

R&S®FSWP

Phase Noise Analyzer and VCO Tester

High-end analysis of signal sources and components



R&S®FSWP Phase Noise Analyzer and VCO Tester At a glance

The R&S®FSWP phase noise analyzer and VCO tester combines extremely low-noise internal sources and cross-correlation, delivering extremely high sensitivity for phase noise measurements. As a result, it takes just seconds to measure even highly stable sources such as those found in radar applications. Additional options such as pulsed signal measurements, residual phase noise (including pulsed) characterization and integrated high-end signal and spectrum analysis make the analyzer a unique test instrument.



The R&S®FSWP phase noise analyzer and VCO tester is the optimal test solution for radar applications and when developing and manufacturing synthesizers, OCXOs, DROs and VCOs. It can be easily configured to meet the required application. The instrument's low-noise internal local oscillator makes it possible to measure most commercially available synthesizers and oscillators without any additional options.

For high-end applications, the R&S®FSWP can be equipped with a second receive path, which enables cross-correlation and, depending on the number of correlations used, increases sensitivity – by up to 25 dB. The analyzer's excellent internal sources and largely digital architecture make it faster than test systems that digitize the signal after the phase detector.

In addition, the R&S®FSWP measures the phase noise of pulsed sources and the residual phase noise of individual (also pulsed) components at the push of a button. It can use the internal source as well as an external source if users possess e.g. a very well suited oscillator. This was previously only possible with costly and complex systems using external sources, splitters and phase shifters.

The R&S®FSWP not only measures phase noise, it is also a full-featured signal and spectrum analyzer. A spectrum analyzer helps users determine, for example, if the desired signal is available.

The R&S®FSWP is an all-in-one solution, so users can easily switch between various measurement channels. One glance at the spectrum and then on with the phase noise measurements – no problem.

Key facts

- Frequency range from 1 MHz to 8/26.5/50 GHz, and up to 500 GHz with external harmonic mixers
- High sensitivity for phase noise measurements thanks to cross-correlation and extremely low-noise internal reference sources
 - typ. –172 dBc (1 Hz) at 1 GHz carrier frequency and 10 kHz offset
 - typ. –158 dBc (1 Hz) at 10 GHz carrier frequency and 10 kHz offset
- Simultaneous measurement of amplitude noise and phase noise
- Measurement of phase noise on pulsed sources at the push of a button
- Internal source for measuring residual phase noise, including on pulsed signals
- Signal and spectrum analyzer and phase noise analyzer in a single box
 - High-end signal and spectrum analyzer, 10 Hz to 8/26.5/50 GHz
 - Wide dynamic range thanks to low displayed average noise level (DANL) of –156 dBm (1 Hz) (without noise cancellation) and high TOI of typ. 25 dBm
 - 320 MHz signal analysis bandwidth
 - Total measurement uncertainty: < 0.2 dB up to 3.6 GHz, < 0.3 dB up to 8 GHz
 - Touchscreen operation
 - Large 12.1" display for simultaneous viewing of multiple measurement windows
 - Various measurement applications can be run and displayed in parallel
- High measurement speed
- Low-noise internal DC sources for VCO characterization
- Automatic VCO characterization
- Analysis of up to 8 GHz wide frequency hops (transients)

R&S®FSWP Phase Noise Analyzer and VCO Tester

Benefits and key features

Measuring phase and amplitude noise with high sensitivity

- ▮ Extremely low phase noise from internal sources
- ▮ Cross-correlation to improve phase noise sensitivity
- ▮ Accuracy of amplitude noise measurements significantly higher than with diode detectors
- ▮ Display of improvement in sensitivity through cross-correlation
- ▮ Up to 300 MHz frequency offset for phase noise measurements, up to 1 GHz for pure noise measurement

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Phase noise measurements on pulsed sources at the push of a button

- ▮ Simple test setup
- ▮ High sensitivity despite desensitization
- ▮ Automatic pulse parameter measurement

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Internal source for measuring residual phase noise, also on pulsed signals

- ▮ Simple and fast measurement
- ▮ Higher sensitivity through cross-correlation
- ▮ Residual phase noise on pulsed signals
- ▮ Additional inputs for an external source

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Signal and spectrum analyzer and phase noise analyzer up to 50 GHz in a single box

- ▮ Simple, cost-optimized test setup
- ▮ A worthwhile investment
- ▮ High-end signal and spectrum analyzer

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High measurement speed

- ▮ Perfect for production applications
- ▮ Faster development

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Low-noise internal DC sources for VCO characterization

- ▮ Complete VCO characterization
- ▮ Measuring higher harmonics
- ▮ Phase noise relative to the tuning voltage

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Measuring transients or frequency hops (transient analysis)

- ▮ Up to 8 GHz bandwidth for frequency and phase analysis
- ▮ Triggering on phase or frequency deviation

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Measuring phase and amplitude noise with high sensitivity

Extremely low phase noise from internal sources

Until now, high-end phase noise measurement systems required costly external signal generators as reference sources. The quality of these generators or external sources limited the sensitivity of phase noise measurements. The R&S®FSWP does not require external reference sources. Its internal local oscillator surpasses almost any generator available on the market when it comes to phase noise performance. The table shows typical values for the internal source at 1 GHz. If even better sensitivity is required, cross-correlation can improve the sensitivity by up to 25 dB.

Cross-correlation to improve phase noise sensitivity

To measure sources that have extremely low phase noise, the R&S®FSWP can be equipped with a second local oscillator (R&S®FSWP-B60 or R&S®FSWP-B61 option) for cross-correlation. This improves the sensitivity by as much as 25 dB, depending on the number of correlations used. The improvement that can be expected 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

Increasing the number of correlations by a factor of 10 lowers the phase noise of the R&S®FSWP by 5 dB. Thanks to the analyzer's low-noise internal sources, often only a few correlations are needed to measure a high-quality oscillator. Users receive reliable results faster, which shortens development and manufacturing times.

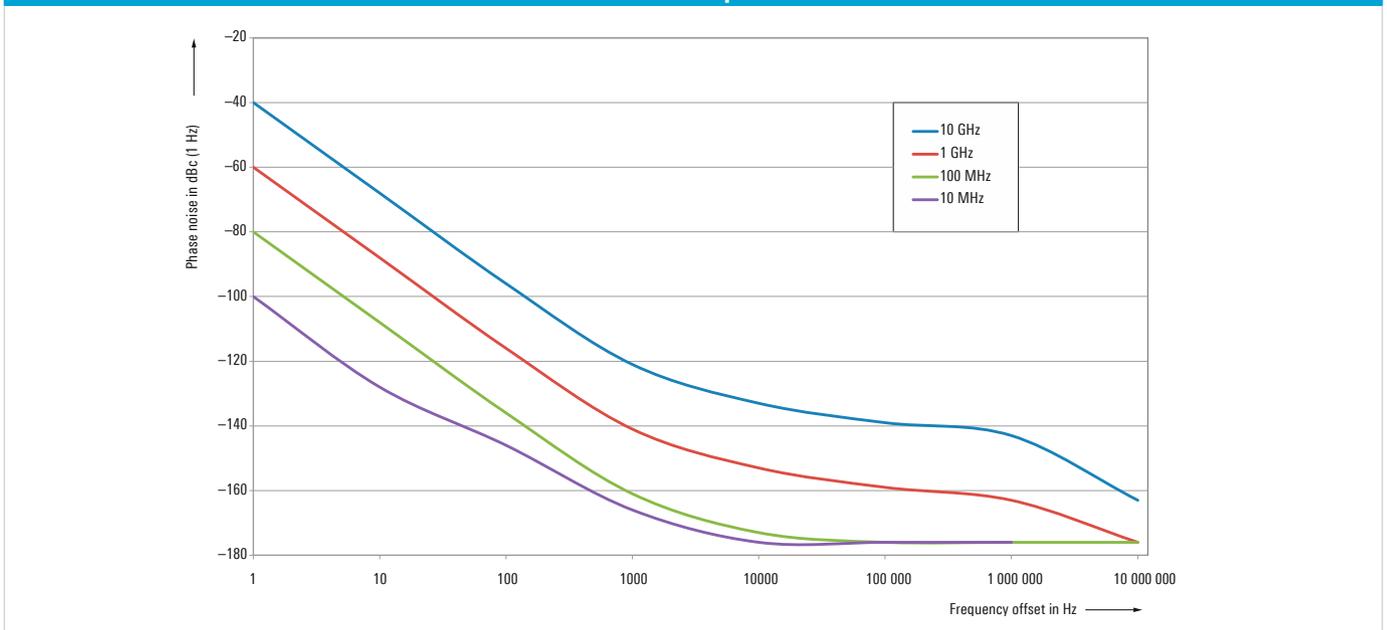
Accuracy of amplitude noise measurements significantly higher than with diode detectors

The R&S®FSWP measures amplitude noise as well as phase noise. The results of both measurements can be simultaneously displayed in a diagram or in separate windows. The R&S®FSWP high-precision sources, in combination with cross-correlation, surpass the accuracy of diode detector based measurements, with a sensitivity up to 20 dB better.

Typical phase noise values of the internal local oscillator

	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz
1 GHz	-60 dBc	-88 dBc	-116 dBc	-141 dBc	-153 dBc	-159 dBc	-163 dBc	-176 dBc

Phase noise of the internal local oscillator at various frequencies



Display of improvement in sensitivity through cross-correlation

Users often do not know how many correlations are needed to measure a signal source. A gray area below the trace therefore shows the achievable level of sensitivity for a particular measurement for the selected number of correlations. The correlation process can be aborted automatically if adding more correlations fails to improve the sensitivity.

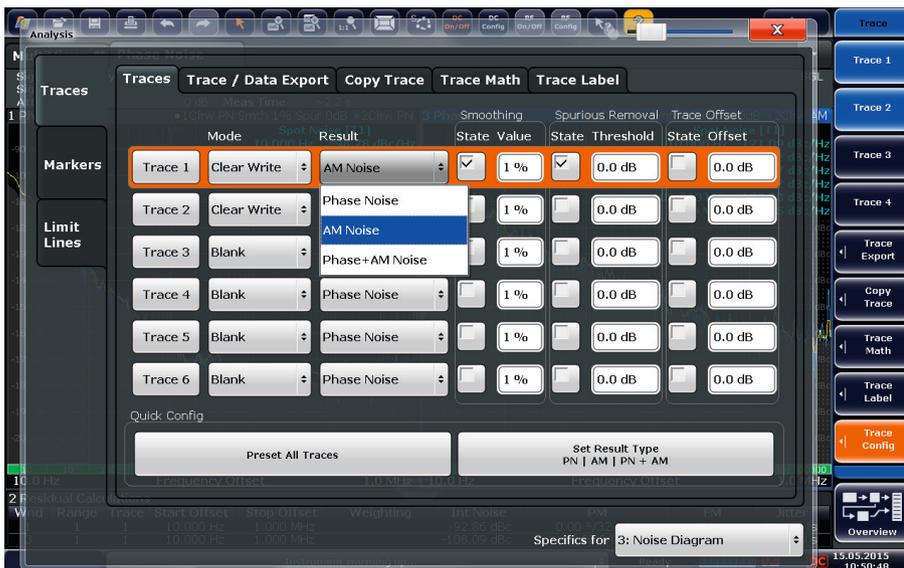
Users can easily adapt the instrument to their specific requirements. Many applications (e.g. manufacturing) do not require high sensitivity. A second local oscillator or the signal and spectrum analyzer functionality are not always required. These functions can easily be added whenever measurement requirements increase, e.g. to measure highly accurate crystal oscillators.

Up to 300 MHz frequency offset for phase noise measurements, up to 1 GHz for pure noise measurement

The R&S®FSWP permits an offset frequency of 10 mHz to 300 MHz for phase noise measurements and even up to 1 GHz for amplitude noise and phase noise together. Despite the bandwidth, users need not worry about dynamic range restrictions. Thanks to the fast frequency processing capabilities of the R&S®FSWP, it covers the measurement range incrementally.



The R&S®FSWP can measure phase noise and amplitude noise simultaneously. The results can be displayed in separate windows or together in one window. (gray area: improved correlation of the R&S®FSWP, green trace: amplitude noise, yellow trace: phase noise)



In the trace menu, users can assign traces to phase noise and/or amplitude noise measurements. They can also select whether they want spurious removed or traces smoothed.

Phase noise measurements on pulsed sources at the push of a button

Simple test setup

Until now, measuring the phase noise of pulsed sources such as used in radar applications required extremely costly and complex systems. Accurate pulse parameter information and a great deal of patience were needed to achieve stable measurements.

When equipped with the R&S®FSWP-K4 option, the R&S®FSWP carries out these measurements at the push of a button. The R&S®FSWP records the signal and calculates all pulse parameters. It then demodulates the signal and displays the phase noise and amplitude noise. Stable measurements take almost no time.

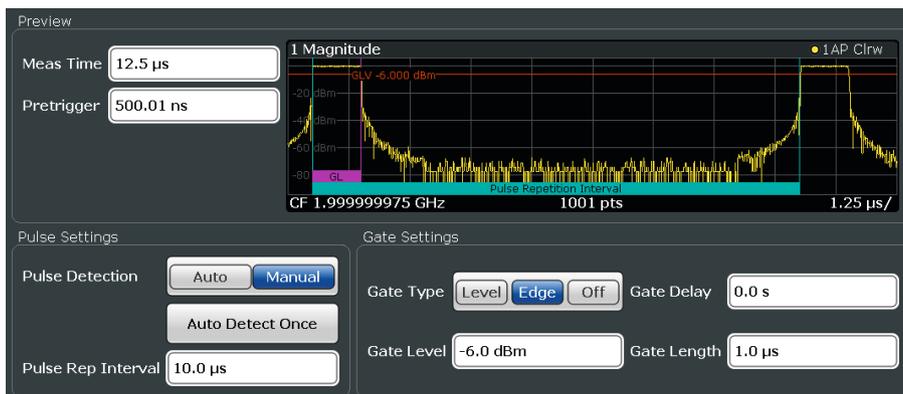
All results are available at the push of a button, enabling users to focus on optimizing their circuit design.

High sensitivity despite desensitization

The R&S®FSWP offers cross-correlation and the option to define a test port (gating) for pulsed source measurements, thereby compensating for desensitization caused by lower average signal power due to long pulse off times. This enables the R&S®FSWP to achieve a large dynamic range even for phase noise measurements on pulsed signals.

Automatic pulse parameter measurement

Similar to a dedicated pulse measurement application (R&S®FSWP-K6/R&S®FSWP-K6), the R&S®FSWP with R&S®FSWP-K4 automatically determines all pulse parameters (e.g. pulse repetition rate and pulse width) that are relevant to measuring the phase noise of pulsed sources. Users do not have to worry about correctly setting these parameters. However, they can define a gate, for example to suppress transients. It is no longer necessary to carry out subsequent corrections, shift the trace or manually limit the available offset range.



The instrument measures pulse parameters automatically; the user can define the gate.



Measuring a pulsed signal in the time and frequency domain with the spectrum analyzer function.

The upper left window shows the phase noise of the pulsed source up to an offset equal to one-half of the pulse repetition rate. The amplitude noise can be seen in the upper right window.

Internal source for measuring residual phase noise, also on pulsed signals

Simple and fast measurement

The R&S®FSWP offers an internal signal source (R&S®FSW-B64 option) for measuring residual phase noise. This option provides users with additional inputs to perform this measurement using their own external sources, for example to compare the results with those of other test setups. Amplifiers, doublers, splitters and other two-port components cause residual phase noise even though they do not generate a signal. When developing high-end radar applications, for instance, it is necessary to know how much phase noise these individual components as well as the local oscillator are adding to the signal path. Only then is it possible to develop extremely low-noise transmitters.

Previously, complex setups with a high-quality external signal source, splitters and the appropriate phase shifters were required to measure this parameter. The measurement was highly vulnerable to electromagnetic disturbances and vibration. With the R&S®FSWP, users simply connect the internal signal source to the input of the DUT and the DUT output back to the R&S®FSWP. The residual phase noise of the DUT is then available at the push of a button.

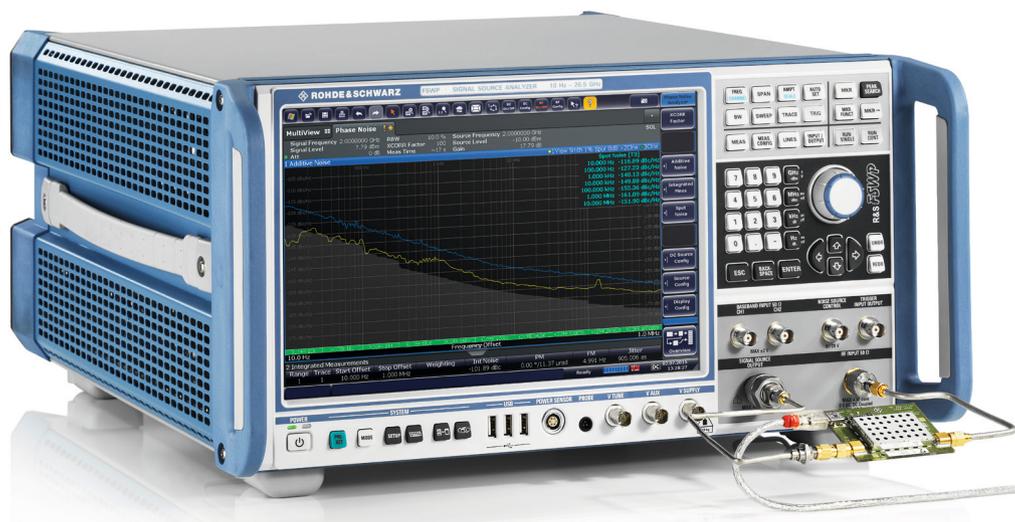
Higher sensitivity through cross-correlation

The R&S®FSWP uses cross-correlation for this operating mode as well. There are two paths for converting the measured signal to the baseband to suppress the residual phase noise of the internal frequency converters. This enables the analyzer to deliver significantly better sensitivity than PLL-based measurements and allows users to develop even lower-noise transmitters, for example to improve the location and time resolution of radar systems.

Residual phase noise on pulsed signals

Equipped with the R&S®FSWP-K4 option, the R&S®FSWP can measure residual phase noise on pulsed signals.

To characterize and optimize components for a radar transmitter, for example, these components have to be tested using pulsed signals under real-world conditions. Amplifiers operating in pulsed mode can behave much differently than in continuous wave mode. This measurement was previously possible only with extremely complex test setups, but the R&S®FSWP performs it at the push of a button.



Typical setup for measuring the residual phase noise of an amplifier and displaying the resulting trace.

Signal and spectrum analyzer and phase noise analyzer up to 50 GHz in a single box

Simple, cost-optimized test setup

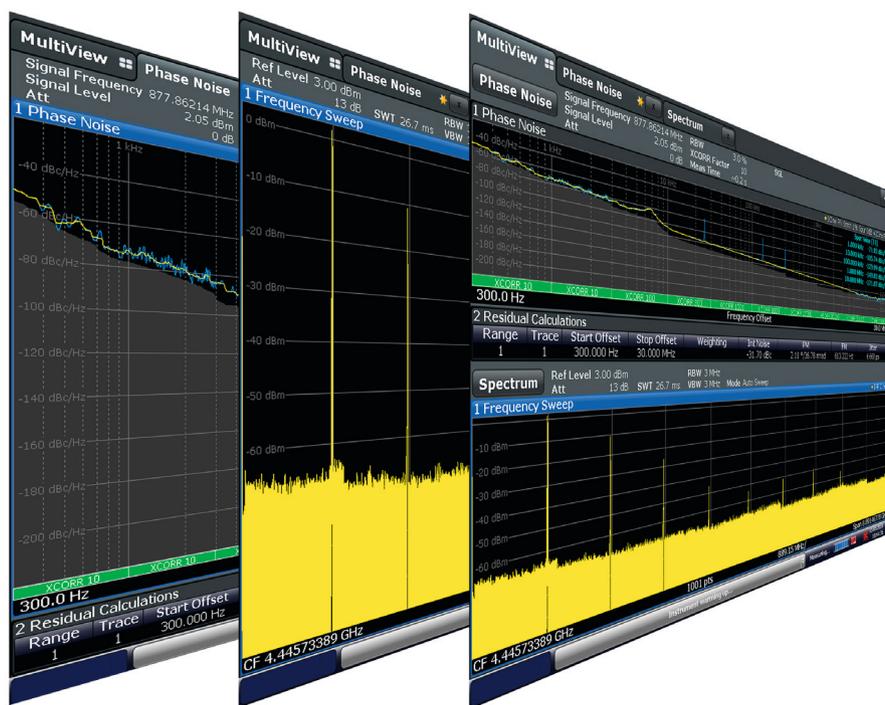
Most phase noise analyzers record noise after the phase detector and then convert it to the frequency domain. The carrier of the signal under test is no longer visible. Users do not know if they are measuring on the right frequency or on an unwanted spurious signal. They do not know if the measurement result is incorrect because the carrier is unstable or drifting too fast or if the difference between the measured signal and the reference source has grown too large. A spectrum analyzer is needed to determine this and also to examine harmonics and spurious emissions.

The R&S®FSWP phase noise analyzer can easily be upgraded to include signal and spectrum analyzer functionality by adding the R&S®FSWP-B1 option. Users can monitor the signal in a different measurement channel and quickly and effectively optimize and start their measurements without additional complicated cabling. This feature is also beneficial in automated test systems.

A worthwhile investment

Often, there are not enough lab applications to justify purchasing just a phase noise analyzer. Adding signal and spectrum analyzer functionality to the instrument ensures extremely good utilization, as it can be used for all the spectral measurements that are performed much more frequently in the lab. Instrument downtime is practically eliminated – a safe investment.

Manufacturers of automatic test systems also save space and money since they do not have to purchase an additional spectrum analyzer.



Users can switch between the spectrum analyzer and phase noise analyzer measurement channels or view both simultaneously.

High-end signal and spectrum analyzer

The signal and spectrum analyzer is based on the R&S®FSW with its unique RF performance and high sensitivity. The analyzer's low phase noise enables users to precisely analyze modulation, measure the power of adjacent channels with high dynamic range and measure spurious emissions, even very close to the carrier. The internal preamplifier lowers the displayed average noise level (DANL) to below -165 dBm (1 Hz). Additional noise cancellation brings the DANL close to the theoretical limit of -174 dBm (1 Hz). Spurious emission measurement in particular is extremely fast, since the R&S®FSWP measures with a higher resolution bandwidth than less sensitive spectrum analyzers.

A high third-order intercept (TOI) of typically 25 dBm provides a wide dynamic range, allowing users to measure small input signals in the presence of large input signals and to determine adjacent channel rejection for wideband modulated signals.

When used as a signal analyzer (R&S®FSWP-B1 option), the R&S®FSWP uses an analysis bandwidth of up to 320 MHz (R&S®FSWP-B320 option) and offers internal, I/Q data based options for signal analysis. This makes it possible, for example, to analyze pulses automatically (R&S®FSWP-K6 option). The R&S®FSWP records the data across a wide band and calculates all important pulse parameters such as pulse width, rise times and pulse repetition rate at the push of a button.

Digitally modulated signals can be evaluated using the internal vector signal analysis function (R&S®FSWP-K70 option). The R&S®FSWP-K7 option is available for analog-modulated signals. Users can also upload the I/Q data to a computer and perform their own analyses.

Key features

- Wide dynamic range thanks to a low noise level of -156 dBm (1 Hz) (without noise cancellation and preamplifier) and high TOI of typ. 25 dBm
- Total measurement uncertainty of < 0.2 dB up to 3.6 GHz, < 0.3 dB up to 8 GHz
- Phase noise of -140 dBc (1 Hz) at 1 GHz (100 kHz offset)
- 320 MHz signal analysis bandwidth
- Optional internal measurement applications for
 - Pulse measurements (R&S®FSWP-K6)
 - Vector signal analysis, for analyzing digitally modulated single carriers (R&S®FSWP-K70)
 - Modulation analysis of analog-modulated (AM, FM, ϕ M) single carriers (R&S®FSWP-K7)
 - Noise figure measurements (R&S®FSWP-K30)



Vector signal analysis, pulsed signal analysis, measurement of higher harmonics, sensitive phase noise measurements. The R&S®FSWP does it all. It switches easily between measurement channels and displays results simultaneously.

High measurement speed

Perfect for production applications

The combination of a fast processor and FPGAs in the R&S®FSWP phase noise analyzer enables immediate data processing. Measurement time is determined solely by the physically required time (data recording). Signal demodulation and correlation of the various measurement sequences take no additional time. High-quality internal sources mean fewer correlations are needed for phase noise measurements, effectively reducing data recording time.

Speed is a vital factor, especially in manufacturing applications. With a sensitivity more than 10 dB better than similar systems, the internal sources of the R&S®FSWP require a hundred times fewer correlations to measure highly sensitive oscillators such as DROs and OCXOs. This saves considerable time and multiplies the measurement throughput, especially when working close to the carrier where data recording is the determining factor for the measurement time.

Faster development

Short measurement times also speed up the development process. The R&S®FSWP takes just minutes to display the phase noise trace of high-end oscillators – a measurement that often took several hours in the past.

Developing and optimizing signal sources becomes substantially simpler and faster, as it only takes a few minutes to measure the influence of circuit modifications such as adding new capacitors or resistors (e.g. on an OCXO).

Low-noise internal DC sources for VCO characterization

The R&S®FSWP features extremely low-noise internal DC sources to supply and control voltage-controlled oscillators (VCO) and other components, making it easy to measure VCOs. Creating VCO data sheets is likewise very easy, since the R&S®FSWP can measure the phase noise at various tuning and supply voltages, delivering the parameter values typically listed in the data sheet.

Specifications for internal DC source

Supply voltage	0 V to 16 V
Max. current load	2000 mA
Tuning voltage	-10 V to +28 V
Max. current load	20 mA

Complete VCO characterization

At the press of a button, the R&S®FSWP measures all the parameters needed to characterize a VCO:

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

The user can decide whether to vary the tuning voltage or supply voltage and whether the current should be measured at the tuning voltage or supply voltage input.



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

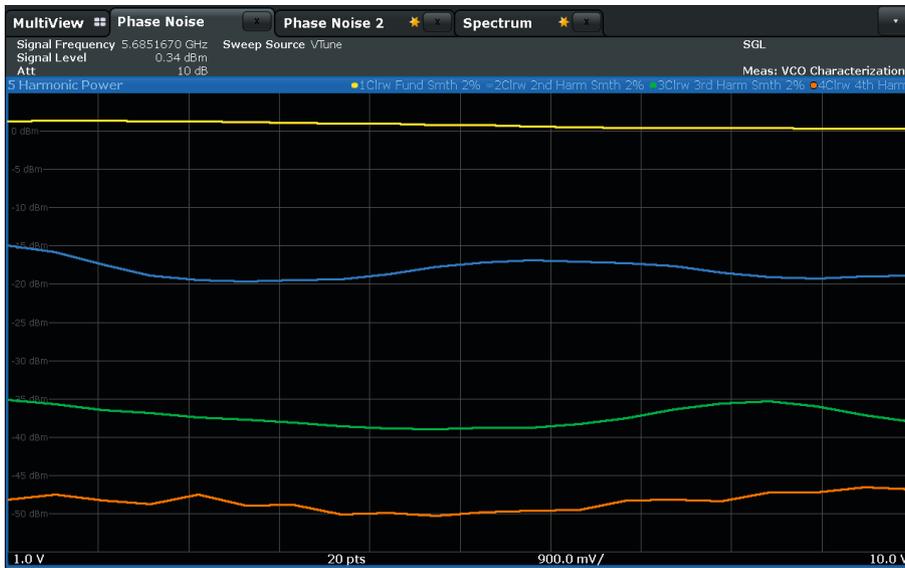
Measuring higher harmonics

The R&S®FSWP can measure not only the fundamental but also the power of the VCO's higher harmonics relative to the tuning voltage.

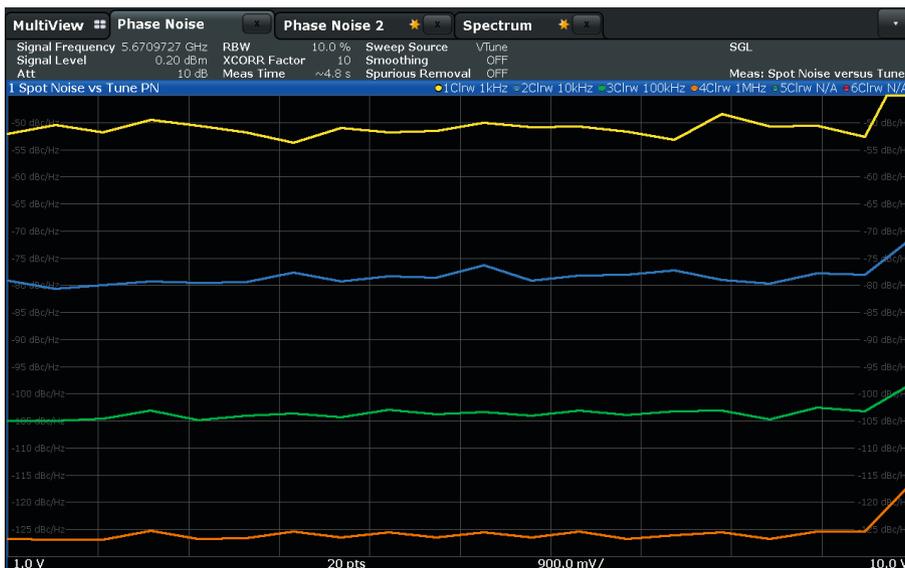
This is particularly important, since an effort is made to suppress harmonics because they can cause interference in the overall system. Higher harmonic suppression is a parameter that VCO users expect to see in the data sheet.

Phase noise relative to the tuning voltage

Due to the high measurement speed of the R&S®FSWP, it can display the phase noise at various offset frequencies relative to the tuning voltage even without long measurement times. This allows the user to verify whether the VCO's phase noise depends on the frequency as expected, or whether additional noise caused by interference or parasitic oscillations can be seen at certain tuning voltages.



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



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

Measuring transients or frequency hops (transient analysis)

Up to 8 GHz bandwidth for frequency and phase analysis

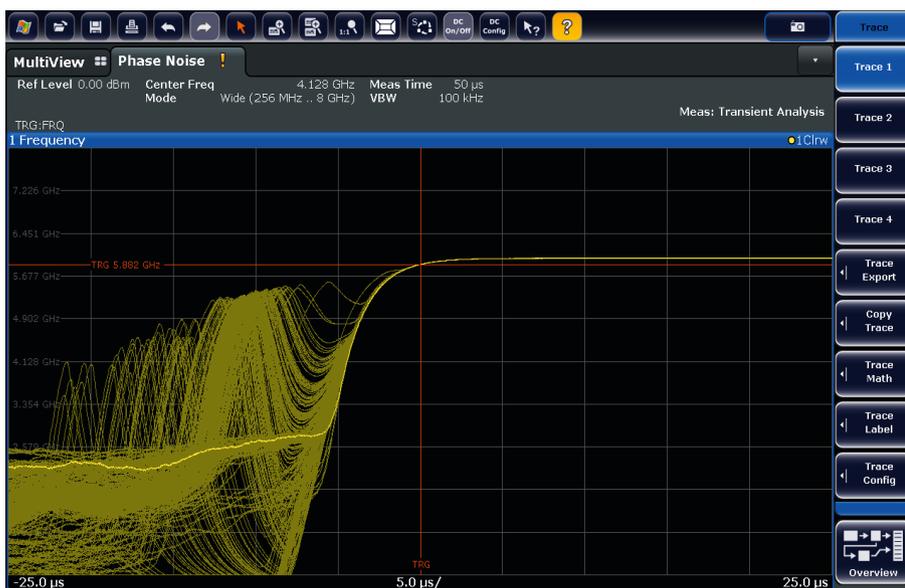
The R&S®FSWP offers up to 8 GHz bandwidth for analyzing the frequency or phase characteristic versus time for detailed characterization of switched sources, synthesizer frequency hops and frequency ramps.

Are the required frequencies met? How long are the switching times? At what point is the frequency in a targeted tolerance range?

The user gets answers to such questions at the press of a button.

Besides this wideband analysis, the R&S®FSWP offers a narrowband analysis down to 40 MHz to examine, for example, the transient response of PLLs in detail.

For characterizing and optimizing the overall performance of signal sources, these narrowband and wideband frequency and phase measurements in the time domain (transient analysis) are of immense value, primarily for designers of synthesizers or frequency agile systems. A persistent display of all traces makes it possible to estimate how strongly these parameters scatter or whether there are any outliers.



Transient response of a synthesizer in persistence mode. The horizontal red line shows the frequency trigger threshold, the vertical line the trigger offset. The bright yellow trace is the current measurement, the dull yellow traces show all previous measurements.

Triggering on phase or frequency deviation

For a detailed examination of a synthesizer's transient response, it is advisable to use a trigger to obtain comparable and reproducible measurement results. Besides utilizing an external trigger or power trigger, in the transient analysis the user can also trigger on the frequency or phase deviation. This is made possible by the input signal's realtime demodulation.

The user can define a frequency threshold so that the signal is displayed only when it is above or below a specified frequency.

For error analysis or to optimize the synthesizer, this makes it easy to selectively trigger on specific frequency hops.



Wideband frequency analysis of a synthesizer. The trace shows frequency versus time. This enables the user to measure switching times and check frequencies.

Specifications in brief

Base unit		
Frequency		
Frequency range, RF input		
Phase noise, amplitude noise measurement	R&S®FSWP8	1 MHz to 8 GHz
	R&S®FSWP26	1 MHz to 26.5 GHz
	R&S®FSWP50	1 MHz to 50 GHz
Phase noise measurement		
Measurement results		SSB phase noise, spurious signals, integrated RMS phase deviation, residual FM, time jitter

Phase noise sensitivity with R&S®FSWP-B60 option (correlations = 1, start offset = 1 Hz) ¹⁾									
RF input frequency	Offset from carrier								
	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz	≥ 30 MHz
10 MHz	-96	-128	-140	-158	-170	-170	-170	-	-
100 MHz	-76	-108	-136	-163	-170	-173	-175	-175	-175
1 GHz	-56	-88	-116	-143	-166	-173	-173	-173	-173
3 GHz	-46	-78	-106	-133	-156	-158	-163	-170	-170
7 GHz	-39	-71	-99	-130	-152	-153	-157	-166	-166
10 GHz	-36	-68	-96	-128	-147	-150	-155	-173	-173
16 GHz	-32	-64	-92	-124	-143	-146	-151	-170	-170
26 GHz	-28	-60	-88	-120	-139	-142	-147	-166	-166
50 GHz	-22	-54	-82	-114	-133	-136	-141	-160	-160

Phase noise sensitivity with R&S®FSWP-B61 option (correlations = 1, start offset = 1 Hz) ¹⁾									
RF input frequency	Offset from carrier								
	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz	≥ 30 MHz
10 MHz	-108	-130	-142	-160	-170	-170	-170	-	-
100 MHz	-92	-115	-140	-166	-170	-173	-175	-175	-175
1 GHz	-72	-95	-120	-150	-166	-173	-173	-173	-173
3 GHz	-62	-85	-110	-140	-156	-158	-163	-170	-170
7 GHz	-55	-78	-103	-133	-152	-153	-157	-166	-166
10 GHz	-52	-75	-100	-133	-152	-153	-157	-173	-175
16 GHz	-48	-71	-96	-129	-148	-149	-153	-170	-171
26 GHz	-44	-67	-92	-125	-144	-145	-149	-166	-167
50 GHz	-38	-61	-86	-119	-138	-139	-143	-160	-161

Amplitude noise measurement									
Offset frequency range	input signal ≤ 100 MHz	10 mHz to 30% of carrier frequency							
	input signal > 100 MHz	10 mHz to 30 MHz							
AM noise sensitivity ¹⁾									
RF input frequency	Offset from carrier								
	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz	30 MHz
1 GHz	-105	-120	-135	-150	-158	-165	-165	-165	-165
10 GHz	-90	-105	-120	-135	-150	-160	-165	-165	-165

Residual phase noise measurement (R&S®FSWP-B64 option), internal source								
Signal source								
Frequency range	R&S®FSWP8		10 MHz to 8 GHz					
	R&S®FSWP26		10 MHz to 18 GHz					
	R&S®FSWP50		10 MHz to 18 GHz					
Residual phase noise measurement								
Offset frequency range	input signal ≤ 100 MHz		10 mHz to 30% of carrier frequency					
	input signal > 100 MHz		10 mHz to 30 MHz					
Sensitivity¹⁾								
RF input frequency)	Offset from carrier							
	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	3 MHz
1 GHz	-115	-123	-137	-147	-160	-165	-165	-161
10 GHz	-85	-104	-120	-138	-148	-154	-164	-160

¹⁾ Values in dBc (1 Hz).

R&S®FSWP-B1 signal and spectrum analyzer option			
Frequency range	R&S®FSWP8		10 Hz to 8 GHz
	R&S®FSWP26		10 Hz to 26.5 GHz
	R&S®FSWP50		10 Hz to 50 GHz
Aging per year			1 × 10 ⁻⁷ /year
	with R&S®FSWP-B4 option		3 × 10 ⁻⁸ /year
Resolution bandwidths	standard filter		1 Hz to 10 MHz with R&S®FSWP-B8 option: 20 MHz, 50 MHz, 80 MHz additionally
	RRC filter		18 kHz (NADC), 24.3 kHz (TETRA), 3.84 MHz (3GPP)
	channel filter		100 Hz to 5 MHz
	video filter		1 Hz to 10 MHz
I/Q demodulation bandwidths			10 MHz
	with R&S®FSWP-B80 option		80 MHz
	with R&S®FSWP-B320 option		320 MHz
Displayed average noise level (DANL)	2 GHz		-150 dBm (1 Hz)
	8 GHz		-150 dBm (1 Hz)
	20 GHz		-145 dBm (1 Hz)
	40 GHz		-137 dBm (1 Hz)
DANL with preamplifier	8 GHz		-162 dBm (1 Hz)
	20 GHz		-160 dBm (1 Hz)
	40 GHz		-156 dBm (1 Hz)
Phase noise	1 GHz carrier frequency, 10 kHz offset		typ. -138 dBc (1 Hz)
Total measurement uncertainty	< 8 GHz		< 0.4 dB

Always up-to-date

The analyzer's firmware can be updated using a USB storage device or via the LAN port. Free firmware updates can be downloaded 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®FSWP8	1322.8003.08
Phase Noise Analyzer and VCO Tester, 1 MHz to 26.5 GHz	R&S®FSWP26	1322.8003.26
Phase Noise Analyzer and VCO Tester, 1 MHz to 50 GHz	R&S®FSWP50	1322.8003.50
Hardware options		
Spectrum Analyzer, 10 Hz to 8 GHz	R&S®FSWP-B1	1322.9997.08
Spectrum Analyzer, 10 Hz to 26.5 GHz	R&S®FSWP-B1	1322.9997.26
Spectrum Analyzer, 10 Hz to 50 GHz	R&S®FSWP-B1	1322.9997.50
High Stability OCXO	R&S®FSWP-B4	1325.3890.02
Resolution Bandwidth > 10 MHz ¹⁾	R&S®FSWP-B8	1325.5028.26
Resolution Bandwidth > 10 MHz, for R&S®FSWP50 ¹⁾	R&S®FSWP-B8	1325.5028.02
External Generator Control ¹⁾	R&S®FSWP-B10	1325.5463.02
Highpass Filter for Harmonic Measurements ¹⁾	R&S®FSWP-B13	1325.4350.02
Spare Solid State Drive (removable hard drive)	R&S®FSWP-B18	1331.4313.02
LO/IF Ports for External Mixers	R&S®FSWP-B21	1325.3848.02
RF Preamp, 100 kHz to 8 GHz ¹⁾	R&S®FSWP-B24	1325.3725.08
RF Preamp, 100 kHz to 26.5 GHz ¹⁾	R&S®FSWP-B24	1325.3848.26
RF Preamp, 100 kHz to 50 GHz ¹⁾	R&S®FSWP-B24	1325.3848.50
Cross-Correlation, 8 GHz	R&S®FSWP-B60	1322.9800.08
Cross-Correlation, 26.5 GHz	R&S®FSWP-B60	1322.9800.26
Cross-Correlation, 50 GHz	R&S®FSWP-B60	1322.9800.50
Cross-Correlation (low phase noise), 8 GHz	R&S®FSWP-B61	1325.3719.08
Cross-Correlation (low phase noise), 26 GHz	R&S®FSWP-B61	1325.3719.26
Cross-Correlation (low phase noise), 50 GHz	R&S®FSWP-B61	1325.3719.50
Residual Phase Noise Measurements	R&S®FSWP-B64	1322.9900.26
80 MHz Analysis Bandwidth ¹⁾	R&S®FSWP-B80	1325.4338.02
320 MHz Analysis Bandwidth	R&S®FSWP-B320	1338.3235.04
Firmware		
Pulsed Phase Noise Measurements	R&S®FSWP-K4	1325.5034.02
Pulse Measurements	R&S®FSWP-K6	1325.4221.02
Time Sidelobe Measurements	R&S®FSWP-K6S	1325.5363.02
Analog Modulation Analysis for AM/FM/φM ¹⁾	R&S®FSWP-K7	1325.4238.02
Noise Figure Measurements ¹⁾	R&S®FSWP-K30	1325.4244.02
Vector Signal Analysis ¹⁾	R&S®FSWP-K70	1325.4280.02
Security Write Protection for Solid State Drive	R&S®FSWP-K33	1325.5040.02

¹⁾ R&S®FSWP-B1 option required.

Warranty		
Base unit		3 years
All other items		1 year
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	

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- ▮ Solution finding/purchase
- ▮ Technical startup/application development/integration
- ▮ Training
- ▮ Operation/calibration/repair



Service that adds value

- ▮ Worldwide
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- ▮ Uncompromising quality
- ▮ Long-term dependability

Rohde & Schwarz

The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

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- ▮ Longevity and optimized total cost of ownership

Certified Quality Management

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R&S®FSWP Phase Noise Analyzer and VCO Tester

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