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Telecommunications Test Equipment Must Meet Tight Space Demands While Providing High Throughput and Accuracy

Mark Hoersten
Keithley Instruments

The Communication Equipment Production Environment

Within the past several years, telecommunications have blossomed all over the world — new products and services are popping up like dandelions. One example is the fast-growing wireless industry, in which an ever-growing number of people worldwide are using cellular phones. Manufacturers are struggling to keep up with demand for the cellular phones and for the infrastructure equipment needed to cover more regions and handle increased cellular phone traffic. Furthermore, new technology is being integrated in the cellular phones to increase their functionality. Phones are or will be integrated with computers and personal digital assistant capabilities. They will link to the Internet and will link to computers. The constant influx of new technology and increasing demand for the new products creates a tremendous challenge in terms of manufacturing capacity.

Often, one of the bottlenecks in a telecommunication equipment plant is found in the production test area. One way to break the bottleneck is to replace or upgrade test equipment so that more tests can be done in less space at higher speeds. Cellular phones are a case in point.

Production tests on cellular phones fall into three broad categories: board level tests, operational adjustments, and final tests. In the first category, some of specific tests and adjustments include internal voltage levels, current drains, audio functionality, and power consumption.

Keithley Instruments, Inc.
28775 Aurora Road
Cleveland, Ohio 44139
(440) 248-0400
Fax: (440) 248-6168
www.keithley.com

Adjustments include bandwidth, carrier frequency, RF output, receiver sensitivity, and audio input/output levels. Typical tests in the third category are simulated calls and overall RF performance. Usually, these measurements and adjustments require the integration of several pieces of test equipment, along with a PC and associated test software. Typically, all the equipment is installed in a standard 19" wide rack mount.

The Search for Productivity Improvements

As production and test needs expand, the ideal situation is to add another test system to the rack, which could handle a second production line or increased throughput on the existing line. Depending on the size of existing test units, this may or may not be possible. So, a major consideration when specifying a new piece of equipment is its footprint and/or rack mount vertical height. By carefully selecting instruments for size as well as functionality, the test engineer can leave enough rack space for future expansion and higher throughput.

When considering new or replacement test equipment, look for instruments that have multiple functions in a single package. Some instrument manufacturers are combining functions formerly supplied by several pieces of equipment in a test system. They are also providing interfaces that are compatible with component handlers and other commonly used test fixtures. Manufacturers and users alike are recognizing the benefits of such packages, including reduced rack space, simplified setup, and less programming time.

One example is the Keithley Model 2400 SourceMeter® instrument, a new class of instrument introduced as a high-speed test solution for large volume component and equipment manufacturers. This unit combines precision voltage and current sources with a high resolution digital multimeter and measurement firmware to provide high throughput as well as a simplified package.

Quantifying the Cost of Ownership and ROI

Throughput affects an instrument's ROI, as does the number of test functions supplied at a given price. But as alluded to earlier, simplified packaging can reduce system integration costs, the expense of configuring equipment, and costs associated with the development of test programs. All of these can reduce the cost of ownership. Where a new, more productive instrument breaks a testing bottleneck, overall production capacity is increased and ROI enhanced for the entire line.

Still, a complete COST/ROI picture involves ongoing operation and maintenance costs and even training expense. Thoughtful instrument designs aimed at production test environments that make it easy for operators to learn and use the equipment also increase productivity and drives down the costs of testing and ATE ownership. So, look for ease-of-use features, such as front panel programming, a display with DMM simplicity, and built-in functions like pass/fail and comparative measurements.

Switching System is Key to High Throughput

In telecommunications equipment testing, the switching system often is the key to measurement integrity and high productivity. Achieving high throughput in a small package requires the careful selection of a switching system with appropriate I/O cards. Fortunately, the shrinking size and increasing functionality of ICs and other electronic modules are giving designers the opportunity to reduce package size.

This is not to say that a new instrument design automatically results in a smaller footprint with better performance. The instrument designer also has to consider the tradeoffs between speed, accuracy and cost. When making rapid multiple measurements with a switching matrix, it takes time for a scanning relay's contacts to settle (to achieve required accuracy), with contact bounce lasting about 3 to 6 milliseconds for dry reed relays. However, instrument manufacturers can reduce this time and increase switch density by using electronic relays that are faster and smaller, albeit more costly.

For example, Keithley's Model 7001 High Density Switch System takes up only a half rack space and has two slots that will accept a wide variety of switching cards for signals up to 1.3GHz. This package supports twice as many channels (80) in half the space compared to earlier switching systems.

Simplicity and Flexibility Don't Have to Compromise Performance

To reduce the time it takes to get a production test system up and running, instrument builders are giving heavy consideration to how easily instruments and switching devices can be integrated. One goal is to make it easier for the user to set up and program instruments and switching systems so they work together more effectively. Instrument design considerations include such things as flexible trigger I/O, ability to handle a wide range of signal types and levels, multiple electronic connectors, and compatible data communication protocols.

Being able to control measurements with a variety of trigger inputs provides a great deal of flexibility in setting up the test configuration. In this regard, the specifier should consider how easily the various system components can be integrated, including compatibility of physical connections between the trigger source and the triggered instruments. Also, the test engineer should be able to program the instruments and switching system easily to work together with appropriate trigger levels, signal types, delays, etc.

Making it easy to modify or expand test programs as requirements change is another feature needed in telecommunication test equipment. Many of today's instruments offer the user two programming options: front panel programming with a graphic status display or programming from a PC controller over an IEEE-488 bus using the SCPI (Standard Commands for Programmable Instruments) command set. In simpler applications, an RS-232 connection may be sufficient, but it's better when an instrument offers both types of connectivity and commonly used protocols to go with them.

Although a larger set of functions provides greater instrument flexibility, it may also mean higher cost if functions are added indiscriminately. Again, tradeoffs must be managed. On one hand, having an instrument with features for a complete set of functional tests, and the capability to meet changing requirements, is highly desirable. While more features may mean fewer instruments for a given set of tests, fewer features may mean lower cost. Understanding the test environment allows an instrument designer to build in the right set of features at the lowest possible cost.

For example, designing a programmable voltage supply for computer-controlled testing can eliminate the need for front panel controls and readouts. These functions are supplied by the computer and its display. The result is a substantially lower power source cost compared to those with comparable precision and all the usual manual controls and digital displays.

Good Packaging Improves Reliability

Often, production test equipment operates around the clock, seven days a week, under harsh manufacturing conditions. To provide reliable test capacity in this environment, instrument designers are improving the physical packaging of instrument circuits in key areas. For example, surface mount technology and circuit boards with no more than two layers can hold down manufacturing costs and improve reliability without sacrificing accuracy or other performance areas. Typically, instrument manufacturers are shooting for mean time between failures (MTBF) measured in thousands of hours.

Conclusion

Although measurement integrity and reproducibility are important in a production testing environment, instrument accuracy is almost taken as an article of faith. When considering new test equipment purchases, production and test engineers quickly turn their attention to productivity, space, and cost issues. Instrument manufacturers, such as Keithley, are addressing these issues by introducing new instruments that are easier to use, with smaller footprints, higher throughput, and better reliability than ever before.

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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

BELGIUM:	**Keithley Instruments B.V.**	Bergensesteenweg 709 • B-1600 Sint-Pieters-Leeuw • 02/363 00 40 • Fax: 02/363 00 64
CHINA:	**Keithley Instruments China**	Yuan Chen Xin Building, Room 705 • 12 Yumin Road, Dewai, Madian • Beijing 100029 • 8610-6202-2886 • Fax: 8610-6202-2892
FRANCE:	**Keithley Instruments Sarl**	3, allée des Garays • 91122 Palaiseau Cédex • 01 64 53 20 20 • Fax: 01 60 11 77 26
GERMANY:	**Keithley Instruments GmbH**	Landsberger Strasse 65 • D-82110 Germering • 089/84 93 07-40 • Fax: 089/84 93 07-34
GREAT BRITAIN:	**Keithley Instruments Ltd.**	The Minster • 58 Portman Road • Reading, Berkshire RG30 1EA • 0118-9 57 56 66 • Fax: 0118-9 59 64 69
INDIA:	**Keithley Instruments GmbH**	Flat 2B, WILLOCRISSA • 14, Rest House Crescent • Bangalore 560 001 • 91-80-509-1320/21 • Fax: 91-80-509-1322
ITALY:	**Keithley Instruments s.r.l.**	Viale San Gimignano, 38 • 20146 Milano • 02-48 39 16 01 • Fax: 02-48 30 22 74
KOREA:	**Keithley Instruments Korea**	2FL., URI Building • 2-14 Yangjae-Dong • Seocho-Gu, Seoul 137-130 • 82-2-574-7778 • Fax: 82-2-574-7838
NETHERLANDS:	**Keithley Instruments B.V.**	Postbus 559 • NL-4200 AN Gorinchem • 0183-635333 • Fax: 0183-630821
SWITZERLAND:	**Keithley Instruments SA**	Kriesbachstrasse 4 • 8600 Dübendorf • 01-821 94 44 • Fax: 01-820 30 81
TAIWAN:	**Keithley Instruments Taiwan**	1FL., 85 Po Ai Street • Hsinchu, Taiwan, R.O.C. • 886-3-572-9077• Fax: 886-3-572-9031

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