



**National Voluntary
Laboratory Accreditation Program**



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

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CALIBRATION LABORATORIES

NVLAP LAB CODE 200762-0

ELECTROMAGNETICS- DC/LOW FREQUENCY

NVLAP Code: 20/E01

AC/DC Difference for Low Frequency Detectors and Shunts

Direct Comparison with standard shunt

<i>Range</i>	<i>Best Uncertainty (\pm) in ppm for indicated frequency range ^{note 1}</i>		
	≤ 20 kHz	> 20 kHz to 50 kHz	> 50 kHz to 100 kHz
10 mA	78	112	130
20 mA	78	112	163
30 mA	78	112	163
50 mA	78	112	163
100 mA	78	112	163
200 mA	78	112	163
300 mA	78	112	163
500 mA	78	112	163
1 A	78	112	163
2 A	78	112	198
3 A	78	112	198
5 A	78	112	281
10 A	117	173	
20 A	117	173	

2009-01-01 through 2009-12-31

Effective dates

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NVLAP Code: 20/E05

Resistance

Range	Best Uncertainty (\pm) in ppm ^{note 1}
0.000001 to 0.0001	25
0.0001 to 0.001	5
0.001 to 0.01	0.35
0.01 to 0.1	0.29
0.1 to 1	0.21
1	0.2
1 to 10	0.2
10 to 100	0.2
100 to 10 ³	0.2
10 ³ to 10 ⁴	0.2
10 ⁴ to 10 ⁵	1.2
10 ⁵ to 10 ⁶	1.22
10 ⁶ to 10 ⁷	1.5
10 ⁷ to 10 ⁸	1.82
10 ⁸ to 10 ⁹	2.3
10 ⁹ to 10 ¹⁰	100
10 ¹⁰ to 10 ¹¹	350
10 ¹¹ to 10 ¹²	400
10 ¹² to 10 ¹³	500

NVLAP Code: 20/E06

DC Voltage

Range in volts	Best Uncertainty (\pm) in ppm for method indicated ^{note 1}	
	Using 3 Zener Intercomparison	Using Josephson Junction
1.0 to 1.018	0.4	0.2
10	0.19	0.02

High Voltage- Dividers, Electrostatic Voltmeters, etc.

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<i>Range</i>	<i>Mode</i>	<i>Best Uncertainty (±) in % ^{note 1}</i>
0.1 to 100 kV	DC	0.03
0.1 to 60 kV	AC (60 Hz)	0.05

NVLAP Code: 20/E09
LF AC Voltage

<i>Range</i>	<i>Best Uncertainty (±) in ppm for indicated frequency range ^{note 1}</i>							
	10 Hz	20 Hz	40 Hz	100 Hz	400 Hz	1 kHz	10 kHz	
1mV to 3 mV	1800	1800	1800	1640	1800	1640	1640	
3mV to 10mV	498	444	444	284	320	284	284	
10mV to 30mV	382	364	364	230	230	230	230	
30mV to 100mV	307	289	289	136	130	139	136	
0.10V to 0.30V	57	51	57	41	41	41	41	
0.30V to 1.0V	31	28	29	28	30	28	28	
1.0V to 3.0V	31	28	28	28	30	28	28	
3V to 10V	33	29	29	28	29	28	28	
10V to 30V	34	28	28	28	29	28	28	
30V to 100V	36	31	30	30	34	30	30	
100V to 300V	52	46	46	46	49	45	46	
300V to 1000V	61	49	49	49	66	49	49	
	20kHz	50kHz	100kHz	300kHz	500kHz	800kHz	1.0MHz	
1mV to 3 mV	1640	1800	1800	1800	1800	1800	1800	
3mV to 10mV	284	584	584	1522	1522	3590	3608	
10mV to 30mV	230	444	444	1204	1204	2790	2790	
30mV to 100mV	136	264	264	679	692	1672	1690	
0.10V to 0.30V	41	106	107	290	305	705	722	
0.30V to 1.0V	29	79	83	275	275	687	699	
1.0V to 3.0V	29	79	82	275	275	686	698	
3V to 10V	29	79	83	274	286	698	710	
10V to 30V	28	78	84	274	286	698	710	
30V to 100V	30	81	84	1026				
100V to 300V	46	101	105					
300V to 1000V	49	140	130					

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NVLAP Code: 20/E10

LF Capacitance

(1 pF to 1 μF)

Test Frequency	Best Uncertainty (±) ^{note 1, 2}
50 Hz	20 ppm + 150 aF
100 Hz	15 ppm + 100 aF
1 kHz	6 ppm + 10 aF
10 kHz	12 ppm + 30 aF
20 kHz	25 ppm + 150 aF

NVLAP Code: 20/E11

LF Inductance

Nominal Value	Best Uncertainty (±) for the test Frequency Indicated in % ^{note 1}		
	100Hz	1khz	10khz
50 μH	0.25	0.25	0.25
100 μH	0.13	0.13	0.13
200 μH	0.08	0.08	0.08
500 μH	0.05	0.05	0.08
1 mH	0.05	0.05	0.08
2 mH	0.05	0.05	0.08
5 mH	0.05	0.05	0.08
10 mH	0.05	0.05	0.08
20 mH	0.05	0.05	0.08
50 mH	0.05	0.05	0.08
100 mH	0.05	0.05	0.08
200 mH	0.05	0.05	
500 mH	0.05	0.05	
1H	0.05	0.08	
2H	0.05	0.08	
5H	0.05	0.13	
10H	0.05	0.3	

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RF/ MICROWAVE

NVLAP Code: 20/R04

Electromagnetic Field Strength
Field Strength Probe Calibrations

Frequency Range **Best Uncertainty (\pm) in %** ^{note 1, 3}
10 kHz to 40 GHz 5.0

NVLAP Code: 20/R08

Antenna Parameters
Antenna Gain Calibrations (1m, 3m, 10m, far field)
Linear/ Circular Polarizations Ratios, Axial Ratio, Tilt Angle

Frequency Range **Best Uncertainty (\pm) in dB** ^{note 1, 4}
30 MHz to 40 GHz 0.2

NVLAP Code: 20/R13

Attenuators

Reflection S_{11}/S_{22}

Range 0-1 in Lin Mag, Phase Range -180° to $+180^\circ$

Frequency Range	Best Uncertainty (\pm) in Lin Mag ^{note 1}	Best Uncertainty (\pm) in Degrees Phase ^{note 1}	Remarks
300 kHz to 1.3 GHz	0.002	0.6	VNA & 7 mm Cal Kit
1.3 GHz to 3 GHz	0.003	1.478	VNA & 7 mm Cal Kit
3GHz to 6 GHz	0.005	2.387	VNA & 7 mm Cal Kit
0.045 GHz to 2 GHz	0.002	0.4	VNA & 7 mm TRL Cal Kit
2 GHz to 8 GHz	0.0015	1.12	VNA & 7 mm TRL Cal Kit
8 GHz to 18 GHz	0.0015	4.05	VNA & 7 mm TRL Cal Kit
0.045 GHz to 2 GHz	0.004	0.63	VNA & 3.5 mm Cal Kit
2 GHz to 8 GHz	0.005	2.26	VNA & 3.5 mm Cal Kit
8 GHz to 26.5 Hz	0.006	3.02	VNA & 3.5 mm Cal Kit
0.045 GHz to 2 GHz	0.008	0.7	VNA & 2.4 mm Cal Kit
2 GHz to 20 GHz	0.008	4.0	VNA & 2.4 mm Cal Kit

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20 GHz to 40 GHz	0.012	5.85	VNA & 2.4 mm Cal Kit
40 GHz to 50 GHz	0.015	11.6	VNA & 2.4 mm Cal Kit

Transmission S_{12}/S_{21}

<i>Range in dB</i>	<i>Best Uncertainty (\pm) in db for Indicated Frequency Range ^{note 1}</i>				<i>Remarks</i>
	0.0003 to 1.3 GHz	1.3 to 3 GHz	3 to 6 GHz		
0 to 20	0.081	0.089	0.120		VNA & 7 mm Cal Kit
20 to 50	0.097	0.097	0.137		VNA & 7 mm Cal Kit
50 to 60	0.134	0.150	0.230		VNA & 7 mm Cal Kit
	0.045 to 2 GHz	2 to 8 GHz	8 to 18 GHz		
0 to 20	0.027	0.023	0.023		VNA & 7 mm TRL Cal Kit
20 to 40	0.037	0.040	0.054		VNA & 7 mm TRL Cal Kit
40 to 50	0.075	0.101	0.143		VNA & 7 mm TRL Cal Kit
50 to 60	0.211	0.308	0.447		VNA & 7 mm TRL Cal Kit
	0.045 to 2 GHz	2 to 8 GHz	8 to 20 GHz	20 to 26.5 GHz	
0 to 20	0.044	0.052	0.046	0.054	VNA & 3.5 mm Cal Kit
20 to 40	0.142	0.058	0.057	0.094	VNA & 3.5 mm Cal Kit
40 to 50	0.416	0.079	0.105	0.220	VNA & 3.5 mm Cal Kit
50 to 60	1.35	0.157	0.273	0.651	VNA & 3.5 mm Cal Kit
	0.045 to 2 GHz	2 to 8 GHz	20 to 40 GHz	40 to 50 GHz	
0 to 20	0.038	0.072	0.158	0.241	VNA & 2.4 mm Cal Kit
20 to 40	0.144	0.086	0.317	1.024	VNA & 2.4 mm Cal Kit
40 to 50	0.42	0.142	0.760	3.295	VNA & 2.4 mm Cal Kit
50 to 60	1.362	0.333	2.341		VNA & 2.4 mm Cal Kit

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Attenuators

<i>Frequency Range</i>	<i>Range in dB</i>	<i>Best Uncertainty (+/-) in dB</i> ^{note 1,5}
< 2GHz	0 to 20	M + 0.03
< 2GHz	20 to 40	M + 0.04
< 2GHz	40 to 60	M + 0.06
< 2GHz	60 to 80	M + 0.10
< 2GHz	80 to 100	M + 0.17
< 2GHz	100 to 110	M + 0.19
2 to 26.5 GHz	0 to 10	M + 0.08
2 to 26.5 GHz	10 to 20	M + 0.09
2 to 26.5 GHz	20 to 30	M + 0.10
2 to 26.5 GHz	30 to 40	M + 0.13
2 to 26.5 GHz	40 to 50	M + 0.14
2 to 26.5 GHz	50 to 60	M + 0.16
2 to 26.5 GHz	60 to 70	M + 0.18
2 to 26.5 GHz	70 to 80	M + 0.20
2 to 26.5 GHz	80 to 90	M + 0.31
2 to 26.5 GHz	90 to 100	M + 0.32
2 to 26.5 GHz	100 to 110	M + 0.34

NVLAP Code: 20/R17

RF/ Microwave Power Meters
Power Sensor Calibration Factor

<i>Power Range</i>	<i>Frequency Range</i>	<i>Best Uncertainty (+/-) in %</i> ^{note 1,5}
10 uW to 100 mW	100 kHz to 1 GHz	M + 1.5
10 uW to 100 mW	1 to 18 GHz	M + 2.0
10 uW to 100 mW	18 to 26.5 GHz	M + 2.5
10 uW to 100 mW	26.5 to 40 GHz	M + 3.5
10 uW to 100 mW	40 to 50 GHz	M + 4.0
100pW to 10 uW	1 to 18 GHz	M + 2.2
100pW to 10 uW	18 to 26.5 GHz	M + 3.7

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Tuned RF Power (Relative to 0 dBm)

<i>Frequency Range</i>	<i>Power Range in dB</i>	<i>Best Uncertainty (+/-) in dB</i>
10 MHz to 26.5 GHz	0 to -10	0.020
10 MHz to 26.5 GHz	-10 to -40	0.080
10 MHz to 26.5 GHz	-40 to -50	0.140
10 MHz to 26.5 GHz	-50 to -80	0.200
10 MHz to 26.5 GHz	-80 to -110	0.300
10 MHz to 26.5 GHz	-110 to 120	0.400

1. Represents an expanded uncertainty using a coverage factor, $k = 2$, at an approximate level of confidence of 95 %.
2. Best uncertainty is in ppm of nominal value. For frequencies in between stated test frequencies, use the larger value. 1 aF equals 1×10^{-18} F.
3. The indicated uncertainty is the best for the frequency range and may be up to 40% depending on frequency and measurement data.
4. The indicated uncertainty is the best for the frequency range. Actual uncertainty may be up to 2 dB depending on frequency, distance, antenna type, polarization, and measurement data.
5. M indicates mismatch uncertainty that is device under test dependant.

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