

Agilent E5052A Signal Source Analyzer

Crystal Oscillator Evaluation is Now Possible in Your Wireless RF Design Process

Importance of Evaluating Crystal Oscillators for RF Circuit Designers

In today's advanced wireless communication systems, the phase noise performance of reference crystal oscillators (TCXOs, VC-TXOs) is increasingly critical. In the systems that employ the OFDM modulation, such as WLAN, the close-in phase noise caused by crystal oscillators can affect adjacent carriers. In cellular systems such as GSM that require rigorous phase noise performance, RF circuit designers need to carefully choose crystal oscillators that have sufficiently low-noise performance. In addition, many cellular handsets are now employing RF transceiver ICs that have on-chip reference oscillator circuits, and RF circuit designers themselves need to configure the reference oscillators and verify their performance by mounting crystal resonators on the ICs.

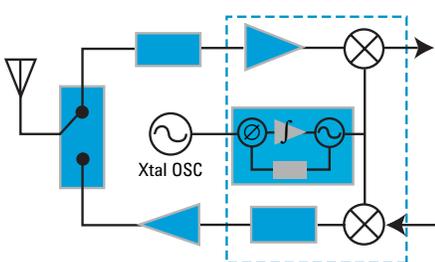


Figure 1. Crystal oscillator in a wireless communication system

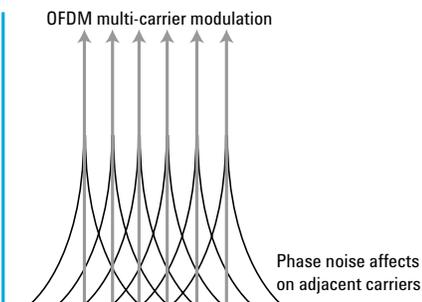


Figure 2. Phase noise in OFDM

Limitation of Conventional Test Solutions

Therefore, it is becoming increasingly important for RF circuit designers to evaluate the crystal oscillator's phase noise. However, it was previously very difficult for them to evaluate the crystal oscillator's phase noise, because the only solution that satisfies required phase noise performance for the crystal measurement was a complicated reference/PLL measurement technique using a dedicated phase noise measurement system and the user's own external reference VCXOs. This traditional measurement method requires a lot of skill, not only to make the measurement, but also to configure and calibrate the system. A much easier measurement solution has been long awaited.

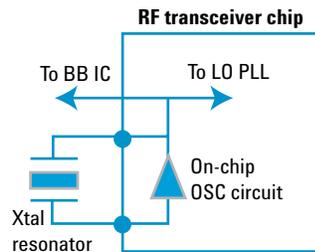


Figure 3. RF chipset for cellular

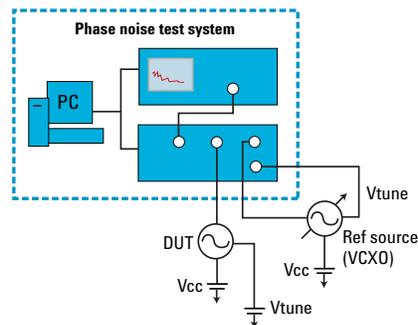


Figure 4. Conventional solution

Easy and Accurate Phase Noise Measurement with the SSA

Now you can measure the phase noise of crystal oscillators more easily by using the new E5052A signal source analyzer (SSA). Its built-in, low-noise reference sources and fully auto-controlled measurement PLL circuits enable accurate phase noise measurement for the 10 MHz to 7 GHz carrier frequency range. It also offers a wide offset range starting from 1 Hz, which satisfies crystal oscillator specs used for wireless communication systems, without the need for external reference oscillators or a complicated calibration procedure.

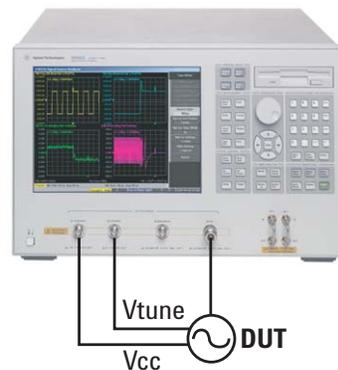


Figure 5. New single-instrument solution with SSA

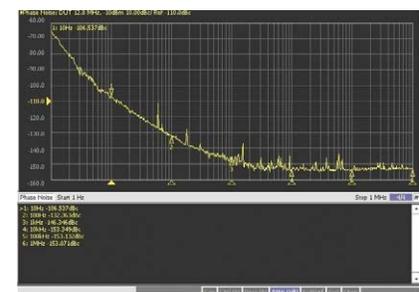


Figure 6. Crystal phase noise measurement with the SSA

Transient Measurement for Crystal Start-Up Time Evaluation

Verifying quick start-up times of crystal oscillators is important to ensure reliable operation of wireless communication equipment. A new 200 kHz bandwidth mode has been added to the SSA's transient measurement function (Feb. 2005 release). It provides high frequency resolution in transient measurement (0.2 to 4.9 Hz rms resolution), and the start-up time measurement can now be easily made for crystal oscillators.

Tuning Voltage vs. Frequency Characteristics

The SSA's frequency/power measurement capability enables tuning sensitivity (tuning voltage V_t vs. frequency) measurements for voltage-controlled crystal oscillators with up to 10 Hz resolution.

If higher frequency resolution is needed, one solution is to use the 200 kHz bandwidth transient mode as a frequency counter, instead of the frequency/power measurement mode. An example procedure is given as follows:

- Set V_t to the start level.
- Measure the DUT's frequency with the transient mode.
- Change V_t to the next level.
- Repeat frequency measurement.
- Plot V_t vs. frequency curve on the user trace display.

The above test sequence can be automated by the SSA's built-in VBA.

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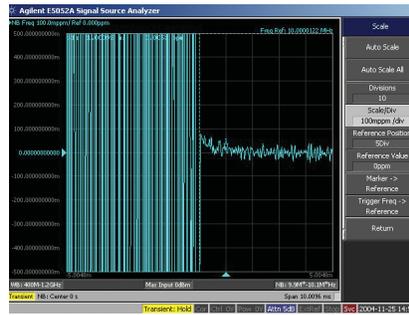


Figure 7. Transient measurement for crystal oscillator

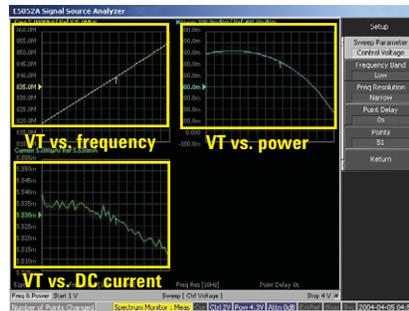


Figure 8. CW frequency measurement with transient measurement mode

Evaluation of Temperature Characteristics

Evaluating the temperature characteristics of crystal oscillators improves the system reliability under actual operating environments. The SSA's built-in VBA helps you build your own test system for temperature characteristics.

- Control an external RF switch and a temperature chamber with the VBA.
- Measure the frequency (with transient mode) and phase noise of the DUTs at each temperature.
- Plot the temperature vs. frequency and phase noise curve on the user trace.

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Phone or Fax

United States:

(tel) 800 829 4444
(fax) 800 829 4433

Canada:

(tel) 877 894 4414
(fax) 800 746 4866

China:

(tel) 800 810 0189
(fax) 800 820 2816

Europe:

(tel) 31 20 547 2111

Japan:

(tel) (81) 426 56 7832
(fax) (81) 426 56 7840

Korea:

(tel) (080) 769 0800
(fax) (080)769 0900

Latin America:

(tel) (305) 269 7500

Taiwan:

(tel) 0800 047 866
(fax) 0800 286 331

Other Asia Pacific Countries:

(tel) (65) 6375 8100
(fax) (65) 6755 0042

Email: tm_ap@agilent.com

Contacts revised: 01/14/05

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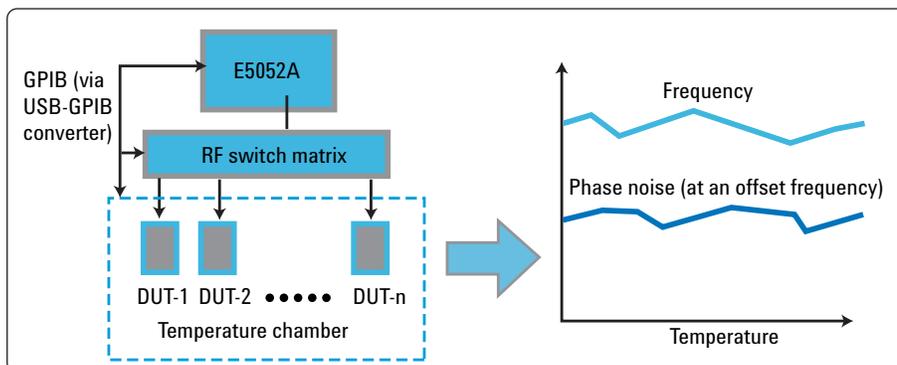


Figure 9. Temperature characteristics test system