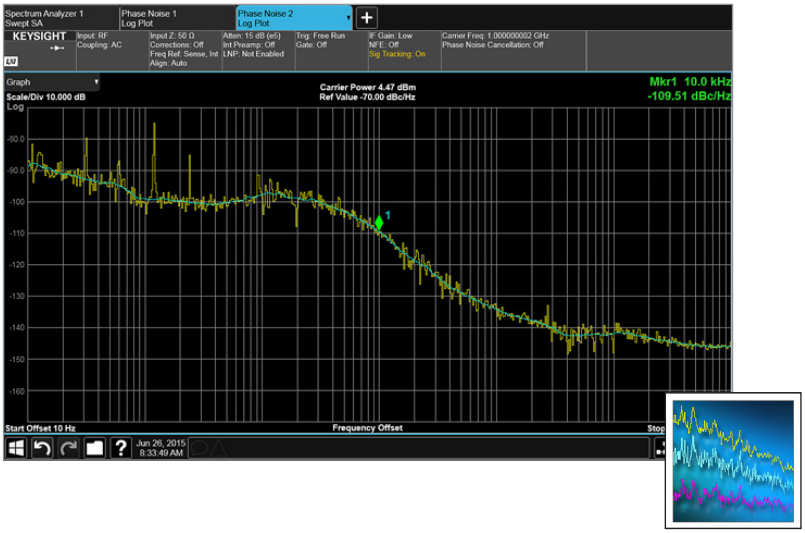
Keysight Technologies
Phase Noise
X-Series Measurement Application
N9068C

Technical Overview



- 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
- Transportable licensing between UXA, PXA, MXA, EXA and CXA X-Series signal analyzers

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Phase Noise

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 N9068C 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.

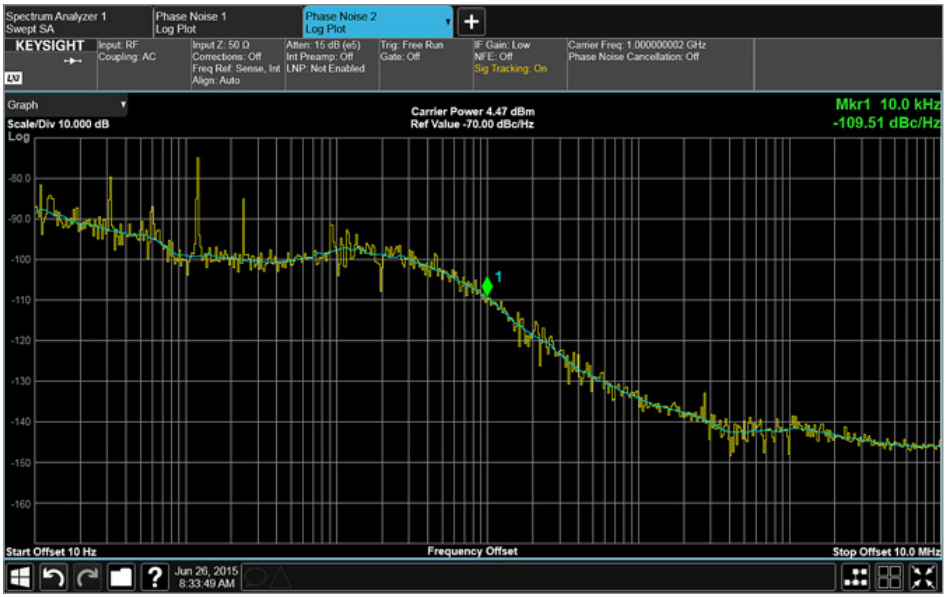


Figure 1.

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.

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.

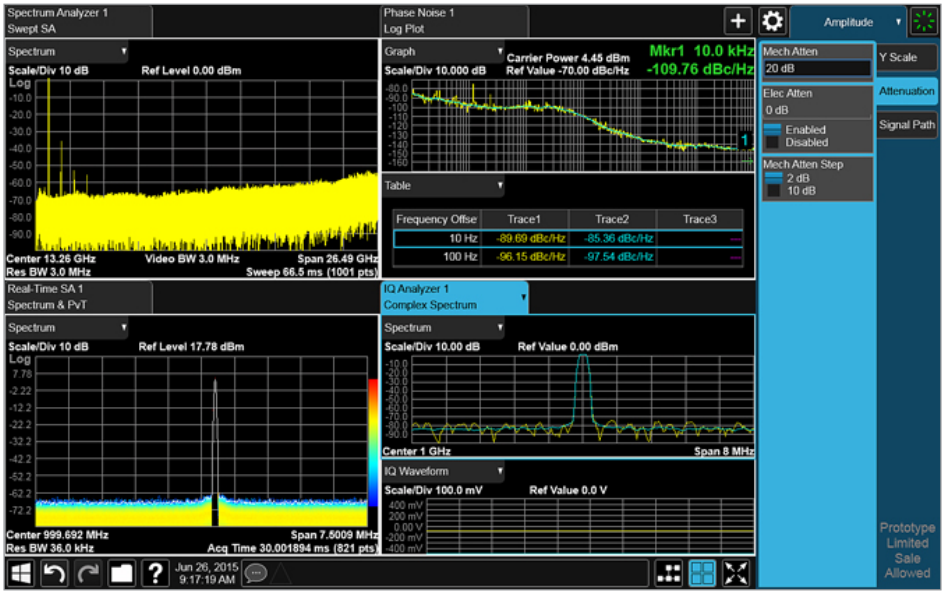


Figure 4.

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.

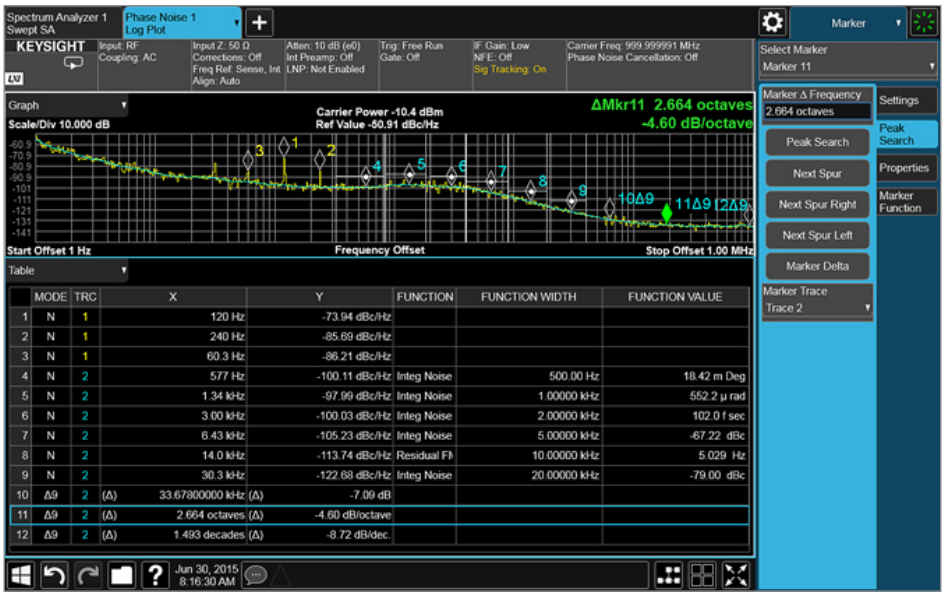


Figure 5.

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.

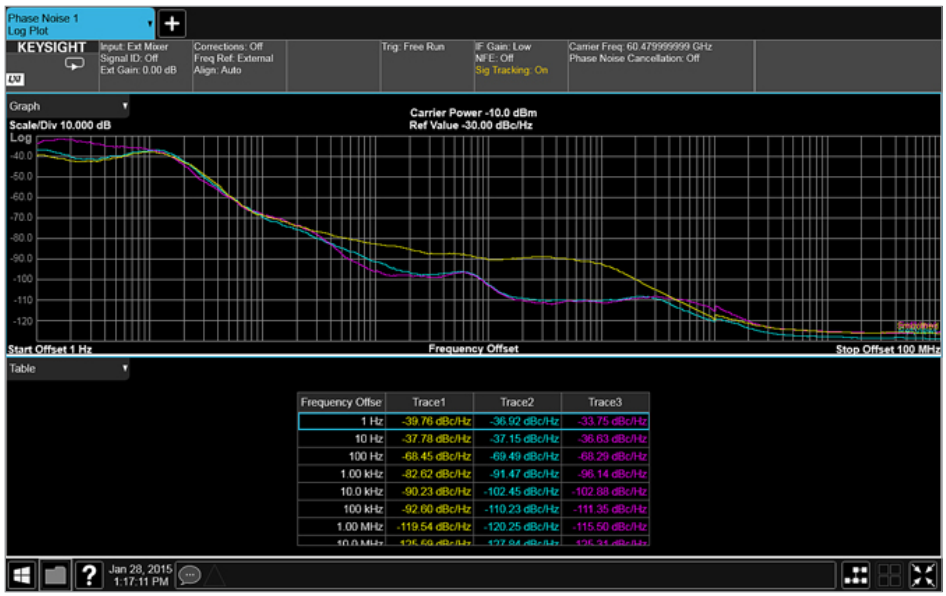


Figure 6.

Key Specifications

Definitions

- Specifications describe the performance of parameters.
- 95th percentile values indicate the breadth of the population (≈2**σ**) of performance tolerances expected to be met in 95% of cases with a 95% confidence.
- Typical values are designated with the abbreviation “typ.” These are performance beyond specification that 80% of the units exhibit with a 95% confidence.
- 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.

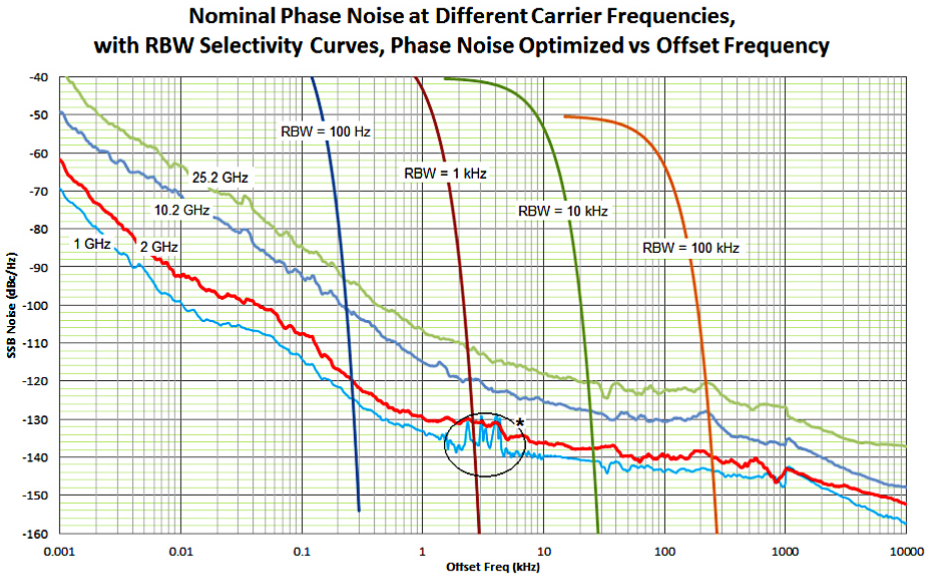
Note: Data subject to change

For a complete list of specifications, refer to the UXA specification guide: **www.keysight.com/find/uxa_specifications**

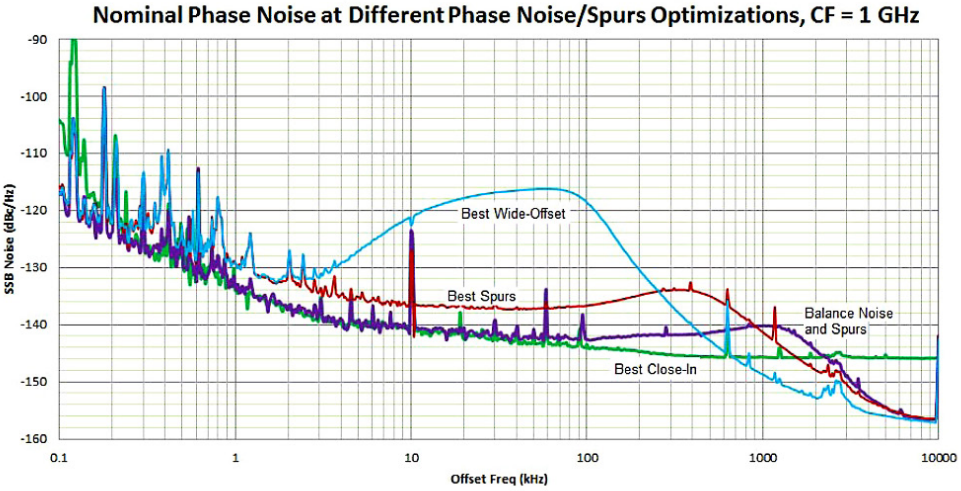
Description	Specifications	Supplemental information
Measurements	**Log plot, RMS noise, RMS jitter, Residual FM, Spot frequency**	
Maximum carrier frequency	> 50 GHz[1]	
Offset frequency range		
Minimum offset frequency	1 Hz[2] (log plot) 10 Hz (spot frequency)	
Maximum offset frequency	($f_{opt} - f_{CF}$) (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)		–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



* A choatic noise contributor is possible centered at offsets within about an octave of 3 kHz. The contributor shown here was artificially enhanced to show much worse than typical, but still possible, contribution.



Licensing and Configuration

X-Series offers flexible licensing options, including:

- **Fixed, perpetual license:** This allows you to run the application in the X-Series multi-touch analyzer in which it is initially installed.
- **Transportable, perpetual license:** This allows you to run the application in the X-Series multi-touch analyzer or controller in which it is initially installed, plus it may be transferred from one X-Series multi-touch analyzer or controller to another.

You Can Upgrade!

Options can be added after your initial purchase.
All of our X-Series application options are license-key upgradeable.

UP GRADE

N9068C phase noise X-Series measurement application

Model-Option	Description, license type
N9068C-2FP	Phase noise measurement application, fixed perpetual
N9068C-2TP	Phase noise measurement application, transportable perpetual
N9068C-AFP	Phase noise feature enhancements, fixed perpetual
N9068C-ATP	Phase noise feature enhancements, transportable perpetual

UXA, PXA, MXA, EXA and CXA signal analyzer configurations

X-Series Signal Analyzer	Description	Model-Option	Additional information
UXA to 110 GHz	89.9875[1] or 110 GHz	N9041B-590[1], 110	One required
UXA to 50 GHz	8.4, 13.6, 26.5 , 44 or 50 GHz	N9040B-508, -513, or -526	One required
PXA	3.6, 8.4, 13.6, 26.5, 44 or 50 GHz	N9030B-503, 508, 513, 526, 544 or 550	One required
MXA	3.6, 8.4, 13.6, or 26.5 GHz	N9020B-503, 508, 513, or 526	One required
EXA	3.6, 7.0, 13.6, 26.5, 32, or 44 GHz	N9010B-503, 507, 513, 526, 532 or 544	One required
CXA	3.6, 7.5, 13.6 or 26.5 GHz	N9000B-503, 507, 513, or 526	One required

1. The maximum frequency for Option 590 depends on the licensed bandwidth option selected for the N9041B UXA: Option B25 up to 89.9875 GHz, Option B40 up to 89.980, and Option H1G up to 89.500.

Additional Information

Measurement, user's and programming guides can be found on the product web page in the document library: **www.keysight.com/find/N9068C**

Phase noise measurement selection guide, literature number 5990-5725EN

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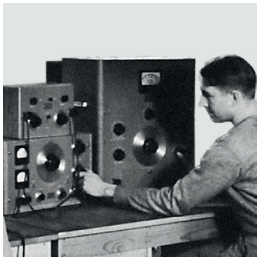
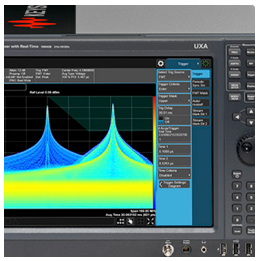


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