



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

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

<b>Sandia National Laboratories</b> Primary Standard Laboratory P.O. Box 5800, Mail Stop 0665 Albuquerque, NM 87185-0665 Dr. Eric Detlefs Phone: 505-845-8961 Fax: 505-844-4372 E-mail: <a href="mailto:ehdetle@sandia.gov">ehdetle@sandia.gov</a> URL: <a href="http://www.sandia.gov/pls/PSLHOME.HTML">http://www.sandia.gov/pls/PSLHOME.HTML</a>	<b>Parameter(s) of Accreditation</b> Dimensional Electromagnetics – DC/Low Frequency Time and Frequency Ionizing Radiation Mechanical Electromagnetics – RF/Microwave Thermodynamic  This laboratory is compliant to ANSI/NCSL Z540-1-1994; Part 1. (NVLAP Code: 20/A01)
--	--

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

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <sup>Note 3</sup>	Remarks
<b>DIMENSIONAL</b>			
<b>NVLAP Code: 20/D01</b> <b>ANGULAR</b> Angle Blocks Optical Squares True Squares		0.50" 0.46" 0.10"	Standard Sizes, 1" to 45°
Angular/Rotary Index Tables and Optical Polygons	30° increments 30° increments	Approximate value. Actual value determined by test results. 0.06" 0.50"	Stack method Comparison method
<b>NVLAP Code: 20/D03</b> <b>GAGE BLOCKS</b>			
Gage Blocks	0 mm to 100 mm 0 in to 4 in	35 nm + 0.19L nm 1.38 $\mu$ in + 0.19L $\mu$ in	Interferometry, Single wring, L is the length in mm of device under test. L is the length in inches of

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
			device under test.
Approximate value. Actual value determined by test results.			
	< 1 mm < 0.04 in	41 nm 1.6 $\mu$ in	Mechanical Comparison to Masters
	1 mm to 100 mm	37 nm + 0.32L nm	$L$ is the length in mm of device under test.
	0.04 in to 4 in	1.46 $\mu$ in + 0.32L $\mu$ in	$L$ is the length in inches of device under test.
	125 mm to 500 mm	127 nm + 0.36L nm	$L$ is the length in mm of device under test.
	5 in to 20 in	5.0 $\mu$ in + 0.36L $\mu$ in	$L$ is the length in inches of device under test.
<b>NVLAP Code: 20/D07 MEASURING WIRES</b>		Approximate value. Actual value determined by test results.  190 nm	
All Standard Thread Measuring Wires	29° and 60°		Comparison to NIST-calibrated Masters, 7.3 $\mu$ in
<b>NVLAP Code: 20/D08 OPTICAL REFERENCE PLANES</b>		Approximate value. Actual value determined by test results.  1.2 $\mu$ in	
Optical Reference Planes, Diameter	0 in to 10 in		Comparison to NIST-calibrated Masters, 30 nm
<b>NVLAP Code: 20/D09 ROUNDNESS</b>		Approximate value. Actual value determined by test results.  5.4 nm + 5.1 % of value 0.2 $\mu$ in + 5.1 % of value  10.6 nm + 6.8 % of value	
Roundness	0 in to 100 mm 0 in to 4 in  0 in to 350 mm		Spindle error deconvolution at limited points.  Spindle-compensated trace. Uncertainty will increase for large artifacts.

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
	0 in to 14 in	0.42 $\mu$ in + 6.8 % of value	
<b>NVLAP Code: 20/D11</b> <b>SPHERICAL DIAMETER;</b> <b>PLUG/RING GAGES</b> Gaging Balls Calibration Spheres	1 mm to 25 mm 0.03125 in to 1 in	160 nm 6.3 $\mu$ in	Comparison to NIST-calibrated Masters
Plain plug/ring gages	0 in to 250 mm 0 in to 10 in	94 nm + 1.1L nm 3.7 $\mu$ in + 1.1L $\mu$ in	$L$ is the length in mm of device under test. $L$ is the length in inches of device under test.
Plain ring gages	0 in to 250 mm 0 in to 10 in	200 + 0.90L 8.0 + 0.90L	$L$ is the length in mm of device under test. $L$ is the length in inches of device under test.
<b>NVLAP Code: 20/D12</b> <b>SURFACE TEXTURE</b>	1.0 $\mu$ in to 500 $\mu$ in (0.025 $\mu$ m to 12.7 $\mu$ m)	Approximate value. Actual value determined by test results.	
Step Height Standards	0 $\mu$ in to 25 $\mu$ in 26 $\mu$ in to 125 $\mu$ in 126 $\mu$ in to 500 $\mu$ in	0.81 $\mu$ in + 1.2 % of value 4.0 $\mu$ in + 0.68 % of value 16 $\mu$ in + 0.47 % of value	
Roughness Average (Ra)	0 $\mu$ in to 7 $\mu$ in 8 $\mu$ in to 32 $\mu$ in 33 $\mu$ in to 150 $\mu$ in	0.33 $\mu$ in + 0.87 % of value 0.92 $\mu$ in + 0.74 % of value 3.5 $\mu$ in + 0.61 % of value	
<b>NVLAP Code: 20/D16</b> <b>CORRDINATE</b>		Approximate value. Actual	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
<b>MEASURING MACHINES</b>		value determined by test results.	
Dimensional Gages	0 m to 1 m	$0.2 \mu\text{m} + 0.76L \mu\text{m}$	1 D, $L$ is the length in m of device under test.
	0 m to 1.4 m	$0.34 \mu\text{m} + 1.2L \mu\text{m}$	2 D, $L$ is the length in m of device under test.
<b>ELECTROMAGNETICS – DC/LOW FREQUENCY</b>			
NVLAP Code: 20/E01 <b>VOLTAGE/CURRENT CONVERTORS (to 1 MHz)</b> Current/AC-DC Difference, 100 Hz	10 mA 25 mA 50 mA 100 mA 250 mA 0.5 A 1.0 A 2.5 A 5.0 A 10.0 A 16.0 A	55 $\mu\text{A}/\text{A}$ 54 $\mu\text{A}/\text{A}$ 58 $\mu\text{A}/\text{A}$ 59 $\mu\text{A}/\text{A}$ 56 $\mu\text{A}/\text{A}$ 56 $\mu\text{A}/\text{A}$ 58 $\mu\text{A}/\text{A}$ 80 $\mu\text{A}/\text{A}$ 68 $\mu\text{A}/\text{A}$ 77 $\mu\text{A}/\text{A}$ 100 $\mu\text{A}/\text{A}$	
50 kHz	10 mA 25 mA 50 mA 100 mA 250 mA 0.5 A 1.0 A 2.5 A 5.0 A 10.0 A 16.0 A	99 $\mu\text{A}/\text{A}$ 99 $\mu\text{A}/\text{A}$ 100 $\mu\text{A}/\text{A}$ 110 $\mu\text{A}/\text{A}$ 110 $\mu\text{A}/\text{A}$ 140 $\mu\text{A}/\text{A}$ 120 $\mu\text{A}/\text{A}$ 130 $\mu\text{A}/\text{A}$ 160 $\mu\text{A}/\text{A}$ 180 $\mu\text{A}/\text{A}$ 220 $\mu\text{A}/\text{A}$	
100 kHz	10 mA	130 $\mu\text{A}/\text{A}$	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
	25 mA 50 mA 100 mA 250 mA 0.5 A 1.0 A 2.5 A 5.0 A 10.0 A 16.0 A	130 $\mu\text{A}/\text{A}$ 140 $\mu\text{A}/\text{A}$ 150 $\mu\text{A}/\text{A}$ 160 $\mu\text{A}/\text{A}$ 160 $\mu\text{A}/\text{A}$ 170 $\mu\text{A}/\text{A}$ 180 $\mu\text{A}/\text{A}$ 210 $\mu\text{A}/\text{A}$ 250 $\mu\text{A}/\text{A}$ 280 $\mu\text{A}/\text{A}$	
<b>NVLAP Code: 20/E03</b> <b>CAPACITANCE</b> <b>DIVIDERS</b> Capacitance Voltage Dividers – Pulsed High-Voltage Condition 1 $\mu\text{s}$ to 30 $\mu\text{s}$ Pulse	1 kV to 350 kV	2.0 %	
<b>NVLAP Code: 20/E05</b> <b>DC RESISTANCE AND CURRENT</b>			
DC Resistance	0.0001 $\Omega$ to 0.001 $\Omega$ 0.001 $\Omega$ to 0.01 $\Omega$ 0.01 $\Omega$ to 0.1 $\Omega$ 0.1 $\Omega$ to 1 $\Omega$  1 $\Omega$  1 $\Omega$ to 10 $\Omega$ 10 $\Omega$ to 100 $\Omega$ 100 $\Omega$ to 1000 $\Omega$ 1000 $\Omega$ to 10 k $\Omega$  $10^4$ $\Omega$ to $10^5$ $\Omega$ $10^5$ $\Omega$ to $10^6$ $\Omega$ $10^6$ $\Omega$ to $10^7$ $\Omega$	5 $\mu\Omega/\Omega$ 0.35 $\mu\Omega/\Omega$ 0.29 $\mu\Omega/\Omega$ 0.21 $\mu\Omega/\Omega$  0.055 $\mu\Omega/\Omega$  0.076 $\mu\Omega/\Omega$ 0.09 $\mu\Omega/\Omega$ 0.11 $\mu\Omega/\Omega$ 0.15 $\mu\Omega/\Omega$  0.20 $\mu\Omega/\Omega$ 0.25 $\mu\Omega/\Omega$ 0.29 $\mu\Omega/\Omega$	6010 + 6011 System Time of Test  6010 + 4220 + double substitution Time of Test 6010 + 4220 System Time of Test  6000 + 4220A System Time of Test

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
Shunts	$10^7 \Omega$ to $10^8 \Omega$	0.58 $\mu\Omega/\Omega$	6010 + 4220 System Time of Test 6000 + 4220A System Time of Test Teraohm Meter
	$10^8 \Omega$ to $10^9 \Omega$	5.0 $\mu\Omega/\Omega$	
	$10^9 \Omega$ to $10^{10} \Omega$	470 $\mu\Omega/\Omega$	
	$10^{10} \Omega$ to $10^{11} \Omega$	670 $\mu\Omega/\Omega$	
	$10^{11} \Omega$ to $10^{12} \Omega$	1400 $\mu\Omega/\Omega$	
	$10^{12} \Omega$ to $10^{13} \Omega$	2000 $\mu\Omega/\Omega$	
	$10^{13} \Omega$ to $10^{14} \Omega$	3300 $\mu\Omega/\Omega$	
	$10^{14} \Omega$ to $10^{15} \Omega$	6700 $\mu\Omega/\Omega$	
	$10^{15} \Omega$ to $10^{16} \Omega$	7.0 %	
	100 mA to 2500 A	2.5 $\mu\Omega/\Omega$	
DC Current	1 $\Omega$ and 1.9 $\Omega$	97 $\mu\Omega/\Omega$	Comparison method
	10 $\Omega$ and 19 $\Omega$	23 $\mu\Omega/\Omega$	
	100 $\Omega$ and 190 $\Omega$	10 $\mu\Omega/\Omega$	
	1 k $\Omega$ , 1.9 k $\Omega$ , 10 k $\Omega$ , 19 k $\Omega$	9 $\mu\Omega/\Omega$	
	100 k $\Omega$ and 190 k $\Omega$	11 $\mu\Omega/\Omega$	
	1 M $\Omega$ and 1.9 M $\Omega$	21 $\mu\Omega/\Omega$	
	10 M $\Omega$ and 19 M $\Omega$	51 $\mu\Omega/\Omega$	
	100 M $\Omega$	102 $\mu\Omega/\Omega$	
	220 $\mu\text{A}$	43 $\mu\text{A}/\text{A} + 6 \text{nA}$	
	2.2 mA	37 $\mu\text{A}/\text{A} + 7 \text{nA}$	
NVLAP Code: 20/E06 <b>DC VOLTAGE</b>	22 mA	35 $\mu\text{A}/\text{A} + 40 \text{nA}$	Comparison method
	220 mA	48 $\mu\text{A}/\text{A} + 0.7 \mu\text{A}$	
	2.2 A	89 $\mu\text{A}/\text{A} + 12 \mu\text{A}$	
	11 A	370 $\mu\text{A}/\text{A} + 490 \mu\text{A}$	
DC Voltage	1.0 V to 1.018 V 10.0 V	0.14 $\mu\text{V}/\text{V}$ 0.017 $\mu\text{V}/\text{V}$	Josephson Array Systems, Zeners, and DVMs

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
Pressure Coefficient of Voltage for Solid State Voltage Standards	220 mV 2.2 V 11 V 22 V 220 V 1100 V  > 5 nV/hPa  0 nV/hPa to 5 nV/hPa	12.0 $\mu\text{V}/\text{V}$ + 0.4 $\mu\text{V}$ 5.8 $\mu\text{V}/\text{V}$ + 0.7 $\mu\text{V}$ 4.3 $\mu\text{V}/\text{V}$ + 2.5 $\mu\text{V}$ 4.3 $\mu\text{V}/\text{V}$ + 4 $\mu\text{V}$ 6.1 $\mu\text{V}/\text{V}$ + 40 $\mu\text{V}$ 7.3 $\mu\text{V}/\text{V}$ + 400 $\mu\text{V}$  2 nV/hPa  0.1 nV/hPa	Comparison method  - 2000 m to + 3000 m elevation (Difference Measurement) - 2000 m to + 3000 m elevation (Josephson Array Measurement)
Voltage divider – Potentiometer Combination	1.5 V to 1500 V  x 1.0 range to 1.05 V  x 1.0 range above 1.05 V  x 0.1 range  x 0.01 range	2.5 $\mu\text{V}/\text{V}$ 0.5 $\mu\text{V}/\text{V}$ of reading + 0.1 $\mu\text{V}$ 1.0 $\mu\text{V}/\text{V}$ of reading + 0.1 $\mu\text{V}$ 1.5 $\mu\text{V}/\text{V}$ of reading + 0.01 $\mu\text{V}$ 2.5 $\mu\text{V}/\text{V}$ of reading + 0.005 $\mu\text{V}$	Volt Box-Potentiometer, $k = 2$  Potentiometer only, $k = 3$
Automated Intermediate Voltage System	0 V to 10.0 V 10 V to 30 V 300 V to 1200 V	0.5 $\mu\text{V}/\text{V}$ + 0.2 $\mu\text{V}$ 1.4 $\mu\text{V}/\text{V}$ 4.0 $\mu\text{V}/\text{V}$	Automated Potentiometer System
High Voltage - Electrostatic Voltmeters, etc.	0 kV to 100 kV 100 kV to 200 kV 0 kV to 10 kV	106 $\mu\text{V}/\text{V}$ 140 $\mu\text{V}/\text{V}$ 2000 $\mu\text{V}/\text{V}$	200 kV system  10 kV system
Ratio/Bridges	1:1 to 1:100 000	0.05 (ratio)	For ratio based on 20 step

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
			first dial ( $k = 3$ ). For bridges, uncertainty combines ratio and resistance uncertainties.
<b>NVLAP Code: 20/E08</b> <b>INDUCTIVE DIVIDERS</b> Inductive Voltage Dividers, 50Hz 1kHz 10kHz	15 V, 35 V, 100 V 15 V, 35 V, 100 V 15 V, 35 V, 100 V	5 $\mu$ V/V 5 $\mu$ V/V 55 $\mu$ V/V	ESI Model 72A Std.
<b>NVLAP Code: 20/E09</b> <b>LF AC VOLTAGE</b> AC Voltage, 100 kHz	1 V 2 V 3 V 4 V 6 V 10 V 12 V 20 V 30 V 40 V 60 V 100 V 120 V 200 V 300 V 400 V 600 V 1200 V	4 $\mu$ V/V 10 $\mu$ V/V 11 $\mu$ V/V 10 $\mu$ V/V 9 $\mu$ V/V 11 $\mu$ V/V 13 $\mu$ V/V 11 $\mu$ V/V 14 $\mu$ V/V 21 $\mu$ V/V 14 $\mu$ V/V 23 $\mu$ V/V 19 $\mu$ V/V 35 $\mu$ V/V 45 $\mu$ V/V 51 $\mu$ V/V 59 $\mu$ V/V 49 $\mu$ V/V	
200 kHz	1 V 2 V 3 V 4 V	75 $\mu$ V/V 74 $\mu$ V/V 72 $\mu$ V/V 71 $\mu$ V/V	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
500 kHz	6 V	73 $\mu$ V/V	
	10 V	72 $\mu$ V/V	
	12 V	72 $\mu$ V/V	
	20 V	71 $\mu$ V/V	
	30 V	72 $\mu$ V/V	
	40 V	91 $\mu$ V/V	
	60 V	72 $\mu$ V/V	
	100 V	90 $\mu$ V/V	
	1 V	82 $\mu$ V/V	
	2 V	74 $\mu$ V/V	
1 MHz	3 V	77 $\mu$ V/V	
	4 V	71 $\mu$ V/V	
	6 V	75 $\mu$ V/V	
	10 V	71 $\mu$ V/V	
	12 V	73 $\mu$ V/V	
	20 V	72 $\mu$ V/V	
	30 V	77 $\mu$ V/V	
	40 V	110 $\mu$ V/V	
	60 V	74 $\mu$ V/V	
	100 V	91 $\mu$ V/V	
	1 V	86 $\mu$ V/V	
	2 V	76 $\mu$ V/V	
	3 V	81 $\mu$ V/V	
	4 V	71 $\mu$ V/V	
	6 V	81 $\mu$ V/V	
	10 V	74 $\mu$ V/V	
	12 V	72 $\mu$ V/V	
	20 V	71 $\mu$ V/V	
	30 V	78 $\mu$ V/V	
	40 V	71 $\mu$ V/V	
	60 V	73 $\mu$ V/V	
	100 V	130 $\mu$ V/V	

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <sup>Note 3</sup>	Remarks
AC Voltage – Measuring Equipment	0 mV to 2.2 mV	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	240 $\mu$ V/V + 4 $\mu$ V 90 $\mu$ V/V + 4 $\mu$ V 80 $\mu$ V/V + 4 $\mu$ V 200 $\mu$ V/V + 4 $\mu$ V 500 $\mu$ V/V + 4 $\mu$ V 1050 $\mu$ V/V + 10 $\mu$ V 1400 $\mu$ V/V + 20 $\mu$ V 2700 $\mu$ V/V + 20 $\mu$ V	Fluke 5720A / Fluke 5725A
	2.2 mV to 22 mV	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	240 $\mu$ V/V + 4 $\mu$ V 90 $\mu$ V/V + 4 $\mu$ V 80 $\mu$ V/V + 4 $\mu$ V 200 $\mu$ V/V + 4 $\mu$ V 500 $\mu$ V/V + 4 $\mu$ V 1050 $\mu$ V/V + 10 $\mu$ V 1400 $\mu$ V/V + 20 $\mu$ V 2700 $\mu$ V/V + 20 $\mu$ V	
	22 mV to 220 mV	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	240 $\mu$ V/V + 4 $\mu$ V 90 $\mu$ V/V + 7 $\mu$ V 80 $\mu$ V/V + 7 $\mu$ V 200 $\mu$ V/V + 7 $\mu$ V 460 $\mu$ V/V + 17 $\mu$ V 900 $\mu$ V/V + 20 $\mu$ V 1400 $\mu$ V/V + 25 $\mu$ V 2700 $\mu$ V/V + 45 $\mu$ V	
	220 mV to 2.2 V	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	240 $\mu$ V/V + 40 $\mu$ V 90 $\mu$ V/V + 15 $\mu$ V 45 $\mu$ V/V + 8 $\mu$ V 75 $\mu$ V/V + 10 $\mu$ V 110 $\mu$ V/V + 30 $\mu$ V 420 $\mu$ V/V + 80 $\mu$ V 1000 $\mu$ V/V + 200 $\mu$ V 1700 $\mu$ V/V + 300 $\mu$ V	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
AC Current – Measuring Equipment	2.2 V to 22 V 22 V to 220 V 220 V to 1100 V 220 V to 750 V 220 V to 1100 V 220 µA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz  10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz  15 Hz to 50 Hz 50 Hz to 1 kHz  30 kHz to 50 kHz 50 kHz to 100 kHz  40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 30 kHz  10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	240 µV/V + 400 µV 90 µV/V + 150 µV 45 µV/V + 50 µV 75 µV/V + 100 µV 100 µV/V + 200 µV 275 µV/V + 600 µV 1000 µV/V + 2000 µV 1500 µV/V + 3200 µV  240 µV/V + 4 mV 90 µV/V + 1.5 mV 52 µV/V + 0.6 mV 80 µV/V + 1 mV 150 µV/V + 2.5 mV 900 µV/V + 16 mV 4400 µV/V + 40 mV 8000 µV/V + 80 mV  300 µV/V + 16 mV 70 µV/V + 3.5 mV  600 µV/V + 11 mV 2300 µV/V + 45 mV  90 µV/V + 4 mV 165 µV/V + 6 mV 600 µV/V + 11 mV  250 µA/A + 16 nA 160 µA/A + 10 nA 120 µA/A + 8 nA 280 µA/A + 12 nA 1100 µA/A + 65 nA	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
	2.2 mA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	250 $\mu$ A/A + 40 nA 160 $\mu$ A/A + 35 nA 120 $\mu$ A/A + 35 nA 200 $\mu$ A/A + 110 nA 1100 $\mu$ A/A + 610 nA	
	22 mA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	250 $\mu$ A/A + 400 nA 160 $\mu$ A/A + 350 nA 120 $\mu$ A/A + 350 nA 200 $\mu$ A/A + 550 nA 1100 $\mu$ A/A + 5000 nA	
	220 $\mu$ A	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	250 $\mu$ A/A + 16 nA 160 $\mu$ A/A + 10 nA 120 $\mu$ A/A + 8 nA 280 $\mu$ A/A + 12 nA 1100 $\mu$ A/A + 65 nA	Fluke 5720A
	2.2 mA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	250 $\mu$ A/A + 40 nA 160 $\mu$ A/A + 35 nA 120 $\mu$ A/A + 35 nA 200 $\mu$ A/A + 110 nA 1100 $\mu$ A/A + 610 nA	
	22 mA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	250 $\mu$ A/A + 400 nA 160 $\mu$ A/A + 350 nA 120 $\mu$ A/A + 350 nA 200 $\mu$ A/A + 550 nA 1100 $\mu$ A/A + 5000 nA	
	220 mA	10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 1 kHz	240 $\mu$ A/A + 4 $\mu$ A 160 $\mu$ A/A + 3.5 $\mu$ A 120 $\mu$ A/A + 2.5 $\mu$ A	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
	22 A  11 A	1 kHz to 5 kHz 5 kHz to 10 kHz  20 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz  40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	200 $\mu\text{A}/\text{A}$ + 3.5 $\mu\text{A}$ 1100 $\mu\text{A}/\text{A}$ + 10 $\mu\text{A}$  260 $\mu\text{A}/\text{A}$ + 35 $\mu\text{A}$ 450 $\mu\text{A}/\text{A}$ + 80 $\mu\text{A}$ 7000 $\mu\text{A}/\text{A}$ + 160 $\mu\text{A}$  460 $\mu\text{A}/\text{A}$ + 170 $\mu\text{A}$ 950 $\mu\text{A}/\text{A}$ + 380 $\mu\text{A}$ 3600 $\mu\text{A}/\text{A}$ + 750 $\mu\text{A}$	Fluke 5720A / Fluke 5725A

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
<b>NVLAP Code: 20/E10</b> <b>LF CAPACITANCE</b> Capacitance 1 kHz	0.01 pF to 1000 pF	5 %	
<b>NVLAP Code: 20/E11</b> <b>LF INDUCTANCE</b> Inductance 100 Hz	50 $\mu\text{H}$ 100 $\mu\text{H}$ 200 $\mu\text{H}$ 500 $\mu\text{H}$ 1 mH 2 mH 5 mH 10 mH 20 mH	0.40 % 0.18 % 0.094 % 0.037 % 0.032 % 0.042 % 0.034 % 0.032 % 0.032 %	Represents uncertainty with coverage factor of $k = 3$ .

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
1 kHz	50 mH	0.031 %	
	100 mH	0.032 %	
	200 mH	0.03 %	
	500 mH	0.03 %	
	1 H	0.03 %	
	2 H	0.032 %	
	5 H	0.031 %	
	10 H	0.032 %	
	50 µH	0.31 %	
	100 µH	0.16 %	
	200 µH	0.076 %	
	500 µH	0.035 %	
	1 mH	0.032 %	
	2 mH	0.040 %	
	5 mH	0.034 %	
	10 mH	0.031 %	
	20 mH	0.033 %	
	50 mH	0.031 %	
	100 mH	0.034 %	
	200 mH	0.03 %	
	500 mH	0.03 %	
10 kHz	1 H	0.081 %	
	2 H	0.075 %	
	5 H	0.16 %	
	10 H	0.31 %	
	50 µH	0.31 %	
	100 µH	0.16 %	
	200 µH	0.075 %	
	500 µH	0.081 %	
	1 mH	0.080 %	
	2 mH	0.083 %	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
	50 mH 100 mH	0.077 % 0.090 %	
<b>NVLAP Code: 20/E18 RESISTANCE DIVIDERS</b> Resistive Voltage Dividers – Pulsed High-Voltage Condition 1 $\mu$ s to 30 $\mu$ s Pulse	1 kV to 350 kV	1.0 %	
<b>NVLAP Code: 20/E20 OSCILLOSCOPES</b> Pulse Amplitude (Digitized Waveform)	0.1 V to 200 V	0.25 % of pulse amplitude	NIST VPMS
<b>TIME and FREQUENCY</b>			
<b>NVLAP Code: 20/F01 FREQUENCY DISSEMINATION</b> Frequency Dissemination	0.1 MHz 1 MHz 5 MHz 10 MHz	$5 \times 10^{-13}$ Hz $5 \times 10^{-13}$ Hz $5 \times 10^{-13}$ Hz $5 \times 10^{-13}$ Hz	NIST FMAS
<b>NVLAP Code: 20/F03 OSCILLATOR CHARACTERIZATION</b> Oscillator Characterization – Phase	-180° to 360°	± 0.005°	
<b>NVLAP Code: 20/F04 PULSE WAVEFORM</b> Transition Duration Time Interval	< 17.5 ps > 500 ps	5 ps 500 ps	Fast Rise Pulse
<b>NVLAP Code: 20/F05 STOPWATCHES and TIMERS</b>			

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
Stopwatches and Timers	1 s to 24 h	0.05 s/day	Time base methods
<b>IONIZING RADIATION</b>			
<b>NVLAP Code: 20/I04 RADIOACTIVE SOURCES</b> Radioactive Sources			
Alpha Emission Rate	1 Bq to $2 \times 10^5$ Bq into $2\pi$	2.0 %	
Beta Emission Rate	10 Bq to $10^4$ Bq into $2\pi$	4.0 %	
<b>MECHANICAL</b>			
<b>NVLAP Code: 20/M05 FLOW RATE</b> Gas Flow	50 cc/min to 1200 L/min	0.5 %	
<b>NVLAP Code: 20/M06 FORCE</b>			
	Approximate value. Actual value determined by test results.		
	ASTM loading range classes (e.g., A, AA) are not used or reported.		
Force	100 lbf to 1000 lbf 1000 lbf to 100 000 lbf	0.0052 % 0.025 %	Primary Standard (Deadweight) Secondary Standards
<b>NVLAP Code: 20/M08 MASS</b> Metric	25 kg 20 kg 10 kg 5 kg 3 kg 2 kg 1 kg 500 g 300 g 200 g 100 g 50 g 30 g 20 g 10 g 5 g	18 mg 12 mg 4 mg 1.7 mg 0.7 mg 0.6 mg 0.11 mg 0.061 mg 0.069 mg 0.037 mg 0.033 mg 0.021 mg 0.020 mg 0.013 mg 0.0098 mg 0.0061 mg	Echelon II

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
	3 g	0.0086 mg	
	2 g	0.0050 mg	
	1 g	0.0050 mg	
	500 mg	0.0033 mg	
	300 mg	0.0031 mg	
	200 mg	0.0030 mg	
	100 mg	0.0029 mg	
	50 mg	0.0027 mg	
	30 mg	0.0026 mg	
	20 mg	0.0025 mg	
	10 mg	0.0023 mg	
	5 mg	0.0020 mg	
	3 mg	0.0018 mg	
	2 mg	0.0016 mg	
	1 mg	0.0014 mg	
<b>NVLAP Code: 20/M11</b> <b>VIBRATION</b> Acceleration/Vibration – Range: 1 gn to 50 gn	10 Hz to 10 000 Hz	2.5 %	
Long Stroke Capability – 0.05 gn	1 Hz	2.5 %	
0.2 gn	2 Hz	2.5 %	
1 gn	5 Hz	2.5 %	
Shock	500 gn to 10 000 gn	4 %	
Static Acceleration - Centrifuge	25 gn to 1000 gn	0.5 %	
<b>NVLAP Code: 20/M15</b> <b>TORQUE</b>		Approximate value. Actual value determined by test results. 0.4 %	
Torque	5 lb-in to 1000 lb-ft		
<b>ELECTROMAGNETICS – RF/MICROWAVE</b>			
<b>NVLAP Code: 20/R05</b>			

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
<b>HF CAPACITANCE</b>			
HF Capacitance			
100 Hz	1 pF 10 pF 100 pF 1000 pF	0.01 % 0.01 % 0.01 % 0.01 %	
1 kHz	0.01 pF 0.1 pF 1 pF 10 pF 100 pF 1000 pF	0.20 % 0.05 % 0.02 % 0.01 % 0.01 % 0.01 %	
	1 pF 2 pF 5 pF 10 pF 20 pF	0.02 % 0.02 % 0.02 % 0.10 % 0.10 %	
	10 pF 100 pF	0.0001 % 0.0001 %	
	1 pF 10 pF 100 pF 1000 pF	0.002 % 0.002 % 0.002 % 0.002 %	
10 kHz	1 pF 10 pF 100 pF 1000 pF	0.006 % 0.0025 % 0.0044 % 0.0043 %	
100 kHz	0.01 pF 0.1 pF 1 pF	1.3 % 1.3 % 0.04 %	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
	10 pF	0.02 %	
	100 pF	0.01 %	
	1000 pF	0.03 %	
	1 pF	0.2 %	
	2 pF	0.35 %	
	5 pF	0.22 %	
	10 pF	0.14 %	
	20 pF	0.13 %	
	50 pF	0.03 %	
	100 pF	0.02 %	
	200 pF	0.01 %	
	500 pF	0.02 %	
	1000 pF	0.02 %	
	1 pF	0.02 %	
	10 pF	0.0025 %	
	100 pF	0.0044 %	
	1000 pF	0.0048 %	
	1 pF	0.30 %	
	2 pF	0.60 %	
	5 pF	0.26 %	
	10 pF	0.15 %	
	20 pF	0.11 %	
	50 pF	0.02 %	
	100 pF	0.02 %	
	200 pF	0.01 %	
	500 pF	0.01 %	
	1000 pF	0.03 %	
	1 pF	0.18 %	
	10 pF	0.003 %	
	100 pF	0.004 %	
	1000 pF	0.003 %	
<b>NVLAP Code: 20/R06</b>			

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
<b>HF INDUCTANCE</b>			
HF Inductance			
10 kHz	0.25 $\mu$ H	1.2 %	
	1 $\mu$ H	0.4 %	
	10 $\mu$ H	0.4 %	
	100 $\mu$ H	0.2 %	
100 kHz	0.1 $\mu$ H	3.1 %	
	0.2 $\mu$ H	1.6 %	
	0.5 $\mu$ H	0.93 %	
	1 $\mu$ H	0.75 %	
	2 $\mu$ H	0.36 %	
	5 $\mu$ H	0.27 %	
	10 $\mu$ H	0.29 %	
	25 $\mu$ H	0.27 %	
	50 $\mu$ H	0.22 %	
	100 $\mu$ H	0.21 %	
	250 $\mu$ H	0.26 %	
	500 $\mu$ H	0.26 %	
	1 mH	0.29 %	
	2.5 mH	0.25 %	
	5 mH	0.18 %	
	10 mH	0.17 %	
	25 mH	0.25 %	
	0.25 $\mu$ H	1.4 %	
	1 $\mu$ H	0.5 %	
	10 $\mu$ H	0.4 %	
	100 $\mu$ H	0.2 %	
1 MHz	0.1 $\mu$ H	4.7 %	
	0.2 $\mu$ H	1.7 %	
	0.5 $\mu$ H	0.97 %	
	1 $\mu$ H	0.77 %	
	2 $\mu$ H	0.76 %	
	5 $\mu$ H	0.69 %	
	10 $\mu$ H	0.72 %	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
	25 $\mu$ H	0.65 %	
	50 $\mu$ H	0.68 %	
	100 $\mu$ H	0.62 %	
	250 $\mu$ H	0.22 %	
	500 $\mu$ H	0.3 %	
	0.25 $\mu$ H	1.7 %	
	1 $\mu$ H	0.9 %	
	10 $\mu$ H	0.6 %	
	100 $\mu$ H	0.2 %	
10 MHz	0.25 $\mu$ H	0.8 %	
	1 $\mu$ H	0.6 %	
	10 $\mu$ H	0.1 %	
<b>NVLAP Code: 20/R10</b> <b>Q-STANDARDS</b> Q-Standards 50 kHz to 45 MHz	Selected values from 95 Q to 607 Q	1.2 % to 4.5 %	Dependent on Q value and frequency

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
<b>NVLAP Code: 20/R11</b> <b>RF-DC VOLTAGE/CURRENT CONVERTER</b> RF-DC Difference, High Frequency TVC	0.5 V	1MHz 10 MHz 20 MHz 30 MHz 40 MHz	0.03 % 0.05 % 0.06 % 0.13 % 0.12 %	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
		5 MHz	0.21 %	
		60 MHz	0.24 %	
		70 MHz	0.30 %	
		80 MHz	0.38 %	
		90 MHz	0.39 %	
		100 MHz	0.41 %	
	1 V	1MHz	0.03 %	
		10 MHz	0.05 %	
		20 MHz	0.06 %	
		30 MHz	0.08 %	
		40 MHz	0.12 %	
		5 MHz	0.19 %	
		60 MHz	0.23 %	
		70 MHz	0.30 %	
		80 MHz	0.38 %	
		90 MHz	0.39 %	
		100 MHz	0.75 %	
	2 V	1MHz	0.03 %	
		10 MHz	0.05 %	
		20 MHz	0.06 %	
		30 MHz	0.09 %	
		40 MHz	0.12 %	
		5 MHz	0.19 %	
		60 MHz	0.23 %	
		70 MHz	0.29 %	
		80 MHz	0.37 %	
		90 MHz	0.37 %	
		100 MHz	0.71 %	
	3 V	1MHz	0.03 %	
		10 MHz	0.05 %	
		20 MHz	0.06 %	
		30 MHz	0.09 %	
		40 MHz	0.12 %	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
		5 MHz	0.17 %	
		60 MHz	0.23 %	
		70 MHz	0.29 %	
		80 MHz	0.37 %	
		90 MHz	0.37 %	
		100 MHz	0.55 %	
	5 V	1MHz	0.03 %	
		10 MHz	0.05 %	
		20 MHz	0.06 %	
		30 MHz	0.14 %	
		40 MHz	0.51 %	
		5 MHz	0.17 %	
		60 MHz	0.24 %	
		70 MHz	0.30 %	
		80 MHz	0.38 %	
		90 MHz	0.39 %	
		100 MHz	0.44 %	
	10 V	1MHz	0.03 %	
		10 MHz	0.06 %	
		20 MHz	0.06 %	
		30 MHz	0.10 %	
		40 MHz	0.12 %	
		5 MHz	0.18 %	
		60 MHz	0.25 %	
		70 MHz	0.31 %	
		80 MHz	0.39 %	
		90 MHz	0.41 %	
		100 MHz	0.43 %	
	20 V	1MHz	0.04 %	
		10 MHz	0.06 %	
		20 MHz	0.07 %	
		30 MHz	0.10 %	
		40 MHz	0.12 %	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
		5 MHz	0.18 %	
		60 MHz	0.24 %	
		70 MHz	0.30 %	
		80 MHz	0.38 %	
		90 MHz	0.38 %	
		100 MHz	0.45 %	
	50 V	1MHz	0.04 %	
		10 MHz	0.06 %	
		20 MHz		
		30 MHz	1.2 %	
		40 MHz		
		5 MHz	0.34 %	
		60 MHz		
		70 MHz		
		80 MHz		
		90 MHz		
		100 MHz	0.93 %	
<b>NVLAP Code: 20/R12</b> <b>RF / MICROWAVE</b> <b>BOLOMETER UNITS</b>				
Calibration Factor: Connector Type N	Approximate value. Actual value determined by test results.			
	The uncertainty ranges are the lowest and highest uncertainty ( $\pm$ ) values within the specified frequency range and quantity range.			
	0.9 to 1	10 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 12 GHz	0.003 to 0.008 0.003 to 0.006 0.004 to 0.007	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
APC-3.5	0.9 to 1	12 GHz to 18 GHz 2 GHz to 8 GHz 8 GHz to 12 GHz 12 GHz to 18 GHz	0.005 to 0.010 0.007 to 0.009 0.009 to 0.010 0.010 to 0.011	
Effective Efficiency: Connector Type N	0.9 to 1	10 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 12 GHz 12 GHz to 18 GHz	0.003 to 0.008 0.003 to 0.005 0.004 to 0.006 0.005 to 0.010	
APC-3.5	0.9 to 1	2 GHz to 8 GHz 8 GHz to 12 GHz 12 GHz to 18 GHz	0.007 to 0.008 0.008 to 0.009 0.009 to 0.010	
<b>NVLAP Code: 20/R13 RF / MICROWAVE ATTENUATORS</b> Reflection Coefficient (or Scattering Parameter, $S_{ii}$ ) HP8510 Vector Network Analyzer; One and two-port devices $ S_{ii} $ Connector Type N				
<small>Approximate value. Actual value determined by test results.</small>				
The uncertainty ranges are the lowest and highest uncertainty ( $\pm$ ) values within the specified frequency range and quantity range.				
$ S_{ii} $ APC-7	0 to 1	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.001 to 0.003 0.001 to 0.009 0.004 to 0.021	
$ S_{ii} $ APC-3.5	0 to 1	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz 18 GHz to 26.5 GHz	0.001 to 0.007 0.004 to 0.020 0.004 to 0.020 0.004 to 0.020	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
$ S_{ii} $ 2.4 mm	0 to 1	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz 18 GHz to 50 GHz	0.002 to 0.006 0.001 to 0.007 0.001 to 0.010 0.001 to 0.032	
Arg( $S_{ii}$ ) Connector Type N	- 180° to + 180°	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.05 to 180 0.36 to 180 <u>1.3</u> to 180	
Arg( $S_{ii}$ ) APC-7	- 180° to + 180°	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.15 to 180 0.16 to 180 0.33 to 180	
Arg( $S_{ii}$ ) APC-3.5	- 180° to + 180°	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz 18 GHz to 26.5 GHz	0.53 to 180 0.33 to 180 0.33 to 180 0.33 to 180	
Arg( $S_{ii}$ ) 2.4 mm	- 180° to + 180°	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz 18 GHz to 50 GHz	0.13 to 180 0.24 to 180 0.14 to 180 0.58 to 180	
HP8510 Vector Network Analyzer; Three and four-port devices Connector Type N	0 to 0.3	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.001 to 0.006 0.001 to 0.006 0.002 to 0.014	
$ S_{ii} $		50 MHz to 2 GHz	0.13 to 180	
Arg( $S_{ii}$ )	- 180° to + 180°	50 MHz to 2 GHz	0.13 to 180	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
Connector Type N $ \Gamma_{ge} $	0 to 0.3	2 GHz to 8 GHz 8 GHz to 18 GHz  50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.23 to 180 0.57 to 180  0.001 to 0.014 0.002 to 0.019 0.004 to 0.019	
Arg( $\Gamma_{ge}$ )	- 180° to + 180°	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	10 to 180 4.6 to 180 6.3 to 180	
SR wcΔρ is the worst-case error in measurement of reflection coefficient, ρ, ( $0.5 \geq \rho \geq 0$ ) as made by a four-port scalar reflectometer which has RF access to all four ports. Uncertainty shown is the uncertainty on value of SR wcΔρ.				
Connector Type N SR wcΔρ	0 to 0.2	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.002 to 0.02 0.002 to 0.5 0.004 to 0.05	
APC-7 $ S_{ii} $	0 to 0.3	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.001 to 0.005 0.001 to 0.005 0.001 to 0.01	
Arg( $S_{ii}$ )	- 180° to + 180°	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.15 to 180 0.16 to 180 0.5 to 180	
APC-7 $ \Gamma_{ge} $	0 to 0.3	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.001 to 0.005 0.001 to 0.007 0.003 to 0.012	
Arg( $\Gamma_{ge}$ )	- 180° to + 180°	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	3 to 180 3 to 180 3 to 180	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
SR $wc\Delta\rho$ is the worst-case error in measurement of reflection coefficient, $\rho$ , ( $0.5 \geq \rho \geq 0$ ) as made by a four-port scalar reflectometer which has RF access to all four ports. Uncertainty shown is the uncertainty on value of SR $wc\Delta\rho$ .				
APC-7 SR $wc\Delta\rho$	0 to 0.2	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.002 to 0.02 0.002 to 0.05 0.004 to 0.05	
APC-3.5 $ S_{ii} $	0 to 0.3	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.002 to 0.007 0.003 to 0.007 0.003 to 0.01	
Arg( $S_{ii}$ )	- 180° to + 180°	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.6 to 180 0.6 to 180 0.6 to 180	
APC-3.5 $ \Gamma_{ge} $	0 to 0.3	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.003 to 0.013 0.004 to 0.012 0.004 to 0.12	
Arg( $\Gamma_{ge}$ )	- 180° to + 180°	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	3 to 180 3 to 180 3 to 180	
2.4 mm $ S_{ii} $	0 to 0.3	2 GHz to 8 GHz 8 GHz to 18 GHz 18 GHz to 50 GHz	0.001 to 0.007 0.001 to 0.01 0.003 to 0.02	
Arg( $S_{ii}$ )	- 180° to + 180°	2 GHz to 8 GHz 8 GHz to 18 GHz 18 GHz to 50 GHz	0.24 to 180 0.14 to 180 0.33 to 180	
2.4 mm				

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
$ \Gamma_{ge} $	0 to 0.3	2 GHz to 8 GHz 8 GHz to 18 GHz 18 GHz to 50 GHz	0.002 to 0.01 0.003 to 0.12 0.003 to 0.03	
$\text{Arg}(\Gamma_{ge})$	- 180° to + 180°	2 GHz to 8 GHz 8 GHz to 18 GHz 18 GHz to 50 GHz	3 to 180 3 to 180 3 to 180	
Approximate value. Actual value determined by test results.				
HP8753 Vector Network Analyzer; One and two-port devices	The uncertainty ranges are the lowest and highest uncertainty ( $\pm$ ) values within the specified frequency range and quantity range.			
$ S_{ii} $ Connector Type N	0 to 1	300 kHz to 25 MHz 25 MHz to 1 GHz 1 GHz to 3 GHz	0.001 to 0.013 0.001 to 0.009 0.003 to 0.016	
$ S_{ii} $ APC-7	0 to 1	300 kHz to 25 MHz 25 MHz to 1 GHz 1 GHz to 3 GHz	0.002 to 0.007 0.002 to 0.04 0.002 to 0.004	
$ S_{ii} $ APC-3.5	0 to 1	300 kHz to 25 MHz 25 MHz to 1 GHz 1 GHz to 3 GHz	0.001 to 0.004 0.006 to 0.02 0.006 to 0.035	
$\text{Arg}(S_{ii})$ Connector Type N	to 180° to + 180°	300 kHz to 25 MHz 25 MHz to 1 GHz 1 GHz to 3 GHz	0.06 to 180 0.2 to 70 1 to 180	
$\text{Arg}(S_{ii})$ APC-7	to 180° to + 180°	300 kHz to 25 MHz 25 MHz to 1 GHz 1 GHz to 3 GHz	0.27 to 180 0.3 to 180 0.2 to 180	
$\text{Arg}(S_{ii})$ APC-3.5	to 180° to + 180°	300 kHz to 25 MHz 25 MHz to 1 GHz 1 GHz to 3 GHz	0.27 to 180 1 to 180 1.6 to 180	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
HP8753 Vector Network Analyzer; Three and four-port devices Connector Type N, APC-7, APC-3.5 $ S_{ii} $	0 to 0.3	300 kHz to 25 MHz 25 MHz to 3 GHz	0.001 to 0.006 0.001 to 0.020	
Arg( $S_{ii}$ )	- 180° to + 180°	300 kHz to 25 MHz 25 MHz to 3 GHz	0.10 to 180 0.09 to 180	
$ \Gamma_{ge} $	0 to 0.3	300 kHz to 25 MHz 25 MHz to 3 GHz	0.003 to 0.005 0.002 to 0.03	
Arg( $\Gamma_{ge}$ )	- 180° to + 180°	300 kHz to 25 MHz 25 MHz to 3 GHz	10 to 180 1.9 to 180	
Connector Type N, APC-7 SR $wc\Delta\rho$	SR $wc\Delta\rho$ is the worst-case error in measurement of reflection coefficient, $\rho$ , ( $0.5 \geq \rho \geq 0$ ) as made by a four-port scalar reflectometer which has RF access to all four ports. Uncertainty shown is the uncertainty on value of SR $wc\Delta\rho$ .			
	0 to 0.2	300 kHz to 25 MHz 25 MHz to 3 GHz	0.001 to 0.006 0.001 to 0.020	
Attenuation (or Scattering Parameter, $S_{ij}$ ) HP8510 Vector Network Analyzer; One and two-port devices $ S_{ij} $ Connector Type N	Approximate value. Actual value determined by test results. The uncertainty ranges are the lowest and highest uncertainty ( $\pm$ ) values within the specified frequency range and quantity range.			
	0 dB to 60 dB	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.01 to 0.12 0.02 to 0.17 0.03 to 0.48	
$ S_{ij} $ APC-7	0 dB to 60 dB	50 MHz to 2 GHz	0.01 to 0.08	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
S <sub>ij</sub>   APC-3.5	0 dB to 60 dB	2 GHz to 8 GHz 8 GHz to 18 GHz	0.01 to 0.13 0.01 to 0.18	
S <sub>ij</sub>   2.4 mm	0 dB to 60 dB	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz 18 GHz to 50 GHz	0.01 to 0.12 0.02 to 0.22 0.04 to 0.49 0.02 to 0.15 0.02 to 0.22 0.03 to 0.34 0.05 to 2.7	
Arg(S <sub>ij</sub> ) Connector Type N	0° to 360°  S <sub>ii</sub>   < 60	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.22 to 1.2 0.32 to 1.3 0.36 to 3.5	
Arg(S <sub>ij</sub> ) APC-7	0° to 360°  S <sub>ii</sub>   < 60	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.22 to 0.73 0.25 to 1.2 0.41 to 2.8	
Arg(S <sub>ij</sub> ) APC-3.5	0° to 360°  S <sub>ii</sub>   < 60	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.45 to 0.80 0.35 to 1.4 0.41 to 3.2	
Arg(S <sub>ij</sub> ) 2.4 mm	0° to 360°  S <sub>ii</sub>   < 60	2 GHz to 8 GHz 8 GHz to 18 GHz 18 GHz to 50 GHz	1.1 to 1.7 1.1 to 1.7 1.3 to 21	
HP8510 Vector Network Analyzer; Three and four-port devices				

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
Connector Type N, APC-7, APC-3.5 Mainline/ Coupling $ S_{ij} $	0 dB to 40 dB	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.01 to 0.12 0.02 to 0.12 0.01 to 0.43	
Isolation $ S_{ij} $	40 dB to 80 dB	50 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 18 GHz	0.2 to 16 0.4 to 9 0.9 to 17	
2.4 mm Mainline/ Coupling $ S_{ij} $	0 dB to 40 dB	2 GHz to 8 GHz 8 GHz to 18 GHz 18 GHz to 50 GHz	0.03 to 0.15 0.04 to 0.5 0.05 to 0.6	
Isolation $ S_{ij} $	40 dB to 85 dB	2 GHz to 8 GHz 8 GHz to 18 GHz 18 GHz to 50 GHz	0.4 to 10 1.0 to 12 1.5 to 15	
HP8753 Vector Network Analyzer; Two-port devices $ S_{ij} $ Connector Type N	0 dB to 60 dB	300 kHz to 25 MHz 25 MHz to 1 GHz 1 GHz to 3 GHz	0.02 to 0.25 0.003 to 0.5 0.004 to 1.2	
$ S_{ij} $ APC-7	0 dB to 60 dB	300 kHz to 25 MHz 25 MHz to 1 GHz 1 GHz to 3 GHz	0.01 to 0.16 0.002 to 0.6 0.003 to 0.9	
$ S_{ij} $ APC-3.5	0 dB to 60 dB	300 kHz to 25 MHz 25 MHz to 1 GHz 1 GHz to 3 GHz	0.01 to 0.22 0.003 to 0.6 0.003 to 1.0	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
Arg( $S_{ij}$ ) Connector Type N, APC-7, APC-3.5	- 180° to + 180°	300 kHz to 25 MHz 25 MHz to 1 GHz 1 GHz to 3 GHz	1.4 - 13 0.4 - 10 0.4 - 10	
HP8753 Vector Network Analyzer; Three and four-port devices Connector Type N, APC-7, APC-3.5 Mainline/ Coupling $ S_{ij} $	0 dB to 40 dB	300 kHz to 25 MHz 25 MHz to 3 GHz	0.008 to 0.2 0.020 to 0.3	
Isolation $ S_{ij} $	40 dB to 87 dB	300 kHz to 25 MHz 25 MHz to 3 GHz	0.1 to 14 0.1 to 14	
Power Ratio Attenuation; Fixed Attenuators Connector Type N, APC-7, APC-3.5	0 dB to 11 dB	10 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 12 GHz 12 GHz to 18 GHz	0.007 to 0.014 0.008 to 0.021 0.010 to 0.025 0.016 to 0.026	
Isolated Step/Variable Attenuators Connector Type N, APC-7, APC-3.5	0 dB to 11 dB	10 MHz to 2 GHz 2 GHz to 8 GHz 8 GHz to 12 GHz	0.007 to 0.014 0.007 to 0.016 0.007 to 0.015	
$ S_{ij} $				

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
		12 GHz to 18 GHz	0.007 to 0.018	
<b>NVLAP Code: 20/R16</b> <b>GROUP DELAY</b>				
Group Delay Connector Type N, APC-7, APC-3.5, 2.4 mm				Approximate value. Actual value determined by test results.
				The uncertainty ranges are the lowest and highest uncertainty ( $\pm$ ) values within the specified frequency range and quantity range.
	5 ns to 500 ns	50 MHz to 1 GHz 1 GHz to 50 GHz	0.2 ns to 0.5 ns 0.02 ns to 1.0 ns	Typical Attenuation: 0 dB to 10 dB
<b>NVLAP Code: 20/R17</b> <b>RF / MICROWAVE POWER METERS</b>				
				Approximate value. Actual value determined by test results.
				The uncertainty ranges are the lowest and highest uncertainty ( $\pm$ ) values within the specified frequency range and quantity range.
				User mismatch uncertainty not included.
Low to Medium CW Power Meters, Type N Connector	0.00 mW to 0.10 mW	10 MHz to 2 GHz 2 GHz to 4 GHz 4 GHz to 12.4 GHz 12.4 GHz to 18 GHz	Uncertainty $k = 3$ 2.1 % to 9.9 % 3.0 % to 9.9 % 3.3 % to 8.1 % 3.8 % to 11 %	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
Low Power, Wide Range, CW Power Meters, Type N Connector	0.10 mW to 10.00 mW	10 MHz to 2 GHz 2 GHz to 4 GHz 4 GHz to 12.4 GHz	1.4 % to 6.5 % 2.4 % to 6.0 % 2.6 % to 7.2 %	
	10.00 mW to 1.00 W	10 MHz to 2 GHz 2 GHz to 4 GHz 4 GHz to 12.4 GHz	1.4 % to 6.0 % 2.4 % to 5.0 % 2.6 % to 5.7 %	
	1 mW to 10 mW	10 MHz to 4 GHz 4 GHz to 8 GHz 8 GHz to 18 GHz	4.7 % to 12 % 5.7 % to 10 % 5.7 % to 10 %	
	10 mW to 100 mW	10 MHz to 4 GHz 4 GHz to 8 GHz 8 GHz to 18 GHz	4.0 % to 7.9 % 4.7 % to 8.4 % 4.7 % to 10 %	
	100 mW to 1 W	10 MHz to 4 GHz 4 GHz to 8 GHz 8 GHz to 18 GHz	3.3 % to 6.4 % 3.8 % to 7.7 % 4.7 % to 8.6 %	
	1 W to 10 W	10 MHz to 4 GHz 4 GHz to 8 GHz 8 GHz to 18 GHz	3.3 % to 6.2 % 3.3 % to 6.4 % 4.2 % to 8.4 %	
Medium Power CW Power Meters, Type N Connector	1 mW to 10 mW 1 mW to 160 mW	10 MHz to 2 GHz 2 GHz to 2.5 GHz	1.8 % to 3.3 % 2.0 % to 4.3 %	
Medium Power CW Power Meters,	0.1 mW to 8 mW	2 GHz to 4 GHz	2.8 % to 4.0 %	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Frequency Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
APC-3.5 Connector		4 GHz to 8 GHz 8 GHz to 18 GHz	3.0 % to 4.9 % 4.0 % to 5.8 %	
High Power CW Power Meters, APC-3.5 Connector	0.2 W to 10 W	10 MHz to 300 MHz 300 MHz to 3 GHz	9.0 % to 9.1 % 3.3 % to 11 %	
	10 W to 200 W	10 MHz to 300 MHz 300 MHz to 3 GHz	4.4 % to 10 % 9.6 % to 11 %	
Pulse Power Meters, Type N Connector, Pulse Width Range: 0.2 $\mu$ s to 5 $\mu$ s PRF: 1 Hz to 20 kHz	10 mW to 100 mW	2 GHz to 18 GHz	7.3 % to 8.2 %	1 Hz to 20 kHz

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
<b>THERMODYNAMIC</b>			
<b>NVLAP Code: 20/T02 HUMIDITY</b> Relative Humidity – High	10 % RH to 50 % RH 50 % RH to 95 % RH	0.5 % RH 1.0 % RH	
Dew Point	-15 °C to 20 °C	0.1 °C	
Relative Humidity – Low	-80 °C to 0 °C (Frost Point)	0.25 °C	
<b>NVLAP Code: 20/T04 LEAK ARTIFACTS</b> Gas Leak	$1 \times 10^{-7}$ mol/s $1 \times 10^{-8}$ mol/s	0.7 % 0.9 %	PΔV Technique; Total gas measurement

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
1 to 200 Atomic Mass Units for any non-reactive, non-hazardous, non-radioactive gas	$1 \times 10^{-9}$ mol/s $1 \times 10^{-10}$ mol/s  $1 \times 10^{-10}$ mol/s to $1 \times 10^{-14}$ mol/s	1.0 % 1.0 %  1.0 %	Accumulate - Dump Technique
Helium	$1 \times 10^{-10}$ mol/s $1 \times 10^{-11}$ mol/s $1 \times 10^{-12}$ mol/s $1 \times 10^{-13}$ mol/s $1 \times 10^{-14}$ mol/s	2.5 % 2.4 % 2.3 % 2.3 % 7.0 %	Comparison Technique
<b>NVLAP Code: 20/T05</b> <b>PRESSURE</b> Pneumatic Deadweight Piston Gages – Absolute Mode			
Nitrogen	0.2 psia to 24 psia [ $\approx 1.4$ kPa to 170 kPa]  2.0 psia to 70 psia [ $\approx 14$ kPa to 480 kPa]  52 psia to 1000 psia [ $\approx 0.4$ MPa to 7.0 MPa]	$3.4 \times 10^{-6}$ psia to $4.1 \times 10^{-4}$ psia [ $2.3 \times 10^{-2}$ Pa to 2.82 Pa] $4.8 \times 10^{-5}$ psia to $1.7 \times 10^{-3}$ psia [ $3.3 \times 10^{-1}$ Pa to 11.7 Pa] $2.2 \times 10^{-3}$ psia to $4.3 \times 10^{-2}$ psia [ $15.2$ Pa to 296.5 Pa]	Direct Pressure Comparison
Pneumatic Deadweight Piston Gages – Gage Mode			
Nitrogen	0.2 psia to 24 psia [ $\approx 1.4$ kPa to 170 kPa]  2.0 psia to 70 psia [ $\approx 14$ kPa to 480 kPa]	$3.4 \times 10^{-6}$ psia to $4.1 \times 10^{-4}$ psia [ $2.3 \times 10^{-2}$ Pa to 2.82 Pa] $4.8 \times 10^{-5}$ psia to $1.7 \times 10^{-3}$ psia [ $3.3 \times 10^{-1}$ Pa to 11.7 Pa]	Direct Pressure Comparison

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
Hydraulic Deadweight Piston Gages – Gage Mode Oil	<p>52 psia to 1000 psia [<math>\approx 0.4</math> MPa to 7.0 MPa]</p> <p>0.4 kpsig to 4.0 kpsig [<math>\approx 2.8</math> MPa to 28 MPa]</p> <p>2.0 kpsig to 20 kpsig [<math>\approx 14</math> MPa to 140 MPa]</p> <p>4.0 kpsig to 40 kpsig [<math>\approx 28</math> MPa to 280 MPa]</p>	<p><math>2.2 \times 10^{-3}</math> psia to <math>4.3 \times 10^{-2}</math> psia [15.2 Pa to 296.5 Pa]</p> <p><math>1.4 \times 10^{-5}</math> kpsig to <math>1.4 \times 10^{-4}</math> kpsig [96.5 Pa to 965.3 Pa]</p> <p><math>7.6 \times 10^{-5}</math> kpsig to <math>7.6 \times 10^{-4}</math> kpsig [524.0 Pa to 5.2 kPa]</p> <p><math>2.1 \times 10^{-4}</math> kpsig to <math>2.1 \times 10^{-3}</math> kpsig [1.4 kPa to 14.5 kPa]</p>	Direct Pressure Comparison
Pneumatic Deadweight Piston Gages Nitrogen	<p>0.2 psig to 24 psig [<math>\approx 14</math> kPa to 170 kPa]</p> <p>2.0 psig to 70 psig [<math>\approx 14</math> kPa to 480 kPa]</p> <p>52 psig to 1000 psig [<math>\approx 0.4</math> MPa to 7.0 MPa]</p>	<p><math>4.8 \times 10^{-6}</math> psig to <math>5.8 \times 10^{-4}</math> psig [<math>3.3 \times 10^{-2}</math> Pa to 4.0 Pa]</p> <p><math>6.8 \times 10^{-5}</math> psig to <math>2.4 \times 10^{-3}</math> psig [<math>4.7 \times 10^{-1}</math> Pa to 16.5 Pa]</p> <p><math>2.4 \times 10^{-5}</math> psig to <math>4.7 \times 10^{-2}</math> psig [16.5 Pa to 324.1 Pa]</p>	Cross Float (effective area)
Hydraulic Deadweight Piston Gages Oil	<p>0.4 kpsig to 4.0 kpsig [<math>\approx 2.8</math> MPa to 28 MPa]</p> <p>2.0 kpsig to 20 kpsig [<math>\approx 14</math> MPa to 140 MPa]</p>	<p><math>1.8 \times 10^{-5}</math> kpsig to <math>1.8 \times 10^{-4}</math> kpsig [124.1 Pa to 965.3 Pa]</p> <p><math>8.6 \times 10^{-5}</math> kpsig to <math>8.6 \times 10^{-4}</math> kpsig [592.9 Pa to 5.9 kPa]</p>	Cross Float (effective area)

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
Secondary Pressure – Low Range Absolute Nitrogen	4.0 kpsig to 40 kpsig [ ≈ 28 MPa to 280 MPa]	2.2 x $10^{-4}$ kpsig to 2.2 x $10^{-3}$ kpsig [1.5 kPa to 15.2 kPa]	
	0.2 psia [ ≈ 1.4 kPa] 1.0 psia 2.0 [ ≈ 7.0 kPa] 6.0 psia [ ≈ 41 kPa] 10 psia [ ≈ 70 kPa] 15 psia [ ≈ 100 kPa]	0.0015 psia 0.0012 psia 0.00095 psia 0.0011 psia 0.0015 psia	
Secondary Pressure – Low Range Gage or Absolute Nitrogen	20 psi [ ≈ 140 kPa] 40 psi [ ≈ 280 kPa] 60 psi [ ≈ 410 kPa] 80 psi [ ≈ 550 kPa] 100 psi [ ≈ 690 kPa]	0.016 psi 0.016 psi 0.015 psi 0.016 psi 0.022 psi	
Secondary Pressure – Mid-Range Gage or Absolute Nitrogen	200 psi [ ≈ 1.4 MPa] 500 psi [ ≈ 3.4 MPa]	0.053 psi 0.061 psi	

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
	1.0 kpsi [ ≈ 7.0 MPa] 1.5 kpsi [ ≈ 10 MPa] 2.0 psi [ ≈ 14 MPa] 4.0 kpsi [≈ 28 MPa] 6.0 kpsi [ ≈ 41 MPa] 8.0 kpsi [ ≈ 55 MPa] 10 kpsi [ ≈ 70 MPa]	0.078 psi  0.17 psi  1.5 psi  1.5 psi  1.8 psi  2.4 psi  3.1 psi	
<b>NVLAP Code: 20/T10</b> <b>VACUUM and LOW</b> <b>PRESSURE</b> <b>TRANSDUCERS</b>			
Ionization Gage Reference for direct comparison	$1.33 \times 10^{-7}$ Pa < reading $\leq 1.2 \times 10^{-2}$ Pa $1.2 \times 10^{-2}$ Pa < reading $\leq 2.67 \times 10^{-2}$ Pa $6.67 \times 10^{-3}$ Pa < reading $\leq 2.67 \times 10^{-2}$ Pa $2.67 \times 10^{-3}$ Pa < reading $< 2.67 \times 10^{-1}$ Pa	2.7 % to 1.3 %  1.3 % to 2.8 %  2.7 % to 2.5 %  2.5 % to 15 %	$N_2$ ; $1 \times 10^{-9}$ Torr to $9 \times 10^{-5}$ Torr, 4 mA $N_2$ ; $9 \times 10^{-5}$ Torr to $2 \times 10^{-4}$ Torr, 4 mA $N_2$ ; $5 \times 10^{-5}$ Torr to $2 \times 10^{-4}$ Torr, 0.1 mA $N_2$ ; $2 \times 10^{-4}$ Torr to $2 \times 10^{-3}$ Torr, 0.1 mA
Spinning Rotor Gage Reference for direct comparison	$0.0667$ mPa < reading $\leq 0.12$ Pa $0.12$ Pa < reading $\leq 1.2$ Pa $1.2$ Pa $\leq$ reading $\leq 1.2$ Pa	1.5 %  1.5 %  1.9 %	$N_2$ ; $5 \times 10^{-7}$ Torr to $9 \times 10^{-4}$ Torr $N_2$ ; $9 \times 10^{-4}$ Torr to $9 \times 10^{-3}$ Torr $N_2$ ; $9 \times 10^{-3}$ Torr to $9 \times 10^{-2}$ Torr
Capacitance Diaphragm Gage	$1.33$ mPa $\leq$ reading $\leq$	8.7 % to 1.2 %	$N_2$ ; 0.0001 Torr to

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### CALIBRATION AND MEASUREMENT CAPABILITIES (CMC) Notes 1,2

Measured Parameter or Device Calibrated	Range	Uncertainty ( $k=2$ ) <small>Note 3</small>	Remarks
Reference for direct comparison	0.133 Pa  0.133 Pa ≤ reading ≤ 1.33 Pa 1.33 Pa ≤ reading ≤ 13.3 Pa	1.2 % to 0.79 %  0.79 % to 0.40 %	0.001 Torr  N <sub>2</sub> ; 0.001 Torr to 0.01 Torr N <sub>2</sub> ; 0.01 Torr to 0.1 Torr
Force Balance and Deadweight Piston Gages – Absolute, Absolute Differential and Gages Modes	0.3 Pa to < 6.0 Pa  > 6.0 Pa to 15.0 kPa 15.0 kPa to 133.3 kPa	30 μPa/Pa + 0.025 Pa  30 μPa/Pa + 0.008 Pa 31 μPa/Pa	Direct Pressure Comparison, N <sub>2</sub> ; 0.1 Torr range N <sub>2</sub> ; 0.1 Torr, 1 Torr, 10 Torr, 100 Torr range N <sub>2</sub> ; 1000 Torr range
Secondary Capacitance Diaphragm Gages Reference for direct comparison	1.3 x 10 <sup>-1</sup> Pa ≤ 13.3 Pa 13.3 Pa ≤ reading ≤ 133.3 133.3 Pa ≤ reading ≤ 1.3 kPa 1.3 kPa ≤ reading ≤ 13.3 kPa 13.3 kPa ≤ reading ≤ 133.3 kPa	1.4 % to 0.4 %  0.39 % to 0.25 % 0.11 % to 0.07 % 0.13 % to 0.08 % 0.4 % to 0.006 %	N <sub>2</sub> ; 0.001 Torr to 0.1 Torr N <sub>2</sub> ; 0.1 Torr to 1 Torr N <sub>2</sub> ; 1 Torr to 10 Torr N <sub>2</sub> ; 10 Torr to 100 Torr N <sub>2</sub> ; 10 Torr to 1000 Torr

END

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology



# National Voluntary Laboratory Accreditation Program



## CALIBRATION LABORATORIES

NVLAP LAB CODE 105002-0

### 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 using a coverage factor,  $k = 2$ , with a level of confidence of approximately 95 %. 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 nontoSI 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.

2012-04-01 through 2013-03-31

Effective dates

For the National Institute of Standards and Technology