Keysight Technologies
Ready. Set. Measure.
Characterizing the Power in Complex Wireless Signals—Simply, Automatically and Accurately

Application Brief
In today’s wireless communication systems, accurate power measurements of digitally modulated signals are crucial to maximizing system capacity and improving quality of service. This is true whether you are developing a new design, verifying its performance, or testing the final product on the manufacturing line.

Of course, there isn’t just one type of power. For any given wireless signal, you may need to measure attributes such as channel power, adjacent channel power (ACP), occupied bandwidth (OBW), burst power, the complementary cumulative density function (CCDF), harmonics, spurious emissions, spectrum emission mask, and third-order intercept (TOI) power.

Because today’s digitally modulated signals contain multiple carriers, power measurements are very complex, technology-dependent and time-consuming—and these factors make it difficult if not impossible to calculate power values manually. That’s why Keysight created PowerSuite, a collection of essential measurements that includes those listed above. These capabilities are a standard feature of Keysight’s X-Series signal analyzers with multi-touch. Together, PowerSuite and the intuitive multi-touch user interface simplify each measurement process through a streamlined menu structure and with preset values for wireless formats such as LTE, W-CDMA, GSM/EDGE, cdma2000, IS-95, Bluetooth®, and WLAN.

Measuring In-Channel Power

Channel power measures the total power present in the channel bandwidth. Unlike a continuous wave (CW) signal, the power of a digitally modulated signal is spread over a wide bandwidth. Thus, calculating the total power in the channel requires a complex integration. An X-Series signal analyzer with PowerSuite makes these measurements quickly and automatically. It takes just two touches to set the center frequency and bandwidth of the measurement, and PowerSuite then performs the test automatically.

As an example, OBW is a measure of the bandwidth containing 99 percent of the total integrated power. OBW is used to confirm that the transmitter does not interfere with adjacent channels. After you enter the carrier frequency, PowerSuite quickly computes the combined power of all signal responses contained in the trace. It places markers at the frequencies bracketing the region containing 99 percent of the power and then automatically calculates the occupied bandwidth.
Quantifying the Power in Spurious Signals

ACP quantifies the amount of interfering power present in an adjacent frequency channel. This is a must-have measurement for wireless communications to ensure that signals are being effectively transmitted within their allocated spectral bandwidth and are conforming to the relevant leakage specifications.

To characterize an oscillator or transmitter, you normally need to identify and determine the power level of the spurious emissions (“spurs”) of the signal, and this includes all non-harmonic components and other unwanted low-level spurs. Measuring spurs is a time-consuming and tedious task that could take days to complete if done by hand. PowerSuite simplifies the task by providing the ability to set pass/fail limits for as many as 200 spurs in up to 20 frequency bands (Figure 1).

Another way to characterize unwanted emissions from spread-spectrum transmitters (e.g., W-CDMA, LTE and WLAN) is to measure the power of in-band and out-of-band emissions in specified frequency bandwidths at fixed offsets. The spectrum emission mask (SEM) measurement provides a generic way to detect unwanted emissions close to the carrier resulting from imperfections in the signal generation process (Figure 2).
Measuring Power in the Time Domain

To maintain acceptable call quality, base stations and mobile devices must transmit enough power with sufficiently accurate modulation to minimize leakage of power into adjacent frequency channels or timeslots. However, many digitally modulated signals are not transmitted continuously but instead are sent in bursts. This type of time-domain modulation is used in signals such as W-CDMA, Bluetooth®, GSM/EDGE and NADC. When using a classic spectrum analyzer, it is difficult to measure the power of burst signals only during the transmission period and not during the gap.

In PowerSuite, the burst-power measurement quickly and accurately determines the average power for an RF signal burst at or above a specified threshold or during a detected burst width. It also verifies the accuracy of the mean transmitted RF power.
Characterizing the Performance of Power Amplifiers

Many digitally modulated signals have a noise-like appearance in either the time or frequency domain. Such signals can have a high peak-to-average power ratio, presenting many challenges to developers trying to optimize distortion performance in a power amplifier. In PowerSuite, the CCDF measurement provides critical information such as a statistical description of the percentage of time the signal is at or above a given power relative to the average power level (Figure 3).

This concept extends to harmonic distortion, which is any alteration or corruption in the output waveform caused by nonlinearities in the device under test (DUT). For example, excessive harmonic distortion at the output of an amplifier can interfere with other communication bands. Measurements of total harmonic distortion (THD), also included in PowerSuite, calculate the ratio of the sum of the powers of all harmonic components relative to the power of the fundamental frequency (Figure 4).
Conclusion

Whether you’re involved in design, validation or production test, PowerSuite is the fast and efficient way to characterize complex wireless signals. In an X-Series signal analyzer with multi-touch, PowerSuite simplifies and automates measurements such as ACP, OBW, burst power, CCDF, harmonics, spurs, SEM, and TOI power.

Keysight’s X-Series signal analyzers are the benchmark for accessible performance that puts you closer to the answer by easily linking cause and effect. Across the full spectrum—from CXA to UXA—you’ll find the tools you need to design, test and deliver your next breakthrough.

For more information on PowerSuite, visit www.keysight.com/find/PowerSuite. To compare our X-Series analyzers, visit www.keysight.com/find/X-Series.
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Published in USA, April 10, 2018
5992-2905EN
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