MULTI-TONE TESTING MULTIPLIES TEST SOLUTIONS

BY PERFORMING MULTI-TONE testing, a large number of benefits can be achieved. For instance, equipment efficiency can be improved and equipment-under-test (EUT) can be tested under real-world threat conditions. Faster time-to-market for both new and enhanced products is another benefit of this approach. In the application note, "Multi-Tone: Testing, Theory and Practice," AR RF/Microwave Instrumentation discusses the multi-tone test methodology. The document explains how this approach can be implemented, as well as the advantages of using this method.

The application note begins with a basic definition of a multi-tone signal. An explanation of how these signals are represented in both the frequency- and time-domains is presented. Modern audio measurements are one example of an application that utilizes multi-tone signals. Intermodulation distortion (IMD) measurements are mentioned, as multi-tone signals are used to test the nonlinear distortion of amplifiers and receivers.

Various methods of generating multi-tone signals are explained. The traditional approach is to generate multiple signals by using multiple independent continuous-wave (CW) generators that are added together with a combiner. Alternately, multiple signals can be generated by using one vector signal generator (VSG) in place of multiple CW generators. A VSG can generate fixed or random initial phase sets, deliver accurate repeatable multi-tone signals, and is easily configurable by independently setting each tone. The third approach is to use multiple signal generators, multiple amplifiers, and multiple antennas. When using this technique, the signals are actually combined in free space. Furthermore, a comparison between analog signal generators and VSGs is provided.

Electromagnetic-compatibility (EMC) testing with multi-tone signals is analyzed. By using a VSG with a frequency selective power measurement device like a vector signal analyzer (VSA), multiple tones can be generated, measured, and controlled. An explanation of how test times can be reduced by using a multi-tone test method is provided. Real-world threats can also be simulated by using this test approach, as EUTs can be exposed to more than one tone at a time in real-world applications.

AR RF/Microwave Instrumentation, 160 School House Rd., Souderton, PA 18964-9990; (215) 723-8181; www.arworldwide.com

LOAD-PULL ANALYSIS WITH SOFTWARE ENABLES WAVE OF DESIGNS

LOAD-PULL ANALYSIS IS an important aspect of the design process of an amplifier, as this technique is often used to determine an appropriate load. Thus, by utilizing load-pull techniques, amplifiers can be designed more efficiently. In the application note, "Load-Pull Analysis Using NI AWR Software," National Instruments presents three design examples that take advantage of the load-pull technique. These designs are aided with the NI AWR Design Environment.

The first example demonstrates a simple load-pull analysis. The impedances that were obtained are presented on the Smith Chart. Additional graphs display saved data sets of measured output power versus gain compression, output power versus power-added efficiency (PAE), and input power versus output power. By taking advantage of the capabilities of the NI AWR software, designers can quickly learn the impact of load/source terminations on an amplifier's performance over swept input power. Power amplifier (PA) designers can therefore gain a better understanding of the tradeoffs between load impedance and gain compression behavior.

In the next example, a device was terminated in a matching network based on a microstrip transmission line transformer. The impedances that were obtained are once again displayed on the Smith Chart. Contour lines on the Smith Chart indicate where +45 dBm of output power and 70% PAE can be attained, respectively. The layout of the matching circuit is presented, as well as the performance characteristics of the device with the matching network.

The third example investigates circuit optimization by means of electromagnetic (EM) field analysis. By leveraging EM analysis, a more accurate representation of the matching network impedance can be achieved. Although EM analysis is often used in design verifications after the final design has been achieved, this example illustrates the accuracy of EM analysis when used earlier in the design process. The schematic and layout of the final project is presented. The output matching circuit for the transistor model was also created based on the measured load-pull file to investigate the current distribution through the matching structure.

National Instruments Corp., 11500 N Mopac Expwy., Austin, TX 78759-3504; (877) 388-1952; www.ni.com