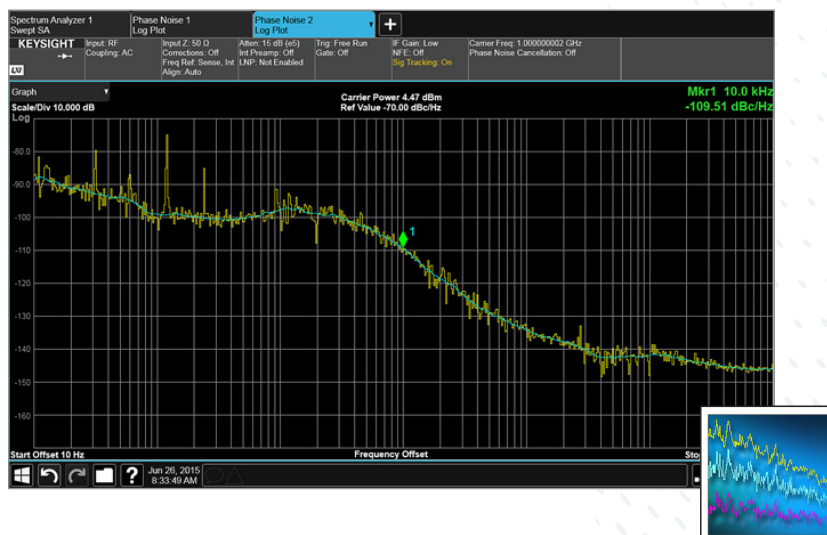


# N9068EM0E Phase Noise X-Series Measurement App, Multi-Touch UI

- Phase noise measurements with log plot and spot frequency views
- Spectrum and IQ waveform monitoring for quick signal checks in frequency or time domain
- Supports external mixing for measurements to 110 GHz
- Multi-touch user interface or SCPI remote user interface
- Built-in context-sensitive help
- Flexible licensing provides the option of using perpetual or time based licenses with one or multiple signal analyzers



# Phase Noise Measurement Application

Phase noise can be expressed as random, short-term frequency instability and is a key specification in both transmitter and receiver performance. For example, transmitting phase noise with digitally-modulated signals leads to the spreading of symbols limiting the symbol rate. Phase noise in receiver local oscillators limits sensitivity by obscuring weak signals in LO phase noise sidebands.

Keysight's N9068EM0E phase noise measurement application for the UXA, PXA, MXA, EXA and CXA X-Series signal analyzers uses the direct spectrum method. This method measures single-sideband phase noise power in the signal analyzer. The application automatically configures and optimizes the analyzer's settings, such as resolution bandwidth (RBW) and phase locked loops to achieve the highest measurement accuracy and speed.

## X-Series measurement applications

X-Series measurement applications increase the capability and functionality of Keysight Technologies, Inc. signal analyzers to speed time to insight. They provide essential measurements for specific tasks in general-purpose, cellular communications, wireless connectivity applications, covering established standards or modulation types. Applications are supported on both benchtop and modular, with the only difference being the level of performance achieved by the hardware you select.

X-Series measurement applications can help you:

- Gain more insight into device performance with intuitive display and graphs for your application. Select from our library of over 25 different measurement applications.
- Ensure that your design meets the latest standard. Updates are made to the X-Series measurement applications as standards evolve.
- Apply the same measurement science across multiple hardware platforms for consistent measurement results over your design cycle from R&D to production.
- Choose the license structure that meets your business needs. We provide a range of license types (node-locked, transportable, floating or USB portable) and license terms (perpetual or time-based).

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# Top Features

## Log plot

Log plot measures SSB phase noise (in dBc/Hz) versus offset frequencies expressed in logarithmic scale. This allows you to view the phase noise behavior of the signal under test across decades of offset frequencies in graphical and tabular form.

Log plot rejects AM noise in offsets of 1 MHz or less so that you measure only the phase component of the noise.

At offsets beyond 1 MHz, the overdrive function improves measurement accuracy by maximizing dynamic range to reduce the adverse effect of broadband noise.

Automatic search of carrier function with Auto Tune Multi-level video filtering.

- Result trace hold with Off, Max hold or min hold
- Result trace filter On/ Off, if on you can specify the high cutoff frequency and slope, low cutoff frequency and slope



Figure 2.

## Spot frequency

The spot frequency measurement continuously measures the phase noise and delta frequency at a user-specified offset from the carrier.

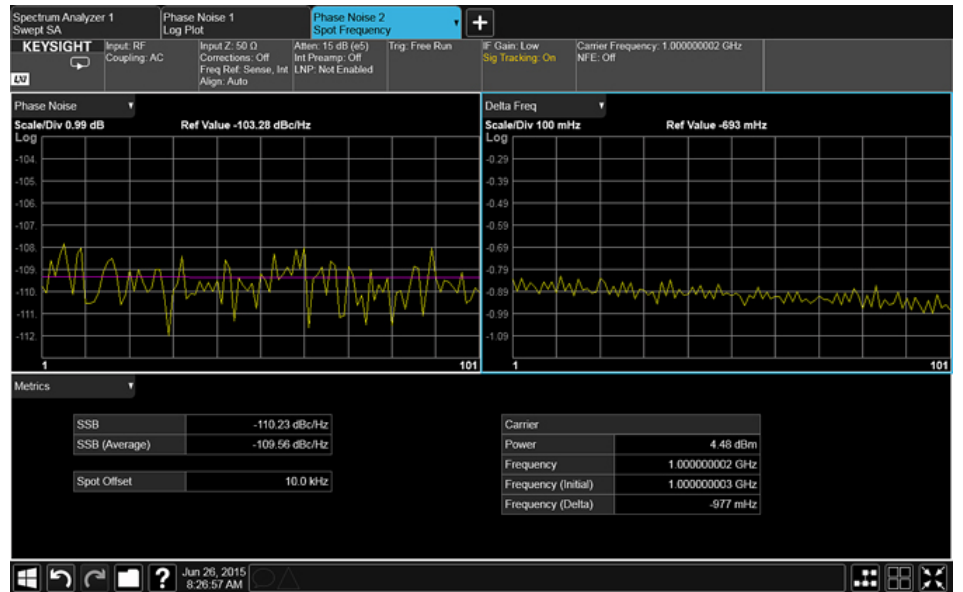


Figure 3.

## Tabbed measurements

Quickly switch between up to 16 measurement mode screens using screen tabs or multi-screen icon.

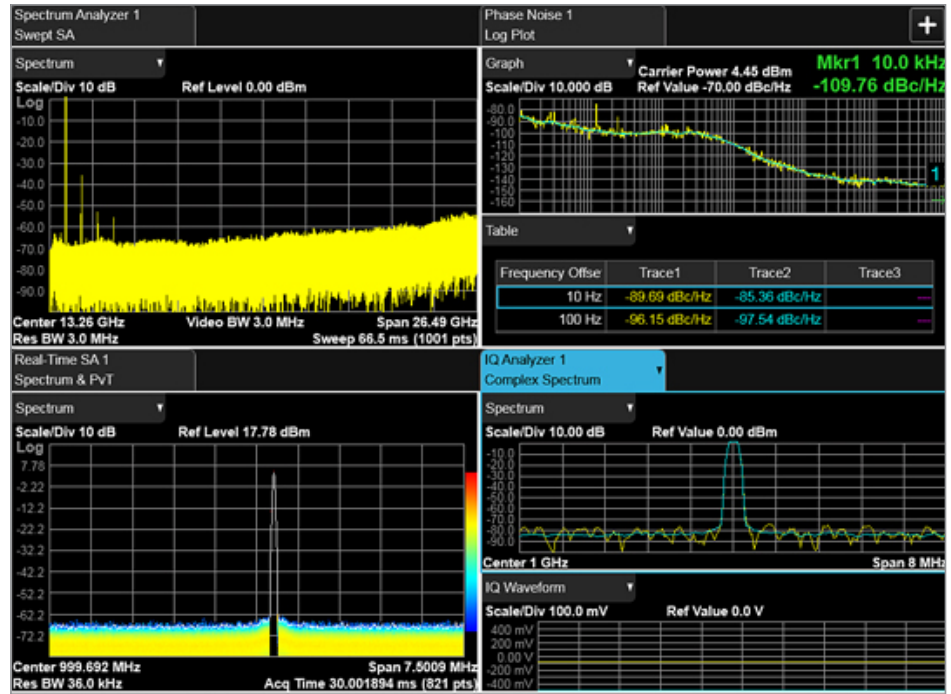


Figure 4.

## Advanced marker functions

The Log Plot measurement provides a wide range of advanced markers and marker functions so that you can analyze various aspects of the trace, such as integrated noise, averaged noise density, and residual FM across the applied band marker span, as well as multiple spurious-peak search functions and absolute, octave slope, and decade slope scale delta markers.

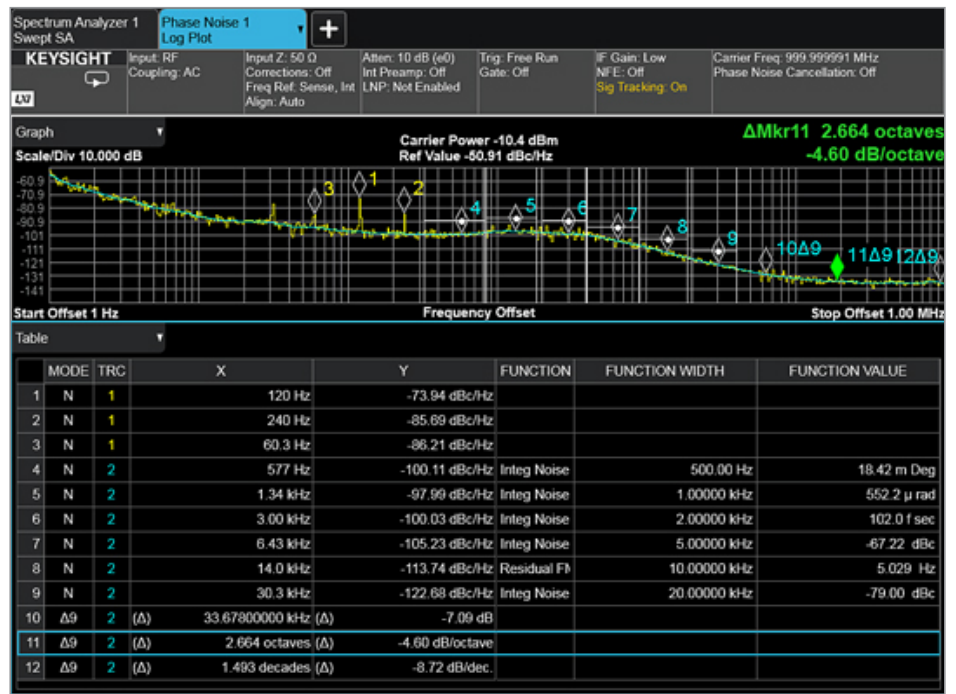


Figure 5.

## Millimeter wave measurements

Using external mixing, phase noise measurements can be made to the terahertz. Support for external mixing is a standard feature of the UXA, PXA, MXA or EXA. Keysight's USB smart harmonic mixers such as the M1970W extend the measurement range of the analyzer to 110 GHz. Solution partners such as Virginia Diodes offer mixers to 1.1 THz.

The N9041B UXA millimeter-wave signal analyzer provides frequency coverage up to 110 GHz. It also integrates the phase noise measurement inside, which can make your millimeter-wave phase noise connection and measurement more convenient and accurate.

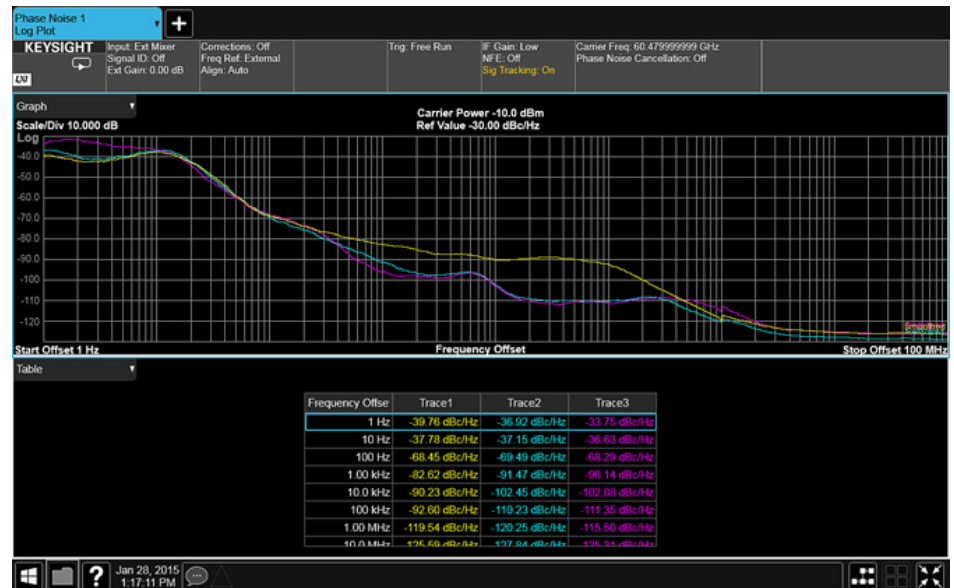


Figure 6.

## Other features:

### Displayed average noise level (DANL) measurements

The DANL floor of a signal/spectrum analyzers sets limitation for measuring the smallest input signal because it may negatively affect phase noise measurement accuracy at the far-out offset frequencies. When the amplitude of a signal under test get closer to the DANL floor, a significant measurement error can occur, invalidating the measurement.

### Reference trace subtraction

By using the trace subtraction function, you can subtract the DANL floor or phase noise of the X-Series signal analyzer or MXE EMI receiver. Subtract the signal analyzer's internal broadband noise from the compounded measurement results to see the phase noise of the DUT at the offset frequency where the noise level of the signal analyzer and DUT s close. Recall the stored DANL data to subtract from measured data.

### Phase noise subtraction

The X-Series signal analyzer also feature phase noise subtraction. Using a source with low phase noise, you can eliminate the influence of the signal analyzer's internal phase noise on measurement results for close-in offset frequencies.

# Key Specifications

## Definitions

- Specifications describe the performance of parameters covered by the product warranty.
- 95th percentile values indicate the breadth of the population ( $\approx 2\sigma$ ) of performance tolerances expected to be met in 95% of cases with a 95% confidence. These values are not covered by the product warranty.
- Typical values are designated with the abbreviation “typ.” These are performance beyond specification that 80% of the units exhibit with a 95% confidence. These values are not covered by the product warranty.
- Nominal values are designated with the abbreviation “nom.” These values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.

Note: Data subject to change.

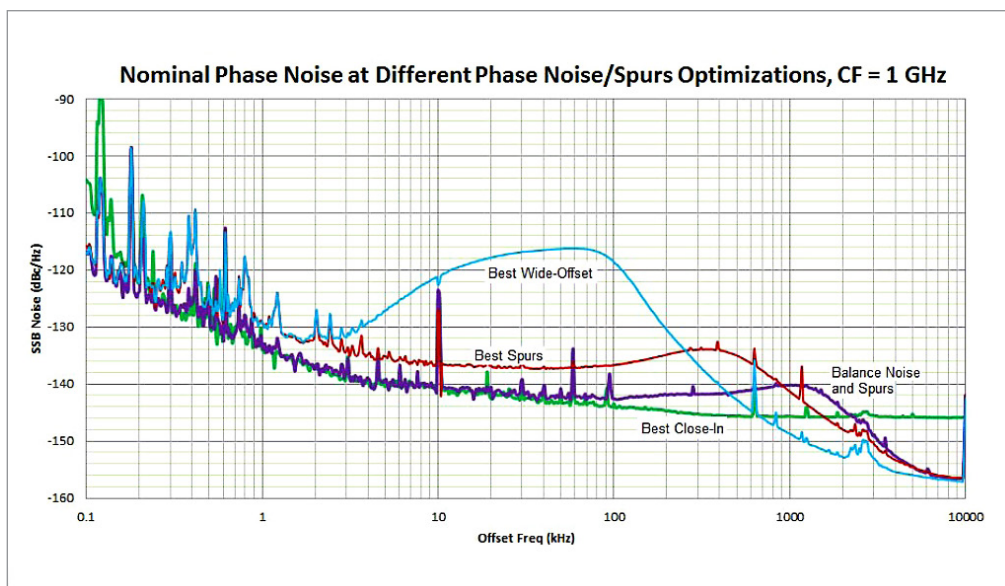
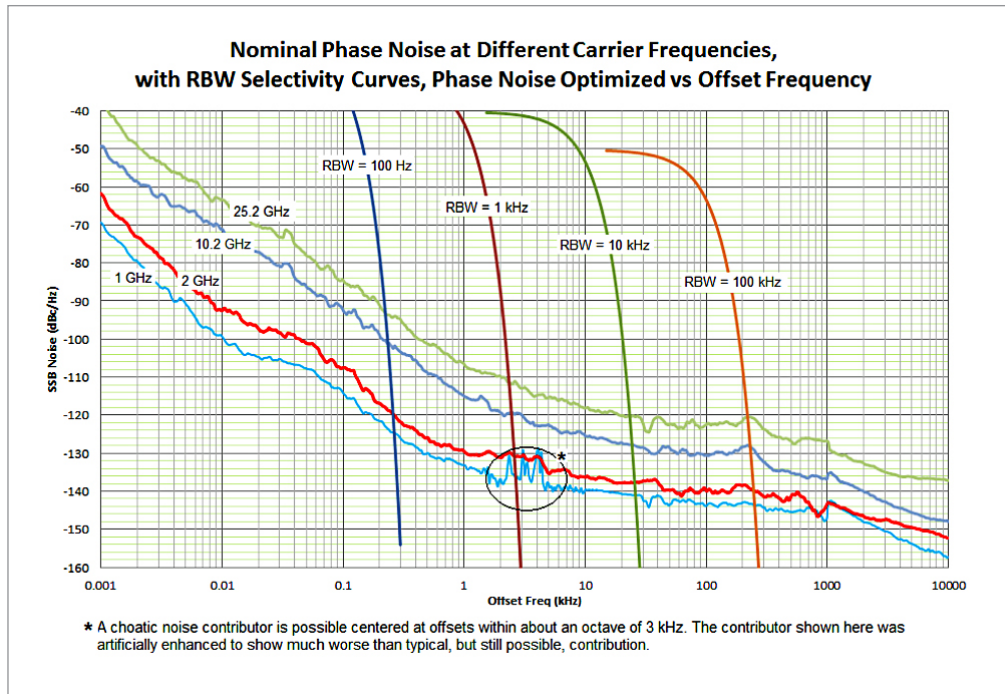
The following table provides phase noise specification for the UXA. For specifications for other X-Series signal analyzers, please refer to the links after this section.

Description	Specifications	Supplemental information
<b>Measurements</b>		
<b>Log plot, RMS noise, RMS jitter, Residual FM, Spot frequency</b>		
Maximum carrier frequency	> 50 GHz <sup>1</sup>	
<b>Offset frequency range</b>		
Minimum offset frequency	1 Hz <sup>2</sup> (log plot) 10 Hz (spot frequency)	
Maximum offset frequency	$(f_{\text{opt}} - f_{\text{CF}})$ (Hz)	$f_{\text{opt}}$ is the frequency option of the analyzer and $f_{\text{CF}}$ is the carrier frequency of the signal under test
Maximum number of decades	Depends on offset frequency range	
<b>Measurement accuracy</b>		
<b>Phase noise density accuracy</b>		
– Default setting	$\pm 0.16$ dB	
– ‘Overdrive on’ setting		$\pm 0.39$ dB (nominal)
<b>Offset frequency accuracy</b>		
– Offset < 1 MHz		Negligible error (nominal)
– Offset $\geq 1$ MHz		$\pm (0.5\%$ of offset + marker resolution) (nominal)
<b>Base instrument phase noise (Center frequency = 1 GHz, best-case optimization, internal reference)<sup>3</sup></b>		
<b>Offset frequency</b>		
10 Hz (Wide ref loop BW)		–95 dBc/Hz (typical)
10 Hz (Narrow ref loop BW)		–88 dBc/Hz (nominal)
100 Hz	–107 dBc/Hz	–112 dBc/Hz (typical)
1 kHz	–124 dBc/Hz	–129 dBc/Hz (typical)
10 kHz	–134 dBc/Hz	–136 dBc/Hz (typical)
100 kHz	–138 dBc/Hz	–142 dBc/Hz (typical)
1 MHz	–144 dBc/Hz	–146 dBc/Hz (typical)
10 MHz	–154 dBc/Hz	–157 dBc/Hz (typical)

1. With external mixing.
2. Requires Option AFP or ATP for previously purchased equipment.
3. See UXA specification guide for more information.



# Performance Specifications



For a complete list of specifications refer to the appropriate specifications guide.

- UXA: [http://www.keysight.com/find/uxa\\_specifications](http://www.keysight.com/find/uxa_specifications)
- PXA: [http://www.keysight.com/find/pxa\\_specifications](http://www.keysight.com/find/pxa_specifications)
- MXA: [http://www.keysight.com/find/mxa\\_specifications](http://www.keysight.com/find/mxa_specifications)
- EXA: [http://www.keysight.com/find/exa\\_specifications](http://www.keysight.com/find/exa_specifications)
- CXA: [http://www.keysight.com/find/cxa\\_specifications](http://www.keysight.com/find/cxa_specifications)

# Ordering Information

## Flexible licensing and configuration

- **Perpetual:** License can be used in perpetuity.
- **Time-based:** License is time limited to a defined period, such as 12-months.
- **Node-locked:** Allows you to use the license on one specified instrument/computer.
- **Transportable:** Allows you to use the license on one instrument/computer at a time. This license may be transferred to another instrument/computer using Keysight's online tool.
- **Floating:** Allows you to access the license on networked instruments/computers from a server, one at a time. For concurrent access, multiple licenses may be purchased.
- **USB portable:** Allows you to move the license from one instrument/computer to another by end-user only with certified USB dongle, purchased separately.
- **Software support subscription:** Allows the license holder access to Keysight technical support and all software upgrades

## Phase noise measurement application (N9068EM0E)

Software license type	Support contract	Support subscription (12-month) <sup>2</sup>
Node-locked perpetual	R-Y5C-001-A <sup>2</sup>	R-Y6C-001-L <sup>2</sup>
Node-locked 12-month	R-Y4C-001-L <sup>1</sup>	Included
Transportable perpetual	R-Y5C-004-D <sup>2</sup>	R-Y6C-004-L <sup>2</sup>
Transportable 12-month	R-Y4C-004-L <sup>1</sup>	Included
Floating perpetual	R-Y5C-002-B <sup>2</sup>	R-Y6C-002-L <sup>2</sup>
Floating 12-month	R-Y4C-002-L <sup>1</sup>	Included
USB portable perpetual	R-Y5C-005-E <sup>2</sup>	R-Y6C-005-L <sup>2</sup>
USB portable 12-month	R-Y4C-005-L <sup>1</sup>	Included

## One month software support subscription extensions <sup>3</sup>

Model	Description
R-Y6C-501 <sup>3</sup>	1-month of software support subscription for node-locked license
R-Y6C-502 <sup>3</sup>	1-month of software support subscription for floating license
R-Y6C-504 <sup>3</sup>	1-month of software support subscription for transportable license
R-Y6C-505 <sup>3</sup>	1-month of software support subscription for USB portable license

1. All time-based X-Series measurement application licenses includes a 12-month support contract which also includes the 12-month software support subscription as same duration.
2. Support contract must bundle software support subscription for all perpetual licenses in the first year. All software upgrades and Keysight support are provided for software licenses with valid support subscription.
3. After the first year, software support subscription may be extended with annual or monthly software support subscription extension.

## You can upgrade!

All of our X-Series application options are license-key upgradeable.



## Try before you buy!

Evaluate a full-featured version of our X-Series measurement application with our **FREE** trial. Redeem one 30-day trial license of each measurement application online at: [www.keysight.com/find/X-Series\\_apps\\_trial](http://www.keysight.com/find/X-Series_apps_trial)

## Hardware Configurations

To learn more about compatible platforms and required configurations, please visit: [www.keysight.com/find/X-Series\\_apps\\_platform](http://www.keysight.com/find/X-Series_apps_platform)

## Software Models and Options

To learn more about X-Series measurement application licensing, model numbers and options, please visit: [www.keysight.com/find/X-Series\\_apps\\_model](http://www.keysight.com/find/X-Series_apps_model)



## Hardware configuration

For optimizing measurements on phase noise signals with the phase noise measurement application, Keysight recommends a minimum level of X-Series multi-touch instrument hardware functionality at each instrument performance point. Supported instruments include:

### Benchtop:

- UXA N9040B
- PXA N9030B
- MXA N9020B
- EXA N9010B
- CXA N9000B

### PXIe:

- VSA up to 6 GHz M9391A
- VSA up to 50 GHz M9393A

Capability	Instrument option	Benefit
Precision frequency reference	-PFR	<b>Recommended:</b> For enhanced frequency accuracy and repeatability for lower measurement uncertainty
Electronic attenuator	-EA3	<b>Recommended:</b> Fast and reliable attenuation changes ideal for manufacturing without the wear associated with mechanical attenuators up to 3.6 GHz in 1 dB steps
Pre-amplifier	3.6 GHz (-P03) or higher	<b>Recommended:</b> For maximizing the measurement sensitivity
Fine resolution step attenuator	-FSA	<b>Recommended:</b> Useful for maximizing useable dynamic range to see signals

## Additional Information

Phase noise X-Series measurement app, multi-touch UI product webpage:  
[www.keysight.com/find/N9068E](http://www.keysight.com/find/N9068E)

X-Series measurement applications:  
[www.keysight.com/find/X-Series\\_Apps](http://www.keysight.com/find/X-Series_Apps)

X-Series signal analyzers:  
[www.keysight.com/find/X-Series](http://www.keysight.com/find/X-Series)

*Phase Noise Measurement Solutions - Selection Guide*, literature number 5990-5729EN.

Learn more at: [www.keysight.com](http://www.keysight.com)

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:  
[www.keysight.com/find/contactus](http://www.keysight.com/find/contactus)

