DNA Series

Digital Phase Noise and Frequency Analyzer

2 MHz up to 400 MHz

NOISE XT

The DNA is the highest performance Frequency Stability and Phase Noise Analyzer with unique digital architecture that allows down to thermal noise and state of the Art close-in phase noise performance with a limitation set by the user's reference clock. DNA family is available in different versions

- DNA 100M-L: 2 MHz to 100 MHz without internal reference
- DNA 100M-F: 2 MHz to 100 MHz with internal references
- DNA 400M-L: 2 MHz to 400 MHz without internal reference
- DNA 400M-F: 2 MHz to 400 MHz with internal references

The key advantages of this platform are not only the extremely low noise floor but the fact that it does not require any phase locking of a reference, as all phase detector-based phase noise analyzers do. Its amazing phase noise extraction process even works on different frequencies, the reference can be at a different frequency than the DUT. External reference could be any single frequency oscillator between 2 MHz and 400 MHz

No isolation problem, no phase lock loop bandwidth, no DC FM tuning port required; this is so many benefits to avoid errors and get simple, fast and reliable performance. And as phase noise is just one of the two ways of analyzing signal purity and stability, the DNA also integrates an excellent frequency stability analyzer making is the new Time and Frequency analyzer standard for the advanced research and development industry.

The F (Full) versions include built-in oscillators for advanced autonomous operation but works also with external reference.
The L (Light) versions will require external frequency reference between 2 MHz and 400 MHz

DNA 100M is software upgradable to DNA 400M at any time the 400_UPG upgrade option. It is not necessary to send back for frequency upgrade it's an on field option.

DNA is a single touch measurement instrument, just connect DUT and press start then after 30’ the first curve is plotted.

By default the measurement time is 300 s (5 mn) but it is user programmable till infinite.

DNA offers also to set up decade by decade the stop condition to save time for measurement. It is possible to set the delta in dBc/Hz between the measurement curve and the residual noise and stop the decade acquisition when it’s reached

All specifications in this document are typical values unless specified otherwise.

RF Input Port

Description	Specification
RF IN connector	Type-N Female, 50 ohms nominal
RF IN frequency range	2 MHz to 100 MHz (DNA 100) 2 MHz to 400 MHz (DNA 400)
RF IN measurement level	-10 dBm to +20 dBm
Input damage level	AC > +23dBm, 0V DC max

Phase Noise Analyzer performance

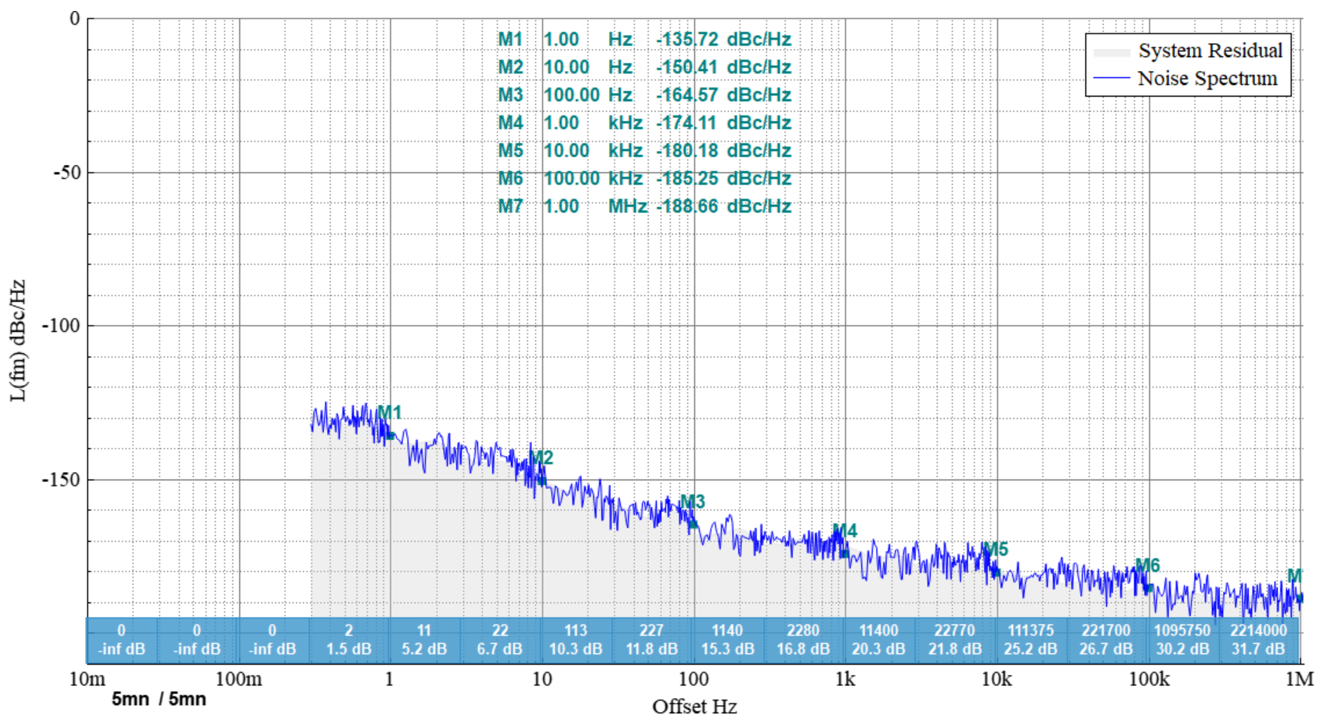
Description	Specification
RF IN frequency range	2 MHz to 100 MHz (DNA 100) 2 MHz to 400 MHz (DNA 400
Measurement parameters	SSB noise (dBc/Hz), Spurious (dBc), Allan & overlapped Allan Variance, Hadamard & overlapped Hadamard variance. Fractional frequency noise chronogram.
Number of traces	20 data traces for SSB phase noise and Frequency stability.
Number of markers	20
Offset frequency range	1 mHz to 1 MHz, 10 MHz Typical
Phase Noise accuracy	+/- 2 dB (+/- 1 dB typical)
SSB noise sensitivity	See Table for complete values
Typical residual phase noise 15min measurement 10 MHz	-137dBc/Hz@1Hz -190dBc/Hz@1MHz
100 MHz	-121dBc/Hz@1Hz -194dBc/Hz@10MHz
Enhanced sensitivity	Fully continuous Cross-correlation method up to millions of averages
Frequency Reference	L version : External Sources (single or dual) F version : Internal or External Sources (single or dual)
Residual Allan deviation (5MHz to 400 MHz) (t=1s) (t=1000s)	 < 7E-14 (5Hz ENBW) < 5E-16 (5Hz ENBW) (Cross variance could improve typicaly by a factor 10 the measurement)
Residual spurious response level (measurement engine), excluding AC power related spurs	-50 dBc at 1 Hz offset -70 dBc at 10 Hz offset -90 dBc at 100 Hz offset <-110 dBc above 1kHz offset
Spurious detection Algorithm	Adjustable Peak detection based on noise statistical information
Measurement time	See time table
Resolution Bandwidth	Variable settings in each independent decade Based on 1024 FFTs in a cascaded continuous noise decimation chain
Internal Source output power (F Version only)	+10 dBm +/- 3 dB

Residual Phase Noise

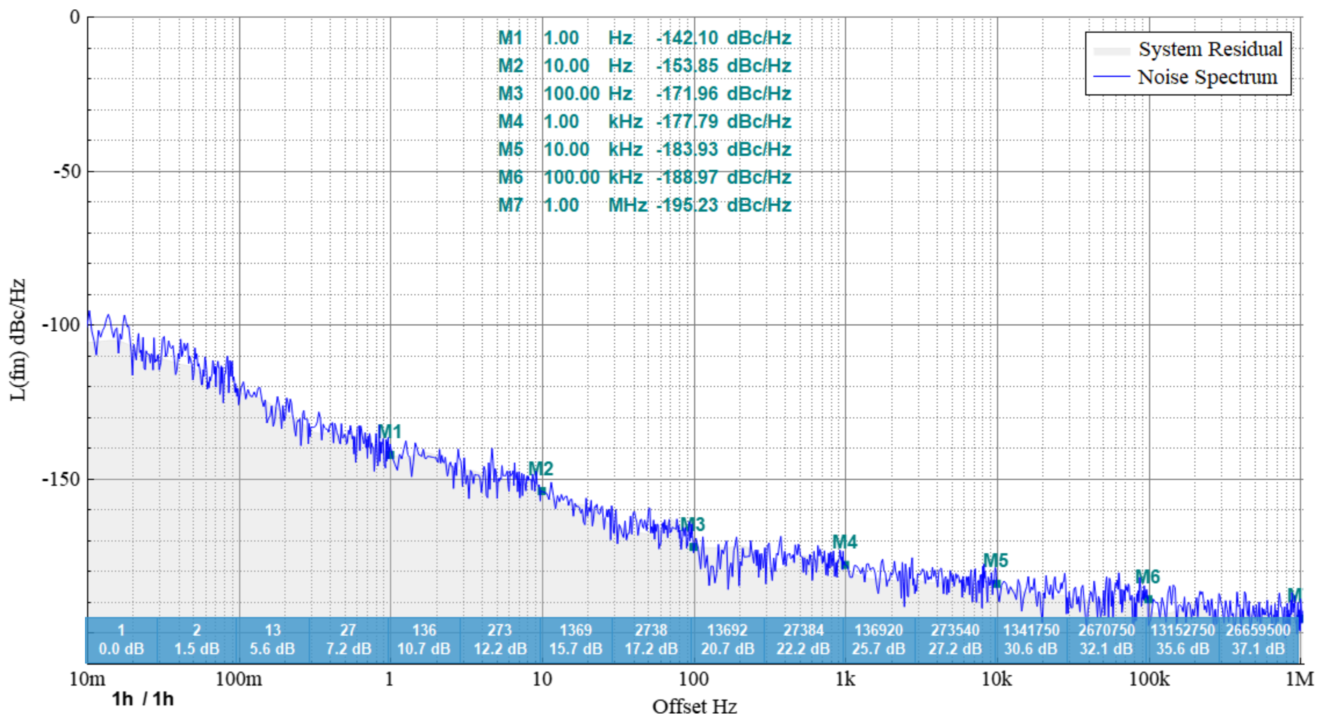
- 10 MHz residual phase noise, nominal Conditions: RF +20dBm Input Power.

Measurement time	dBc/Hz vs Offset (Hz)	1	10	100	1k	10k	100k	1M
5 min	Typical Phase Noise	-135	-150	-164	-174	-180	-185	-188
15 min	Typical Phase Noise	-137	-151	-166	-175	-182	-187	-190
60 min	Typical Phase Noise	-141	-154	-170	-177	-184	-189	-192

Please add +5dB for guaranteed performance



Typical 10 MHz residual Phase Noise, 5min measurement time

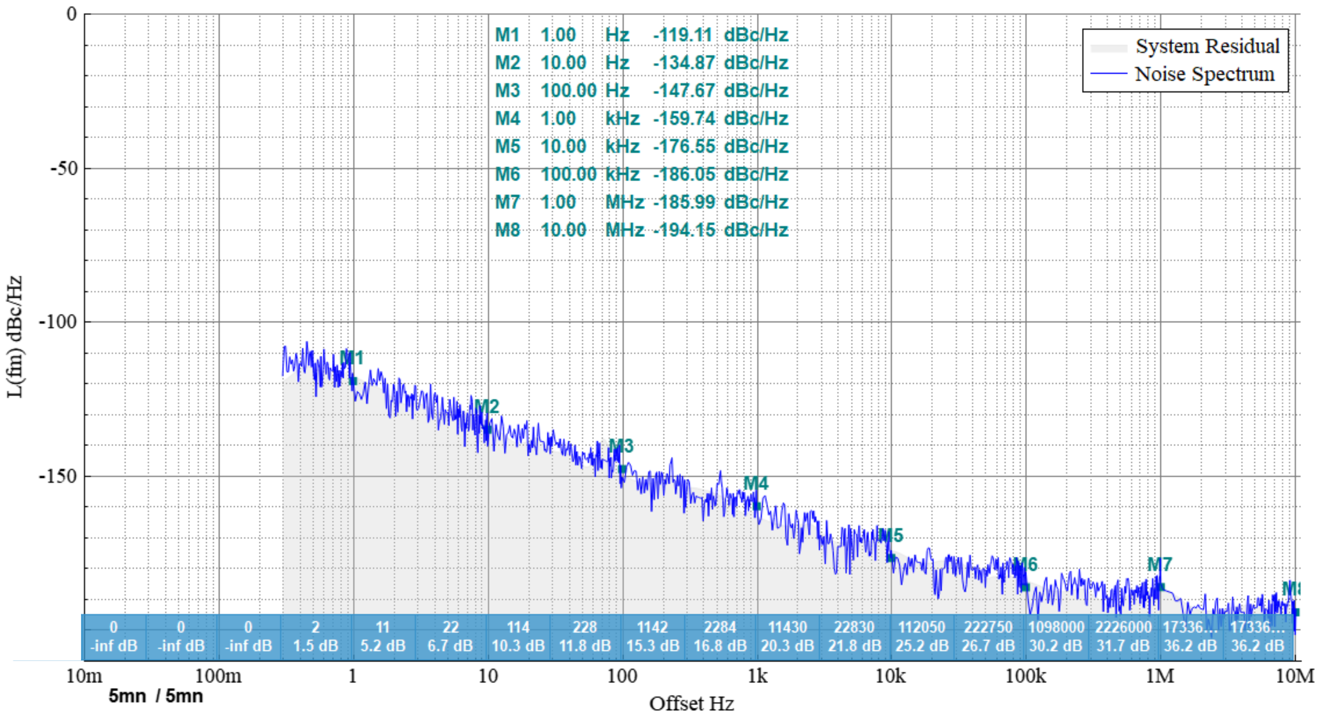


Typical 10 MHz residual Phase Noise, 60 min measurement time

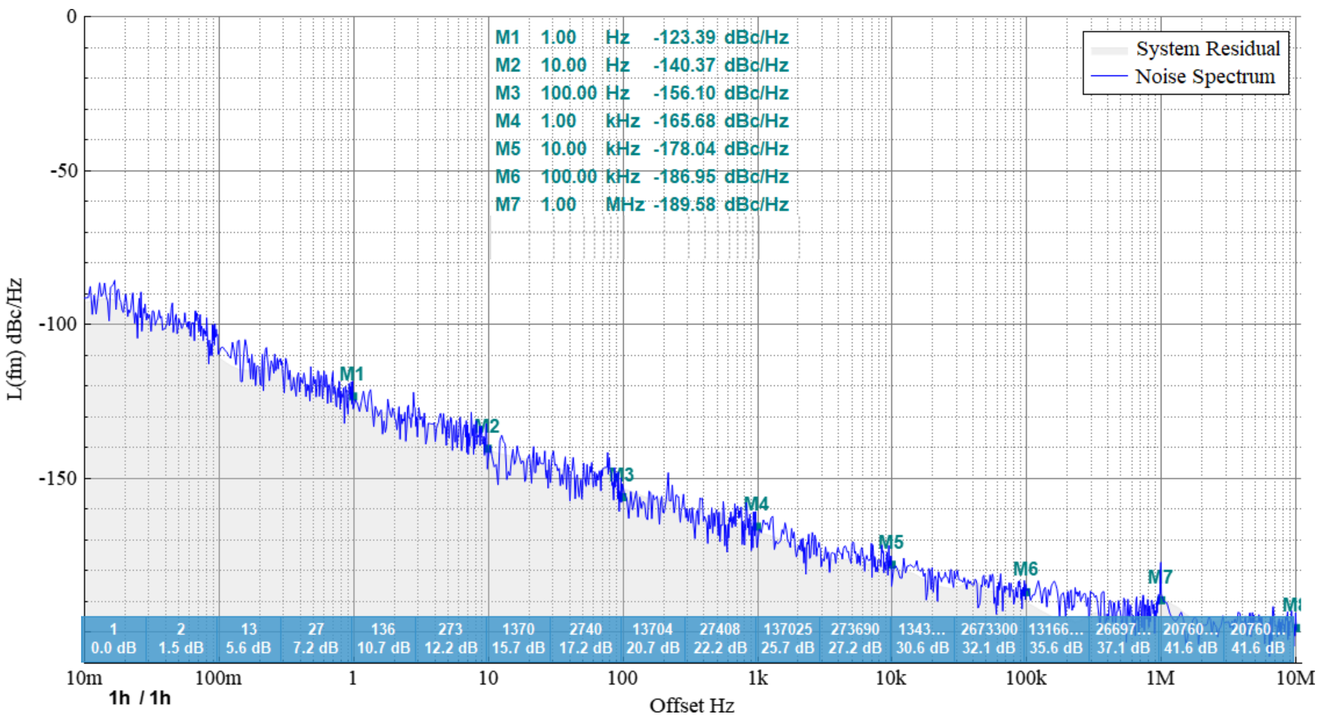
- 100 MHz residual phase noise, nominal Conditions: RF +20 dBm Input Power.

Measurement time	dBc/Hz vs Offset (Hz)	1	10	100	1k	10k	100k	1M	10M option
5 min	Typical Phase Noise	-119	-134	-146	-159	-175	-185	-185	-192
15 min	Typical Phase Noise	-121	-136	-150	-164	-178	-185	-188	-192
60 min	Typical Phase Noise	-123	-140	-156	-165	-178	-186	-189	-192

Please add +5dB for guaranteed performance



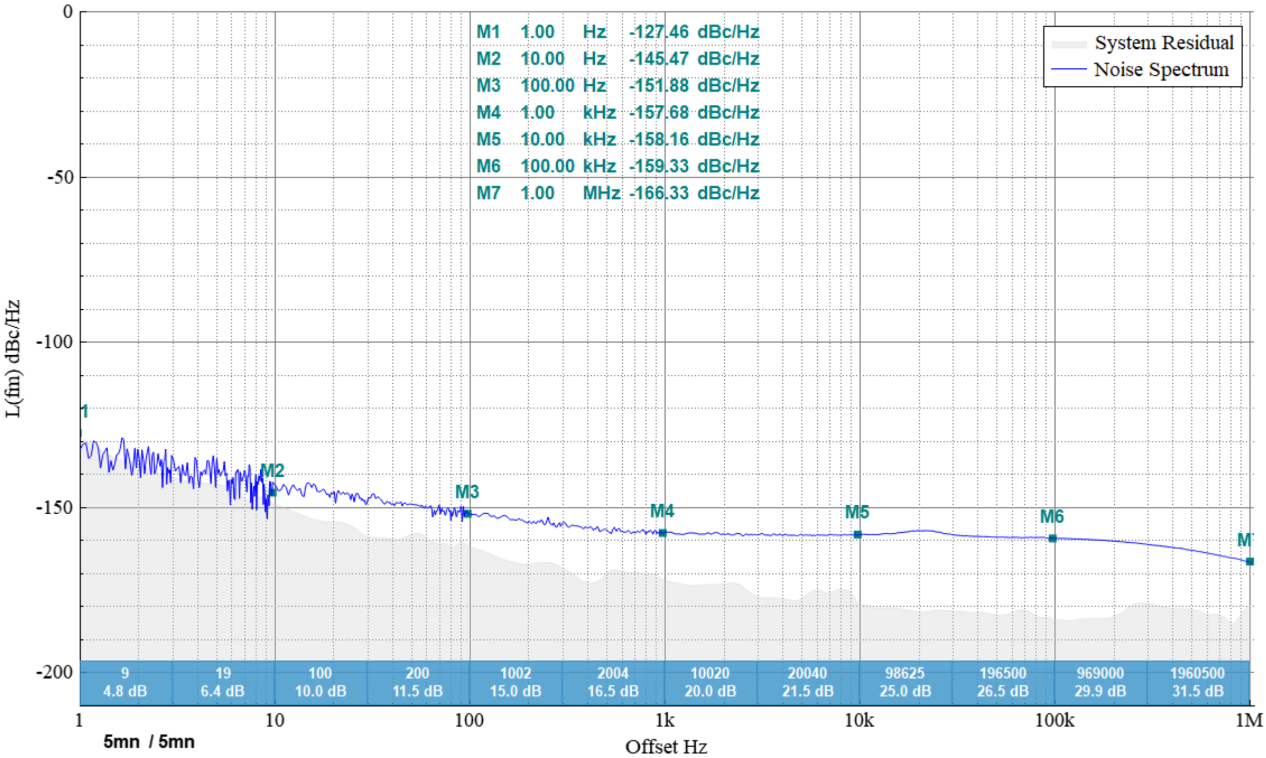
Typical 100 MHz residual Phase Noise, 5 min measurement time



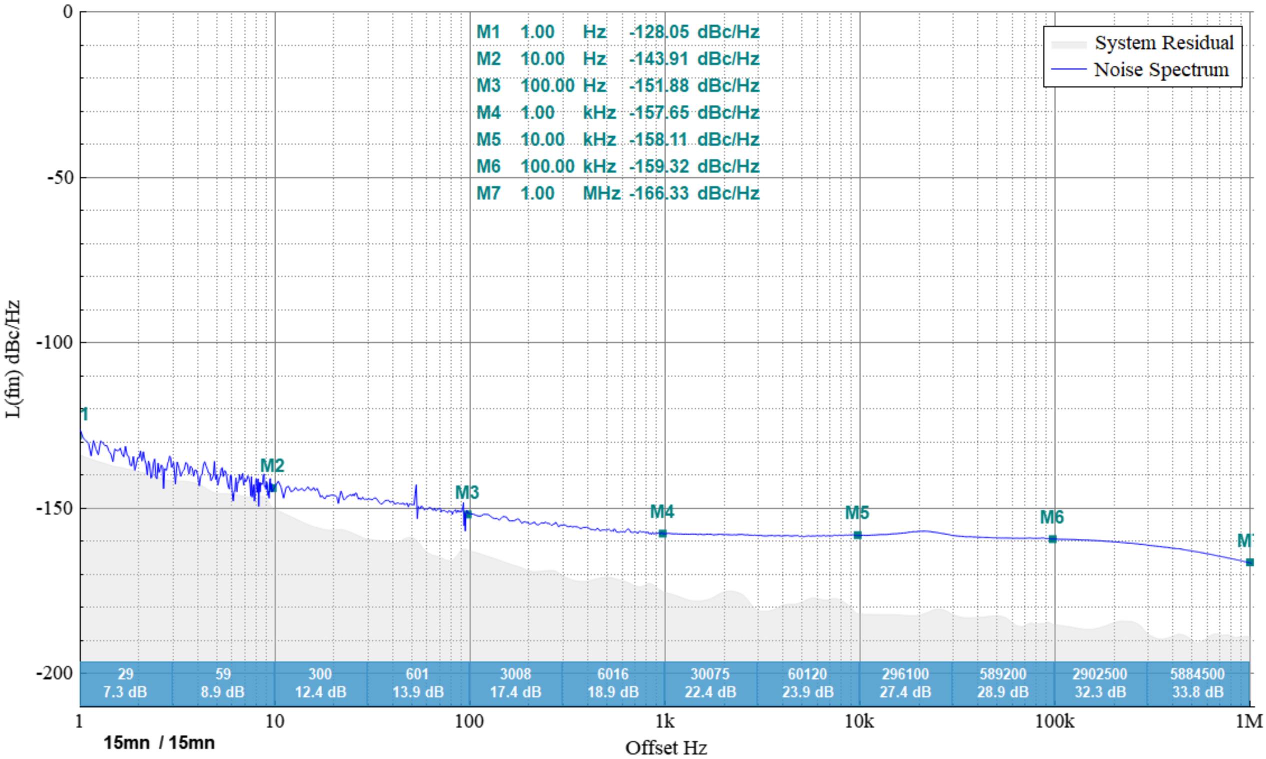
Typical 100 MHz residual Phase Noise, 60 min measurement time

Measurement time

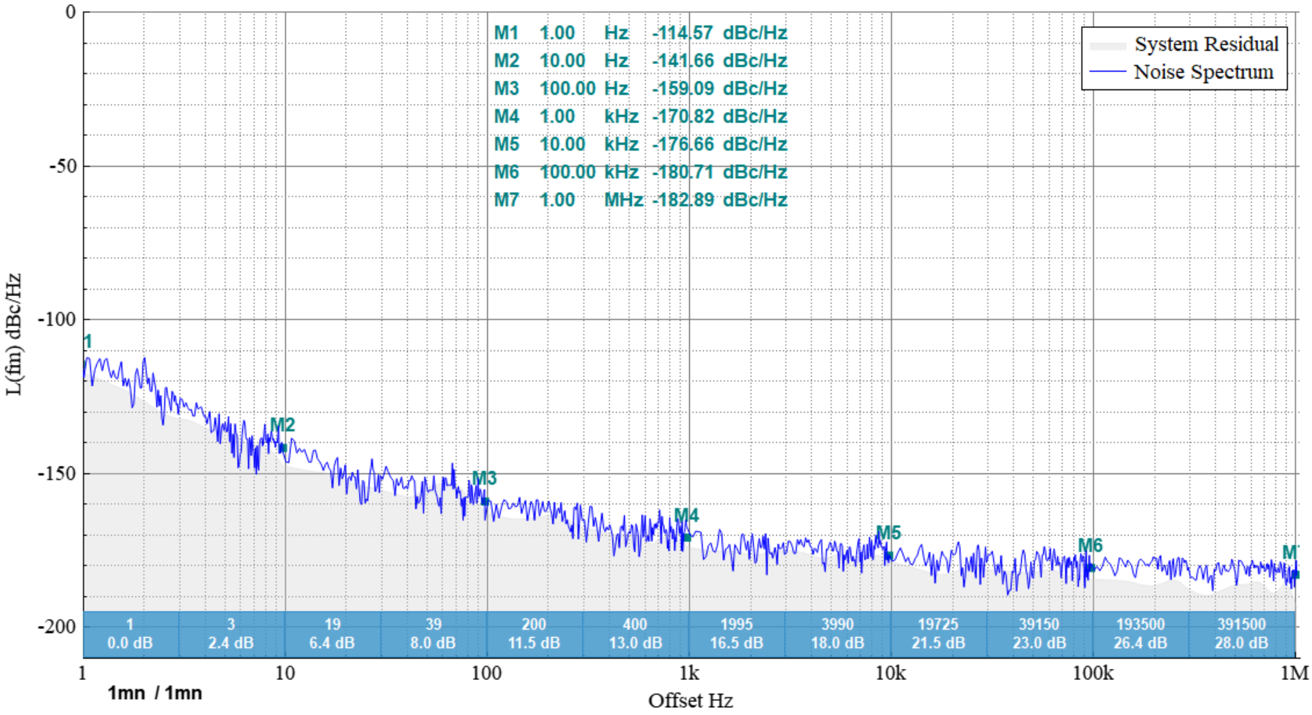
The DNA can measure continuously up to days and automatically uses the maximum number of cross-correlation averages. The only thing that can be set is the measurement time you wish to allow to this test. Measurement time depends on reference specification and expected result.
The results shows below are using the internal reference.



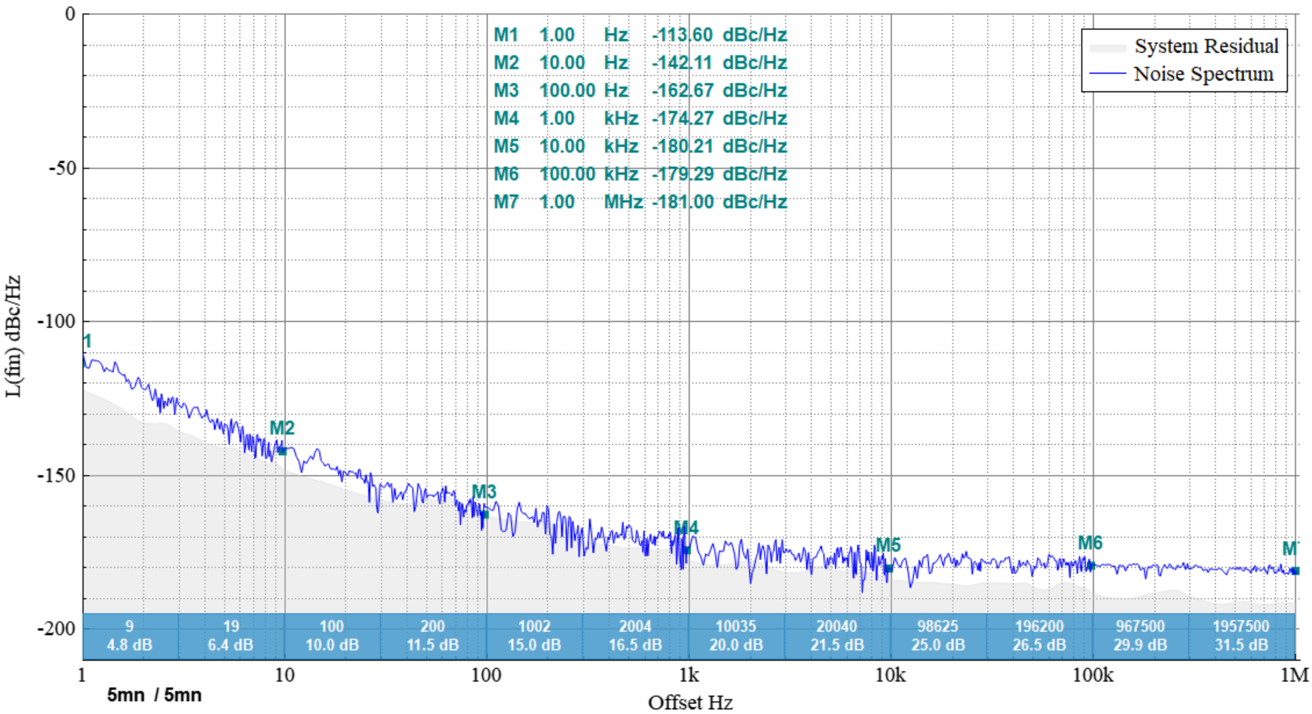
*5 MHz OCXO / **5 min measurement time** phase noise plot*



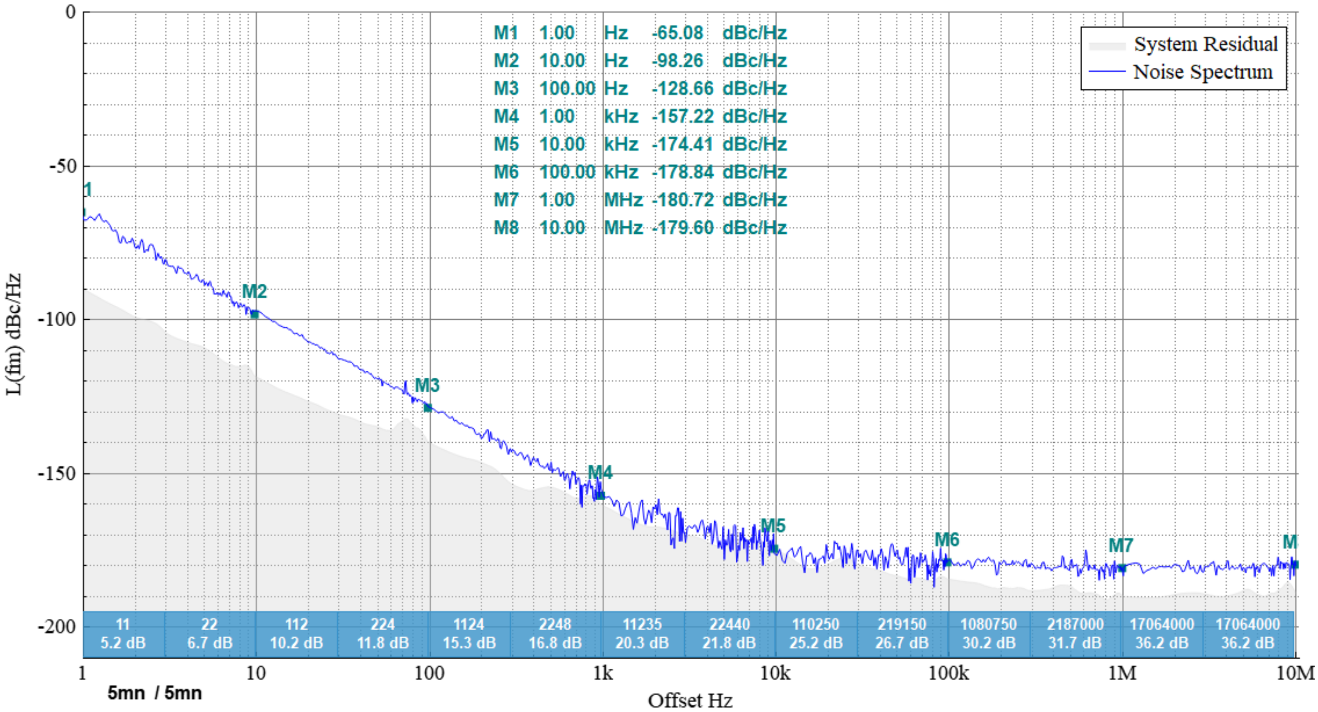
*5 MHz OCXO / **15 min measurement time** phase noise plot*



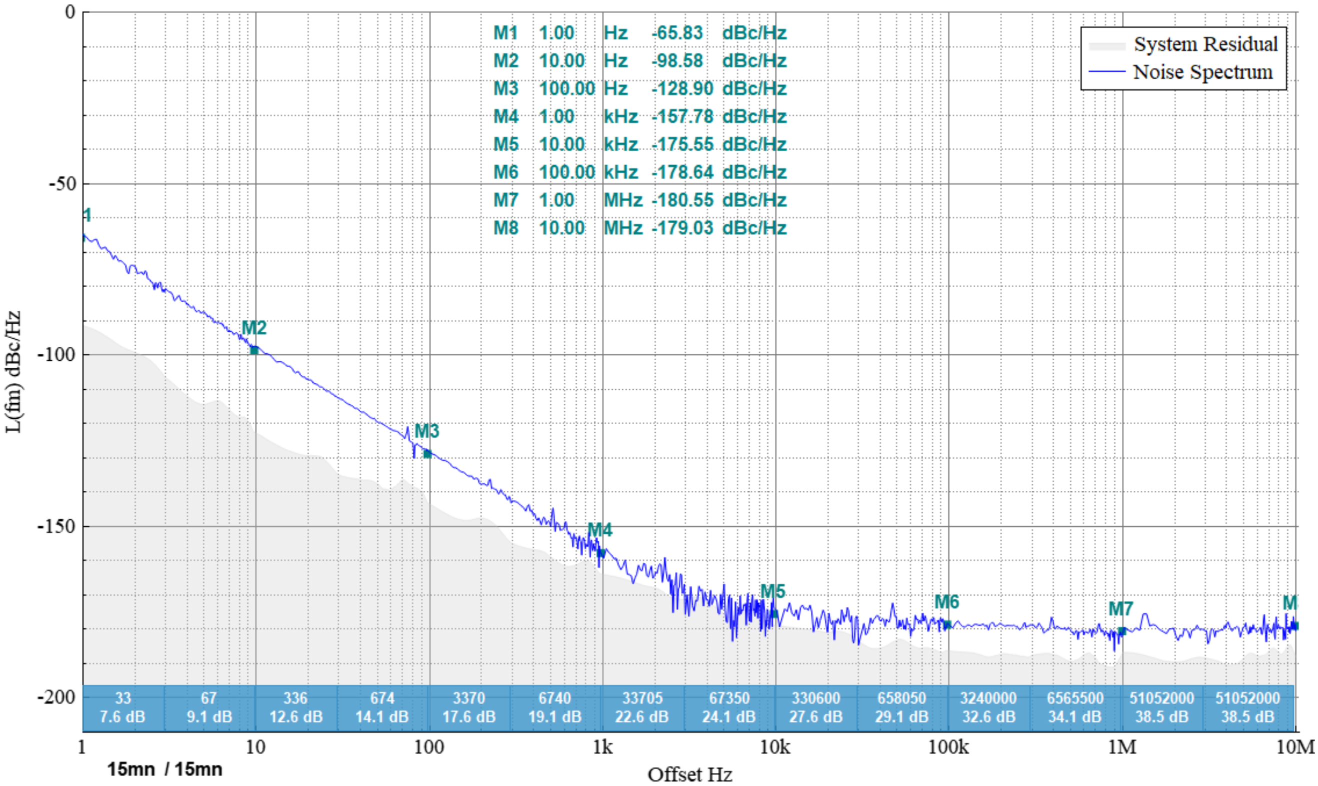
*10 MHz OCXO / **1 min measurement time** phase noise plot*



*10 MHz OCXO / **5 min measurement time** phase noise plot*



*100 MHz OCXO / **5 min measurement** time phase noise plot*



*100 MHz OCXO / **15 min measurement time** phase noise plot*

Frequency Stability Measurements

The DNA has a feature to measure frequency stability and display plots from 0.001 to 1,000,000 seconds with ENBW 500 Hz and 5 Hz.
This measurement can be done at any frequency where the regular phase noise plots can be done.
It uses the instantaneous frequency measure between DUT and reference. An external 10 MHz reference can be used.

The frequency stability measurements available are:

- Allan Variance & Overlapped Allan variance
- Hadamard & Overlapped Hadamard variance

There are two methods for measuring the variance: the auto-variance and the cross-variance.

- The auto-variance method uses the instantaneous fractional frequency between the DUT and the first reference. It is noted that both the DUT and the first reference contribute to this value.
- The cross-variance method uses the instantaneous frequency between the DUT and both references. This method allows minimizing the contribution of the references on the variance measurement improving measurement up to a factor 10 typical.

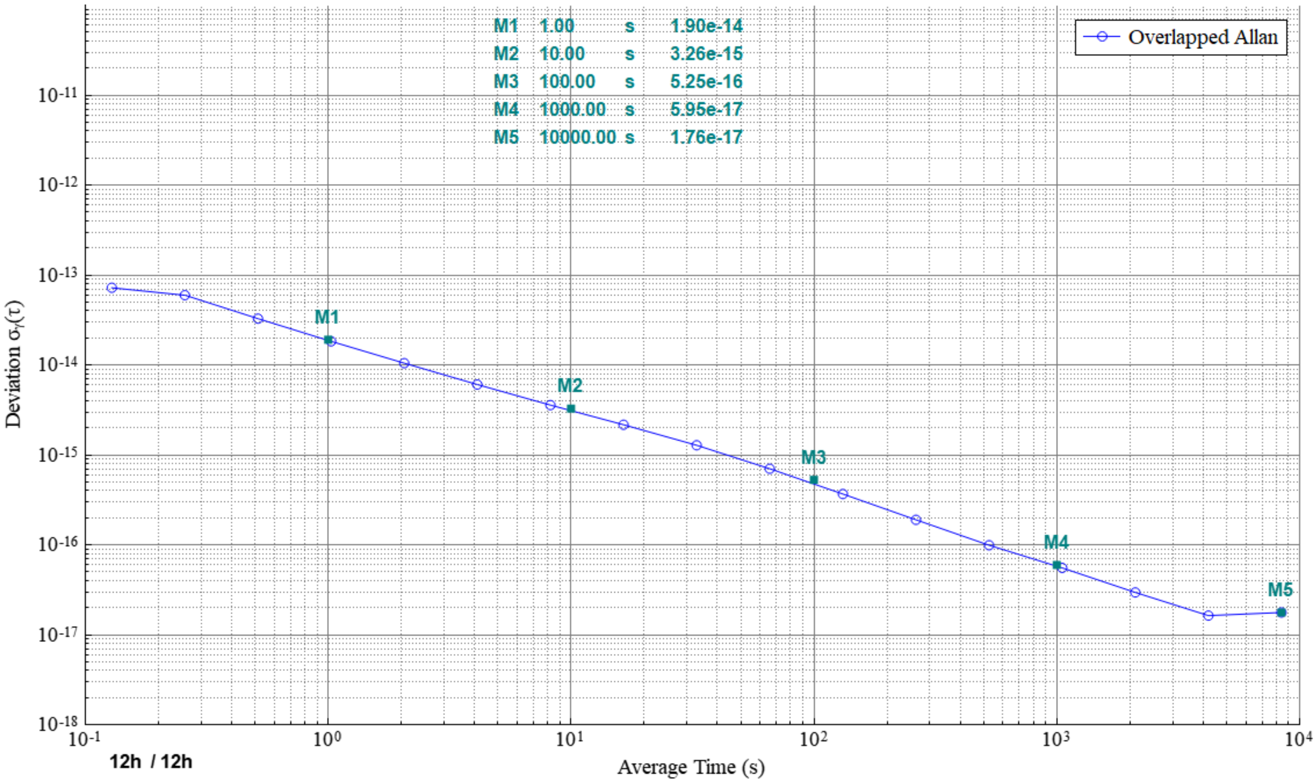
All frequency measurement data is available as text files for external post processing through any statistical analysis software.
Frequency measurement data could be store on disk or usb stick up to 1 kHz offset
Storage is Stable32 compatible format

Residual Allan deviation specification (1)		
(5MHz to 400 MHz)	*(t=1s)*	*< 7E-14 (5Hz ENBW)*
	(t=1000s)	*< 5E-16 (5Hz ENBW)*

([1]) The best results will be obtained by using the cross-variance and an external 10 MHz reference with a good stability.

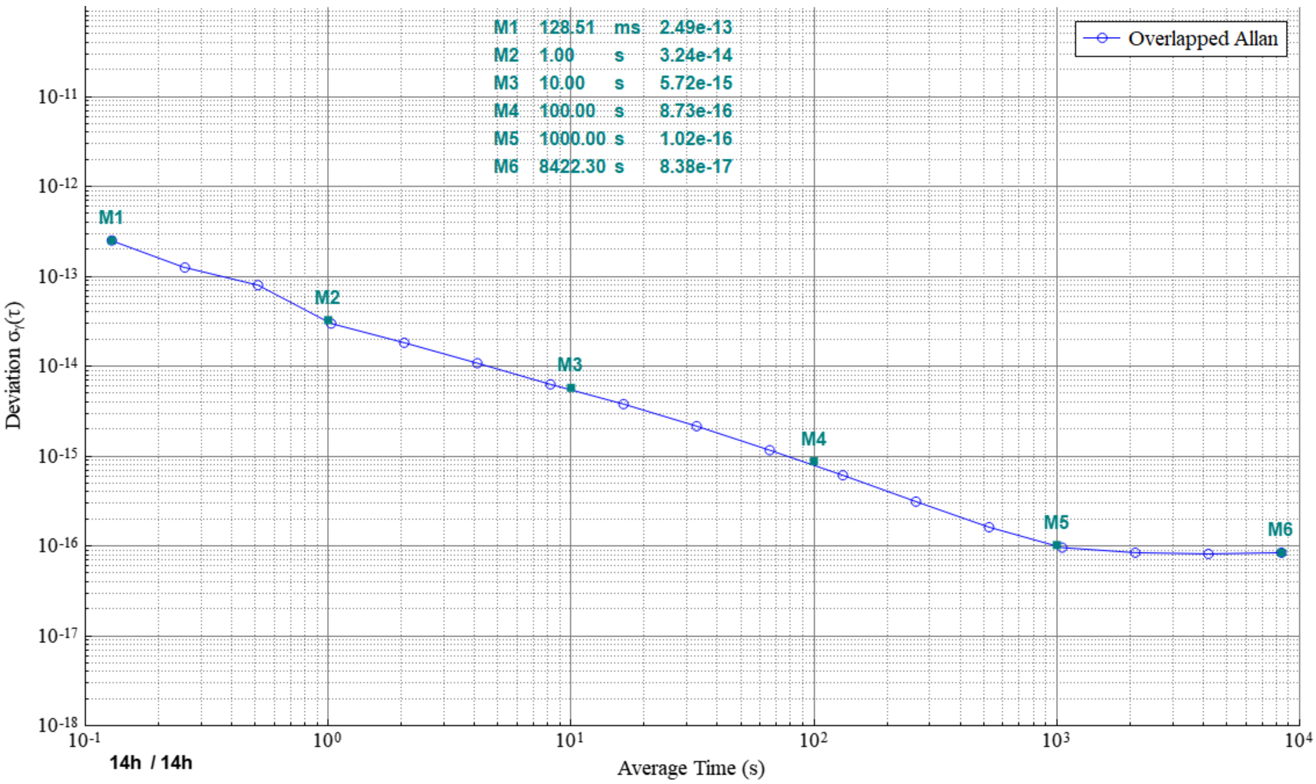
Residual Allan Deviation Typical results:

Residual Allan Deviation ENBW = 5Hz	0.125	1	10	100	1k	10k
Typical results at 100 MHz	1.10^{-13}	2.10^{-14}	3.10^{-15}	6.10^{-16}	6.10^{-17}	2.10^{-17}



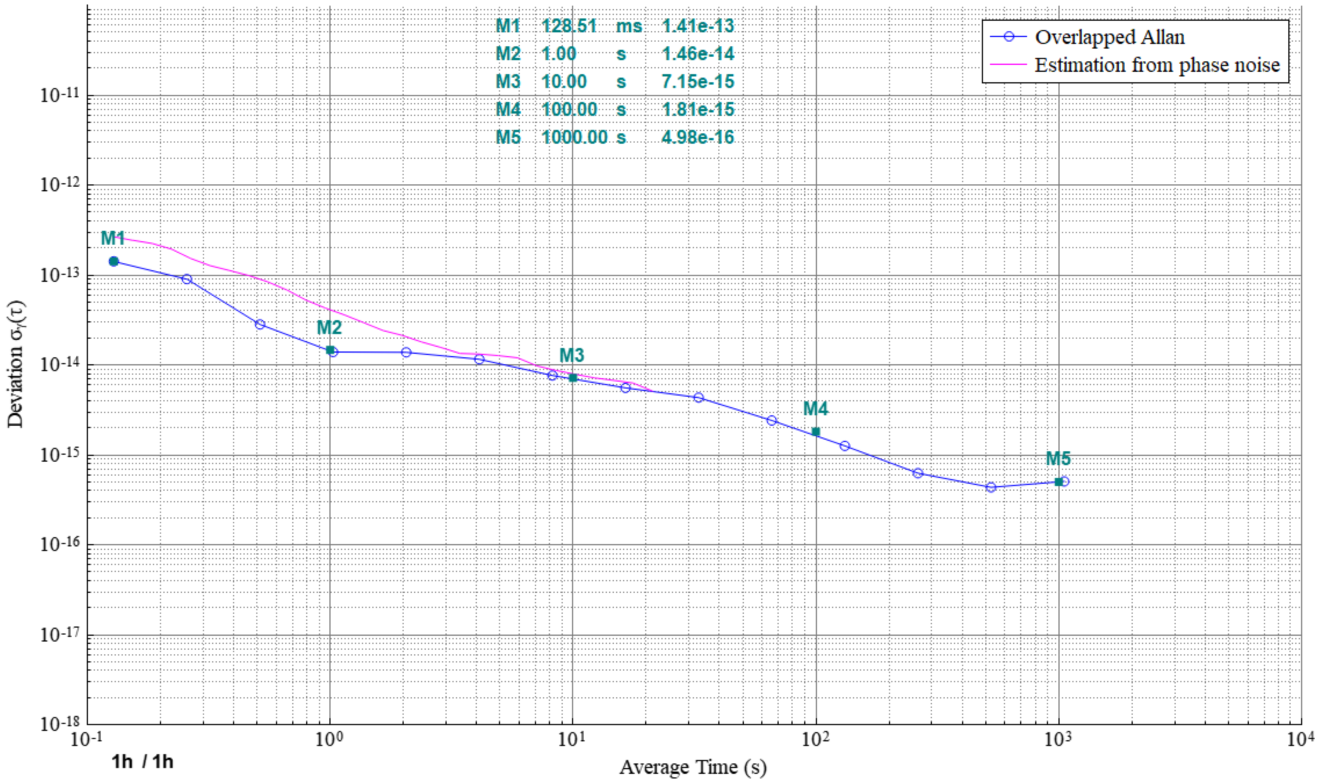
*100 MHz / **12H measurement time** Residual Overlapped Allan Deviation ENBW=5Hz*

Residual Allan Deviation ENBW = 5Hz	0.125	1	10	100	1k	10k
Typical results at 10 MHz	2.10^{-13}	3.10^{-14}	5.10^{-15}	1.10^{-15}	1.10^{-16}	1.10^{-16}



*10 MHz / **14H measurement time** Residual Overlapped Allan Deviation ENBW=5Hz*

Residual Allan cross Deviation ENBW = 5Hz	1	10	100	1k	10k
Typical results at 5 MHz	4.10^{-14}	8.10^{-15}	2.10^{-15}	5.10^{-16}	



*5 MHz / **60min measurement time** Residual Overlapped Allan cross variance Deviation ENBW=5Hz*

Internal references specifications

DNA F versions have two internal 400 MHz frequency references. They are used for the phase noise measurement with cross correlation mode.

Typical specifications are:

Frequency	400 MHz
Output Level	10 dBm
1 Hz offset phase noise	-85 dBc/Hz
10 Hz offset phase noise	-112 dBc/Hz
100 Hz offset phase noise	-120 dBc/Hz
1000 Hz offset phase noise	-147 dBc/Hz
10 kHz offset phase noise	-159 dBc/Hz
100 kHz offset phase noise	-161 dBc/Hz
1000 kHz offset phase noise	-163 dBc/Hz

General Information

Front panel information

Description	Supplemental information
RF Input	N type (female), 50 ohms
Reference Oscillator Input (L version) Reference Oscillator I/O (F version)	SMA type (female), 50 ohms SMA type (female), 50 ohms
Digitizer channel A to D Input	SMA type (female), 50 ohms

Rear panel information

Description	Supplemental information
RJ-45	Gigabit Ethernet
AC	100-240 VAC 50/60Hz 2A max
FAN	Exhaust

Analyzer environment and dimensions

Description	Supplemental information
Operating environment	
Temperature	+10 °C to +40 °Celsius
Humidity	RH 20% to 80% at wet bulb temp.<29 °C (non-condensing)
Non-operating storage environment	
Temperature	-10 °C to +60 °C
Humidity	RH 20% to 90% at wet bulb temp.<40 °C (non-condensing)
Vibration	0.5 G maximum, 5 Hz to 500 Hz
Instrument dimensions	19'' 4U
Weight (NET)	7 kg + options (L Version) 10 kg + options (F Version)

Display functions

Description	Supplemental information
Spectrum Window	10 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
Marker functions	20 independent markers
Frequency stability plots	In addition to a real-time measurement based on instantaneous fractional frequency values, the frequency stability is also estimated from the phase noise trace.
Fractional Frequency Plot	A fractional frequency plot versus time can be added. This plot can help to see if the DUT has some transitory frequency instabilities.
Special Processing	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® 10 OS with a Touch Screen The user can use keyboard, the mouse or any combination of the two.
File Management	The DNA uses *.csv format to store and load traces.
Limit-line test	Any limit-line test can be done and load using the *.csv format.
Raw Data (Option)	Raw phase data (radian) at the output of the four channels can be optionally recorded into disk for post processing. It is noted that the phase values have been already unwrapped.
Internal Data Storage	Internal Removable SSD drive (option) that contains Operating System, DNA Operating Software and calibration tables This HDD/SSD drive may be used to store measurements and configuration files
Removable Internal Data Storage (Option)	Internal Removable SSD drive (option) that contains Operating System, DNA Operating Software and calibration tables This HDD/SSD drive may be used to store measurements and configuration files
External Data Storage	USB thumb drives may be connected to any USB port of the DNA
Printing	Any Windows® OS compatible printer may be used.
Automation	Remote control of the DNA can be done over the TCP/IP. SCPI format

Ordering information's

DNA 100M-L	2 MHz to 100 MHz Digital Phase Noise and Frequency Analyzer without internal reference
DNA 100M-F	2 MHz to 100 MHz Digital Phase Noise and Frequency Analyzer with internal references
DNA 400M-L	2 MHz to 400 MHz Digital Phase Noise and Frequency Analyzer without internal reference
DNA 400M-F	2 MHz to 400 MHz Digital Phase Noise and Frequency with internal references
400 UPG	100 MHz to 400 MHz upgrade for DNA 100 versions
Option R	DNA Rack Mount

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