Agilent
E5052A Signal Source Analyzer

A New Class of Instrument Improves Your Wireless RF Design Process

- **Easy to use high-performance analyzer speeds your design cycle**
- **Comprehensive signal source evaluation enables robust design**
- **Option 011: More than 25% price reduction for just the essential features**

Lack of the right equipment slows down the design process and lowers design reliability

Everyone agrees that the signal source is a key building block of wireless communication systems. However, signal-source evaluation is too often insufficient, simply due to a lack of the right equipment.

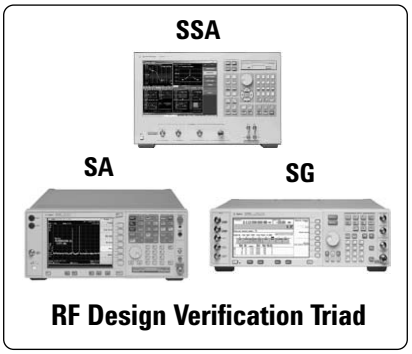
For example, a local synthesizer must have a good phase noise characteristic because it has a large impact on the system performance parameters such as EVM, ACPR, BER, and receiver selectivity, as shown in Figure 1. However, many RF designers simply check the phase noise with a spectrum analyzer, despite the fact that its capability is often insufficient for thorough analysis. Accordingly, if a system failure is caused by a phase noise problem, troubleshooting will likely take a long time.

Another notable example is that a fast lock-up time of a local synthesizer is required for various wireless communication systems, but traditional test instruments, such as a modulation domain analyzer, often do not have sufficient frequency and time resolution. As a result, many engineers are forced to just assume the correct operation of a synthesizer, which risks your RF design.

The E5052A breaks the current measurement paradigm

The E5052A Signal Source Analyzer (SSA) is an entirely new class of instrument, which performs all the critical signal source evaluations in one instrument. The SSA complements the traditional basic tools, including a spectrum analyzer (SA) and signal generator (SG), to offer a complete set of RF design verification environments.

The SSA replaces the large, complex rack of test equipment necessary for complete signal source evaluation with a single instrument. SSA performs tests faster and more accurately, at much lower cost, with unprecedented simplicity. The right combination of performance, versatility, and ease-of-use allows you to thoroughly evaluate signal sources at any stage of your RF design process.



RF Design Verification Triad

In the early phase, you can precisely evaluate key components of a signal source, such as a crystal oscillator and VCO. The SSA is also a powerful tool to ensure robust operation of a PLL synthesizer in an end product such as a cellular system, providing efficient testing under various operating conditions.

This new class of instrument fills in the gap in signal source evaluation to optimize your RF design process.

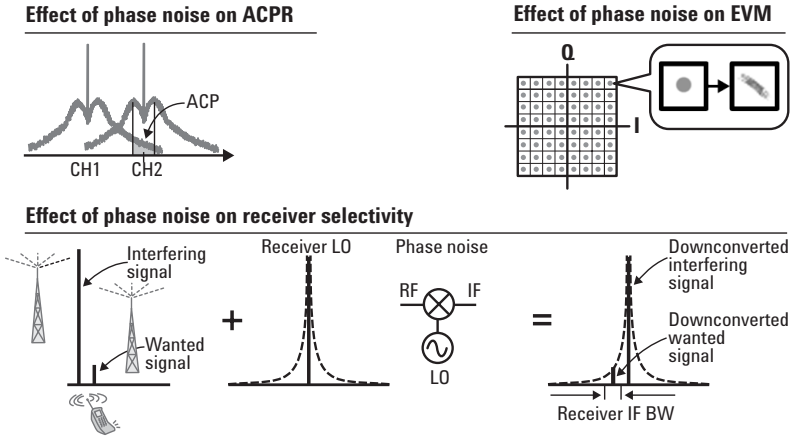


Figure 1. Phase noise effects on final system performances

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One-box, single-connection solution drastically speeds the synthesizer design process

One of the challenges in synthesizer design is that multiple parameters need to be evaluated throughout the design process, as shown in Figure 2. The SSA enables you to quickly perform phase noise, transient (lockup time), near-carrier spurious measurements without changing cable connections; drastically improving the efficiency of your synthesizer design. It is particularly powerful when you optimize a circuit by balancing trade-offs between phase noise, lockup time, and other parameters.

A budget solution is also available if you don't need ultimate phase noise measurements

The entry model, E5052A Option 011, provides the optimal combination of measurement functionality and performance at an even more affordable price. This model covers fundamental measurements for synthesizer design verifications with sufficient performance. At the high end, the standard version provides the ultimate phase noise performance with expanded offset ranges (from 1 Hz) and a comprehensive VCO analysis function. (An upgrade kit from Option 011 to standard is also available.)

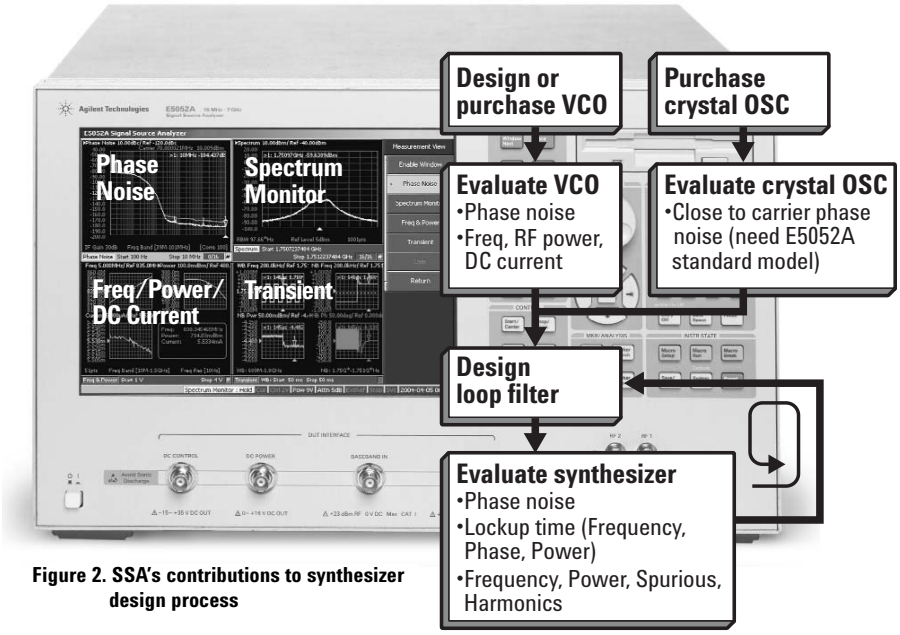

Figure 2. SSA's contributions to synthesizer design process

Table 1. Key feature comparison between Option 011 and standard

	E5052A Option 011	E5052A standard
Phase noise	• 10 Hz to 40 MHz offset range • Satisfies fundamental needs for synthesizers and VCOs	• 1 Hz to 40 MHz offset range • Ultra-low noise measurement that enables crystal oscillator evaluations
Transient	Frequency/Phase/RF Power	
Freq/RF power/ DC current	Tester mode	Tester mode and DC voltage swept analyzer mode
Spectrum monitor	Up to 15 MHz span/harmonics search	
Built-in DC sources	Ultra-low noise sources for power supply and VCO control	

Synthesizer design trap example which could have been avoided with the SSA

An engineer was designing a local synthesizer. Fast lockup time and good phase noise were two critical requirements. Fortunately the engineer had access to a phase noise measurement system. The 53310A modulation domain analyzer (MDA) was also sufficient for evaluating the lockup time requirement. The engineer confirmed that the phase noise met the requirement, and also tested lockup time in every frequency condition to be used. Thus, the engineer had confidence in the design.

However, later on it was found that the phase noise at one particular frequency didn't meet the requirement. Figure 3 shows the measurement results of the synthesizer using the SSA: lockup time is fine but phase noise is quite different between the two frequency settings. The engineer had not evaluated phase noise for all frequency settings because it was too time-consuming. This is an example of design traps and limitations that exist due to a lack of the right equipment. If the SSA had been used, the engineer would have evaluated phase noise more thoroughly because it was very quick and easy. Moreover, problems at later stages of development could have been avoided.

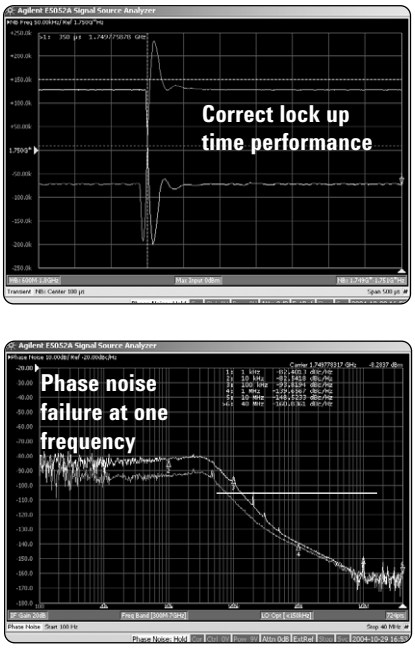

Figure 3. Synthesizer measurement examples

Easily evaluate the most stringent phase noise requirements:

- **Near-carrier requirement of crystal oscillators**
- **Far-from-carrier requirement of cellular systems: -168 dBc/Hz @ 20 MHz (GSM example)**

The SSA's function for phase noise measurement provides much higher sensitivity than spectrum analyzers. In fact, the SSA's performance matches or exceeds conventional dedicated phase noise test solutions, all in an easy "one-connection" operation.

Figure 4 shows a measurement example of a PLL for a UMTS handset. You can measure this very-low far-carrier phase noise by merely connecting the DUT and pressing a few buttons, without using any external devices such as notch filters. The SSA can also display the integrated phase noise and RMS Jitter for your specified frequency range. (1 kHz to 3.84 MHz in the example)

The SSA's exceptional phase noise measurement performance provides valuable insights for troubleshooting problems with system performance such as EVM and BER.

The SSA provides the right combination of high-performance and ease-of-use for RF designers, as shown in the technology comparison table. (Table 2)

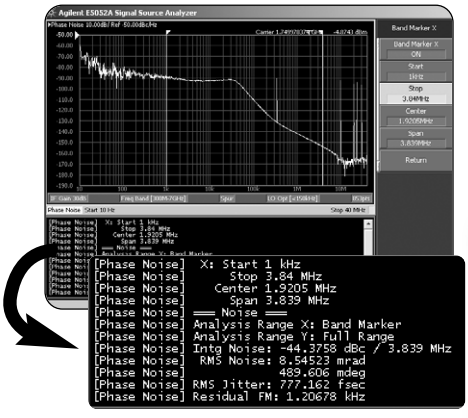

Figure 4. UMTS PLL phase noise measurement

Table 2. Comparison of phase noise measurement methods

Method	Advantage / disadvantage
Spectrum analyzer	• Easy operation • Not enough sensitivity to evaluate crystal oscillators • Significant measurement error for free-running oscillators like VCO
Conventional phase noise test systems	• Can measure low phase noise at broad offset range by using two measurement techniques (reference source / PLL technique and delay-line technique) • Difficult operation, including complicated setup and calibration
E5052A SSA	• ***Easy operation*** • ***Can measure low phase noise at broad offset range by just connecting DUTs*** • ***No complicated needed***

Fast sampling, high-frequency–resolution transient measurement satisfies requirements of high-speed synthesizers

The SSA gives a minimum of 10-nsec time resolution, while maintaining a high-frequency resolution, which allows you to evaluate, for example, fast frequency switching evaluation to meet the hard hand-off requirement of cellular systems. Compared to the modulation domain analyzer, which has been commonly used for wireless synthesizer evaluation, the SSA provides a resolution more than ten times higher. The difference is marked, as Figure 5 illustrates: The SSA reveals the real transient characteristics you cannot see with an 53310A MDA.

Frequency results can be displayed with ppm difference from the target frequency as well as absolute frequency. Thus, you can easily see if your synthesizer stabilizes within the frequency limits given in ppm.

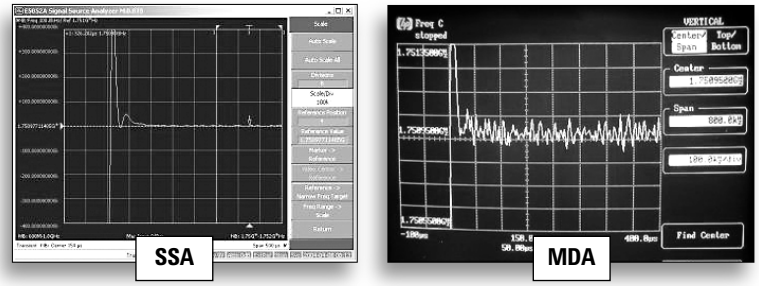

Figure 5. Comparison in actual transient measurement (Time span: 500 µs; Frequency span: 800 kHz)

A limit-line testing and statistical analysis functions further enhance measurement efficiency. (Figure 6)

Another SSA advantage is that the analyzer performs wide-band (maximum 4.8 GHz span) and narrow-band (25.6-MHz or 1.6-MHz span) transient measurements simultaneously; allowing you to observe both the entire picture of frequency jumps and detailed transients over time. In the narrow-band mode, you can measure not only frequency but also power and phase. (Figure 7)

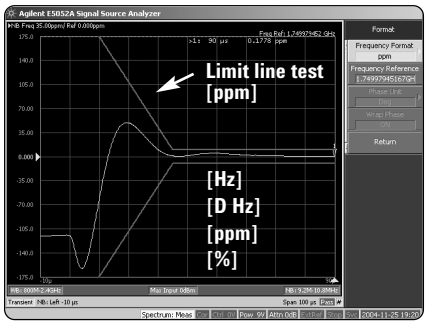

Figure 6. UMTS PLL transient measurement for hard hand-off

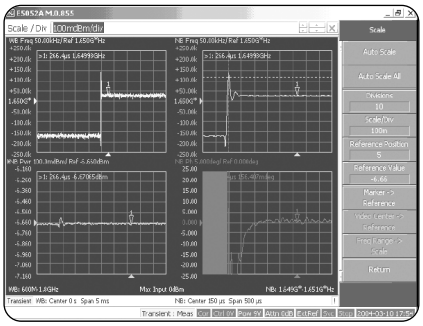

Figure 7. Simultaneous wide-/narrow-band measurements for PLL synthesizers

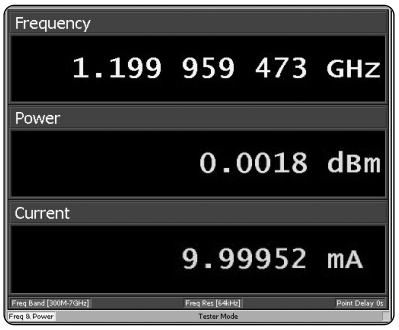

Figure 8. Tester mode displays frequency, power, and DC current

Frequency/RF power/ DC current measurement

The tester mode displays frequency/RF power/DC current simultaneously as shown in Figure 8, which allows you to evaluate basic signal source characteristics very easily. The analyzer mode, which features an advanced DC- voltage swept analysis capability, is a powerful tool for detailed VCO characterizations, including tuning sensitivity and frequency pushing. (The analyzer mode is not available when Option 001 is selected.)

Spectrum Monitor

The spectrum monitor function provides spectrum analysis spanning up to 15 MHz. In the synthesizer verification process for loop filter optimization, you can quickly check near-carrier spurious together with the phase noise and the lockup time without switching the connection from the SSA to the spectrum analyzer. The harmonics search function automatically finds the specified harmonic and sets the center frequency accordingly.

Built-in ultra low-noise DC sources

The SSA has a precisely conditioned, exceptionally low-noise DC power source to provide tuning voltage for VCOs. This provides unparalleled low-noise performance (1 nV/√Hz at 10 kHz offset), which enables accurate frequency/RF power measurements and phase noise measurements for VCOs, without cumbersome low-pass filtering. The SSA also has a very low-noise DC power supply to provide various signal sources with clean DC power for accurate evaluation.

Conclusion

The E5052A signal source analyzer is a new class of instrument that significantly improves the quality and efficiency of the RF design process and serves as an essential tool for every RF engineer.

For more information, visit the Signal Source Analyzer Web page:

www.agilent.com/find/SSA

Related Literature

E5052A Signal Source Analyzer, Brochure
Literature number 5989-0902EN

E5052A Signal Source Analyzer, Data Sheet
Literature number 5989-0903EN

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