009 to 80	0.43 dB	2
LCL ≤ 65 dB 0.009 to 80	0.63 dB	2
LCL ≤ 75 dB 0.009 to 80	2.3 dB	2
Decoupling Attenuation 0.009 to 80	1.2 dB	2
Symmetric Insertion Loss 0.009 to 80	0.07 dB	2
Voltage Division Factor 0.009 to 80	0.12 dB	2

Frequency Range in MHz	***Best Uncertainty (±)*** *note 2*	***Value of k***
Symmetric Impedance 0.009 to 80	2.2 %	2
Absorbing Clamp CISPR 16-1-3		

CISPR 16-1:1998		
30 to 10000	2.3 dB	2
Original Method		
30 to 10000	1.2 dB	2
Jig Method		
30 to 10000	0.82 dB	2
Decoupling Factor		
30 to 1000	3.7 dB	2
Decoupling Ratio for CMD		
30 to 1000	3.3 dB	2
EM, Injection Clamp *note 3*		
IEC 61000-4-6		
Coupling Factor		
0.1 to 230	0.53 dB	2
230 to 1000	1.3 dB	2
Decoupling Factor		
0.1 to 230	0.52 dB	2
230 to 1000	1.3 dB	2
Frequency Range in MHz	***Best Uncertainty (±) note 2***	***Value of k***
E- Field Sensor		
IEEE Std.1309		
Frequency Response (Septum Height = 500 mm)		
0.01 to 0.1	1.2 dB	2
0.1 to 1800	1.5 dB	2

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1800 to 4000	2.3 dB	2
4000 to 6000	2.8 dB	2
Frequency Response (Septum Height = 330 mm)		
0.01 to 0.1	1.2 dB	2
0.1 to 1800	1.6 dB	2
1800 to 4000	2.5 dB	2
4000 to 6000	3.2 dB	2
Linearity		
0.1 to 6000	0.29 dB	2
Isotropic Response		
0.1 to 6000	0.19 dB	2

Range/Parameter	***Best Uncertainty*** [note2] ***(±)***	***Value of k***
NVLAP Code: 20/R13		
Directional Coupler [note 3]		
Insertion Loss, Coupling Factor, Directivity, Isolation		
0.01 to 1000	0.12 dB	2
1000 to 40000	0.20 dB	2
NVLAP Codes: 20/F01, 20/R02, 20/R13, 20/R17		
Spectrum Analyzer, RF Voltmeter [note 3]		
Frequency Response		
10 Hz to 1000 MHz	0.56 dB	2
1 GHz to 18 GHz	0.86 dB	2
18 GHz to 40 GHz	1.1 dB	2
VSWR		
10 Hz to 1000 MHz	0.41 %	2
1 GHz to 6 GHz	1.3 %	2
6 GHz to 26.5 GHz	1.2 %	2

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Frequency		
10 Hz to 18 GHz	0.00011 %	2
Frequency Span		
10 Hz to 1800 MHz	0.27 %	2
Reference Level		
0 dB to 60 dB	0.52 dB	2
Input Attenuator		
0 dB to 60 dB	0.38 dB	2

NVLAP Codes: 20/F01, 20/R17
Signal Generators, RF Generator *note 3*

Sine Wave Power, Frequency Response		
9 kHz to 1000 MHz	0.07 dB	2
1 GHz to 18 GHz	0.17 dB	2
18 GHz to 40 GHz	0.78 dB	2
Frequency		
9 kHz to 1000 MHz	1.2 E-07 + 0.1 Hz	2
AM Frequency		
20 Hz to 100 kHz	0.05 %	2
AM Depth		
1 % to 99 %	0.25 %	2
Spurious, Harmonics		
9 kHz to 1000 MHz	0.59 dB	2
1 GHz to 6 GHz	0.61 dB	2

NVLAP Code: 20/R17
Power Meter & other signal sources

Termination Type Power Meter		
9 kHz to 1000 MHz	1.5 %	2
1 GHz to 18 GHz	1.8 %	2
18 GHz to 40 GHz	6.9 %	2
Reference & other signal source		
10 MHz to 18 GHz	0.08 dB	2

Thru Line type		
9 kHz to 6 GHz	3.3 %	2

NVLAP Codes: 20/E06, 20/E09, 20/F01, 20/R17
Oscilloscope and Probes

Vertical Axis (Voltage)		
DC, 10 mV to 650 V	0.0099 %	2
AC, < 1 kHz, 10 mV to 650 V	0.11 %	2
AC, 1 kHz to 1 GHz, 10 mV to 1 V	3.1 %	2
AC, 1 GHz to 3 GHz, 10 mV to 1 V	6.9 %	2
Horizontal Axis (Time)		
0.1 Hz to 1 GHz	1.9 %	2
1 GHz to 3 GHz	5.3 %	2
Frequency Response		
10 Hz to 1000 MHz	0.28 dB	2
1 GHz to 3 GHz	0.62 dB	2

NVLAP Codes: 20/E09, 20/F01
Function Generator *note 3*

Voltage (Sine Wave)		
10 mV to 1 V	3.5 %	2
Voltage (Square Wave)		
10 mV to 1 V	3.5 %	2
Time (Sine Wave)		
1 Hz to 20 MHz	0.75 %	2
Time (Square Wave)		
1 Hz to 20 MHz	0.51 %	2

NVLAP Codes: 20/E05, 20/E06, 20/F04, 20/R13
Electrostatic Discharge Generator
IEC 61000-4-2 First Edition *note 4*

First Peak Current	3.6 %	2

Rise Time	2.8 %	2
Current at 30 ns	4.2 %	2
Current at 60 ns	4.6 %	2
Output Voltage	4.3 %	2
IEC 61000-4-2 Edition 2.0 *note 4*		
First Peak Current	4.9 %	2
Rise Time	3.3 %	2
Current at 30 ns	4.6 %	2
Current at 60 ns	4.9 %	2
Output Voltage	4.7 %	2
Current Target Annex B		
Transfer Impedance Z_{sys}, DC	1.1 %	2
Insertion Loss to 4 GHz	3.3 %	2

NVLAP Codes: 20/E05, 20/E06, 20/F04
Surge Generator *note 3*
IEC 61000-4-5 First Edition, Edition 2.0 *note 4*

Open circuit voltage of generator		
Front Time	2.9 %	2
Time to half value	3.7 %	2
Undershoot	3.5 %	2
Peak Voltage	4.1 %	2
Phase Shifting	3.5 %	2
Effective Output Impedance	6.4 %	2
Short circuit output of generator		
Front Time	4.9 %	2
Time to half value	2.2 %	2
Undershoot	4.3 %	2
Peak Current	4.2 %	2
Open circuit voltage of CDN		
Front Time	5.3 %	2
Time to half value	3.3 %	2
Undershoot	3.6 %	2

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Peak Voltage	4.0 %	2
Residual Surge Voltage	5.0 %	2
Short circuit current of CDN		
Front time	4.0 %	2
Time to half value	3.5 %	2
Undershoot	4.5 %	2
Peak Current	4.2 %	2

NVLAP Codes: 20/E06, 20/F01, 20/F04
Electrical Fast Transient Burst Generator *note 3*
IEC 61000-4-4 First Edition, Edition 2.0 *note 4*

Waveform characteristics for generator output with 50 or 1000 ohm load		
Repetition Frequency	1.9 %	2
Rise Time	2.4 %	2
Impulse Duration 50 % value	3.6 %	2
Burst Duration	1.9 %	2
Burst Period	1.9 %	2
Output Voltage Peak Value	1.9 %	2
Coupling/decoupling network for AC/DC mains supply port		
Rise Time	2.5 %	2
Impulse Duration 50 % value	2.4 %	2
Peak Voltage	3.8 %	2
Residual Test Voltage	4.3 %	2

NVLAP Code: 20/E10
Capacitive Coupling Clamp *note 3*
IEC 61000-4-4 First Edition, Edition 2.0 *note 4*

Typical Coupling Capacitance		
100 pF to 1000 pF	0.12 %	2

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NVLAP Codes: 20/E05, 20/E10, 20/R02
Test Load 50 and 1000 ohm [note 3]
IEC 61000-4-4 First Edition, Edition 2.0 [note 4]

Insertion Loss		
10 kHz to 500 MHz	0.12 dB	2
Resistance		
50 Ω and 1000 Ω	0.0014 %	2
Capacitance (for 1000 Ω)		
≤ 6 pF	0.12 %	2
Impedance		
10 kHz to 500 MHz	0.41 %	2

NVLAP Codes: 20/E06, 20/E15, 20/F04
Voltage Dip Generator [note 3]
IEC 61000-4-11 First Edition, Edition 2.0 [note 4]

Output voltage at Unload		
0.1 V to 300 V	6.8 %	2
Output voltage at 100 ohm load		
0.1 V to 300 V	4.5 %	2
Rise/Fall Time	8.2 %	2
Overshoot, Undershoot	4.8 %	2
Phase angle accuracy	2.4 %	2
Duration time for voltage dips	2.0 %	2

NVLAP Codes: 20/E05, 20/E06, 20/E09, 20/E15, 20/F01
Power, Harmonic Analyzer
IEC 61000-4-7 [note 4]

Frequency		
0.1 Hz to 1 MHz	1.26 E-07 %	2
Voltage		
DC, 1 mV to 1000 V	0.0099 %	2
DC, 1 kV to 30 kV	0.76 %	2

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AC, 10 Hz to 20 kHz, 1 mV to 750 V	0.10 %	2
AC, 3 Hz to 10 Hz, 1 mV to 750 V	1.9 %	2
AC, 20 kHz to 300 kHz, 1 mV to 750 V	1.9 %	2
Current Harmonics, Interharmonics		
DC, 1 mA to 50 A	0.050 %	2
AC, 40 Hz to 1 kHz, 1 mA to 50 A	0.051 %	2
AC, 1 Hz to 40 Hz, 1 mA to 50 A	0.053 %	2
AC, 1 kHz to 10 kHz, 1 mA to 50 A	0.053 %	2
Power		
DC, 50 kW (1000 V * 50 A)	0.051 %	2
AC, 38 kW (750 V * 50 A)	1.9 %	2
Power Factor		
0 to 1, 50 Hz or 60 Hz	0.82 %	2

NVLAP Code: 20/E09
Flicker Analyzer
IEC 61000-4-15 ***note 4***

Δ V at P_{st} = 1	0.14 %	2

NVLAP Codes: 20/E05, 20/E06, 20/E09, 20/F01
General Capabilities for Voltage, Current, Resistance, & Frequency

Frequency		
0.1 Hz to 1 MHz	1.26 E-07 %	2
Voltage		
DC, 1 mV to 1000 V	0.0099 %	2
AC, 10 Hz to 20 kHz, 1 mV to 750 V	0.10 %	2
AC, 3 Hz to 10 Hz, 1 mV to 750 V	1.9 %	2
AC, 20 kHz to 300 kHz, 1 mV to 750 V	1.9 %	2
Current		
DC, 1 mA to 50 A	0.050 %	2
AC, 40 Hz to 1 kHz, 1 mA to 50 A	0.051 %	2
AC, 1 Hz to 40 Hz, 1 mA to 50 A	0.053 %	2
AC, 1 kHz to 10 kHz, 1 mA to 50 A	0.053 %	2

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Resistance		
1 Ω to 100 MΩ	0.059 %	2

1. Represents an expanded uncertainty using a coverage factor, $k = 2$, at an approximate level of confidence of 95 %.
2. Represents an expanded uncertainty corresponding to a 95% level of confidence using a coverage factor, k. Values of k other than 2 were approximated by a t-distribution with the effective degrees of freedom Veff obtained from the Welch-Satterthwaite formula.
3. Items available for on-site service.
4. When international, national, or commercial / engineering – society methods or standards are cited, such references apply only to the specific equipment, parameters and conditions listed in this scope of accreditation, and do not imply compliance to other requirements that may appear within the cited documents.

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