

## Product Datasheet - Technical Specifications



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### Your contact

Technical and commercial sales, price information,  
quotations, demo/test equipment, consulting:

Tel.: **+49 - (0)81 41 - 52 71-0**

FAX: **+49 - (0)81 41 - 52 71-129**

E-Mail: [sales@meilhaus.com](mailto:sales@meilhaus.com)

**Meilhaus Electronic GmbH**  
Am Sonnenlicht 2  
82239 Alling/Germany

Tel. **+49 - (0)81 41 - 52 71-0**  
Fax **+49 - (0)81 41 - 52 71-129**  
E-Mail [sales@meilhaus.com](mailto:sales@meilhaus.com)

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# N9324C Basic Spectrum Analyzer

## 1 MHz to 20 GHz



## Definitions and conditions

### **Specification**

Describes the performance of parameters covered by the product warranty and apply to the full temperature range of 5 to 45 °C, unless otherwise noted.

### **Typical**

Describes additional product performance information that is not covered by the product warranty. It is performance beyond specifications that 80 percent of the units exhibit with a 95 percent confidence level. This data does not include measurement uncertainty and is valid only at room temperature (approximately 25 °C).

### **Nominal**

Indicates expected performance or describe product performance that is useful in the application of the product but are not covered by the product warranty.

The analyzer will meet its specifications when:

- It is within its calibration cycle
- It has been turned on at least 30 minutes
- It has been stored at an ambient temperature within the allowed operating range for at least two hours before being turned on; if it had previously been stored at a temperature range inside the allowed storage, but outside the allowed operating range

## Frequency and Time Specifications

		Supplemental information
<b>Frequency</b>		
Range	1 MHz to 20 GHz	AC coupled
Resolution	1 Hz	
<b>Frequency reference</b>		
	<b>Option PFR</b>	<b>Standard</b>
Nominal frequency	10 MHz	10 MHz
Aging rate	$\pm 1 \times 10^{-7}/\text{Year}$	$\pm 1 \times 10^{-6}/\text{Year}$
<b>Temperature stability</b>		
20°C to 30°C	$\pm 1.5 \times 10^{-8}$	
5°C to 45°C	$\pm 5 \times 10^{-8}$	$\pm 1 \times 10^{-6}$
Achievable initial calibration accuracy	$\pm 4 \times 10^{-8}$	$\pm 1 \times 10^{-6}$
<b>Frequency readout accuracy (start, stop, center, marker)</b>		
Marker resolution	$(\text{frequency span})/(\text{number of sweep point} - 1)$	
Uncertainty	$\pm (\text{freq indication} \times \text{freq reference uncertainty}^1 + 1\% \times \text{span} + 20\% \times \text{resolution bandwidth} + \text{marker resolution} + 1 \text{ Hz})$	
Sweep point	461, fixed	
<b>Marker frequency counter</b>		
Resolution	1 Hz	
Accuracy	$\pm [(\text{marker freq} \times \text{freq reference uncertainty}^1) + (\text{counter resolution})]$	RBW/Span $\geq 0.02$ Marker level to displayed noise level > 25 dB, frequency offset = 0 Hz

1. Frequency reference uncertainty = Aging rate x period since adjustment + temperature stability.

		Supplemental information
<b>Frequency span (FFT and swept mode)</b>		
Range	0 Hz (zero span), 100 Hz to 20 GHz	
Resolution	1 Hz	
Accuracy	$\pm (0.22\% \times \text{span} + \text{span}/(\text{sweep point} - 1))$	Nominal
<b>Sweep time and triggering</b>		
Range	2 ms to 1000 s	Span $\geq$ 100 Hz
	600 ns to 200 s	Span = 0 Hz (minimum resolution = 600 ns, when RBW $\geq$ 30 kHz)
Mode	Continuous, Single	
Sweep time rule	Accuracy or Speed	
Trigger	Free run, video, external, RF burst	
Trigger slope	Selectable positive or negative edge	
Trigger delay	$\pm$ 12 ms to $\pm$ 12 s, nominal	Span = 0 Hz
<b>Time gated sweep (Option TMG)</b>		
Gate sources	External, RF burst	
	Periodic timer	Sync sources include free and external Period 0 to 20 s (It should be greater than gate delay plus gate length) Offset -5 to +5 s
Gate delay range	12 $\mu$ s to 10 s	Resolution = 200 ns
Gate length range	84 $\mu$ s to 10 s	Resolution = 200 ns
RBW range	$\geq$ 1 kHz	VBW is fixed and equal to RBW for efficiency

		Supplemental information
<b>Resolution bandwidth (RBW)</b>		
Range (-3 dB bandwidth)	10 Hz to 3 MHz	In 1-3-10 sequence
Accuracy	± 5%, nominal	< 10% when RBW = 3 MHz
Resolution filter shape factor	< 5 : 1, nominal	60 dB/3 dB bandwidth ratio, digital, Gaussian-like
EMI bandwidth (CISPR compliant)	200 Hz, 9 kHz, 120 kHz, 1 MHz	Option EMC required
Accuracy	± 10%, nominal	
Resolution filter shape factor	< 5 : 1, nominal	-60 dB/-6 dB bandwidth ratio
<b>Video bandwidth (VBW)</b>		
Range	1 Hz to 3 MHz	In 1-3-10 sequence
Accuracy	± 10%, nominal	VBW = 1 Hz to 1 MHz

## Amplitude Specifications

		Supplemental information
<b>Measurement range</b>		
1 MHz to 500 MHz	Displayed average noise level (DANL) to +10 dBm	Preamp off
500 MHz to 20 GHz	Displayed average noise level (DANL) to +20 dBm	
Input attenuator range	0 to 50 dB, in 5 dB steps	
<b>Maximum damage level</b>		
Average continuous power	+30 dBm, 3 minutes maximum	Input attenuator $\geq$ 20 dB, 1 MHz to 20 GHz
DC voltage	$\pm$ 50 VDC maximum	
<b>Level display range</b>		
Scale units	dBm, dBmV, dB $\mu$ V, W, V, dBmV EMF, dB $\mu$ V EMF, V EMF	
Marker level readout	0.01 dB	Log scale
Resolution	< 1% of signal level	Linear scale
Number of traces	4	
Detectors	Normal, positive peak, sample, negative peak, average (video, RMS, voltage), quasi-peak (option EMC required)	
Trace function	Clear/write, maximum hold, minimum hold, average	
<b>Frequency response</b>		
Attenuation 20 dB, reference frequency 50 MHz, typical		
1 MHz to 50 MHz	$\pm$ 0.3 dB	
50 MHz to 4 GHz	$\pm$ 0.4 dB	
4 GHz to 7 GHz	$\pm$ 0.45 dB	
7 GHz to 13.6 GHz	$\pm$ 0.6 dB	
13.6 GHz to 20 GHz	$\pm$ 0.85 dB	

		Supplemental information
<b>Input attenuation switching uncertainty at 50 MHz</b>		
1 to 50 dB attenuation	± 0.2 dB, typical	Relative to 20 dB reference setting
<b>Resolution bandwidth switching uncertainty</b>		
10 Hz to 3 MHz RBW	+0.1 dB, typical	
<b>Absolute amplitude accuracy</b>		
Peak detector, RBW 1 kHz, VBW 300 Hz, sweep time Accuracy, input signal -50 to 0 dBm, attenuation 20 dB, typical		
At 50 MHz	± 0.3 dB	
At all frequencies	± (0.3 dB + frequency response)	
<b>Overall amplitude accuracy</b>		
1 MHz to 7 GHz	± 1.3 dB	<ul style="list-style-type: none"> <li>• 20 to 30 °C, 30 to 70% RH, peak detector, preamp off, input signal -50 to 0 dBm, 95% percentile</li> <li>• Swp Time Rule is set to Accuracy</li> <li>• Adds ± 0.3 dB when Swp Time Rule is set to Speed</li> </ul>
7 GHz to 18 GHz	± 1.6 dB	
18 GHz to 20 GHz	± 1.8 dB	
<b>Preamplifier (Option P20)</b>		
Frequency range	1 MHz to 20 GHz	
Gain	15 dB	Nominal



## Dynamic Range Specifications

Displayed average noise level		Normalized to 1 Hz	Minimum RBW
RMS detector, average > 40, 0 dB attenuation, input terminated 50 Ω, RBW = 1 kHz, 20 to 30 °C			
Preamp off	1 to 10 MHz	-125 dBm, typical -140 dBm	-115 dBm, typical -130 dBm
	10 MHz to 3 GHz	-137 dBm, typical -142 dBm	-127 dBm, typical -132 dBm
	3 to 7 GHz	-135 dBm, typical -140 dBm	-125 dBm, typical -130 dBm
	7 to 10 GHz	-139 dBm, typical -142 dBm	-129 dBm, typical -132 dBm
	10 to 13 GHz	-137 dBm, typical -140 dBm	-127 dBm, typical -130 dBm
	13 to 16 GHz	-136 dBm, typical -139 dBm	-126 dBm, typical -129 dBm
	16 to 18 GHz	-134 dBm, typical -139 dBm	-124 dBm, typical -129 dBm
	18 to 20 GHz	-126 dBm, typical -131 dBm	-116 dBm, typical -121 dBm
Preamp on	1 to 10 MHz	-140 dBm, typical -156 dBm	-130 dBm, typical -146 dBm
	10 MHz to 3 GHz	-150 dBm, typical -154 dBm	-140 dBm, typical -144 dBm
	3 to 6 GHz	-145 dBm, typical -150 dBm	-135 dBm, typical -140 dBm
	6 to 13 GHz	-151 dBm, typical -155 dBm	-141 dBm, typical -145 dBm
	13 to 16 GHz	-149 dBm, typical -153 dBm	-139 dBm, typical -143 dBm
	16 to 18 GHz	-147 dBm, typical -151 dBm	-137 dBm, typical -141 dBm
	18 to 20 GHz	-137 dBm, typical -142 dBm	-127 dBm, typical -132 dBm
<b>Spurious response</b>			
Mixer signal level at -30 dBm, input attenuation 0 dB, preamp off, 20 to 30 °C			
Second harmonic distortion	< -65 dBc, typical < -70 dBc, 50 MHz to 7 GHz		
	< -80 dBc, typical < -90 dBc, 7 to 20 GHz		

**Spurious response (continued)**

Two – 20 dBm tones at input mixer, spaced by 100 kHz, input attenuation 0 dB, preamp off, reference level  $\geq$  -30 dBm, 20 to 30 °C

Third order intermodulation distortion (third order intercept)	50 to 300 MHz	+8 dBm, typical +9 dBm
	300 MHz to 8 GHz	+9 dBm, typical +11 dBm
	8 to 13 GHz	+10 dBm, typical +12 dBm
	13 to 20 GHz	+13 dBm, typical +15 dBm

-30 dBm signal at input mixer, span < 2.9 GHz  
Exception: - 55 dBc ( $2 \times F1 =$  center frequency – 5,890 MHz, 7 GHz < center frequency < 10 GHz, with F1 input frequency)

Input related spurious	< -60 dBc, typical < -70 dBc
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Input terminated and 0 dB input attenuation, preamplifier off

Residual response	1 MHz to 7 GHz	< -95 dBm, typical -110 dBm
	7 to 20 GHz	< -85 dBm, typical -93 dBm

**Phase noise**

20 to 30 °C, center frequency = 500 MHz

Offset from CF signal	10 kHz	Typical -92 dBc/Hz
	30 kHz	-86 dBc/Hz, typical -89 dBc/Hz
	100 kHz	-97 dBc/Hz, typical -99 dBc/Hz
	1 MHz	-115 dBc/Hz, typical -119 dBc/Hz

## Option Specifications

		Supplemental information
<b>Tracking generator (Option TG7)</b>		
Frequency range	5 MHz to 7 GHz	
Output level	0 to -20 dBm	1 dB steps
VSWR	< 2.0:1	Nominal
Connector and impedance	Type-N female, 50 Ω	
<b>AM/FM modulation analysis (Option AMA)</b>		
Frequency range	10 MHz to 20 GHz	
Carrier power accuracy	< 7 GHz, ± 1.5 dB	Nominal
	7 to 18 GHz, ± 1.8 dB	Nominal
	18 to 20 GHz, ± 2.0 dB	Nominal
Carrier power range	-30 to +10 dBm	1 to 500 MHz
	-30 to +20 dBm	500 MHz to 20 GHz
Carrier power displayed resolution	0.01 dBm	
<b>AM measurement (included in option AMA)</b>		
Modulation rate	20 Hz to 100 kHz	
Accuracy	1 Hz	Nominal (modulation rate < 1 kHz)
	< 0.1% modulation rate	Nominal (modulation rate > 1 kHz)
Depth	5 to 95%	
Accuracy	± 4%	Nominal
<b>FM measurement (included in option AMA)</b>		
Modulation rate	20 Hz to 200 kHz	
Depth	20 Hz to 400 kHz	

		Supplemental information
<b>FM measurement (included in option AMA, continued)</b>		
Accuracy	1 Hz	Nominal (modulation rate < 1 kHz)
	< 0.1% modulation rate	Nominal (modulation rate > 1 kHz)
Accuracy	± 4%	Nominal
<b>ASK/FSK modulation analysis (Option DMA)</b>		
Frequency range	2.5 MHz to 6 GHz	
Carrier power accuracy	± 2 dB	Nominal
Carrier power range	-30 to +20 dBm	Nominal
Carrier power displayed resolution	0.01 dBm	
<b>ASK measurement (included in option DMA)</b>		
Symbol rate range	100 Hz to 100 kHz	
Modulation depth/index	5 to 95%	
Accuracy	± 4%	Nominal
Displayed resolution	0.1%	
<b>FSK measurement (included in option DMA)</b>		
FSK deviation	100 Hz to 400 kHz	
Symbol rate range	100 Hz to 20 kHz	$1 \leq \beta^1 \leq 20$
	20 to 50 kHz	$1 \leq \beta \leq 8$
	50 to 100 kHz	$1 \leq \beta \leq 4$
Accuracy	± 4%	Nominal
Displayed resolution	0.01 Hz	

1.  $\beta$  is the ratio of frequency deviation to symbol rate (deviation/rate).

		Supplemental information
<b>Time-gated spectrum analysis (Option TMG)</b>		
Gate sources	External	
	RF burst	
	Periodic timer	<ul style="list-style-type: none"> <li>• Sync sources include free, external, and RF burst</li> <li>• Period: 0 to 20.0 s</li> <li>• (It should be greater than gate delay plus gate length)</li> <li>• Offset: -5 to +5 s</li> </ul>
Gate delay range	12 $\mu$ s to 10 s	Resolution = 200 ns
Gate length range	84 $\mu$ s to 10 s	Resolution = 200 ns
RBW range	$\geq$ 1 kHz	VBW is fixed and equal to RBW for efficiency
<b>Channel scanner (Option SCN)</b>		
Scan modes	Top N, bottom N, and list	
Channels displayed	1 to 20	
Displayed orientation	Vertical	Number of channels $\leq$ 5
	Horizontal	Number of channels $>$ 5
Chart	Bar chart, and time chart	
Log file	*.csv	
<b>Spectrum monitor (Option MNT)</b>		
Display modes	Spectrogram	
	Spectrum trace	
	Combination of spectrogram and spectrum trace in one screen	

		Supplemental information
<b>Security features (Option SEC)</b>		
Security erase method	Erase the entire user flash memory by writing single character “1” over all memory locations	Non-recoverable
Port control	Disable or enable LAN or USB connectors	
<b>Task planner (Option TPN)</b>		
Task plan execution mode	Auto, manual, and manual if fail	
Task plan file	*.TPN	Complementary task plan editor is available with <b>Keysight HSA and BSA PC software</b>
Number of tasks	Maximum 20 in a single .TPN file	
Measurements supported	Spectrum analysis and power suite (channel power, ACPR and OBW)	
	For more information, visit <a href="http://www.keysight.com/find/taskplanner">www.keysight.com/find/taskplanner</a>	
<b>USB average power sensor support (Option PWM)</b>		
Power sensor supported	Keysight U2000 Series USB power sensor	
Frequency range	9 kHz to 24 GHz	Sensor dependent
Dynamic range	-60 to +44 dBm	Sensor dependent
<b>USB peak and average power sensor support (Option PWP)</b>		
Power sensor supported	Keysight U2020 and U2042/44 X-Series USB peak and average power sensor	
Frequency range	50 MHz to 40 GHz	Sensor dependent
Dynamic range	-30 to +20 dBm	Sensor dependent

## Inputs and Outputs

Front panel		
RF input connector	N-type female, 50 $\Omega$ , nominal	
VSWR	1 MHz to 7 GHz	< 1.5:1, nominal, $\geq$ 10 dB attenuation
	7 to 18 GHz	< 2:1, nominal, $\geq$ 10 dB attenuation
	18 to 20 GHz	< 2.5:1, nominal, $\geq$ 10 dB attenuation
Calibration output	Amplitude	$-25 \pm 0.25$ dBm
	Frequency	40 MHz
	Connector and impedance	BNC-type female, 50 $\Omega$ , nominal
Probe power	Voltage/Current	+15 V, 150 mA maximum
		-12.6 V, 150 mA maximum
RF output connector	N-type female, 50 $\Omega$ , nominal	Option TG7 installed
USB interface (host)	A plug, version 1.1	
Rear panel		
10 MHz reference output	Output amplitude	> 0 dBm
	Frequency	10 MHz $\pm$ (10 MHz $\times$ frequency reference accuracy)
	Connector and impedance	BNC-type female, 50 $\Omega$ , nominal
10 MHz reference input	Input amplitude	-5 to +10 dBm, nominal
	Frequency	10 MHz
	Connector and impedance	BNC-type female, 50 $\Omega$ , nominal
External trigger input	Input amplitude	5 V TTL level, -12.6 V, 150 mA max (nominal)
	Connector and impedance	BNC-type female, 10 k $\Omega$
LAN TCP/IP interface	100Base-T, RJ-45 connector	

Rear panel (continued)		
USB interface (device)	B plug, version 1.1	
Mini USB (device)	Mini-AB female, version 1.1	
GPIO interface	IEEE-488 bus connector	Optional G01 installed

## General

Temperature and relative humidity	
Operating temperature range	+5 to +45 °C
Storage temperature range	-20 to +70 °C
Relative humidity	< 95%
EMC	
Complies with European EMC Directive 2014/30/EU	
IEC/EN 61326-1	
CISPR Pub 11 group 1, class A	
AS/NZS-AS CISPR 11:2017	
ICES/NMB-001	
This ISM device complies with Canadian ICES-001	
Cet appareil ISM est conforme à la norme NMB-001 du Canada	
Safety	
Complies with European Low Voltage Directive 2014/35/EU	
· IEC/EN 61010-1 3.1 Edition	
· Canada: CAN/CSA-C22.2 No 61010-1-12	
· USA: UL 61010-1 3.1 Edition	



<b>Audio noise</b>	
Normal position. Per ISO 7779.	
Acoustic noise emission	LpA < 70 dB
<b>Environmental stress</b>	
Samples of this product have been type tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of storage, transportation, and end-use; those stresses include, but are not limited to, temperature, humidity, shock, vibration, altitude, and power line conditions. Test methods are aligned with IEC 60068-2 and levels are similar to MILPRF-28800F Class 3	
<b>Power requirements</b>	
Voltage and frequency (nominal)	100 to 240 VAC, 50 to 60 Hz, Auto ranging
Power consumption	≤ 25 W, < 20 W, typical
<b>Display</b>	
Resolution	640 x 480
Size	165.1 mm (6.5 inch) diagonal (nominal)
<b>Data storage</b>	
Internal	64 MB nominal
External	Supports USB 3.0 compatible memory devices
<b>Weight (without options)</b>	
Net	7.9 kg (17.4 lbs), nominal
Shipping	14.5 kg (30.9 lbs), nominal

## Dimensions

Height	132.5 mm (5.2 inch)
Width	320 mm (12.6 inch)
Length	400 mm (15.7 inch)

## Warranty

The N9324C spectrum analyzer is supplied with a five-year warranty

## Calibration cycle

The recommended calibration cycle is one year. Calibration services are available through Keysight service centers