



**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 100290-0**

**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005**

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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.

**CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) <sup>Notes 1,2</sup>**

Measured Parameter or Device Calibrated	Range	Uncertainty ( <i>k</i> =2) <sup>Note 3,5</sup>	Remarks
<b>ELECTROMAGNETICS – DC/LOW FREQUENCY</b>			
<b>AC RESISTORS and CURRENT (20/E02)</b>			
AC Current – Measure 1 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 10 kHz	50 $\mu$ A to 50 A	0.70 % 0.70 % 0.70 %	
Harmonics, Inter-Harmonics 1 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 10 kHz	50 $\mu$ A to 50 A	0.70 % 0.70 % 0.70 %	IEC 61000-4-7
Reference Impedance Network AC (50 Hz)	0.01 $\Omega$ to 1 $\Omega$	0.69 %	IEC 61000-3-3
In-Rush Current	1A to 1000 A	3.3 %	IEC 61000-4-11
<b>DC RESISTANCE and CURRENT (20/E05)</b>			
DC Current - Measure	50 $\mu$ A to 50 A	0.70 %	

2015-12-16 through 2016-12-31

Effective dates

For the National Voluntary Laboratory Accreditation Program



**National Voluntary  
Laboratory Accreditation Program**



**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 100290-0**

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Measured Parameter or Device Calibrated	Range	Uncertainty ( <i>k</i> =2) <sup>Note 3,5</sup>	Remarks	
DC Resistance - Measure	1 Ω to 100 MΩ	0.059 %	IEC 61000-3-3 JIS C 61000-3-2  IEC 61000-4-5 IEC 61000-4-12           IEC 61000-4-12           IEC 61000-4-2           IEC 61000-4-4	
Reference Impedance Network DC Resistance	0.03 Ω to 3 Ω	0.78 %		
Surge Generator Field calibrations available <sup>Note 4</sup> Impedance	1 Ω to 50 Ω	6.4 %		
Short Circuit Output Undershoot	0 % to 100 %	4.3 %		
Peak Current	1 A to 6 kA	4.2 %		
Short Circuit CDN Current Undershoot	0 % to 100 %	4.5 %		
Peak Current	1 A to 6 kA	4.2 %		
Ring Wave Generator Field calibrations available <sup>Note 4</sup> Short Circuit Current or Generator and CDN Short Circuit Current (Pk1, value)	1 A to 6 kA	5.3 %		
Electrostatic Discharge Generator First Peak Current	0.5 A to 60 A	3.6 %		
First Peak Current	0.5 A to 75 A	5.3 %		
Peak Current	0.5 A to 75 A	5.3 %		
Test Load (50 Ω and 1 kΩ) Resistance	50 Ω and 1 kΩ	0.0014 %		
<b>DC VOLTAGE (20/E06)</b>				
DC Voltage Measure	1 mV to 1000 V	0.0099 %		IEC 61000-4-2, ISO 10605
	1 kV to 30 kV	0.76 %		
Electrostatic Discharge Generator Output Voltage	1 kV to 30 kV	1.8 %		

2015-12-16 through 2016-12-31

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Laboratory Accreditation Program**



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**NVLAP LAB CODE 100290-0**

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Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <sup>Note 3,5</sup>	Remarks
Surge Generator Field calibrations available <sup>Note 4</sup>			IEC 61000-4-5 IEC 61000-4-12
Open Circuit Output			
Undershoot	0 % to 100 %	3.5 %	
Peak Voltage	100 V to 7 kV	4.1 %	
Open Circuit Voltage of CDN			
Undershoot	0 % to 100 %	3.6 %	
Peak Voltage	100 V to 7 kV	4.0 %	
Residual Surge Voltage	1 V to 7 kV	5.0 %	
Ring Wave Generator Field calibrations available <sup>Note 4</sup>			IEC 61000-4-12
Open Circuit Voltage of Generator and CDN Open Circuit Voltage (Pk1, value) Decaying	100 V to 7 kV	4.8 %	
0.4 < Pk2/Pk1 < 1.1		4.8 %	
0.4 < Pk3/Pk2 < 0.8		5.2 %	
0.4 < Pk4/Pk3 < 1.1		6.7 %	
Electrical Fast Transient Burst Generator Field calibrations available <sup>Note 4</sup>			IEC 61000-4-4
Waveform Characteristics			
Output Voltage Peak Value	100 V to 5 kV	3.8 %	50 Ω or 1000 Ω Load
Coupling/decoupling network for AC/DC mains supply port			
Peak Voltage	100 V to 5 kV	3.8 %	
Residual Test Voltage	1 V to 5 kV	4.3 %	
Capacitive Coupling Clamp			
Peak Voltage	100 V to 5 kV	3.5 %	

2015-12-16 through 2016-12-31

Effective dates

For the National Voluntary Laboratory Accreditation Program



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 100290-0

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Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <sup>Note 3,5</sup>	Remarks
Voltage Dip Generator Field calibrations available <sup>Note 4</sup> Voltage at No Load Voltage at 100 $\Omega$ Load	0.1 V to 400 V	6.8 % 4.5 %	IEC 61000-4-11
<b>LF AC VOLTAGE (20/E09)</b>			
LF AC Voltage – Measure 3 Hz to 10 Hz 10 Hz to 20 kHz 20 kHz to 300 kHz 50 Hz to 60 Hz	1 mV to 750 V  700 V to 10 kV	1.9 % 0.10 % 1.9 % 3.5 %	
Function Generator 1 Hz to 20 MHz	10 mV to 1 V	3.5 %	
Flicker Analyzer $\Delta V$ at $P_{st} = 1$	0.9 to 1.1	0.14 %	IEC 61000-4-15
<b>LF CAPACITANCE (20/E10)</b>			
Capacitive Coupling Clamp Field calibrations available <sup>Note 4</sup> Coupling Capacitance	100 pF to 1000 pF	0.12 %	IEC 61000-4-4
1000 $\Omega$ Test Load Capacitance	$\leq 6$ pF	0.12 %	IEC 61000-4-4
<b>LF INDUCTANCE (20/E11)</b>			
Reference Impedance Network Field calibrations available <sup>Note 4</sup> 50 Hz to 60 Hz	0.32 mH to 3.2 mH	0.69 %	JIS C 61000-3-2
<b>LF POWER/ENERGY (20/E12)</b>			
Power, Harmonic Analyzer DC AC 3 Hz to 40 Hz	1 mW to 50 kW  1 mW to 38 kW	0.70 %  2.0 %	IEC 61000-4-7 Maximum 1000 V x 50 A  Maximum 750 V x 50 A

2015-12-16 through 2016-12-31

Effective dates

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**NVLAP LAB CODE 100290-0**

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Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <sup>Note 3,5</sup>	Remarks
40 Hz to 1 kHz 1 kHz to 10 kHz		0.71 % 2.0 %	
Electric Energy 50 Hz to 60 Hz	1 Wh to 38 kWh	0.71 %	
<b>PHASE METERS (20/E15)</b>			
Voltage Dip Generator Field calibrations available <sup>Note 4</sup> Phase Angle Accuracy	0° to 360°	2.5 % + 1°	IEC 61000-4-11
Power, Harmonic Analyzer Power Factor	0.1 to 1	0.82 %	IEC 61000-4-7 50 Hz or 60 Hz Only
<b>OSCILLOSCOPES (20/E20)</b>			
Oscilloscopes and Probes Vertical Axis (Voltage)			
DC	10 mV to 650 V	0.0099 %	
AC, < 1 kHz		0.11 %	
AC, 1 kHz to 1 GHz	10 mV to 1 V	3.1 %	
AC, 1 GHz to 3 GHz		6.9 %	
Horizontal Axis (Time)			
	0.1 Hz to 1 GHz	1.9 %	
	1 GHz to 3 GHz	5.3 %	
Frequency Response			
	10 Hz to 1 GHz	0.28 dB	
	1 GHz to 3 GHz	0.62 dB	
<b>TIME and FREQUENCY</b>			
<b>FREQUENCY DISSEMINATION (20/F01)</b>			
Frequency Measure	10 Hz to 300 kHz	$1.3 \times 10^{-7} \% + 0.01 \text{ Hz}$	Using digital multimeter
	0.1 Hz to 18 GHz	$5.2 \times 10^{-8} \% + 0.1 \text{ Hz}$	Using frequency counter
	18 GHz to 40 GHz	$1.2 \times 10^{-8} \% + 0.1 \text{ Hz}$	Using frequency counter
Impulse Bandwidth			
Method 1	$BW_{imp} = 1 \text{ MHz}$	4.1 %	CISPR 16-1-1
Method 2		4.3 %	

2015-12-16 through 2016-12-31

Effective dates

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**NVLAP LAB CODE 100290-0**

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Method 3		4.0 %	
Spectrum Analyzer, RF Voltmeter Field calibrations available <sup>Note 4</sup>			
Frequency	10 Hz to 40 GHz	1.0 x 10 <sup>-5</sup> %	
Frequency Span	10 kHz to 100 MHz	1.0 x 10 <sup>-5</sup> %	
Resolution Bandwidth	200 Hz to 5 MHz	2.7 %	
Function Generator Field calibrations available <sup>Note 4</sup>			
Time (Sine Wave)	1 Hz to 20 MHz	0.75 %	
Time (Square Wave)		0.51 %	
Electrical Fast Transient Burst Generator Field calibrations available <sup>Note 4</sup>			IEC 61000-4-4
Repetition Frequency	1 kHz to 1 MHz	1.9 %	
Ring Wave Generator			IEC 61000-4-12
Voltage Oscillation Frequency	1 kHz to 1 MHz	3.6 %	
Surge Generator Field calibrations available <sup>Note 4</sup>			IEC 61000-4-5 IEC 61000-4-12
Phase Shifting	0° to 360°	3.6 % + 1°	Measured by Differential Time
<b>OSCILLATOR CHARACTERIZATION (20/F03)</b>			
Signal Generators, RF Generator Field calibrations available <sup>Note 4</sup>			
AM Frequency	20 Hz to 100 kHz	0.05 %	
AM Depth	1 % to 99 %	0.25 %	
FM Modulation	20 Hz to 200 kHz	0.29 %	
FM Deviation	20 Hz to 400 kHz	0.57 %	
Spurious Responses	10 MHz to 4 GHz	1.6 dB	

2015-12-16 through 2016-12-31

Effective dates

For the National Voluntary Laboratory Accreditation Program



# National Voluntary Laboratory Accreditation Program



CALIBRATION LABORATORIES

NVLAP LAB CODE 100290-0

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Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3,5</small>	Remarks
<b>PULSE WAVEFORM (20/F04)</b>			
Electrostatic Discharge Generator			
Rise Time	0.5 ns to 1.5 ns	2.8 %	IEC 61000-4-2
Current at 30 ns	0.1 A to 50 A	4.2 %	
Current at 60 ns	0.1 A to 50 A	4.6 %	
Rise Time	0.5 ns to 1.5 ns	7.6 %	IEC 61000-4-2, ISO 10605
Current at 30 ns to 400 ns	0.1 A to 50 A	5.4 %	
Current at 60 ns to 800 ns	0.1 A to 50 A	5.5 %	
Surge Generator			IEC 61000-4-5
Field calibrations available <small>Note 4</small>			
Open Circuit Voltage of Generator			
Front Time	0.1 $\mu$ s to 20 $\mu$ s	2.9 %	
Time to Half Value	1 $\mu$ s to 1 ms	3.7 %	
Short Circuit Output of Generator			
Front Time	0.1 $\mu$ s to 20 $\mu$ s	4.9 %	
Time to Half Value	1 $\mu$ s to 1 ms	2.2 %	
Open Circuit Voltage of CDN			
Front Time	0.1 $\mu$ s to 20 $\mu$ s	5.3 %	
Time to Half Value	1 $\mu$ s to 1 ms	3.3 %	
Short Circuit Current of CDN			
Front Time	0.1 $\mu$ s to 20 $\mu$ s	4.0 %	
Time to Half Value	1 $\mu$ s to 1 ms	3.5 %	
Fast Transient Burst Generator			IEC 61000-4-4
Field calibrations available <small>Note 4</small>			
Rise Time	3.0 ns to 10 ns	3.8 %	
Impulse Duration 50 %	6.5 ns to 200 ns	3.6 %	
Burst Duration	0.5 ms to 20 ms	1.9 %	
Burst Period	200 ms to 400 ms	1.9 %	

2015-12-16 through 2016-12-31

Effective dates

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**NVLAP LAB CODE 100290-0**

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Coupling/decoupling network Rise Time Impulse Duration 50 %	3.0 ns to 10 ns 6.5 ns to 200 ns	3.9 % 2.4 %	AC/DC mains supply port
Capacitive Coupling Clamp Rise Time Pulse Width	3.0 ns to 10 ns 6.5 ns to 200 ns	4.1 % 4.0 %	
Voltage Dip Generator Field calibrations available <sup>Note 4</sup> Rise/Fall Time Overshoot, Undershoot Duration Voltage Dips	0.5 $\mu$ s to 100 $\mu$ s < 300 V 5 ms to 1000 ms	8.2 % 4.8 % 2.0 %	IEC 61000-4-11
Ring Wave Generator Field calibrations available <sup>Note 4</sup> Open Circuit Voltage of Generator and CDN Voltage Rise Time  Short Circuit Current of Generator and CDN Current Rise Time	0.1 $\mu$ s to 20 $\mu$ s  0.1 $\mu$ s to 20 $\mu$ s	4.7 %  4.8 %	IEC 61000-4-12
<b>ELECTROMAGNETICS – RF/MICROWAVE</b>			
<b>ELECTROMAGNETIC FIELD STRENGTH (20/R04)</b>			
E- Field Sensor Frequency Response Septum Height = 500 mm (using G-TEM)  Septum Height = 330 mm (using G-TEM)	10 kHz to 100 kHz 100 kHz to 1.8 GHz 1.8 GHz to 4 GHz 4 GHz to 6 GHz  10 kHz to 100 kHz 100 kHz to 1.8 GHz	1.3 dB 1.6 dB 2.4 dB 3.0 dB  1.3 dB 1.7 dB	Reference Sensor Method  IEEE Std.1309

2015-12-16 through 2016-12-31

Effective dates

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**NVLAP LAB CODE 100290-0**

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Septum Height = 200 mm (using TEM Cell)  Septum Height = 500 mm (using G-TEM)  Septum Height = 1500 mm (using FAR)  Linearity  Isotropic Response	1.8 GHz to 4 GHz	2.6 dB	Standard E-Field Method IEC 61000-4-3
	4 GHz to 6 GHz	3.3 dB	
	10 kHz to 500 MHz	1.5 dB	
	500 MHz to 1 GHz	1.5 dB	
	1 GHz to 6 GHz	3.1 dB	
100 kHz to 6 GHz	0.34 dB		
100 kHz to 6 GHz	0.20 dB		

**MICROWAVE ANTENNA PARAMETERS (20/R08)**

Biconical, Log-Periodic, Complex Horizontal Antenna Factor (D = 1 m, H = 1 m)	20 MHz to 25 MHz	1.5 dB	Standard Site Method ANSI C63.5-1998 ANSI C63.5:-2004 ANSI C63.5-2006 <sup>Note 8</sup> SAE ARP 958 Revision D (up to 3000 MHz)
	25 MHz to 1 GHz	1.5 dB	
	1 GHz to 3 GHz	1.6 dB	
Vertical Antenna Factor (D = 1 m, H = 1 m)	20 MHz to 25 MHz	1.1 dB	
	25 MHz to 1 GHz	1.1 dB	
	1 GHz to 3 GHz	1.1 dB	
Horizontal Antenna Factor (D = 1 m, H = 1.5 m)	20 MHz to 25 MHz	1.5 dB	
	25 MHz to 1 GHz	1.5 dB	
	1 GHz to 3 GHz	1.5 dB	
Vertical Antenna Factor (D = 1 m, H = 1.5 m)	20 MHz to 25 MHz	1.0 dB	
	25 MHz to 1 GHz	1.1 dB	
	1 GHz to 3 GHz	0.96 dB	

2015-12-16 through 2016-12-31

Effective dates

For the National Voluntary Laboratory Accreditation Program



**National Voluntary  
Laboratory Accreditation Program**



**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 100290-0**

**CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) <sup>Notes 1,2</sup>**

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <sup>Note 3,5</sup>	Remarks
Horizontal Antenna Factor (D = 1 m, H = 2 m)	20 MHz to 25 MHz	1.5 dB	
	25 MHz to 1 GHz	1.5 dB	
	1 GHz to 3 GHz	1.4 dB	
Vertical Antenna Factor (D = 1 m, H = 2 m)	20 MHz to 25 MHz	1.0 dB	
	25 MHz to 1 GHz	1.1 dB	
	1 GHz to 3 GHz	0.92 dB	
Horizontal Antenna Factor (D = 1 m, H = 3 m)	20 MHz to 25 MHz	1.5 dB	
	25 MHz to 1 GHz	1.5 dB	
	1 GHz to 3 GHz	1.5 dB	
Vertical Antenna Factor (D = 1 m, H = 3 m)	20 MHz to 25 MHz	1.1 dB	
	25 MHz to 1 GHz	1.1 dB	
	1 GHz to 3 GHz	1.2 dB	
Horizontal Antenna Factor (D = 3 m, H = 1 m)	20 MHz to 25 MHz	0.68 dB	
	25 MHz to 1 GHz	0.68 dB	
	1 GHz to 3 GHz	0.54 dB	
Vertical Antenna Factor (D = 3 m, H = 1 m)	20 MHz to 25 MHz	0.80 dB	
	25 MHz to 1 GHz	0.88 dB	
	1 GHz to 3 GHz	0.56 dB	
Horizontal Antenna Factor (D = 3 m, H = 1.5 m)	20 MHz to 25 MHz	0.80 dB	
	25 MHz to 1 GHz	0.68 dB	
	1 GHz to 3 GHz	0.66 dB	
Vertical Antenna Factor (D = 3 m, H = 1.5 m)	20 MHz to 25 MHz	0.88 dB	
	25 MHz to 1 GHz	0.80 dB	
	1 GHz to 3 GHz	0.62 dB	
Horizontal Antenna Factor (D = 3 m, H = 2 m)	20 MHz to 25 MHz	0.68 dB	
	25 MHz to 1 GHz	0.68 dB	
	1 GHz to 3 GHz	0.48 dB	

2015-12-16 through 2016-12-31

Effective dates

For the National Voluntary Laboratory Accreditation Program



**National Voluntary  
Laboratory Accreditation Program**



**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 100290-0**

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Vertical Antenna Factor (D = 3 m, H = 2 m)	20 MHz to 25 MHz	0.92 dB	
	25 MHz to 1 GHz	0.82 dB	
	1 GHz to 3 GHz	0.54 dB	
Horizontal Antenna Factor (D = 10 m, H = 1 m)	20 MHz to 25 MHz	0.78 dB	
	25 MHz to 1 GHz	0.68 dB	
	1 GHz to 3 GHz	0.58 dB	
Vertical Antenna Factor (D = 10 m, H = 1 m)	20 MHz to 25 MHz	0.74 dB	
	25 MHz to 1 GHz	0.80 dB	
	1 GHz to 3 GHz	0.60 dB	
Horizontal Antenna Factor (D = 10 m, H = 1.5 m)	20 MHz to 25 MHz	0.70 dB	
	25 MHz to 1 GHz	0.68 dB	
	1 GHz to 3 GHz	0.62 dB	
Vertical Antenna Factor (D = 10 m, H = 1.5 m)	20 MHz to 25 MHz	0.76 dB	
	25 MHz to 1 GHz	0.82 dB	
	1 GHz to 3 GHz	0.54 dB	
Horizontal Antenna Factor (D = 10 m, H = 2 m)	20 MHz to 25 MHz	0.72 dB	
	25 MHz to 1 GHz	0.66 dB	
	1 GHz to 3 GHz	0.60 dB	
Vertical Antenna Factor (D = 10 m, H = 2 m)	20 MHz to 25 MHz	0.76 dB	
	25 MHz to 1 GHz	0.78 dB	
	1 GHz to 3 GHz	0.56 dB	
Biconical, Log-Periodic, Complex Horizontal Antenna Factor (D = 10 m, H = 2 m)	25 MHz to 1 GHz	0.85 dB	Reference Antenna Method ANSI C63.5-1998, ANSI C63.5-2004 ANSI C63.5-2006 (up to 1000 MHz)
Complex Horizontal Antenna Factor (D = 10 m, H = 2 m)	25 MHz to 1 GHz	0.86 dB	

2015-12-16 through 2016-12-31

Effective dates

For the National Voluntary Laboratory Accreditation Program



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Laboratory Accreditation Program**



**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 100290-0**

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Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <sup>Note 3,5</sup>	Remarks
Dipole Horizontal Antenna Factor (D = 10 m, H = 2 m)	25 MHz to 1 GHz	0.82 dB	
Shortened Dipole Horizontal Antenna Factor (D = 10 m, H = 2 m)	25 MHz to 1 GHz	0.82 dB	
Horn, Log-Periodic Free Space Antenna Factor (D = 10 m, H = Free Space)	1 GHz to 2600 MHz 2.6 GHz to 12 GHz 12 GHz to 18 GHz	0.97 dB 1.4 dB 2.0 dB	
Antenna VSWR	20 MHz to 1 GHz 1 GHz to 18 GHz 18 GHz to 26.5 GHz	0.50 % 0.31 % 0.28 %	Gamma, Impedance, and Return Loss measurements also available
Antenna Symmetry Vertical (D = 3 m, H = 1 m)	20 MHz to 30 MHz 30 MHz to 1 GHz 1 GHz to 3 GHz	0.80 dB 0.88 dB 0.56 dB	ANSI C63.5-2006
Vertical (D = 10 m, H = 1 m)	20 MHz to 25 MHz 25 MHz to 1 GHz 1 GHz to 3 GHz	0.74 dB 0.80 dB 0.60 dB	
Monopole Antenna Field calibrations available <sup>Note 4</sup>	20 Hz to 50 MHz	0.72 dB	Capacitance Substitution Method CISPR 16-1-4, ANSI C63.5 SAE ARP958 Revision D
Loop Antenna	10 Hz to 300 kHz	1.2 dB	Standard Field Strength Method Standard Field using Shunt SAE ARP958 Revision D
Standard Field	9 kHz to 100 kHz 100 kHz to 30 MHz	0.52 dB 0.39 dB	Varco Junction

2015-12-16 through 2016-12-31

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For the National Voluntary Laboratory Accreditation Program



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**NVLAP LAB CODE 100290-0**

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Current Probe, Injection Probe, Transfer Impedance Field calibrations available <sup>Note 4</sup>	10 Hz to 20 Hz 20 Hz to 500 MHz 500 MHz to 2.1 GHz	0.89 dB 0.86 dB 2.3 dB	CISPR 16-1-2, ANSI C63.4
Magnetic Field Meter	DC to 200 Hz	1.6 %	Standard H-Field Method
Horn Antennas, Log-Periodic Distance = 1 m	1 GHz to 2.6 GHz 2.6 GHz to 12 GHz 12 GHz to 18 GHz 18 GHz to 26.5 GHz 26.5 GHz to 40 GHz	1.1 dB 1.4 dB 1.2 dB 1.8 dB 2.3 dB	Standard Site Method ANSI C63.5-1998 ANSI C63.5-2004 ANSI C63.5-2006 SAE ARP958 Revision D
Distance = 3 m	1 GHz to 2.6 GHz 2.6 GHz to 12 GHz 12 GHz to 18 GHz 18 GHz to 26.5 GHz 26.5 GHz to 40 GHz	1.1 dB 1.4 dB 1.4 dB 1.8 dB 2.3 dB	
Log Spiral Antennas Distance = 1 m	200 MHz to 1 GHz 1 GHz to 10 GHz	0.97 dB 1.0 dB	Standard Site Method SAE ARP958 Revision D
Absorbing Clamp Test Site (ACTS) Field calibrations available <sup>Note 4</sup>	30 MHz to 1 GHz	0.6 dB	CISPR 16-1-3 (4.5.4)
Large Loop Antenna Field calibrations available <sup>Note 4</sup>	9 kHz to 30 MHz	1.1 dB	CISPR 16-1-4 (4.7.1)
Normalized Site Attenuation Field calibrations available <sup>Note 4</sup>			CISPR 16-1-4 (5.2.6, 5.3.2) ANSI C63.4 (5.4.4) VCCI (5.3.3 I, II) Discrete Frequency Method
Horizontal (D=3 m, 10 m, H=2.0 m)	30 MHz to 1 GHz	1.3 dB	
Vertical (D=3 m, 10 m, H=2.75 m)		1.3 dB	

2015-12-16 through 2016-12-31

Effective dates

For the National Voluntary Laboratory Accreditation Program



**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 100290-0**

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Horizontal (D=3 m, H=1.0 m)	30 MHz to 1 GHz	1.3 dB	Swept Frequency Method		
Vertical (D=3 m, H=1.0 m)		1.5 dB			
Vertical (D=3 m, H=1.5 m)		1.5 dB			
Horizontal (D=3 m, H=2.0 m)		1.4 dB			
Horizontal (D=10 m, H=1.0 m)		1.3 dB			
Vertical (D=10 m, H=1.0 m)		1.5 dB			
Vertical (D =10 m, H=1.5 m)		1.5 dB			
Horizontal (D=10 m, H=2.0 m)		1.3 dB			
Evaluation of Set-up Table $U_{table}$		200 MHz to 1 GHz		1.1 dB	CISPR 16-1-4 (5.5.2)
		1 GHz to 6 GHz		1.2 dB	
		6 GHz to 18 GHz		1.3 dB	
S/N	200 MHz to 1 GHz	4.1 dB	CISPR 16-1-4 (8.3.3) VCCI (VI)		
	1 GHz to 18 GHz	3.9 dB			
Site VSWR Measurement Field calibrations available <sup>Note 4</sup>	1 GHz to 6 GHz	1.1 dB			
Site VSWR	6 GHz to 18 GHz	1.3 dB			
S/N	1 GHz to 18 GHz	3.9 dB			
<b>RF/MICROWAVE POWER (20/R17)</b>					
CISPR Receiver (50 $\Omega$ Nominal) Field calibrations available <sup>Note 4</sup>			CISPR 16-1-1		
Input Impedance	9 kHz to 6 GHz	1.3 %			
	6 GHz to 26.5 GHz	1.2 %			

2015-12-16 through 2016-12-31

Effective dates

For the National Voluntary Laboratory Accreditation Program



**National Voluntary  
Laboratory Accreditation Program**



**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 100290-0**

**CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) <sup>Notes 1,2</sup>**

<b>Measured Parameter or Device Calibrated</b>	<b>Range</b>	<b>Uncertainty (<math>k=2</math>) <sup>Note 3,5</sup></b>	<b>Remarks</b>
Sine Wave Voltage Accuracy	9 kHz to 4 GHz	0.39 dB	
	4 GHz to 18 GHz	1.3 dB	
	18 GHz to 40 GHz	2.3 dB	
Overall Selectivity	9 kHz to 4GHz	1.3 dB	
Amplitude (absolute)	9 kHz to 1 GHz	0.4 dB	
Amplitude (relative)	9 kHz to 1 GHz	0.35 dB	
Spectrum Analyzer, RF Voltmeter Field calibrations available <sup>Note 4</sup>			
Frequency Response	10 Hz to 1 GHz	0.40 dB	
	1 GHz to 18 GHz	0.56 dB	
	18 GHz to 40 GHz	1.0 dB	
Reference Level	40 dB $\mu$ V to 100 dB $\mu$ V	0.50 dB	
Input Attenuator	0 dB to 60 dB	0.35 dB	
Signal Generators, RF Generator Field calibrations available <sup>Note 4</sup>			
Frequency Response	9 kHz to 1 GHz	0.07 dB	
	1 GHz to 18 GHz	0.27 dB	
	18 GHz to 40 GHz	0.78 dB	
Spurious Harmonics	9 kHz to 1 GHz	0.69 dB	
	1 GHz to 6 GHz	0.97 dB	
Power Meter			
Termination Type	9 kHz to 1 GHz	1.5 %	
	1 GHz to 18 GHz	1.8 %	
	18 GHz to 40 GHz	6.9 %	
Through Line Type	9 kHz to 6 GHz	3.3 %	
Reference & Other Signal Sources	10 MHz to 18 GHz	0.08 dB	

*John S. Laman*

2015-12-16 through 2016-12-31

Effective dates

For the National Voluntary Laboratory Accreditation Program



# National Voluntary Laboratory Accreditation Program



**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 100290-0**

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Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <sup>Note 3,5</sup>	Remarks
Disturbance / Click Analyzer Amplitude	60 dB $\mu$ V to 120 dB $\mu$ V	0.56 dB	
<b>SCATTERING PARAMETERS (20/R18)</b>			
Electrostatic Discharge Generator Current Target Annex B Transfer Impedance $Z_{sys}$ , DC	1 $\Omega$ to 600 $\Omega$	1.1 %	IEC 61000-4-2, ISO 10605
VSWR (1 to 2)	10 Hz to 1 GHz 1 GHz to 6 GHz 6 GHz to 26.5 GHz	0.41 % 1.3 % 1.2 %	Gamma, Impedance, and Return Loss measurements also available
CDNs, CDNE Field calibrations available <sup>Note 4</sup>			CISPR 16-1-2, IEC 61000-4-6, CISPR 20
Insertion Loss (0 dB to 50 dB)	9 kHz to 80 MHz 80 MHz to 300 MHz	0.50 dB 0.48 dB	
Voltage Division Factor	9 kHz to 30 MHz 30 MHz to 300 MHz	0.50 dB 0.48 dB	
Isolation	9 kHz to 30 MHz 30 MHz to 300 MHz	0.52 dB 1.1 dB	
Phase	9 kHz to 80 MHz 80 MHz to 300 MHz	1.4 % 1.4 %	
Impedance (Nominal 150 $\Omega$ )	9 kHz to 80 MHz 80 MHz to 300 MHz	1.9 % 1.8 %	
150 $\Omega$ Adapter Field calibrations available <sup>Note 4</sup>			CISPR 16-1-2, IEC 61000-4-6
Insertion Loss	9 kHz to 80 MHz 80 MHz to 300 MHz	0.54 dB 0.48 dB	
Impedance	9 kHz to 80 MHz 80 MHz to 300 MHz	0.66 % 6.0 %	

2015-12-16 through 2016-12-31

Effective dates

For the National Voluntary Laboratory Accreditation Program





**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 100290-0**

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<b>Measured Parameter or Device Calibrated</b>	<b>Range</b>	<b>Uncertainty (<math>k=2</math>) <sup>Note 3,5</sup></b>	<b>Remarks</b>
Voltage Probe Field calibrations available <sup>Note 4</sup>			CISPR 16-1-2
Insertion Loss, VDF	9 kHz to 30 MHz	0.49 dB	
Impedance	9 kHz to 30 MHz	3.4 %	
Current Probe, Injection Probe Field calibrations available <sup>Note 4</sup>			CISPR 16-1-2
Insertion Impedance	10 Hz to 500 MHz	1.7 %	
Capacitive Voltage Probe Field calibrations available <sup>Note 4</sup>			CISPR 16-1-2
Insertion Loss, VDF	9 kHz to 30 MHz	0.56 dB	
Insertion Loss with Influence of External Electric Field	9 kHz to 30 MHz	1.9 dB	
ISNs Field calibrations available <sup>Note 4</sup>			CISPR 16-1-2
Asymmetric Impedance	9 kHz to 80 MHz	2.2 %	
Asymmetric Impedance Phase		0.44 %	
LCL $\leq 55$ dB		0.43 dB	
LCL $\leq 65$ dB		0.63 dB	
LCL $\leq 75$ dB		2.3 dB	
Decoupling Attenuation		1.2 dB	
Symmetric Insertion Loss		0.07 dB	
Voltage Division Factor		0.12 dB	
Symmetric Impedance		2.2 %	
Absorbing Clamp Clamp Factor	30 MHz to 1 GHz	2.0 dB	CISPR 16-1:1999

2015-12-16 through 2016-12-31

Effective dates

For the National Voluntary Laboratory Accreditation Program



**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 100290-0**

**CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) <sup>Notes 1,2</sup>**

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <sup>Note 3,5</sup>	Remarks
Clamp Factor Original Method		0.6 dB	CISPR 16-1-3
Clamp Factor Jig Method		0.82 dB	
Decoupling Factor		3.6 dB	
Decoupling Ratio for CMD		3.0 dB	
EM, Injection Clamp Field calibrations available <sup>Note 4</sup>			IEC 61000-4-6
Coupling Factor	9 kHz to 100 kHz	0.56 dB	
	100 kHz to 230 MHz	0.53 dB	
	230 MHz to 1 GHz	1.3 dB	
Decoupling Factor	9 kHz to 100 kHz	0.50 dB	
	100 kHz to 230 MHz	0.52 dB	
	230 MHz to 1 GHz	1.3 dB	
Impedance	9 kHz to 100 kHz	2.8 %	
	100 kHz to 230 MHz	13.6 %	
	230 MHz to 1 GHz	16.9 %	
Directional Coupler Field calibrations available <sup>Note 4</sup>			CISPR 16-1-1
Insertion Loss, Coupling Factor, Directivity, Isolation (0 dB to 100 dB)	10 kHz to 1 GHz	0.12 dB	
	1 GHz to 40 GHz	0.20 dB	
CISPR Receiver 50 $\Omega$ Input Field calibrations available <sup>Note 4</sup>			
Random Noise	9 kHz to 4 GHz	0.31 dB	

2015-12-16 through 2016-12-31

Effective dates

For the National Voluntary Laboratory Accreditation Program



**National Voluntary  
Laboratory Accreditation Program**



**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 100290-0**

**CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) <sup>Notes 1,2</sup>**

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <sup>Note 3,5</sup>	Remarks
Response to Intermittent, unsteady and Drifting narrowband disturbances	9 kHz to 1 GHz	0.84 dB	CISPR 16-1-2, ANSI C63.4, CISPR 25, ISO 7637-2, IEC 61000-4-6 and RTCA/DO-160F
LISNs			
Field calibrations available <sup>Note 4</sup>			
Insertion Loss (0 dB to 50 dB)	9 kHz to 30 MHz 30 MHz to 200 MHz	0.20 dB 0.44 dB	
Isolation (0 dB to 100 dB) (Balance of Delta Network)	9 kHz to 30 MHz 30 MHz to 200 MHz	0.50 dB 1.4 dB	
Impedance	9 kHz to 30 MHz 30 MHz to 200 MHz	1.4 % 6.6 %	
Phase	9 kHz to 30 MHz 30 MHz to 200 MHz	0.94° 5.6°	
Voltage Drop Ratio	50 Hz, 60 Hz	0.30 %	
Frequency Response Gain	10 Hz to 10 kHz 10 kHz to 1 GHz 1 GHz to 40 GHz	0.48 dB 0.33 dB 0.42 dB	
Field calibrations available <sup>Note 4</sup>			
Frequency Response Insertion Loss	10 Hz to 10 kHz 10 kHz to 1 GHz 1 GHz to 40 GHz 40 GHz to 67 GHz	0.27 dB 0.12 dB 0.20 dB 0.24 dB	IEC 61000-4-2, ISO 10605
Field calibrations available <sup>Note 4</sup>			
Electrostatic Discharge Generator Current Target Annex B Insertion Loss to 4 GHz	100 kHz to 4 GHz	0.3 dB	
Test Load (50 Ω and 1000 Ω) Insertion Loss (0 dB to 70 dB)	10 kHz to 500 MHz	0.12 dB	IEC 61000-4-4

2015-12-16 through 2016-12-31

Effective dates

For the National Voluntary Laboratory Accreditation Program



**National Voluntary  
Laboratory Accreditation Program**




**CALIBRATION LABORATORIES**

**NVLAP LAB CODE 100290-0**

**CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) <sup>Notes 1,2</sup>**

<b>Measured Parameter or Device Calibrated</b>	<b>Range</b>	<b>Uncertainty (<math>k=2</math>) <sup>Note 3,5</sup></b>	<b>Remarks</b>
CMAD S11	30 MHz to 200 MHz 200 MHz to 1 GHz	0.63 % 0.97 %	CISPR 16-1-4
S21	30 MHz to 200 MHz 200 MHz to 1 GHz	1.6 % 1.6 %	
END			

2015-12-16 through 2016-12-31  
Effective dates

  
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For the National Voluntary Laboratory Accreditation Program



CALIBRATION LABORATORIES

NVLAP LAB CODE 100290-0

Notes

**Note 1:** A Calibration and Measurement Capability (CMC) is a description of the best result of a calibration or measurement (result with the smallest uncertainty of measurement) that is available to the laboratory's customers under normal conditions, when performing more or less routine calibrations of nearly ideal measurement standards or instruments. The CMC is described in the laboratory's scope of accreditation by: the measurement parameter/device being calibrated, the measurement range, the uncertainty associated with that range (see note 3), and remarks on additional parameters, if applicable.

**Note 2:** Calibration and Measurement Capabilities are traceable to the national measurement standards of the U.S. or to the national measurement standards of other countries and are thus traceable to the internationally accepted representation of the appropriate SI (Système International) unit.

**Note 3:** The uncertainty associated with a measurement in a CMC is an expanded uncertainty with a level of confidence of approximately 95 %, typically using a coverage factor of  $k = 2$ . However, laboratories may report a coverage factor different than  $k = 2$  to achieve the 95 % level of confidence. Units for the measurand and its uncertainty are to match. Exceptions to this occur when marketplace practice employs mixed units, such as when the artifact to be measured is labeled in non-SI units and the uncertainty is given in SI units (Example: 5 lb weight with uncertainty given in mg).

**Note 3a:** The uncertainty of a specific calibration by the laboratory may be greater than the uncertainty in the CMC due to the condition and behavior of the customer's device and specific circumstances of the calibration. The uncertainties quoted do not include possible effects on the calibrated device of transportation, long term stability, or intended use.

**Note 3b:** As the CMC represents the best measurement results achievable under normal conditions, the accredited calibration laboratory shall not report smaller uncertainty of measurement than that given in a CMC for calibrations or measurements covered by that CMC.

**Note 3c:** As described in Note 1, CMCs cover calibrations and measurements that are available to the laboratory's customers under *normal conditions*. However, the laboratory may have the capability to offer special tests, employing special conditions, which yield calibration or measurement results with lower uncertainties. Such special tests are not covered by the CMCs and are outside the laboratory's scope of accreditation. In this case, NVLAP requirements for the labeling, on calibration reports, of results outside the laboratory's scope of accreditation apply. These requirements are set out in Annex A.1.h. of NIST Handbook 150, Procedures and General Requirements.

**Note 4:** Uncertainties associated with field service calibration may be greater as they incorporate on-site environmental contributions, transportation effects, or other factors that affect the measurements. (This note applies only if marked in the body of the scope.)

**Note 5:** Values listed with percent (%) are percent of reading or generated value unless otherwise noted.

**Note 6:** NVLAP accreditation is the formal recognition of specific calibration capabilities. Neither NVLAP nor NIST guarantee the accuracy of individual calibrations made by accredited laboratories.

**Note 7:** See [NIST Handbook 150](#) for further explanation of these notes.

**Note 8:** All antenna calibrations required to be conducted on an open test site (OATS) are performed on the Intertek OATS that has been fully qualified as a standard antenna calibration site (SACS) following the requirements of ANSI standard C63.5, 2006. Antennas so calibrated are qualified for all uses such as testing and site characterization as respectively required in the C63 standards.

2015-12-16 through 2016-12-31

Effective dates

For the National Voluntary Laboratory Accreditation Program