LA Techniques Ltd

LA19-13-04B 8.5 GHz Vector Network Analyser

Overview and Data Sheet

The LA19-13-04B is a 8.5 GHz USB controlled Vector Network Analyser capable of providing professional performance and capability at an unprecedented level of affordability. The instrument uses a four-receiver architecture allowing support for 8 error terms calibration techniques as well as traditional 12 error terms correction.

The LA19-13-04B uses a highly integrated design in order to provide a uniquely affordable solution which nevertheless boasts exceptional performance such frequency translation measurements, close to 124 dB of dynamic range, 0.006 dB rms trace noise at its maximum operating bandwidth of 140 kHz, a maximum measurement speed of 190 µs per point for all 4 s-parameters and 10 Hz frequency setting resolution. All of this in a compact package with a footprint of 29 cm x 17 cm.

The LA19-13-04B can be supported by most commercially available calibration kits as well as LA Technique's precision PC3.5 calibration kits. These are TRL referred offering excellent accuracy and value.

Take anywhere professional performance

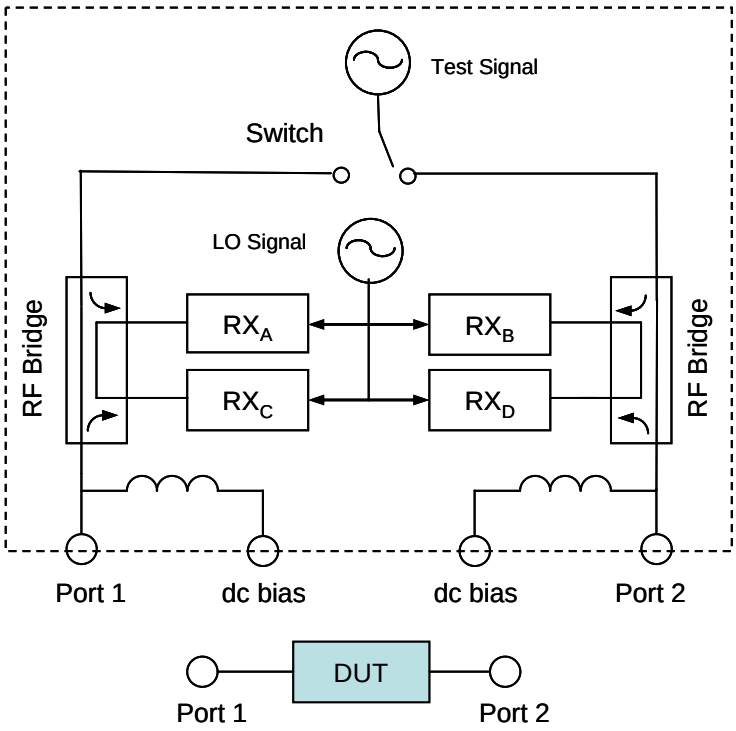
- Fast speed of 190 µs per frequency point for all 4 s-parameters measurement
- Mixer measurements including VSWR correction
- Up to 124 dB of dynamic range with 10 Hz operating bandwidth
- Trace noise of 0.006 dB rms at a bandwidth of 140 kHz
- Time domain transmission and reflectometry
- Network de-embedding and reference plane extension
- Signal generator (CW and frequency sweep) utility

Four receiver architecture

At the centre of the instrument is a four receiver architecture. This approach is more complex than traditional three or even two receiver arrangements but has the benefit that the imperfections of the forward / reverse switch can be removed mathematically. This in turn allows 8-term calibration methods such as the 'unknown thru' to be implemented.

The forward / reverse switch has been designed to achieve very fast settling times so that both forward and reverse measurements can be taken at every frequency point tuned by the signal synthesizers. Some competing instruments require two frequency sweeps as the switch is too slow, taking tens of milliseconds to settle.

The hardware implementation provides sweep trigger signals to allow synchronised measurements to be carried out. Another feature of the hardware is the provision of bias-Ts which provide a means of powering up active devices under test.



Precision calibration kits

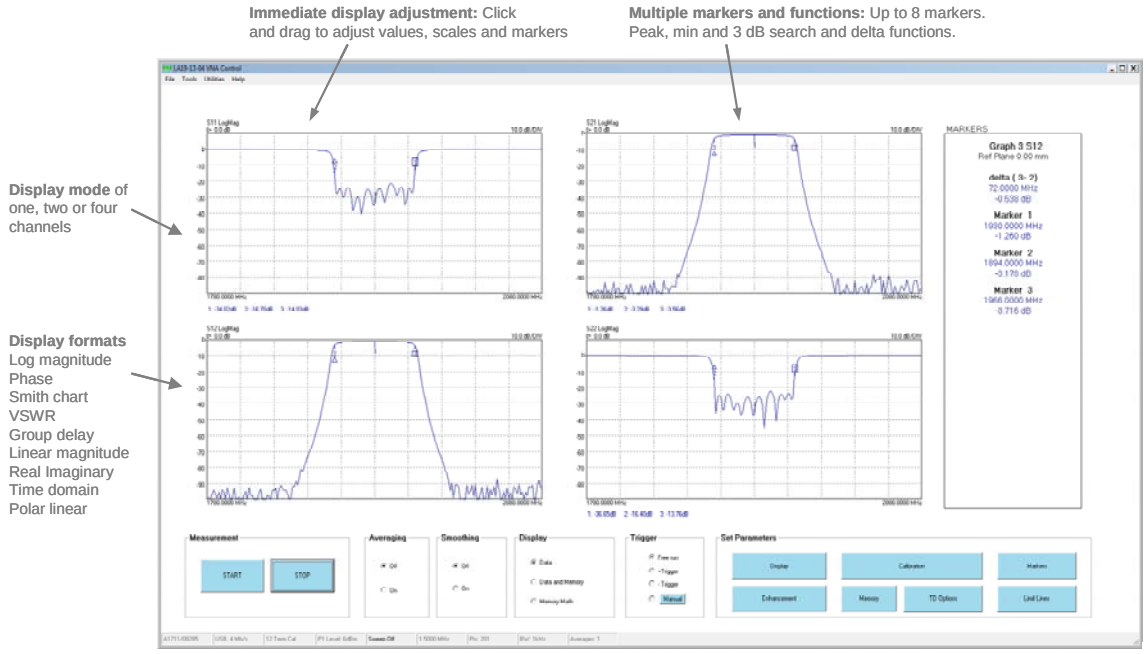
Precision PC3.5 calibration kits are available as optional accessories. These kits are data based. That means that each of the standards (Short, Open, Load and Thru) is defined by measured data rather than the more traditional approach of model parameters. The advantage of measured data is of lower cost but without sacrificing accuracy.

Each of the standards is characterised over the range 1 MHz to 8.5 GHz in two bands. From 1 MHz to 1.0 GHz they are measured using a reference VNA with a commercial precision calibration kit and SOLT (Short/Open/Load/Thru) calibration. Above 1.0 GHz a TRL calibration is employed to carry out very accurate measurements referred to a precision air line. A further refinement is the application of post-measurement processing to remove systematic errors introduced by small variations of the characteristic impedance of the air line associated with effects of skin depth, particularly at the lower microwave frequencies.

Comprehensive and easy to use software

The user interface software was developed by experienced users of VNAs with ease of use being the key driver. The main tasks such as calibration, display set up and measured data saving are simple and straightforward to carry out.

The combination of professional grade performance, small size, weight and cost make the LA19-13-04B ideal for a range of applications including research and development, production, field service, installation test, and classroom applications. With its support for remote automation, the LA19-13-04B is also ideal for ATE applications. With respect to production testing, there is the ability to set up limit lines with up to 11 segments over the measurement band for limit line testing. Visual and audio limit fail alarms are provided.



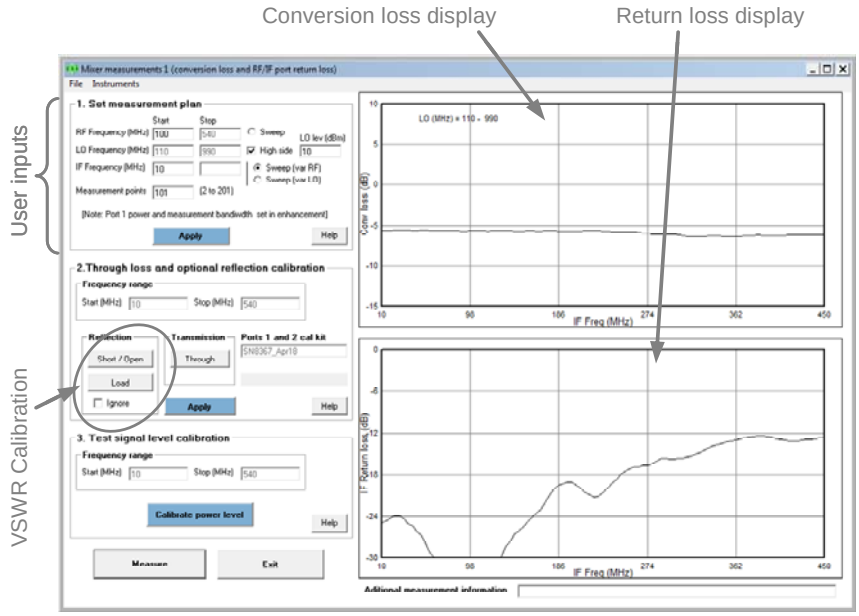
Reference plane extension (manual and automatic) together with network de-embedding provide very useful aids to measurement of, for example, surface mount components.

Support for Unknown Thru calibration, an efficient method for measuring devices which are not ‘insertable’, for example, typical evaluation boards fitted with female SMA connectors at both ends.

LA Techniques have been designing and manufacturing USB driven VNAs for close to 20 years and all versions of the software have included a simple to use calibration kit editor. The editor with the LA19-13-04B allows for very quick creation of calibration kits from either model data or measured data. This versatility allows kits to be created for most commercially available calibration kits. Using the editor, the user can also quickly create “clone” kits from precision kits using low cost parts.

Other useful utilities include Data Compare (compares measured data with reference data loaded from disk), P1dB gain compression measurement, AM to PM conversion measurement and a signal generator function able to operate in CW or frequency sweep modes. Sweep plans of up to 1001 points are allowed with adjustable dwell times of between 250 µs and 60,000 µs.

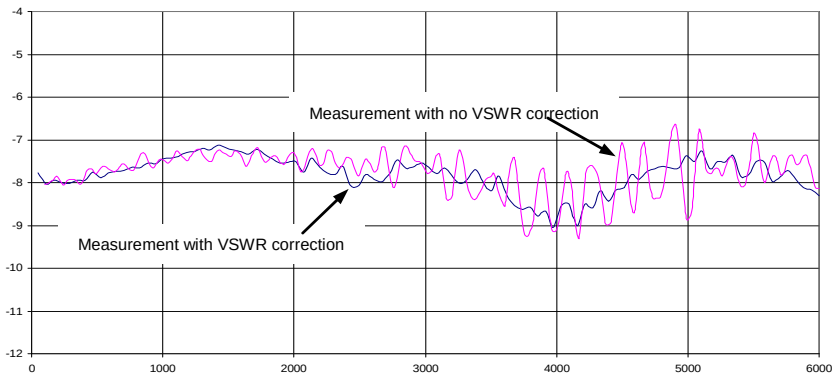
Mixer measurements



- External LO support
- External Power Meter support

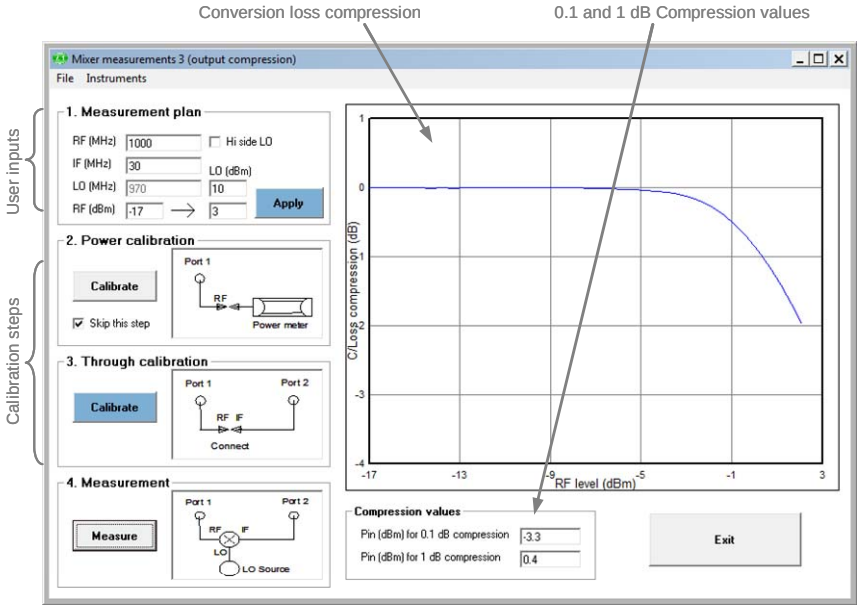
A wide range of mixer measurements can be carried out including swept RF or IF with a choice of low or high side LO. Support for an external LO source and power meter is provided. Contact the factory for your choice of external LO generator to be considered.

In addition to the above, port to port isolation measurements can also be carried out.



- VSWR Correction

Mixers with high port VSWRs can be difficult to measure accurately. The LA19-13-04B mixer measurement calibration includes the option of VSWR error correction. This reduces the conversion loss measurement uncertainty as shown in the diagram.



- Mixer compression

Conversion loss variation as a function of the input RF level can easily be carried out. Level calibration can be done using an external power meter or the internal sensitivity of the instrument receiver.

The 0.1 and 1 dB compression points are displayed on completion.

Specification

The instrument's specification is given below. Unless otherwise stated, the figures apply with a 10Hz resolution bandwidth, at 0dBm test power using a 12-term calibration with no averaging and no interpolation and 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. Where applicable, the figures apply to the use of LA's calibration kits DW97157 Iss.2.0 and DW97158 Iss.2.0 or better precision kits.

Receiver Characteristics

Measurement Bandwidth (Hz):
140 k, 70 k, 35 k, 15 k, 10 k, 5 k,
1 k, 500, 100, 50, 10

Average displayed noise floor, across the band specified, dB below the test signal level set to maximum power after an S21 calibration with ports terminated as during the isolation calibration step

Band (MHz)	Typical	Max
0.3 - 1	-100	-90
1 – 6000	-124	-110
> 6000	-120	-100

Dynamic Range, with 10Hz bandwidth, maximum test power and no averaging: see graph (typical, excludes crosstalk)

Temperature stability, measured after an S21 calibration, typical:

0.02 dB/ º C for F < 4 GHz
0.04 dB/ º C for F ≥ 4 GHz

Trace noise, dB rms, measured using a 201 points sweep covering 0.3 MHz to 8.5 GHz and test power set to 0 dBm

Bandwidth	Typical	Max
10 kHz	0.0006	0.002
70 kHz	0.003	0.005
140 kHz	0.006	0.01

Measurement Uncertainty

In addition to the conditions outlined earlier in this section, the figures apply for a 12 error term calibration (insertable device) carried out with a good quality 3.5 mm calibration kit capable of achieving the performance specified.

Reflection measurements

Range	Magnitude	Phase
-15 dB to 0 dB		
Freq < 2MHz	0.7	8º
Freq > 2MHz	0.5	4º
-25 dB to -15 dB		
Freq < 2MHz	0.8	6º
Freq > 2MHz	1.0	10º
-30 dB to -25 dB		
Freq < 2MHz	3.0	20º
Freq > 2MHz	3.0	20º

Transmission measurements

Range	Magnitude	Phase
+0 dBm to +10 dBm		
Freq < 2MHz	0.4	6º
Freq > 2MHz	0.2	2º
-40 dBm to 0 dBm		
Freq < 2MHz	0.2	2º
Freq > 2MHz	0.1	1º
-60 dBm to -40 dBm		
Freq < 2MHz	0.5	8º
Freq > 2MHz	0.2	4º
-80 dBm to -60 dBm		
Freq < 2MHz	2.0	15º
Freq > 2MHz	1.5	12º

Spurious responses

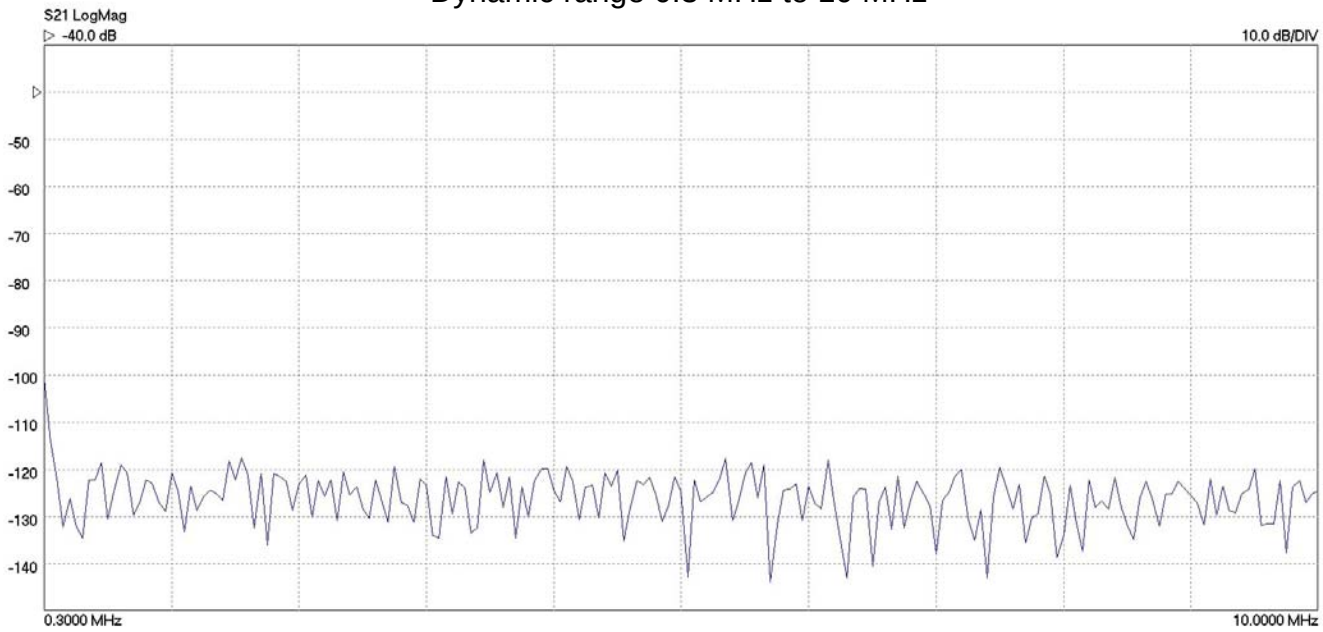
The main spurious responses occur at close to (3 x RF + 2.6) MHz, where RF is the test frequency in MHz. For example, when testing a band-pass filter with a centre frequency of, say 1900 MHz, then an unwanted response may occur around 632.47 MHz. There may also be spurious responses close to (2 x RF + 1.3) MHz. In all known cases the levels will be as follows:

-76 dBc typical, -70 dBc max

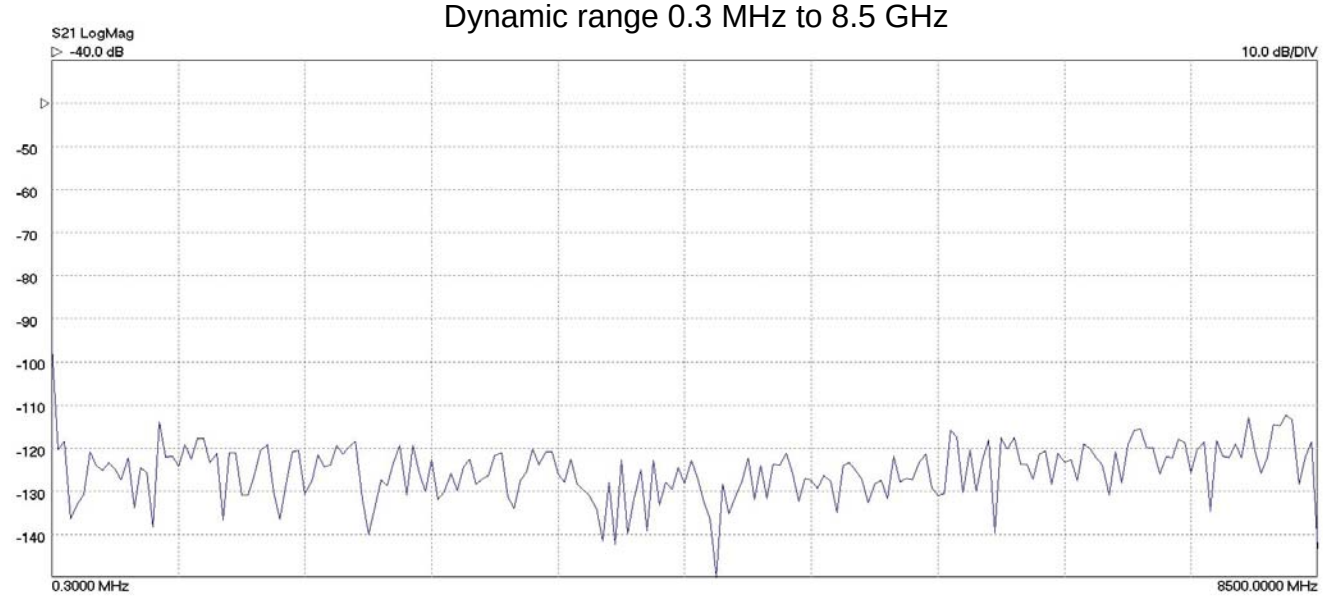
Dynamic range

Typical, excludes crosstalk, after a 12-term calibration, with the test signal level set to maximum, the IF bandwidth set to 10 Hz and a sweep plan of 201 points. See also the related average displayed noise floor table previously shown.

Dynamic range 0.3 MHz to 10 MHz



Dynamic range 0.3 MHz to 8.5 GHz



Test port characteristics

Load match
Uncorrected: 15 dB, typical
Corrected: 46 dB, typical
40 dB, min

Source match
Uncorrected: 15 dB, typical
Corrected: 46 dB, typical
40 dB, min

Directivity
Corrected: 47 dB, typical
40 dB, min

Crosstalk
Corrected, measured with both calibrated ports terminated in short circuits after isolation calibration over band specified.

Band	Typical	Max
< 2 MHz	-100	-90
2 MHz – 6 GHz	-110	-90
6 GHz – 8.5 GHz	-100	-90

Maximum input level
0.1 dB compression: +10 dBm, typ

Maximum input level
No damage: +23 dBm

Test port connectors
Type N, female

Bias-T maximum current
250 mA (7.5Ω path resistance, typ)

Bias-T maximum dc voltage
±15 V

Bias-T current protection
Built-in resettable fuse

Bias-T dc port connectors
SMB

Sweep trigger output voltage
Low: 0 V to 0.8 V
High: 2.2 V to 3.6 V

Sweep trigger input voltage
Low: -0.1 V to 1 V
High: 2.0 V to 4 V

Sweep trigger input voltage
No damage: ±6 V

Sweep trigger in/out connectors
BNC, female on back panel

Measuring functions

Measuring parameters
S11, S21, S22, S12
Mixer conversion loss, return loss, isolation and compression
P1dB, 1dB gain compression
AM-PM conversion factor

Error correction
12 error term full s-parameter correction (insertable DUT)

12 error term full s-parameter correction
(non-insertable DUT using calibrated thru adaptor)

8 error term full s-parameter unknown thru adaptor correction (non-insertable DUT)

S11 (1 port correction)

de-embed (2 embedding networks may be specified), impedance conversion

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,

Display channels
4 channels

Traces
2 traces per display channel

Display formats
Amplitude (logarithmic and linear)
Phase, Group Delay, VSWR, Real, Imaginary, Smith Chart, Polar, Time Domain

Memory trace
One per display channel

Limit lines
6 segments per channel (overlap allowed)

Markers
8 markers

Marker functions
Normal, Δ marker, fixed marker, peak / min hold, 3 dB and 6 dB bandwidth

Sweep functions

Sweep type
Linear sweep
CW sweep (timed sweep)
Power sweep (P1dB utility)

Sweep times
140 kHz bandwidth
10 MHz to 8.5 GHz sweep
201 points (12-term cal): 38 ms
201 points (S21 cal): 25 ms

Number of sweep points
51, 101, 201, 401, 801, 1024, 2001, 4001, 9001, 10001

Signal Source Characteristics

Frequency range:
300 kHz to 8.5 GHz

Frequency setting resolution:
10 Hz

Frequency accuracy:
with ambient of 23 ±3 ºC
10 ppm max

Frequency temperature stability:
±0.5 ppm/ºC max over the range +15 ºC to +35 ºC

Harmonics:
With test power set to < -3 dBm
-20 dBc max

Non-harmonic spurious:
-40 dBc typical

Phase noise (10 kHz offset):
-90 dBc/Hz [0.3 MHz to 1 GHz]
-80 dBc/Hz [1 GHz to 4 GHz]
-76 dBc/Hz [> 4 GHz]

Test signal power:
≤ 6 GHz: +10 to -20 dBm
> 6 GHz: +6 to -20 dBm

Power setting resolution:
0.1 dB

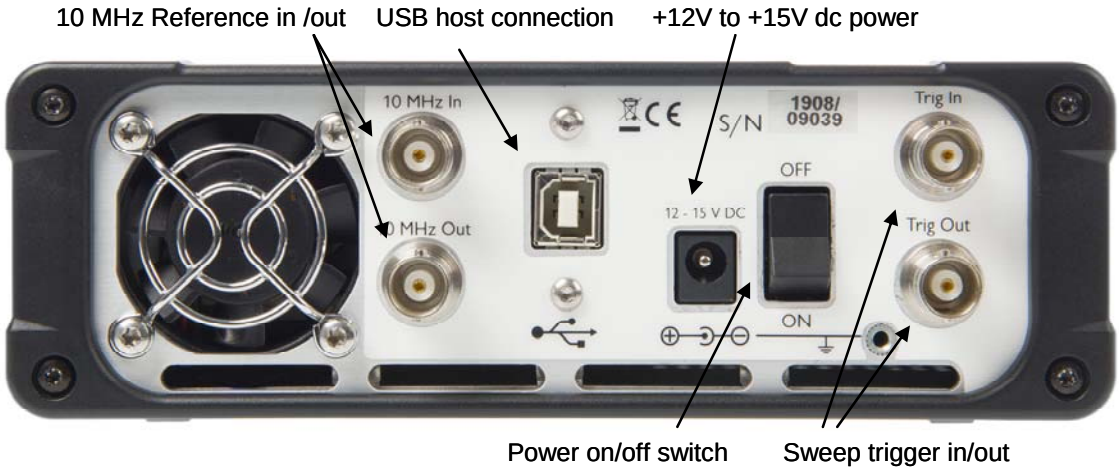
Power setting accuracy:
±1.5 dB

Reference input frequency:
10 MHz ±6 ppm

Reference input level:
0 ±3 dBm

Reference output level:
0 ±3 dBm

Rear panel connections



Miscellaneous

Controlling PC data interface:
USB 2.0

Support for third party test software:
Dynamic Link Library (DLL) as part of user interface software

External dimensions (mm):
286 x 174 x 61 (L x W x H)
Excluding connectors

Weight:
2.1 kg

Temperature range (operating):
+15 ºC to +35 ºC

Temperature range (storage):
-20 ºC to +50 ºC

Humidity:
80% max, non-condensing

Vibration (storage):
0.5G, 5 Hz to 300 Hz

Power source and current:
+12 Vdc to +15 Vdc, 1.9A max with +15 Vdc supply.

Power source connector:
5.5 mm diameter hole, 2.1 mm diameter centre contact pin. Centre pin is positive.

Host PC requirements:
MS Windows© XP or later
2 GB RAM or more
Screen resolution 1680x1050 or higher
A high-performance graphics card is recommended for larger (>1001 points) sweep points.

Ordering information

The prices given may exclude any local taxes and shipping costs. Please contact the factory or your local LA Techniques Ltd representative for more information.

The LA19-13-04B is supplied in a carry case, with the operating software in a CD ROM or USB memory stick and with a universal AC to DC power supply capable of operating with a mains voltage of between 90 VAC and 250 VAC.

Vector Network Analyzer

Item	Description	GBP
LA19-13-04B	VNA, carry case, universal power supply and operating software in a CD ROM (or USB memory stick)	tbd

Calibration Kits

Item	Description	GBP
DW97157 Iss.2.0	PC3.5 Female calibration kit including female Short, Open, Load and a female to female adaptor all in a presentation case. Kit data in a CD ROM or USB memory stick.	tbd

Item	Description	GBP
DW97158 Iss.2.0	PC3.5 Male calibration kit including male Short, Open, Load and a male to male adaptor all in a presentation case. Kit data in a CD ROM or USB memory stick.	tbd

Item	Description	GBP
DW97157 + DW97158	DW97157 and DW97158 (Iss.2.0) in a single presentation case with all kit data in a single CD ROM or USB memory stick	tbd

Test cables

Item	Description	GBP
VcableSet1	Set of two economy flexible test cable, N (male) to PC3.5 (male), 500 to 600 mm long. Flexing phase stability < 3º at 8 GHz	tbd

Item	Description	GBP
VcableSet2	Set of two precision flexible test cable, N (male) to PC3.5 (male), approximately 600 mm long. Flexing phase stability < 1º at 8 GHz	tbd

Torque spanner

Item	Description	GBP
TSpan1	Suitable for PC3.5 and SMA connectors	tbd

Verification device

The DW97194 Iss.4 is an insertable verification device with PC3.5 connectors. It consists of a section of 25Ω transmission line that provides a consistent means of verifying the correct performance of the VNA.
The device is ideal for use with the LA19-13-04B's Compare Data utility as quick and easy way of checking the correct operation of the VNA, associated calibration kits and test cables.

Item	Description	GBP
DW97194 Iss.4	Mismatched line verification device supplied with reference factory data including uncertainty values.	tbd

Post sales calibration

Item	Description	GBP
VNACal	Factory calibration of LA19-13-04B with up to two calibration kits. Calibration certificate, test report and instrument sticky labels.	tbd