TECHNICAL OVERVIEW

N9068EM0E Phase Noise X-Series Measurement App with the 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 and beyond
- 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

KEYSIGHT TECHNOLOGIES

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).

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.

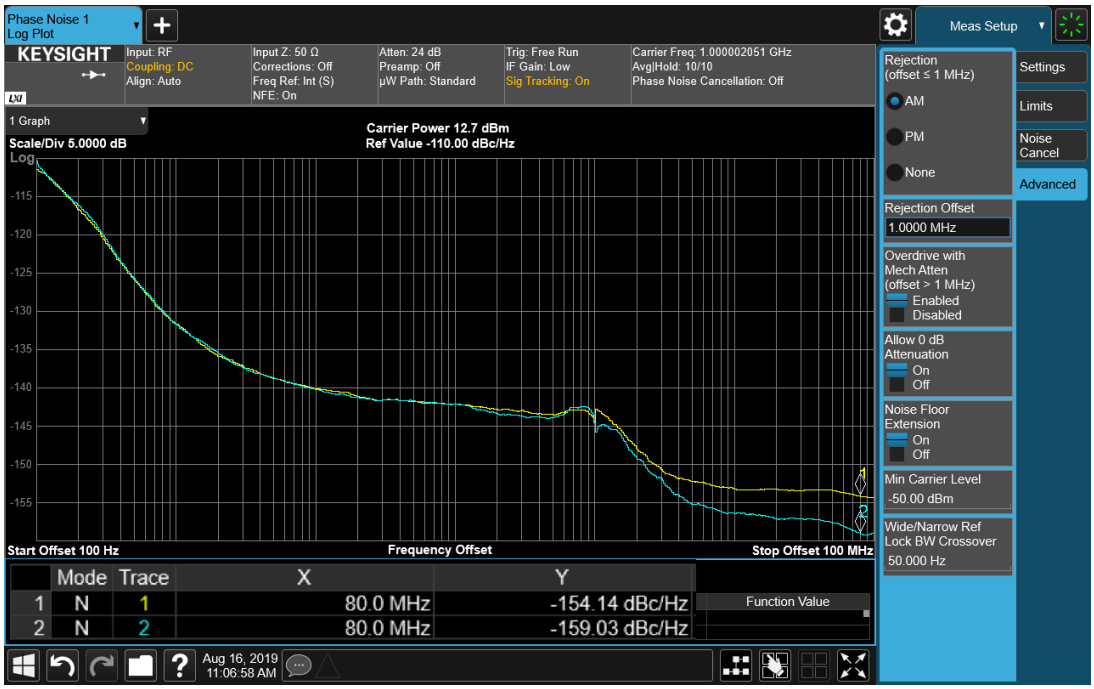
Log plot rejects AM and PM noise in offsets up to half the bandwidth of the widest band digitizer, which can be up to a 1 GHz offset for the N9032B and N9042B. Using either noise rejection allows you to measure only the phase or the amplitude component of the noise.

When measuring far offset phase noise measurements, the DANL performance of the analyzer dominates of its phase noise performance. Noise Floor Extensions (NFE) and overdrive in the Phase Noise Application can give a dramatic improvement in the measurement floor for wide-offset phase noise but can only be used for offsets greater than the AM/PM rejection settings.

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

Noise Floor Extensions (NFE) can be used to improve log plot results for far offsets where the DANL floor performance dominates over phase noise performance of the Signal Analyzer. As shown below on a UXA at the 80 MHz offset, the noise floor was lowered by 5 dB when using NFE.

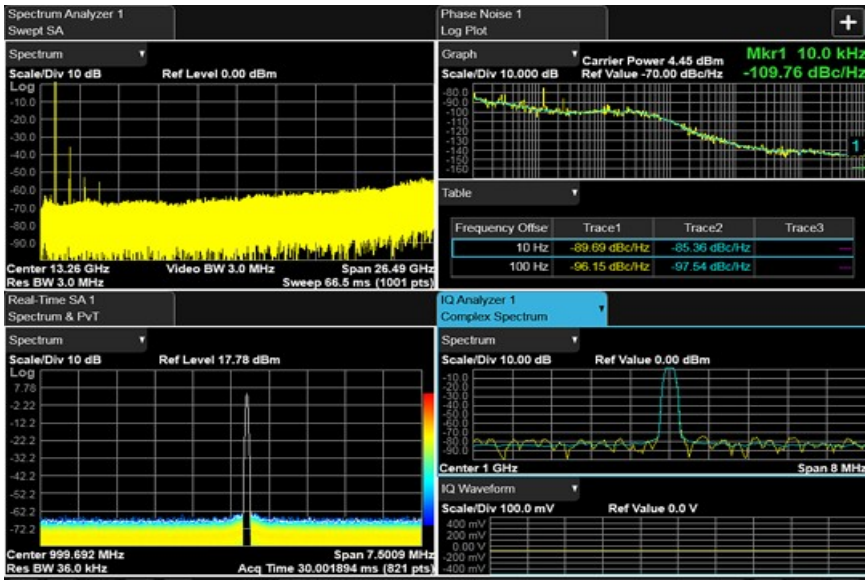


Spot frequency

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

Tabbed Measurements

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



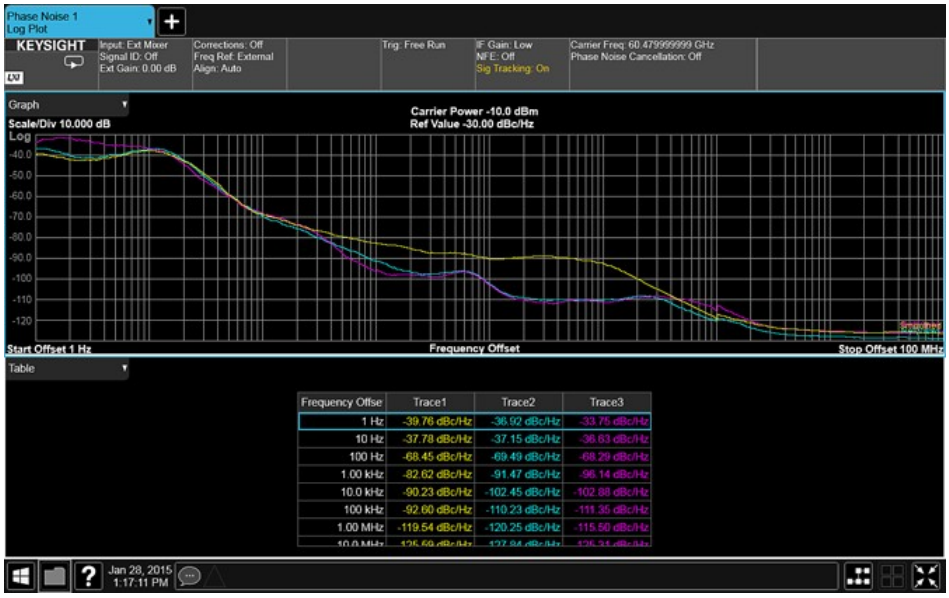
Advanced Marker Functions

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.

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.

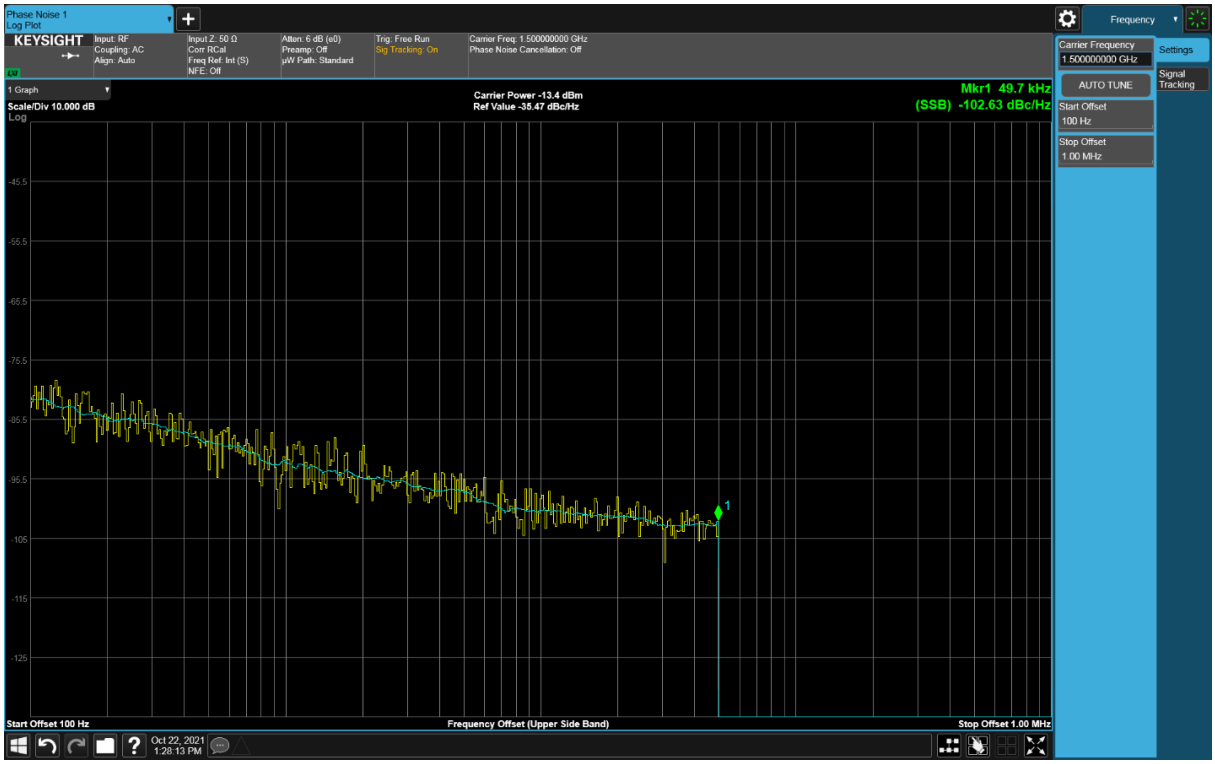
The N9041B UXA millimeter-wave signal analyzer provides frequency coverage up to 110 GHz. It also integrates the phase noise measurement inside, which can make your millimeter-wave phase noise connection and measurement more convenient and accurate.



Gated Phase Noise Measurements

The X-Series Phase Noise Application can measure pulsed CW Phase Noise for close-in offsets within half the pulse repetition frequency (PRF). The measured carrier power will be decreased by 20log(Pulse Width*PRF). This will reduce the sensitivity of the measurement; however, valid phase noise offset measurements within this range can be made. Phase noise information at offsets above the PRF/2 are otherwise under sampled and cannot be measured.

For example, the log plot measurement can be made with gating turned on using a pulsed signal with PRF of 100 kHz. Time gating can help give correct measurements up until just below the PRF/2.



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 analyzers or MXE / PXE EMI receivers. 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 (≈2σ) 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.

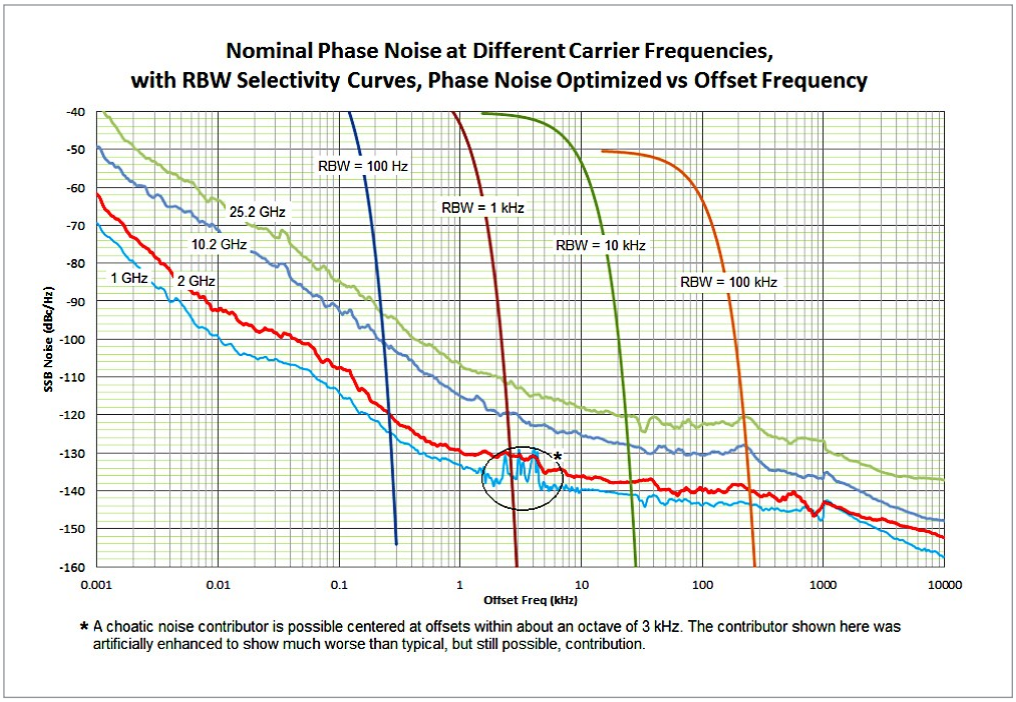
The following table provides phase noise specification for the N9040B UXA. For specifications for other X-Series signal analyzers, please refer to the links after this section.

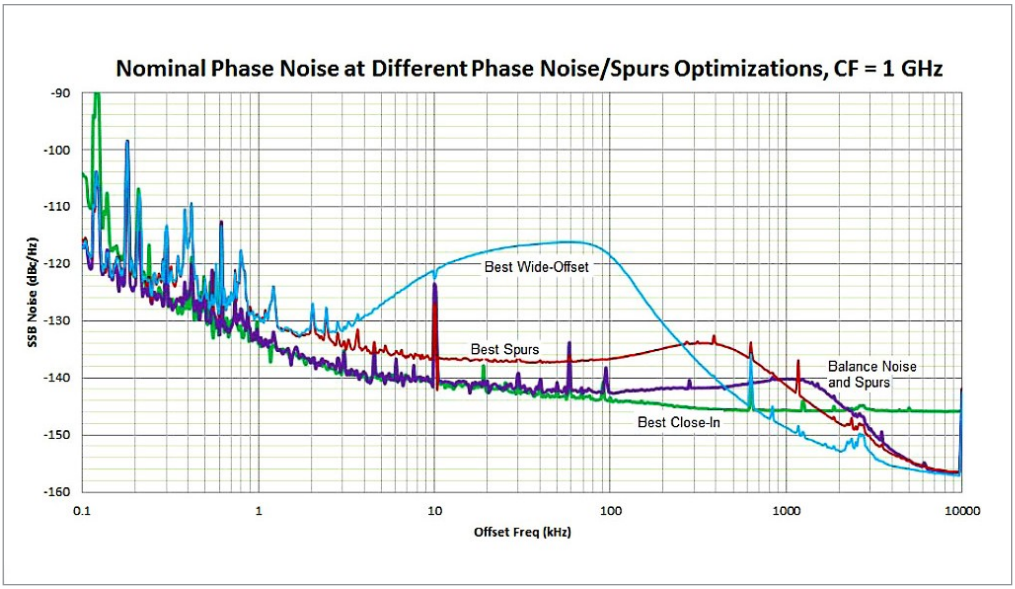
Description	Specifications	Supplemental information
Measurements	**Log plot, RMS noise, RMS jitter, Residual FM, Spot frequency**	
Maximum carrier frequency	> 50 GHz [1]	
Offset frequency range		
Minimum offset frequency	1 Hz [2] (log plot) 10 Hz (spot frequency)	
Maximum offset frequency	($f_{opt} - f_{CF}$) (Hz)	f_{opt} is the frequency option of the analyzer and f_{CF} is the carrier frequency of the signal under test
Maximum number of decades	Depends on offset frequency range	
Measurement accuracy		
Phase noise density accuracy		
– Default setting	± 0.16 dB	
– ‘Overdrive on’ setting		± 0.39 dB (nominal)
Offset frequency accuracy		
– Offset < 1 MHz		Negligible error (nominal)
– Offset ≥ 1 MHz		± (0.5% of offset + marker resolution) (nominal)
Base instrument phase noise (Center frequency = 1 GHz, best-case optimization, internal reference) [3]		
Offset frequency		
10 Hz (Wide ref loop BW)		−93 dBc/Hz (typical)
10 Hz (Narrow ref loop BW)		−88 dBc/Hz (nominal)
100 Hz	−107 dBc/Hz	−112 dBc/Hz (typical)
1 kHz	−123 dBc/Hz	−127 dBc/Hz (typical)

10 kHz	−132 dBc/Hz	−135 dBc/Hz (typical)
100 kHz	−138 dBc/Hz	−141 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 N9040B 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
- **PXA:** http://www.keysight.com/find/pxa_specifications
- **MXA:** http://www.keysight.com/find/mxa_specifications
- **EXA:** http://www.keysight.com/find/exa_specifications
- **CXA:** 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) [2]
Node-locked perpetual	R-Y5C-001-A [2]	R-Y6C-001-L [2]
Node-locked 12-month	R-Y4C-001-L [1]	Included
Transportable perpetual	R-Y5C-004-D [2]	R-Y6C-004-L [2]
Transportable 12-month	R-Y4C-004-L [1]	Included
Floating perpetual	R-Y5C-002-B [2]	R-Y6C-002-L [2]
Floating 12-month	R-Y4C-002-L [1]	Included
USB portable perpetual	R-Y5C-005-E [2]	R-Y6C-005-L [2]
USB portable 12-month	R-Y4C-005-L [1]	Included

One Month Software Support Subscription Extensions[3]

Model	Description
R-Y6C-501 [3]	1-month of software support subscription for node-locked license
R-Y6C-502 [3]	1-month of software support subscription for floating license
R-Y6C-504 [3]	1-month of software support subscription for transportable license
R-Y6C-505 [3]	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.

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, N9041B, N9042B
- PXA N9030B, N9032B
- MXA N9020B, N9021B
- 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	Recommended: For enhanced frequency accuracy and repeatability for lower measurement uncertainty

Electronic attenuator	-EA3	Recommended: 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	Recommended: For maximizing the measurement sensitivity
Fine resolution step attenuator	-FSA	Recommended: 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

X-Series measurement applications:
www.keysight.com/find/X-Series_Apps

X-Series signal analyzers:
www.keysight.com/find/X-Series

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

Learn more at: 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

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