

# LA19-13-03 Vector Network Analyser 300 kHz to 8 GHz

## Data Sheet



- 300 kHz to 8GHz Operation
- Up to 120 dB dynamic range
- 200 $\mu$ s per point sweep speed
- Access to internal receivers
- Fully featured signal generator mode
- Small footprint



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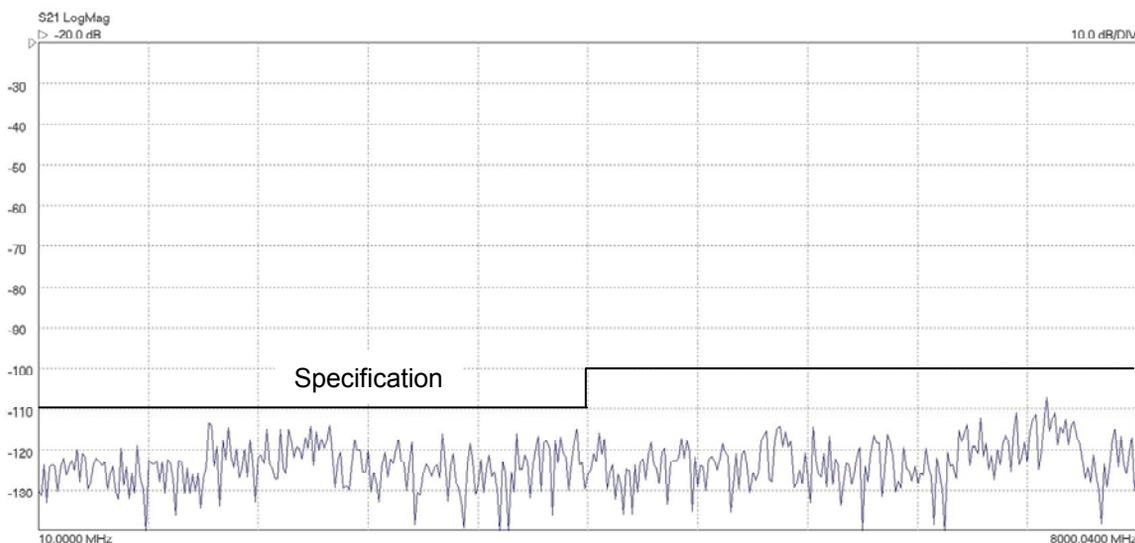
## Conditions

The instrument's specification is given below. Unless otherwise stated, the figures apply with a 20Hz resolution bandwidth, at +6dBm test power, at an ambient temperature of between 20°C and 30°C but within 1°C of the calibration temperature and 60 minutes after power up.

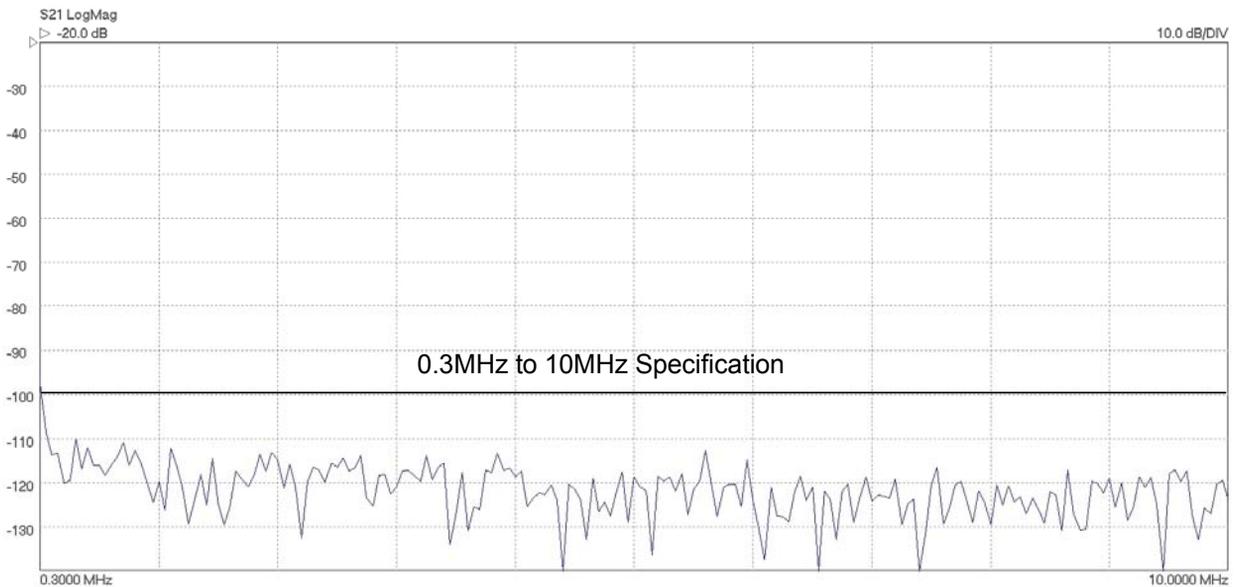
Receiver Characteristics			
Measurement bandwidth	20 kHz, 2 kHz, 1 kHz, 200 Hz, 100 Hz, 20 Hz, 10 Hz		
Average displayed noise floor, dB below the test signal level [S21 calibration, BW set to 20Hz, 16 averages, ports terminated as during isolation calibration]	<b>Band</b>	<b>Typical</b>	<b>Max</b>
	0.3 MHz – 10 MHz	-110	-100
	10 MHz – 6 GHz	-124	-110
	6 GHz – 8 GHz	-115	-100
Average displayed noise floor, dB below the test signal level [S21 calibration BW set to 20kHz, no averaging]	<b>Band</b>	<b>Typical</b>	<b>Max</b>
	10 MHz – 6 GHz	-84	-80
	6 GHz – 8 GHz	-80	-76
Dynamic range (dB) <sup>1</sup> [S21 calibration, BW set to 20Hz, 16 averages]	See graph		
Temperature stability [typical, after S21 calibration]	0.025 dB/°C		
Trace noise (mdBrms) [Full band, test level set to +6dBm, using a 401 point sweep]	<b>Bandwidth</b>	<b>Typical</b>	<b>Max</b>
	2 kHz	1	3
	10 kHz	3	5
	20 kHz	15	20

### Notes:

- Dynamic range is taken to be the difference between the test signal level at port 1 and the average displayed noise level with ports terminated as during isolation calibration step. In practice the useful dynamic range is limited by the crosstalk



Measured wideband (10MHz to 8GHz) system dynamic range excluding crosstalk ( $P_{\text{test}} = +6\text{dBm}$ , BW=20Hz and 16 averages)



Measured low frequency (0.3MHz to 10MHz) system dynamic range excluding crosstalk ( $P_{\text{test}} = +6\text{dBm}$ ,  $\text{BW}=20\text{Hz}$  and 16 averages)

## Measurement Uncertainty

Unless otherwise stated, the figures below apply with 20Hz resolution bandwidth, at +3dBm test power, averages set to 16, at an ambient temperature of  $23 \pm 2^\circ\text{C}$  and 60 minutes after power up and taken at the calibration temperature.

Calibration is carried out with a good quality 3.5mm or K-type calibration kit capable of achieving the instrument performance specified.

Uncertainty				
S11 / S22 <sup>1</sup>	See plots			
S21 / S12 amplitude and phase uncertainty with DUT attenuation range <sup>2</sup>	<b>Freq</b>	<b>0 – 30 dB</b>	<b>30 – 60 dB</b>	<b>60 – 80 dB</b>
	≤ 6 GHz	0.1dB / 1°	0.3 dB / 2°	1dB / 6°
	> 6 GHz	0.2dB / 2°	0.5 dB / 4°	2dB / 15°

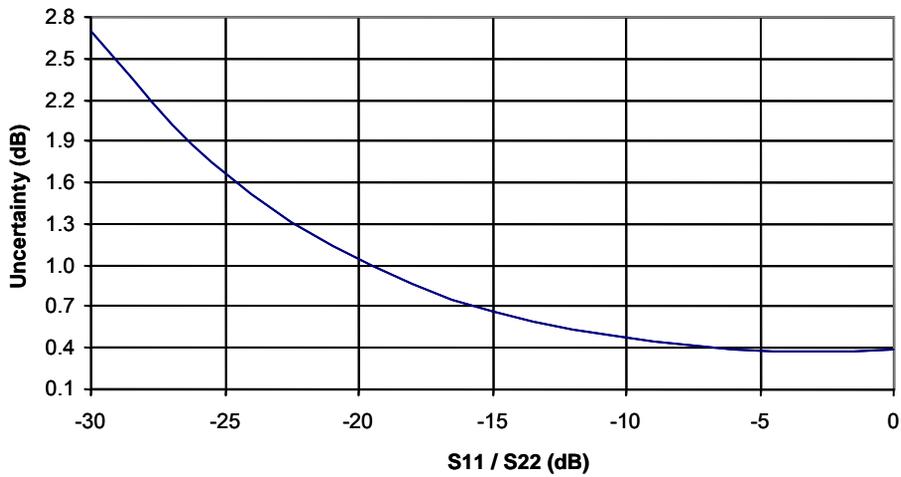
### Notes:

1. Assumes a single port device under test or if 2 ports that it has an insertion loss > 10 dB
2. Assumes that the device under test has a reflection coefficient at both ports of less than 0.1

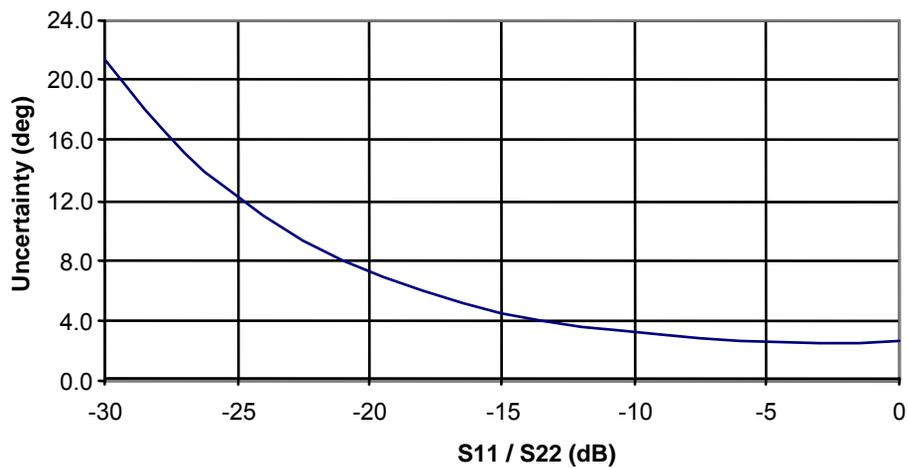
# Measurement Uncertainty (continued)

## S11 / S22 Uncertainty Plots

### S11 / S22 Amplitude Uncertainty



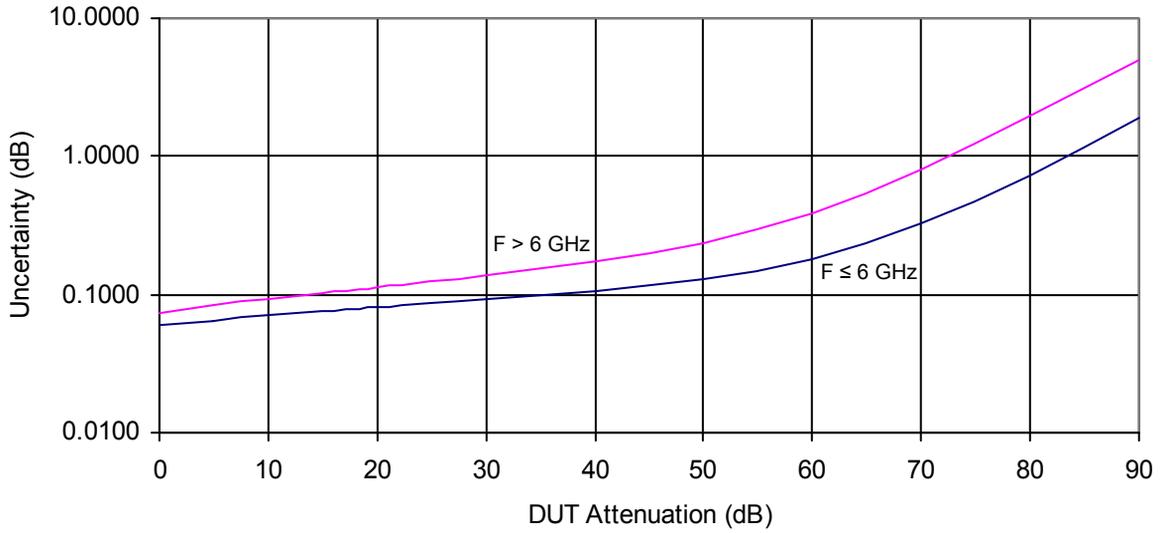
### S11 / S22 Phase Uncertainty



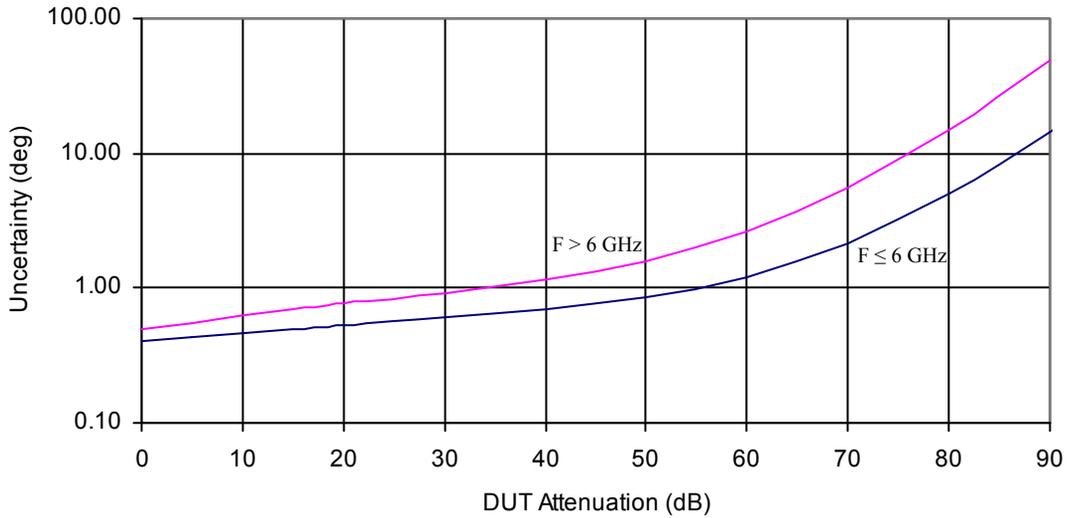
# Measurement Uncertainty (continued)

## Typical S21 / S12 Uncertainty Plots

S21/S12 Amplitude Uncertainty



S21/S12 Phase Uncertainty



<b>Test Port Characteristics</b>			
Load match (uncorrected)	18 dB typical, 10 dB min		
Source match (uncorrected)	18 dB typical, 10 dB min		
Directivity (corrected)	47 dB typical, 40 dB min		
Source match (corrected)	46 dB typical, 40 dB min		
Load match (corrected)	46 dB typical, 40 dB min		
Crosstalk (dB, corrected) Measured as the average noise floor with both ports open circuit	<b>Band</b>	<b>Typical</b>	<b>Max</b>
	0.3MHz – 4GHz	-110	-97
	4GHz – 8GHz	-100	-85
Maximum input level (1 dB compression, typical)	+11 dBm		
Maximum input level (no damage)	+23 dBm		
Test port connectors	Type N, female		
Direct receiver inputs, RCVRA / RCVRB (1 dB compression)	- 8dBm [no dc allowed]		
Direct receiver input, REF RCVR (1 dB compression)	+ 4dBm [no dc allowed]		
Direct receiver input ports (no damage)	+10 dBm [no dc allowed]		
Direct receiver inputs ports connectors	SMA		
Bias-T maximum current	250 mA		
Bias-T maximum dc voltage	±25V		
Bias-T current protection	Built-in resettable fuse		
Bias-T dc port connectors	BNC, female located on back panel		
Sweep trigger voltage	Low: -0.1 to +1.5V High: +2.0 to +5V		
Sweep trigger voltage (no damage)	±7V		
Sweep trigger connector	BNC, female located on back panel		

<b>Signal Source Characteristics (including signal generator utility)</b>	
Frequency range	300 kHz to 8.192 GHz
Frequency setting resolution	10Hz [20Hz for F > 4GHz]
Frequency accuracy	10ppm max [23 ±3°C]
Frequency temperature stability	±0.5ppm/°C max [+15 to 35°C]
Harmonics	-20 dBc max
Non-harmonic spurious	-40 dBc typical
Phase noise (10kHz offset)	-90 dBc/Hz [0.3 MHz to 1000 MHz] -80 dBc/Hz [1000 MHz to 4000 MHz] -76 dBc/Hz [>4000 MHz]
Test signal power	F < 3GHz 3GHz to 8GHz
	+10 to -20 dBm +6 to -20 dBm
Power setting resolution	0.1 dB
Power setting accuracy	±1.5dB max
Phase setting resolution <sup>1</sup>	F < 250 MHz 250-500 MHz 500-1000 MHz 1000-2000 MHz 2000-4000 MHz 4000-8000 MHz
	< 0.05° < 0.1° < 0.2° < 0.4° < 0.8° < 1.6°
FM and AM Modulation rates (internal) <sup>1,2</sup>	400 Hz and 1 kHz
FM Modulation deviation <sup>1,2</sup>	200 kHz max
AM Modulation depth <sup>1,2</sup>	90 % max
Frequency, level sweep and hop modes dwell time per point <sup>1,2</sup>	26 to 65500 µs
Frequency settling time to ±10ppm <sup>1,2</sup>	40 µs
Level settling time to ±5% <sup>1,2</sup>	13 µs
Reference input frequency	10MHz ±10ppm
Reference input level	0±3dBm
Reference output level	0±3dBm
Reference input / output connectors	BNC

1: Applicable to signal generator utility only

2. AM and FM modulation internally generated only

<b>Measuring Functions</b>	
Measuring parameters	S11,S21,S22, S12 P1dB (Power at 1dB gain compression) AM-PM conversion factor
Error correction	12 term (full s-parameter correction), S11 (1 port correction) S21 (normalise, normalise + isolation) S21 (source match correction + normalise + isolation) averaging, smoothing, Hanning and Kaiser Bessel filtering on time domain measurements, electrical length compensation (manual), electrical length compensation (auto), effective dielectric constant correction, de-embed (2 embedding networks may be specified), impedance conversion
Display channels	4 channels (CH1, CH2, CH3, CH4)
Traces	2 traces per channel
Display formats	Amplitude (logarithmic and linear) Phase, Group Delay, VSWR, Real, Imaginary, Smith Chart, Polar, Time Domain
Memory trace	One per channel
Limit lines	6 segments per channel (overlap allowed)
Markers	8 markers
Marker functions	Normal, $\Delta$ marker, fixed marker, peak / min, 3 dB and 6 dB bandwidth

<b>Sweep Functions</b>	
Sweep type	Linear sweep CW sweep (timed sweep) Power sweep ( $P_{1dB}$ utility)
Sweep times, 20kHz bandwidth, 10 MHz to 8 GHz sweep	51 points (12-term cal): 28 ms 201 points (12-term cal): 108 ms 101 points (s21 cal) : 19 ms
Number of points	51, 101, 201, 401, 801, 1024, 2001, 4001, 9001

P1dB Utility	
Frequency range	0.3 to 8192 MHz
Measurement modes	Fixed frequency and swept frequency range
Test power sweep range	-20 to +6 dBm
Test power sweep step	1 dB
P <sub>1dB</sub> calculation method	2 <sup>nd</sup> order curve fit
Display format	Graphical, gain and output power
Data storage	Measured data can be saved to file or printed
Accuracy	0.5 dB, typical

AM to PM Utility	
Frequency range	0.3 to 8192 MHz
Test power sweep range	-20 to +6 dBm
Test power sweep step	1 dB
P <sub>1dB</sub> calculation method	2 <sup>nd</sup> order curve fit
Display format	Graphical, phase conversion (deg / dB)
Data storage	Measured data can be saved to file or printed
Accuracy	1°, typical

Group Delay	
Range (180° maximum phase shift per frequency step)	$\tau = \frac{0.5}{\Delta f}$ where $\Delta f$ is the aperture frequency
Aperture frequency	Sweep step size
Accuracy	$\Delta \tau = \frac{PhaseError}{360 \cdot \Delta f}$

<b>Data Handling</b>	
Calibration data	Store / Recall on hard disk
Calibration kit data	Store / Recall on hard disk
Calibration error terms	Store on hard disk
Raw uncorrected measurement data	Store on hard disk
Print measured data (graphics)	To any printer installed on host PC
Save measured data (graphics)	Store on hard disk
Measured data	Store on hard disk
Measured data (Touchstone® format)	Store on hard disk
Measured data (Touchstone® format)	Recall to memory trace from hard disk

[Touchstone® is a Trade Mark of Agilent Corporation]

<b>Miscellaenous</b>	
Controlling PC data interface	USB
Support for third party test software	Dynamic Link Library (DLL) provided as part of user interface software
Controlling PC minimum requirements	Intel Pentium 4 (2GHz) or higher, 2GB RAM 50MB Hard disk storage on C: partition Windows ® XP or 7 (English language)
External dimensions (handle retracted)	316 x 140 x 319 mm
Weight	5.8 kg
Temperature range (operating)	+15°C to +35°C
Temperature range (storage)	-20°C to +50°C
Humidity	80% max , non-condensing
Vibration (storage)	0.5G, 5Hz to 300Hz
Power source	AC, 90 to 250V
Power consumption	55 VA max
Fuses	2 x 20 mm, F1.6A, quick blow, IEC127