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Saving Time and Money on Mobile Phone Production Testing

Walt Strickler, Keithley Instruments, Inc.

The right test setup can reduce test-system capital investment and increase throughput

Unlike most other electronic products, mobile telephones are 100 percent tested. Because of the numbers of cell phones manufactured, and the small profit on each unit, keeping the cost of test under control is vital. This article discusses the choice of equipment available for production testing of cells phones and explains the tradeoffs among them.

The old way: heavy iron

Testing mobile phones has traditionally involved a communications analyzer, which includes an RF source, a spectrum analyzer, and the ability to simulate a base station. There can be no argument that this arrangement gets the job done; it can test every parameter with great precision. The problem is the cost. A communications analyzer has more capabilities than necessary for the task and is expensive. It was a good solution during the wireless boom, because it was easy to employ an all-in-one solution, and test equipment funds were easy to obtain. With increasing price pressure, however, users are beginning to look at a less-expensive alternative: testing the receive and transmit functions separately and using test equipment appropriate for production, rather than development testing, thereby saving considerable up-front investment and significantly reducing test time. For example, one RF source and a power divider can test the receive function of four phones at once. For the transmit function the choice is a little more complicated.

Transmitter testing

The two main equipment choices for transmitter testing are a spectrum analyzer and an RF power analyzer. The spectrum analyzer has unmatched versatility, but it is more suited for the R&D lab than the production floor. It takes time to set up, it takes a significant time to run each part of the test, and it takes a long time for an operator to learn to use it well. It is, at heart, a piece of R&D equipment.

The RF power analyzer (***Figure 1***) is meant for a single task: production test of mobile phones. It works only at cell phone frequencies, and it measures only those parameters that are required for cell phone transmitter testing, for example, carrier frequency, primary channel power, upper and lower adjacent channel power, and upper and lower alternate channel power. It omits the waveform display as it is an unnecessary expense and is usually turned off on alternative products during production test.

Timing issues

By focusing on mobile phone production test, the RF power analyzer can do its job very quickly. It can make a 1.23MHz bandwidth cdmaOne primary power measurement and transfer the measurement to a computer in 6ms. It can measure a 3.84MHz bandwidth primary channel measurement in 10ms, and can make power measurements on consecutive 577 microsecond pulses occurring every 4.6ms in a GSM frame. It can make a total of five measurements in only 23ms (including PC command time and data transfer to the PC time): cdmaOne primary power, upper adjacent power, lower adjacent power, upper alternate power, and lower alternate power. A GSM primary power measurement and two spurious power measurements take only 14ms. This is anywhere from a quarter to a tenth of the time it would take with a spectrum analyzer, and the instrument costs less than half as much as a high-end spectrum analyzer.

Figure 1: The RF power analyzer is meant for production test of mobile phones. It works only at cell phone frequencies, and it measures only those parameters that are required for cell phone testing: carrier frequency, primary channel power, upper and lower adjacent channel power, and upper and lower alternate channel power.

Integrating the test system

In high-volume testing, it's important to automate as much of the process as possible. People are slower than automated systems, and they introduce errors into the system. One way to automate the process is to combine an RF power analyzer, signal source, and other instruments with a switching system and automatic DUT handling equipment. This equipment can be controlled via IEEE-488 (GPIB), which makes it possible to configure a completely automated test setup. While this method is quick, using a GPIB (IEEE-488) link to deliver commands to control each step of a test has drawbacks. GPIB has considerable communications overhead, and using GPIB generally means there's a PC running Windows® somewhere in the system. Rather than trying to depend on the sometimes-unpredictable timing of Windows, it's often better to let the instruments run themselves. The RF power analyzer can be set up to make power measurements based on a specific standard with a single command. It takes only five commands to set up the instrument and to make a primary power measurement and four alternate/adjacent channel measurements. Other methods take at least twice as many commands. The use of block transfer techniques makes data transfer extremely efficient. A high speed test control mode based on Device Dependent Commands (DDCs) eliminates the overhead associated with using conventional SCPI commands. Specialized command sequences acquire multiple measurements for power level calibration and frequency compensation calibration. The role of GPIB then becomes downloading the test program before the test and uploading the results to the PC afterwards, without interfering with the actual testing process.

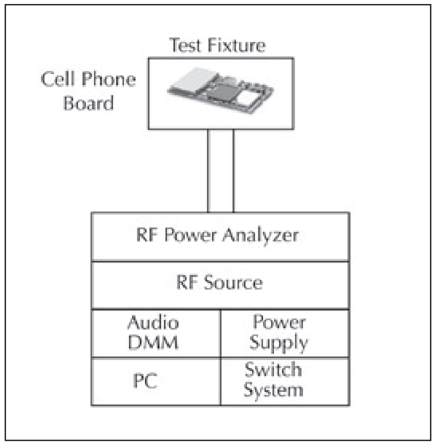

Figure 2: By combining an RF power analyzer, an RF source, a battery simulating power supply, and an audio analyzing DMM, it's possible to put together a high speed wireless phone transmitter/receiver calibration station at less cost than with other types of instruments and in no more than 6U of rack space.

Integrating the RF power analyzer into a larger system

As shown in ***Figure 2***, by combining an RF power analyzer, an RF source, a battery simulating power supply, and an audio analyzing DMM (***Figure 3***), it's possible to put together a high speed wireless phone transmitter/receiver calibration station at less cost than with other types of instruments, and in less space (no more than 6U of rack space). The RF power analyzer calibrates the transmitter circuitry and the RF source calibrates the wireless phone's receiver circuit. The battery charger/simulator monitors battery load currents in all states of operation and tests for proper charger system operation. The audio analyzing DMM determines total harmonic distortion and frequency response of the microphone and speaker circuits to verify that audio performance meets specification. Adding a switch system makes it possible to test multiple phones at a test station or to control test system automation.

Figure 3: An audio analyzing DMM is an essential part of a complete cell phone board testing system.

The next logical step is to tie all the instruments together with a PC and a component-handling system, so the testing can be done automatically. Such a system can run an entire sequence of tests without operator intervention, sending good boards on for product assembly and shunting bad boards to a queue for repair or disposal.

Conclusion

The cost of test is a significant part of the total cost of mobile phone manufacturing. Changing from laboratory-type instruments to instrumentation designed specifically for high-speed testing of mobile phones can significantly reduce that cost and speed production.

About the Author

Walt Strickler is the Senior Business Manager for the Wireless Business Unit at Keithley Instruments, Inc. and is responsible for strategic marketing and business development. Prior to coming to Keithley, Strickler spent nearly 10 years in various business development and engineering positions in the Space Communications Office and Space Electronics divisions at the National Aeronautic and Space Administration's (NASA's) Glenn Research Center. Strickler holds a B.S. in Electrical Engineering from the University of Akron and an MBA from the Weatherhead School of Management at Case Western Reserve University.

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Keithley Instruments, Inc. 28775 Aurora Road • Cleveland, Ohio 44139 • 440-248-0400 • Fax: 440-248-6168
1-888-KEITHLEY (534-8453) • www.keithley.com

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