R&S®FSPN
PHASE NOISE ANALYZER AND VCO TESTER

Unrivaled sensitivity meets high speed

3 year warranty

Product Brochure
Version 03.00

ROHDE&SCHWARZ
Make ideas real

AT A GLANCE

The R&S®FSPN phase noise analyzer and VCO tester features very high sensitivity and metrological accuracy and provides highest reliability. It measures phase noise on highly stable sources like synthesizers, VCOs, OCXOs and DROs found in radar and satellite applications.

The R&S®FSPN phase noise analyzer and VCO tester has everything needed to keep up with demanding measurements from lab to production.

With its extremely high measurement speed and easy usability, it is the perfect instrument for efficient phase noise analysis tasks both in R&D and on production lines.

Thanks to its low-noise internal local oscillators, the R&S®FSPN measures all commercially available synthesizers and oscillators without any additional options.

Front view of the R&S®FSPN.

KEY FACTS

- Frequency range from 1 MHz to 8 GHz/26.5 GHz
- Very high sensitivity for phase noise measurements thanks to dual synthesizers and cross-correlation included in the base unit, typ. –163 dBc (1 Hz) at 1 GHz carrier frequency and 10 kHz offset
- Extremely low-noise internal DC sources for automatic VCO characterization
- High measurement speed with hardware-implemented real-time cross-correlation
- Simultaneous measurement of phase noise and amplitude noise

Rear view of the R&S®FSPN.

BENEFITS AND KEY FEATURES

Measurement speed taken to its limit

- Save time and multiply your measurement throughput in production
- Speed up the development of your devices

Phase noise measurements with highest sensitivity

- Cross-correlation for improved phase noise sensitivity
- Display multiple measurements in parallel

Fastest VCO characterization

- Harmonics suppression measurement
- Enhanced tuning voltage capabilities

Transient response analysis

- Up to 8 GHz wideband analysis for frequency and phase measurements in time domain
- Trigger capabilities for reproduceable measurements on phase or frequency deviation

MEASUREMENT SPEED TAKEN TO ITS LIMIT

Save time and multiply measurement throughput in production

Speed is a crucial factor, especially in manufacturing applications. With an extremely good phase noise sensitivity, the R&S®FSPN requires a hundred times fewer correlations compared to other solutions on the market to measure highly sensitive oscillators such as DROs and OCXOs. This saves measurement time and multiplies measurement throughput, two of the core parameters for production lines.

This is possible due to the state-of-the-art hardware built into the instrument: a fast processor and FPGAs which enable instantaneous data processing and analysis. The built-in high-quality internal sources shorten the number of correlations needed for phase noise measurements.

Speed up the development of your devices

Signal sources can be developed and optimized faster using an instrument that delivers results in a short measurement time. The R&S®FSPN takes just a few seconds to display the phase noise trace of high-end sources like OCXOs or DROs.

PHASE NOISE MEASUREMENTS WITH HIGHEST SENSITIVITY

Cross-correlation for improved phase noise sensitivity

The R&S®FSPN base unit includes cross-correlation functionality to measure sources that have very low phase noise, even lower than the phase noise of the internal high-end sources. The improvement that can be expected when using this functionality is as follows:

$$\Delta L = 5 \cdot log(n)$$

- ΔL: improvement in phase noise sensitivity through cross-correlation (in dB)
- n: number of correlations/averages

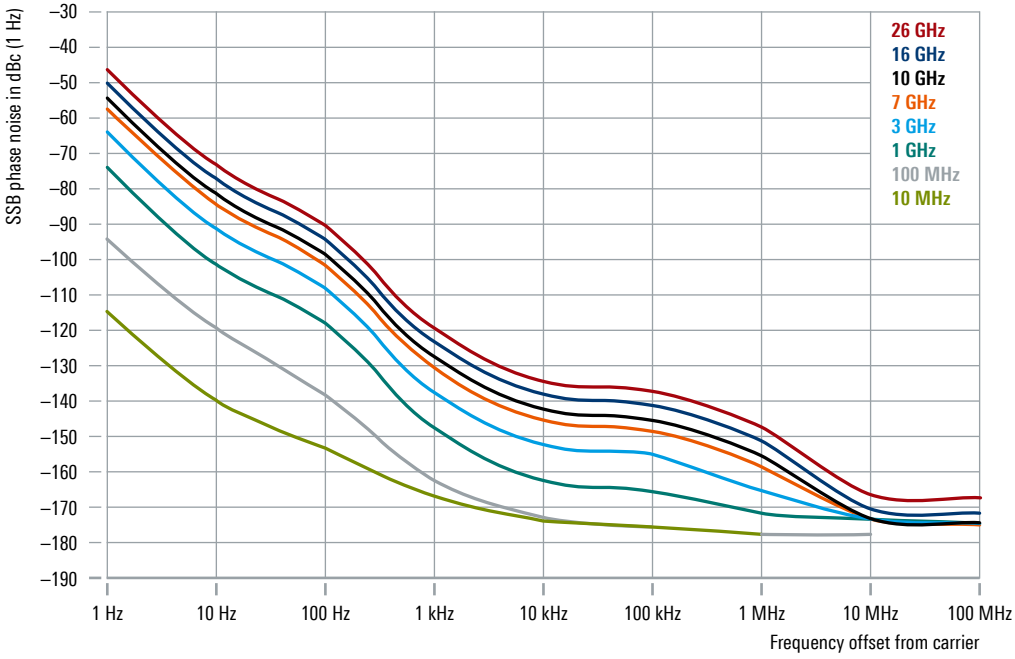
Using the R&S®FSPN, just a few correlations are needed to measure a very good quality oscillator. This shortens measurement time which is essential in production environments. As an example, increasing the number of correlations by a factor of 10 lowers the inherent phase noise of the R&S®FSPN by 5 dB.

Display multiple measurements in parallel

The R&S®FSPN can measure amplitude noise and phase noise simultaneously, displaying the results of both measurements in a common diagram or in separate windows.

Sometimes it is difficult to know in advance how many correlations are necessary to measure a signal source. A gray area below the trace helps to estimate the achievable sensitivity level and cross-correlation gain for the selected number of correlations.

Typical phase noise sensitivity (correlation factor = 1, signal level = 10 dBm)



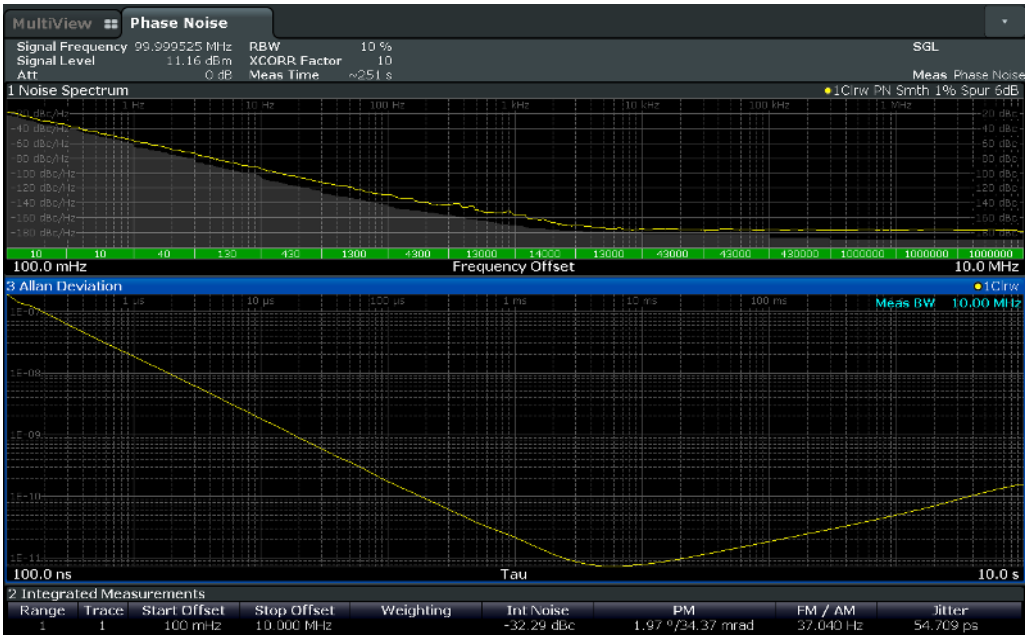
Measurement of Allan variance

To characterize the long-term frequency stability of oscillators, the frequency is measured in the time domain at fixed time intervals and the deviation of the measurement is calculated. This is known as the Allan variance. The R&S®FSPN calculates the Allan variance from the phase noise measurement, where cross-correlation can be applied and spurs can be suppressed.

This parameter is typically plotted over time, unlike the phase noise, which is displayed in the frequency domain. The Allan variance or deviation is especially important for characterizing highly stable sources such as those used in satellite navigation systems.

The R&S®FSPN can measure phase noise and amplitude noise simultaneousously.
The gray area below the traces shows the correlation gain of the R&S®FSPN.

The R&S®FSPN calculates the Allan variance based on the phase noise measurement (upper window).
For example, an offset range of 100 mHz to 10 MHz corresponds to a time-domain display of 100 ns to 10 s.



FASTEST VCO CHARACTERIZATION

Thanks to its extremely low-noise internal DC sources, the R&S®FSPN can measure the phase noise of voltage-controlled oscillators (VCO) at various tuning and supply voltages. VCO characterization varying the tuning voltage or the supply voltage can be completed extremely fast. The following parameters are delivered instantaneously:

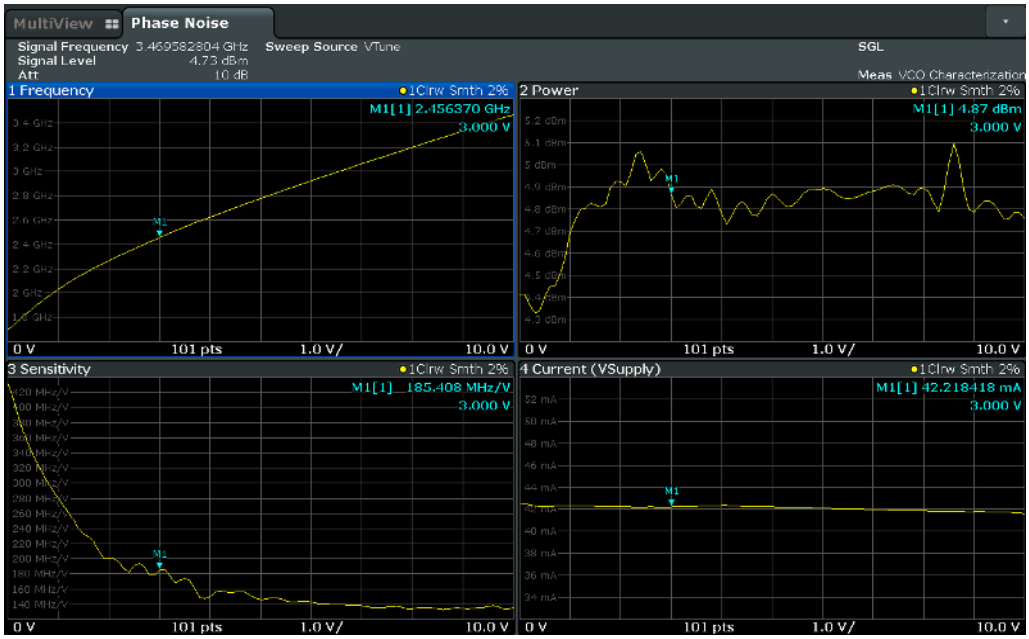
- Frequency versus voltage
- Tuning slope versus voltage
- Output power versus voltage
- Current drain versus voltage
- Output power versus frequency

Specifications for internal DC source	
Supply voltage	0 V to 16 V
Maximum current load	2000 mA
Tuning voltage	–10 V to +28 V
Maximum current load	20 mA

Harmonics suppression measurement

One problem of many VCO manufacturers is trying to suppress harmonics that can cause interference in the system. The R&S®FSPN measures the power of the VCO's higher harmonics relative to the tuning voltage.

A typical VCO measurement. Key parameters such as frequency, power, sensitivity (tuning slope) and current consumption are measured relative to the tuning voltage.

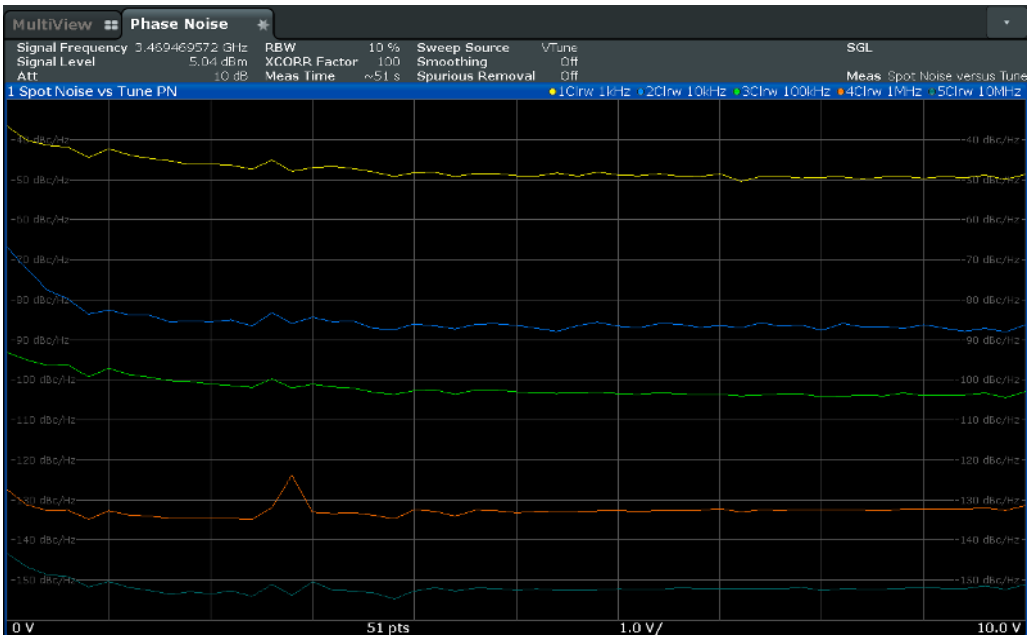


Enhanced tuning voltage capabilities

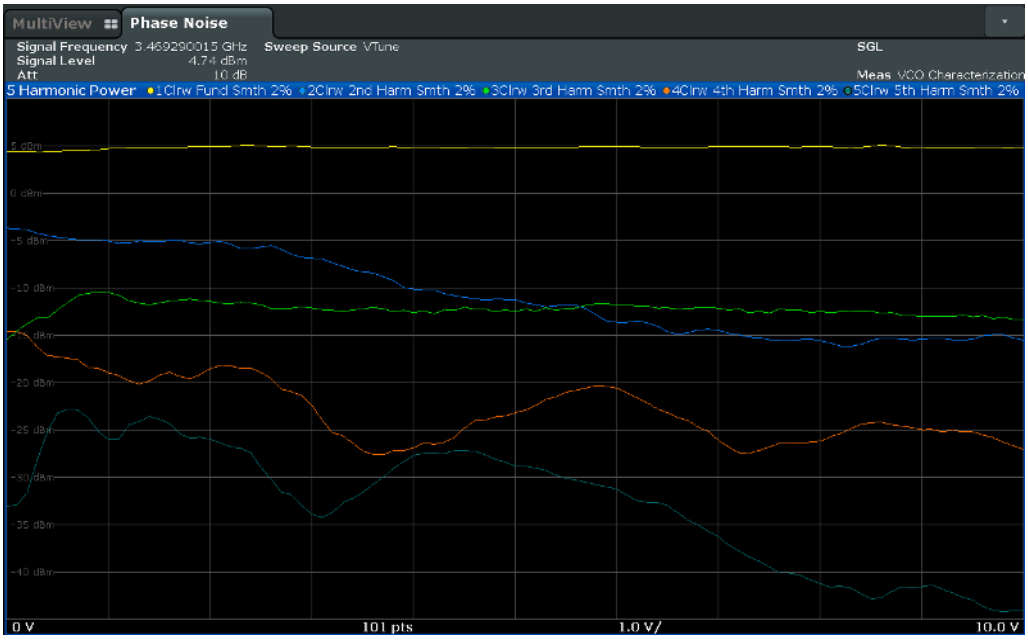
Verifying if the VCO's phase noise depends on the frequency as expected, or whether additional noise is caused by interference at certain frequencies are typical tasks when developing those components. This can only be seen if phase noise is measured over the whole tuning voltage range.

In seconds, the R&S®FSPN can automatically display the phase noise at various offset frequencies relative to the tuning voltage.

VCO's phase noise at offset frequencies of 1 kHz, 10 kHz, 100 kHz, 1 MHz and 10 MHz relative to the tuning voltages.



Display of higher harmonics power compared to the fundamental (yellow line) relative to the tuning voltage.



TRANSIENT RESPONSE ANALYSIS

Up to 8 GHz wideband analysis for frequency and phase measurements in time domain

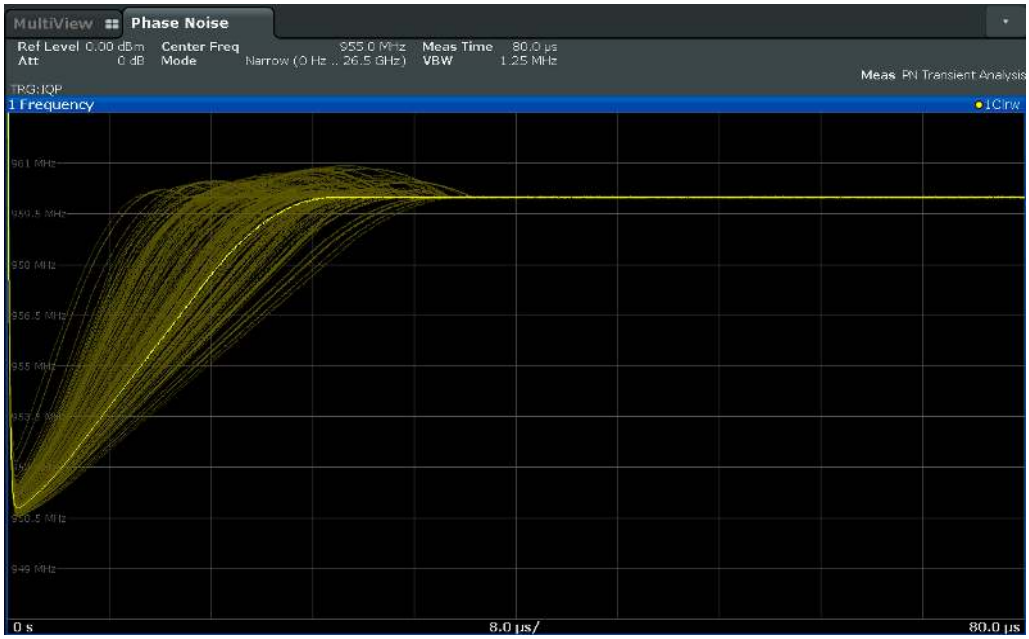
Detailed characterization of synthesizers and signal sources is essential for designers of frequency agile systems. This includes the wideband frequency and phase measurements in the time domain (transient analysis).

The R&S®FSPN offers up to 8 GHz bandwidth for detailed characterization of synthesizers, measuring the settling times after a frequency hop, ramps, switching times etc.

For narrowband characterization, the R&S®FSPN offers narrowband analysis down to 40 MHz, e.g. to analyze the transient response of PLLs in detail.

The display offers a persistence mode of all traces, which makes it easy to estimate how strongly the parameters scatter or whether there are any outliers.

Transient response of a synthesizer in persistence mode. The bright yellow trace is the current measurement, and the dull yellow traces show all previous measurements.



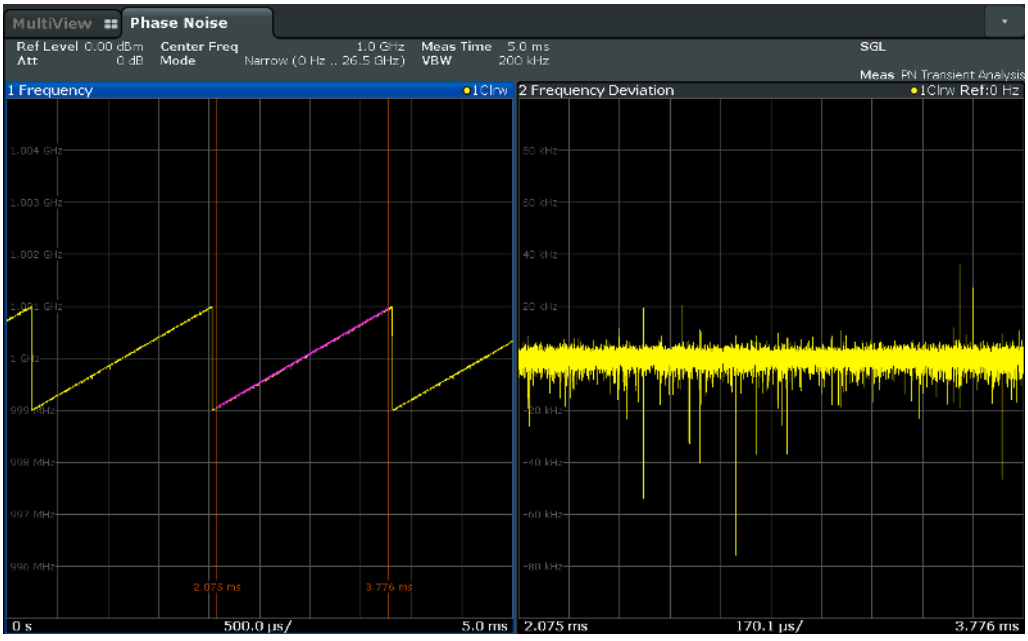
Trigger capabilities for reproduceable measurements on phase or frequency deviation

For a detailed analysis of a synthesizer's transient response on phase or frequency deviation, the user can utilize the trigger functionality to obtain comparable and reproducible measurement results.

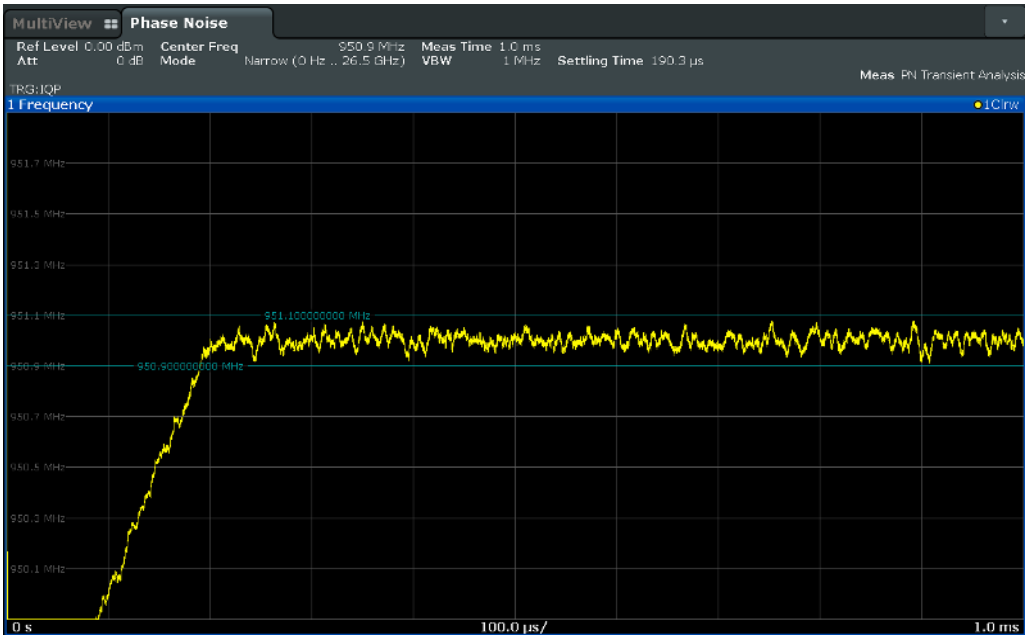
Different trigger events are possible:

- External trigger
- Power trigger
- Triggering on frequency
- Triggering on phase deviation
- Triggering on specific frequency hops

After a trigger event, the R&S®FSPN automatically measures the settling time that passes until the frequency of the synthesizer stays within a certain tolerance range for the frequency.



In the phase noise transient analysis, the frequency deviation can be analyzed in user-specified time intervals. The measured frequency deviation (right) is automatically evaluated against the linear interpolation of the frequency as visualized in the frequency plot (left).



Settling time until the frequency of the synthesizer stays within a certain tolerance range.

SPECIFICATIONS IN BRIEF

Base unit		
Frequency range, RF input		
Phase noise, amplitude noise measurement	R&S®FSPN8	1 MHz to 8 GHz
	R&S®FSPN26	1 MHz to 26.5 GHz
Phase noise measurement		
Measurement results		SSB phase noise, spurious signals, integrated RMS phase deviation, residual FM, AM noise, time jitter, RMS jitter, periodic jitter
Offset frequency range	carrier frequency ≤ (maximum input frequency – 1 GHz)	1 µHz to (maximum input frequency – carrier frequency)
	carrier frequency ≥ (maximum input frequency – 1 GHz)	1 µHz to 1 GHz
Amplitude noise measurement		
Offset frequency range	input signal ≤ 100 MHz	1 µHz to 40 % of carrier frequency
	input signal > 100 MHz	1 µHz to 40 MHz

Phase noise sensitivity in dBc (1 Hz) [1)]

RF input frequency	Offset frequency from carrier							
	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz
10 MHz	(–115)	(–140)	–140 (–146)	–158 (–164)	–170 (–176)	–170 (–176)	–170 (–176)	
100 MHz	(–95)	(–120)	–133 (–139)	–157 (–163)	–167 (–173)	–170 (–176)	–172 (–178)	–172 (–178)
1 GHz	(–75)	(–102)	–113 (–119)	–142 (–148)	–157 (–163)	–160 (–166)	–167 (–173)	–168 (–174)
3 GHz	(–65)	(–92)	–103 (–109)	–132 (–138)	–147 (–153)	–150 (–156)	–160 (–166)	–168 (–174)
7 GHz	(–58)	(–85)	–96 (–102)	–125 (–131)	–140 (–146)	–143 (–149)	–153 (–159)	–168 (–174)
10 GHz	(–55)	(–82)	–93 (–99)	–122 (–128)	–137 (–143)	–140 (–146)	–150 (–156)	–168 (–174)
16 GHz	(–51)	(–78)	–89 (–95)	–118 (–124)	–133 (–139)	–136 (–142)	–146 (–152)	–165 (–171)
26 GHz	(–47)	(–74)	–85 (–91)	–114 (–120)	–129 (–135)	–132 (–138)	–142 (–148)	–161 (–167)

[1)] Start offset = 1 Hz, correlation factor = 1, numbers in brackets are typical values in dBc (1 Hz).

AM noise sensitivity in dBc (1 Hz)

RF input frequency	Offset frequency from carrier								
	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz	≥ 30 MHz
1 GHz	–108	–123	–138	–153	–151	–171	–171	–171	–171
10 GHz	–103	–118	–133	–148	–158	–166	–171	–171	–171

Always up-to-date

Update the firmware using a USB storage device or via the LAN port.
Simply download the free firmware updates from the internet at www.rohde-schwarz.com.

ORDERING INFORMATION

Designation	Type	Order No.
Phase noise analyzer and VCO tester, 1 MHz to 8 GHz	R&S®FSPN8	1322.8003.06
Phase noise analyzer and VCO tester, 1 MHz to 26.5 GHz	R&S®FSPN26	1322.8003.24

Warranty		
Base unit		3 years
All other items [1]		1 year
Service options		
Extended warranty, one year	R&S®WE1	Please contact your local Rohde&Schwarz sales office.
Extended warranty, two years	R&S®WE2	
Extended warranty with calibration coverage, one year	R&S®CW1	
Extended warranty with calibration coverage, two years	R&S®CW2	
Extended warranty with accredited calibration coverage, one year	R&S®AW1	
Extended warranty with accredited calibration coverage, two years	R&S®AW2	

[1] For options installed, the remaining base unit warranty applies if longer than 1 year. Exception: all batteries have a 1 year warranty.

Service that adds value

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- Customized and flexible
- Uncompromising quality
- Long-term dependability

Rohde&Schwarz

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Sustainable product design

- Environmental compatibility and eco-footprint
- Energy efficiency and low emissions
- Longevity and optimized total cost of ownership

Certified Quality Management
ISO 9001

Certified Environmental Management
ISO 14001

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R&S®FSPN Phase Noise Analyzer and VCO Tester
Data without tolerance limits is not binding | Subject to change

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