



National Voluntary Laboratory Accreditation Program



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

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CALIBRATION LABORATORIES

NVLAP LAB CODE 200154-0

DC/LOW FREQUENCY

NVLAP Code: 20/E02
 AC Current

Source <i>Range</i>	<i>Frequency in Hz</i>	<i>Best Uncertainty (\pm) in % ^{note 1}</i>	<i>Remarks</i>
10 μ A	10 to 1 k	0.4389	Fluke 5700A/5725A
100 μ A	10 to 1 k	0.1270	Fluke 5700A/5725A
1 mA	10 to 1 k	0.1273	Fluke 5700A/5725A
10 mA	10 to 1 k	0.0982	Fluke 5700A/5725A
100 mA	10 to 1 k	0.0982	Fluke 5700A/5725A
1 A	40 to 1 k	0.0912	Fluke 5700A/5725A
10 A	40 to 1 k	0.0551	Fluke 5700A/5725A
10 μ A	1 k to 10 k	1.3626	Fluke 5700A/5725A
100 μ A	1 k to 10 k	0.3233	Fluke 5700A/5725A
1 mA	1 k to 10 k	0.3233	Fluke 5700A/5725A
10 mA	1 k to 10 k	0.3233	Fluke 5700A/5725A
100 mA	1 k to 10 k	0.3233	Fluke 5700A/5725A
1 A	1 k to 10 k	1.1778	Fluke 5700A/5725A
10 A	1 k to 10 k	1.1778	Fluke 5700A/5725A
100 A	1 k	0.69	Valhalla 2555A AC-DC Calibrator

2009-04-01 through 2010-03-31

Effective dates

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Measure			
10 A	1 k	0.214	Valhalla 2575A AC-DC Shunt
100 A	1 k	0.135	Valhalla 2575A AC-DC Shunt
10 A	10 k	1.157	Valhalla 2575A AC-DC Shunt
100 μ A	10 to 5 k	0.4850	Agilent 3458A
1 mA	10 to 100 k	0.8083	Agilent 3458A
10 mA	10 to 100 k	0.8083	Agilent 3458A
100 mA	10 to 100 k	0.8083	Agilent 3458A
1 A	10 to 20 k	0.4850	Agilent 3458A
1 A	20 k to 50 k	1.2009	Agilent 3458A

NVLAP Code: 20/E05

DC Current

Source Range	Best Uncertainty (\pm) in % ^{note 1}	Remarks
1 μ A	1.1617	Fluke 5700A/5725A
10 μ A	0.1224	Fluke 5700A/5725A
100 μ A	0.0185	Fluke 5700A/5725A
1 mA	0.0081	Fluke 5700A/5725A
10 mA	0.0081	Fluke 5700A/5725A
100 mA	0.0092	Fluke 5700A/5725A
1 A	0.0144	Fluke 5700A/5725A
10 A	0.0471	Fluke 5700A/5725A
100 A	0.07 %	Valhalla 2555A AC-DC Calibrator

Measure		
10 A	0.023	Valhalla 2575A AC-DC Shunt
100 A	0.058	Valhalla 2575A AC-DC Shunt
100 nA	0.0497	Agilent 3458A
1 μ A	0.0070	Agilent 3458A
10 μ A	0.0037	Agilent 3458A
100 μ A	0.0034	Agilent 3458A
1 mA	0.0031	Agilent 3458A
10 mA	0.0031	Agilent 3458A
100 mA	0.0048	Agilent 3458A
1 A	0.0139	Agilent 3458A

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Resistance

Source

Range	Best Uncertainty (\pm) in % ^{note 1}	Remarks
1 Ω	0.0127	Fluke 5700A/5725A
10 Ω	0.0038	Fluke 5700A/5725A
100 Ω	0.0023	Fluke 5700A/5725A
1 k Ω	0.0017	Fluke 5700A/5725A
10 k Ω	0.0016	Fluke 5700A/5725A
100 k Ω	0.0018	Fluke 5700A/5725A
1 M Ω	0.0027	Fluke 5700A/5725A
10 M Ω	0.0053	Fluke 5700A/5725A
100 M Ω	0.0150	Fluke 5700A/5725A

Measure

Range	Best Uncertainty (\pm) in % ^{note 1}	Remarks
1 Ω	0.0075	Agilent 3458A
10 Ω	0.0023	Agilent 3458A
100 Ω	0.0020	Agilent 3458A
1 k Ω	0.0012	Agilent 3458A
10 k Ω	0.0012	Agilent 3458A
100 k Ω	0.0012	Agilent 3458A
1 M Ω	0.0020	Agilent 3458A
10 M Ω	0.0069	Agilent 3458A
100 M Ω	0.0589	Agilent 3458A
1 G Ω	0.5785	Agilent 3458A

NVLAP Code: 20/E06

DC Voltage

Source

Range	Best Uncertainty (\pm) in % ^{note 1}	Remarks
1 mV	0.0934	Fluke 5700A/5725A
10 mV	0.0103	Fluke 5700A/5725A
100 mV	0.0020	Fluke 5700A/5725A
1 V	0.0010	Fluke 5700A/5725A
10 V	0.0010	Fluke 5700A/5725A

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100 V	0.0012	Fluke 5700A/5725A
1000 V	0.001	Fluke 5700A/5725A

Measure

Range	Best Uncertainty (\pm) in % ^{note 1}	Remarks
1 mV	0.1165	Agilent 3458A
10 mV	0.0126	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 %	with HVD
1 kV to 40kV	2.33 %	with HV Probe

NVLAP Code: 20/E09

AC Voltage

Source

Range	Frequency in Hz	Best Uncertainty (\pm) in % ^{note 1}	Remarks
1 mV	10 to 100 k	1.0335	Fluke 5700A/5725A
10 mV	10 to 100 k	0.2021	Fluke 5700A/5725A
100 mV	10 to 100 k	0.1385	Fluke 5700A/5725A
1 V	10 to 100 k	0.0808	Fluke 5700A/5725A
10 V	10 to 100 k	0.0808	Fluke 5700A/5725A
100 V	10 to 100 k	0.0808	Fluke 5700A/5725A
1000 V	50 to 1 k	0.0109	Fluke 5700A/5725A
1 mV	100 k to 1 M	3.8800	Fluke 5700A/5725A
10 mV	100 k to 1 M	0.7621	Fluke 5700A/5725A
100 mV	100 k to 1 M	0.5312	Fluke 5700A/5725A
1 V	100 k to 1 M	0.3926	Fluke 5700A/5725A
10 V	100 k to 1 M	0.4503	Fluke 5700A/5725A
100 V	100 k to 200 k	1.7552	Fluke 5700A/5725A

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Measure

1 mV	1 to 100 k	0.7044	Agilent 3458A
10 mV	1 to 100 k	0.5901	Agilent 3458A
100 mV	1 to 100 k	0.0947	Agilent 3458A
1 V	1 to 100 k	0.0947	Agilent 3458A
10 V	1 to 100 k	0.0947	Agilent 3458A
100 V	1 to 100 k	0.1409	Agilent 3458A
1000 V	1 to 100 k	0.3487	Agilent 3458A
1 mV	100 k to 300 k	4.8498	Agilent 3458A
10 mV	100 k to 300 k	4.6420	Agilent 3458A
100 mV	100 k to 300 k	0.3580	Agilent 3458A
1 V	100 k to 300 k	0.3580	Agilent 3458A
10 V	100 k to 300 k	0.3580	Agilent 3458A
100 V	100 k to 300 k	0.4734	Agilent 3458A
100 mV	300 k to 2 M	1.7436	Agilent 3458A
1 V	300 k to 2 M	1.7436	Agilent 3458A
10 V	300 k to 2 M	1.7436	Agilent 3458A
100 V	300 k to 1 M	1.7436	Agilent 3458A

NVLAP Code: 20/E17

Pulse Waveform

Parameter	Range	Best Uncertainty (\pm)^{note 1}	Remarks
Risetime (Generate)	< 20 ps	14.43 %	
Risetime (Measure)	\leq 100ps	4.6×10^{-12} sec	Single Shot
Impulse Spectral Amplitude			
Impulse Noise (Source)	10 kHz to 150 kHz	14.21 %	Band A
Impulse Noise (Source)	150 kHz to 30 MHz	14.21 %	Band B
Impulse Noise (Source)	30 MHz to 1 GHz	23.43 %	Band C & D

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Oscilloscopes

Source

Range	Best Uncertainty (\pm) in % ^{note 1}	Remarks
1 mVDC	2.9170	Fluke 9500B w/9530
10 mVDC	0.3290	Fluke 9500B w/9530
100 mVDC	0.0584	Fluke 9500B w/9530
1 VDC	0.0058	Fluke 9500B w/9530
10 VDC	0.0329	Fluke 9500B w/9530
100 VDC	0.0302	Fluke 9500B w/9530

Range	Frequency in Hz	Best Uncertainty (\pm) in % ^{note 1}	Remarks
Fast Edge Pulse 5 mV to 3 V	10 to 2 M	4.1600	Fluke 9500B w/9530
High Edge Pulse 1 mV to 200 V	10 to 100 k	4.1600	Fluke 9500B w/9530
Level Sinewave 5 mV to 2 V	0.1 to 3.2 G	6.03	Fluke 9500B w/9530

Timing Markers

Range	Best Uncertainty (\pm) in ppm ^{note 1}	Remarks
10 nsec to 55 sec	0.29	Fluke 9500B w/9530

Capacitance

Measure

Range	Best Uncertainty (\pm) in % ^{note 1}	Remarks
10 pF to 95 pF	3.464	Fluke 9500B w/9530

Impedance

10 Ohm to 12 M Ohm	0.580	Fluke 9500 B w/9530
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TIME AND FREQUENCY

NVLAP Code: 20/F01
Frequency Dissemination

<i>Parameter</i>	<i>Nominal</i>	<i>Best Uncertainty (±) ^{note 1}</i>	<i>Remarks</i>
Frequency/Period			
Frequency (Source)	10 MHz	3.69×10^{-11}	GPS Reference Output
Frequency (Measure)	10 MHz, 1 Vrms	6.25×10^{-10}	Rubidium Counter
Frequency (Comparison)	10 MHz, 1 Vrms	8.17×10^{-10}	Rubidium Counter
Frequency (Measure)	26.5 GHz to 46 GHz	1.7×10^{-10}	High Frequency Counter

NVLAP Code: 20/F03
Oscillator Characterization

<i>Parameter</i>	<i>Nominal</i>	<i>Best Uncertainty (±) ^{note 1}</i>	<i>Remarks</i>
Duty Cycle/Duration @ 10s Time Interval	10 MHz, 1 Vrms	8.51×10^{-10}	Rubidium Counter
Jitter			
@ 200 mV p-p	2 GHz	1.38 %	
@ 1 Vrms	10 MHz	1.71 %	
Drift			
@ 10 s Time Interval	10 MHz	8.1×10^{-10}	Rubidium Counter
Spectral Purity Phase Noise			
0 to -138 dBc/Hz	10 MHz to 18 GHz	34.3 %	Noise Test Set
0 to -22 dBm	1 GHz	15.10 %	Spectrum Analyzer
Harmonic Distortion			
@ 0 dBm	0.2 Hz to 100 Hz	5.44 %	
@ 0 dBm	1 GHz	15.10 %	
@ -22 dBm	10 Hz to 100 kHz	29.91 %	

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2nd Order Harmonic/Intermodulation Distortion

@ 0 dBm	0.24 Hz to 100 Hz	5.44 %
@ 0 dBm	1 GHz	15.10 %

AM Modulation

AM (Source)	50 Hz to 50 kHz Rates	0.18 %	AM/FM Test Test
AM (Measure)	50 Hz to 50 kHz Rates	1.41 %	Meas. Receiver
AM (Source)	33.33 % of depth	0.12 %	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	1.72 %	Meas. Receiver
FM (Source)	34 kHz Peak Deviation	0.12 %	Meas. Receiver Calibrator
PM Modulation			
PM (Measure)	150 kHz to 1300 MHz	4.77 %	Meas. Receiver

Spurious Content

@ 0 dBm	0.2 Hz to 100 Hz	5.44 %
@ 0 dBm	1 GHz	15.10 %

RF/MICROWAVE

NVLAP Code: 20/R09

Noise Temperature

Noise Figure

Range	Frequency Range	Best Uncertainty (\pm)^{note 1}	Remarks
0 dB to +30 dB	10 MHz to 2.9 GHz	0.828 dB	Noise Source, Pre Amp Spectrum Analyzer
0 dB to +30 dB	2.9 GHz to 26.5 GHz	0.993 dB	Noise Source, Pre Amp Spectrum Analyzer

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NVLAP Code: 20/R13

Attenuators

Relative RF Power (Attenuation-Measure)

<i>Frequency</i>	<i>Nominal</i>	<i>Best Uncertainty</i> (\pm) ^{notes 1, 2}	<i>Remarks</i>
100 kHz to 2.6 GHz	0 dB to -20 dB	M + 0.02 dB	Meas. Receiver
100 kHz to 2.6 GHz	-20 dB to -40 dB	M + 0.03 dB	Meas. Receiver
100 kHz to 2.6 GHz	-40 dB to -60 dB	M + 0.04 dB	Meas. Receiver
100 kHz to 2.6 GHz	-60 dB to -80 dB	M + 0.05 dB	Meas. Receiver
100 kHz to 2.6 GHz	-80 dB to -100 dB	M + 0.06 dB	Meas. Receiver
100 kHz to 2.6 GHz	-100 dB to -110 dB	M + 0.12 dB	Meas. Receiver
100 kHz to 2.6 GHz	-110 dB to -120 dB	M + 0.17 dB	Meas. Receiver
2.5 GHz to 26.5 GHz	-0 dB to -10 dB	M + 0.22 dB	Meas. Receiver
2.5 GHz to 26.5 GHz	-10 dB to -20 dB	M + 0.09 dB	Meas. Receiver
2.5 GHz to 26.5 GHz	-20 dB to -30 dB	M + 0.10 dB	Meas. Receiver
2.5 GHz to 26.5 GHz	-30 dB to -40 dB	M + 0.13 dB	Meas. Receiver
2.5 GHz to 26.5 GHz	-40 dB to -50 dB	M + 0.14 dB	Meas. Receiver
2.5 GHz to 26.5 GHz	-50 dB to -60 dB	M + 0.16 dB	Meas. Receiver
2.5 GHz to 26.5 GHz	-60 dB to -70 dB	M + 0.18 dB	Meas. Receiver
2.5 GHz to 26.5 GHz	-70 dB to -80 dB	M + 0.20 dB	Meas. Receiver
2.5 GHz to 26.5 GHz	-80 dB to -90 dB	M + 0.31 dB	Meas. Receiver
2.5 GHz to 26.5 GHz	-90 dB to -100 dB	M + 0.32 dB	Meas. Receiver
2.5 GHz to 26.5 GHz	-100 dB to -110 dB	M + 0.34 dB	Meas. Receiver
2.5 GHz to 26.5 GHz	-110 dB to -120 dB	M + 0.36 dB	Meas. Receiver
30 MHz	0 dB to 50 dB	M + 0.07 dB	Verification Kit
26.5 GHz to 40 GHz	0 dB to -30 dB	M + 2.29 dB	
40 GHz to 50 GHz	0 dB to -30 dB	M + 2.83 dB	
Attenuation High Power (Generate)			
DC to 2 GHz	20 dB	M + 0.44 dB	with Narda 766-20 ATTN
DC to 2 GHz	20 dB	M + 0.80 dB	with Narda 769-20 ATTN
Attenuation High Voltage (Generate)			
DC to 1 GHz	20 dB	M + 0.30 dB	
DC to 2 GHz	20 dB	3M + 0.64 dB	

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Impedance (Source)

DC to 18 GHz	50 ohms	1.84 %
DC to 6 GHz	50 ohms	0.61 %
DC to 3 GHz	75 ohms	0.76 %

Impedance (Measure)

10 Hz to 500 MHz	10 ohms to 1000 ohms	8.8 %	Impedance Probe and VNA
100 kHz to 500 MHz		2.2 %	Vector Analyzer
DC to 6 GHz	50 ohms	11.79 %	(TDR)

Electrical Length (TDR)

1 GHz	30 cm	7.57 %
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Scattering Parameters (Reflection) S11, S22 ^{note 3}

<i>Range in LinMag</i>	<i>Frequency</i>	<i>Best Uncertainty (±) in LinMag ^{note 1}</i>	<i>Remarks</i>
0 to 0.333	0.05 GHz to 2 GHz	0.00693	VNA - 3.5 mm Cal Kit
0 to 0.333	2 GHz to 26.5 GHz	0.00541	VNA - 3.5 mm Cal Kit
0 to 0.333	30 kHz to 300 kHz	0.00327	VNA - 7 mm Cal Kit
0 to 0.333	300 kHz to 1.3 GHz	0.00328	VNA - 7 mm Cal Kit
0 to 0.333	1.3 GHz to 3 GHz	0.00495	VNA - 7 mm Cal Kit
0 to 0.333	3 GHz to 6 GHz	0.00865	VNA - 7 mm Cal Kit
0 to 0.333	18.0 GHz to 26.5 GHz	0.04959	SNA - 2.4 mm Cal Kit
0 to 0.333	26.5 GHz to 40 GHz	0.07319	SNA - 2.4 mm Cal Kit
0 to 0.333	40 GHz to 50 GHz	0.10603	SNA - 2.4 mm Cal Kit

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

0.0031 to 0.8912	0.05 GHz to 2 GHz	0.0046	VNA - 3.5 mm Cal Kit
0.0031 to 0.8912	2 GHz to 8 GHz	0.0019	VNA - 3.5 mm Cal Kit
0.0031 to 0.8912	8 GHz to 20 GHz	0.0021	VNA - 3.5 mm Cal Kit
0.0031 to 0.8912	20 GHz to 26.5 GHz	0.0022	VNA - 3.5 mm Cal Kit
0.0031 to 0.8912	30 kHz to 300 kHz	0.0021	VNA - 7 mm Cal Kit
0.0031 to 0.8912	300 kHz to 1.3 GHz	0.0019	VNA - 7 mm Cal Kit
0.0031 to 0.8912	1.3 GHz to 3 GHz	0.0024	VNA - 7 mm Cal Kit

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0.0031 to 0.8912	3 GHz to 6 GHz	0.0044	VNA - 7 mm Cal Kit
0.0031 to 0.8912	18 GHz to 26.5 GHz	0.05197	SNA - 2.4 mm Cal Kit
0.0031 to 0.8912	26.5 GHz to 40 GHz	0.16051	SNA - 2.4 mm Cal Kit
0.0031 to 0.8912	40 GHz to 50 GHz	0.33724	SNA - 2.4 mm Cal Kit

NVLAP Code: 20/R17

Power Meters

<i>Frequency</i>	<i>Nominal</i>	<i>Best Uncertainty (\pm)</i> ^{notes 1, 2}	<i>Remarks</i>
RF Power Sensor Transfer			
10 MHz to 18 GHz		M + 1.54 %	
50 MHz to 26.5 GHz		M + 2.90 %	
RF Power Absolute			
10 MHz to 18 GHz	+20 dBm to -20 dBm	M + 1.52 %	
26.5 MHz to 40 GHz	+20 dBm to -20 dBm	M + 4.41 %	
26.5 MHz to 40 GHz	-20 dBm to -70 dBm	M + 3.8 %	
40 GHz to 50.0 GHz	+20 dBm to -20 dBm	M + 5.95 %	
40 GHz to 50 GHz	-20 dBm to -70 dBm	M + 5.07 %	
50 MHz to 26.5 GHz	+20 dBm to -20 dBm	M + 2.89 %	
10 kHz to 100 MHz	0.5 mV	M + 0.20 dB	RF Millivoltmeter Probes
100 MHz to 300 MHz	0.5 mV	M + 0.24 dB	RF Millivoltmeter Probes
300 MHz to 1 GHz	0.5 mV	M + 0.28 dB	RF Millivoltmeter Probes
1 GHz to 1.2 GHz	0.5 mV	M + 0.43 dB	RF Millivoltmeter Probes
10 kHz to 100 MHz	1.0 mV	M + 0.14 dB	RF Millivoltmeter Probes
100 MHz to 1 GHz	1.0 mV	M + 0.20 dB	RF Millivoltmeter Probes
300 MHz to 1 GHz	1.0 mV	M + 0.24 dB	RF Millivoltmeter Probes
1 GHz to 1.2 GHz	1.0 mV	M + 0.42 dB	RF Millivoltmeter Probes
10 kHz to 100 MHz	10 mV to 1000 mV	M + 0.11 dB	RF Millivoltmeter Probes
100 MHz to 300 MHz	10 mV to 1000 mV	M + 0.11 dB	RF Millivoltmeter Probes
300 MHz to 1 GHz	10 mV to 1000 mV	M + 0.22 dB	RF Millivoltmeter Probes
1 GHz to 1.2 GHz	10 mV to 1000 mV	M + 0.41 dB	RF Millivoltmeter Probes

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Tuned RF Power - Absolute

100 kHz to 2.6 GHz	0 dBm to -100 dBm	M + 0.28 db	Meas. Receiver
100 kHz to 2.6 GHz	-100 dBm to -110 dBm	M + 0.30 db	Meas. Receiver
100 kHz to 2.6 GHz	-110 dBm to -120 dBm	M + 0.32 db	Meas. Receiver
2.5 GHz to 26.5 GHz	0 dBm to -10 dBm	M + 0.64 db	Meas. Receiver
2.5 GHz to 26.5 GHz	-10 dBm to -40 dBm	M + 0.61 db	Meas. Receiver
2.5 GHz to 26.5 GHz	-40 dBm to -60 dBm	M + 0.62 db	Meas. Receiver
2.5 GHz to 26.5 GHz	-60 dBm to -80 dBm	M + 0.63 db	Meas. Receiver
2.5 GHz to 26.5 GHz	-80 dBm to -90 dBm	M + 0.67 db	Meas. Receiver
2.5 GHz to 26.5 GHz	-90 dBm to -110 dBm	M + 0.68 db	Meas. Receiver
2.5 GHz to 26.5 GHz	-110 dBm to -120 dBm	M + 0.69 db	Meas. Receiver

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	2.68 dB	HP 4395A VNA
Transmission (Loss)	10 kHz to 400 MHz	2.92 dB	HP 4395A VNA
Longitudinal Conversion Loss	100 kHz to 1.5 MHz	1.338 %	Schaffner LCL Probes
Longitudinal Conversion Loss	1.5 MHz to 30 MHz	1.337 %	Schaffner LCL Probes
Longitudinal Conversion Loss	30 MHz to 100 MHz	1.387 %	Schaffner LCL Probes
Transmission (Loss – Crosstalk)	10 kHz to 100 MHz	4.329 %	HP 4395A VNA

THERMODYNAMIC

NVLAP Code: 20/T02
Humidity Source

<i>Range in RH</i>	<i>Best Uncertainty (±) in RH ^{note 1}</i>	<i>Remarks</i>
5% to 95%	1.605%	General Eastern C1

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NVLAP Code: 20/T08

Temperature

Measure

Range in °C

-25 to 300

Best Uncertainty (\pm) ^{note 1}

0.032 °C

Remarks

Hart Scientific 5613

Source

-25 to 140

140 to 600

0.158 °C

0.590 °C

Hart Scientific 9105

Hart Scientific 9123

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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 $S_{12} \geq 0.8912$ LinMag.
 4. Assumes S_{11} and $S_{22} \leq 0.3349$ LinMag.

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