

National Institute
of Standards and Technology



National Voluntary
Laboratory Accreditation Program

ISO/IEC 17025:1999
ISO 9002:1994

Scope of Accreditation



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CALIBRATION LABORATORIES

NVLAP LAB CODE 200154-0

HEWLETT-PACKARD COMPANY

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DC/LOW FREQUENCY

NVLAP Code: 20/E17
Pulse Waveform

<i>Parameter</i>	<i>Range</i>	<i>Best Uncertainty (\pm)^{note 1}</i>	<i>Remarks</i>
Risetime (Generate)	< 20 ps	14.43 %	
Risetime (Measure)	\leq 100 ps	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
HV (Measure)	1 kV to 60 kV	0.13 %	with HVD
	1 kV to 40 kV	2.33 %	with HV Probe

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TIME AND FREQUENCY

NVLAP Code: 20/F03

Oscillator Characterization

<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 to 46 GHz	1.7×10^{-10}	High Frequency Counter
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%	
@ 1Vrms	10 MHz	1.71%	

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Drift

@ 10 s Time Interval	10 MHz	8.1×10^{-10}	Rubidium Counter
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Spectral Purity Phase Noise

	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%

Noise Figure

0 to +30 dB	10 MHz to 2.9 GHz	0.828 dB	Noise Source, Pre Amp Spectrum Analyzer
0 to +30 dB	2.9 GHz to 26.5 GHz	0.993 dB	Noise Source, Pre Amp Spectrum Analyzer

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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
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Spurious Content

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

RF/MICROWAVE

NVLAP Code: 20/R13

Attenuators

Relative RF Power (Attenuation-Measure)

<i>Frequency</i>	<i>Nominal</i>	<i>Best Uncertainty (\pm)^{note 1,2}</i>	<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

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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 to -30 dB	M + 2.29 dB	
40 GHz to 50 GHz	0 to -30 dB	M + 2.83 dB	

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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

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 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)

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0 to 0.333	26.5 to 40 GHz	0.07319	SNA - 2.4 mm Cal Kit
0 to 0.333	40 to 50 GHz	0.10603	SNA - 2.4 mm Cal Kit
Scattering Parameters (Transmission) S ₂₁ , S ₁₂ ^{note 4}			
0.0031 to 0.8912	0.05 to 2 GHz	0.0046	VNA - 3.5 mm Cal Kit
0.0031 to 0.8912	2 to 8 GHz	0.0019	VNA - 3.5 mm Cal Kit
0.0031 to 0.8912	8 to 20 GHz	0.0021	VNA - 3.5 mm Cal Kit
0.0031 to 0.8912	20 to 26.5 GHz	0.0022	VNA - 3.5 mm Cal Kit
0.0031 to 0.8912	30 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 to 3 GHz	0.0024	VNA - 7 mm Cal Kit

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

NVLAP Code: 20/R17
Power Meters

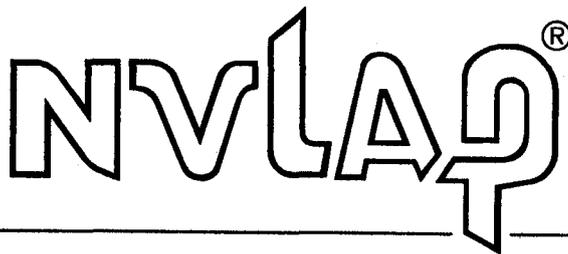
<i>Frequency</i>	<i>Nominal</i>	<i>Best Uncertainty (\pm)^{note 1,2}</i>	<i>Remarks</i>
RF Power Sensor Transfer			
10 MHz to 18 GHz		M + 1.54%	
50 MHz to 26.5 GHz		M + 2.90%	
RF Power Absolute			
10 MHz to 18 GHz	+20 to -20 dBm	M + 1.52%	
26.5 GHz to 40 GHz	+20 to -20 dBm	M + 4.41%	
26.5 GHz to 40 GHz	-20 to -70 dBm	M + 3.8%	
40 GHz to 50.0 GHz	+20 to -20 dBm	M + 5.95%	

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40 GHz to 50 GHz	-20 to -70 dBm	M + 5.07%	
50 MHz to 26.5 GHz		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

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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

1. Represents an expanded uncertainty using a coverage factor, $k=2$.
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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