



**National Voluntary
Laboratory Accreditation Program**



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

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CALIBRATION LABORATORIES

NVLAP LAB CODE 200154-0
Scope Revised: 2011-12-29

DC/LOW FREQUENCY

NVLAP Code: 20/E02
AC Current
Source

<i>Range</i>	<i>Frequency Range</i>	<i>Best Uncertainty (±) in %^{note 1}</i>	<i>Remarks</i>
10 µA	10 Hz to 1 kHz	0.38	Fluke 5700A/5725A
100 µA	10 Hz to 1 kHz	0.11	Fluke 5700A/5725A
1 mA	10 Hz to 1 kHz	0.12	Fluke 5700A/5725A
10 mA	10 Hz to 1 kHz	0.098	Fluke 5700A/5725A
100 mA	10 Hz to 1 kHz	0.085	Fluke 5700A/5725A
1 A	40 Hz to 1 kHz	0.091	Fluke 5700A/5725A
10 A	40 Hz to 1 kHz	0.053	Fluke 5700A/5725A
10 µA	1 kHz to 10 kHz	1.1	Fluke 5700A/5725A
100 µA	1 kHz to 10 kHz	0.28	Fluke 5700A/5725A
1 mA	1 kHz to 10 kHz	0.28	Fluke 5700A/5725A
10 mA	1 kHz to 10 kHz	0.28	Fluke 5700A/5725A
100 mA	1 kHz to 10 kHz	0.28	Fluke 5700A/5725A
1 A	1 kHz to 10 kHz	1.0	Fluke 5700A/5725A
10 A	1 kHz to 10 kHz	1.0	Fluke 5700A/5725A
100 A	1 kHz	0.6	Valhalla 2555A AC-DC Calibrator

2011-04-01 through 2012-03-31

Effective dates

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Range Measure	Frequency Range	Best Uncertainty (\pm) in % ^{note 1}	Remarks
10 A	1 kHz	0.2	Valhalla 2575A AC-DC Shunt
100 A	1 kHz	0.1	Valhalla 2575A AC-DC Shunt
10 A	10 kHz	1.0	Valhalla 2575A AC-DC Shunt
100 μ A	10 Hz to 5 kHz	0.42	Agilent 3458A
1 mA	10 Hz to 100 kHz	0.7	Agilent 3458A
10 mA	10 Hz to 100 kHz	0.7	Agilent 3458A
100 mA	10 Hz to 100 kHz	0.7	Agilent 3458A
1 A	10 Hz to 20 kHz	0.42	Agilent 3458A
1 A	20 kHz to 50 kHz	1.0	Agilent 3458A

NVLAP Code: 20/E05
DC Current Source

Range	Best Uncertainty (\pm) in % ^{note 1}	Remarks
1 μ A	1.0	Fluke 5700A/5725A
10 μ A	0.1	Fluke 5700A/5725A
100 μ A	0.016	Fluke 5700A/5725A
1 mA	0.007	Fluke 5700A/5725A
10 mA	0.007	Fluke 5700A/5725A
100 mA	0.0081	Fluke 5700A/5725A
1 A	0.012	Fluke 5700A/5725A
10 A	0.04	Fluke 5700A/5725A
100 A	0.076	Valhalla 2555A AC-DC Calibrator

Measure

10 A	0.02	Valhalla 2575A AC-DC Shunt
100 A	0.054	Valhalla 2575A AC-DC Shunt
100 nA	0.1	Agilent 3458A
1 μ A	0.0087	Agilent 3458A
10 μ A	0.0034	Agilent 3458A
100 μ A	0.0032	Agilent 3458A
1 mA	0.0028	Agilent 3458A
10 mA	0.0028	Agilent 3458A

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<i>Range</i>	<i>Best Uncertainty (±) in % ^{note 1}</i>	<i>Remarks</i>
100 mA	0.007	Agilent 3458A
1 A	0.012	Agilent 3458A

NVLAP Code: 20/E05

Resistance
Source

1 Ω	0.011	Fluke 5700A/5725A
10 Ω	0.0035	Fluke 5700A/5725A
100 Ω	0.0024	Fluke 5700A/5725A
1 kΩ	0.0015	Fluke 5700A/5725A
10 kΩ	0.0014	Fluke 5700A/5725A
100 kΩ	0.0016	Fluke 5700A/5725A
1 MΩ	0.0024	Fluke 5700A/5725A
10 MΩ	0.0047	Fluke 5700A/5725A
100 MΩ	0.015	Fluke 5700A/5725A

Measure

1 Ω	0.0077	Agilent 3458A
10 Ω	0.0023	Agilent 3458A
100 Ω	0.0018	Agilent 3458A
1 kΩ	0.0011	Agilent 3458A
10 kΩ	0.0011	Agilent 3458A
100 kΩ	0.0011	Agilent 3458A
1 MΩ	0.0017	Agilent 3458A
10 MΩ	0.0061	Agilent 3458A
100 MΩ	0.051	Agilent 3458A
1 GΩ	0.5	Agilent 3458A

NVLAP Code: 20/E06

DC Voltage
Source

1 mV	0.0025	Fluke 5700A
10 mV	0.0025	Fluke 5700A
100 mV	0.0028	Fluke 5700A

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Range	Best Uncertainty (\pm) in % ^{note 1}	Remarks
1 V	0.0007	Fluke 5700A
10 V	0.0007	Fluke 5700A
100 V	0.0008	Fluke 5700A
1000 V	0.0013	Fluke 5700A

Measure

1 mV	0.11	Agilent 3458A
10 mV	0.012	Agilent 3458A
100 mV	0.0022	Agilent 3458A
1 V	0.0010	Agilent 3458A
10 V	0.0010	Agilent 3458A
100 V	0.0012	Agilent 3458A
1000 V	0.0026	Agilent 3458A

HV (Measure)

1 kV to 60kV	0.13 %	HVD-60 HV Divider
1 kV to 40kV	2.0 %	80K-40 HV Probe

NVLAP Code: 20/E09

AC Voltage
Source

Range	Frequency Range	Best Uncertainty (\pm) in % ^{note 1}	Remarks
1 mV	10 Hz to 100 kHz	0.89	Fluke 5700A/5725A
10 mV	10 Hz to 100 kHz	0.17	Fluke 5700A/5725A
100 mV	10 Hz to 100 kHz	0.12	Fluke 5700A/5725A
1 V	10 Hz to 100 kHz	0.07	Fluke 5700A/5725A
10 V	10 Hz to 100 kHz	0.07	Fluke 5700A/5725A
100 V	10 Hz to 100 kHz	0.07	Fluke 5700A/5725A
1000 V	50 Hz to 1 kHz	0.07	Fluke 5700A/5725A
1 mV	100 kHz to 1 MHz	3.4	Fluke 5700A/5725A
10 mV	100 kHz to 1 MHz	0.66	Fluke 5700A/5725A
100 mV	100 kHz to 1 MHz	0.46	Fluke 5700A/5725A
1 V	100 kHz to 1 MHz	0.34	Fluke 5700A/5725A
10 V	100 kHz to 1 MHz	0.39	Fluke 5700A/5725A

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Range	Frequency Range	Best Uncertainty (\pm) in % ^{note 1}	Remarks
100 V	100 kHz to 1 MHz	1.5	Fluke 5700A/5725A
Measure			
1 mV	1 Hz to 100 kHz	0.8	Agilent 3458A
10 mV	1 Hz to 100 kHz	0.51	Agilent 3458A
100 mV	1 Hz to 100 kHz	0.082	Agilent 3458A
1 V	1 Hz to 100 kHz	0.082	Agilent 3458A
10 V	1 Hz to 100 kHz	0.082	Agilent 3458A
100 V	1 Hz to 100 kHz	0.14	Agilent 3458A
1000 V	1 Hz to 100 kHz	0.3	Agilent 3458A
1 mV	100 kHz to 300 kHz	4.2	Agilent 3458A
10 mV	100 kHz to 300 kHz	4.0	Agilent 3458A
100 mV	100 kHz to 300 kHz	0.31	Agilent 3458A
1 V	100 kHz to 300 kHz	0.31	Agilent 3458A
10 V	100 kHz to 300 kHz	0.31	Agilent 3458A
100 V	100 kHz to 300 kHz	0.41	Agilent 3458A
100 mV	300 kHz to 2 MHz	1.5	Agilent 3458A
1 V	300 kHz to 2 MHz	1.5	Agilent 3458A
10 V	300 kHz to 2 MHz	1.5	Agilent 3458A
100 V	300 kHz to 1 MHz	1.5	Agilent 3458A

NVLAP Code: 20/E12

LF Power/ Energy

True Power (W), Apparent Power (VA) Generate

23 W to 13 kW (46 V to 650 V) (0.5 A to 20 A)	16 Hz to 850 Hz	0.024 %	Fluke 6105A Power Standard
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NVLAP Code: 20/E17

Pulse Waveform

Parameter	Range	Best Uncertainty (\pm) ^{note 1}	Remarks
Risetime (Generate)	< 20 ps	12 %	
Risetime (Measure)	\leq 100ps	4.7×10^{-12} sec	Single Shot

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<i>Parameter</i>	<i>Range</i>	<i>Best Uncertainty (±) ^{note 1}</i>	<i>Remarks</i>
Impulse Spectral Amplitude			
Impulse Noise (Source)	10 kHz to 150 kHz	12 %	Band A
Impulse Noise (Source)	150 kHz to 30 MHz	12 %	Band B
Impulse Noise (Source)	30 MHz to 1 GHz	20 %	Band C & D

NVLAP Code: 20/E20
Oscilloscopes
Source

<i>Range</i>	<i>Best Uncertainty (±) in % ^{note 1}</i>	<i>Remarks</i>
1 mVDC	2.6	Fluke 9500B w/9530
10 mVDC	0.26	Fluke 9500B w/9530
100 mVDC	0.052	Fluke 9500B w/9530
1 VDC	0.0064	Fluke 9500B w/9530
10 VDC	0.027	Fluke 9500B w/9530
100 VDC	0.026	Fluke 9500B w/9530

<i>Range</i>	<i>Frequency</i>	<i>Best Uncertainty (±) in % ^{note 1}</i>	<i>Remarks</i>
Fast Edge Pulse			
5 mV to 3 V	10 kHz to 2 MHz	3.8	Fluke 9500B w/9530
High Edge Pulse			
1 mV to 200 V	10 kHz to 100 kHz	3.8	Fluke 9500B w/9530
Level Sinewave			
5 mV to 2 V	10 kHz to 3.2 GHz	6.0	Fluke 9500B w/9530

<i>Range</i>	<i>Best Uncertainty (±) in μs/s ^{note 1}</i>	<i>Remarks</i>
10 ns to 55 s	0.25	Fluke 9500B w/9530

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Capacitance
Measure

Range	Best Uncertainty (\pm) in % ^{note 1}	Remarks
10 pF to 95 pF	3.0	Fluke 9500B w/9530

Impedance

10 Ω to 12 M Ω	0.51	Fluke 9500 B w/9530
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TIME AND FREQUENCY

NVLAP Code: 20/F01
Frequency Dissemination

Parameter	Nominal	Best Uncertainty (\pm) ^{note 1}	Remarks
Frequency/Period			
Frequency (Source)	10 MHz	8.4×10^{-11}	GPS Reference Output
Frequency (Measure)	10 MHz, 1 Vrms	6.2×10^{-10}	Rubidium Counter
Frequency (Comparison)	10 MHz, 1 Vrms	8.2×10^{-10}	Rubidium Counter
Frequency (Measure)	26.5 GHz to 46 GHz	8.6×10^{-10}	High Frequency Counter

NVLAP Code: 20/F03
Oscillator Characterization

Parameter	Nominal	Best Uncertainty (\pm) ^{note 1}	Remarks
Duty Cycle/Duration @ 10s Time Interval	10 MHz, 1 Vrms	8.5×10^{-10}	Rubidium Counter
Drift @ 10 s Time Interval	10 MHz	8.2×10^{-10}	Rubidium Counter
Spectral Purity Phase Noise 0 to -138 dBc/Hz @ (0 to -22) dBm	10 MHz to 18 GHz 1 GHz	34 % 14 %	Noise Test Set Spectrum Analyzer

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<i>Parameter</i>	<i>Range</i>	<i>Best Uncertainty (±) ^{note 1}</i>	<i>Remarks</i>
Harmonic Distortion (0 to 80) dbc	1 GHz	14 %	71210C Spectrum Analyzer
(0 to 80) dbc	10 Hz to 100 kHz	8.4 %	Agilent U8903A Analyzer
AM Modulation			
AM (Source)	50 Hz to 50 kHz Rates	0.47 %	AM/FM Test
AM (Measure)	50 Hz to 50 kHz Rates	1.2 %	Meas. Receiver
AM (Source)	33.33 % of depth	0.11 %	Meas. Receiver Calibrator
FM Modulation			
FM (Source)	DC to 100 kHz Rates	0.16 %	AM/FM Test Set
FM (Measure)	50 Hz to 100 kHz Rates	1.6 %	Meas. Receiver
FM (Source)	34 kHz Peak Deviation	0.14 %	Meas. Receiver Calibrator
PM Modulation			
PM (Measure)	150 kHz to 1300 MHz	4.2 %	Meas. Receiver

RF/MICROWAVE

NVLAP Code: 20/R09
Noise Temperature

Noise Figure

<i>Range</i>	<i>Frequency Range</i>	<i>Best Uncertainty (±) ^{note 1}</i>	<i>Remarks</i>
0 dB to +30 dB	10 MHz to 2.9 GHz	0.73 dB	70875A Plug-In
0 dB to +30 dB	2.9 GHz to 26.5 GHz	0.88 dB	70875A Plug-In

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NVLAP Code: 20/R13

Attenuators

Relative RF Power (Attenuation-Measure)

Frequency	Nominal	Best Uncertainty (\pm) ^{notes 1, 2}	Remarks
30 MHz to 26.5 GHz	0 dB to -58 dB	0.05 dB + M	Agilent N5530S Measuring Receiver System
	-58 dB to -78 dB	0.10 dB + M	
	-78 dB to -114 dB	0.15 dB + M	
30 MHz	0 dB to 50 dB	M + 0.07 dB	Agilent Verification Kit

Impedance (Measure)

10 Hz to 500 MHz	10 Ω to 1000 Ω	7.7 %	Impedance Probe and VNA
100 kHz to 500 MHz	10 Ω to 1000 Ω	1.9 %	HP 4395A VNA

Scattering Parameters (Reflection) S11, S22 ^{note 3}

Range in LinMag	Frequency	Best Uncertainty (\pm) in LinMag ^{note 1}	Remarks
0 to 0.333	0.05 GHz to 2 GHz	0.017	N5230A VNA & 3.5mm Cal Kit
0 to 0.333	2 GHz to 26.5 GHz	0.013	N5230A VNA & 3.5mm Cal Kit
0 to 0.333	30 kHz to 300 kHz	0.018	8753D VNA & 7mm Cal Kit
0 to 0.333	300 kHz to 1.3 GHz	0.017	8753D VNA & 7mm Cal Kit
0 to 0.333	1.3 GHz to 3 GHz	0.015	8753D VNA & 7mm Cal Kit
0 to 0.333	3 GHz to 6 GHz	0.036	8753D VNA & 7mm Cal Kit
0 to 0.333	18.0 GHz to 26.5 GHz	0.049	8757D VNA & 2.4mm Cal Kit
0 to 0.333	26.5 GHz to 40 GHz	0.073	8757D VNA & 2.4mm Cal Kit
0 to 0.333	40 GHz to 50 GHz	0.11	8757D VNA & 2.4mm Cal Kit

Scattering Parameters (Transmission) S21, S12 ^{note 4}

0.0031 to 0.8912	0.05 GHz to 2 GHz	0.0095	N5230A VNA & 3.5mm Cal Kit
0.0031 to 0.8912	2 GHz to 26.5 GHz	0.0095	N5230A VNA & 3.5mm Cal Kit
0.0031 to 0.8912	30 kHz to 300 kHz	0.017	8753D VNA & 7mm Cal Kit

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<i>Range in LinMag</i>	<i>Frequency</i>	<i>Best Uncertainty (±) in LinMag^{note 1}</i>	<i>Remarks</i>
0.0031 to 0.8912	300 kHz to 1.3 GHz	0.016	8753D VNA & 7mm Cal Kit
0.0031 to 0.8912	1.3 GHz to 3 GHz	0.014	8753D VNA & 7mm Cal Kit
0.0031 to 0.8912	3 GHz to 6 GHz	0.035	8753D VNA & 7mm Cal Kit
0.0031 to 0.8912	18 GHz to 26.5 GHz	0.052	8757D VNA & 2.4mm Cal Kit
0.0031 to 0.8912	26.5 GHz to 40 GHz	0.16	8757D VNA & 2.4mm Cal Kit
0.0031 to 0.8912	40 GHz to 50 GHz	0.33	8757D VNA & 2.4mm Cal Kit

NVLAP Code: 20/R17

Power Meters - RF Power Sensor Transfer

<i>Frequency</i>	<i>Nominal</i>	<i>Best Uncertainty (±)^{notes 1, 2}</i>	<i>Remarks</i>
10 MHz to 18 GHz		M + 1.3 %	1807A RF Standard
50 MHz to 26.5 GHz		M + 2.5 %	F1117AC RF Standard

RF Power Absolute

30 MHz to 26.5 GHz	+30 dBm to +10 dBm +10 dBm to -30 dBm	M + 0.24 dB M + 0.14 dB	Agilent N5530S
26.5 GHz to 40 GHz	+20 dBm to -70 dBm	M + 4.4 %	8487A Power Sensor
40 GHz to 50.0 GHz	+20 dBm to -70 dBm	M + 5.6 %	
50 MHz to 26.5 GHz	+20 dBm to -20 dBm	M + 2.8 %	M1118 RF Standard
10 kHz to 1.2 GHz	0.5 mV	M + 0.43 %	9520001-1 RF Sensor
10 kHz to 1.2 GHz	1.0 mV	M + 0.41 %	
10 kHz to 1.2 GHz	10 mV to 1000 mV	M + 0.40 %	

Tuned RF Power – Absolute

30 MHz to 26.5 GHz	0 dBm to -58 dBm -58 dBm to -78 dBm -78 dBm to -114 dBm	0.15 dB + M 0.17 dB + M 0.20 dB + M	Agilent N5530S Measuring Receiver System
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RF Current - Frequency Response measured in dB

<i>Parameter</i>	<i>Frequency Range</i>	<i>Best Uncertainty (±) ^{note 1}</i>	<i>Remarks</i>
Transfer Impedance	10 kHz to 400 MHz	2.1 dB	HP 4395A VNA
Transmission (Loss)	10 kHz to 400 MHz	2.6 dB	HP 4395A VNA
Longitudinal Conversion Loss	100 kHz to 1.5 MHz	1.5 %	Schaffner LCL Probes
Longitudinal Conversion Loss	1.5 MHz to 30 MHz	1.3 %	Schaffner LCL Probes
Longitudinal Conversion Loss	30 MHz to 100 MHz	1.3 %	Schaffner LCL Probes
Transmission (Loss – Crosstalk)	10 kHz to 100 MHz	5.6 %	HP 4395A VNA

THERMODYNAMIC

NVLAP Code: 20/T02
Humidity Measure

<i>Range in RH</i>	<i>Best Uncertainty (±) in RH ^{note 1}</i>	<i>Remarks</i>
5 % to 85 %	0.85 %	Optsonde Hygrometer

NVLAP Code: 20/T03
Temperature Measure

<i>Range in °C</i>	<i>Best Uncertainty (±) ^{note 1}</i>	<i>Remarks</i>
-25 to 300	0.039 °C	Hart Scientific 5609 PRT
Source		
-25 to 140	0.12 °C	Hart Scientific 9105
140 to 300	0.52 °C	Hart Scientific 9123

1. Represents an expanded uncertainty using a coverage factor, $k = 2$, at an approximate level of confidence of 95 %.
2. M = Mismatch uncertainty.
3. Assumes S_{21} and $S_{12} > = 0.8912$ LinMag.
4. Assumes S_{11} and $S_{22} < = 0.3349$ LinMag.

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