NXA Series Phase Noise Analyzer

2 MHz to 6.2 / 26 / 50 GHz

Datasheet

The NXA is the most advanced Phase Noise Analyzer with unique capabilities as summarized below:

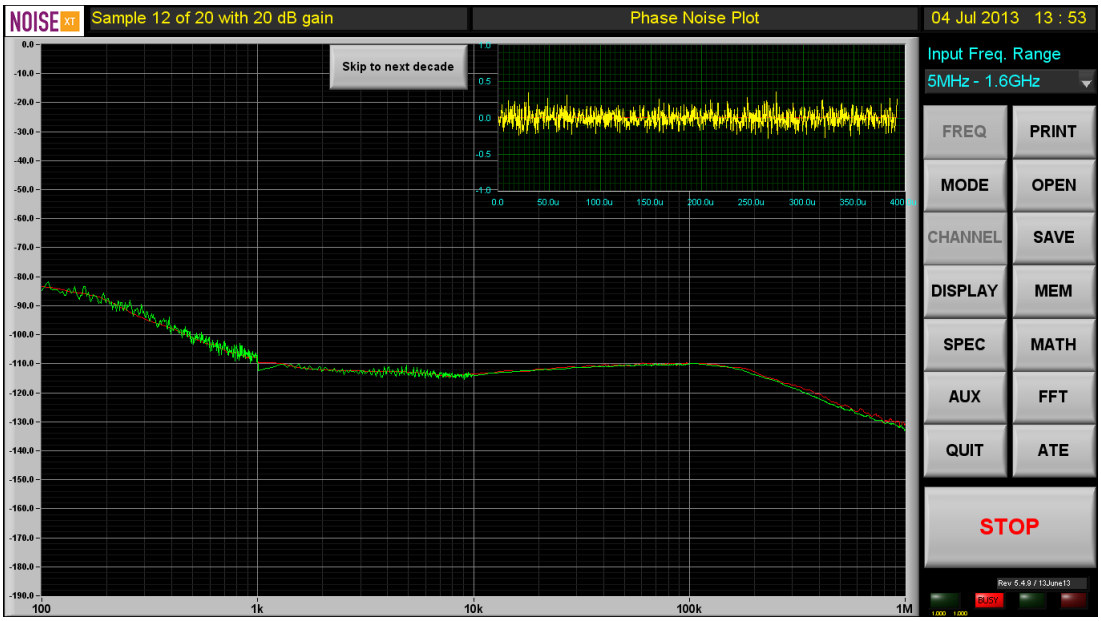
	Phase Noise	Amplitude Noise	Absolute Noise	Allan Variance	Jitter	Low Spurious
Absolute for 1 port DUT	Yes	Yes	Yes	Yes	Yes	Yes
Residual for 2 ports DUT	Yes	Yes(1)	No	Yes	Yes	Yes
Continuous Wave	Yes	Yes	n.a.	Yes	Yes	Yes
Pulsed Carrier	Yes	Yes	n.a.	Yes	Yes	Yes
INT/EXT Reference Source	Yes	Yes(1)	n.a.	Yes	Yes	Yes
INT/EXT Detectors	Yes	Yes	n.a.	Yes	Yes	Yes

(1) in-phase residual noise technique for 2 ports DUTs measures absolute AM noise.

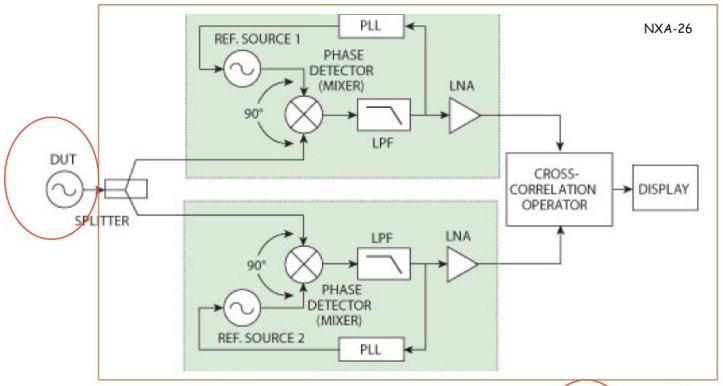
The NXA measures phase or amplitude noise on continuous or pulsed signals (gated CW) with the help of external low-pass video filters; the user can select to work on

CW signals or pulsed. This selection is available for all modes excepted for Analog Baseband (absolute noise voltage) measurements.

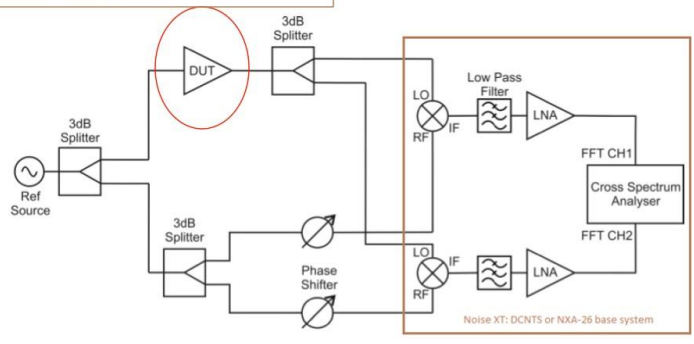
The NXA operation is simplified compared to traditional Phase Noise Test Systems thanks to the use of a large touchscreen interface.



The NXA can use its internal synthesizers or use external reference oscillators or synthesizers in order to speed-up measurement time. The NXA can also use external phase detector to extend its frequency coverage to any requirement, only limited by the customer supplied phase detectors or reference sources frequency coverage.



ABSOLUTE Phase Noise



RESIDUAL Phase Noise

RF Input Port

Description	Specification
RF IN connector	Type-N F(NXA-6/26) or 1.85mm (NXA-50), 50 ohms nominal
RF IN frequency range	2 MHz to 6.2 / 26 / 50 GHz (1)
RF IN measurement level	-30 dBm to +20 dBm (<200 MHz) -20 dBm to +20 dBm (<1 GHz) -10 dBm to +20 dBm (<1.4 GHz) 0 dBm to +15dBm (<9.99 GHz) +5 dBm to +15dBm (>9.99 GHz)
RF Input Gain	-10 / 0 / +10 / +20 dB (2MHz to 1.4 GHz only)
Input damage level	AC > +23dBm, 0V DC max (hybrid couplers)

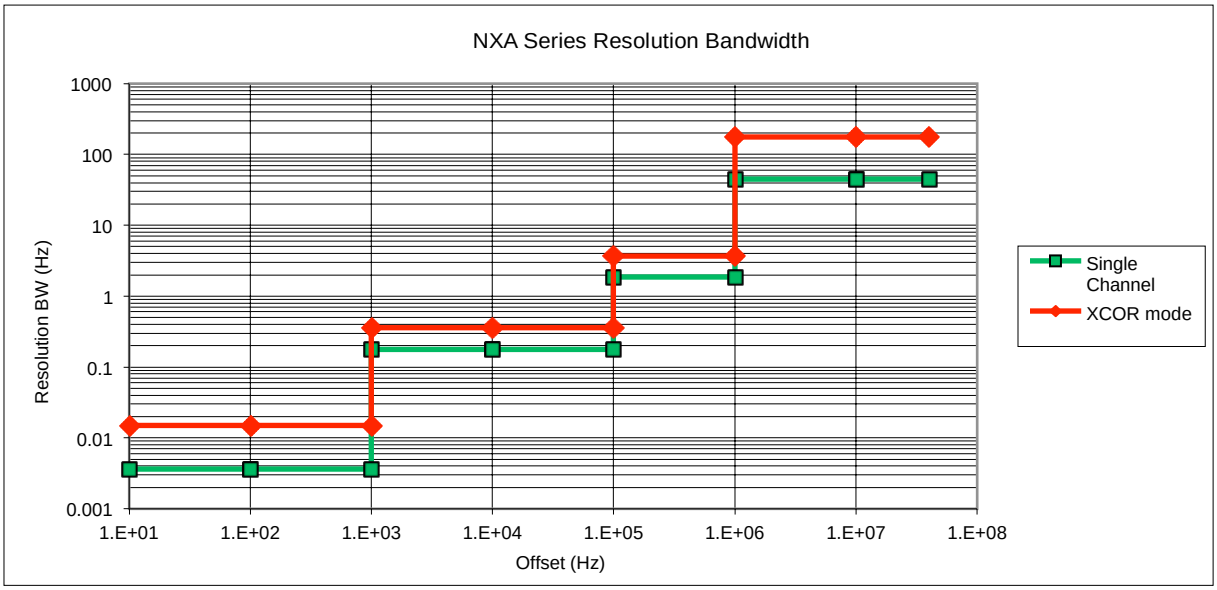
(1) Maximum frequency depends on model type

Phase Noise Analyzer performance

Description	Specification
RF IN frequency range	2 MHz to 6.2 / 26 / 50 GHz (1)
Measurement frequency bands	2-1400 MHz, 1.4 to 9.99 GHz, 9.99 GHz to max frequency
Measurement parameters	SSB noise (dBc/Hz), Spurious (dBc), Integrated phase deviation (dBc, deg, rad), Jitter (s, UI), Residual FM (Hz)
Number of traces	10 data traces in 10 memories with access to all math tools
Number of markers	7 tracking independently any trace
Measurement trigger	Manual through GUI, Remote through Ethernet
Offset frequency range	0.01 Hz to 1 MHz (Fc <80 MHz) 0.01 Hz to 40 MHz (Fc>80 MHz)
Phase Noise uncertainty	+/- 4 dB for 0.01 to 10 Hz offset +/- 3 dB for 10 to 100 Hz offset +/- 2 dB for 100 Hz to 100 kHz +/- 3 dB for 100kHz to 40 MHz
SSB noise sensitivity	See Table for complete values
IF gain setting	0 to +90 dB in 10 dB step (automated) +20 to +40 dB in Pulsed PM for Kphi meas
Enhanced sensitivity	Cross-correlation method available in all modes 1 to 100,000 averages Independent setting per offset decade
Reference Local Oscillator	Internal Synthesizers or External Sources
Residual spurious response level	<-100 dBc above 10kHz offset (external sources) <-80 dBc 1k to 10 kHz (external sources) <-70 dBc above 10kHz (internal sources) <-60 dBc 1k to 10 kHz (internal sources)
Spurious detection Algorithm	Normal Enhanced for High Resolution mode 2D mode for faster noise floor improvement (2)
Measurement time	See time table
Resolution Bandwidth	Variable settings in each independent decade Lowest offsets: 4 mHz min 1MHz offset: 2 Hz min High offsets: 45 Hz min See RBW graph below
Internal Synthesizers output power	+12 dBm +/- 3 dB

(1) Maximum frequency depends on model type
(2) Patent pending

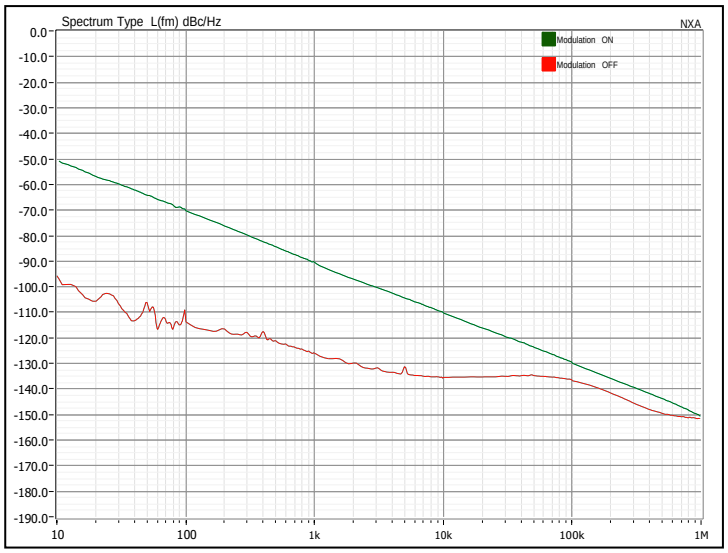
NXA Series Instantaneous Resolution Bandwidth



1- to allow perfect detection with a RefSpur of 10dB, the resolution bandwidth has to be lower than 10 Hz
2- RBW lower than 1 Hz are not useful to detect spurious as it corresponds to the same level as the phase noise plot. However the user should pay attention at the RBW at high offsets.

The accuracy of the instrument to report correct phase noise points at various offsets is calibrated using a swept spurious that generates a flatness response calibration table. This is done per decade and for various IF gains values.

A simple verification can be done using a commercial Signal Generator with built-in White Gaussian frequency noise modulation. Below is the result of the test with the modulation ON and OFF. The correct response is a 20dB slope straight line through the display.



Linearity check at 1GHz with white FM modulation on signal generator

Low Frequency band Phase Noise Sensitivity

2 to 1 400 MHz band, Kphi = 0.600 V/rad, typical

dBc/Hz vs offset (Hz)	1	10	100	1k	10k	100k	1M	10M	40M
External Source noise floor	-150	-160	-170	-178	-187	-188	-193	-195	-190
10MHz internal noise floor		-123	-156	-166	-177	-178	-184		
100MHz internal noise floor		-103	-140	-162	-172	-174	-178	-182	-185
1GHz internal noise floor		-83	-122	-144	-155	-155	-160	-170	-175

Please add +5dB for guaranteed performance

High Frequency band Phase Noise Sensitivity

1.4 GHz min, Kphi = 0.200 V/rad, typical

dBc/Hz vs offset (Hz)	1	10	100	1k	10k	100k	1M	10M	40M
External Source noise floor	-125	-135	-150	-160	-175	-183	-188	-188	-183
2 GHz internal noise floor		-77	-117	-139	-150	-149	-153	-165	-169
6 GHz internal noise floor		-67	-107	-130	-140	-139	-142	-152	-159

Please add +5dB for guaranteed performance

NXA-26 and NXA-50, Kphi = 0.200 V/rad, typical

dBc/Hz vs offset (Hz)	1	10	100	1k	10k	100k	1M	10M	40M
External Source noise floor	-125	-135	-150	-160	-175	-183	-188	-188	-183
8 GHz internal noise floor		-65	-104	-127	-139	-139	-142	-154	-157
12 GHz internal noise floor		-62	-100	-128	-134	-134	-138	-150	-153
24 GHz internal noise floor		-55	-94	-117	-128	-129	-131	-144	-147

Please add +5dB for guaranteed performance

NXA-50, Kphi = 0.200 V/rad, typical

dBc/Hz vs offset (Hz)	1	10	100	1k	10k	100k	1M	10M	40M
External Source noise floor	-120	-130	-145	-155	-170	-178	-180	-180	-175
36 GHz internal noise floor		-52	-90	-118	-124	-124	-128	-140	-143

Please add +5dB for guaranteed performance

Cross-correlation Settings for specified performance

Default resolution bandwidth and 2D spurious detection algorithm

offset (Hz)	1	10	100	1k	10k	100k	1M	10M	40M
Averages (# cross-correlations)	10	10	100	100	1k	1k	10k	10k	10k

Measurement timetable

Default FFT settings used

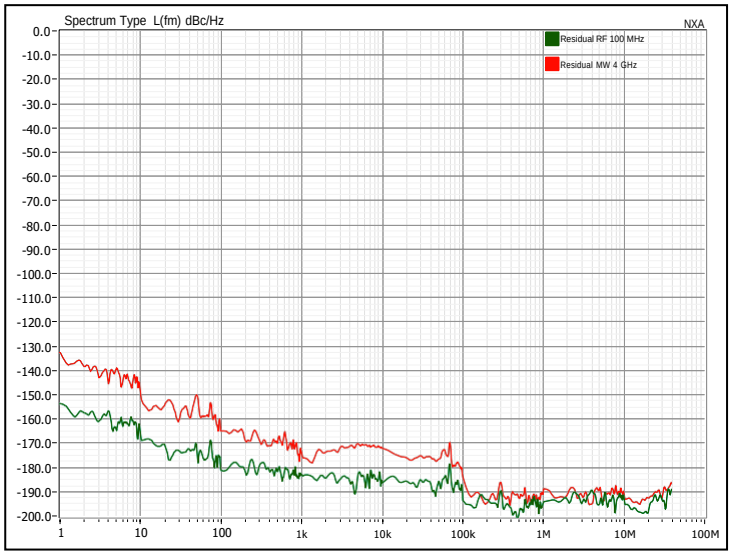
Decade up to	Averages	Resolution BW (Hz)	Meas. Time (s)
0.1 Hz	2	4m	839
1 Hz	5	4m	2100
10 Hz	5	57m	131
100 Hz	7	915m	12
1 kHz	7	915m	12
10 kHz	20	45	1.7
100 kHz	20	45	1.7
1 MHz	20	477	1.1
10 MHz	20	11k	1
40 MHz	20	11k	1

Example: for a measurement with default setting from 100 Hz to 1 MHz, time= 20s

External programs installed on the NXA by the customer may affect measurement speed.

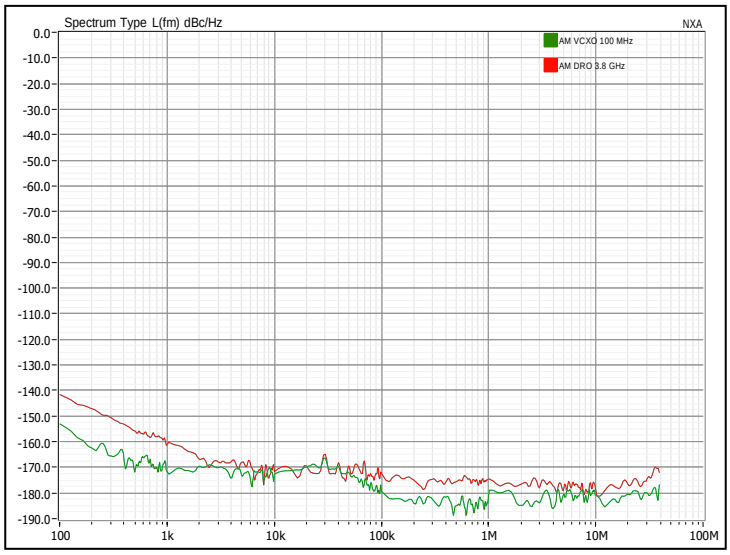
Internal Detectors Noise floor plots of the NXA

The NXA Series contains multiple phase detectors to operate over the very wide frequency coverage.



Phase Noise floor at 100 MHz and 4 GHz (external source mode)

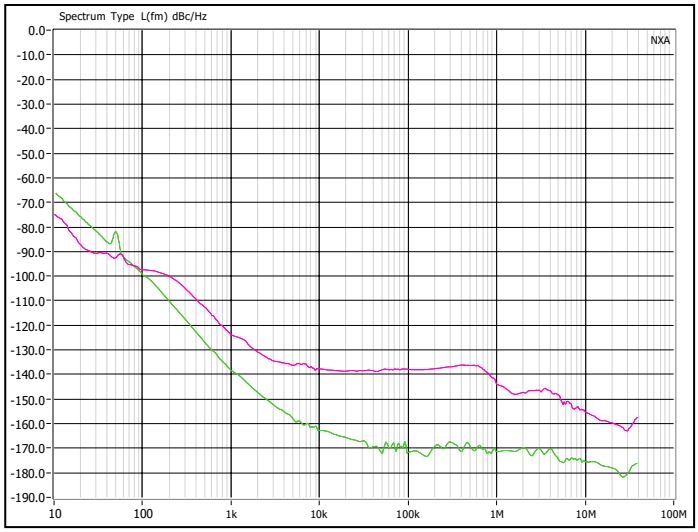
NXA-26 and NXA-50 also have built-in optional AM crystal detectors allowing very low noise measurements without the need for any reference source.



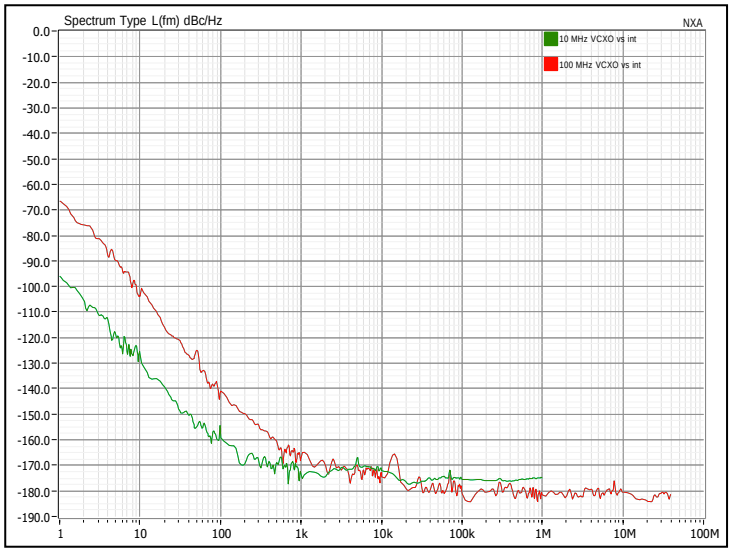
Amplitude Noise measurements at 100 MHz and 3.8 GHz

Simple testing using the internal synthesizers

The NXA can measure phase noise on signals without the help of external sources. Two internal synthesizers cover the very wide frequency range of the instrument.



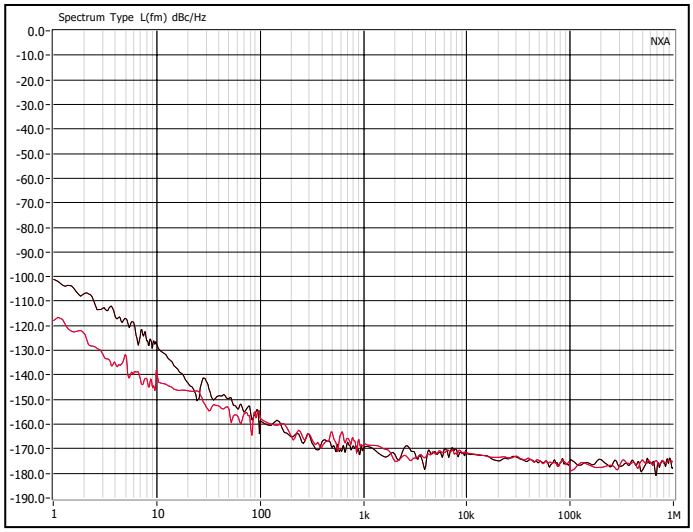
SAW Oscillator at 500 MHz and Synthesizer at 6 GHz (internal sources mode)



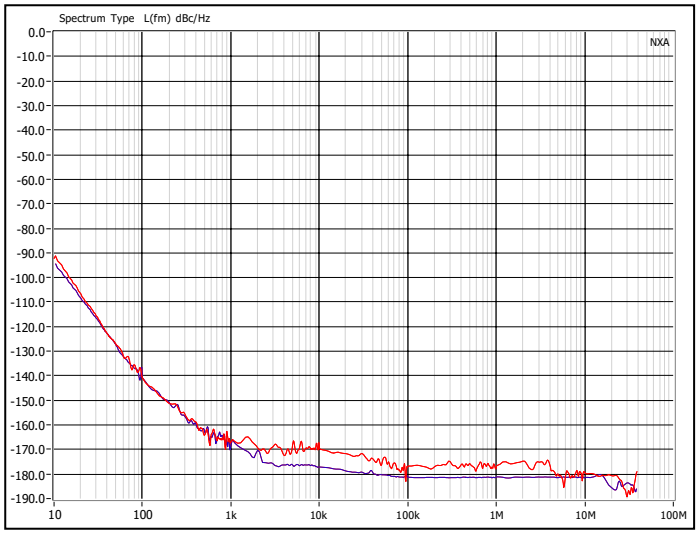
Crystal Oscillators at 10 MHz and 100 MHz (internal sources mode)

Using external Reference Oscillators

Below are some examples of crystal oscillators tested by the NXA alone and tested using the addition of external crystal oscillators. This method improves the noise floor of the measurement and speeds up the test time as you may not need as much cross-correlation averages as with the internal synthesizers



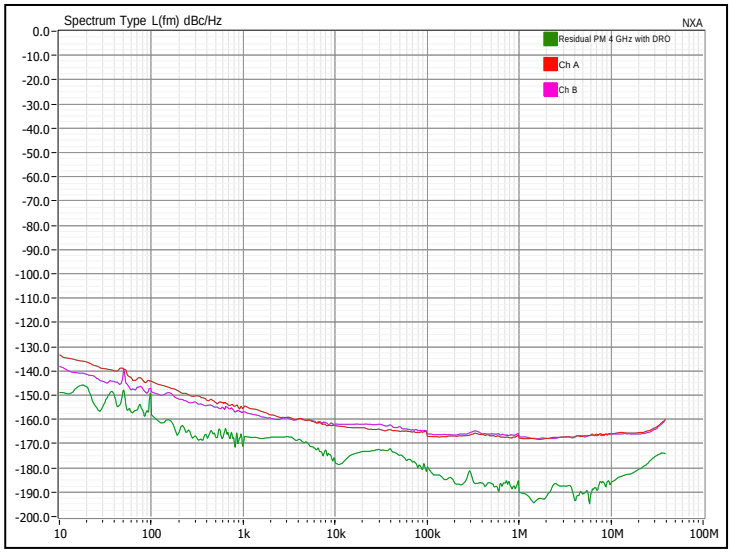
10 MHz OCXO tested using internal sources or external sources



100 MHz OCXO tested using internal sources or external sources

Residual Phase Noise Testing

While Absolute phase noise is widely used and the main testing method for signal generators, additive (or residual) phase noise is extremely useful to measure the added phase noise of 2 ports devices like amplifiers, frequency multipliers or dividers.
With the help of external phase shifters (line stretchers, variable delay lines or trombones), the NXA can fully automate the very low noise measurements, making this test easy to implement in production, even by non-experts.
The Cross-correlation helps a lot to improve the dynamic range compared to signle channel systems, in particular when high power (over +20dBm) is not available.

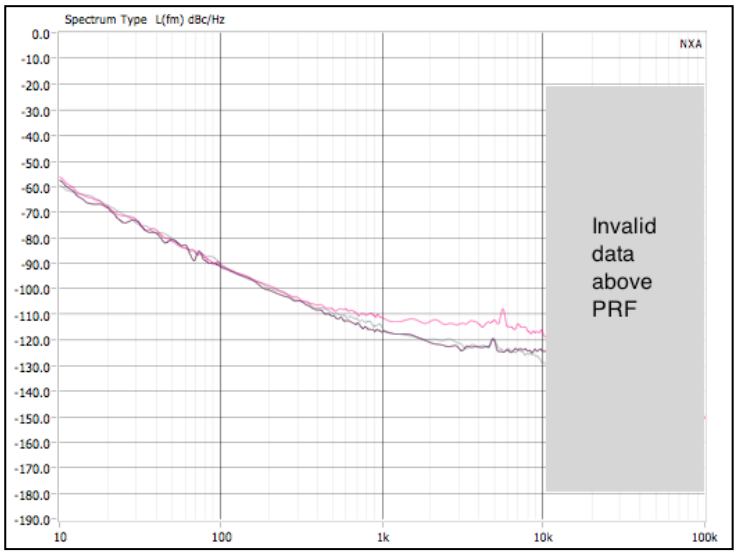


4 GHz Residual Phase noise (Single channel vs Xcor)

Measuring Pulsed signals

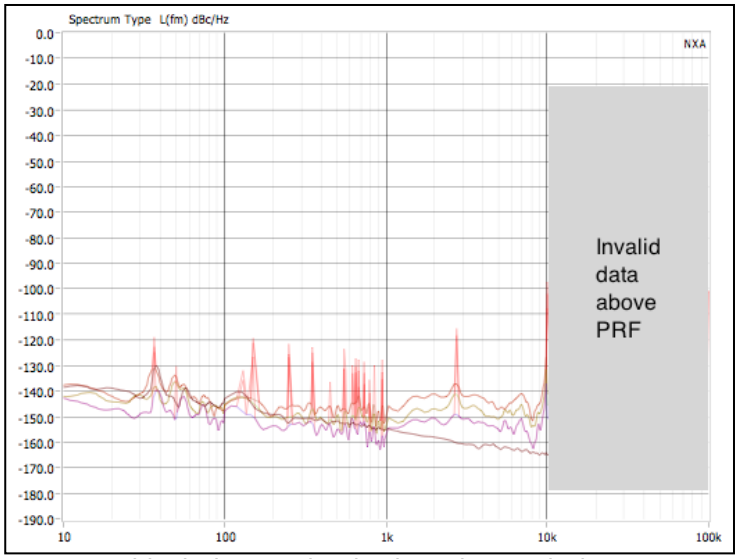
In modern radars, signals are pulsed and it is very important to verify the quality of the transmitted signal. The gated CW signal can have a duty cycle as low as 5% and most of the phase noise analyzers cannot handle non CW tones.

The NXA-26 and NXA-50 have special features to allow phase and amplitude noise measurements on pulsed signals. Both absolute and residual noise measurement are possible, making the instrument ideal to test power transmitters as well as complete emitters.



8 GHz 10% duty cycle with 10kHz LPF Absolute Phase noise vs CW

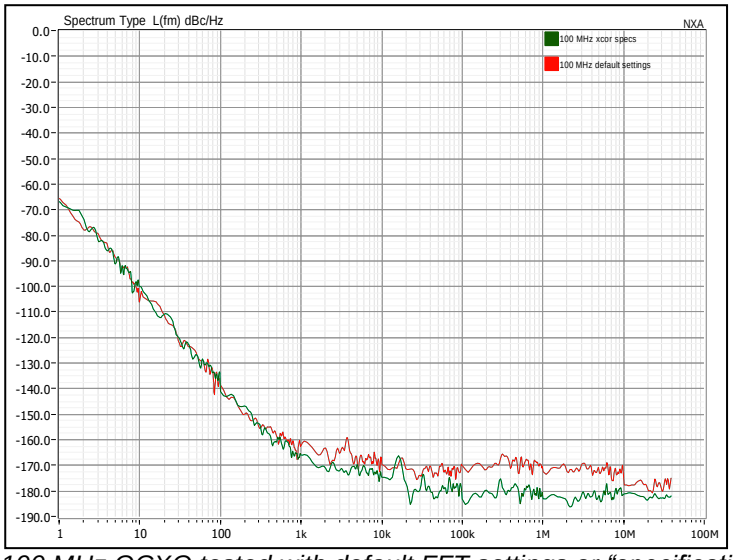
With the help of an external phase shifter, a similar measurement can be done in a Residual (Additive) phase noise method providing very good dynamic range over a 26 GHz frequency coverage.



4 GHz Residual Phase noise (various duty cycles)

Varying the Number of Cross-correlations

In addition to traditional FFT settings to control the resolution bandwidth, number of displayed points and spurious extraction, the user can optimize the dynamic range of the instrument in each decade by adjusting the number of cross-correlation averages.



100 MHz OCXO tested with default FFT settings or "specifications above" settings (internal sources)

General Information

Front panel information

Description	Supplemental information
RF Input	Type-N F(NXA-6/26) or 1.85mm (NXA-50), 50 ohms nominal
Baseband IN	2 x SMA (female), 110 ohms, DC coupled
DC control	2 x BNC (female)
Local Oscillator IN / OUT	4 x SMA (female), 50 ohms
Extension Auxiliary ports	2 x SMA (female)
USB	4 ports (USB 2.0)
Display	14 inch TFT color LCD with touch screen 1366 x 768 resolution
Extractible Hard Drive	Removable 64GB SSD Sata II drive

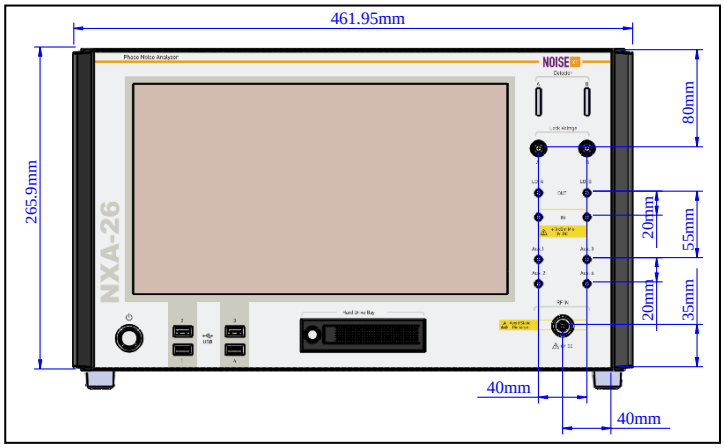
Rear panel information

Description	Supplemental information
USB	4 ports (USB 2.0)
LAN port	RJ-45 Gigabit Ethernet
Video	VGA DVI
IO ports	2 x RS232 1 x LPT
PS2	Shared kbd/ms port
Audio	3 audio jacks
DC	+12V Input port
AC	100-240 VAC 50/60Hz 4A max
FAN	Intake

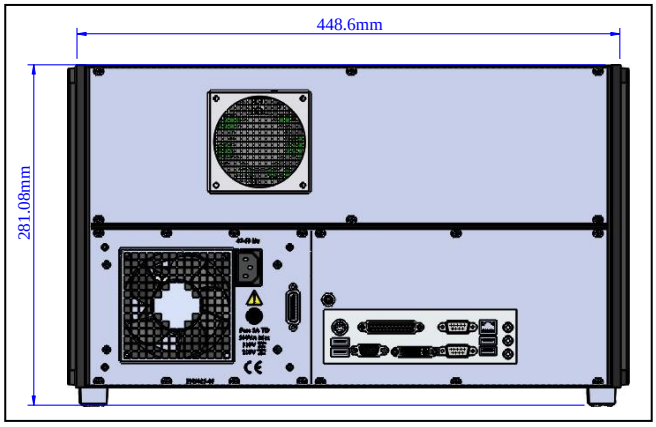
Analyzer environment and dimensions

Description	Supplemental information
Operating environment	
Temperature	+10 degC to +40 degC
Humidity	RH 20% to 80% at wet bulb temp.<29 degC (non-condensing)
Altitude	0 to +2 000 m
Non-operating storage environment	
Temperature	-10 degC to +60 degC
Humidity	RH 20% to 90% at wet bulb temp.<40 degC (non-condensing)
Altitude	-427 to +4 810 m
Vibration	0.5 G maximum, 5 Hz to 500 Hz
Instrument dimensions	See figure below
Weight (NET)	35 kg

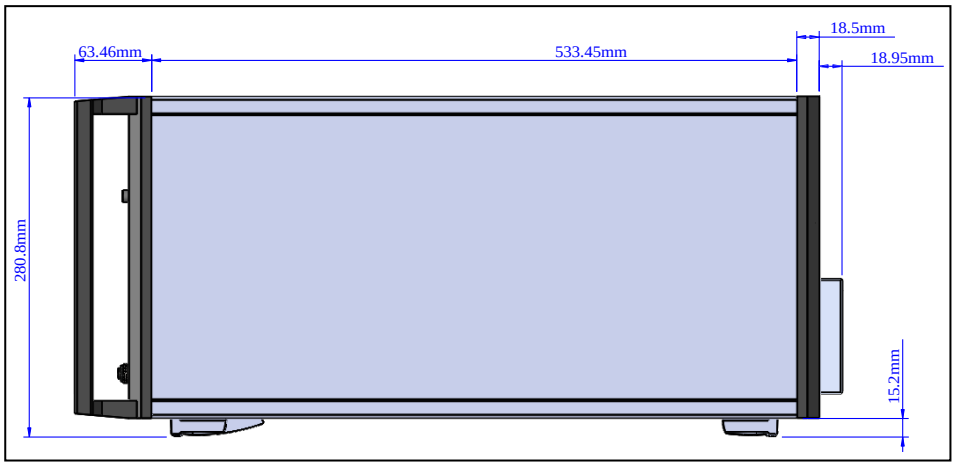
Dimensions information



Front view



Rear view



Side view

Display functions

Description	Supplemental information
Measurement windows	Up to 2 windows
Spectrum Window	8 traces or specification lines trace color, thickness adjustable by trace and by type (noise in dBc/Hz and spurious in dBc) Math tools: Addition, subtraction, multiplication or division of trace data Combination of traces (concatenate tool) X-axis adjustable by decade Y-axis min/max values set by user
Time domain window	Baseband / Phase detector voltage display versus time
Marker functions	7 independent markers marker color matches trace color
Jitter and Variance	Plots can be obtained from the phase noise plots to display the frequency stability or jitter density
Special Processing	A Radar computation function is included in the math tools as well as smoothing functions with variable parameters Additional specialty functions can be added in the software, please contact Noise XT for details.

Data Processing Capabilities

Description	Supplemental information
Graphical user interface	The analyzer uses a graphical user interface based on Windows® OS The user can use the touch screen, the keyboard, the mouse or any combination of the three.
Limit-line test	Test limits can be defined and stored on trace memories like regular measurements Test limits are defined by a list of 7 X-Y coordinates
Internal Data Storage	Internal Removable SSD drive that contains Operating System, NXA Operating Software and calibration tables This internal SSD drive may be used to store measurements and configuration files
External Data Storage	USB thumb drives may be connected to any USB port
File Management	The NXA uses proprietary format to store plots (*.plot) that can only read by Noise XT's products. However, there are multiple export formats either as text files that can be open in any spreadsheet software (tab separated)
Printing	Any Windows® OS compatible printer may be used, a default pdf printer is installed by default Printing can also be done to BMP, JPG and PNG picture files.
Automation	Remote control of the NXA can be done over the TCP/IP layer (even when no Ethernet cable is connected). National Instruments LabView® examples and Microsoft VBA® examples are available for scripting purposes
GPIB	The NXA can also be remotely controlled over GPIB with the help of an optional National Instruments GPIB-USB-HS adapter.