Cross Correlation Cuts Phase Noise

This two-channel phase-noise measurement system uses cross-correlation techniques to cancel the effects of internal noise from RF through millimeter-wave frequencies.

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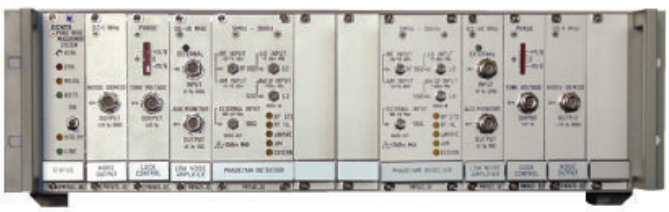
Phase noise is a key specification for many RF and microwave systems, although measuring it can often be problematic. However, the innovative Dual Channel Phase Noise Test System (DCNTS) from NoiseXT (*www.noisext.com*) is a two-channel amplitude and phase noise analyzer that can measure absolute phase noise through 50 GHz and residual phase noise to 18 GHz. It employs a dual-demodulator architecture that allows the use of cross-correlation techniques to cancel the internal noise of the instrument's electronics, achieving outstanding sensitivity in phase-noise measurements at offsets from 0.01 Hz to 40 MHz.



The DCNTS modular noise analyzer uses cross-correlation to measure low-level phase and AM noise on two-port devices through 50 GHz.

Cross correlation is commonly used in signal processing to search for a short event among longer waveforms, by comparing two or more waveforms that are delayed relative to one another. It can be applied to continuous-wave (CW) or pulsed signals. The modular DCNTS system (*see figure*) allows an operator to perform measurements of phase noise and amplitude-modulation (AM) noise on two-port devices, such as amplifiers, manually or automatically (with software and an Ethernet-equipped computer). Modules for each channel include a phase/AM detector and a phase-lock module with tunable output (bias) voltage. The instrument features a dual-demodulator architecture in support of the cross-correlation techniques to reduce instrument noise to almost negligible levels. Cross correlations can be selected from 1 to 100,000 (with longer processing times for greater numbers of cross correlations), with a drop in noise floor corresponding to an increase in the number of cross correlations.

Using the phase/AM detector module, measurements can be performed on input signals from 2 MHz to 26.5 GHz at levels from 0 to +20 dBm and at offsets from 10 Hz to 10 MHz. By increasing the number of cross correlations for these measurements, the noise levels drop dramatically. For example, the AM noise level at 1-kHz offset for 100 cross correlations is -155 dBc/Hz. For the same offset frequency, the AM noise level is -160 dBc/Hz for 1000 cross correlations and -165 dBc/Hz for 10,000 cross correlations.

For absolute phase-noise measurements the numbers are more impressive. Measurements can be performed from 2 MHz to 1.8 GHz with a standard (0 to +13 dBm) or high-level (0 to +23 dBm) RF detector, or from 1.8 to 26.5 GHz with a standard (0 to +15 dBm) or high-level (0 to +23 dBm) microwave detector. The typical phase noise for the high-level RF detector at 1-kHz offset is -180 dBc/Hz for 100 cross correlations, -185 dBc/Hz for 1000 cross correlations, and -190 dBc/Hz for 10,000 cross correlations. The phase noise for the high-level microwave detector at 1-kHz offset is -168 dBc/Hz for 100 cross correlations, -173 dBc/Hz for 1000 cross correlations, and -178 dBc/Hz for 10,000 cross correlations.

Depending upon the modules, the noise measurement system can be equipped for absolute phase measurements from 2 MHz to 1.8 GHz, 26.5 GHz, 40 GHz, or 50 GHz, and for residual phase-noise measurements from 50 MHz to 1.8 GHz or 18 GHz. **Noise eXtended Technologies S.A.S. (NoiseXT), 5 Place du General de Gaulle, 78990 Elancourt, France; +33 6 80 46 23 07, FAX: +33 9 58 86 05 42, Internet: www.noisext.com.** MR