

# **Agilent E5052B Signal Source Analyzer**

**Technical Overview** 

See how easy it is to characterize a free-running VCO

Measure phase noise of a wandering oscillator
with minimal effort



A voltage controlled oscillator (VCO) is one of the most critical electronic components in today's world of advanced wireless communication and broadcasting. Frequency tuning characteristics (tuning voltage versus output signal frequency) and phase noise characteristics (offset frequency versus phase noise power ratio) of a free-running VCO are fundamental parameters that specify the performance of the VCO. Although VCO's

are conceptually easy to understand and describe, actual measurements of frequency tuning and phase noise are very difficult and time-consuming. Particularly for the phase noise measurement, a conventional direct method by using a spectrum analyzer can not achieve an accurate measurement and often results in discontinuity due to frequency drift or wander (slow jitter) of the free-running VCO shown in Figure 1.

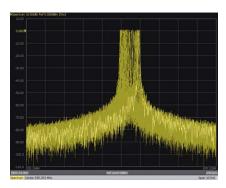


Figure 1. Drift of a free-running VCO

In order to avoid this difficulty an automatic measurement system using phase tracking technique is constructed with a spectrum analyzer as shown in Figure 2\*. However, this approach is complicated to configure and measurement results heavily depend on noise level of each component.

\* Based on "Phase Noise Measurement of Free-Running VCO Using Spectrum Analyzer" by Chung Ming Yuen and Kim Fung Tsang, Radio and Wireless Conference 2004 IEEE; September, 2004 (pp443-446).

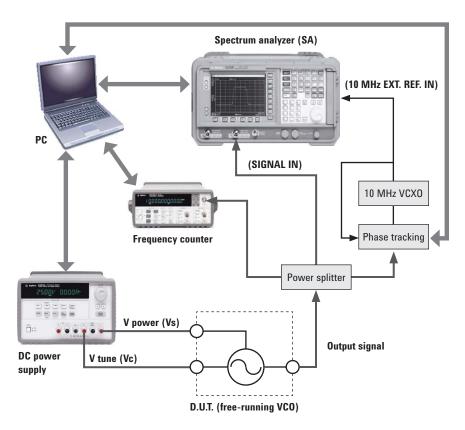


Figure 2. Conventional SA solution

The Agilent E5052B has dramatically improved phase noise measurements of a free-running VCO. As shown in Figure 3, the measurement configuration is quite simple. All necessary DC voltage sources with sufficient low-noise are equipped in the instrument, and phase noise measurements from 1 Hz to 100 MHz (in Normal capture mode) or 40 MHz (in Wide capture mode) offset frequency can be done within 13 seconds. The measurement speed is exceptionally fast such as 0.45 seconds if offset frequency is set at a range between 1 kHz and 100 MHz/40 MHz.

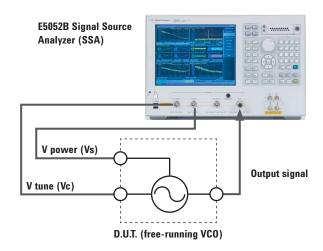


Figure 3. SSA solution

Figure 4 and Figure 5 are measured results of 835 MHz free-running VCO by the E5052B in phase noise (PN) and amplitude noise (AM). Figure 4 shows two results in parallel and Figure 5 shows a user display window with two traces in the same vertical scale.

Typically spectrum analyzer's measured results show only the sum of PN and AM noise, so that the both can not be identified separately. However, the E5052B provides both results independently.

The E5052B has the capability to measure many of other VCO parameters such as:

- Frequency tuning voltage (Vc) or supply voltage (Vs)
- Power level tuning voltage (Vc) or supply voltage (Vs)
- Supply current tuning voltage (Vc) or supply voltage (Vs)
- VCO gain (df/dVc [Hz/V])
- Harmonics level (higher order harmonics power)

An example of VCO parameter measurements is shown in Figure 6 in which four measured parameters at 401 points of tuning voltage (Vc) are displayed simultaneously within 10 seconds.



Figure 4. Phase noise and AM noise in two windows

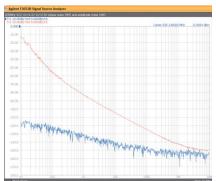


Figure 5. Phase noise and AM noise comparison in a user window

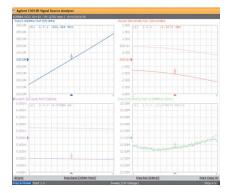


Figure 6. Frequency, Power, DC supply current and tuning sensitivity displayed in one window

#### **Related literature**

Publication title	Publication type	Publication number
Advanced Phase Noise and Transient Measurement Techniques	Application Note	5989-7273EN
Agilent E5052B Signal Source Analyzer	Brochure	5989-6389EN
Agilent E5052B Signal Source Analyzer	Data Sheet	5989-6388EN

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