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Test & MEASUREMENT WORLD®

THE MAGAZINE FOR QUALITY IN ELECTRONICS

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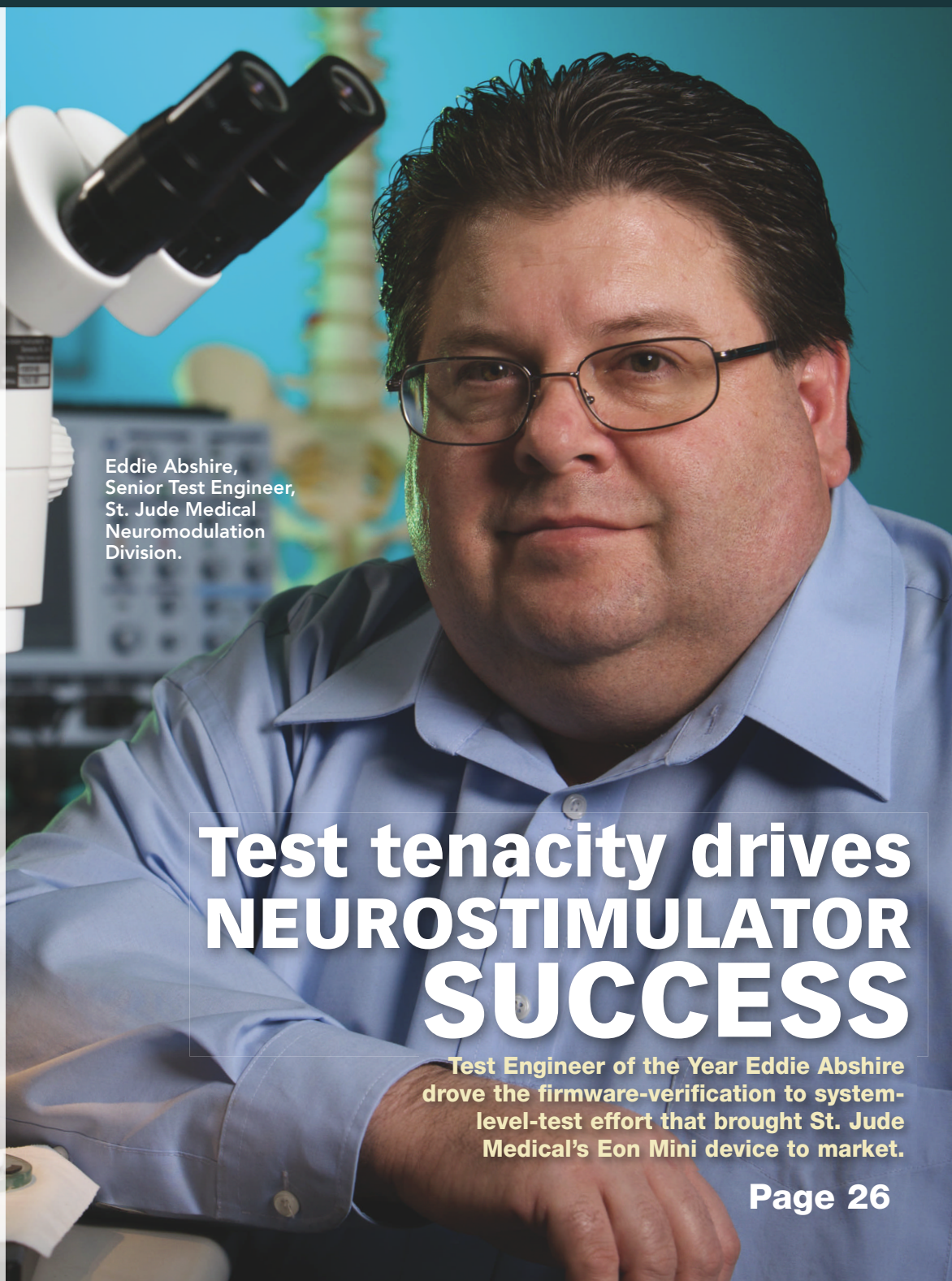

Eddie Abshire, Senior Test Engineer, St. Jude Medical Neuromodulation Division.

Test tenacity drives NEUROSTIMULATOR SUCCESS

Test Engineer of the Year Eddie Abshire drove the firmware-verification to system-level-test effort that brought St. Jude Medical's Eon Mini device to market.

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USB Data Acquisition. Simultaneous.
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Product Selection Chart

	Model	Summary	Analog Input Features: # of Channels	Throughput	Resolution	Input Range
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	DT9832	Simultaneous, 4 A/Ds @ 1.25MHz each, 500V isolation	4SE	1.25MHz per channel	16-bit	±10V
	DT9836	Simultaneous, up to 12 A/Ds @ 225kHz each, 500V isolation	6 or 12SE	225kHz per channel	16-bit	±5V, 10V
Temp.	TEMPpoint	Thermocouple, voltage, or RTD inputs, A/D and CJC per input, high accuracy	8-48	10Hz per channel	24-bit	±1.250V (0.15mV LSB)
	DT9805 DT9806	7 thermocouples, 1 CJC, temperature applications, 500V isolation	8DI/16SE	50kHz		±20mV, 100mV, 1V, 10V
Sound & Vibration	DT9837 DT9837A	4 IEPE (ICP) sensor inputs, tachometer, simultaneous A/Ds				V, 10V
	DT9841-VIB	8 IEPE (ICP) sensor inputs, simultaneous A/Ds with DSP, 500V isolation				10V
High Speed	DT9834	High-speed, up to 16 analog inputs, 500kHz, 16-bit, 500V isolation				±1.25V, 2.5V, 5V, 10V
	DT9834-32	High-speed, up to 32 analog inputs, 500kHz, 16-bit, 500V isolation	32SE		16-bit	±1.25V, 2.5V, 5V, 10V
se	DT9801 DT9802	Multifunction analog I/O, 100kHz, 12-bit, 500V isolation	16SE/8D	100kHz	12-bit	0-1.25V, 2.5V, 5V, 10V; ±1.25V, 2.5V, 5V, 10V

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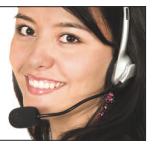

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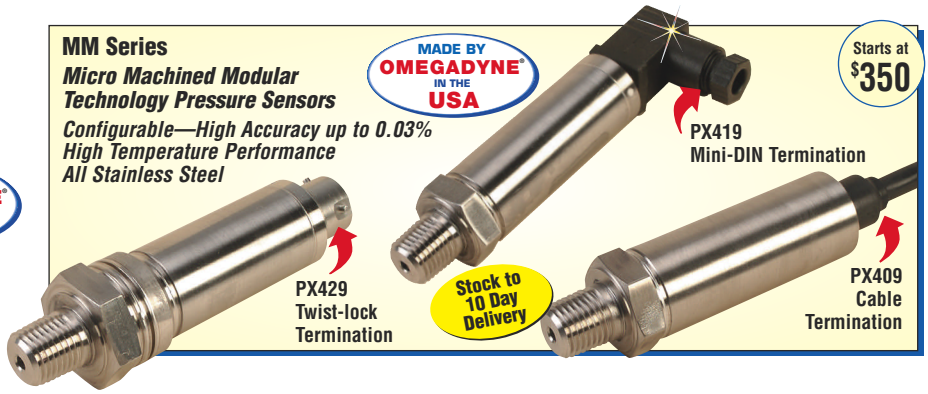

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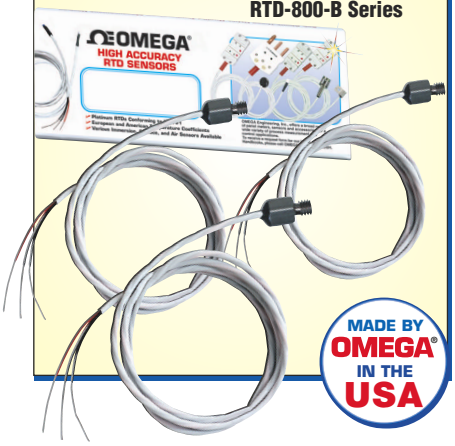

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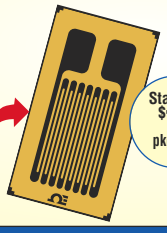

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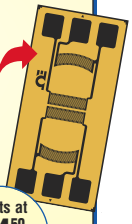

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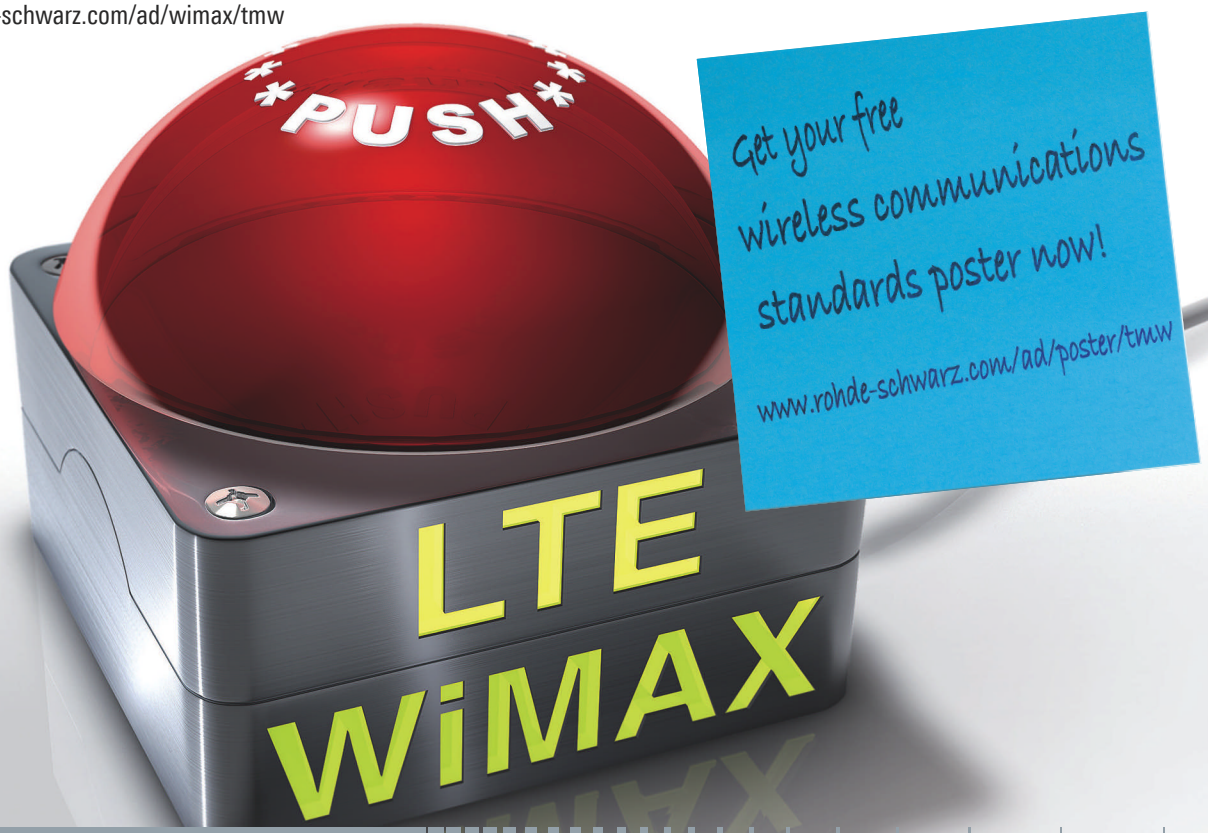

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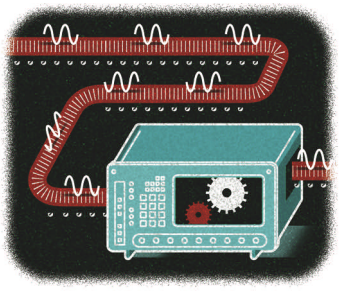

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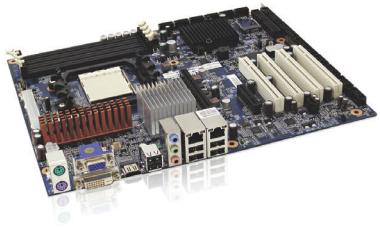

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Innovation Awards announced

Altera's Stratix IV 40-nm design team took the Innovator of the Year award at sibling publication *EDN*'s 19th Annual Innovation Awards ceremony, held March 30 in San Jose. Efforts that led to the team receiving the award included working with foundry TSMC on development of the 40-nm process while proceeding with the design of the FPGAs themselves and the associated design tools.

Awards in test-related categories went to Mentor Graphics and Agilent Technologies' RF Design Solution, Agilent's 90000A Series oscilloscopes, Tektronix's RSA3000B real-time spectrum analyzer, and Agilent's Cover-Extend Technology for printed-circuit-board test. See the full list of winners on the *EDN* site.

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The R&S®CMW500 wireless tester – for more capabilities, more standards and most return on investment

Fig. 1:
The R&S®CMW500 wideband radio communication tester addresses the complete test scenario from development to production. It covers all layers and all relevant standards.

Rohde&Schwarz is presenting a wideband radio communication tester for manufacturers of wireless devices and baseband and RF chipsets as well as for network operators. The tester combines unique advantages that make it a safe investment for years to come.

As a true one-box tester, the R&S®CMW500 fulfills the increasing requirements in the development and production of chipsets and wireless devices. Manufacturers are currently working intensively on the next product generations, with wireless devices evolving more and more into multistandard platforms. It goes without saying that the R&S®CMW500 supports all important cellular and noncellular standards. Moreover, the wideband radio communication tester makes it possible to test all the functional layers of a wireless device – from RF parameters to protocols to applications – using a single instrument. This, in turn, allows products to be made ready for the market fast and reliably.

Compared with existing technologies such as WCDMA or GSM, standards such as LTE and HSPA+ place more stringent requirements on test and measurement equipment, due to more complex modulation methods (64QAM), multi-antenna systems (MIMO – multiple input, multiple output) and expanded layer-1 configuration capabilities. Processes are becoming more complicated in the protocols as well. In close cooperation with wireless device manufacturers and chipset designers, Rohde&Schwarz has tailored the R&S®CMW500 specially to these requirements. It combines RF generator and RF analyzer functionality. At the same time, it controls the interplay of downlink and uplink signals by means of signaling. Featuring a modular, fit-for-the-future design, the tester promises a maximum return on investment – a crucial requirement for users' economic success.

Multistandard platform for development and production
The development of wireless communications standards is driven by higher data rates, lower latency and efficient use of resources. Chipset and wireless device manufacturers have to include a number of technologies to successfully launch their products on the market. They integrate different combinations of standards into their products. In addition, users of wireless devices demand mobility plus stable service quality across network boundaries. These requirements must be met. The R&S®CMW500 from Rohde&Schwarz supports all standards that are important for wireless devices in a single box (see Table 1). This allows manufacturers to achieve high test coverage with a minimum investment.

The one-box tester is ideal for both development and production. Development engineers need a solution that allows in-depth functional analysis of RF and protocol layers and that flexibly handles sophisticated measuring tasks. The multitechnology support allows users to test, for example, all the necessary handover and cell-selection scenarios across the different standards.

In production testing, on the other hand, the focus is on saving time and costs. Rohde&Schwarz has developed special approaches to this: By utilizing the R&S®Smart Alignment test concept, the R&S®CMW500 makes alignment times up to ten times faster than with conventional methods. Plus, the tester is optionally equipped with two channels, which allows parallel measurement of two DUTs using different standards. Since a maximum first pass yield is necessary in order to achieve minimum production costs, high standards were placed on absolute accuracy, repeatability and linearity during the development of the tester.

Consistent test concepts from development to production
An advantage that has been given hardly any attention up to now is the use of consistent test concepts in all phases involved in the creation of a product. Since the R&S®CMW500 can be used from development to production, it provides consistent, comparable results throughout. Errors that occur in production can be easily reproduced in development. Conversely, test scripts or alignment routines that were written during development can be used again later for the integration phase or in production. Since the test capabilities of the R&S®CMW500 can

Fig. 2: R&S®multi-evaluation RF measurements

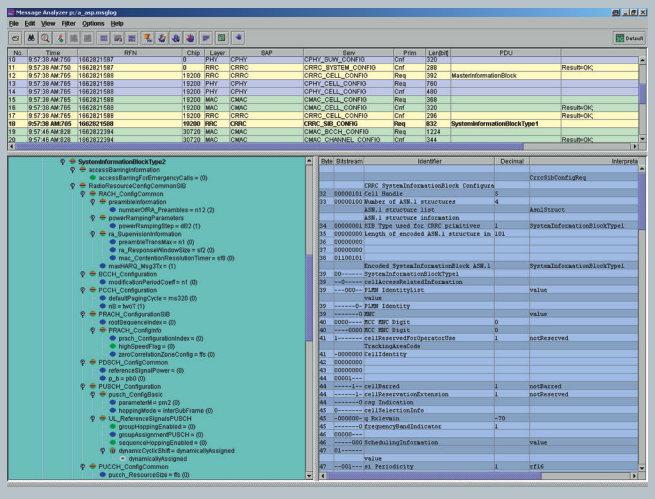

Fig. 3: protocol message analysis

usually be expanded by means of optional software enhancements, the tester can be used universally. Different development teams can thus use the same instrument for various tasks.

From RF to protocol to end-to-end application testing

The transmission of high data rates via the (less than ideal) radio interface channel involves highly complex processes at the protocol layers of the mobile station. Errored data packets must be corrected, and multiple data streams must be handled in parallel. These extremely fast processes such as hybrid automatic repeat request (HARQ) and MIMO run at layer 1 and layer 2. Since the R&S®CMW500 performs protocol analysis as well as hardware-oriented RF measurements simultaneously, it makes troubleshooting much simpler.

Already in the early phases of development, the test plans of manufacturers include RF parameter measurements of the physical layer unit and protocol analysis. To achieve test scenarios as realistic and practice-oriented as possible, solutions are required that allow end-to-end performance measurements across all layers. The high test depth provided by the R&S®CMW500 – achieved through the combination of RF, protocol and application tests – is ideal for this purpose.

Fit for the next generation

Modern test and measurement equipment should be suitable for use across all development and production cycles and flexibly scalable across all layers. The required test solution must support all relevant technologies for cost-sensitive production as well as for complex development requirements. The R&S®CMW500 provides chipset and mobile-phone manufacturers as well as network operators with a flexible, scalable platform for performing all the relevant tests for their products. Featuring a frequency range up to 6 GHz, the R&S®CMW500 is ideally prepared to meet future technological challenges. Its modular concept, which allows users to add new standards easily via optional updates, ensures minimum test costs plus high investment safety. The R&S®CMW500 is a single-box solution that performs all tasks that usually require multiple test instruments. It is thus a cost-efficient and space-saving solution that promises a high return on investment for years to come.

R&S®CMW500 platform at a glance

- Scalable wideband radio communication tester for development and production
- Multistandard solution
- Supports all layers (RF, protocol, application)
- Future-oriented hardware (frequency range optionally up to 6 GHz, MIMO-capable)
- Reduced test times and costs (alignment up to ten times faster)
- High precision and reproducibility

Table 1:
Supported Standards

GSM/(E)GPRS	Mobile WIMAX
WCDMA/HSPA	WLAN
LTE	Bluetooth
TD-SCDMA	DVB-T
CDMA2000 1xRTT	GPS
CDMA2000 1xEV-DO	

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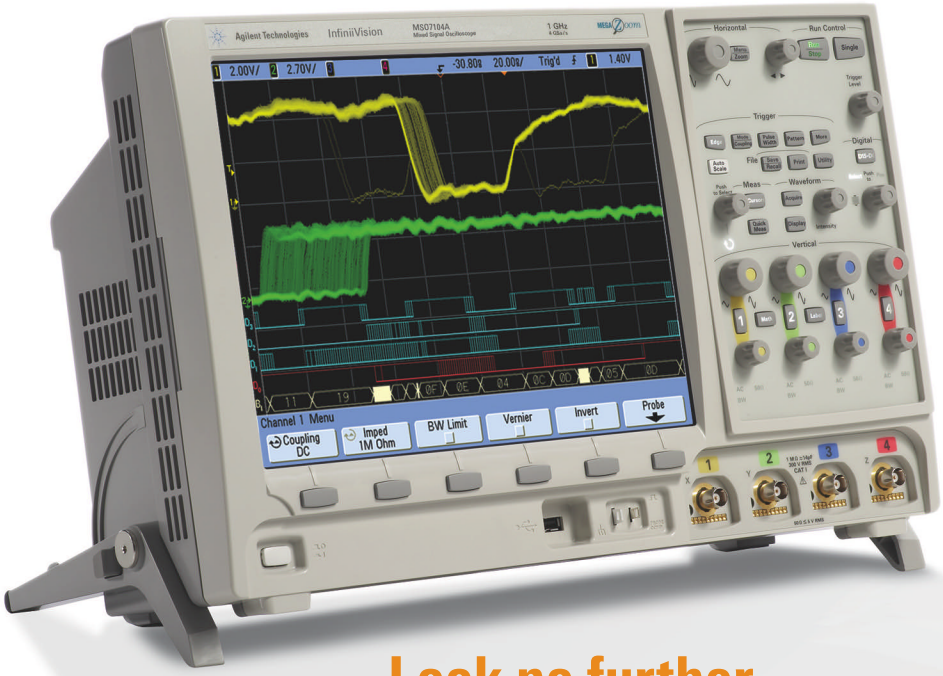

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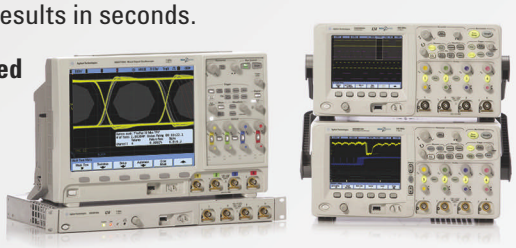

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RICK NELSON
EDITOR IN CHIEF

A base of innovation for 2009

Innovation is proceeding despite the economic downturn. We present some of the fruits of innovation from last year on p. 34, where we feature our Best in Test and Test Product of the Year winners. In addition, sibling publication *EDN* highlights its 19th Annual Innovation Award product and engineering-team winners, which were announced March 30, at www.edn.com/innovation.

Of course, these awards recognize innovations that occurred before the economic downturn hit. But innovations that occurred throughout 2008 represent a level of competence that should make it possible to turn the challenges of 2009 into opportunities.

Some of those challenges stem from environmental regulations—such as hazardous materials restrictions and recycling requirements—likely to be imposed by the Obama administration. But the administration's environmental concerns will also open up new opportunities. "As the recession prolongs, our semiconductor customer community will look at what Uncle Sam is investing in," said Rajeev Madhavan, chairman and CEO of Magma Design Automation. "Uncle Sam," Madhavan told me in a recent phone interview, "is going to invest in green energy."

What we don't need are naysayers who see opportunities as cause for complaint.

The innovation required to meet the needs of green applications, he said, will involve a move from big digital chips to mixed-signal designs. He said he's confident that a new category of electric vehicles are emerging, noting that government financial support for the automakers will probably be tied to whether they come out with electric vehicles. "So we are going to see a big injection of capital from Uncle Sam in these areas," he said, which will result in semiconductor companies migrating toward mixed-signal SOCs.

Other opportunities for environment-related innovation lie in what Tektronix technical marketing manager Darren McCarthy called "the greening of wireless"—which relates to the low-power infrastructure that can serve the coming wave of cellphone users who live on less than $2 per day. Tektronix is addressing that market, he said, by supporting real-world measurements of the linear and nonlinear performance of power amplifiers and other components necessary for building energy-efficient wireless equipment.

As for the economy, Cascade Microtech president and CEO Geoff Wild told me it's important to emphasize R&D during a recession to address customers' future technological requirements while controlling cost of ownership. He noted that a dialog with customers is critical and that "now is a good time to have that discussion, when people are not rushing around," and added that Cascade has a good cash position that lets it take advantage of the opportunity. Engineers at the maker of test stations, probes, probe cards, and sockets are emphasizing high-frequency measurements for automotive radar applications while investigating the test requirements of through-silicon vias.

As innovation proceeds in 2009, what we don't need are naysayers. For example, we don't need Parker Brugge, VP of environmental affairs and industry sustainability for the Consumer Electronics Association, complaining that government mandates on power limits for consumer electronics could stifle innovation. Unless the consumer electronics industry wants to go the way of the Detroit auto industry, it needs to look at such potential mandates as opportunities for innovation. T&MW

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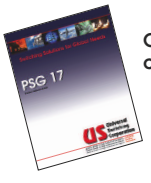

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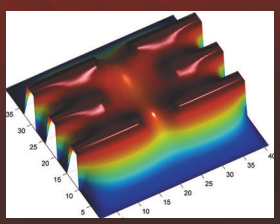

Modeling electric potential in a quantum dot. Contributed by Kim Young-Sang at HYU.

This example available at mathworks.com/ltc

Image: Kim Young-Sang, Jeong HeeJun, Quantum Device Lab, Hanyang Univ. ©2007 The MathWorks, Inc.

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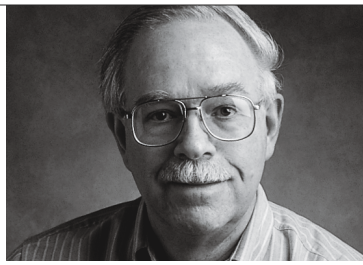
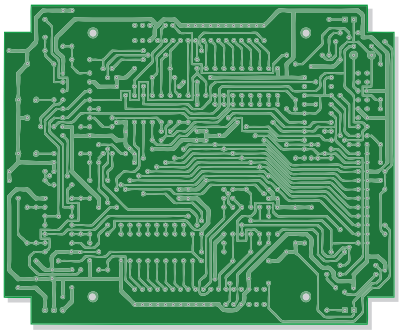


Alternative circuits

When Dr. Paul Eisler (1907–1995) graduated from the Technical University of Vienna in 1930, anti-Semitic prejudice ensured that no Austrian electronics firm would hire him because of his Jewish heritage. After a stint as a consultant, he helped start a weekly radio journal, and in the process he became acquainted with printing technologies and began to explore their application to mass-producing interconnection circuitry.

An attempted coup d'etat by Austrian Nazis in 1934 failed, but social upheaval put Dr. Eisler out of work again and he emigrated to England in 1936. An executive at Plessey who viewed Eisler's prototype printed-circuit radio rejected it, stating that the company's "Assembly work was done by girls, who are cheaper and more flexible...."



When World War II broke out, Eisler vowed to use his invention to help defeat Germany. More demonstrations and rejections followed, until the US National Bureau of Standards adopted the idea for the antiaircraft proximity fuze. Under assault by German V-1 buzz bombs and aircraft, England's antiaircraft gunners used proximity fuzes to good advantage, shooting down hundreds of V-1s and bombers.

Eisler's career as an inventor continued after the war. By 1957, Eisler worked as a freelance consultant for several start-up companies, many of which were doomed by economic hard times. Eisler offered a lesson for today: "As money ran out, expenditure for anything new was the first to be cut...."

In the mid-1950s, primitive PCBs (printed-circuit boards) appeared in consumer electronics. Armed only with 140-W soldering guns, service technicians attempted to repair the boards with disastrous results: Copper traces detached from paper-phenolic substrates, and the extraction of multipin components frequently damaged the boards. Technicians disparaged products containing PCBs. In fact, for years afterward, Zenith Electronics boasted that its radios and TVs featured "handcrafted" circuitry and "The quality goes in before the name goes on." Dr. Eisler's ill-fated invention faded into well-deserved obscurity.

Nowadays, we can take pride in the tens of millions of nimble-fingered young women and men who patiently hard-wire our computers, portable telephones, test instruments, and the myriad of other electronic appliances that make our information-based culture possible. Where would our industry be without their skilled hands? T&MW

TO LEARN MORE

Don't shred your cellphone looking for masses of wires—you'll only find Dr. Eisler's circuit boards inside. His autobiography is out of print, but your local library or used bookstore may have a copy; you may also find it in an online bookstore:

My Life with the Printed Circuit, by Paul Eisler (edited with notes by Mari Williams), Lehigh University Press, Bethlehem, PA. 1989. 170 pages.

An equally obscure book explores the proximity fuze's history:

The deadly fuze: the secret weapon of World War II, by Ralph Belknap Baldwin, Presidio Press, San Rafael, CA. 1980. 322 pages.

MAKE YOUR OWN PCBS

There's really no excuse for not making your own boards for small-quantity test fixtures and auxiliary circuits. At least two PCB fabricators offer free downloadable layout software:

ExpressPCB: www.expresspcb.com (ExpressPCB and ExpressSCH schematic-capture software)

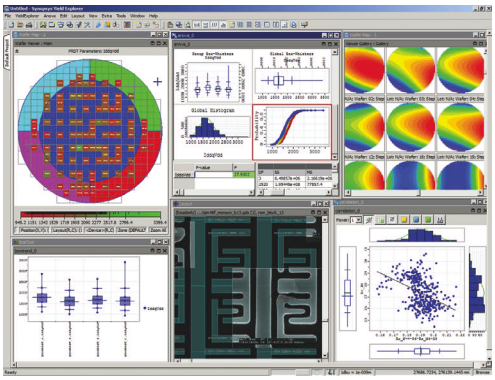
Advanced Circuits: www.4pcb.com (PCB Artist integrated schematic-capture and layout software)

Current versions of these layout packages produce proprietary-formatted output files, and they can print 1:1 scaled board drawings.

You can use a clothes iron to apply laser-printed toner patterns directly to copper-clad laminate and etch your own boards—this Web site describes the process: www.robotroom.com/PCB.html

If you prefer not to process your own boards, ExpressPCB and Advance Circuits will fabricate professional-quality prototype circuit boards.

Synopsys Yield Explorer supports volume diagnostics analysis



Synopsys has introduced Yield Explorer, a yield-management product that expedites the discovery and mitigation of yield limiters in ICs. When compared with traditional methods, Yield Explorer can accelerate the first-silicon debug time by an order of magnitude, according to Sagar Kekare, product marketing manager at Synopsys.

A key goal, Kekare said, is to reduce the need for re-spins. He explained that as many as 40% of designs require re-spins and that 60% of re-spins result from silicon-debug issues. Yield Explorer minimizes the need for such re-spins, Kekare said, by establishing connectivity between the design, simulation, manufacturing, and test domains to identify design-process-test interactions that cause low yield. According to Kekare, the software aggregates design, simulation, test, and manufacturing data; it supports automated statistical, data-mining, and visualization functions; and it tracks daily production trends to identify complex design-process-test interactions. He added that Yield Explorer is targeted at both product and design engineers.

To help engineers uncover systematic yield limiters, the GUI of Yield Explorer is structured around a layout viewer that permits superposition of test failures on the corresponding layers of physical design. Users also benefit from the Tcl scripting environment built into the GUI; this environment can accommodate large volumes of data with customer-specific data-naming and content requirements. Its extendable data model provides a way of assimilating new types and formats of data without any loss of information or efficiency. www.synopsys.com.

Test your wireless devices

ETS-Lindgren's Model 5247 RF shielded enclosure lets you measure transmitter power and receiver sensitivity on wireless devices at frequencies from 700 MHz to 6 GHz. You can use the chamber for precertification and production testing of cellphones, WiMAX devices, WiFi devices, Bluetooth devices, and others. The anechoic absorbers let you test your device indoors as they prevent reflected signals from interfering with wanted signals.

The low end of the Model 5247's frequency range will let you test devices in the 700-MHz band once reserved for UHF TV. The chamber provides more than 80 dB of RF isolation from outside interference.

To get signals into and out of the enclosure, you can use the bulkhead feed-through connector panel that includes one SMA connector, three type N connectors, one filtered DB25 connector, a six-line fiber-optic feed-through, and a ground stud. You can also use an optional USB fiber-optic media converter with a two-port hub. The enclosure includes a quick-change antenna mounting panel and a premounted antenna for receiving transmitted signals from your device. The antenna also lets you produce test signals for measuring receiver performance.

Price: $18,500. *ETS-Lindgren, www.ets-lindgren.com.*

Editors' CHOICE

Spreadtrum uses V93000 to test mobile DTV ICs

Verigy has announced that Spreadtrum Communications selected the V93000 system for production testing of its CMMB (China Multimedia Mobile Broadcasting) mobile digital television decoder/demodulator semiconductors. CMMB is the mobile television and multimedia standard developed and specified in China by the State Administration of Radio, Film, and Television.

"Being the leading demodulator IC provider in the CMMB market, which is expected to grow substantially in China over the next several years, we selected the V93000 for its high-accuracy analog-to-digital converter [ADC] test and fast integrated-circuit quiescent-current [I_{DDQ}] measurement capabilities," said Brian Chen, VP of operations at Spreadtrum. "The V93000 meets the accuracy and performance requirements of testing our highly integrated, high-quality CMMB demodulator and audio/video decoder designs."

"Spreadtrum is well-positioned to take advantage of China's fast-growing mobile TV market," said Pascal Ronde, VP of sales, service, and support at

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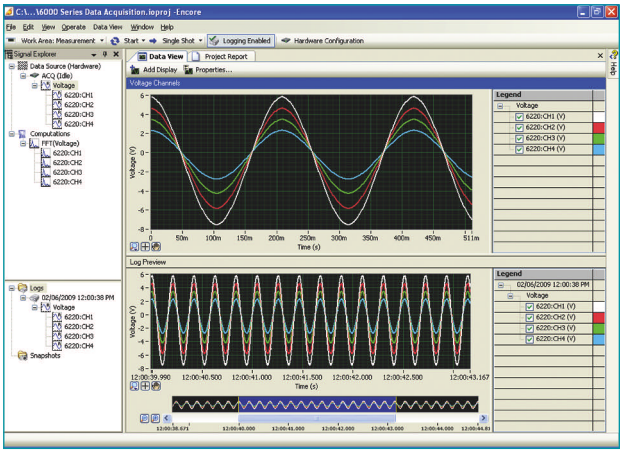

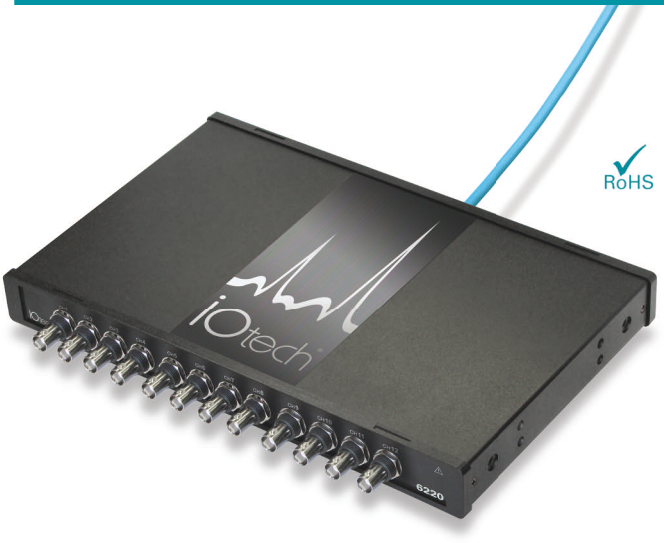

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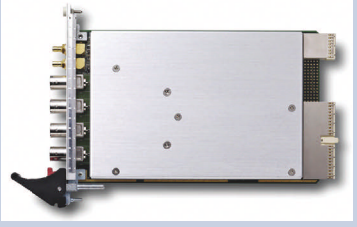
High-speed cards added to PXI digitizer line

Editors' CHOICE

ADLink has added three high-speed digitizer cards to its PXI product line. The four-channel PXI-9816, PXI-9826, and PXI-9846 sample at 10 Msamples/s, 20 Msamples/s, and 40 Msamples/s, respectively, all with 16-bit resolution. Channel bandwidth is 5 MHz, 10 MHz, and 20 MHz, depending on model. Each card can store up to 256 Msamples in its 512 Mbytes of data storage, shared among the four channels, and each channel has its own ADC, so you can simultaneously sample on all channels.



You can trigger an acquisition based on software, on a trigger pulse through the card's front-panel connector, on an analog trigger level (rising or falling) from any channel, from a PXI star trigger, or from the PXI trigger bus. Trigger modes include pretrigger, post-trigger, middle trigger, or delayed trigger. For timing, you can use the card's internal oscillator or you can supply your own clock signal. Software support includes drivers for Microsoft C++, Visual Basic, and National Instruments' LabView.

Base price: $1699. *ADLink Technology, www.adlinktech.com/digitizers.*

Verigy. "The flexibility and scalability of the V93000 will make it easy for Spreadtrum to add support for future design requirements. Verigy's large installed base of V93000s also provides the supply-chain flexibility needed to handle market fluctuations." www.spreadtrum.com; www.verigy.com.

Keithley discontinues parametric tester line

Keithley Instruments has announced that it is discontinuing its S600 series parametric test product line. The company will accept orders for the S600 testers until February 2010 and will continue to provide technical support and repair services through February 2014. Keithley claims that sales from the S600 series products have not represented a significant portion of total revenue since mid-2007.

"Orders for our S600 series product line serving [device companies and semiconductor manufacturing foundries] have been declining now for many quarters. Based on these facts and because we do not expect to be able to achieve results from this product line that are consistent with our business model, we have made the extremely difficult decision to discontinue the product line," said Joseph P. Keithley, the company's chairman, in a prepared statement. www.keithley.com.

CALENDAR

ESTECH, May 4–7, Schaumburg, IL. Institute of Environmental Sciences and Technology. *www.iest.org/estech/estech.htm.*

International Microwave Symposium, June 7–12, Boston, MA. *IEEE Microwave Theory and Techniques Society. www.ims2009.org.*

Semicon West, July 14–16, San Francisco, CA. *SEMI. www.semiconwest.org.*

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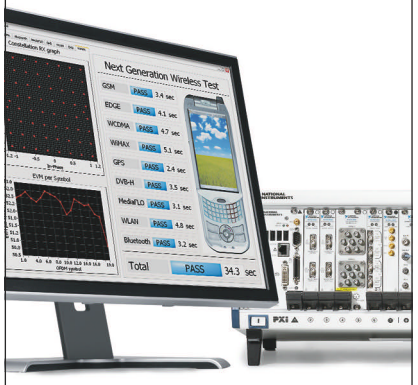

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PCI card slots are still available

Recently, I visited an online forum where one engineer asked for options for duplicating an existing PC-based test system that has four PCI expansion slots. His problem: Consumer-grade desktop PCs still have expansion slots, but not that many.

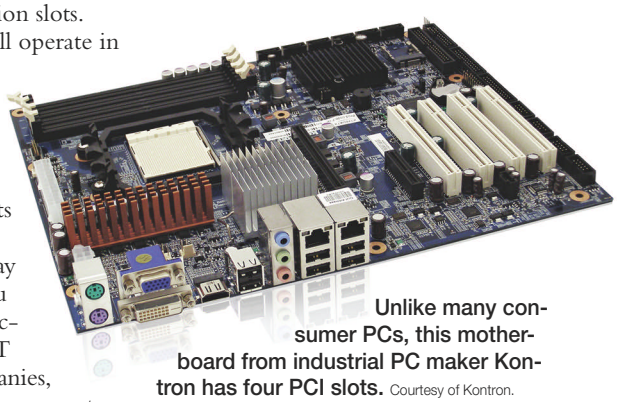
If you look at new Dell or HP desktop PCs, you're unlikely to find any with more than two expansion slots. Fred Blönnigen, CEO of Bustec, explained how the problem has affected business decisions: "We bought a Dell computer recently that didn't provide any PCI expansion slots. That's why we prefer to offer instruments that use industry-standard buses such as Ethernet and VXI over PCI, PCI Express, or USB."

The PCI bus, though, is far from dead in all but high-volume consumer PCs. You can find plenty of PCI slots if you look to industrial PCs. For example, an engineer in the online forum suggested industrial PC maker Kontron, which offers a PC motherboard with four PCI slots (**photo**).

But you don't have to go to industrial PCs to get PCI slots. Ted Briggs, chief technologist at GaGe Applied Technologies, said, "Intel, ASUS, Tyan, and other motherboard manufacturers provide full-featured motherboards with as many as six expansion slots. Most current PCI cards will operate in a PCI-X slot at 33-MHz speeds with 32-bit data buses." I couldn't, though, find an ASUS or Tyan motherboard with more than three PCI/PCI-X slots (plus two PCIe slots).

Briggs noted that you may run into a barrier when you need a PC for test or data acquisition: your company's IT department. In many companies, the IT department purchases computers, and you may have to get special approval to buy a "nonstandard" PC for the lab or production floor.

"PCI desktop PCs are throwaways now," said Bob Judd, marketing manager at United Electronic Industries. "A typical data-acquisition card can cost more than the computer housing it." High-end instrument cards can cost several thousand dollars, far exceeding the cost of a desktop PC.



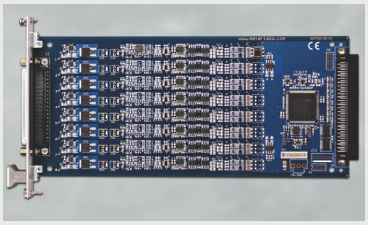
Unlike many consumer PCs, this motherboard from industrial PC maker Kontron has four PCI slots. Courtesy of Kontron.

Instrument makers not only still produce PCI cards, they're still developing new cards. In the last few months, we've received several press releases for PCI instrument cards such as digitizers, bus communicators, and frame grabbers. Not only are engineers still building PCI-based instrument systems, but as Briggs pointed out, "PCI interfaces are well documented and relatively easy to design."

Richard McDonell, product marketing manager at National Instruments, noted that "Plug-in modules are still preferred for rack-mount automated test-and-measurement applications. PCI-to-GPIB and PCIe-to-GPIB instrument cards remain the leading preference for instrument control." McDonell also noted that engineers prefer the PCI bus over USB or Ethernet because of PCI's low latency.

You can expect PCs with enough PCI slots to be available for years to come, even if not from consumer PC or motherboard makers. As testimony to this, both Judd and Briggs note that their companies still sell ISA instrument cards even though consumer PCs lost these slots years ago. T&MW

Transmit signals on 4–20-mA loops



Microstar Labs has added a card that lets you transmit control signals on eight 4–20-mA current loops. The MSXB 074 signal-interface module mounts in the company's DAP (Data Acquisition Processor) chassis and lets you build control loops for machinery and other devices. The card can produce 0 mA to 24 mA so you can test control loops for out-of-range conditions. www.mstarlabs.com.

Software analyzes eye diagrams

LeCroy's Eye Doctor II software lets the company's oscilloscopes emulate a signal at the point it enters an IC rather than at the IC package. Eye Doctor II removes de-emphasis or pre-emphasis from a signal measured at the transmitter output. It also adds de-emphasis or pre-emphasis, emulates a transmission channel, and compensates for cable losses. www.lecroy.com.

Simulate circuits and order parts

Sunstone Circuits and National Instruments now let you use NI Multisim to simulate a circuit, then order parts for your prototype. Using Sunstone's free PCB123 software, you can design a PCB and connect directly to Digi-Key to order components. www.sunstone.com.

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So what a nice surprise to find so many great features. Like the energy-saving "sleep" mode and the highly-evolved "help" screen that makes navigation simple and keeps information clear. And front panel displays that give you digital data on everything you need to know, right when you need to know it.

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PRATHIMA BOMMAKANTI
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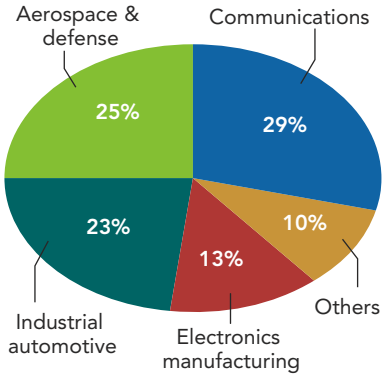
A bright spot in an ever-bleak economy

Cost cutting is one key strategy adopted by almost all businesses to sail through the current poor economic conditions. One option for users looking to keep a check on their capital expenditures is to invest in used equipment. With increasing pricing pressure and easy replacement of test equipment, you might expect that the acceptance of used test equipment would be growing rapidly. Yet, the used equipment market is facing constraints on a variety of fronts.

Participants in recent research we conducted indicated that there is increased demand for used equipment as buyers can save approximately 40% on the price while still receiving product support along with a warranty similar to when they purchase new equipment. But the purchase of used equipment still requires capital expenditures, and tight budgets can limit the growth of the used test equipment market, though at a lesser extent than the new equipment market.

Brokers have become more active in the used equipment market, as they offer more competitive prices than direct dealers and manufacturers. But with brokers, there may be little transparency regarding the condition of the equipment. This affects the buyer's confidence, which in turn affects end-user adoption of used equipment.



The communications market was the largest contributor of revenues in the worldwide used general-purpose test equipment market in 2008.

Recently, government officials have been recommending that companies continue making investments. One recommendation aimed at furthering that goal, which has a direct impact on the used equipment market, is that companies pay no interest when they buy new equipment to continue production. Such recommendations have been announced in France and Belgium, and other countries are expected to follow suit.

Another factor that puts pressure on the used equipment market is the option to rent equipment. There is greater demand for rental equipment than for used equipment, as such expenditure is covered under operational expenditures. A buyer's liberty to terminate the rental contract when the equipment is no longer needed proves to be a major driver for market growth. And end users perceive the absence of maintenance requirements as a key benefit to renting instead of purchasing.

But used equipment does offer advantages. To compete with the OEMs and enhance their customer base, dealers and brokers are focusing on offering high-quality equipment, and used equipment suppliers provide value-added services including calibration certificates, software upgrades, and guarantees. In addition, end users can strengthen their maintenance-and-support contracts in order to get more years out of the equipment purchased. The uncertain global economy, along with the availability of a wider range of choices when it comes to used equipment, has shifted the focus of end users from just quality to price. This is a key factor driving demand for used equipment. The used equipment market has been witnessing medium growth in the past. Going forward, it is expected that the growth will remain stable in 2009 and 2010. T&MW

PCB book-to-bill

Rigid PCB shipments are down 18.9% and bookings are down 30.7% in January 2009 from January 2008. The book-to-bill ratio for the North American rigid PCB industry in January 2009 slipped to 0.88. Flexible circuit shipments in January 2009 were up 16.6% and bookings were down 1.8% compared with January 2008. The North American flexible circuit book-to-bill ratio declined to 0.98. The combined (rigid and flex) industry book-to-bill ratio in January 2009 fell to 0.89. www.ipc.org.

Semiconductor equipment book-to-bill

North American-based semiconductor equipment manufacturers posted $285.6 million in orders in January 2009 (on a three-month average basis) and a book-to-bill ratio of 0.48. The three-month average of worldwide bookings in January 2009 was $285.6 million. The bookings figure is about 51% less than the final December 2008 level. The three-month average of worldwide billings in January 2009 was $592.2 million. www.semi.org.

EDGE dominates base-station deployment

EDGE will capture 40% of new base station deployments in 2009, reports In-Stat. "EDGE will still lead new base-station deployments for some time," said Allen Nogee, In-Stat analyst. "However, HSUPA is on the horizon. Strong deployments in the Asia Pacific, Western Europe, and North America promise to make the crossover point from EDGE to HSUPA in new deployments occur in 2011." The market-research firm presents its findings in the $3495 study, "Worldwide Cellular Base Station Forecast Driven by Data." www.in-stat.com.

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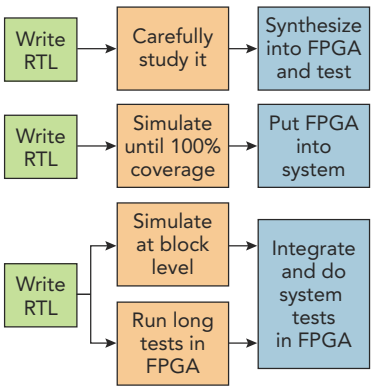
FPGA TEST

Simulate, emulate, or hope for the best?

Once upon a time, you verified a logic design for an FPGA (field-programmable gate array) by compiling it, loading it, and pushing the reset button on your evaluation board. But as FPGAs have become larger, this "Blow-and-Go" verification style, as Xilinx director of software product marketing Hitesh Patel terms it, has become counterproductive. The odds of creating a multimillion-gate design so close to perfection that you could debug it from the pins on the package are vanishingly small. So, design teams have begun to employ software-based simulation of the design, much as ASIC teams have done for years.

The huge advantage of simulation, of course, is access. You can observe any signal in an RTL design down to clock-cycle resolution. You can control the state of the design to whatever degree you find worthwhile. Observability and controllability are limited only by your knowledge of the RTL and your skill with the simulation environment. You can work interactively on limited areas of a design, or you can set up grand experiments that may run for days. And the relatively speedy setup of simulation runs makes it possible to try lots of things quickly.

But simulation also raises a series of important questions: Should the role of simulation in an FPGA design be the same as it is in an ASIC design? Should the verification team still, at some point, just put the design in the target FPGA and start testing it at-speed? If so, when is that point?



Three different approaches to blending simulation with in-circuit debug show the variety of verification flows that teams are using today.

To find out what design teams are doing today, I spoke with some of the people who work most closely with FPGA users. And for reference, I asked a few ASIC design teams who use FPGA prototypes in their verification processes for their views as well. The full online version of this article, which appeared in the February 19 issue of sibling publication *EDN*, explores the answers they gave, suggesting that large-FPGA designs can benefit from an ASIC-like design flow, despite the lack of established guidelines for blending simulation. You can link to the complete story from the online version of this article at www.tmworld.com/2009_04.

Ron Wilson, Executive Editor, EDN

AUDIO TEST

HDMI audio devices need rigorous tests

When you connect a DVD or Blu-ray player to an HDTV, you expect the player to send the highest quality video and audio that the TV can support. That doesn't always happen, even though HDMI (high-definition multimedia interface) equipment manufacturers attend "plugfests" before shipping their products to market. Plugfests offer an efficient way for manufacturers to test their products, but they can't guarantee that every DVD or Blu-ray player has been tested with every TV.

Tom Kite, VP of engineering at Audio Precision, attended a plugfest in October 2008 and found that not all HDMI products deliver the audio formats that they claim to support. An HDMI sink such as an HDTV contains a ROM that holds information about the audio and video formats that the TV supports. An HDMI source such as a Blu-ray player is responsible for reading the sink's EDID (extended display identification data) from the ROM and providing the highest quality formats that both devices can support. Sometimes, though, a sink's EDID contains information indicating that the sink can support formats that it really can't. That's where interoperability problems can occur.

At the plugfest, an engineer approached Kite about testing his SPDIF (Sony/Philips Digital Interconnect Format)-to-HDMI audio converter, which is both an HDMI source and sink. Upon analyzing the SPDIF input audio and the HDMI output audio, Kite discovered that the converter had truncated the last four bits of audio in a 24-bit stream. "The engineer couldn't believe it," said Kite. "He was ready to release the product and now had to fix the problem."

Audio Precision engineer Dave Mathew found issues with Blu-ray players. For example, one player that supported movies with LFE (low-frequency effects) in its audio was clipping the output signal. Apparently, not all players put out the same digital audio at the same amplitude levels.

To learn more about how Kite and Mathew conducted these tests, see the online version of this article at www.tmworld.com/2009_04 for a link to an interview. There, you will learn why losing four of 24 bits of audio can cause a TV to reject an incoming audio stream.

Martin Rowe, Senior Technical Editor

Serial port tests digital circuits

Check TTL signal levels using a PC's serial port and a simple application.

By Yury Magda, Consultant, Cherkassy, Ukraine

A PC's serial port provides signal lines that you can use to expand the number of input signals. With some additional circuitry tied to these lines, you can use the port to test digital TTL logic-level circuits. You just need to convert the TTL logic levels to RS-232 voltages and add a multiplexer to increase the number of signals that the serial port can sense.

The schematic in **Figure 1** uses a MAX232 IC to convert RS-232 voltage levels to TTL-logic levels. A 74HC4051 multiplexer lets you select any of four digital inputs and route them to the serial port. Software available from the online version of this article lets you control the RTS (ready to send) and DTR (data terminal ready) pins in the serial port that select the signal under test (www.tmworld.com/2009_04). The CTS (clear to send) pin then reads the signal under test into the PC.

Table 1. Binary codes for the multiplexer inputs

Signal to X pin	RTS bit	DTR bit
A0	0	0
A1	1	0
A2	0	1
A3	1	1

The four digital-input signals (A0–A3) from your device under test connect to the first four inputs (X0–X3) of the multiplexer. Only one of those signals can pass through to the X output (pin 3) at a time. By setting the appropriate binary code on the serial port's RTS and DTR lines, you can select the signal to pass through the multiplexer. **Table 1** describes the selection of inputs

The PC software, running on Windows XP, sequentially sets those binary combinations on the port's RTS and DTR lines and reads the digital signal on the CTS line. When you click the "Check status" button on the user interface, the software reads and displays the status of the selected bit.

The code is written in Microsoft C# .NET 2008, but it will run on the 2005 version as well. To create the application, launch the project wizard and select the "Windows Forms Application" from the

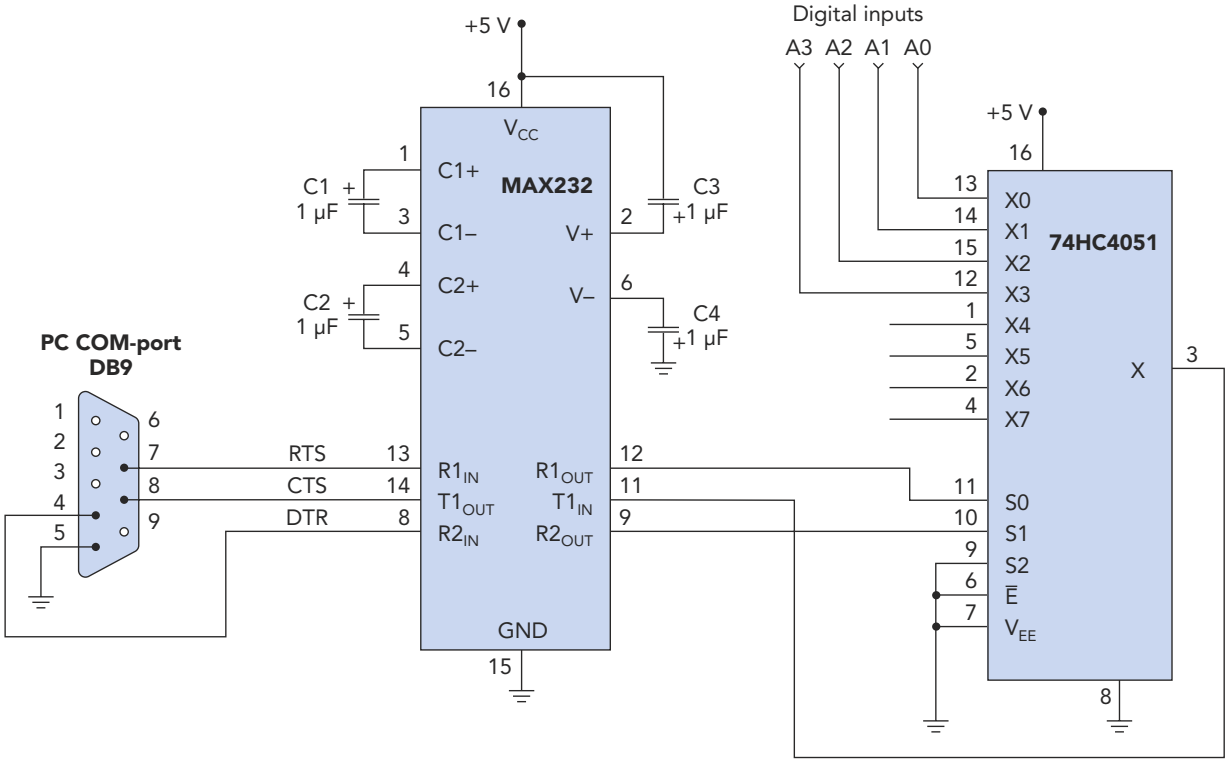


Figure 1 This circuit lets you pass up to four TLL-level signals to an RS-232 port to read their status.

C# .NET templates. Place the TextBox, Label, and Button components on the project's main form and assign titles to them. You should place the SerialPort component on the design area of the project. Then, set the appropriate parameters for the SerialPort component (port number, baud rate, data bits, and parity and stop bits).

When you build the circuit, follow all precautions in the manufacturers' data sheets concerning the wiring of the MAX232 and 74HC4051. Remember to place bypass capacitors as close as possible to the IC's power and ground. You can replace the MAX232 with a MAX225 or MAX233, neither of which requires external components. T&MW

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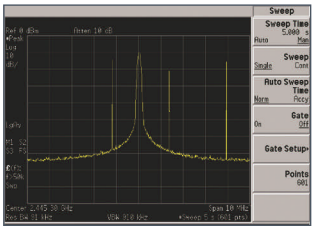
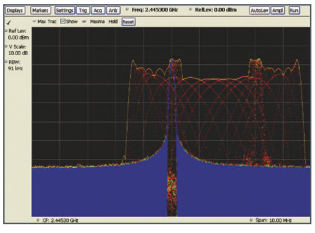


Traditional Spectrum Analyzer 5 seconds



Tektronix 5 seconds

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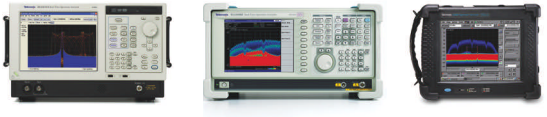

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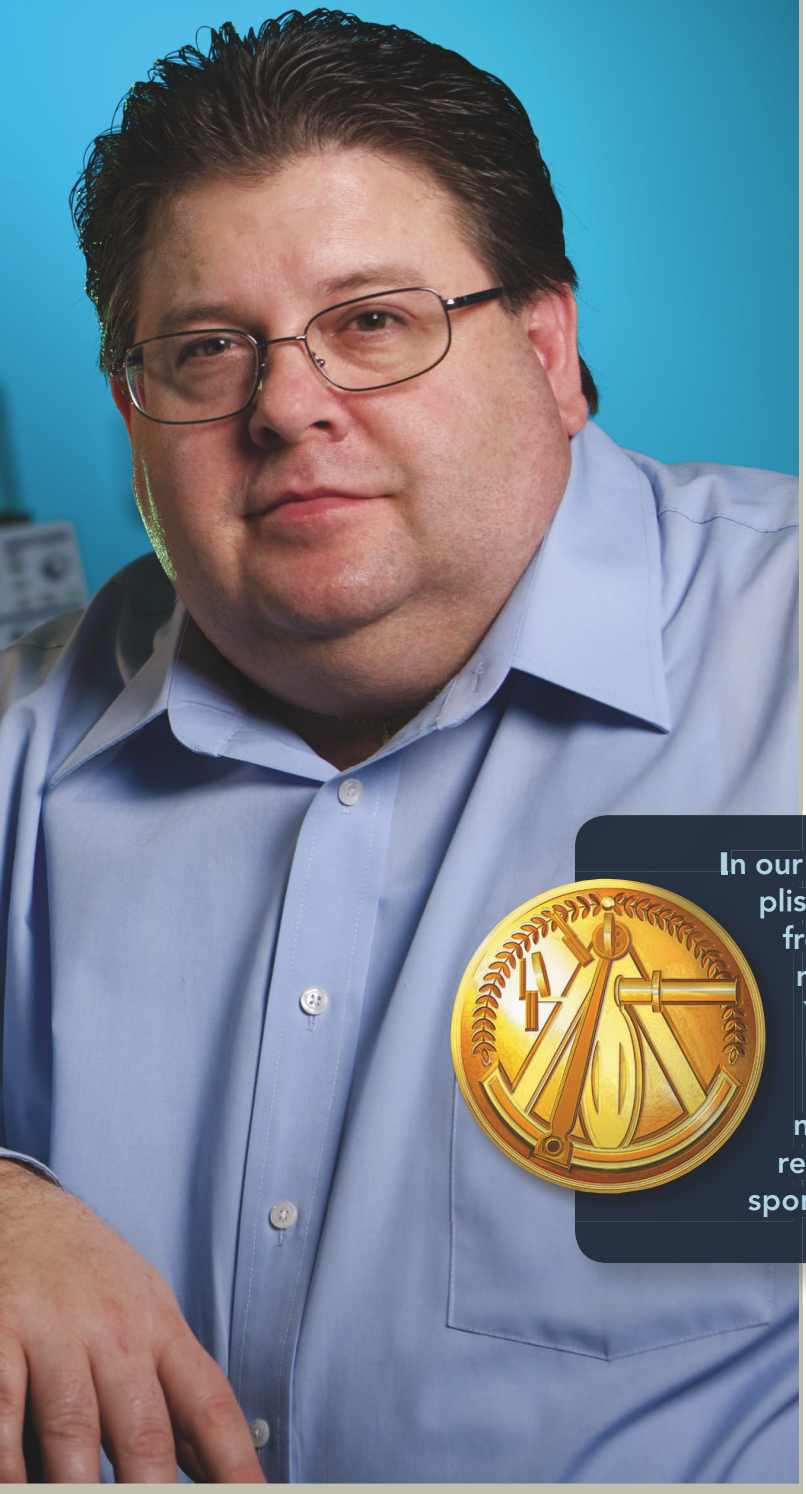
Eddie Abshire, Senior Test Engineer, St. Jude Medical Neuromodulation Division.

Test tenacity drives NEUROSTIMULATOR SUCCESS



Test Engineer of the Year Eddie Abshire drove the firmware-verification to system-level-test effort that brought St. Jude Medical's Eon Mini device to market.

BY RICK NELSON, EDITOR IN CHIEF

In our October 2008 issue, we profiled the accomplishments of six outstanding test engineers from various industries, and we asked our readers to vote for the Test Engineer of the Year. Your choice? Eddie Abshire of St. Jude Medical.

As part of his award, Abshire will designate an engineering or science program to receive a $10,000 grant, courtesy of award sponsor National Instruments.

PLANO, TX—Chronic pain sufferers may soon find relief, thanks to advances undertaken by the St. Jude Medical Neuromodulation Division. Those who benefit from the company's latest product—the Eon Mini device—will owe a portion of their gratitude to Eddie Abshire, who brought to the project his skills in testing embedded software and hardware as well as his tenacity in identifying and solving system problems. Because of his accomplishments, Abshire was nominated for the 2009 Test Engineer of the Year award and was voted as the winner by the readers of *Test & Measurement World*.

The Eon Mini is a rechargeable spinal-cord stimulator that treats chronic pain of the trunk and limbs as well as pain from failed back surgery. The device is typically implanted above the buttock area and sends mild electrical pulses to percutaneous leads or surgically implanted paddle leads located near the spinal cord. These pulses interrupt the pain signals as they travel to the brain. Slightly larger than a silver dollar, the device is less obtrusive and more comfortable for patients and requires a smaller incision than earlier, larger models. In April 2008, St. Jude Medical announced that the device had received US FDA (Food and Drug Administration) and European CE Mark approvals. In February 2009, the company announced Australian TGA (Therapeutic Goods Administration) approval of the device.

As a senior test engineer in the Neuromodulation Division's system-integration group, Abshire, whose 21-year career includes work in missile systems for Texas Instruments, helped St. Jude Medical verify the low-level firmware and electrical circuitry of the Eon Mini early in the project, and he worked closely with other engineers to characterize the functionality of the implantable device and to uncover potential problem areas. He then leveraged this knowledge to develop system-level tests to ensure correct functionality between the implant, the portable charger system, the programming software, and the controller a patient

JENSEN WALKER/GETTY IMAGES

uses to adjust the stimulation program throughout the day. Finally, he provided support that helped guide the device through the approval process.

Evolution of pain treatment

Rohan Hoare, VP of R&D at St. Jude Medical Neuromodulation Division, described the background that led to the development of the Eon Mini. "Neuromodulation was born out of a 2000-year-old idea of treating pain with electrical stimulation." An early proponent of

JENSEN WALKER/GETTY IMAGES

Ben Tranchina, VP of product development, described Abshire's role in the evolution of St. Jude Medical's neuromodulation products: "He actively participates in the design process as well as the later verification and validation phases."

such treatment was Scribonius Largus, a Roman physician who used torpedo fish for treatment of headaches and gout and described his efforts in his *Compositiones Medicae* in AD 46.

But the technology has come a long way in 2000 years, and the path that led to the development of the Eon Mini, said Hoare, began 40 years ago with the development of the first modern neurostimulator. Since that time, he said, neuromodulation has blossomed into a multibillion-dollar business. He added, "In the nearly 30 years our Neuromodulation Division has been in the business, the technology has evolved to provide a variety of patient treatment options and to give physicians more control over procedures and outcomes." The technology not only treats pain through spinal-cord stimulation, but St. Jude Medical also has clinical studies underway in the US for deep brain stimulation to treat conditions including Parkinson's disease and essential tremor and depression. Treatment for chronic migraine sufferers is now undergoing clinical studies.

"One of the most appealing and motivating factors for us is that as we continue to drive technology forward, we improve patient care and improve the physicians' ability to use the devices," Hoare said.

Ben Tranchina, VP of product development, described Abshire's role in the evolution of St. Jude Medical's neuromodulation products. "Eddie is involved early on in terms of helping to define the system and bring to it his knowledge of legacy devices," said Tranchina. "He actively participates in the design process as well as the later verification and validation phases." When asked if that makes Abshire a design engineer with test responsibilities rather than a member of a dedicated test group, Tranchina explained, "He is a true test engineer, but we found it's important to have his involvement early on as part of a cross-functional team. Having team members with experience in multiple disciplines enables us to be more proficient in delivering a quality product."

Abshire's responsibilities include supporting early device characterization as well as final system verification, which may involve testing prototypes in saline solutions. Although he's not part of the team that builds automated test equipment for manufacturing test, he advises that group as well, Tranchina said.

Said Hoare, "Fundamentally, Eddie plays a bookend role—up front, making sure specifications are set appropriately, and at the back end, making sure we have achieved what we set out to achieve."

Thanks comes at the end

Abshire is happy to play the bookend role, despite some reservations. Test at times can seem to be a pretty thankless job, he said, adding, "You work behind the scenes, and you report problems when everybody else wants the project to be moving along." But the effort is ultimately worth it. "The entire team thanks you at the end when the product is successful," he said.

The Eon Mini device is typically implanted above the buttock area and sends mild electrical pulses to leads located near the spinal cord. These pulses interrupt the pain signals as they travel to the brain. Courtesy of St. Jude Medical.

Abshire's technical career had its roots in courses he took at what was then the University of Southwest Louisiana, but, he said, family issues prompted him to suspend his studies and make money working in the oil industry. But after four or five years, he said, "I went running back to school—I wanted to get as far away from the Gulf of Mexico as possible"—except for the occasional fishing trip.

(continued)

The Eon Mini neurostimulator is approved to treat chronic pain of the trunk and limbs and pain from failed back surgery. Courtesy of St. Jude Medical.

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Waveforms	Sine, square, pulse, ramp, triangle, noise, DC	Sine, square, pulse, ramp, triangle, noise, DC	Sine, square, pulse, ramp, noise, DC, triangle
I/O	GPIB, USB, LAN	GPIB, USB, LAN	GBIB, RS-232
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Abshire then completed an associate's degree and immediately got recruited by Texas Instruments. "I came to Dallas in about 1987 and started working for TI in defense programs—in particular, missile systems." In about 10 years at TI, he said, "I got a lot of experience as far as troubleshooting and testing systems—anywhere from board level and component level up to system level."

"TI," he added, is often said to stand for "training institute," and he said he took full advantage, learning a lot about test at TI that he never would have been exposed to in a classroom setting. "It was good on-the-job training, and I rely on that experience in what I'm doing today," he said. Not that he sells classroom training short—he has continued to accumulate college credits through educational programs at TI and St. Jude Medical, but he commented that test is not an issue formally addressed by most college programs.

JENSEN WALKER/GETTY IMAGES

Rob Egemo, system-integration and test manager, shared a defense background with Abshire: "We both apply the same structure and discipline toward medical products that we applied to defense projects."

Military to medical

Abshire's work in defense coincided with the Gulf War, and he said, "We got to speak with a lot of military personnel who thanked us for building an effective system so that they were able to come home and see their families." That, he said, reinforced his motivation to "get these systems right and make them effective so our guys come home."

With the wind-down of the Gulf War, employment prospects in defense industries became more tenuous, although Abshire expressed the view that test remains a good field for job security: "It's a good niche, because not a lot of people are willing and able to do it." As for his own willingness, he said, "I really can't explain why, but test fits me."

In any event, Abshire was ready for a change and moved from defense to the medical industry, which, he said, shares a similar test philosophy. Both industries, he said, are regulated, with test requirements spelled out. In commercial applications, he noted, companies can go through the motion of testing or make a business decision to eliminate test altogether. That's not possible in military and medical applications.

Coincidentally, Abshire's immediate manager, Rob Egemo, shared a TI background with Abshire. "Eddie and I worked in the same building but didn't know each other then. I had a similar test background, working on military programs. I was an integration and test engineer back then, which served me well in becoming system-integration and test manager at St. Jude Medical."

Abshire, too, said he found that his defense experience carried over into the medical applications he works with now. "It's just as important to make sure that these systems are safe and that the patients enjoy a good quality of life. My approach with test is to make a system the best that it can be, whether for a military purpose or a medical purpose—both are just as important."

Added Egemo, "As Eddie said, we both apply the same structure and discipline toward medical products that we applied to defense projects. I've appreciated having Eddie work for me. He works well with the software folks, with the hardware engineers, and with the marketing folks, and he understands how the product is supposed to work and can figure out the details of how it's actually working."

Serving patients

Abshire's emphasis on test goes well beyond the minimum necessary for regulatory compliance: "You are at your most vulnerable when you are sick and go to a doctor to ask for help. What if the doctor implanted a device in you that would make you worse? I'd be ashamed to be a part of something like that."

As for quality, he continued, "We really take it seriously, and that comes down from Chris [Neuromodulation Division president Chris Chavez] and Rohan [Hoare, the VP of R&D]. They put a lot of trust in guys like us to make sure that the product is right. Of course we have schedules and budgets, but we're determined to get the product right, whatever it takes."

JENSEN WALKER/GETTY IMAGES

Rohan Hoare, VP of R&D, said, "Fundamentally, Eddie plays a bookend role—up front, making sure specifications are set appropriately, and at the back end, making sure we have achieved what we set out to achieve."

Hoare elaborated on the division's focus on quality: "Clearly everything we do impacts patients. We are always striving for the utmost quality. These devices

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are being used to treat people, and we have to be cognizant of that in everything we do with regard to design, manufacture, and test. You asked about a dedicated test group—one reason we have that is so we can ensure that we have the highest quality products we possibly can coming out of this organization."

VP of product development Tranchina added, "We believe, as Rohan said, in having the patient in the forefront when we are thinking about these products and understanding where they are going to be used. What value is it going to bring in terms of quality of life? We make an effort to both educate all of our teams, either through bringing in patients who have received therapy and having them speak, or having our employees travel along with some of our field representatives and see firsthand the good that the product is bringing to these patients—they are really changing their quality of life."

Abshire said he has not worked directly with patients, but Egemo said he values Abshire as a resource when problems arise. "Eddie has indirectly supported me and some of the other engineers when we have some technical issue or question" when dealing with patients who aren't responding as expected to the therapy. "I might fly out and meet with a field rep and doctor to figure out what the solution is."

Said Abshire, "We are dealing with human bodies, and we have a solution that is going to fit pretty well across most normal demographics, but there are always going to be variations that will cause a specific problem with some person." Egemo explained, "The problem could be physiological, a lead could have moved, the program might not be optimized, or it could be related to changes in a patient's pain pattern. There are a lot of variables. It can be challenging, but Eddie is always there as a resource to help me brainstorm what could be going on and help get to the bottom of what helps each patient."

Abshire concluded that although he's worked on a variety of defense and medical systems and devices, he's looking forward to extending his nearly four-year stint at St. Jude Medical. "I hope to work for this company as long as I can, because I really believe in the product, I believe in everything the company stands for, and the future looks very bright for us." T&MW

ON TMWorld.com

MORE ON NEUROSTIMULATION

See the online version of this article for more information on neurostimulation, including a time line of pain-treatment methods, profiles of patients who have benefited from neurostimulator devices, and video demonstrations.

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T&MW ANNOUNCES

BY *TEST & MEASUREMENT WORLD* STAFF

Here, we present the winners of our annual Best in Test awards, which recognize important and innovative new products and services in the electronics test and measurement industry. We announced the finalists for the Best in Test awards in our December/January issue and asked readers to vote for their favorites. The 2009 Best of Test award winner in each of the 15 product categories is listed below. The overall top vote getter—Wi-Fi Data Acquisition Devices from National Instruments—has been named the Test Product of the Year (see facing page).

The annual Test of Time award honors a product that continues to provide state-of-the-art service five years or more after its introduction. We named the six finalists for this award in our December/January issue; from those, our readers have chosen TestKompress ATPG Tool from Mentor Graphics as the 2009 Test of Time award recipient (see facing page).

2009 Best in Test Award Winners

Audio/video and multimedia
Multimedia Test System
VI Technology

Board and system test and configuration
Cover-Extend Technology
Agilent Technologies

Boundary scan
JT 37x7 Rack-Mountable Instrument
JTAG Technologies

Data acquisition
Wi-Fi Data Acquisition Devices
National Instruments

EDA/DFx/Test data-analysis software
Global Test Operations Solution
OptimalTest

General-purpose instruments (non-oscilloscopes)
287 True-rms Electronics Logging Multimeter
Fluke

Machine vision and inspection
OptiCon TurboLine AOI System
GOEPEL electronic

Network physical-layer test
MW90010A Coherent OTDR
Anritsu

Oscilloscopes
WavePro 7 Zi
LeCroy

Protocol analyzers
TestCenter 3000 Series Module
Spirent Communications

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DigRF V4 Exerciser/Analyzer
Agilent Technologies

RF/microwave instruments: General purpose
6.6 GHz PXI Express RF Modular Instruments
National Instruments

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AWARD WINNERS

TEST PRODUCT OF THE YEAR

Wi-Fi Data Acquisition Device

National Instruments www.ni.com

The Wi-Fi Data Acquisition (DAQ) devices are a family of wireless measurement devices that make it easy to set up and acquire wireless measurements without compromising on the security or performance of a cabled solution. The devices combine IEEE 802.11 wireless or Ethernet communication, direct sensor connectivity, and LabView software for remote real-time monitoring and instantaneous analysis of electrical, physical, mechanical, and acoustical dynamic signals.

Wi-Fi DAQ devices can stream data on each channel at rates of more than 50 ksamples/s with 24 bits of resolution. In addition, built-in NIST-approved 128-bit AES encryption and advanced network authentication methods offer the highest commercially available network security, according to NI.

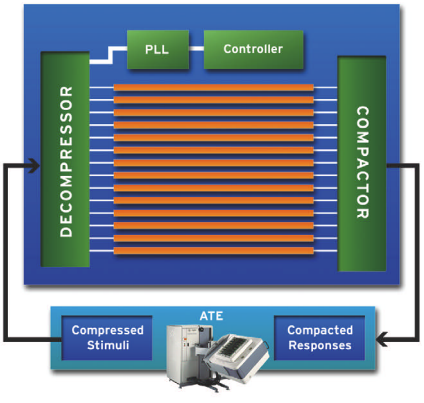
With Wi-Fi DAQ, you can easily incorporate secure wireless connectivity into PC-based measurement or control systems as well as remote monitoring applications. Engineers can also leverage Wi-Fi DAQ C Series I/O modules interchangeably with NI's CompactDAQ, CompactRIO, and single-module USB carriers.

The Wi-Fi DAQ product family comprises five wireless device models and numerous accessories, with prices starting at $699.

TEST OF TIME

TestKompress ATPG Tool

Mentor Graphics www.mentor.com



The TestKompress ATPG (automatic test-pattern generation) tool includes embedded test compression for delivering high-quality scan test while lowering cost. As test requirements grow, compression is needed to keep high-quality testing of ICs feasible within a high-throughput production environment. It simply isn't possible to apply test vectors to an advanced technology IC without it.

With TestKompress, test access I/O can be reduced to three pins, thereby facilitating multisite testing, increasing device packaging options, and streamlining modular design techniques. Its EDT (Embedded Deterministic Test) technology gives consistent results for design types ranging from microprocessors to automotive electronics, without any loss of fault coverage.

TestKompress was introduced by adding pattern compression capability to the FastScan ATPG engine in 2001. Initial compression levels of 10X have evolved to levels exceeding 100X. Added features include distributed processing for faster execution and direct failure diagnosis without the need for special patterns. Designs can employ multiple compression levels so testing is optimized for wafer test, package test, and burn-in. A vectorless test, LBIST (logic built-in self-test), can be added to enable a thorough system test while the device is in the end application.

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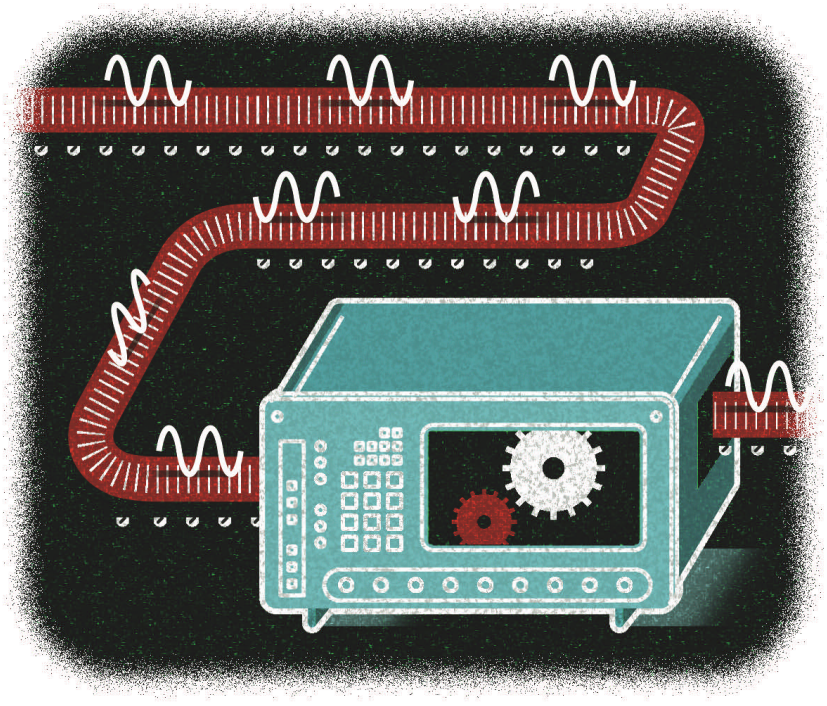

DANIEL GUIDERA

Many test engineers sidestep the built-in capabilities in today's RF test equipment and devise their own algorithms, applications, and automated tests.

RF ENGINEERS AUTOMATE TESTS

BY MARTIN ROWE, SENIOR TECHNICAL EDITOR

RF testing for devices such as amplifiers and RFICs can be tedious work. Such devices work over a wide range of frequencies and power levels, and they must meet specifications over temperature and power-supply ranges. Testing for all of those conditions can generate loads of data. Fortunately, automation can cut test time and help you make sense of all that information.

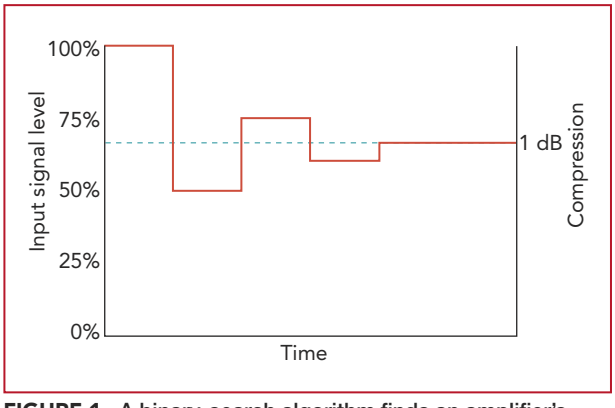

FIGURE 1. A binary-search algorithm finds an amplifier's 1-dB compression point. Courtesy of L-3 Communications.

Just because you have a spectrum analyzer, network analyzer, or power meter with features that can improve testing, you may not be able to use the instrument if you need to maintain compatibility with older models. If you're testing cutting-edge RF products, your test equipment may not have the necessary dedicated features and you'll have to develop your own.

Test engineer Bill Drago of L-3 Communications Narda Microwave East supports production of RF amplifiers, downconverters, upconverters, and transceivers that operate in the C band through the Ka Band. These products often remain in production for years, which is why Drago can't take advantage of features in newer test equipment that can automate many of the measurements he needs to make—he developed his tests before such automation was available, and he needs all of his test instruments to continue to follow identical procedures. Thus, he has written software that performs automated measurements such as amplifier gain, 1-dB compression, IMD (intermodulation distortion), return loss, spurious noise, and noise figure. Drago explained why spurious-noise testing is im-

portant. "Downconverters and upconverters mix an input signal with an LO [local oscillator]," he said. "The converter's LO must be tuned to customer specifications within a certain range and step size. The converter needs a frequency synthesizer that's programmable with specified steps over its frequency range. The frequency synthesizer can't introduce any spurs into the converter, so we must test for that."

To measure spurious noise, Drago uses an Agilent Technologies' spectrum analyzer to perform a frequency sweep through an approximately 1-GHz band around the carrier. He usually breaks that sweep into a number of smaller sweeps, each consisting of 601 frequency points. Each step might be a few kilohertz wide.

If Drago used one large sweep, its step size and the instrument's RBW (resolution bandwidth) would be too wide and might miss a spur. He adjusts sweep span and RBW so that spurs don't fall between the points in a sweep.

Using a number of smaller sweeps is also faster than a single sweep for the RBW that Drago needs. He noted that a single sweep could take as long as an hour, depending on RBW and frequency. Furthermore, smaller sweeps can reveal failures sooner than waiting for a large sweep to complete.

Although some of Drago's spectrum analyzers have built-in test applications for measuring spurious noise, he doesn't use them, because not all of his spectrum analyzers have that function. If he were to use that feature, he might not have a replacement instrument for the production line should that instrument fail. Instead, he wrote his own applications, and by keeping the test applications outside the instrument, he can use any spectrum analyzer that's available.

Drago has written several other test programs, including one that measures an amplifier's 1-dB compression point. This test is built into some, but not all, of his VNAs (vector network analyzers). The algorithm uses a binary-search process, similar to that used by a successive-approximation analog-to-digital converter. He starts with an input signal from an Agilent RF signal generator that's the highest possible value for the amplifier under test. He then measures output power with an Agilent RF power meter. If the output signal is compressed by more than 1 dB, he cuts the input signal in half, then increases it or decreases it by half of that value until he finds the 1-dB compression point (**Figure 1**).

Finding harmonics

Michael Ford is a test engineer at Comtech PST, a manufacturer of RF amplifiers that operate from 500 MHz to 6 GHz at power levels from 100 W to 10 kW.

"We write our own routines using a modular format because it lets us use equipment from multiple vendors such as Agilent or Rohde & Schwarz. We use the same test routines and just change instrument command libraries." For example, his routine for spurious noise measurements works with spectrum analyzers from either manufacturer.

Ford's routines for measuring harmonics of a carrier frequency use variables for parameters such as center frequency, span, RBW, and VBW (video bandwidth). After receiving those parameters, the routine runs sweeps at multiples of the carrier frequency to find the power of its harmonics. The results go to a spreadsheet for analysis.

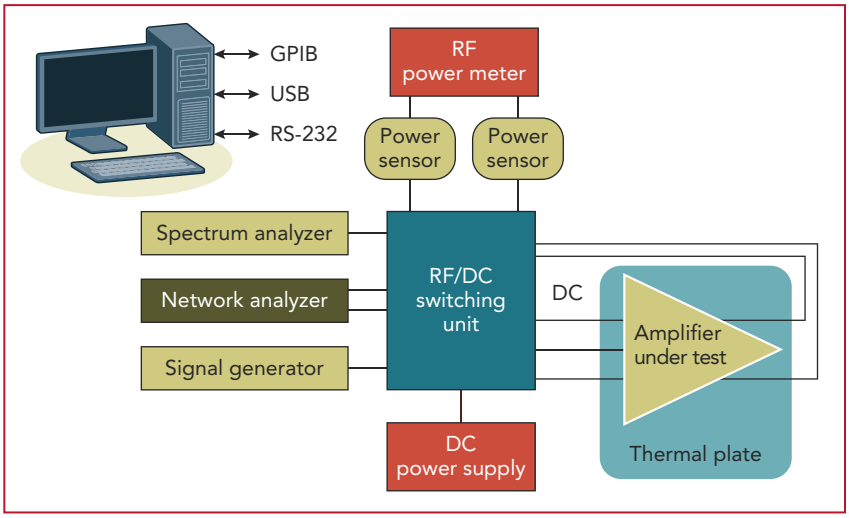

FIGURE 2. A typical automated tester for RF amplifiers uses a power meter, spectrum analyzer, network analyzer, and signal generator. Courtesy of Comtech PST.

Ford's typical test station contains an RF signal generator, a spectrum analyzer, a network analyzer, a power meter, and RF switches (**Figure 2**). A USB digital I/O module from Measurement Computing controls the RF switches. The amplifiers mount on an environmental plate that changes their temperature. The test station measures gain, output power, harmonic distortion, IMD, efficiency, spurious noise, and harmonics.

On occasion, Ford will use an instrument's built-in functions. For example, he might measure spurious noise with an Agilent spectrum analyzer's built-in application. But he also writes his own applications to make those measurements if his instrument doesn't have that feature.

Ford supports both engineering and production. When making measurements for engineering evaluations, he uses built-in functions such as spurious noise and harmonic analysis. For production, Ford always uses his own software routines.

Multiple cellular networks

While Drago and Ford must support products that remain in production for years, engineers developing tests for RFICs face different problems and have different reasons for not always using an instrument's automation features.

Joe Flynn is a staff engineer at fabless semiconductor company Sequoia Communications. He evaluates RFICs that support several cellular wireless standards (Ref. 1). He has developed several test stations for evaluating the devices. "We characterize transceivers for gain, noise figure, IMD, cross modulation, and EVM [error-vector magnitude]." Flynn also develops his own automation tools, but

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measurement speed was his critical feature in choosing equipment.

Because RFICs transmit and receive modulated signals, Flynn's test stations include spectrum analyzers for characterizing frequency content, and they include modulation analyzers for characterizing modulated content. **Figure 3** shows a simplified diagram of a system that tests the receivers in Sequoia's ICs. The receiver test bench lets Flynn evaluate how a receiver performs in the presence of undesired blocking signals such as those from simulated cellular base stations, other cellphones, and broadcast radio stations.

test analysis tools to view engineering data. For example, he might want to see the distribution of parameters such as gain, return loss, and current consumption across the 100 parts in a preproduction run. "When we look at the data, we get a feel for how production parts will behave," he said.

Sequoia also developed an in-house Visual Basic Web-based tool that manipulates the bench-characterization data. The tool uses .netCharting software (dotnetcharting.com) to create some 1200 data plots on the parts. "When we have a test review, the tool lets us find

ments are frequency and phase locked, which synchronizes the measurements. He then had to optimize RBW and sweep time to minimize test time. "When I started, a single SNR measurement on one channel at one blocker frequency took about a second. Now, I make each measurement in 18 ms."

Flynn also learned how to minimize test time by using both LAN and GPIB communications. Most instruments in the test system use GPIB because, according to Flynn, "You can't beat GPIB when sending a series of short commands. The overhead needed to use Ethernet is only apparent when transferring large blocks of data." Thus, he uses Ethernet for the logic analyzer, which collects data on digital baseband signals. He also uses a dedicated Gigabit Ethernet LAN card to avoid packet collisions between the test equipment and the corporate network. He uses three GPIB cards to cover all of the test equipment.

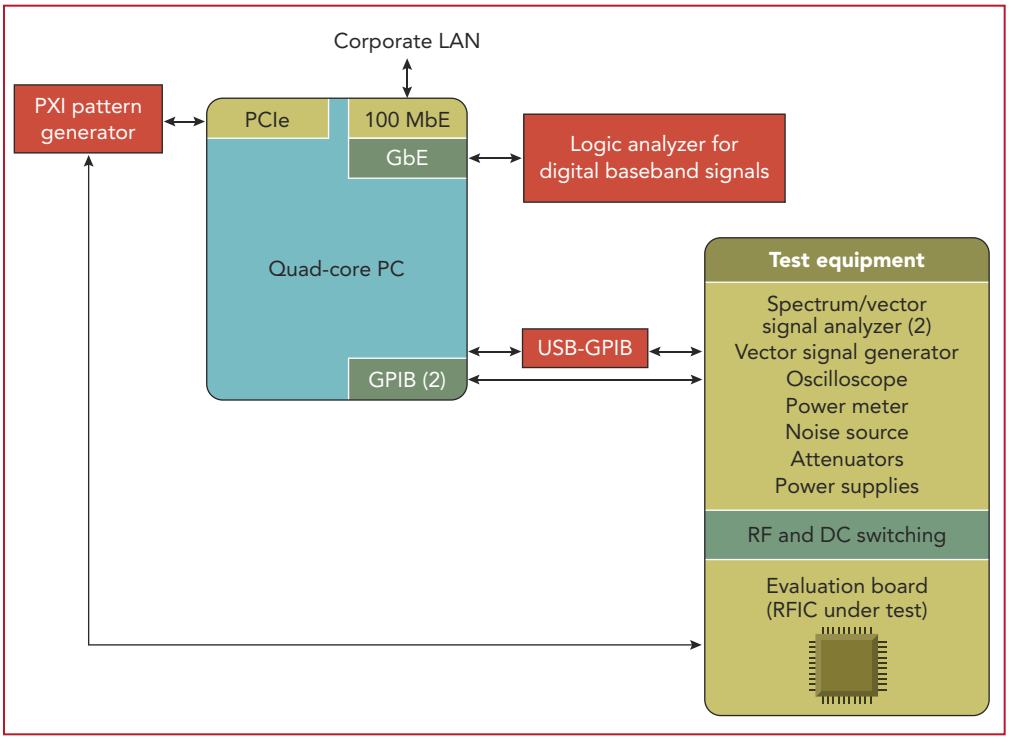

FIGURE 3. An RFIC test station for testing receivers uses two GPIB cards and a LAN to communicate with instruments. Courtesy of Sequoia Communications.

As part of the blocking-signal test, Flynn must measure SNR (signal-to-noise ratio) over a frequency range of 100 kHz to 12.7 GHz in 200-kHz steps. That's approximately 60,000 measurements per channel, and the RFIC has 1300 channels over seven frequency bands. An SNR test generates loads of measurement data, and it's just one of many tests that Flynn must run on a preproduction lot of parts.

To help analyze the data, Flynn developed a data converter that produces data plots. The tool lets him use production

any out-of-spec measurements." The tool lets him select data parameters to plot and refine the data by selecting certain test conditions. For example, it lets him look at receiver gain and noise figure versus temperature or power-supply voltage.

Because he must make so many measurements, speed was key for Flynn when he selected a spectrum analyzer and developed a test method. To cut measurement time, he uses two Agilent MXA spectrum analyzers, one each for a receiver's I and Q channels. The instru-

Mix and match

CSR is a fabless semiconductor company that develops wireless communication RFICs for personal area networks such as Bluetooth and WiFi. James Blackwell heads the company's applications engineering group. He helps customers evaluate CSR's RFICs and develop products based on the company's devices.

CSR engineers use a mixture of in-house and purchased test equipment, usually starting with in-house testers. "Because we're often on the leading edge," said Blackwell, "we have to develop our own test suites until the test-equipment companies catch up."

One example is a Bluetooth tester for performing loopback tests. Blackwell noted that the Bluetooth specification defines a loopback test where the tester wirelessly controls the DUT (device

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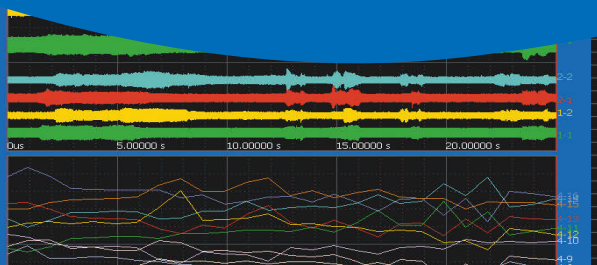

400us	-2.000mV	1.150mV	-1.625mV	1.438mV	4.0094mV
450us	-2.100mV	1.250mV	-1.063mV	1.125mV	3.8906mV
500us	0.150mV	0.450mV	0.875mV	-0.125mV	3.6812mV
550us	2.000mV	-1.000mV	1.750mV	-0.875mV	4.1938mV
600us	2.000mV	-1.400mV	1.688mV	-0.937mV	3.8438mV
650us	1.900mV	-1.050mV	1.688mV	-0.937mV	3.4375mV
700us	1.950mV	-1.250mV	1.812mV	-0.937mV	3.0563mV
750us	1.900mV	-1.050mV	1.750mV	-0.937mV	1.4344mV
800us	2.400mV	-1.100mV	1.750mV	-0.937mV	-1.9437mV
850us	2.300mV	-0.950mV	1.875mV	-0.937mV	-3.3969mV
900us	2.450mV	-1.600mV	1.625mV	-1.125mV	-3.3875mV
950us	2.300mV	-1.050mV	1.187mV	-0.562mV	-3.8000mV
1.00ms	0.350mV	-0.250mV	-0.687mV	0.750mV	-3.6469mV
1.05ms	-1.700mV	0.850mV	-1.688mV	1.250mV	-3.4844mV
1.10ms	-2.150mV	1.300mV	-1.500mV	1.375mV	-3.8563mV
1.15ms	-1.800mV	0.900mV	-1.688mV	1.312mV	-3.5625mV
1.20ms	-1.650mV	1.350mV	-1.750mV	1.312mV	-2.6438mV
1.25ms	-1.600mV	1.200mV	-1.750mV	1.312mV	-1.2969mV
1.30ms	-1.850mV	1.250mV	-1.563mV	1.438mV	1.6594mV
1.35ms	-1.800mV	1.350mV	-2.000mV	1.250mV	3.7937mV
1.40ms	-1.800mV	0.950mV	-1.625mV	1.500mV	3.8688mV
1.45ms	-1.750mV	1.000mV	-0.687mV	1.312mV	3.7313mV
1.50ms	0.150mV	0.250mV	0.500mV	-0.750mV	3.8938mV
1.55ms	1.850mV	-0.750mV	1.563mV	-0.813mV	3.8250mV

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under test). With loopback testing, a manufacturer can test a Bluetooth product wirelessly as it moves along a production line.

When CSR's engineers developed a Bluetooth RFIC several years ago, engineers had to build their own RF test system using RF signal generators, spectrum analyzers, and vector signal analyzers. They wrote Matlab scripts to control the instruments, process the data, and produce test reports.

In a loopback test, the tester will command the DUT to produce a 2.405-GHz tone with a specified modulation signal, for example. The tester will measure as many as 20 parameters such as transmitted RF power (peak and average). It will also perform receiver tests such as sensitivity and bit-error rate.

Some Bluetooth devices transmit at controlled power levels, so the DUT must operate in steps in its power table while the tester measures differences in power. It will also measure frequency tolerance and drift. A test of the frequency response of the DUT's modulation filter uses 10101010 and 11110000 bit patterns.

As time went on, test-equipment makers developed Bluetooth testers, and CSR was able to use them. Today, the company's engineers use Bluetooth testers from Rohde & Schwarz, Agilent, and Anritsu. CSR has all three instruments, so the engineers always have one that their customers use. That's crucial when an engineer needs to reproduce a customer's test.

CSR engineers didn't switch to a dedicated Bluetooth tester immediately. "We work with the test-equipment manufacturers to develop test applications for their equipment," Blackwell explained, "but sometimes we must wait for a second or third generation of a tester before we can use it. Even after we adopt a commercially available tester, we may still use our own test suites for certain tests."

Blackwell noted that dedicated Bluetooth testers may perform some tests faster or more accurately than CSR's in-house testers, but the company's engineers still use the in-house tester when they feel that it performs the tests better than a dedicated tester can.

Test companies respond

Despite the best efforts of test-equipment manufacturers, some engineers still often find that they need to develop their own test algorithms. Test-equipment makers point out that some tests require application software in the instrument to perform a test because you need real-time results. To find out more, see "Test-equipment manufacturers respond" in the online version of this article (www.tmworld.com/2009_04). T&MW

REFERENCES

1. Rowe, Martin, "The RFIC evaluator," *Test & Measurement World*, March 2009, p. 9. www.tmworld.com/2009_03.

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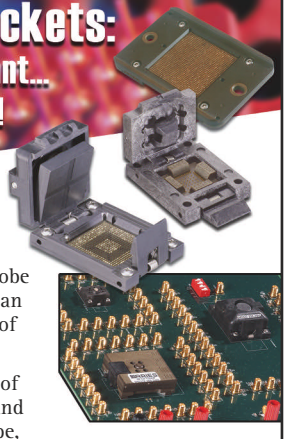

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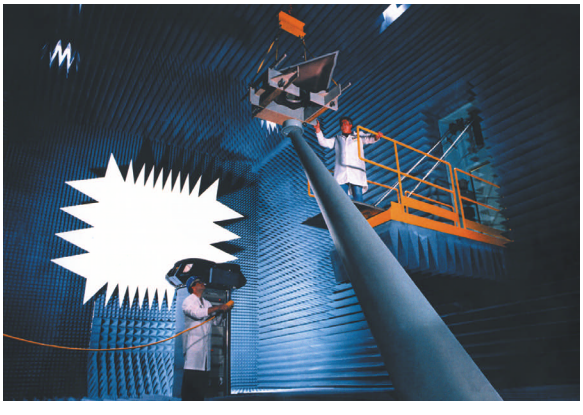

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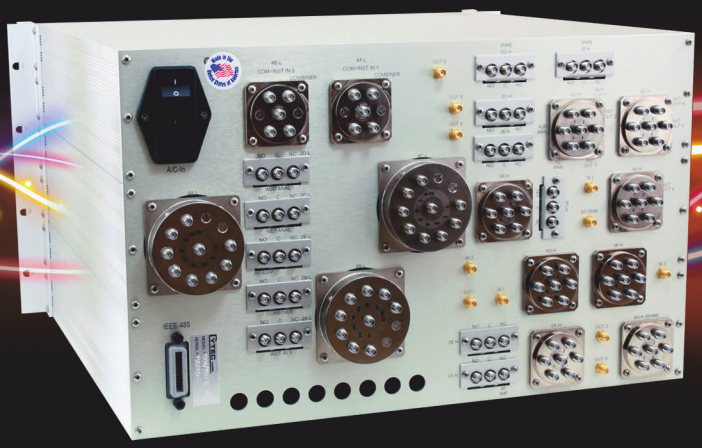

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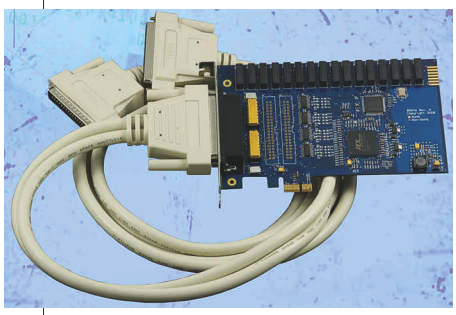


You can connect the DIO-32.PCIe to your equipment through a 72-in. cable that breaks the card's DB-78 connector into two DB-37 connectors. You can then design an interface board or cable to connect to your systems. Software support for the DIO-32.PCIe includes drivers and utilities for Windows 2000, XP, and Vista as well as drivers for Linux.

Price: $479. *Sealevel Systems, www.sealevel.com.*

Portable logger accepts analog and digital inputs

The OM-SQ2010 general-purpose datalogger provides four differential or eight single-ended analog-input channels to measure current, voltage, resistance, and temperature. The unit also furnishes eight digital-input channels to automatically trigger or stop logging. The OM-SQ2010 handles routine datalogging needs, including applications requiring up to 10 readings/s on a single channel. An RS-232 port allows you to connect the unit to other devices.

The standard OM-SQ-SOFT software enables logger configuration, data download, and data export. The optional OM-SQ-SOFT-PLUS software provides advanced data-analysis and data-archiving features as well as report generation. It lets you display data with two different auto-scaling y axes; zoom in on areas of interest; use a cursor to pick out exact values, times, and dates; get a statistical summary of your data; set high and low alarm thresholds; and use the calculation function to create new virtual channels from existing channels.

Base prices: OM-SQ2010—$1500; OM-SQ-SOFT-PLUS software—$293. *Omega Engineering, www.omega.com.*

Radio test set offers EIA/TIA-603 compliance option

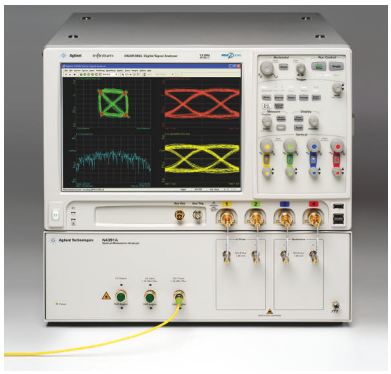
With its enhanced Auto-Test II test function, the 3920 digital radio test set from Aeroflex performs test functions as prescribed by the EIA/TIA-603 standard for FM land mobile radios. The 3920 can program up to 30 channels, enabling users to verify transmitter and receiver performance with the option to use PTT (push-to-talk) auto-key and de-key to automate radio testing. Test results are saved and can be printed directly from the 3920.

Transmitter tests include frequency, power, FM hum and noise, audio distortion, audio frequency response, microphone sensitivity, modulation limiting, and CTCSS (continuous tone-coded squelch system). Receiver tests include SINAD (signal-to-noise and distortion), audio distortion, audio sensitivity, hum and noise, audio frequency response, displacement bandwidth, audio squelch sensitivity, and audio squelch blocking.

Base prices: 3920 digital radio test set—$27,995; EIA/TIA-603 test function—$2000. *Aeroflex, www.aeroflex.com.*

Signal analyzer uses RF techniques on optical signals

The N4931 optical modulation analyzer from Agilent combines an optical receiver with a 90000 series Infiniium oscilloscope and vector-signal-analysis software. It covers 1528-nm to 1630-nm wavelengths with 34-GHz bandwidth (74 GHz optical) and analyzes 34 optical-modulation formats. In addition to time-domain analysis of optical signals, the N4931 can analyze signals in the frequency domain using fast Fourier transforms. The instrument's primary application is testing optical transmitters that handle 40-Gbps and 100-Gbps transmissions.



To measure EVM (error-vector magnitude), the analysis software computes the error vector between corresponding symbol points in measured and reference I/Q signals. You display data as EVM, as error-vector phase, using only the I component, or using only the Q component. In addition, the N4931 can generate a symbol table and measurements such as frequency error, magnitude error, phase error, and I/Q offset.

Base price: $195,000. *Agilent Technologies, www.agilent.com.*

Test software allows remote updates

Proligent 4.1, Averna's test-engineering platform, gives OEMs the ability to update remote test stations automatically and gain fast access to massive amounts of test data. The Test Package Manager lets you deploy test software versions to stations anywhere in the world, while the Data Warehouse lets you pull together data for viewing in customizable reports. In addition, Proligent 4.1 supports National Instruments' TestStand 4.1 test executive.

With the Test Package Manager, you can bundle and deploy executables, DLLs, and other binaries as version-specific test applications. Rollbacks are also possible, allowing a user to return to a previous test version at any point in time. The Data Warehouse helps managers gather terabytes of test data from across the company and create custom reports for in-depth analysis; it also enables users to create links between business intelligence systems.

Averna, www.averna.com.

Vision Research 1-Mpixel camera runs at 3400 fps

Extending the Phantom family of high-speed digital cameras from Vision Research is the v310, which achieves a top speed of 3400 fps at a maximum resolution of 1280x800 pixels. At reduced resolution, the v310 can record at speeds of up to 500,000 fps. The camera is appropriate for applications such as product development and ballistics testing.

The wide aspect ratio afforded by the v310's CMOS sensor allows you to keep moving subjects in a frame longer and see more of the event being recorded. Available in color and monochrome versions, the 1-Mpixel camera features an active pixel size of 20 µm. To eliminate blur and accentuate detail, the v310 offers exposure times as fast as 1 µs.

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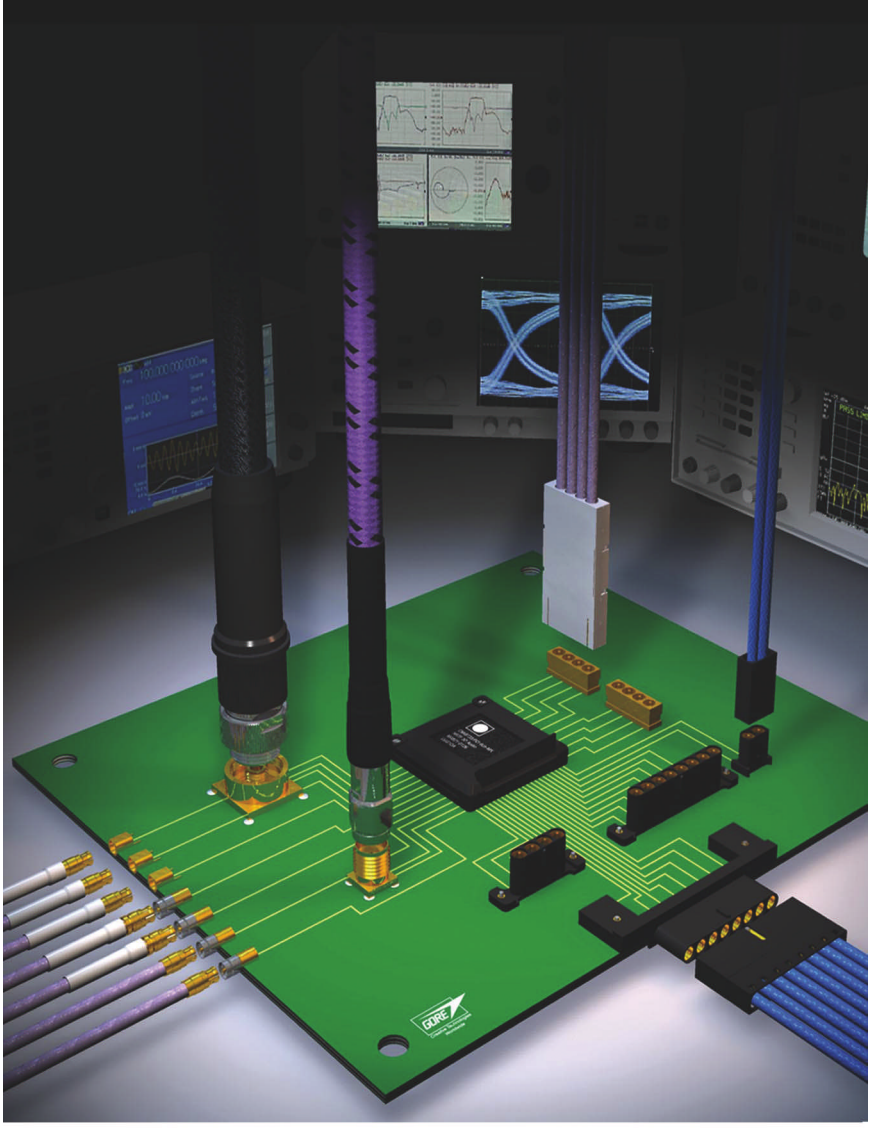

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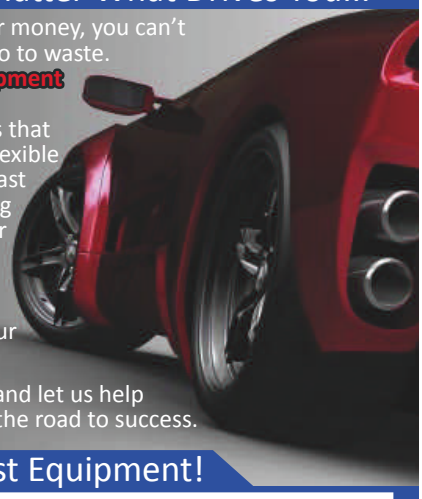

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The Phantom v310 comes with 8 Gbytes of RAM with an option to upgrade to 16 or 32 Gbytes. The camera features an analog video-out port for use with a component video monitor, allowing the recordings to be viewed in NTSC, PAL, and high-definition 720p formats.

Vision Research, www.visionresearch.com.

Diagnostic tool detects terminal bugs

Joining Anite's SAS network simulator platform is the DMI (Diagnostic Mobile Interface) Cell Configurator, designed to help handset developers detect terminal bug problems. The DMI Cell Configurator lets users record live network scenarios and import them into the SAS network simulator; SAS then populates the cell configurations and allows them to be used interactively or with a playback script using logs from Anite's Nemo Outdoor test tool. Users can develop tests and scripts without having to follow a prescribed test flow.

The latest release of the SAS platform includes example scenario files from AT&T's network that were created using the DMI Cell Configurator.

Anite, www.anite.com/wireless.

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The OM-SQ2020 series of handheld dataloggers feature eight true-differential or 16 single-ended universal analog inputs plus two high-voltage, four pulse, and eight digital event/state inputs. The analog inputs can be used with thermistors, thermocouples, and RTD temperature sensors. *Omega Engineering, www.omega.com/pptst/om-sq2020.html.*

Frequency synthesizer sources

A catalog describes the complete line of PTS frequency synthesizers that produce fast switching, low-phase-noise precision frequencies. Options and accessories are available to provide a product that will match your specifications. Models range from 0.1 to 6400 MHz. *Programmed Test Sources, www.programmedtest.com.*

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The new 6000 Series is IOtech's latest Out-of-the-Box DAQ solution. Up to 24-bit strain or voltage modules are available. The included Encore interactive measurement software combines ease of use with powerful functionality. *IOtech, www.iotech.com.*

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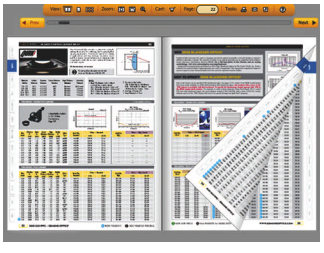


Edmund Optics' digital version of its *Master Source Book* is now online featuring enhanced searching and linking capabilities. The catalog is linked by stock number for easy shopping and offers e-mail and print functions for purchase or PO documentation. *Edmund Optics, www.edmundoptics.com/digitalcatalog.*

Hybrid test socket

Aries Electronics' new CSP/BallNest hybrid socket is suitable for prototyping, test, or burn-in of CSP (chip-scale package), BGA (ball-grid array), microBGA, and LGA (land-grid array) devices. *Aries Electronics, www.arieselec.com/Web_Data_Sheets/23016/23016.htm.*

Economical Camera Link grabber

The PIXCI EB1 is a low-cost PoCL (Power over Camera Link) frame grabber, starting at $445, and includes XCAP-Lite software with camera controls for most Camera Link cameras and generic controls for others. *EPIX, www.epixinc.com.*

Fast data acquisition

The Yokogawa SL1000 data-acquisition system offers independent, isolated channels (up to 1 kV) at 100-Msamples/channel rates, with no compromise in bit resolution, memory depth, or streaming performance. *Yokogawa, www.tmi.yokogawa.com.*

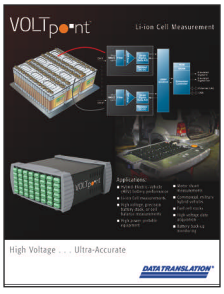
500-W amplifier

The Model 500A250A amplifier covers 10 kHz to 250 MHz and provides a minimum of 500 W. An innovative design packs more power into a smaller size and boasts roughly a 35% reduction in size and weight over previous products. *AR RF/Microwave Instrumentation, www.ar-worldwide.com.*

Over-the-air test lab

The ETS-Lindgren Model AMS-8800 is a turnkey system for OTA (over-the-air) testing per CTIA and WiMAX RPT (radiated performance test) specifications. A theta rotational-arm scanning system enables quick, accurate, and convenient testing of wireless devices. *ETS-Lindgren, www.ets-lindgren.com/AMS-8800.*

Lithium-ion-cell measurement



VOLTpoint is a series of precision high-voltage USB or Ethernet-compatible measurement instruments that perform lithium-ion cell-by-cell battery testing. Direct voltage inputs of any value up to ±100 V can be applied from a single cell or from a series of stacked cells. *Data Translation, www.datatranslation.com.*

High-speed USB DAQ

The USB-1208HS series modules feature eight single-ended/four differential, 13-bit, 1-Msample/s analog inputs; up to four 12-bit analog outputs; 16 digital I/O lines; two 32-bit counters; and a 32-bit timer. Pricing starts at $499. *Measurement Computing, www.mccdaq.com.*

PXI instrumentation amplifier

The Model 4040A is a fast PXI instrumentation amplifier designed for PXI digitizers. It offers 100-V differential inputs with 70 dB of CMRR (common-mode rejection ratio) and bandwidth from DC to 50 MHz with programmable gain, attenuation, offset, and filters. *Tegam, www.tegam.com.*

Instrumentation product guide

Keithley's 2009 *Test & Measurement Product Guide* includes selector guides, technical information, and the company's newest innovations in test and measurement for today's challenging applications. *Keithley Instruments, www.keithley.com/at/556.*

DC power supply tips

Three free white papers from Agilent Technologies provide tips for working with DC power supplies. Topics include: creating complex sequences, improving power-supply performance, and creating cleaner signals by minimizing noise. *Agilent Technologies, www.agilent.com/find/3powertips.*

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UF3e-4121	250 MS/s	250 MS/s	PCI, PCIe	$6895
UF3e-4140	400 MS/s	-	PCI, PCIe	$7495
UF3e-4141	400 MS/s	250 MS/s	PCI, PCIe	$8495

Each instrument is supplied with 256 MBytes signal memory that can be upgraded to 4 GBytes onboard to give a full 5 seconds of recording time at 400 MS/s! Timestamp, memory segment-ation, gated sampling, synchronous digital inputs and multiple card synchronization are all available as cost-options.

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Machine-vision software improves

By Ann R. Thryft, Contributing Technical Editor

Purchasing third-party machine-vision software can make a lot of sense for OEMs who don't want to maintain their own in-house code library. Heiko Eisele, president of MVTec LLC, the US subsidiary of Germany-based MVTec, commented on recent changes in standard software packages and talked about how vendors are improving their offerings.

Q: What's behind the rise of third-party, hardware-independent machine-vision software?

A: As machine-vision hardware has become a commodity, innovation now occurs mostly in software, and there are more vendors offering third-party standard packages. Standard products have been used in tens of thousands of similar installations and are extensively tested and field-proven, so they're more reliable than a package you create in-house. There are still far more hardware than software manufacturers, but competition among software vendors has increased in terms of the tools, algorithms, and hardware SDK [software development kit] support they provide. For example, although MVTec has offered support for parallel processing since 2000, multiprocessor and multicore support is now also a feature of some other vendors' software packages.

Q: What other improvements are appearing in machine-vision software?

A: Support for 3-D vision is improving. In 3-D calibration, for example, you want to be able to precisely measure the image, and that requires an accurate camera model. In our latest software release, Halcon 9.0, we extended the existing model to include higher-order mathematical terms. This gives a more accurate description of the imaging process, so the camera produces more accurate data. We also provided new operators for sheet-of-light measurement and added multigrid stereo capability.

Other changes include increasing the user friendliness of the development environment. For example, ours provides tools that let you develop algorithms much faster, by automatically generating code based on the user's interaction with the software. Users have access to the entire library so they can write their own code, but certain tasks can be made more intuitive with a graphical user interface. We are providing this combination for more and more tools in our library, so users can quickly fix problems in the applications they develop.

Heiko Eisele
President
MVTec LLC

Q: How else are vendors improving software?

A: In semiconductor and solar-cell inspection, as well as flat-panel displays, you must look at very fine detail in a large area. So, the use of line-scan cameras is increasing because of their higher resolution and their larger field of view. That means bigger images, which is the main reason we have removed the previous image size restriction of 32k x 32k. Larger images also require more memory, driving the trend to packages like Halcon that support 64-bit operating systems. As long as there's enough memory in the host computer, you can process images of any size.

Another trend is the increased use of infrared imaging in inspection as sensor quality improves, bringing less noise and more accurate response. Infrared cameras used to be big and expensive, because the sensor had to be cooled down considerably to reduce image noise. Now, many infrared cameras operate at room temperature, making them cheaper and easier to use in a manufacturing environment, such as for managing heat dissipation. □

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EDITOR'S NOTE

Cutting costs, boosting performance

By Ann R. Thryft
Contributing Technical Editor

In the middle of bad economic news, there's some good news for users of vision and inspection technologies. Products continue to become more commoditized, bringing down average selling prices and speeding up the return on investment.

This may not always be advantageous for vendors. In fact, Agilent Technologies cited commoditization in optical inspection and the consequent lower average selling prices, along with the large number of players, as major challenges to the imaging business when announcing its exit from automated optical inspection in February. But users can certainly benefit.

Users also benefit from the fact that more technologies keep getting added to the engineer's toolkit, for use either on the production line or in the lab. Thermal imaging, for example, can help with the verification of new designs as well as in failure-analysis labs (p. 55). Meanwhile, inspection systems are getting smaller and more portable, aided by innovations such as Power over Camera Link in cameras and frame grabbers (p. 51), and by increasingly powerful notebook computers equipped with tiny frame grabbers that fit into an ExpressCard slot. And frame grabbers in general are incorporating more functions to cope with the faster data rates required for today's applications (p. 52). □

Contact Ann R. Thryft at ann@tmworld.com.

HIGHLIGHTS

Camera Link camera boasts 209 fps

Basler Vision Technologies claims that its A406k is the fastest 4-Mpixel Camera Link camera on the market, capable of operating at 209 fps at full resolution. The A406k achieves this high frame rate using a 10-tap, 85-MHz Camera Link configuration, transferring approximately 800 Mbytes/s, although this bandwidth limits the A406k to a maximum data depth of 8 bits.

Like other members of the A400 family, the A406k employs a CMOS sensor with a rolling shutter and is available in both monochrome and color versions. By using the supplied AOI (area of interest) list editor, users can change the size, position, and exposure time of a series of AOIs. www.baslerweb.com.

PCI Express frame grabber offers PoCL

The PIXCI EB1, a PCI Express x1 frame grabber from Epix, works with all area-scan and line-scan base-configuration Camera Link cameras and can be outfitted with a PoCL (Power over Camera Link) interface. The PIXCI EB1 offers low-latency, 250-Mbyte/s image transfer to a PCI Express bus x1 through x16 slot. The board safely supports PoCL cameras by detecting when a PoCL camera is connected and will disconnect power if it exceeds the specification.

The frame grabber comes with XCAP-Lite software and has camera-specific controls for most Camera Link cameras and generic controls for all other cameras. XCAP-Lite lets you load, view, and save images to and from files when the PIXCI EB1 is present. www.epixinc.com.

Pleora GigE SDK gains Linux option

With Version 3.0.0 of the iPORT Vision Suite for Linux, the iPORT SDK from Pleora Technologies now allows Linux-based GigE imaging programs to run on 64-bit architectures, effectively doubling the level of processing power available to Linux developers. Geoff MacGillivray, product manager at Pleora, explained that the Linux enhancement rounds out the company's offerings for 64-bit platforms, complementing support for Windows Vista and XP. www.pleora.com.

Sapera Essential gains improved color capability

Dalsa reports that it has improved the color capability of its Sapera Essential machine-vision software. The hardware-independent Sapera Essential combines board-level image acquisition and control with advanced image-processing capabilities; the latest version supports Windows 64-bit and the .Net interface.

With the introduction of the Sapera Essential Color Tool, the software supports RGB, YUV, HSV, and LAB formats for color conversions. Split and merge functions are also available for plane-by-plane processing. The software processes color images through basic operators such as thresholding, histogram, projections, statistics, clustering, and color reduction. A color-correction algorithm can compensate for different lighting conditions, and a color classifier can separate color regions of an image.

Sapera Essential offers features such as Blob analysis, area and shaped-based pattern matching, and optical character recognition. An evaluation copy (32 bit or 64 bit) is available from the company's Web site. www.dalsa.com.

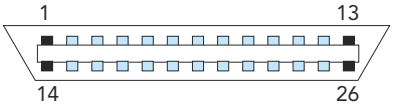
Power over Camera Link enables smaller systems

By Ann R. Thryft, Contributing Technical Editor

A little more than two years ago, the AIA (Automated Imaging Association) ratified two extensions to the Camera Link standard: the PoCL (Power over Camera Link) interface and the mini-Camera Link connector. Since then, user demand has risen for these interfaces, especially PoCL, in cameras and frame grabbers used in machine vision. Both help facilitate smaller cameras by reducing the size of the camera's back panel.

PoCL helps reduce the number of necessary cables, and the number of connectors on the back of a camera, by powering a camera directly through the interface. "The interface eliminates the need for a separate power supply," said Steve Kinney, JAI's director of technical pre-sales and support, who also chairs the AIA's Camera Link committee. "It provides a clean, one-cable solution that fits more easily into crowded spaces, saves on cabling costs, and avoids problems caused by cables rubbing together." This is important in repetitive, space- and weight-critical environments such as semiconductor and electronics inspection, where cameras repeatedly move very quickly over the surface of a board or wafer.

Since PoCL provides only 4 W, users of high-performance cameras will still need external power supplies. But many smaller cameras can be powered with PC-based frame grabbers using PoCL, said Kinney. "In the Camera Link standard, there are four redundant pins assigned to ground, one on each corner of the connector. In Power over Camera Link, two of those pins are reassigned for power."



In a Camera Link connector, pins 1, 13, 14, and 26 are connected to an inner shield to provide an isolated internal ground. In a PoCL connector, pins 1 and 26 are reassigned to carry +12-V power. Courtesy of JAI.

The size of the back plate in most frame grabbers accommodates a maximum of two Camera Link connectors, said Kinney. But the mini-Camera Link connector, which is pin-for-pin compatible with the original, is only half the width and half the height of it, so four can fit in that same space.

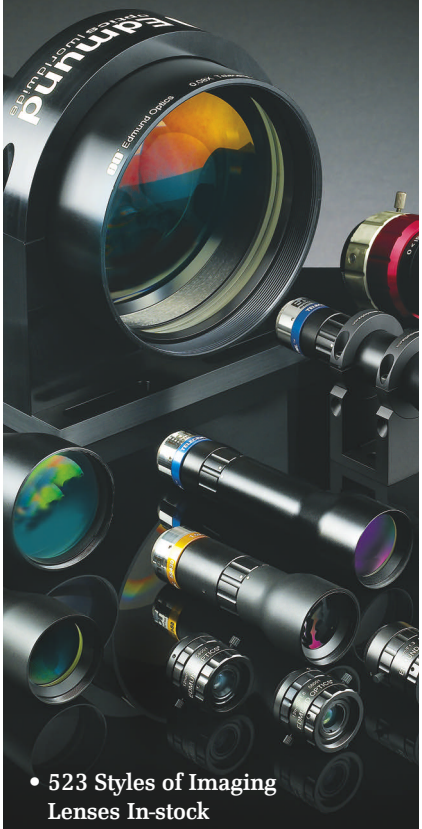
The CM-030PMCL-RH industrial CCD camera has a remote head lens and a PoCL interface. Courtesy of JAI.

"We see Camera Link and GigE Vision as the two dominant vision standards in the near future," said Kinney. Improvements to PoCL are in the works: Although the current implementation only provides for 4 W over a single base Camera Link configuration, in theory it is also possible to provide 8 W over a medium or full configuration. Members of the Camera Link committee are currently working on proposals to do exactly that. □

FOR MORE INFORMATION

Hardin, Winn, "Camera Link 1.2: Power in Small Spaces," Automated Imaging Association, February 28, 2007. www.machinevisiononline.org/public/articles/details.cfm?id=3072.

IMAGING solutions.



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Frame grabbers thriving in inspection

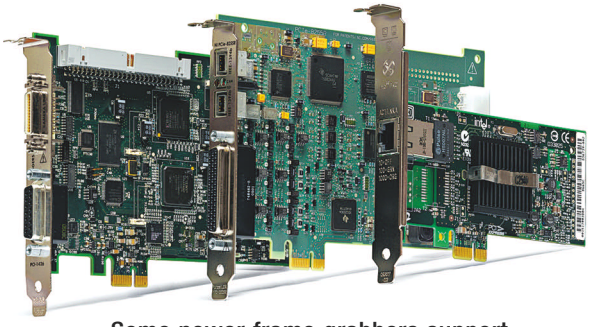
By Ann R. Thryft, Contributing Technical Editor

If a slew of new frame-grabber products is any indication, these image-acquisition boards are thriving in electronics and semiconductor inspection. Recent product introductions from Adlink, Dalsa, Euresys, Matrox Imaging, National Instruments, and Sensoray, among others, include interfaces such as PoCL (Power over Camera Link) or 1394b (FireWire), take advantage of PCI Express bandwidth, incorporate additional logic for image preprocessing, or take GigE Vision functions onboard. One frame grabber from Imperx resides on an ExpressCard in a notebook computer.

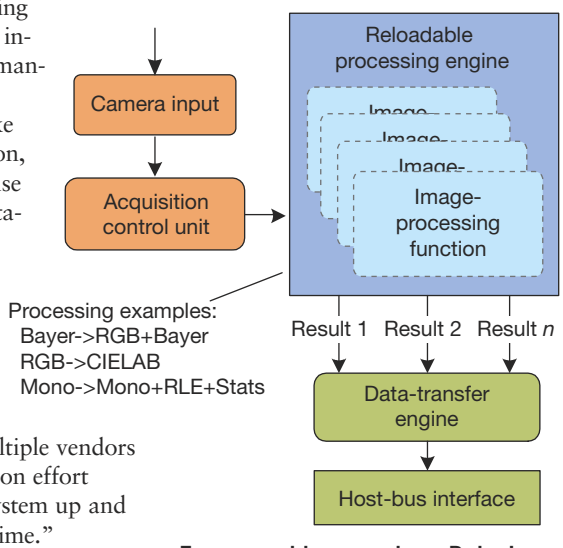
Although users may associate frame grabbers with older analog interfaces, engineers are actually using them widely with digital interfaces. "Most camera manufacturers are moving to standard digital buses like Camera Link, GigE Vision, and IEEE 1394a/b because of their lower implementation cost," said Matt Slaughter, vision products manager for National Instruments. "With standard interfaces, the ease of combining cameras and frame grabbers from multiple vendors with a minor configuration effort means you can have a system up and running in a very short time."

In particular, vendors say, frame grabbers are needed where either the combination of resolution and bandwidth or else bandwidth alone is very high. "In terms of imaging needs, the semiconductor/electronics segment can be divided into two major groups," said Dwayne Crawford, product manager for Matrox Imaging. Wafer, LCD, and PCB (printed-circuit board) inspection constitute the first, high-end group, with similar data rates and image sizes. "The number of pixels you need to inspect an LCD panel or the larger dies is increasing exponentially," he said. "Fine details are shrinking in semiconductor geometries, as well. In PCBs, geometries are also shrinking, but throughput is more of an issue." In the second group, wafer bumping and wire-bonding inspection, large images are not a concern: Although frame rates are high, data throughput is not. But in these applications, image acquisition must be synchronized with motion-control I/O.

Because of its very high bandwidth, Camera Link has become the de facto serial digital standard for use with frame grabbers in machine vision, said Inder Kohli, Dalsa's product manager for frame grabbers and vision processors. "Since FireWire and GigE Vision interfaces are ubiquitous in PCs, you can use them to bring in camera data," he said. "But Camera Link is driving both the growth of, and many trends in, frame grabbers and vision processors." In semiconductor and electronics inspection, users want more efficient, less costly production lines, reflected in better resolution and higher frame rates in cameras. GigE and FireWire rates are not high enough for every application in this segment, so frame grabbers are still needed here, he said.



Some newer frame grabbers support standard digital buses such as Camera Link, IEEE 1394b, and GigE Vision. Courtesy of National Instruments.



Frame grabbers such as Dalsa's Xcelera-CL PX4 SE are integrating more preprocessing tasks, such as color space conversion and defect analysis, to ease the host CPU's burden. Courtesy of Dalsa.

One trend affecting frame grabbers is the evolution of the AIA's Camera Link standard, as evidenced in the PoCL interface, said Kohli. In some semiconductor and electronics applications, such as wire-bonding inspection, small, lightweight, high-bandwidth cameras use single-cable connections incorporating power and data. He explained that although in-line power is native to FireWire, adding power to GigE lines could add cost and complexity to a vision system. "Power over Camera Link cameras cost-effectively deliver power and higher bandwidth data on the same cable," he said. Crawford said that Matrox Imaging, like some other frame-grabber manufacturers, has added support for the interface to its newer product families because PoCL helps reduce camera size and simplify cabling.

Manufacturers are also adding onboard logic to handle a variety of processing tasks. As data rates increase, image data must be processed faster, so even more preprocessing tasks must be offloaded onto frame grabbers to

reduce the load on the host computer's CPU, said Kohli. Dalsa's Xcelera-CL PX4 SE has a suite of onboard processing functions, such as color space conversion and defect analysis, that users previously performed with custom boards or a vision-processor board. "Combining onboard processing capability with PCI Express's high transfer bandwidth, as we've done with the Xcelera SE, lets the frame grabber provide both raw images and processed data concurrently, making processing more efficient and cost effective," he said.

Notebook computers equipped with frame grabbers such as the FrameLink Express from Imperx are making machine vision portable. Courtesy of Imperx.

Preprocessing functions can help correct optical artifacts such as distortion that are becoming a greater problem as sensors get larger and pixels shrink in geometry, said Crawford. "Preprocessing operations—such as optical and prospective distortion correction, flat-field correction for uniform sensitivity and responsivity across the sensor, and dead pixel replacement—are therefore more relevant," he said. "Single FPGAs [field-programmable gate arrays] can handle these operations well, and correcting image artifacts must occur before you even begin processing the images, so we've put them on our frame grabbers, such as the Matrox Solios family."

In some of its frame grabbers, National Instruments offers the option of onboard, user-programmable FPGAs for controlling timing, triggering, and I/O. The FPGA can also be used to synchronize multiple cameras and lights, or control hardware like actuators with precise timing, said Slaughter.

All of Imperx's frame grabbers are made for notebook computers, said company sales manager Nathan Cohen. "Notebooks are entering machine-vision applications more and more as they come equipped with dual-core and quad-core processors, huge amounts of memory, and higher bus speeds" he said. "You can use

10 GigE may be coming to machine vision

At the high end of electronics inspection, bandwidth needs surpass what's available in FireWire and GigE, said Dwayne Crawford, product manager for Matrox Imaging. "They even surpass what's available in Camera Link, pushing the envelope beyond 1 Gbyte/s to as high as 5 to 6 Gbytes/s. No standard interfaces handle data rates that high, not even 10 GigE."

For this reason, the AIA's (Automated Imaging Association's) GigE Vision committee has started the High-Speed Transmission subcommittee to investigate technologies with speeds faster than Camera Link, said Crawford, a member of the subcommittee. "These include aggregating multiple 10-GigE links to apply networking techniques to high-end machine vision. In a system that uses Ethernet, managing determinism becomes a major issue, much more so than it is in networking applications such as VoIP."

To bring a 10-GigE layer onto GigE Vision, a frame grabber is needed to convert packet data into an image format, offloading that function from the host, said Eric Carey, director of R&D for Dalsa and chair of the AIA's GigE Vision committee. "Although GigE cameras use the host to de-packetize images, at much higher 10-GigE data rates, this would prevent the host from accomplishing other tasks," he said.

Frame-grabber-like products in high-end applications enable the packets for deterministic events, such as triggers and exposures, to be manipulated at a very low level in the protocol by hardware, before the operating system can introduce latency and jitter, Crawford explained.—*Ann R. Thryft*

Camera Link Frame Grabbers

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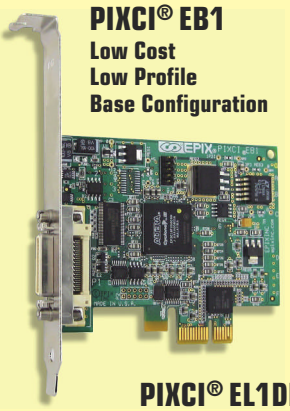

PIXCI® EL1DB
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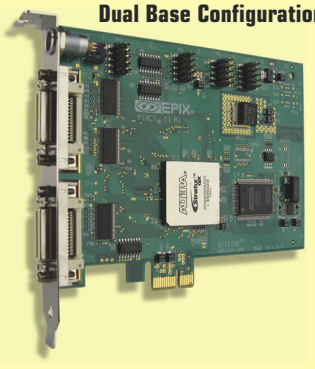

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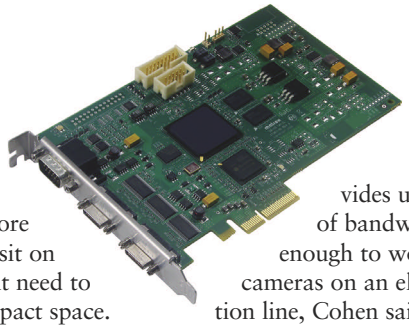

Some frame grabber manufacturers are adding support for Power over Camera Link because it helps reduce camera size and simplify cabling. Courtesy of Matrox Imaging.

them for a small production run, [for] simpler systems that do not need many I/O controls, or for more complex systems that sit on the production line but need to be contained in a compact space. We're seeing a rise in inquiries for electronics applications because people are shrinking their systems." Notebooks equipped with frame grabbers make machine vision portable, and they are becoming popular in situations where a full desktop computer is not needed, he said.

The company's newest model, FrameLink Express, was originally designed for military applications. A Camera Link model for newer, faster ExpressCard laptops, it can simultaneously acquire images from two Camera Link cameras. Because it's compliant with ExpressCard, it provides up to 235 Mbytes/s of bandwidth, which is fast enough to work with line-scan cameras on an electronics production line, Cohen said. The FrameLink Express can do histograms, look-up tables, and hex pixel dumps, and it also integrates a timing generator. "With two inputs on the frame grabber, you can designate one camera as a primary and one as a slave and synchronize imagery very precisely for 3-D inspection, or use multiple cameras at different points on a production line," he said. "Multiple inputs in a laptop also let you overlay images for multispectral inspection such as IR, UV, and visible light."

More trends in machine vision will affect frame grabbers in the near future. One of the most important is dealing with the high bandwidth and huge images resulting from the use of Camera Link, said Slaughter. "In PCB and component inspection, you might want a really high-resolution image of a board or wafer, but what do you do with it? Do you stream it to a RAID array, or try to do some kind of in-line processing? If you are doing in-line processing, you won't be able to do it very fast, so do you do post-processing?"

PCs equipped with multicore processors may be one solution, according to Slaughter. "One machine with a multicore processor can chop up the image into smaller data sets that can be processed in parallel," he said. "Our software makes this easy by automatically splitting up the images into the right number of pieces based on how many cores your PC has." □

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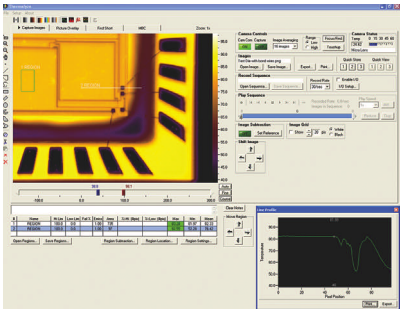
Thermal imaging finds faults quickly

By Ann R. Thryft, Contributing Technical Editor

As chip sizes continue to get smaller, the ability to detect uneven heat generation and thermal dissipation on a chip's surface becomes increasingly difficult but also increasingly important. Engineers in failure-analysis labs and design labs need thermal-imaging tools that can measure temperature distribution over chip surfaces and quickly detect hot spots, which decrease efficiency and frequently lead to early failure.



Thermal-analysis software can help engineers in failure-analysis labs measure temperature variations on chip surfaces and detect hot spots.

Courtesy of OptoTherm.

"Hot spots reduce chip performance, because current and speed decrease exponentially with temperature," said Richard Barton, technical director for OptoTherm. "An increase of only 10 to 15°C can decrease chip life by 50%. And large thermal gradients can cause signal-integrity and timing problems, such as when a hot processor circuit is located next to relatively cold RAM."

Other causes of hot spots on chips are incorrect wiring patterns, shorts or breaks in wiring, incorrect deposition of insulating films, increased transistor leakage, and improper die bonding. If the thermal-imaging system shows that there is indeed a hot spot or spike in temperature on a packaged chip, the system user may need to decapsulate the device in order to look at the bare die and try to isolate the hot spot, said Barton.

Thermal imaging can also make it easier for engineers to locate short circuits. For example, OptoTherm's Micro thermal-imaging microscope system includes a Find Shorts software tool that quickly detects very small increases in temperature as a chip or board is powered. "Using this tool, we've found temperature increases as small as 0.03°C, which translates into an increase of only a few hundred microwatts," said Barton.

Although thermal imaging is typically used in failure-analysis labs, engineers can also use it to verify new designs. At the design stage, engineers can check for problems like thermal runaway, which is caused by transistor current leakage, which in turn increases as temperature increases.

Failure analysis of small boards, such as identifying defective and marginal components, is also made easier with thermal-microscope systems. Another OptoTherm software tool, called Model Board Comparison, detects very small temperature differences between properly functioning components and defective components on small circuit boards. It captures a sequence of thermal images during functional or diagnostic tests of one or more known-good boards that have an established, correct thermal performance. Those images are then used to create a software model of the board, which is compared with a defective board.

"If you are running a functional test where different areas or components are powering up at different times, it's important to know where hot or cold spots occur, or to identify an area of a module that's not receiving power, or a component that's activating when it shouldn't be," said Barton. □

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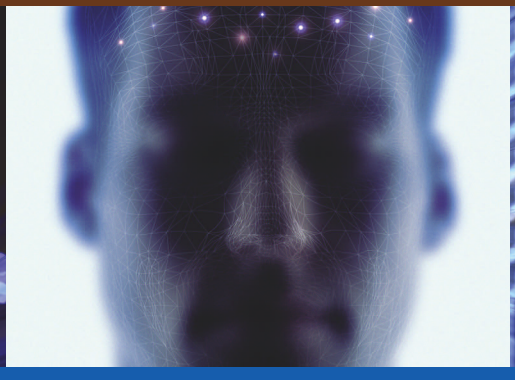


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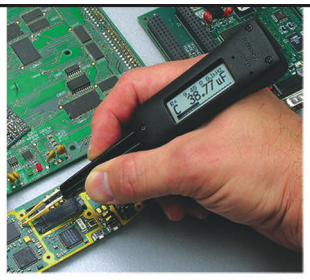

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VIEWPOINT

[An exclusive interview with a technical leader]

THOMAS H. RESLEWIC
President and CEO
LeCroy
Chestnut Ridge, NY

Thomas H. Reslewic has served as president and CEO of LeCroy since January 2002, when he was also named to the company's board of directors. Joining LeCroy in 1990, Reslewic previously served the company as executive VP and COO. From 1993 to 1998, he held key sales and marketing functions, helping to increase oscilloscope revenues from $43 million to $105 million. Prior to his tenure at LeCroy, Reslewic spent eight years in sales and marketing management with another leading oscilloscope manufacturer. Reslewic earned a bachelor's degree in physics from the College of the Holy Cross and an MBA from the University of Oregon.

Contributing editor Larry Maloney conducted a phone interview with Reslewic on the performance challenges facing vendors of high-end test and measurement devices.

Race quickens on scope performance

Q: What are today's engineers demanding from oscilloscopes?
A: In high-level applications particularly, they're looking for speed, which can be defined in two forms: the responsiveness of the instrument and measurement throughput. In addition, they're looking for long-waveform-handling capabilities. We feel that our toolset is second to none in meeting all these demands. The user interface is also very important, and LeCroy is a pacesetter in digital scopes when it comes to form factor, layout, and displays.

Q: What are the key advancements in your WaveMaster digital scopes?
A: The new WaveMaster 8 Zi Series gives engineers the raw horsepower they need to capture the signal. Incorporating our new Apollo chipset, featuring IBM's silicon-germanium technology, these oscilloscopes provide up to 30 GHz of bandwidth, 80 Gsamples/s of sample rate, 512 Mpoints of analysis, and greater than 15-GHz edge triggering. The new line delivers 10 to 100 times faster analysis processing time versus our previous high-performance scopes and other scopes on the market.

Q: Any other important changes in these new scopes?
A: Both our WavePro and WaveMaster 7 and 8 Zi embody the second generation of our streaming architecture, called X-Stream II. It's a unique waveform-processing architecture that enables high data throughput, even when the scope is analyzing eight 256-Mpoint waveforms. This architecture uses variable waveform segment lengths to improve the use of CPU cache memory, which substantially decreases processing time. X-Stream II also leverages the new 64-bit Vista operating system for additional performance.

Q: What applications need this type of performance edge?
A: At the root of virtually everything we do with our instruments are applications involving high-speed serial-data standards. This embraces the latest developments in computers, servers, semiconductors, and consumer-electronics devices. Many demanding applications involve data-transport rates of 6 Gbps, and the underlying signals have harmonics that require oscilloscope bandwidths between 15 and 20 GHz.

In fact, there's no shortage of engineers who are intrigued with oscilloscopes that offer 30-GHz solutions. They are already looking ahead to the next generation of high-speed serial-data standards, such as PCI Express 3.0 and USB 3.0—the so-called SuperSpeed USB. Within the next year and a half, USB 3.0 will very likely be the most widely deployed standard in the 5- to 6-Gbps range. Beyond that, we see a future where there will be widely deployed 10-Gbps serial-data standards.

Q: Won't the economic slowdown hamper the pace of innovation?
A: I believe that technology developments stemming from these new data standards are somewhat immune from the economic slump. One reason is that many engineers interested in adopting SuperSpeed USB are involved with mass data-storage applications, and they're looking forward to at least a 10 times improvement in transfer rates between mass storage devices and PCs. That can be a very big competitive advantage for companies that get to market first.

Q: Looking forward, where will LeCroy focus its growth efforts?
A: We'll continue to attack three primary markets: computers/consumer electronics, automotive electronics, and data storage. In all these segments, we try to identify areas of technical change and emerging applications that will create more challenges and opportunities for us. T&MW

Thomas Reslewic answers more questions on how real-world demands are changing measurement devices in the online version of this interview: www.tmworld.com/2009_04.

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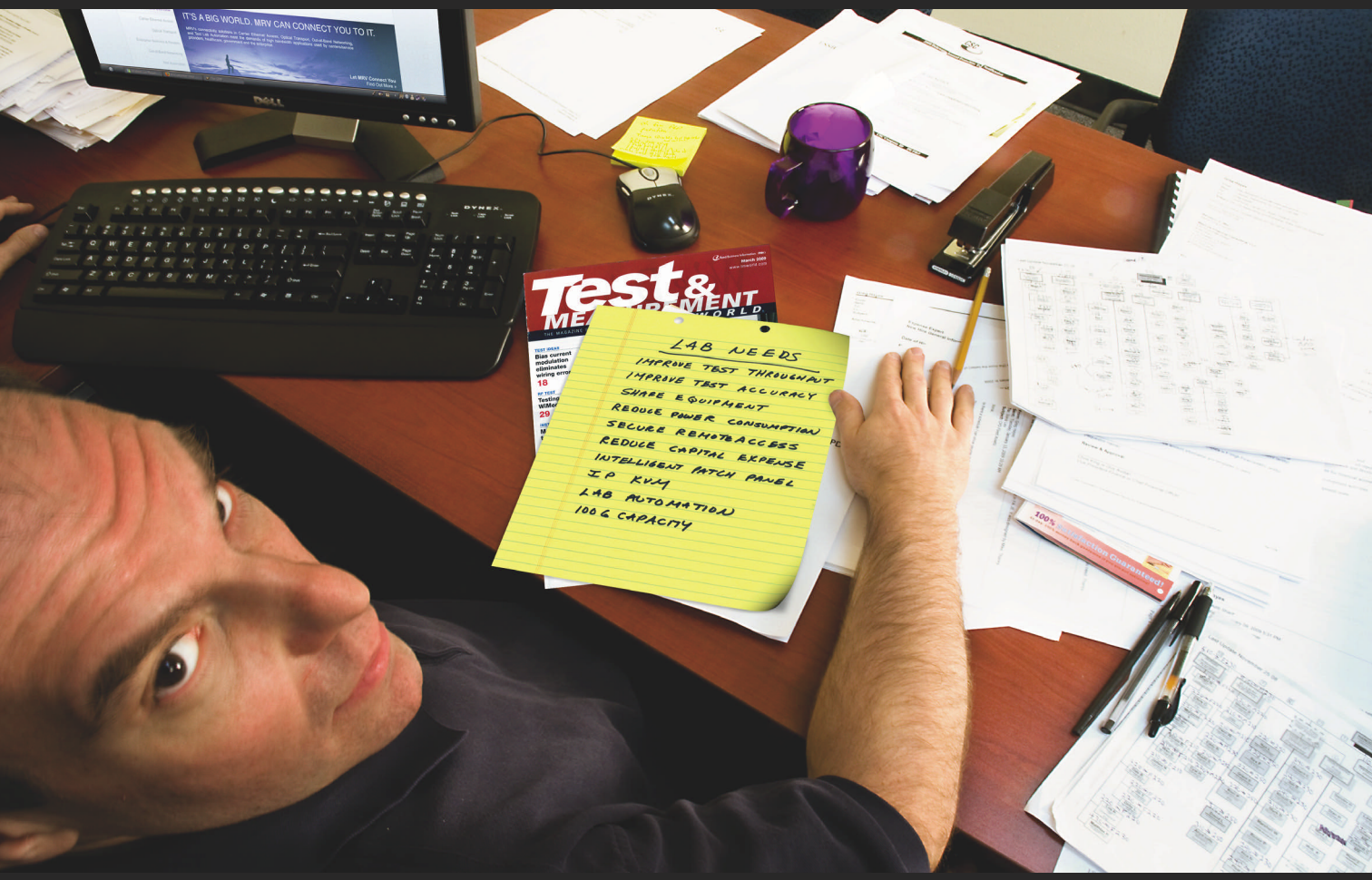

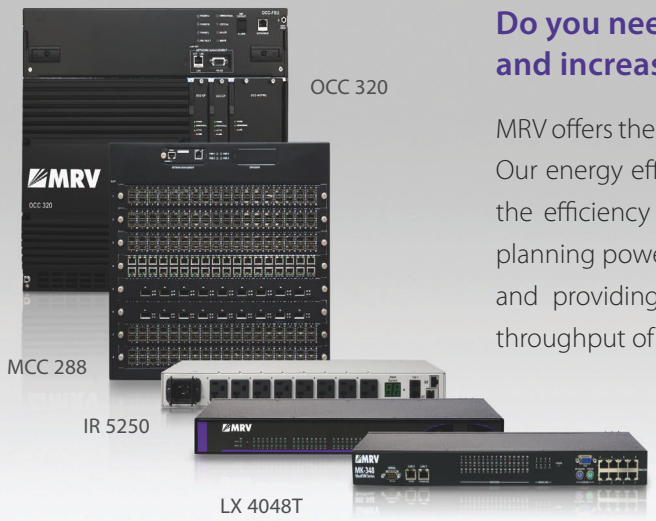

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