

The R&S®FSUP signal source analyzer provides new measurement capabilities

The R&S®FSUP is the only instrument on the market that unites a high-end signal and spectrum analyzer with a phase noise tester in a single box. Now, it also offers impressive new measurement capabilities for parameters such as residual phase noise and AM noise, along with an expanded frequency range for cross-correlation that enables greater dynamic range in microwave measurements.

Cross-correlation from 1 MHz to 50 GHz

Cross-correlation eliminates uncorrelated noise from the two independent internal reference sources by means of averaging. This can improve the dynamic range by as much as 20 dB, depending on the number of averages. With the new R&S®FSUP-B60/-B61 hardware options for the R&S®FSUP, this method can now be used with input frequencies between 1 MHz and 50 GHz, a range that is especially interesting when measuring signal sources in radar and microwave link applications and in satellite communications. This is a welcome addition for developers and production managers because, even in the case of challenging measurement requirements, the necessary phase noise measurements can now be carried out at the push of a button. The test setup is simple and no longer requires costly reference sources. FIGs 1 and 2 show a typical measurement on a high-quality signal source at 25.2 GHz. Although it takes more than 1000 averages to measure this signal source at a frequency offset of 10 kHz, the R&S®FSUP only needs a few seconds. The new hardware option also permits measurements with cross-correlation at input frequencies of less than 10 MHz. This is a capability that should

particularly interest OCXO manufacturers because, to date, there is nothing comparable on the market in terms of ease-of-use that would allow them to test their entire product portfolio (with frequencies from a few megahertz through to the 100 MHz range) simply by pressing a button.

Measuring residual phase noise

With RF transmitters, the oscillator is not the only source of phase noise. Particularly in high-end applications, it is helpful to know which other components – amplifiers and frequency dividers, for example – contribute to phase noise. The R&S®FSUP has all the capabilities and the flexibility to carry out these complex measurements. They can be performed by using an external phase shifter, with the software in the R&S®FSUP conveniently guiding the user through the entire calibration process. An external phase detector can also be used in addition to the internal detector, enabling users to continue working with older, more complex phase noise test setups, particularly in cases where the internal phase detector is not sufficiently sensitive.

R&S®FSUP: a unique combination of phase noise tester and signal and spectrum analyzer

The R&S®FSUP is a high-end signal and spectrum analyzer combined with a PLL-based phase noise tester. It is currently the only complete, single-box solution of its kind on the market and can be used at

frequencies up to 50 GHz (or 110 GHz with external mixers). Besides these capabilities, the R&S®FSUP can also fully characterize VCOs. Its integrated, exceptionally low-noise DC sources support oscillator operation and tuning. At the press of a button, it analyzes the frequency range, the tuning slope, the influence of the supply voltage, the behavior of upper harmonics, transient response, and more. For users testing the direct impact of phase noise on modulation quality, special analysis options are available for a number of digital mobile radio standards, including WCDMA and GSM. The R&S®FSQ-K70 vector signal analysis option expands the R&S®FSUP to support the universal demodulation and analysis of digital radio signals down to the bit stream level. [The R&S®FSUP was featured in detail in News from Rohde & Schwarz \(2006\) No. 190, pp 30–33.](#)



FIG 1 Phase noise measurement on a quality signal source at an input frequency of 25.2 GHz: without cross-correlation (blue), with approx. 1000 averages (green), and with approx. 20000 averages (yellow).



FIG 2 Results of a phase noise measurement with the R&S®FSUP on a quality signal source.

	Specification in signal source data sheet	R&S®FSUP measurement without cross-correlation	R&S®FSUP measurements with cross-correlation based on different numbers of averages		
			100	1000	20000
Phase noise at 25.2 GHz with frequency offset of 10 kHz	-122 dBc/Hz	-102.7 dBc/Hz	-113.6 dBc/Hz	-117.3 dBc/Hz	-125.9 dBc/Hz

AM noise and baseband noise

Phase noise measurements with a spectrum analyzer always show the sum of phase noise and amplitude noise – the two usually cannot be measured separately. With the phase detector method, though, amplitude noise is suppressed, making separate phase noise measurements possible. However, in many applications (digital I/Q modulation, for example), amplitude noise is a relevant factor and therefore needs to be specified. Amplitude noise could be measured in the AM/FM demodulator, but only with a limited dynamic range. With the new R&S®FSUP and the R&S®FSUP-Z1 external diode, however, amplitude noise can be measured at a dynamic range that is expanded by 30 dB to 40 dB. This makes it possible to test the specifications of transceiver chips for modern wireless communications standards, for example.

The residual noise input or AM noise input can also be connected directly to a signal source, in which case the instrument shows the (noise) power at the various offset frequencies. This new capability can be especially valuable for users who want to measure DC sources, which have a major impact on oscillator characteristics.

An advanced processor platform for greater speed

With its new hardware options and measurement capabilities, the R&S®FSUP is not just more versatile. It also runs on a new processor platform that provides significantly more speed in compute-intensive measurements – a benefit that can be crucial in production environments, for example, where every second saved is a plus.

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