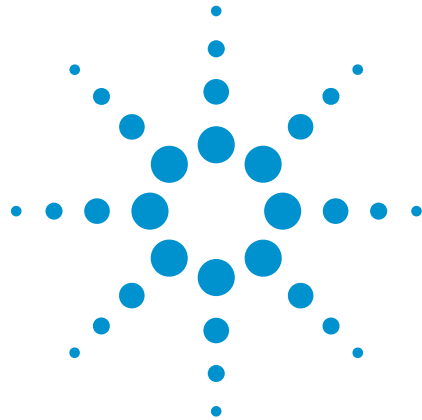


# Agilent ESA-L Series Spectrum Analyzers

Data Sheet



## Available frequency ranges

*E4411B*      *9 kHz to 1.5 GHz*

*E4403B*      *9 kHz to 3.0 GHz*

*E4408B*      *9 kHz to 26.5 GHz*

As the lowest cost ESA option, these basic analyzers are ideal for cost conscious bench-top or manufacturing environments.

Customers looking for a more portable solution would benefit from the new Agilent N9340B handheld RF spectrum analyzer.

Customers looking for a lower cost alternative to the ESA-L should consider the Agilent N9320B handheld RF spectrum analyzer.



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The ESA-L Series spectrum analyzers are tested to ensure they will meet their warranted performance. Unless otherwise stated, all specifications are valid over 0 to 55 °C. Supplemental characteristics, shown in italics, are intended to provide additional information that is useful in using the instrument. These typical (expected) or nominal performance parameters are not warranted but represent performance that 80 percent of the units tested exhibit with 95 percent confidence at room temperature (20 to 30 °C).

This data sheet is intended as a quick reference to ESA-L spectrum analyzer specifications, and is by no means complete. Please refer to the ESA-L specification guide for full information and specifications, publication number: E4403-90036.

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## ESA-L Express Analyzer Option BAS or BTG

Receive faster delivery and a favorable price when you order the ESA-L express analyzer Option BAS or BTG. This express analyzer is configured based on the most frequently ordered ESA-L configuration and most popular options. The express analyzer options simplify the ordering process while maintaining the flexibility of the ESA platform.

### Choose your frequency range:

E4411B	9 kHz to 1.5 GHz
E4403B	9 kHz to 3.0 GHz
E4408B	9 kHz to 26.5 GHz

### Choose your express option:

BAS	Includes IF/sweep port (A4J) and GPIB connection (A4H)
BTG	Includes BAS, plus tracking generator functionality

### And receive the following advantages:

- 1.1 dB overall amplitude accuracy
- +7.5 dBm TOI
- 1 kHz minimum RBW
- 100 Hz minimum RBW with Option 1DN

The BAS or BTG express option can be combined with Option 1DN, narrow resolution bandwidth.

Customers looking for a more portable solution would benefit from the new handheld spectrum analyzer N9340B.

[www.agilent.com/find/N9340B](http://www.agilent.com/find/N9340B)

Customers looking for a lower cost alternative to the ESA should consider the N9320B.

[www.agilent.com/find/N9320B](http://www.agilent.com/find/N9320B)

## Frequency Specifications

Frequency range	E4411B	E4403B	E4408B
BAS/BTG configuration	9 kHz - 1.5 GHz	9 kHz - 3 GHz	9 kHz - 26.5 GHz
Custom configuration	(75 Ω input Option 1DP) 1 MHz - 1.5 GHz	N/A	N/A

Frequency range	100 Hz - 3 GHz	2.85 - 6.7 GHz	6.2 - 13.2 GHz	12.8 - 19.2 GHz	18.7 - 26.5 GHz
Band	0	1	2	3	4
Harmonic (N <sup>a</sup> ) mixing mode	1-	1-	2-	4-	4-

Basic analyzer		
<b>Frequency reference</b>		
Frequency reference error = $\pm$ [(aging rate x time since last adjustment) + settability + temperature stability]		
Frequency readout accuracy (start, stop, center, marker) = $\pm$ (frequency indication x frequency reference error + SP <sup>b</sup> +15% of RBW + 10 Hz + 1 Hz x N <sup>a</sup> )		
Aging rate	$\pm 2 \times 10^{-6}$ /year	
Temperature stability	$\pm 5 \times 10^{-6}$ /year	
Settability	$\pm 5 \times 10^{-7}$ /year	
Span coefficient (SP) <sup>b</sup>	0.75% x span	
External reference	10 MHz	
<b>Marker frequency counter<sup>c</sup></b>		
Accuracy = $\pm$ (marker frequency x frequency reference error + counter resolution)		
Counter resolution = selectable from 1 Hz to 100 kHz		
<b>Frequency span</b>		
Range = 0 Hz (zero span), 100 Hz to maximum frequency range of the analyzer		
Accuracy	Linear scale	1% of span
	Logarithmic scale	N/A

a. N is the harmonic mixing mode. For negative mixing modes (as indicated by "-"), the desired first LO harmonic is higher than the tuned frequency by the first IF (3.9214 for the 9 kHz to 3 GHz band, and 321.4 MHz for all other bands.)

b.  $+5\%$  of span +  $\frac{\text{span}}{\text{sweep pts.} - 1}$ . Sweep points fixed at 401 for basic analyzer.

c. Not available in RBW < 1 kHz (Option 1DR).

## Frequency Specifications *(continued)*

Basic analyzer		
<b>Sweep time and trigger</b>		
Range	Span = 0 Hz	4 ms - 4000 s
	Span ≥ 100 Hz	4 ms - 4000 s
Accuracy (Span = 0 Hz)		±1%
Trigger type		Free run, single, line, video, offset, delayed, external
Delayed trigger range		1 μs to 400 s
<b>Sweep (trace) points</b>		
Range	Span = 0 Hz	401
	Span ≥ 100 Hz	401

Basic analyzer		
<b>Resolution bandwidths (1-3-10 sequence)</b>		
Range		
(-3 dB) (-6 dB EMI)		1 kHz - 5 MHz <sup>a</sup> 9 kHz, 120 kHz
With 1DR <sup>b</sup> (-3 dB) (-6 dB EMI)		Add 100 Hz, 300 Hz Add 200 Hz
<b>Accuracy</b>		
1 to 300 Hz		±10%
1 kHz to 3 MHz		±15%
5 MHz		±30%
<b>Selectivity (60 dB/3 dB bandwidth ratio)</b>		
100 to 300 Hz		< 5:1 digital, approximately Gaussian
1 kHz to 5 MHz		< 15:1 synchronously tuned four poles, approximately Gaussian
<b>Video bandwidths (1-3-10 sequence)</b>		
Range with 1DR		30 Hz to 3 MHz Adds 1, 3, 10 Hz for RBWs less than 1 kHz

- a. For resolution bandwidths < 1 kHz or > 3 MHz, not compatible with the rms detector.  
 b. Only available for spans < 5 MHz.

## Frequency Specifications *(continued)*

Basic analyzer		
	E4411B	E4403B/08B
<b>Stability</b>		
Noise sidebands offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector		
Offset from CW signal	<i>Specification and typical dBc/Hz applies to all frequencies <math>\leq 6.7</math> GHz<sup>a, b</sup> Italics indicate typical performance</i>	
$\geq 10$ kHz	<i>-93, -95 dBc/Hz</i>	<i>-90, -94 dBc/Hz</i>
$\geq 20$ kHz	<i>-100, -102 dBc/Hz</i>	<i>-100, -105 dBc/Hz</i>
$\geq 30$ kHz	<i>-104, -106 dBc/Hz</i>	<i>-106, -112 dBc/Hz</i>
$\geq 100$ kHz	<i>-113, -116 dBc/Hz</i>	<i>-118, -122 dBc/Hz</i>
<b>Residual FM (peak-to-peak)</b>		
1 kHz RBW, 1 kHz VBW (measurement time)	$\leq 150 \text{ Hz} \times N^b$ (100 ms) $\leq 30 \text{ Hz} \times N^b$ (20 ms), Option 1DR	
<b>System related sidebands</b>		
$\geq 30$ kHz offset from carrier CW signal	$\leq -65 \text{ dBc} + 20\log N^b$	

a. Add  $20\log(N)$  for frequencies  $> 6.7$  GHz.

b.  $N$  = LO harmonic mixing number.

## Amplitude Specifications

		E4411B	E4403B/08B
<b>Amplitude range</b>			
<b>Measurement range</b>		Displayed average noise level (DANL) to maximum safe input level	
Input attenuator range (5 dB step)		0 - 60 dB	0 - 65 dB
<b>Maximum safe input level</b>			
Input attenuator setting		≥ 15 dB	≥ 5 dB average continuous power; ≥ 30 dB peak pulse power
Average continuous power		+30 dBm (1 W)	+30 dBm (1 W)
Peak pulse power <sup>a</sup>			+50 dBm (100 W)
DC voltage	AC coupled	100 Vdc +75 dBmV (0.4 W) Option 1DP	100 Vdc
<b>1 dB gain compression</b>		Two tone	
Total power at input mixer <sup>b</sup> 50 MHz to 6.7 GHz 6.7 to 13.2 GHz 13.2 to 26.5 GHz		0 dBm to 1.5 GHz 46.75 dBmV (1DP)	0 dBm
			-3 dBm
			-5 dBm

a. < 10 μs pulse width, < 1% duty cycle.

b. Mixer power level (dBm) = Input power (dBm) minus input attenuation (dB).

## Amplitude Specifications *(continued)*

Basic analyzer				
	E4411B	E4403B	E4408B	
Displayed average noise level (dBm) (input terminated, 0 dB attenuation, sample detector) specification <i>Italics indicate typical performance</i>				
Conditions	100 Hz RBW; 1 Hz VBW (Option 1DR);			
Frequency				
1 - 10 MHz	-123, -129	-126	-129	
10 - 500 MHz	-127, -131	-125, -130	-124, -129	
500 MHz - 1 GHz	-125, -130			
1 - 1.5 GHz	-121, -128	-124, -130	-123, -130	
1.5 - 2 GHz	N/A	-122, -130	-120, -128	
2 - 3 GHz				
3 - 6 GHz		N/A		-118, -127
6 - 12 GHz				-115, -124
12 - 22 GHz			-109, -122	
22 - 26.5 GHz				



## Amplitude Specifications (continued)

Basic analyzer	
<b>Display</b>	
Display range	0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps (10 display divisions)
<b>Log scale</b>	
RBW $\geq$ 1 kHz	Calibrated 0 to $-85$ dB from reference level
RBW $\geq$ 300 Hz	Calibrated 0 to $-120$ dB <sup>a</sup> from reference level
<b>Linear scale</b>	
	10 divisions
Scale units	dBm, dBmV, dB $\mu$ V, dB $\mu$ A, A, V, and W
Trace detectors	Peak, negative peak, sample, rms <sup>b</sup> , video averaging
Trace functions	Clear/write, maximum hold, minimum hold, view, blank, operations, normalize
<b>Marker readout resolution</b>	
Log scale	0.04
0 to $-85$ dB	
0 to $-120$ dB (1DR)	
Linear scale	0.01% of reference level
<b>Reference level</b>	
Range	$-149.9$ dBm to maximum mixer level + attenuator setting
Resolution	$\pm 0.1$ dB
Log scale	
Linear scale	
<b>Accuracy<sup>c</sup></b> For reference level (dBm) – input attenuator setting (dB) + preamp gain (dB)	
$-10$ to $> -60$ dBm	$\pm 0.3$ dB
$-60$ to $> -85$ dBm	$\pm 0.5$ dB
$-85$ to $> -90$ dBm	$\pm 0.7$ dB
<b>Display scale switching uncertainty</b> (referenced to 1 kHz RBW at reference level)	
Linear to log switching	$\pm 0.15$ dB at reference level
<b>Resolution bandwidth switching uncertainty</b> (referenced to 1 kHz at reference level)	
100 Hz, 300 Hz RBW	$\pm 0.3$ dB (1DR)
1 kHz to 3 MHz RBW	$\pm 0.3$ dB
5 MHz RBW	$\pm 0.6$ dB

a. 0 to  $-70$  dB range when span = 0 Hz, or when IF gain fixed.

b. Not available for RBW  $<$  1 kHz or  $>$  3 MHz.

c. 50  $\Omega$ , accuracy (at a fixed frequency, a fixed attenuator, and referenced to  $-35$  dBm).

## Amplitude Specifications (continued)

Basic analyzer	
<b>Input attenuator switching uncertainty (at 50 MHz)</b>	
Attenuator setting 0 to 5 dB	±0.3 dB
10 dB	Reference
15 to 60 dB	±(0.1 dB + 0.01 x attenuator setting)
<b>Frequency response (10 dB input attenuation)</b>	
Absolute <sup>a</sup> 9 kHz to 3 GHz	±0.5 dB
3 to 6.7 GHz	±1.5 dB
6.7 to 13.2 GHz	±2 dB
13.2 to 26.5 GHz	
<b>Absolute amplitude accuracy</b>	
At reference settings <sup>b</sup>	±0.4 dB
Overall amplitude accuracy <sup>c</sup>	±(0.6 dB + absolute frequency response)
<b>Display scale fidelity</b>	
Log max cumulative dB below reference level RBW ≥ 1 kHz 0 dB reference > 0 to 70 dB	±(0.3 dB + 0.01 x dB from reference level)
RBW ≤ 300 Hz (Option 1DR) span > 0 Hz, auto range on 0 to 98 dB <sup>d</sup> > 98 to 120 dB	±(0.3 dB + 0.01 x dB from reference level) ±2.0 dB from reference level, characteristic
Log incremental accuracy dB below reference level 0 to 80 dB <sup>d</sup>	±0.4 dB/4 dB
Linear accuracy	±2% of reference level

- a. Frequency response values are referenced to the amplitude at 50 MHz (20 to 30 °C).
- b. Settings are: reference level -25 dBm; (75 Ω reference level +28.75 dBmV); input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; amplitude scale linear or log; span 2 kHz; frequency scale linear; sweep time coupled, sample detector, signal at reference level.
- c. For reference level 0 to -50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; amplitude scale log, log range 0 to -50 dB from reference level; frequency scale linear; sweep time coupled; signal input 0 to -50 dBm; span ≤ 20 kHz (20 to 30 °C).
- d. 0 to 30 dB for RBW = 200 Hz.

## Amplitude Specifications *(continued)*

Basic analyzer E4411B/03B/08B	
<b>Spurious responses</b>	
Third order intermodulation distortion	For two –30 dBm signals at input mixer <sup>a</sup> and > 50 kHz separation
100 MHz to 26.5 GHz	< –75 dBc, +7.5 dBm TOI
<b>Second harmonic distortion</b>	
2 to 750 MHz –40 dBm tone at input mixer <sup>a</sup>	< –75 dBc, +35 dBm SHI (E4411B)
10 to 500 MHz –30 dBm tone at input mixer <sup>a</sup>	< –60 dBc, +30 dBm SHI
500 MHz to 1.5 GHz –30 dBm tone at input mixer <sup>a</sup>	< –70 dBc, +40 dBm SHI
1.5 to 2.0 GHz –10 dBm tone at input mixer <sup>a</sup>	< –80 dBc, +70 dBm SHI
> 2 GHz –10 dBm tone at input mixer <sup>a</sup>	≤ –95 dBc, +85 dBm SHI
<b>Other input related spurious</b>	
Inband > 30 kHz offset	< –65 dBc for –20 dBm tone at input mixer <sup>a</sup>
Out of band responses	< –80 dBc for –10 dBm tone at input mixer <sup>a</sup>
<b>Residual responses (Input terminated and 0 dB attenuation)</b>	
50 Ω RF input impedance	
150 kHz to 1.5 GHz/6.7 GHz <sup>b</sup>	< –90 dBm
75 Ω RF input impedance ( <i>Option 1DP only available on ESA-L custom configuration for the E4411B</i> )	
1 MHz to 1.5 GHz	< –36 dBmV

a. Mixer power level (dBm) = input power (dBm) - input attenuation (dB).

b. Up to 1.5 GHz for models E4411B/03B. Up to 6.7 GHz for model E4408B.

## Tracking Generator Specifications

Tracking generator specifications (Options 1DN and 1DQ)	
<b>Frequency range</b>	
E4411B	
Option 1DN, (50 Ω)	9 kHz to 1.5 GHz
Option 1DQ, (75 Ω)	1 MHz to 1.5 GHz
<b>RBW range</b>	
E4411B	1 kHz to 5 MHz
<b>Output power level range</b>	
E4411B	
Option 1DN	0 to -70 dBm
Option 1DQ	+42.75 to -27.25 dBmV
<b>Output vernier range</b>	
E4411B	10 dB
<b>Output attenuator range</b>	
E4411B	0 to 60 dB, 10 dB steps
<b>Output flatness</b>	
E4411B	
Option 1DN, (50 W)	
9 kHz to 10 MHz	±2.0 dB
10 MHz to 1.5 GHz	±1.5 dB
Option 1DQ, (75 W)	
1 to 10 MHz	±2.5 dB
10 MHz to 1.5 GHz	±2.0 dB
<b>Effective source match (characteristic)</b>	
E4411B	< 2.5:1
<b>Spurious output</b>	
Harmonic spurs	
E4411B	
(0 dBm output)	
9 kHz to 20 MHz	< -20 dBc
20 MHz to 1.5 GHz	< -25 dBc
<b>Non-Harmonic spurs</b>	
E4411B	< -35 dBc
<b>Dynamic range</b>	
Maximum output power – displayed average noise level	
<b>Output power sweep range</b>	
E4411B	
Option 1DN	(-15 to 0 dBm) - (source attenuator setting)
Option 1DQ	(+27.75 to +42.75 dBmV) - (source attenuator setting)

## General Specifications

Basic analyzer			
	E4411B	E4403B	E4408B
<b>Temperature range</b>			
Operating	0 to +55 °C		
Storage	-40 to +75 °C		
Disk drive	10 to +40 °C		
<b>EMI compatibility</b>	Conducted and radiated interference is in compliance with CISPR Pub. 11/1990 Group 1 Class A Conducted and radiated interference is in compliance with CISPR Pub. 11/1990 Group 1 Class B <sup>a</sup> (Option 060)		
<b>Audible noise sound pressure at 25 ° C</b>	< 40 dBa pressure and < 4.6 bels power (ISODP7779)		
<b>Military specifications</b>	Type tested to the environmental specifications of MIL-PRF-28800F class 3		
<b>Power requirements</b>	Type tested to the environmental specifications of MIL-PRF-28800F class 3		
AC operation on (line  )	90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz Power consumption < 300 W		
Standby (line ⏻)	Power consumption < 5 W		
DC operation	12 to 20 Vdc, < 200 W power consumption		
<b>Data storage (nominal)</b>			
Internal <sup>b</sup>	200 traces or states/8.0 MB		
External	3.5 in, 1.44 MB, MS-DOS		
<b>Memory usage (nominal)</b>			
State	16 kB <sup>c</sup>		
State plus 401- point trace	20 kB <sup>c</sup>		
<b>Weight (without options)</b>			
	13.2 kg 29.1 lbs	15.5 kg 34.2 lbs	17.1 kg 37.7 lbs
<b>Measurement speed</b>			
Local measurement rate	≥ 35/s	≥ 30/s	≥ 28/s
Remote measurement and GPIB transfer	≥ 30/s	≥ 30/s	≥ 30/s
RF center freq tuning time	≤ 90 ms	≤ 90 ms	≤ 90 ms
<b>Display resolution<sup>d</sup></b>	640 x 480		

a. Meeting class A performance during DC operation.

b. For serial numbers < US414400 or MY41440000, 1 MB without Option B72, 8 Mb with Option B72.

c. 401 sweep points. The size of a state will increase depending on the installed application(s).

d. The LCD display is manufactured using high precision technology. However, there may be up to six bright points (white, blue, red, or green in color) that constantly appear on the LCD screen. These points are normal in the manufacturing process and do not affect the measurement integrity of the product in any way.

## General Specifications *(continued)*

<b>Inputs/outputs</b>	
<b>Front panel</b>	
Input	50 $\Omega$ type N (f); 75 $\Omega$ BNC (f) (Option 1DP); 50 $\Omega$ APC 3.5 (m) (Option BAB)
RF out	50 $\Omega$ type N (f); 75 $\Omega$ BNC (f) (Option 1DQ)
Probe power	+15 Vdc, -12.6 Vdc at 150 mA maximum (characteristic)
External keyboard	6-pin mini-DIN, PC keyboards (for entering screen titles and file names)
Headphone Power output	Front panel knob controls volume 0.2 W into 4 $\Omega$ (characteristic)
AMPT REF out	50 $\Omega$ BNC (f) (nominal)
IF INPUT (Option AYZ)	50 $\Omega$ SMA (f) (nominal)
LO OUTPUT (Option AYZ)	50 $\Omega$ SMA (f) (nominal)
<b>Rear panel</b>	
10 MHz REF OUT	50 $\Omega$ BNC (f), > 0 dBm (characteristic)
10 MHz REF IN	50 $\Omega$ BNC (f), -15 to +10 dBm (characteristic)
GATE TRIG/EXT TRIG IN	BNC (f), 5 V TTL
GATE /HI SWP OUT	BNC (f), 5 V TTL
VGA OUTPUT	VGA compatible monitor, 15-pin mini D-SUB, (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced analog RGB 640 x 480)
<b>IF, sweep and video ports (Option A4J or AYX)</b>	
AUX IF OUT	BNC (f), 21.4 MHz, nominal -10 to -70 dBm (uncorrected)
AUX VIDEO OUT	BNC (f), 0 to 1 V, characteristic (uncorrected)
HI SWP IN	BNC (f), low stops sweep, (5 V TTL)
HI SWP OUT	BNC (f), (5 V TTL)
SWP OUT	BNC (f), 0 to +10 V ramp
<b>GPIO interface (Option A4H)</b>	IEEE-488 bus connector
<b>Serial interface (Option 1AX)</b>	RS-232, 9-pin D-SUB (m)
<b>Parallel interface</b>	
(Option A4H or 1AX)	25-pin D-SUB (f) printer port only
<b>I/O connectivity software</b>	IO libraries suite ( <a href="http://www.agilent.com/find/iosuite/data-sheet">www.agilent.com/find/iosuite/data-sheet</a> )
<b>Dimensions and weight for the ESA family of analyzers.</b>	
Width to outside of instrument handle	416 mm (16.4 in)
Width to outside of the shipping cover	373 mm (14.7 in)
Overall height	222 mm (8.75 in)
Depth from front frame to rear frame	409 mm (16.1 in)
Depth with instrument handle rotated horizontal	516 mm (20.3 in)
<b>E4411B</b>	
Instrument weight	13.2 kg (29.1 lbs)
Shipping weight	25.1 kg (55.4 lbs)
<b>E4403B</b>	
Instrument weight	15.5 kg (34.2 lbs)
Shipping weight	27.4 kg (60.4 lbs)
<b>E4408B</b>	
Instrument weight	17.1 kg (37.7 lbs)
Shipping weight	31.9 kg (70.3 lbs)

## For More Information

For the latest information on the Agilent ESA-L Series see our Web page at:

[www.agilent.com/find/esa](http://www.agilent.com/find/esa)



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	*0.125 €/minute
Germany	07031 464 6333**
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Israel	972-3-9288-504/544
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Other European Countries:

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