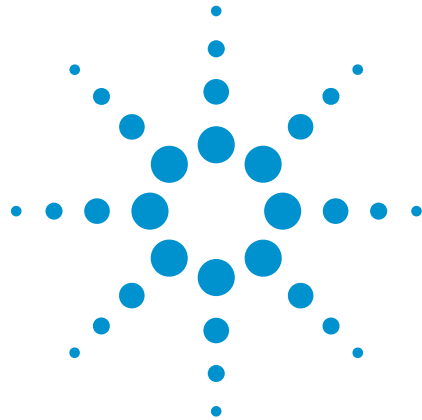


Agilent ESA-L Series Spectrum Analyzers

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.



Agilent Technologies

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

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

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 ^a) mixing mode	1-	1-	2-	4-	4-

Basic analyzer		
Frequency reference		
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 ^b +15% of RBW + 10 Hz + 1 Hz x N ^a)		
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) ^b	0.75% x span	
External reference	10 MHz	
Marker frequency counter^c		
Accuracy = \pm (marker frequency x frequency reference error + counter resolution)		
Counter resolution = selectable from 1 Hz to 100 kHz		
Frequency span		
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		
Sweep time and trigger		
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
Sweep (trace) points		
Range	Span = 0 Hz	401
	Span ≥ 100 Hz	401

Basic analyzer		
Resolution bandwidths (1-3-10 sequence)		
Range		
(-3 dB) (-6 dB EMI)		1 kHz - 5 MHz ^a 9 kHz, 120 kHz
With 1DR ^b (-3 dB) (-6 dB EMI)		Add 100 Hz, 300 Hz Add 200 Hz
Accuracy		
1 to 300 Hz		±10%
1 kHz to 3 MHz		±15%
5 MHz		±30%
Selectivity (60 dB/3 dB bandwidth ratio)		
100 to 300 Hz		< 5:1 digital, approximately Gaussian
1 kHz to 5 MHz		< 15:1 synchronously tuned four poles, approximately Gaussian
Video bandwidths (1-3-10 sequence)		
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
Stability		
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 ≤ 6.7 GHz^{a, b} Italics indicate typical performance</i>	
≥ 10 kHz	<i>-93, -95 dBc/Hz</i>	<i>-90, -94 dBc/Hz</i>
≥ 20 kHz	<i>-100, -102 dBc/Hz</i>	<i>-100, -105 dBc/Hz</i>
≥ 30 kHz	<i>-104, -106 dBc/Hz</i>	<i>-106, -112 dBc/Hz</i>
≥ 100 kHz	<i>-113, -116 dBc/Hz</i>	<i>-118, -122 dBc/Hz</i>
Residual FM (peak-to-peak)		
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	
System related sidebands		
≥ 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	
Amplitude range			
Measurement range		Displayed average noise level (DANL) to maximum safe input level	
Input attenuator range (5 dB step)		0 - 60 dB	0 - 65 dB
Maximum safe input level			
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 ^a			+50 dBm (100 W)
DC voltage	AC coupled	100 Vdc +75 dBmV (0.4 W) Option 1DP	100 Vdc
1 dB gain compression		Two tone	
Total power at input mixer ^b		0 dBm to 1.5 GHz 46.75 dBmV (1DP)	0 dBm
50 MHz to 6.7 GHz			-3 dBm
6.7 to 13.2 GHz			-5 dBm
13.2 to 26.5 GHz			

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		N/A	-118, -127
3 - 6 GHz			-115, -124
6 - 12 GHz			-109, -122
12 - 22 GHz			
22 - 26.5 GHz			

Amplitude Specifications (continued)

Basic analyzer	
Display	
Display range	0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps (10 display divisions)
Log scale	
RBW \geq 1 kHz	Calibrated 0 to -85 dB from reference level
RBW \geq 300 Hz	Calibrated 0 to -120 dB ^a from reference level
Linear scale	10 divisions
Scale units	dBm, dBmV, dB μ V, dB μ A, A, V, and W
Trace detectors	Peak, negative peak, sample, rms ^b , video averaging
Trace functions	Clear/write, maximum hold, minimum hold, view, blank, operations, normalize
Marker readout resolution	
Log scale	0.04
0 to -85 dB	
0 to -120 dB (1DR)	
Linear scale	0.01% of reference level
Reference level	
Range	-149.9 dBm to maximum mixer level + attenuator setting
Resolution	± 0.1 dB
Log scale	
Linear scale	$\pm 0.12\%$ of reference level
Accuracy^c	For reference level (dBm) – input attenuator setting (dB) + preamp gain (dB)
-10 to > -60 dBm	± 0.3 dB
-60 to > -85 dBm	± 0.5 dB
-85 to > -90 dBm	± 0.7 dB
Display scale switching uncertainty (referenced to 1 kHz RBW at reference level)	
Linear to log switching	± 0.15 dB at reference level
Resolution bandwidth switching uncertainty (referenced to 1 kHz at reference level)	
100 Hz, 300 Hz RBW	± 0.3 dB (1DR)
1 kHz to 3 MHz RBW	± 0.3 dB
5 MHz RBW	± 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 Ω , accuracy (at a fixed frequency, a fixed attenuator, and referenced to -35 dBm).

Amplitude Specifications (continued)

Basic analyzer	
Input attenuator switching uncertainty (at 50 MHz)	
Attenuator setting 0 to 5 dB	±0.3 dB
10 dB	Reference
15 to 60 dB	±(0.1 dB + 0.01 x attenuator setting)
Frequency response (10 dB input attenuation)	
Absolute ^a 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	
Absolute amplitude accuracy	
At reference settings ^b	±0.4 dB
Overall amplitude accuracy ^c	±(0.6 dB + absolute frequency response)
Display scale fidelity	
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 ^d > 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 ^d	±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	
Spurious responses	
Third order intermodulation distortion	For two –30 dBm signals at input mixer ^a and > 50 kHz separation
100 MHz to 26.5 GHz	< –75 dBc, +7.5 dBm TOI
Second harmonic distortion	
2 to 750 MHz –40 dBm tone at input mixer ^a	< –75 dBc, +35 dBm SHI (E4411B)
10 to 500 MHz –30 dBm tone at input mixer ^a	< –60 dBc, +30 dBm SHI
500 MHz to 1.5 GHz –30 dBm tone at input mixer ^a	< –70 dBc, +40 dBm SHI
1.5 to 2.0 GHz –10 dBm tone at input mixer ^a	< –80 dBc, +70 dBm SHI
> 2 GHz –10 dBm tone at input mixer ^a	≤ –95 dBc, +85 dBm SHI
Other input related spurious	
Inband > 30 kHz offset	< –65 dBc for –20 dBm tone at input mixer ^a
Out of band responses	< –80 dBc for –10 dBm tone at input mixer ^a
Residual responses (Input terminated and 0 dB attenuation)	
50 Ω RF input impedance	
150 kHz to 1.5 GHz/6.7 GHz ^b	< –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)	
Frequency range	
E4411B	
Option 1DN, (50 Ω)	9 kHz to 1.5 GHz
Option 1DQ, (75 Ω)	1 MHz to 1.5 GHz
RBW range	
E4411B	1 kHz to 5 MHz
Output power level range	
E4411B	
Option 1DN	0 to -70 dBm
Option 1DQ	+42.75 to -27.25 dBmV
Output vernier range	
E4411B	10 dB
Output attenuator range	
E4411B	0 to 60 dB, 10 dB steps
Output flatness	
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
Effective source match (characteristic)	
E4411B	< 2.5:1
Spurious output	
Harmonic spurs	
E4411B	
(0 dBm output)	
9 kHz to 20 MHz	< -20 dBc
20 MHz to 1.5 GHz	< -25 dBc
Non-Harmonic spurs	
E4411B	< -35 dBc
Dynamic range	
Maximum output power – displayed average noise level	
Output power sweep range	
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
Temperature range			
Operating	0 to +55 °C		
Storage	-40 to +75 °C		
Disk drive	10 to +40 °C		
EMI compatibility	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 ^a (Option 060)		
Audible noise sound pressure at 25 ° C	< 40 dBa pressure and < 4.6 bels power (ISODP7779)		
Military specifications	Type tested to the environmental specifications of MIL-PRF-28800F class 3		
Power requirements	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		
Data storage (nominal)			
Internal ^b	200 traces or states/8.0 MB		
External	3.5 in, 1.44 MB, MS-DOS		
Memory usage (nominal)			
State	16 kB ^c		
State plus 401- point trace	20 kB ^c		
Weight (without options)			
	13.2 kg 29.1 lbs	15.5 kg 34.2 lbs	17.1 kg 37.7 lbs
Measurement speed			
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
Display resolution^d	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)*

Inputs/outputs	
Front panel	
Input	50 Ω type N (f); 75 Ω BNC (f) (Option 1DP); 50 Ω APC 3.5 (m) (Option BAB)
RF out	50 Ω type N (f); 75 Ω 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 Ω (characteristic)
AMPT REF out	50 Ω BNC (f) (nominal)
IF INPUT (Option AYZ)	50 Ω SMA (f) (nominal)
LO OUTPUT (Option AYZ)	50 Ω SMA (f) (nominal)
Rear panel	
10 MHz REF OUT	50 Ω BNC (f), > 0 dBm (characteristic)
10 MHz REF IN	50 Ω 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)
IF, sweep and video ports (Option A4J or AYX)	
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
GPIO interface (Option A4H)	IEEE-488 bus connector
Serial interface (Option 1AX)	RS-232, 9-pin D-SUB (m)
Parallel interface	
(Option A4H or 1AX)	25-pin D-SUB (f) printer port only
I/O connectivity software	IO libraries suite (www.agilent.com/find/iosuite/data-sheet)
Dimensions and weight for the ESA family of analyzers.	
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)
E4411B	
Instrument weight	13.2 kg (29.1 lbs)
Shipping weight	25.1 kg (55.4 lbs)
E4403B	
Instrument weight	15.5 kg (34.2 lbs)
Shipping weight	27.4 kg (60.4 lbs)
E4408B	
Instrument weight	17.1 kg (37.7 lbs)
Shipping weight	31.9 kg (70.3 lbs)