UBM Electronics

May 2011
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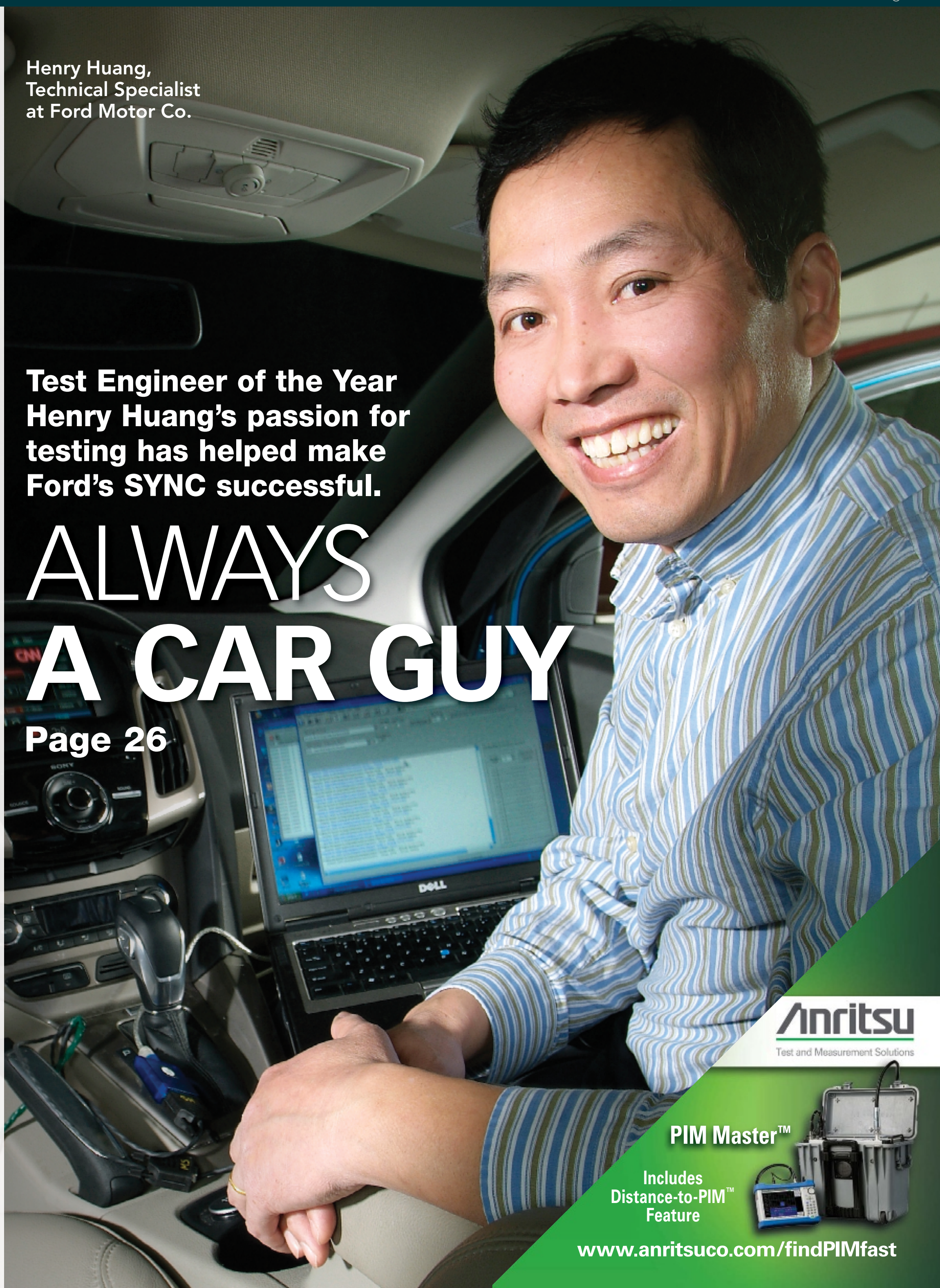
Test & Measurement World

THE MAGAZINE FOR QUALITY IN ELECTRONICS



Henry Huang, Technical Specialist at Ford Motor Co.

Test Engineer of the Year Henry Huang's passion for testing has helped make Ford's SYNC successful.

ALWAYS A CAR GUY

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"I need the fastest DMM they make."

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34410A	6 ½	0.0030%	10,000 / sec	2.6 ms	GPIB, USB, LAN (LXI)
34411A/ L4411A	6 ½	0.0030%	50,000 / sec	2.6 ms	GPIB, USB, LAN (LXI)
34420A	7 ½	0.0030%	250 / sec	.02 sec	GPIB, RS-232
3458A	8 ½	0.0008%	100,000 / sec	3.0 ms	GPIB

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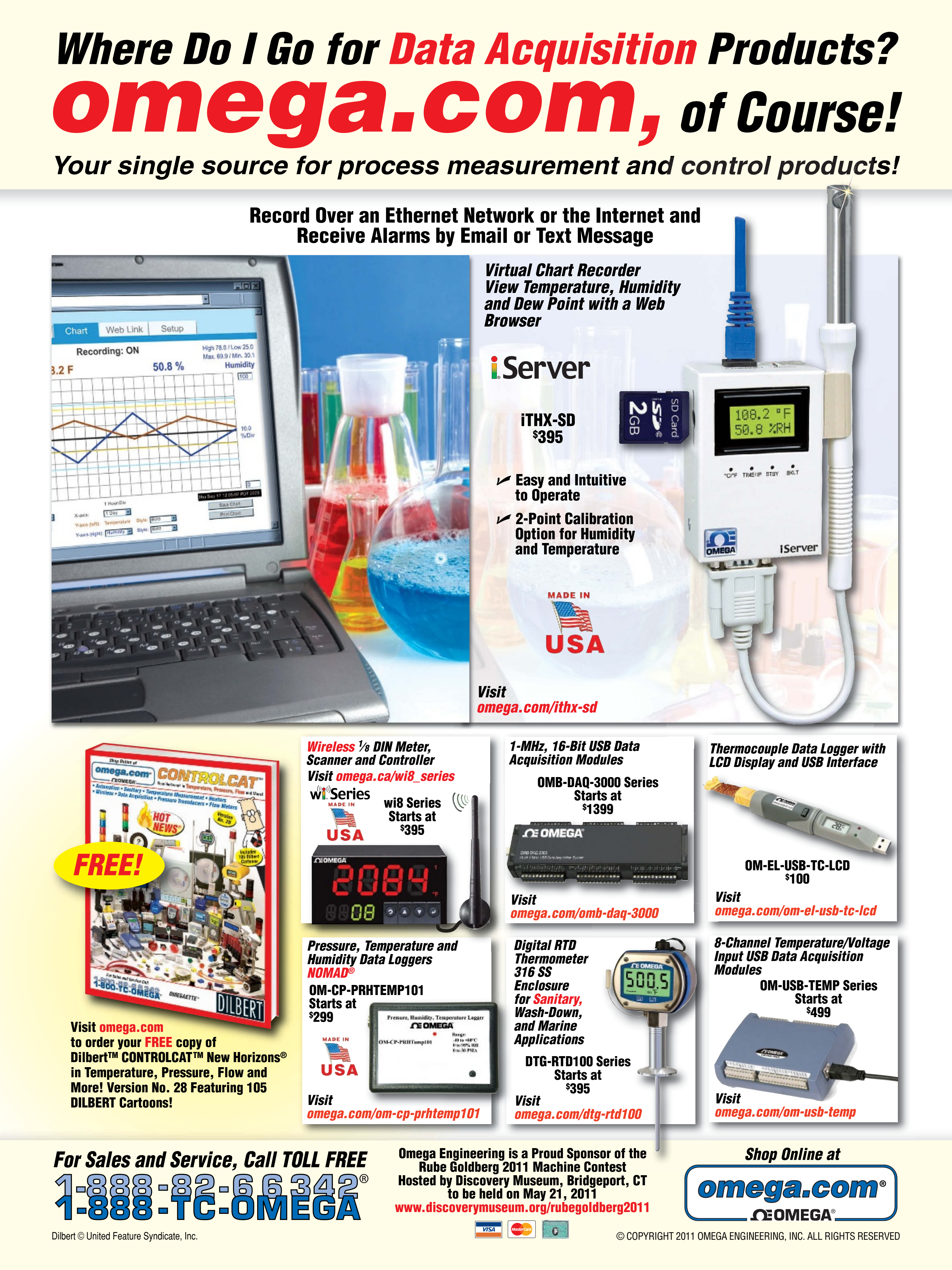
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MAY 2011
VOL. 31 NO. 4

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Survey: modular instruments

Test & Measurement World and Frost & Sullivan are conducting a survey on traditional and modular instruments. The survey, which is *not* being conducted for a specific client or vendor, will provide an understanding of the direction in which the industry is heading. Complete the survey and receive a report that analyzes responses and offers a summary of the findings.

bit.ly/dZ8B7q

Test high-speed ADCs for analog-input phase imbalance

Output harmonics from an ADC can produce errors in the device's digital output. Many ADCs have differential inputs, and you must apply signals with identical amplitudes that are 180° out of phase. If you don't, the ADC's output will contain unwanted harmonics that produce measurement errors. With a test system consisting of two RF signal generators and an oscilloscope, you can measure the effects of differential imbalance on an ADC's input. Rob Reeder of Analog Devices explains how.

www.tmworld.com/2011_ADC_imbalance

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Taking the Measure

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- Unglamorous analog?
- Semiconductor test consolidation process continues

Rowe's and Columns

Martin Rowe, Senior Technical Editor

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RICK NELSON
EDITORIAL DIRECTOR

The road ahead for EEs

The road ahead for electrical engineers is likely to be crowded, with practitioners of multiple engineering disciplines accompanying EEs. For example, at the Automate 2011 show in Chicago in March, the robots on display incorporated considerable amounts of electronics, but bringing them to fruition required considerable mechanical engineering expertise as well.

Bill Schweber had a similar observation from his recent visit to BIOMEDevice Exposition and Forum, which he described in an April 7 *EE Life* post titled, "Sorry, EEs: it's not all about you." Schweber described the event as "…a vivid reminder of how electronic-design centric we sometimes are…. Seeing the exhibit floor and the conference sessions at the event made it clear, to paraphrase that cliché: it takes a multidisciplinary team to make a real product."

Demonstrate your value by looking for synergies among the various engineering disciplines.

Schweber also visited the co-located Design and Device Manufacturing event and came away with the impression that combinations of materials science, CAD/CAM, finite element analysis, and rapid prototyping can work to EEs' advantage, if the EEs reach out to their counterparts in the other disciplines.

There may be more and more of these counterparts to reach out to. According to the Bureau of Labor Statistics' "Occupational Outlook Handbook, 2010–11 Edition," the number of EEs will remain at 2008 levels through 2018, while over that same period, the number of materials engineers will increase 9%; aerospace engineers, 10%; environmental engineers, 31%; and biomedical engineers, an impressive 72%.

The Bureau of Labor Statistics attributes the lack of growth of EE jobs for designing communications equipment, defense-related equipment, medical electronics, and consumer products to foreign competition. Another factor may be a lack of engineers to take on the work that otherwise would have remained in the US.

Stephen Moore, senior economics writer for the *Wall Street Journal* editorial page, in an April 1 column titled, "We've Become a Nation of Takers, Not Makers," stated that in the US, nearly twice as many people work for the government as work in manufacturing. The next generation, he suggested, might prefer to work at the department of motor vehicles rather than design and build motor vehicles. Moore noted that surveys of college graduates indicate that many top performers seek the security of government jobs and are unwilling to take career risks.

That might well be a rational choice. As *New York Times* columnist Paul Krugman put it in a March 6 column titled, "Degrees and Dollars," "…the idea that modern technology eliminates only menial jobs, that well-educated workers are clear winners, may dominate popular discussion, but it's actually decades out of date."

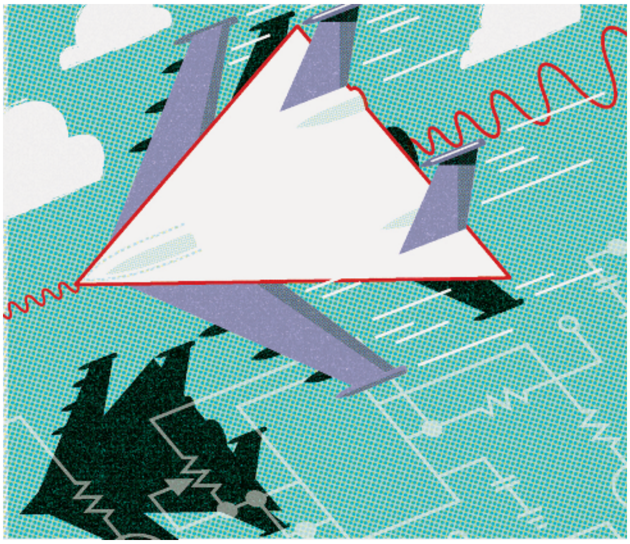
That's true. Robots such as the ones I saw at Automate 2011 have already taken over most menial tasks, and as Krugman pointed out, computers will increasingly take over cognitive tasks as well. Engineers need to demonstrate that automation can enhance their efforts but not replace them in the drive for innovation. Looking for synergies among the various engineering disciplines may be a good place to start. T&MW

> > > *POST YOUR COMMENTS AT WWW.TMWORLD.COM/BLOG.*

[An exclusive interview with a test engineer]

The designer who automates tests

Kenneth Schnebly is an analog and digital controls engineer at AML Communications, a maker of RF/microwave amplifiers for military applications. When he's not designing RF amplifiers and their internal control circuits, Schnebly is automating measurements for both engineering and production. Senior technical editor Martin Rowe spoke with Schnebly at his office in Camarillo, CA.



DANIEL GUIDERA

Q: What kinds of tests have you automated?
A: Our tests include S-parameters, power, VSWR [voltage-standing wave ratio], 1-dB compression points, second- and third-order intercepts, and noise figure. The frequency range is typically 1 GHz to 18 GHz, but we increasingly get requests for amplifiers that run at frequencies up to 40 GHz. We also perform a range of specialized tests per customer requirements, both on the bench and using an ATE [automated test equipment] system that I developed.

Q: What's in the ATE system?
A: The test system consists of a network analyzer, a spectrum analyzer, a power meter, a signal generator, an RF power meter, and a noise-figure meter. All instruments connect to the amplifier under test through a switching system. All equipment runs under software control over GPIB. We use the spectrum analyzer to measure power at specific frequencies and through frequency sweeps. We need better accuracy for measuring power levels at a specific frequency when we measure the amplifier's 1-dB compression points. That's then we use the RF power meter. For gain, phase, and VSWR measurements, the ATE system uses the network analyzer. The ATE system connects to the company network so we can download test data.

Q: What kind of specialized tests do you perform?
A: One customer wanted to us to measure a broadband amplifier's in-band and out-of-band second-order harmonics. We made the measurements with a spectrum analyzer with the frequency increasing from a baseline in 100-MHz intervals. The spectrum analyzer made the power measurements as the signal generator's output frequency increased. Because the tests required just two instruments, we performed the tests at the technician's bench.

Another specialized test requires us to match, within a tolerance, the phase shift of amplifiers across a production run. A technician has to look at phase, gain, and other parameters while adjusting the amplifier to bring phase shift into tolerance. Of course, adjusting for phase shift causes other parameters to change, so we must find the optimal setting for all parameters.

Q: How has automation improved your testing?
A: A full suite of production tests, performed manually, required an hour of a technician's time. Through automation, we reduced test time to between 3 min and 5 min. When I first set up the ATE station, I used test routines that engineers at Agilent Technologies provided. That was enough to get started. Using those routines, our test times ran between 8 min and 10 min. Over time, I modified the code, which reduced the test time to between 3 min and 5 min, with improved measurement accuracy.

Q: How did you become the automation engineer?
A: A few years ago, management saw that in order to stay competitive, we had to automate our testing and production, so I was asked to develop an automated test system. At the time, I lacked automation experience. During the process, I gained the skills and knowledge necessary to create automated systems and have since moved beyond just manipulating the ATE system. Today, I create different specialized systems. As a result, my company can test higher volumes in less time. T&MW

Every other month, we interview an electronics engineer who has test, measurement, or inspection responsibilities. To participate in a future column, contact Martin Rowe at martin.rowe@ubm.com. To read past Test Voices columns, go to www.tmworld.com/testvoices.

Goepel enhances OptiCon inspection systems

Goepel Electronic reports that its OptiCon AOI (automated optical inspection) systems can now inspect bonding pads for solder splashes, deformations, and any other impurities in the micrometer range by means of a camera module with a 3-μm resolution. An adaptive illumination system optimizes fault detection while maintaining low false-call rates. The high-resolution camera can be used in a parallel mode to permit inspection of both soldered components and bonding pads in one production run.

OptiCon AOI systems can be used before and after the soldering process as stand-alone and in-line machines. They can detect manufacturing faults such as faulty solder joints and misplaced components.

Goepel also announced it has enhanced its OptiCon X-Line 3D inline x-ray inspection system (pictured) to detect voids within various layers of high-volume solder joints in applications—such as those involving power electronics for wind power or solar electricity—where solder quality is important for the components' thermal coupling, enabling the components to achieve maximum heat dissipation. The enhanced OptiCon X-Line 3D system employs an adapted-image recording feature and supports layer-by-layer image reconstruction.

The recorded images allow for an automatic detection of voids in each layer, classifying the voids with respect to quality parameters separately defined for each respective layer. For PCB (printed-circuit board) inspection applications, the system can automatically analyze critical solder joints (such as those under ball-grid arrays) layer-by-layer. www.goepel.com.

IEEE ratifies 802.3bg

On March 31, the IEEE announced the ratification of IEEE 802.3bg-2011, a standard that defines a new 40-Gbps Ethernet single-mode fiber-optic interface and paves the way for telecom carriers to adopt Ethernet technology in their networks. The new interface, called 40GBase-FR, supports transmissions that travel up to 2 km over single-mode fiber; it also enables telecom carriers to configure new equipment to interoperate with existing equipment that conforms to standards such as OC-768, OTU3, STM-256, and 40G POS (Packet-over-SONET).

"The telecom carrier community is very keen to adopt Ethernet technologies but also needs to leverage its significant installed base of OTN, SONET, SDH, or POS equipment," said Mark Nowell, chair of the IEEE 802.3bg Task Force and a senior director of engineering at Cisco, in a prepared statement. He added, "The excellent cooperation between the IEEE and ITU standards bodies and members enabled us to develop and complete this IEEE Ethernet specification in record time for an optical interface. Completing in only 16 months from the original Call for Interest and 12 months from the project approval enables the industry to quickly respond to the growing need for Ethernet adoption in the carrier networks."

The 40GBase-FR Ethernet optical interface for single-mode fiber is compatible with the existing IEEE 802.3 standards and installations. The IEEE anticipates that equipment suppliers will be able to support 40GBase-FR interfaces in equipment that already supports 40GBase-LR4. standards.ieee.org.

Editors' CHOICE

PXI system speeds ECU functional test

Agilent Technologies has introduced the modular PXI-based TS-8900 automotive functional-test system for medium- to high-pin-count ECUs (electronic-control units). Agilent reports that the new PXI system provides up to 20% better throughput than previous VXI and LXI automotive functional-test systems from the company.

At the heart of the system is the new 32-channel M9216A high-voltage data-acquisition module, which can acquire dynamic voltage levels ranging from 1 mV to 100 V at 250 ksamples/s per channel simultaneously. Two other new automotive-focused modules include the M9186A voltage-current source and the M9185A DAC that enables parallel test methodologies. In addition, the system includes 200 automotive-applications-tuned libraries for faster deployment.

The new system can test power-train ECUs (including engine-control, fuel-injector-control, and emission-control modules), safety ECUs (including personal-occupancy-detection, lane-departure-warning, and collision-avoidance systems), and body-control ECUs (including power-steering and adaptive-cruise-control modules).

Base price: $60,000. *Agilent Technologies, www.agilent.com.*

CALENDAR

Design Automation Conference, June 5–10, San Francisco, CA. *EDA Consortium, www.dac.com.*

International Microwave Symposium, June 5–10, Baltimore, MD. *IEEE, ims2011.org.*

Sensors Expo & Conference, June 6–8, Rosemont, IL. *Questex Media Group, www.sensorsexpo.com.*

Semicon West, July 12–14, San Francisco, CA. *SEMI, www.semiconwest.org.*

To learn about other conferences, courses, and calls for papers, visit www.tmworld.com/events.

Editors' CHOICE

SMU goes high power

Keithley Instruments' Model 2651A SourceMeter lets you test high-brightness LEDs, power MOSFETs, and other devices. It can produce 200 W of continuous power or 2000 W of pulsed power in pulses as short as 100 µs with 1-µs resolution. Programmable duty cycle ranges from 1% to 100%. If you need more power, you can combine two SMUs in series or in parallel.

The Model 2651A uses four ADCs, two to measure voltage and two to measure current. You can select an 18-bit ADC pair for high speeds (1 Msample/s), or you can use the 22-bit pair for better resolution. The high-speed ADCs let you capture voltage or current transients as the instrument applies them to a device. You can use the high-speed pair to measure a device's response just before or after you apply a rising or falling voltage or current and then switch to the integrating ADCs for DC and steady-state measurements.

The Model 2651A comes with LAN, GPIB, and USB ports. If you use LAN, you can download Keithley's TPS Express software from the instrument to configure and operate one or two instruments. Software support also includes LabView drivers and a scripting tool.

Price: $13,700. *Keithley Instruments, www.keithley.com.*

Speed increases move out of the lab

> > > OFC/NFOEC conference and exhibition, March 7–10, Los Angeles, CA, www.ofcnfoec.org.

Wireless communications is driving higher optical data rates. That became clear in the plenary session at OFC/NFOEC 2011, when Kristin Rinne, senior VP of architecture and planning at **AT&T,** told the audience how AT&T is upgrading its networks. The telecom carrier is deploying LTE technology in its wireless network.

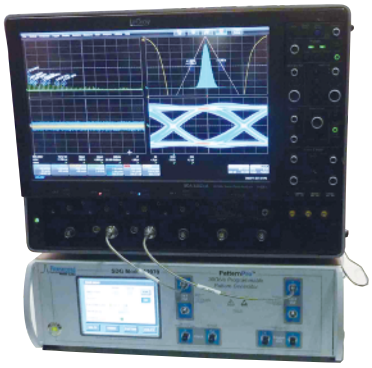
Wireless data communications is stressing the backhaul networks as well. As a result, networks are moving to 40-Gbps and 100-Gbps data rates. Optical components and test equipment that handle those data rates were thus more prevalent at this year's conference than in the past. Furthermore, test is already moving beyond the physical layer and is heading up the protocol stack, particularly to Ethernet, the so called "client side" of a network.

EXFO added 100G/40G EoOTN (Ethernet mapping over optical transport network) testing capabilities to its FTB/IQS-85100G Packet Blazer test modules. Working with optical module manufacturer **Opnext,** EXFO demonstrated a test of a 100GBase-LR4 CFP MSA (multisource agreement) optical module using its FTB-85100G Packet Blazer module.

Picosecond Pulse Labs demonstrated the Model 12070, a 30-Gbps pattern generator, connected to a **LeCroy** SDA 830Zi-A 30-GHz oscilloscope.

The 40-Gbps and 100-Gbps links generally combine four or ten 10-Gbps Ethernet streams. To address the needs for testing above the physical layer, **JDSU** introduced the ONT-600 multiport test module, which tests optical links up to protocol layer 3 at data rates up to 11.1 Gbps.

To address the need for physical-layer testing of 14.025-Gbps Fibre Channel and 14.063-Gbps Infiniband links, T**ektronix** announced the 80C14 optical module for its DSA8200 digital serial analyzer. The module also lets you test standard data rates from 8 Gbps to 12.5 Gbps. T&MW



The high-speed Model 12070 (bottom) provides one or two output channels with programmable patterns, data rate, and amp/offset.

Courtesy of Picosecond Pulse Labs.

Measurements abound at the MSC

> > > Measurement Science Conference, March 14–18, Pasadena, CA, www.msc-conf.com.

At the 2011 Measurement Science Conference, **Agilent Technologies** focused on RF measurement equipment with its N5247A PNA-X microwave network analyzer, which can operate at frequencies up to 67 GHz. The company also exhibited the N5531S measuring receiver, used to calibrate RF signal sources.

Fluke introduced the Model 1551A thermometer, a handheld instrument that combines an RTD probe with measurement electronics in a single unit. The 1551A is a replacement for the mercury thermometers used in many calibration labs. NIST (National Institute of Standards and Technology) won't calibrate mercury glass thermometers anymore because they contain mercury.

The 1551A is available in two temperature ranges, –50°C to 160°C and –80°C to 300°C. It can log data and transfer measurements to a computer over an RS-232 port.

Designed to operate in an oil batch at 25°C for calibrating resistance meters, the Model 202 reference resistor's value changes less than 1 ppm/°C.

Courtesy of Ohm Labs.

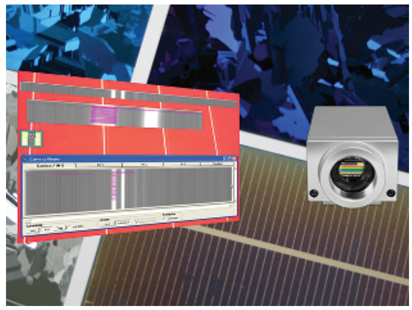
Fluke also added protection circuits to its 5520A multifunction calibrator. The circuits prevent damage to the unit from accidental voltage connections at its terminals without sacrificing accuracy. Dave Postetter, marketing director at Fluke, demonstrated the protection circuits by placing 500 V across the terminals. The 5520A went into a standby mode and its display indicated the fault condition.

Ohm Labs demonstrated the Model 202 reference resistor whose value changes less than 1 ppm/°C. The resistor is designed to operate in an oil bath at 25°C for calibrating resistance meters that are then used to calibrate reference-standard temperature probes. The company also demonstrated the SmartResistor, an instrument that contains eight reference resistors in a constant-temperature enclosure and contains scanners for connecting the reference resistors to measurement equipment. T&MW

Vendors highlight multiple camera interfaces

> > > Automate 2011, March 21–24, Chicago, IL. www.automate2011.com.

CoaXPress, GigE Vision, Camera Link, and USB 3.0 garnered machine-vision vendor support at Automate 2011, with IEEE 1394b still finding applications. **Adimec** debuted what it calls the industry's first production-ready cameras using the new CoaXPress standard, the OPAL series, available in 1- to 8-Mpixel versions. Also highlighting CoaXPress, **Active Silicon** presented its CXP-6 CoaXPress frame grabber. Adimec also showcased its Quartz Q-4A180 4-Mpixel global-shutter CMOS-based camera.



In solar-cell manufacturing applications, the VC4002L line-scan camera can monitor the separation of conducting paths via laser. Courtesy of Vision Components.

Highlighting support for other standards was **Sony,** which introduced its XCD-MV6 miniature monochrome camera and XCG-SX99E 27-fps cameras with IEEE 1394b and GigE Vision interfaces, respectively. Sony touts the 1394b capability as a bridge technology providing an easy transition from analog. In addition, **Point Grey** showcased its Grasshopper2 GigE Vision cameras and previewed upcoming USB 3.0 models of its 1.3-Mpixel Flea3.

In other news, **Teledyne Dalsa** launched its new Boa IDR product, which can handle part recognition, tracking, and verification; the Boa IDR is targeted at the automotive, electronics, packaging, and pharmaceutical industries. **Vision Components** highlighted its VC4002L line-scan camera for solar-cell manufacturing.

Edmund Optics displayed its line-up of optical components, including its TechSpec Telecentric lenses, which compensate for perspective errors, or parallax. **Epix** exhibited its Silicon Video 10C6 and 10M6 color and monochrome 10-Mpixel cameras. **Matrox Imaging** highlighted the Matrox Iris GT color smart camera, with system integrator **Honeyville Automation** demonstrating the use of the Iris GT in a robotic pick-and-place application. T&MW

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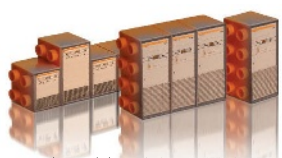

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RICK NELSON
EDITORIAL DIRECTOR
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Vendors target LTE design and deployment

Test-equipment vendors are gearing up to facilitate the design and deployment of LTE systems, with companies such as Aeroflex, Agilent Technologies, Anritsu, ETS-Lindgren, and Rohde & Schwarz highlighting instruments, technologies, and options to support the rollout of the 4G technology.

Aeroflex, for instance, is touting its range of instrumentation for design, verification, manufacturing test, and servicing of LTE networks and user equipment. The company's current offerings include the TM500, which serves in base-station test applications; the 7100 LTE single-box tester, which can characterize UE (user-equipment) chipsets and mobile terminals; and the PXI 3000 series modular RF test system, which targets manufacturing test of cellular products that work with multiple standards.

In March, Aeroflex announced that its TM500 now supports UE beamforming for both TDD (time-division duplex) and FDD (frequency-division duplex) modulation schemes and also supports 4x2 MIMO transmit-diversity and special-multiplexing measurements. As for the 7100, the company has added an option that supports test in accordance with SV-LTE (Simultaneous Voice-LTE), which combines LTE data and CDMA voice functionality.

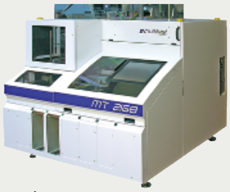
The TM500 family of mobile instruments for base-station test supports both FDD and TDE modes of the LTE standard.
Courtesy of Aeroflex.

For its part, Anritsu has announced the MD8475A multiformat signaling tester that can test multimode wireless devices, including ones supporting FDD-LTE. Also, the company announced that ETS-Lindgren has selected the Anritsu MT8820C one-box tester for OTA (over-the-air) LTE testing, including MIMO testing. The companies said they will integrate support for the MT8820C into the ETS-Lindgren's EMQuest EMQ-108 MIMO OTA test package. ETS-Lindgren has written an instrument driver for the EMQuest EMQ-108 that can control the test equipment as well as position the measurement antenna relative to the device under test to measure 3-D radiation patterns.

Agilent Technologies, too, has been addressing LTE test, and in March the company enhanced its N5971A CDMA IFT (Interactive Functional Test) software with the introduction of the N5973A IFT application for automating LTE to CDMA inter-RAT (inter-radio access technologies) compliance test. The new capability will help demonstrate that new LTE UE, when out of range of an LTE network, will successfully fall back to available 2G or 3G networks.

Aeroflex, Anritsu, ETS-Lindgren, and Agilent highlighted their new offerings at the CTIA Wireless 2011 show, held March 22 to 24 in Orlando, FL. Prior to the event, in February, Rohde & Schwarz had announced that its R&S FSH4 and R&S FSH8 handheld analyzers now include functions for detailed measurements in LTE networks. The handheld analyzers, the company said, allow users to perform modulation analysis in the LTE FDD and TDD modes. The instruments can demodulate LTE frames with up to 10 subframes and display the power and modulation quality of the data signal and of other signal components. T&MW

Sigurd installs MT2168 handler



Multitest has announced that Sigurd Microelectronics has become the first user of the Multitest MT2168 handler in volume production in Taiwan. Sigurd installed the MT2168 pick-and-place handler for use in a hot-test application of QFN packages. After running production tests, Sigurd said it experienced minimal handler jam rate and found that the system's high-soak-buffer design allowed it to almost double daily output. www.multitest.com.

Agilent updates RFIC simulation software

GoldenGate 2011, the latest version of Agilent Technologies' RFIC simulation, verification, and analysis software, offers improved performance, fast mismatch analysis for analog/RF applications, and a new user interface. The release also extends the program's RFIC analysis to more easily incorporate package and board effects. www.agilent.com.

Goepel extends ScanFlex with multifunctional controller

Goepel Electronic has introduced its SFX/COMBO1149-(x), the first desktop compact controller for the ScanFlex boundary-scan hardware platform. The multifunctional controller enables the combination of numerous strategies for testing, programming, and design validation, and is ready to support standards such as IEEE 1149.7 (the Compact JTAG or cJTAG standard) and IEEE P1687 (the proposed internal JTAG or IJTAG chip-embedded-instrumentation standard). www.goepel.com.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Camera interface choices expand

Vision-system and manufacturing engineers are demanding vision systems with greater sensitivity, faster frame rates, and more image data. In response, camera makers are choosing from an expanding menu of interfaces to handle the resulting bandwidth.

Multi-megapixel CCD sensors, and CMOS sensors with global shutters and high frame rates, are driving the need for faster interfaces, especially in applications that employ AOI (automated optical inspection) systems and semiconductor inspection systems. In these applications, manufacturers want a very high-resolution, high-sensitivity camera for a competitive price.

Interface choices include revved-up versions of existing technologies, like USB 3.0 and 10 GigE over GigE Vision, or those based on new technologies such as CoaXPress and Camera Link HS. With the exception of Camera Link and CoaXPress, which are dedicated machine-vision interfaces, all the other interfaces originated in consumer applications, said Michael Gibbons, product marketing manager for Point Grey Research. "USB 3.0 and 10 GigE will be adopted into machine vision because the millions of chipsets sold into consumer markets drive down prices for all markets," he said.

Meanwhile, some sensors, such as the CMOSIS CMV4000, are being developed specifically for industrial vision, said Gibbons. Other high-speed, high-resolution CMOS sensors aimed at security and surveillance applications, such as Sony's 3-Mpixel IMX036, are also coming into machine-vision applications.

Gibbons said that Point Grey decided to use the CMOSIS CMV4000 sensor for its Gazelle camera for several reasons. "The sensor's 2-Mpixel and 4-Mpixel resolutions are in the sweet spot for many industrial inspection applications," he said. "In particular, the 4-Mpixel version's square 2k-by-2k array works well with a lot of inspection and alignment applications, where a one-to-one aspect ratio is preferred to optimize the pixel area that is seen by a round lens. The sensor's high speed, sensitivity, and global shutter are also very important."

The Gazelle camera, which includes a Camera Link interface, is well-suited to many electronics inspection and alignment applications.

Courtesy of Point Grey Research.

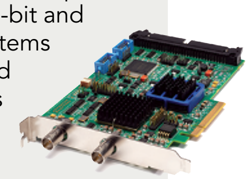
For this high-resolution, 4-Mpixel sensor at 180 fps, Point Grey had several interface choices. "We selected Camera Link," said Gibbons, "because it's an industry-standard machine-vision interface, it's widely accepted, and it is still the bandwidth leader."

USB 3.0 is also becoming attractive because of its higher maximum signaling speed, about 3 Gbps after overhead and encoding. "We showed our first prototype USB 3.0 camera a year ago," Gibbons said. "This standard has taken all of the strengths of USB 2.0, such as ubiquity in laptops, plug and play, and single-cable power and data, and addressed its limitations for machine vision by improving the data rate, reliability, and amount of power provided over the wire to the camera."

Point Grey believes that USB 3.0 will be the next big interface for machine vision, said Gibbons. "We plan a new line of USB 3.0 products to be introduced by the third quarter," he said. These will be small, ice-cube-style cameras, the same size as the company's existing Flea2 line, and will use a number of high-speed CMOS sensors, such as the Sony IMX036. T&MW

CoaXPress frame grabber is Windows 7-compatible

BitFlow's Karbon-CXP frame grabbers with a CoaXPress interface have 8 PCI Express lanes. They support up to four CoaXPress cameras and also support multi-link cameras with up to four links. The software-development kit supports both 32-bit and 64-bit operating systems as well as drivers and utilities for Windows XP, Vista, and Windows 7. Applications can be developed using C, C++, and .NET. www.bitflow.com.

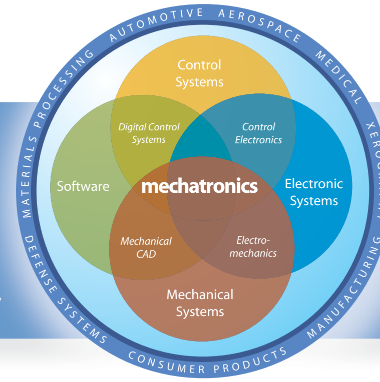


System inspects flat-panel displays, wafers

Boulder Imaging's Vision Inspector Beacon for Web Inspection system is targeted at in-line materials inspection, defect detection and archiving, and real-time awareness and reporting for applications such as glass flat panels, solar film, and semiconductor wafers. Inspection types include presence/absence, alignment, color matching, and surface irregularities. The system identifies defects and anomalies in materials at speeds above 900 ft/min. www.boulderimaging.com.

Software supports ActiveX

Version 10.1 of PPT Vision's Impact machine-vision software works with all of the company's smart cameras. This new version supports ActiveX programming for PPT Vision's M-Series vision processors, offers an enhanced 2-D Data Matrix inspection tool, and provides improved histogram and graphing capabilities for easier inspection tool setup and troubleshooting. www.pptvision.com.



Educate engineering students in context

Engineers practice engineering in context, so why isn't it taught that way?

Kevin C. Craig, PhD, is the Robert C. Greenheck chair in engineering design and a professor of mechanical engineering, College of Engineering, Marquette University.

For more mechatronics news, visit: mechatronicszone.com.

If a boy wants to become a baseball player, he must be able to field, throw, run the bases, and hit with power, and he must be able to apply all these skills in a game. To achieve this goal, he learns all these skills at once, improving gradually in each one while playing games, and, over time, he develops into a baseball player. The result is not only the sum of the skills he learned but also a sense of confidence and savvy that makes him a winner.

In mechatronics, the necessary skills include modeling and analysis of multidisciplinary dynamic systems, analog- and digital-control systems, and sensors and actuators with the necessary electronics. Theory and practice must be in balance when an engineer masters these skills. Putting together these skills to create a system to solve a problem rarely happens in engineering education, and, if it does, it happens for only a few students who aggressively seek out that integrated, total experience. Universities devote separate courses to each skill and somehow think that learning each skill well will magically enable a student to graduate and critically think, integrate it all, and solve a real-world problem. In the baseball analogy, this scenario would be utter madness, yet it is routine in engineering education.

I am now teaching a course in electromechanical engineering systems to 60 second-year engineers with whom I have 16 personal-contact hours each week—10 in studios and six in classes. I have no teaching assistants, just graders, and I do everything in the context of real-world engineering practice and problem solving.

The process works as follows, and the students apply and learn mathematics and physics when necessary: First, the students choose an electrical, mechanical, or electromechanical engineering system that must behave dynamically in a specified way. The students then physically model the system with simplifying assumptions and then mathematically model the system by applying the laws of nature and appropriate component-constitutive equations to the physical model. They start with a system whose model is first-order and study it from both the time- and the frequency-domain perspectives. Putting the mathematical model in a standard form—that is, time constant and steady-state gain—allows the engineers to relate performance, including speed of response, steady-state error, and relative stability, to the hardware parameters in the physical model. In some cases, the system cannot meet performance specifications while operating open loop. The students must then design and implement a feedback-control system.

Closed-loop PI (proportional-integral) control of a first-order model results in a closed-loop differential equation that is second-order with a numerator of zero. I introduce second-order dynamic systems as part of the process, along with the effect that a real zero has on ideal second-order behavior, again emphasizing time- and frequency-domain perspectives.

Once the students select PI-control gains by a combination of pole placement and simulation iteration, it is time to build the system. First, the students build an analog-op-amp system with a difference amplifier and PI controller. They must then address loading effects and the limit on the control effort due to op-amp implementation, as well as compare measurements to model predictions and adjust the model. The inexpensive and open-source Arduino microcontroller is used for digital control, with the MathWorks Matlab/Simulink Real-Time Workshop providing automatic code generation. Students can address issues such as pulse-width modulation; low-pass filtering, which introduces a real pole; saturation; and analog-to-digital and digital-to-analog resolution—first in simulation and then easily in hardware implementation. They address loading issues with buffer op amps.

In this scenario, the students are "playing the game" from the start. In the past, I have decried engineering silos and engineer comfort zones, both in industry and academia, as the two biggest obstacles to innovation. Add this educational deficiency to that list. Let's get our heads out of the sand! T&MW

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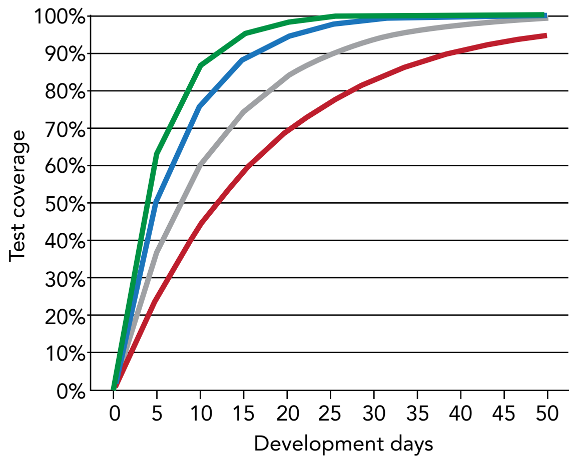
SEMICONDUCTOR TEST

Optimizing the SOC test-development effort



In this example, memory requires the smallest test-development effort (green trace), followed by digital logic (blue trace) and high-speed I/O (gray trace). The analog/RF functions will typically require the greatest effort (red trace).

Every product or process can benefit from an ROI (return-on-investment) analysis that enables managers to determine how much to invest, how many resources to allocate, and when a product is ready for prime time. An effective ROI analysis is especially important in the semiconductor industry, where the stakes are very high given the small market windows, extreme nonrecurring engineering costs, and razor-thin profit margins.

To understand the value of ROI analysis in semiconductor design and production, consider a typical SOC design as a baseline. During SOC development, project managers need to make tradeoffs when they determine how many resources and how much time to devote to the development of the manufacturing-test system, including the test architecture, the design infrastructure, and the test application. Test development typically requires significant human and capital resources. If not properly optimized, test development can also be a time-to-market limiter.

It is accepted in the industry that the higher the investment in test development, the higher the test coverage will be. Developers need to take into account the "10X rule," which states that each subsequent stage of manufacturing contributes a factor of 10X in terms of the increased costs of finding and eliminating a defect at that stage. Managers must decide how much test coverage is required at wafer sort vs. package test or system test in order to optimize the test process and ensure that market windows and cost constraints are met.

Our company has devised a test-strategy ROI model that can help you determine the optimal level of test-development investment. The full online version of this article at www.tmworld.com/2011_05 describes the model as applied to a typical SOC design.

Mick Tegethoff and Tom Jackson, SageSim

EMC TEST

ESD measurements enhance simulations

Design engineers often add ESD (electrostatic discharge) protection to electronic circuits, and then test engineers or EMC (electromagnetic compatibility) engineers must verify that a discharge won't harm the circuits. Students and faculty at the Missouri University of Science and Technology's EMC lab study the effects of ESD and develop models that designers can use to predict performance.

In a recent paper, graduate student Dazhao Liu and others developed a SPICE model of an air-discharge ESD event (see the online version of this article for a link to the paper, www.tmworld.com/2011_05). Their goal was to estimate an arc length based on a rise-time measurement of current discharged into a device. From the arc-length model and the impedance of the DUT (device under test), the researchers simulate the effects that ESD will have on a device. Those effects include electromagnetic fields produced by the discharge, which can couple into PCB (printed-circuit board) traces and produce damaging currents.

To verify the model, the researchers used an ESD simulator in air-discharge mode to discharge 5 kV into an MP3 player placed in a dielectric sheet above a ground plane. They measured the current from the discharge that entered the MP3 player using a current probe and an oscilloscope. The rise-time measurement went into a SPICE model based on the Rompe and Weizel model. It describes an arc as a resistance during the first tens of nanoseconds following a discharge.

An ESD generator creates a repeatable discharge. Courtesy of NoiseKen.

Because they knew the DUT's impedance, the researchers used the recorded data to simulate the fields that a discharge can generate inside the MP3 player. Those fields can couple into circuits in the player, producing unwanted current.

Martin Rowe, Senior Technical Editor

Measure an optocoupler's CTR

Current-transfer ratio is an important specification that may require troubleshooting.

By Chee Hua How, TDK Malaysia

Manufacturers of optocouplers characterize their devices for CTR (current-transfer ratio), and an optocoupler's data sheet will list its CTR ranges. Unfortunately, the CTR range may be too wide for some applications, requiring you to screen incoming devices when you need a tighter tolerance.

Optocouplers are commonly used in the feedback path of a switched-mode power supply. The CTR determines the DC gain of a power supply's open-loop frequency response, which affects the loop's phase margin. An optocoupler influences multiple operating parameters, so CTR variations between devices can cause production tests to reject a power supply. When this happens, you must measure CTR as part of your troubleshooting.

With the circuit in the **figure,** you can measure CTR at V_{OUT} with a multimeter. Besides serving as the V_{CC} source for the DUT (device under test) circuits, IC5's 10-V output also provides virtual ground to IC3, so the latter can operate with a single, unipolar power supply.

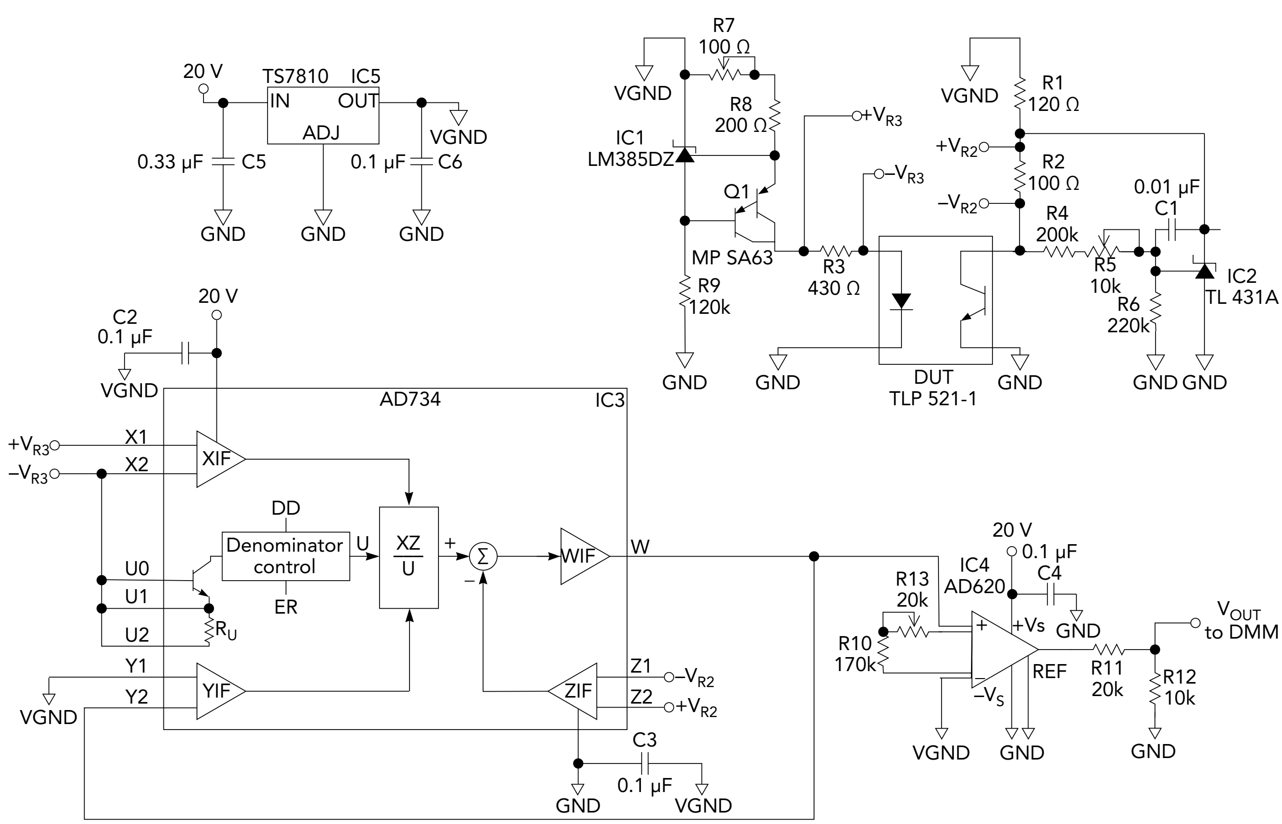
At TDK, we use this circuit to test the TLP521-1(GR) optocoupler. We measure the device's CTR under fixed I_F (forward current) and V_{CE} (collector-to-emitter voltage). The network surrounding IC1 forms a current source that provides a fixed current (I_F = 5 mA) that drive's the DUT's photodiode. The circuit around IC2 forms a shunt-regulation network that keeps the DUT's V_{CE} at a fixed voltage at 5V. CTR is defined as I_C/I_F.

We calculate I_C (the collector current) and I_F by measuring the voltages across resistors R2 and R3:

$$I_C = V_{R2} / \mathrm{R2} \quad \text{and} \quad I_F = V_{R3} / \mathrm{R3}$$

The rest of the circuits are mainly for signal conditioning.

Analog multiplexer IC3 functions as a divider that produces its output, W, with a transfer function of:



This circuit lets you directly read a DUT's CTR across V_{OUT} using a multimeter.

$$W = 10 \times \left(\frac{V_{R2}}{V_{R3}}\right) + \text{VGND} = 2.326 \times \frac{I_C}{I_F} + 10$$

IC3's output feeds amplifier IC4, removes the offset voltage of 10 V, and amplifies the signal with a gain of:

$$G = \left[\frac{49.4\text{k}}{(\text{R10} + \text{R13})} + 1\right] = 1.29$$

The resistor divider network of R12 and R11 scales down the voltage from IC4 by a factor of 1/3. Thus,

$$V_{OUT} = \left[2.326 \times \frac{I_C}{I_F} \times 1.29 \times \frac{1}{3}\right] = \frac{I_C}{I_F}$$

Voltage V_{OUT} represents the optocoupler's CTR.

Resistors R5, R7, and R13 will let you calibrate the initial error of IC1, IC2, and IC3. We adjust the value of R7 to trim the initial error of IC1's reference voltage. We measure the voltage across R3 and adjust R7 until the voltage across R3 is 2.15 V. Potentiometer R5 lets us trim the error in IC2. Measuring the voltage across V_{CE} of the DUT lets us trim R5 until V_{CE} = 5 V.

Using the circuit, we've found that IC3's gain contributes most of the error in V_{OUT}. By measuring V_{R3} (hence I_F), V_{R2} (hence I_C), and V_{OUT} simultaneously, we can trim R13 so that V_{OUT} is reflecting an actual ratio of I_C/I_F.

IC5 is a 10-V TS7810 whose output is labeled as VGND (virtual ground). This voltage acts as the V_{CC} source that supplies test current to IC1, IC2, and the DUT circuits. It also provides virtual ground potential to IC3 (AD734), which lets the device operate from single supply voltage.

The test circuit lets us evaluate the CTR of the TLP521-1(GR), but we also use it to test many types of optocouplers with a CTR that is within 1 to about 3.8 without making changes to it. Factors that may limit the ability of the circuit to measure the CTR range include the input and output "rail-to-rail" capability of IC3 and the power dissipation of IC2. If you need to adapt the test circuit because an optocoupler's operating parameters force the circuit out of its linear region, then you can change the values of resistors R1, R2, R3, R7, and R8 as needed. T&MW

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ALWAYS A CAR GUY

Test Engineer of the Year Henry Huang's passion for testing has helped make Ford's SYNC successful.

BY DAN ROMANCHIK, CONTRIBUTING TECHNICAL EDITOR

Dearborn, MI—Henry Huang, *Test & Measurement World*'s 2011 Test Engineer of the Year, is a technical specialist and supervisor for the SYNC platform QA group at Ford Motor Co. in Dearborn, MI. His job title, however, doesn't do him justice.

"He's a saint."

"You couldn't have picked a better guy."

"Dedicated."

These were the words his manager and co-workers used to describe Huang as I toured the Ford labs and talked to them. They not only respected his technical abilities, but also had a real affection for him as a person. After spending a day with Huang and his crew, I came to agree with them: *T&MW*'s readers couldn't have picked a better engineer for this award.

Huang, a native of China, has always been a car guy. "Ever since I was a kid," he said, "cars and trucks have been fascinating to me." Huang earned his bachelor's degree and master's degree in electrical engineering from Hefei University of Technology in China, and then came to the US to continue his studies.

After receiving his master's degree from the University of Detroit, Huang went to work for Ford, and he's been a Ford employee for 20 years. He hasn't always been a test engineer, though. He started out in research and development, working on ECMs (electronic-control modules).

Huang eventually worked on a project called the 42V/14V Dual Voltage Vehicle Electrical and Electronic System Architecture. The goal of this project was to investigate the feasibility of transitioning automotive electronics from a 12-V supply to a 42-V supply that could more easily handle the higher power requirements of today's vehicles.

Proponents of the 42-V system claimed it would reduce the current levels and lower the cost of the electrical system by allowing companies to downsize wiring and electrical components. This would also reduce the mass and volume required by the electrical system and, ultimately, improve fuel efficiency.

It was while working on this project that Huang realized the importance of testing, specifically integration testing. In addition to Ford Motor Co., the project involved MIT, Mercedes-Benz, Motorola, Yazaki, and other automotive suppliers. To ensure that electronic modules worked under the new architecture, the companies needed to perform integration tests, so they set up a lab at Ford where they could evaluate their new 42-V components and modules. The lab was equipped to allow the partners to perform their bench tests remotely. The companies would send their modules to the Ford lab, where technicians would configure and run the tests. The data was gathered automatically and then transmitted to the companies for their analysis.

Ultimately, Huang noted, the 42-V systems didn't pan out, because other technologies, such as hybrid-vehicle technology, proved to be more effective in improving fuel economy and reducing emissions. Even so, Huang's efforts were duly recognized. With other Ford engineers, he published two papers on 42-V technology, and one of them, "Automotive Electrical System in the New Millennium," was named the Outstanding Paper for the 1999 SAE International Truck & Bus Meeting & Exposition.

(continued)

Henry Huang, the 2011 Test Engineer of the Year, is responsible for the development testing of Ford Motor Co.'s SYNC technology, which helps drivers interact with communications and entertainment systems while driving.

PHOTO BY JEFFERY WHITE

In our December 2010/January 2011 issue, we profiled six outstanding test engineers, and we asked our readers to vote for the Test Engineer of the Year. The winner is Henry Huang, a technical specialist at Ford Motor Co.

As part of his award, Huang will designate an educational institution to receive a $10,000 grant, courtesy of National Instruments, the award sponsor.
www.tmworld.com/awards

Transition to test engineer

Huang's work on ECMs eventually led him into test engineering. "Even in development," he said, "testing is always part of what we do." He added, "Automotive electronic-control modules have hundreds of I/O pins as well as data-communication ports, so testing them can be a real challenge."

Someone in management must have noticed Huang's affinity for test, because he was asked to set up Ford's first HIL (hardware-in-the-loop) test lab. The lab's first project was to test the Body Control Module that controlled components such as door locks, windows, and headlights. Huang formed and led a group of engineers who developed a system to automatically test both the hardware and software of this complex module.

Their efforts paid off. According to Huang, the HIL tests dramatically reduced testing time and significantly increased test coverage. As a result, his group won the 2005 Technical Excellence Award for the Electrical Electronic System Engineering Division at Ford.

The project also sold Ford on the benefits of HIL testing. The HIL test lab has been expanded from that single test station to more than 10 stations, and it runs tests on nearly all of the ECMs now found in Ford vehicles.

SYNC challenges test engineers

Currently, Huang is working on the second generation of the Ford SYNC, which is the backbone of the company's MyFord Touch product that lets a driver use voice controls, touch screens, and buttons on the steering wheel to activate phones, entertainment systems, climate controls, and navigation devices (see "SYNC's second generation," p. 29). Huang is responsible for all of the development testing of SYNC, and he is indirectly responsible for the production testing as well.

As you can imagine, testing the SYNC module is a complicated task. First, there are the technical challenges. The SYNC module is a complex system that includes hardware and software from a number of companies. It also communicates with and controls several other ECMs over three different CAN (controller area network) buses.

The testing also introduces logistical nightmares. Huang not only supervises engineers who report directly to him, but he must also coordinate efforts with other groups, some of whom are testing parts of the SYNC system at remote locations. For example, a plant in Guadalajara, Mexico, manufactures and tests SYNC hardware, and groups in Pune, India, and Bellevue, WA, perform software testing.

Fortunately, Huang seems to be the perfect man for the job. In addition to his technical chops (he holds master's degrees in both electrical engineering and computer science), Huang also has the personality to pull it all off. His manager, Sukhwinder Wadhwa, told me, "He's a saint. I've never seen him blow up." And as we toured the facility and I met the engineers who work with Huang, they all seemed to have a genuine affection for him.

I can understand why, too. As we talked about all the projects Huang has

SYNC's second generation

In 2007, Ford introduced SYNC, the company's first attempt to mesh the world of consumer electronics with the automotive dashboard. MyFord Touch, powered by the SYNC technology, is the second generation of this product. In developing MyFord Touch, Ford engineers redesigned the in-car interface, mirroring how consumers operate other devices by using touch-sensitive buttons, touch screens, and voice recognition.

The system displays information using two 4.2-in. full-color LCD screens flanking an analog speedometer and an 8-in. touch-screen LCD at the top of the center stack. The driver uses a five-way switch on each side of the steering wheel crossbar, similar to the ones found on mobile phones and MP3 players, to control the information displayed on the instrument-panel screens.

Some of the notable features in the system include:

- a wide range of audio inputs including USB ports, an SD card slot, RCA audio- and video-input jacks, and support for MP3 players and smartphones;
- WiFi and Bluetooth ports for wireless interfaces;
- direct speech commands for climate-control functions and radio functions;
- storable user profiles that customize the radio and climate-control settings; and
- navigation controls, including a TDI (Traffic, Directions and Information) application that alerts drivers to traffic backups and adjusts routes accordingly.

Inside, the SYNC sports two processors. The first, a Freescale i.MX5x 64-bit microprocessor, hosts the operating system, Microsoft Auto. The second, a Freescale S12XE microcontroller, interfaces with the three CAN buses in the vehicle. Via the CAN buses, SYNC communicates with other electronic-control modules, allowing it to accept inputs from buttons mounted on the steering column and to display messages on the instrument panel's LCD screen.

The MyFord Touch technology launched on the 2011 Ford Edge, while its sister product, MyLincoln Touch, is available on the 2011 Lincoln MKX. The technologies will be extended to the entire Ford and Lincoln lines beginning with the 2012 model year.—*Dan Romanchik*

worked on over the years, he was always quick to credit the engineers who worked with him.

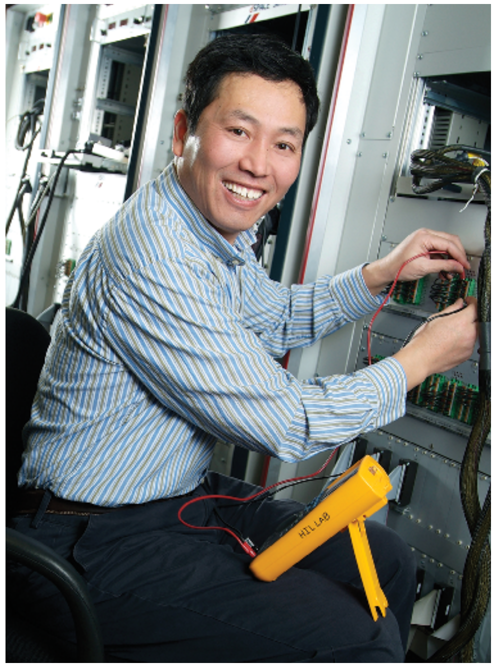
One of the technical contributions Huang has made to the SYNC project is something his co-workers call the "Henry Test." Early in the development of the technology, the engineers found that the SYNC module and its software would sometimes fail to start up properly. To ensure that modules installed in a production vehicle did not fail, Huang devised a development test that cycles power to the SYNC up to 50 times at selected and random intervals. A system passes the test if it boots up and functions properly every time. If a design passes the "Henry Test," the engineers know it's ready for the real world.

Bringing it back in-house

In the automotive industry, there is a trend toward pushing design and test costs to Tier 1 suppliers. Huang's commitment to test-process improvement helped reverse this process—at least as far as the SYNC is concerned.

Huang made an important contribution to the scheme for what Ford calls "provisioning" the SYNC module, or programming it with the software that it needs for a particular vehicle. Provisioning allows the company to manufacture a single version of the hardware module rather than numerous model-specific versions. The same hardware gets installed in economy models, such as the Ford Edge, as in top-of-the-line cars, such as the Lincoln MKX (where the product is called MyLincoln Touch). It's the software that differentiates one model from the next.

Huang figured out a way to install the software using the SYNC's WiFi link as the vehicle moves down the assembly line. When the vehicle reaches the end-of-line test station, a tester runs a functional test to ensure that the software was installed properly.



Huang was the first supervisor of the hardware-in-the-loop test lab at Ford. The company's HIL test lab now has more than 10 test systems.

PHOTO BY JEFFERY WHITE

As he was explaining this, Huang related a story about how his team debugged the process. As Ford was setting up the assembly line at its factory in Oakville, ON, Canada, Huang actually rode down the line with the car, monitoring the process on a laptop PC. He got some funny looks from the assembly-line workers, but in the end, the company had a solid process that ensured that each SYNC was programmed correctly.

The improvements that Huang and his group made in testing and provisioning convinced Ford to move the design and development in-house. And because the improvements allow the company to manufacture only one version of the hardware, they have also helped Ford save millions of dollars.

Moving forward

After our whirlwind tour of the labs, I had a chance to sit down with Huang as he reflected on his career and talked about where things are going in test engineering. Regarding his career, he said, “I’ve been very lucky. I’ve worked for good bosses and have been able to work on good projects.” While that may be true, Huang, like all good engineers, has also made his own luck by working hard and taking steps such as writing technical papers and filing for patents to advance his career. For example, Huang and his colleague Michael Westra recently received US Patent 0190439 for a message-transmission protocol they devised for securely transporting information, such as vehicle-maintenance data, between a vehicle-based system and a service-delivery network.

As far as the future of test engineering, Huang pointed to the complexity of today’s electronics as the biggest challenge test engineers face. The SYNC is a good example. The hardware includes multiple processors, multiple data-communications buses, and human-machine interfaces. The software may be even more complex, with multiple suppliers providing the operating system and application software. Huang expects this kind of complexity to increase as customers ask for more features and Ford seeks to satisfy them.

When I asked how we’re going to deal with increased complexity, Huang replied that testing has to start earlier in the design process. I got a chuckle out of this. “Haven’t we been saying this for decades?” I asked. “Yes,” he answered, “but now we really have no choice.” He then pointed out that Ford, at least, is really starting to take this seriously. He noted that there are nearly as many test and quality engineers working on the SYNC project as there are design engineers.

Finally, I asked what makes a good test engineer. He replied, “a passion for testing.” Huang certainly has that passion, and that’s why he’s the 2011 Test Engineer of the Year. T&MW

MAXIMIZE A *waveform generator's* MEMORY

BY JOAN MERCADÉ, ARBITRARY RESOURCES, BARCELONA, SPAIN

You can use sequencing, loops, and branches to produce a signal that requires less memory and cuts calculating and loading time.

The architecture of an AWG (arbitrary waveform generator) looks like that of a DSO (digital storage oscilloscope) in reverse. Waveform memory plays a critical role in both instruments. DSOs capture waveforms and store them in memory, while AWGs create waveforms from data stored in memory.

AWGs must generate continuous signals for seconds, minutes, hours, or days to properly emulate actual systems, but they must do this within the limits of their memory. An AWG can have one of four architectures: the so-called "true arb," DDS (direct-digital synthesis), interpolating, or interleaving, each of which interacts with the waveform memory in a different way (the online version of this article at www.tmworld.com/2011_05 includes a description of the four architectures). Fortunately, regardless of which type of AWG you have, you can program the instrument with loops and branches to reuse segments of memory and generate longer waveforms.

An AWG's waveform *RL* (record length) gives it the ability to generate nonrepeating signals. A waveform's *TW* (time window) is proportional to the *RL* and is inversely proportional to the AWG's *SR* (sampling rate). For AWGs with a "true-arb" architecture, in which samples are converted by the DAC one after the other at the sampling speed, you can calculate the time window with this equation: $TW = RL/SR$.

As AWG sample rates grow, the amount of waveform memory needed must keep pace. Increasing the memory size at such high sampling rates raises two main issues. One is whether you can justify the cost of implementing the extra memory and the sophisticated memory-access architectures that feed the DAC at the required speeds. The other is whether you can afford to expend the effort and time required to calculate samples for complex signals and move them from mass storage devices (local or remote) to the waveform memory.

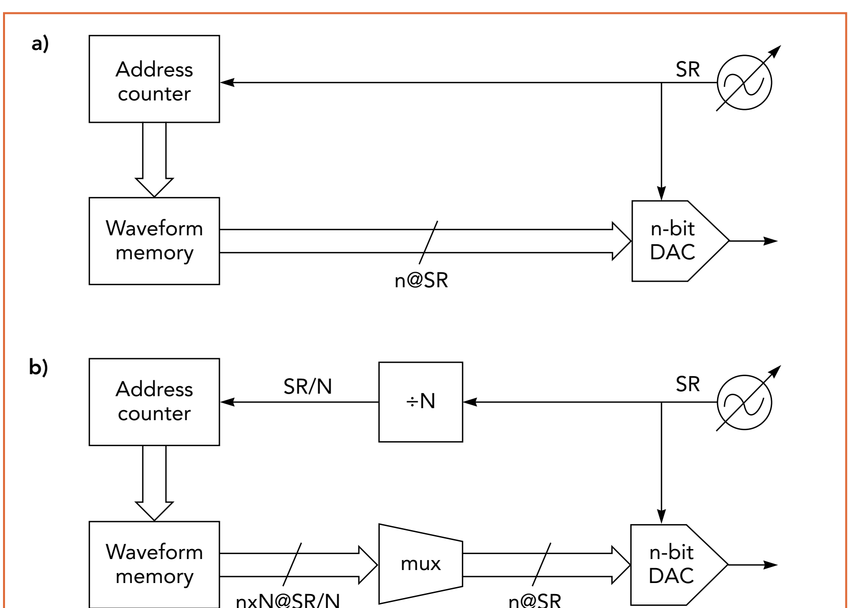


FIGURE 1. Memory-access parallelization uses lower-cost memory at the expense of record-length granularity. Waveforms use *n* samples, where *n* is a multiple of the memory bus width. (*N* is the number of channels in the mux; *SR* is the sampling rate.)

Memory access issues

AWGs combine ultra-high-speed RAM and massive demultiplexing of the memory access buses to resolve these issues. **Figure 1** shows two AWG architectures: one with a mux and one without a mux. The mux lets the AWG read slower memory at a lower speed while keeping the overall data throughput constant.

There are always tradeoffs among design complexity, size, and cost. As a result, high-speed AWGs (those with sample rates greater than 2 GHz) typically limit the available waveform memory to some tens of megasamples. Even that much memory may limit time windows. For example, a 32-Msample, 12-Gsamples/s AWG can generate just over 2.5 ms of a nonrepeating waveform.

Just because an AWG has a large waveform memory doesn't mean that you should use all of it. You should minimize waveform length to reduce calculation and transfer time. For short waveforms, you should consider increasing the amount of waveform memory beyond what you need for building the basic waveform. You'll increase waveform quality, because you can increase the sampling rate (oversampling). A higher sampling rate will spread out quantization noise over frequency and improve signal-to-noise ratio. You can further improve signal quality by applying sigma-delta techniques. For periodic signals, simply store one cycle of the signal and repeat it.

Unfortunately, using short waveforms creates periodic quantization noise that will appear as high-amplitude spurious spectral lines in the output signal's frequency spectrum. That noise will reduce the instrument's SFDR (spurious-free dynamic range). Repeating the signal many times while ensuring that the signal does not repeat itself exactly in the waveform memory (such as by selecting a prime number for the record length or by selecting a number of cycles that is not a divisor of the selected record length) will result in a lower repetition rate for the quantization noise; likewise, adding some small amplitude dither will also result in a lower repetition rate. You'll have about the same amount of noise power, but it will be spread over many more spectral lines. Thus, you'll reduce the average power for each line and improve the SFDR.

Some AWGs have a specification for the minimum usable record length just as they do for the minimum sample rate. In addition to those limits, a parallel waveform-memory-access bus architecture forces the waveform length to be a multiple of a given integer to reflect the number of samples transferred simultaneously in each memory access cycle. This integer number (typically a power of 2) reflects the number of samples that the AWG transfers in parallel from the waveform memory to the DAC. You can call this characteristic the "record-length granularity." AWGs with interleaving DACs double the record-length granularity because they use a two-DAC architecture, with each DAC connected to an independent memory bus.

You can update an AWG's waveform memory from local, nonvolatile storage; from a remote computer; or from a DSO. But with any of these options, the update process may be unacceptably slow for applications such as automated test. Most high-performance AWGs allow for segmentation of their waveform memory, where each segment can hold a different number of samples, which maximizes flexibility. Switching from one segment to another is as easy as updating the sample pointer. Memory segmentation plays a fundamental role in sequencing and real-world interaction.

FIGURE 3. **The rear panel of a Tabor Electronics WX2182 2.1-Gsamples/s, two-channel AWG shows multiple signal inputs (event, sequence/segment control) and outputs (markers) designed to interact with other test equipment.** Courtesy of Tabor Electronics.

Sequencing

Many tests require long waveform memory records, and eventually, the necessary record length may exceed the available waveform memory. Sequencing is a popular way to increase a signal's length. In sequencing, different waveform segments repeat (or are played back one after the other) through a user-defined sequence list.

For example, to produce a serial-data signal with one anomalous bit every second at 10 Gsamples/s, a typical AWG would need a 10-Gsample memory. A sequencing AWG could accomplish the same effect by repeating a 1-Msample record containing one bit 9999 times and then producing one anomalous bit (**Figure 2**). Doing this reduces waveform memory by 5000 times (2 Msamples versus 10 Gsamples), and it reduces the time needed to calculate, transfer, and load the necessary samples.

Using signals with regularities may result in huge memory savings. Video-test signals are a good example. Each video line may contain similar sections, or synchronization signals: Lines with the same video information repeat many times in a single frame or field, and each frame or field requires similar synchronization signals at the beginning.

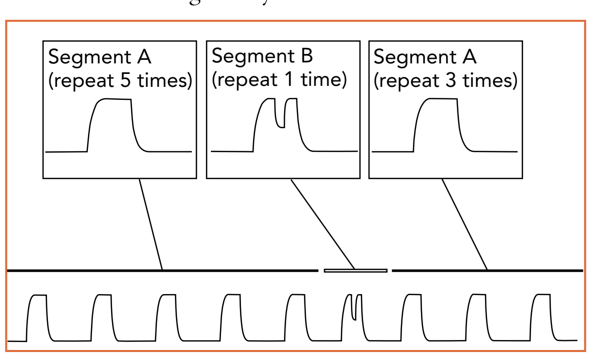


FIGURE 2. **Waveform memory segmentation and sequencing lets you implement very long signals and generate signals that are responsive to real-world conditions. In this example, two different segments are combined through a sequencing list to produce a much longer signal.**

Straightforward sequencing—where each entry, or step, in the table (sequence list) specifies a waveform segment and the number of times it should be repeated before the AWG proceeds to the next step—may produce the necessary synchronization signals. Complex signals such as video-test signals, however, may require long

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sequences. You can reduce memory usage by implementing nested sequences where you define "sequences of sequences" or even mix regular segments and other sequences. For a video-test signal, one low-level sequence could contain the segment with the line synchronization, and a second sequence could contain the luminance and chrominance information. Another sequence could contain the same segment with the line synchronization and the contents of the frame synchronization, and then a higher-level sequence could link all these sequences and include specific segments for each frame. With this structure, defining a new test pattern becomes as easy as changing the luminance segment entry in the sequence list.

Although memory segmentation and sequencing can improve the versatility of an AWG, they can introduce performance issues. First, there may be a limit to the number of segments that an AWG can support, regardless of its waveform-memory size. Memory-access considerations and the speed of the sequencer may also limit the minimum or the maximum segment size. The sequencer itself may also place a limit on the number of entries in the sequencing list and on the depth of nested sequences.

Real-world interaction

Engineers often use AWGs to generate predefined waveforms and sequences. Some applications, though, may require the AWG to interact with the DUT (device under test) at speeds beyond programmatic control. Many high-performance AWGs incorporate trigger-and-sequence or segment-control signals, providing real-time interaction with a DUT. Typical interactions include:

- *Basic sequence control.* You can instruct the sequencer to stop the output (typically by keeping the analog level established by the last sample) at the end of a given step until an external trigger signal activates. Then, the sequencer advances to the next step in the list.
- *Vectored segment control.* A series of input signals may change the segment that the AWG outputs. As an example, a commercially available high-performance AWG uses nine input lines (eight address lines plus a validation line) to select one of up to 256 waveform segments stored in memory. Although this solution provides extreme flexibility, its practical implementation in most test situations would force you to develop very complex hardware to map DUT behavior to AWG stimulus. **Figure 3** shows the rear panel of a Tabor Instruments AWG. Each channel has a nine-pin connector for trigger signals.
- *Advanced sequence control.* Conditional branching (or jumps) may depend on the status of some external signals as defined for each entry in the sequence list. This capability provides the most flexibility because it allows similar capabilities to those allowed by vectored segment control, but without the need to develop complex external hardware.

You can trigger an action synchronously or asynchronously. In the first case, the AWG will wait for the end of the current step or segment before triggering. In the second case, the trigger takes place when the trigger conditions are satisfied. An AWG's response to trigger and control inputs may be slower than expected, so you must know the minimum duration and maximum bandwidth that a trigger supports. Trigger delay or latency is another important factor as well.

Marker and trigger outputs in AWGs interact with the DUT or other test equipment through digital signaling. Marker outputs are typically fed from the waveform memory, providing timing and synchronization for other equipment. In some cases, you can associate markers with segments instead of individual samples. You may have some control on the marker output levels, easing the integration with the target circuits.

Some AWGs, instead of storing marker information, reserve some of the low bits otherwise connected to the DAC. Activating the markers may reduce the vertical resolution of the arbitrary waveform. Although markers share the same data path as the waveform data, the output circuitry is different. Thus, skew

ON THE WEB

See the online version of this article for a description of the four types of architectures used in AWGs: **www.tmworld.com/2011_05**

between the analog waveform output and the marker outputs is an issue, especially for AWGs with high sampling rates.

Wrap-around issues

Seamless, continuous waveform generation requires the looping or sequencing of waveforms or waveform segments. But many applications won't tolerate waveforms that contain any discontinuities. Think of a serial data signal with a fraction of a bit at the end of the waveform. Connecting a looping signal like this to any clock-recovery system would end in complete havoc, because any discontinuity or signal anomaly when looping or linking a signal results in a wrap-around artifact.

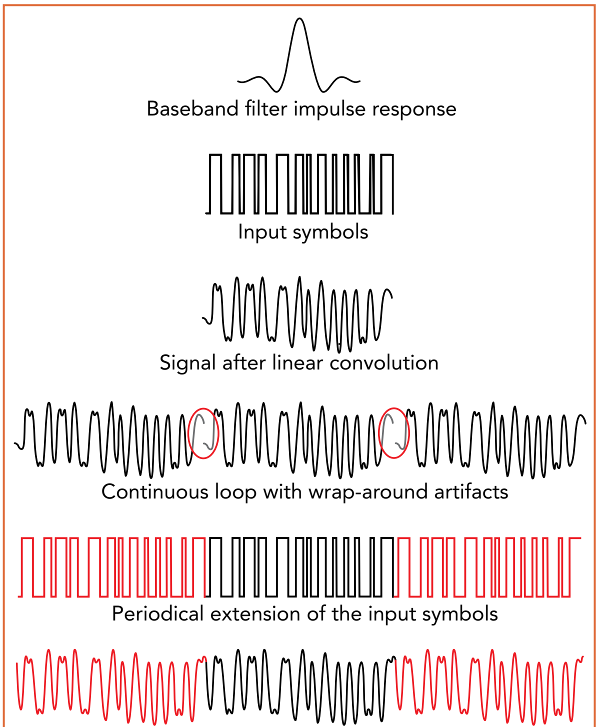

FIGURE 4. Wrap-around artifacts can introduce discontinuities into an AWG's output. Adding "linking segments" provides perfect continuity.

You can minimize or even cancel wrap-around artifacts by using some special techniques or by carefully designing the waveforms. For a single, looping segment, the number of symbols or cycles contained in a given segment must be an integer, and any convolution process (such as filtering) must keep consistency between the end and the beginning of the waveform. Even if you meet those conditions for every waveform or waveform segment, problems may arise when sequences of segments are involved.

IQ baseband generation of digitally modulated signals provides a good example. You can design any segment to be looped so it contains an integer number of symbols and then apply the required baseband filter through circular convolution (**Figure 4**). The result will be a signal without any artifact or discontinuity at any domain (time, spectral, or modulation).

If you must use two of those segments in sequence, the end of one segment and the beginning of the next one will be inconsistent. There are two solutions. In the first, you use the same symbols at the beginning of the two segments; the number of symbols depends on the accuracy required or the length of the convolution process. Of course, this method may be unacceptable if the application requires arbitrary symbols. In the second solution, you add a "linking segment" at the end of each segment that links with the symbols of the next segment. In this method, the first symbols of a segment are convolved with the last symbols of the previous segment. The result would be something like: A,…A, A, AB, B, B,…B, BC, C, C,…, C, CA…, where AB, BC, and CA are the linking segments. The number of waveform segments will grow as well as the sequencing list, especially if you need multiple links, because any of those will require a specific linking segment. T&MW

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Firms collaborate on fast PXI digitizer

By Richard A. Quinnell, Contributing Technical Editor

In August 2009, National Instruments and Tektronix announced they were joining forces to create a PXI Express high-speed digitizer with a bandwidth greater than 3 GHz, a sampling rate greater than 10 Gsamples/s, and data throughput in excess of 600 Mbytes/s. This collaboration has now borne fruit with the just-released NI PXIe-5186, a digitizer that significantly exceeds its initial performance goals and offers up to a 5-GHz bandwidth, a 12.5-Gsamples/s sampling rate, and 700-Mbytes/s data streaming. I spoke with Eric Starkloff, VP of product marketing at National Instruments, and Dr. Kevin J. Ilcisin, CTO at Tektronix, about the project.

Q: What prompted your companies to join forces on this?

KI: We have collaborated on projects for more than 20 years; this is just the first joint hardware-development activity. We started by identifying where there were unmet customer needs that neither company could address on its own. High-performance production test was one such segment, and based on an assessment of our individual strengths—Tektronix's heritage in hardware, NI's legacy in software—we saw an opportunity to combine these capabilities and delight production-test customers.

ES: Tektronix has leading-edge ASIC technology for high-bandwidth, high-speed data acquisition with high signal integrity. NI has back-end expertise in data transport as well as in software for test equipment. Together, we were able to use the best of each company to create this product.

Q: How did you partition the development effort?

ES: We did a ton of learning up front about each other's technologies and expertise to help answer open questions like, "Who's going to manufacture this product?" This was not simply a transfer of technology from one team to another, like sourcing an ASIC to put into a board. This project needed a true collaboration to get the target performance level into the compact PXI form factor.

KI: We have to give both teams credit for stretching beyond their normal operating modes. For example, when we faced design problems, being open to reviews by colleagues at the other company and jumping in to identify the best solution, regardless of who "owned" the problem, was a key part of the success.

Q: What kinds of challenges did you face?

ES: We needed to engineer very-high-performance instrumentation within the low power and small form factor of PXI, which has significant economic advantages to our customers. Also, creating the ability to synchronize multiple modules with high time precision to achieve increased channel count was a significant effort.

Dr. Kevin J. Ilcisin
CTO
Tektronix

KI: We also had to coordinate two development teams working in different time zones under different corporate cultures.

Q: What lessons did you learn?

KI: Effective communication was critical. The effort needed tightly coupled program managers who each knew what the other team was doing. There also needed to be executive support to create an escalation path for quickly resolving roadblocks such as the appropriate engineering tradeoffs like performance vs. power and space when the engineering teams couldn't resolve them on their own.

Q: How will the product be sold?

ES: It will be branded as containing Tektronix technology and jointly marketed but will be sold by NI exclusively.

Q: Will you collaborate in this way again?

ES: NI and Tektronix have a long history of partnership, and we most certainly will continue to work together to better serve our customers.

KI: As Eric stated, both companies are interested in further collaboration to meet customer needs. □

INSIDE THIS REPORT

EDITOR'S NOTE

The thrill is gone

By Richard A. Quinnell
Contributing Technical Editor

Perhaps it's because another birthday just rolled past, but I find myself feeling nostalgic for rack-and-stack bench instruments. I was once the proud teen owner of my very own Dumont cathode-ray oscillograph with sweep frequency and voltage gain knobs you could twiddle in an attempt to freeze the trace of a repeating signal so you could study its structure (no calibration markings, you just twiddled). The thrill of seeing the electronic signals I had been working with while building a short-wave receiver was immense.

Unfortunately, as an engineer turned writer, I don't get much opportunity to play with such toys anymore. Nor, I think, would I find them as thrilling if I did. Clicking a mouse button, typing in a command, or dragging my fingertips across a touch screen just don't provide the same visceral experience as flipping switches and twisting knobs. And with the industry steadily progressing to modular instruments with GUIs and networking, my opportunities to relive those glory days are rapidly fading.

There are many good and compelling reasons why test technology is shifting as it is. I understand that modular test instrumentation has increased in performance, in the depth of information it provides, and even in ease of use. But that's just intellect.

Of course, the truth about nostalgia is that things never were like what we remember. Still, for me, something of the thrill is gone. □

Contact Richard A. Quinnell at richquinnell@att.net.

HIGHLIGHTS

ADLink introduces PCIe digitizer

The PCIe-9842 PCI Express digitizer from ADLink is designed for applications such as LIDAR tests, optical fiber tests, and radar signal acquisition. The digitizer has a 200-Msamples/s sampling rate for 14 bits of data across one channel, and its 100-MHz bandwidth analog input is designed to receive ±1-V high-speed signals with 50-Ω impedance. As the PCIe-9842 converts a signal from analog to digital, it can transfer the data to the host-system memory at a rate of 400 Mbytes/s.

ADLink provides legacy drivers so users can develop applications with Microsoft C++ and Visual Basic. The company also provides a task-oriented driver (DAQPilot) for accelerating development. www.adlinktech.com.

Pickering expands RF switch family

Pickering Interfaces is expanding its range of PXI RF switches with the introduction of the 40-755 multiplexer. The 40-755, which supports up to 10 SP4T RF switches in a single module, is available in two versions.

The high-density version occupies one slot of a 3U PXI chassis and uses a multi-way connector that is suitable for switching frequencies to 500 MHz. A high-frequency version uses SMB connectors and is suited for switching signals to 1.8 GHz.

Pickering says the 40-755 is suitable for use in both commercial and military ATE systems. It can serve in PXI- and LXI-based systems that are replacing VXI-based military ATE systems that require large numbers of SP4T RF switch subassemblies. www.pickeringtest.com.

Microwave Office and VSS aid PXI design

AWR has announced that National Instruments employed AWR's Microwave Office and VSS (Visual System Simulator) software tools to optimize the performance of NI's 20-Hz-to-3.6-GHz downconverter, a key element used within NI's PXIe-5665 VSA (vector signal analyzer). Using the AWR tools, AWR reports, NI was able to optimize the downconverter and adhere to space constraints to develop the high-performance VSA. AWR's software tools allowed NI to model the downconverter within VSS and then select various components from Microwave Office's Modelithics library to ensure sufficient isolation and RF power.

"We have used AWR's Microwave Office and Visual System Simulator throughout the process of developing the PXIe-5665 VSA," said Jin Bains, R&D hardware director of RF products at National Instruments. "The tools are extremely intuitive, and they allow us to do critical RF design with a minimum number of iterations."

Bains (Ref. 1) noted that the AWR tools were helpful in designing a high-frequency filter that helped meet both size and performance requirements. He added that NI relied on Microwave Office software to design bias networks for RF amplifiers used in the downconverter, providing sufficient bandwidth while offering adequate RF isolation, all without wasting DC power or generating excessive heat. He also said that the design flow process converged in a few steps and resulted in minimal EM simulation time, resulting in a minimum number of design spins.

REFERENCE

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"Outlook" explores test-and-measurement trends

By Richard A. Quinnell, Contributing Technical Editor

National Instruments recently released the 2011 version of its annual "Automated Test Outlook" report, in which the company described four key trends it sees affecting the test industry. The report (Ref. 1) provides some thought-provoking insights regarding system architecture, heterogeneous computing, concurrent design and test, and business strategy. NI's conclusions, however, are not entirely shared by other companies in the test industry.

In the area of test-system architecture, NI sees the industry moving away from creating monolithic stacks for test software and toward the use of modular software elements. NI says companies are looking for "separate yet tightly integrated elements for test management software, application software, and driver software." Such elements allow test engineers to choose between commercial and in-house offerings to obtain the optimal tool at each level. Increasing modularity will also help reduce future test-development time and mitigate obsolescence, NI concludes.

Mike Dewey, senior product marketing manager at Geotest, agreed that modularity is essential. "Obsolescence is a huge problem with monolithic test software," he said. "A lot of proprietary systems are really paying the price for it now as they try to upgrade." He added that although the trend toward modular is not new, he sees it gaining depth: "The good news is that there are so many more good modular tools available today. It's a lot easier to mix and match to do what you need done."

Mixing software improves test

The ability to mix software elements is an essential part of using modularity in test systems, according to Larry DesJardin, GM of the modular products operation at Agilent Technologies. "We're finding that customers are all different in formulating their test-system software, often for valid reasons," said DesJardin. "So, the key theme is choice—people mixing and matching tools under different software environments like LabView, Matlab, and Visual Studio."

DesJardin further noted that modularity at different software levels allows companies to more easily offer unique value, and he pointed to Agilent's 89601B vector signal analysis software as an example. The software accepts I and Q data from virtually any instrument for analysis, and because it works in numerous software environments, it can easily be included in the software stack of a modular system.

NI's "Outlook" report points out that the use of modular software in test systems is pushing beyond the test software itself to include software-development-tool modules that support the design process. "Recently, the industry has seen an increase in companies adopting reusable test code libraries and more source code control (SCC) tools," says the report. "Additionally, companies are increasingly integrating requirements management software tools in the application software layer."

New processing options in test

A second, established, trend that the "Outlook" report describes is the move toward heterogeneous computing. The advent of modular test standards such as PXImc and AXIe that support multiprocessing and the increased use of FPGAs as processing elements in modular test demonstrate the extent to which heterogeneous computing has penetrated test-system design. The report also identified two emerging computing options that test engineers should consider: graphics processors and cloud computing (**Figure 1**).

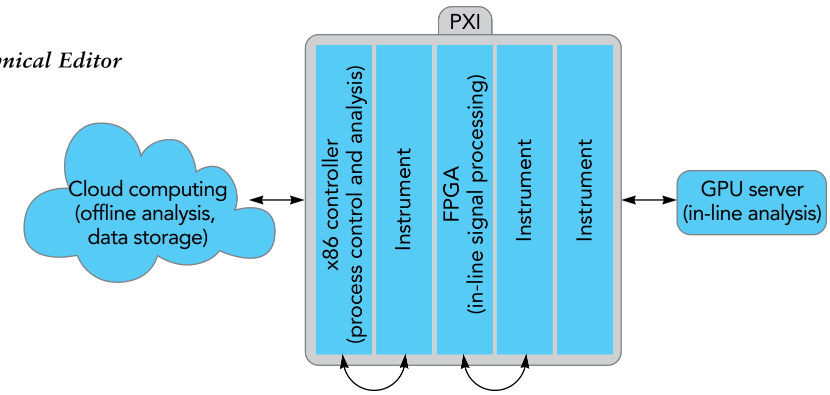

Fig. 1 **Test systems are increasingly employing multiple computing elements, including such resources as GPUs and cloud-based computing.**
Courtesy of National Instruments.

GPUs (graphics processing units) are computing elements used principally in the consumer, gaming, and media industries, where they provide real-time rendering of 2-D and 3-D images for animation and special effects. As the "Outlook" report points out, these processors are essentially massively parallel computer cores that are ideal for vector processing. This parallelism makes the processors also suitable for use in data-intensive test such as spectral monitoring, and the report indicates that some engineers are working to adapt GPUs for more general use.

Cloud computing refers to computing resources that are accessible over the Internet; users only need to rent the processing power they require rather than purchase and maintain equipment. The major drawback, however, is latency. The delays associated with sending data reliably across the network mean that cloud computing is inappropriate for anything requiring real-time responsiveness. But if a test system generates massive amounts of data that need significant processing and can wait a little while for results, cloud computing presents an intriguing avenue for test engineers to investigate.

Design IP moves to tester

The third trend that NI's report identifies is a movement in test software and I/O development to incorporate a device's design building blocks, sometimes called IP (intellectual property), into the systems that test the device. This move, which NI calls "IP to the pin," reflects the fact that in many designs, the same functional blocks are needed in both the device and the tester.

For example, a device such as a cellphone processor needs IP for data encoding and decoding, signal modulation and demodulation, data encryption and decryption, and communications handshaking protocols. A tester for the device needs the same functions in order to simulate another communications element, such as a base station, to validate the device design. The "Outlook" report indicated that making the design IP available to the test team can dramatically shorten design verification and validation as well as improve production test time and fault coverage by supporting concurrent design and test.

One supporting element of "IP to the pin" is the availability of FPGAs on test modules (Ref. 2). Modules such as the Geotest GX3500 (**Figure 2**), which has an FPGA for implementing custom logic and which can support a mezzanine card that holds a custom interface, provide the flexibility needed to implement the design IP. Such modules, along with the use of common high-level design software, greatly speed the implementation of design IP in test.

DesJardin agreed that transferring the IP and simulation software used for verification test can be an important link between design and manufacturing, but he said, "Simulation can be a complicated and expensive way to test." He noted that to support manufacturing test, many device designs are adding specialized test modes that perform such simulations internally. "In design-verification testers, you need a lot of IP content. When in production, we can expect that the design and embedded algorithms work, so for manufacturing test, you just need to put the device into test mode and make parametric measurements to verify that it was fabricated properly." DesJardin pointed out that engine-controller design and test are already following this approach, and he said he is increasingly seeing it used with cellphone devices, as well.

The practicality of using such built-in test modes may vary by industry, but DesJardin said that where it occurs, it breaks the model of leveraging design-test knowledge to develop a production test. The use of built-in test thus stands at odds with the fourth trend that NI's "Outlook" report discussed: organizational test integration. According to the report, "The differences between validation and production test teams are being blurred," with production test becoming more embedded in the product-development process and with validation teams increasingly using production-test systems for design debugging.

Geotest's Dewey, though, is not convinced that tighter linkage between the design and test teams is practical in many circumstances. "In industries such as semiconductors and printed-circuit boards that heavily utilize contract manufacturing," Dewey said, "production is completely separated from design. Fabless semiconductor manufacturers that design devices may need a little test capability but never get involved with production test. And the manufacturing-test people may not even have access to the designers."

Dewey noted that in organizations with in-house manufacturing, there may be more opportunity to integrate validation and production test, but barriers remain. "Corporations have always considered the test business a 'necessary evil,' so no one wants to spend much money on it," he said, adding that "the total cost of test is only about 4% of product cost." He recommended that test managers who are considering such integration evaluate how much it will really lower the cost of test.

Should tightening the connections between validation and production test seem worthwhile, though, NI's "Outlook" report has recommendations for maximizing the chances of success. One recommendation is to first secure executive-level support by demonstrating how the project will assist in achieving a corporate-wide objective. Failure to secure such support, the report notes, is a main cause of project failure. A second recommendation is to get the test teams to start influencing the company's new-product-introduction process by learning who makes key decisions and when they make them, and then seeking a "seat at the table" for this decision making. □

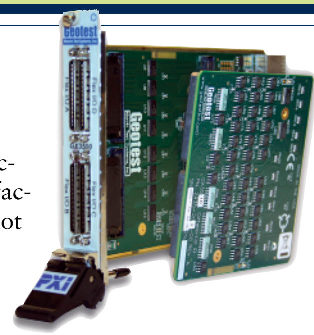

Fig. 2 Modules such as the GX3500 provide configurable FPGA computing as well as mezzanine-module capacity.
Courtesy of Geotest—Marvin Test Systems.

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2. Quinnell, Richard A., "User-configurable FPGA modules boost PXI system versatility," *PXI Test Report, Test & Measurement World*, May 2010. p. 43. www.tmworld.com/2010_05.

Pickering Interfaces adds PXI battery simulator

The Pickering Interfaces 41-753 battery-simulator module can simulate the power supplies of cellular phones and other portable battery-operated devices. The 3U PXI module can deliver voltages up to 6 V. Its fast-responding remote-sense connections allow the module to regulate the supply voltage at the device under test; load response time is 15 μs from 1 A to 2 A using a 2-m connection cable, so there is no need for bulky decoupling capacitors in the device under test. The isolated output terminals can float ±50 V relative to the front-panel ground to ensure the accurate simulation of battery operation.

The module can source or sink current to provide simulation of a battery supply or a battery under charge. It can absorb up to 0.5 A of the load current, permitting it to act as a net current sink when connected to a charger circuit. The 41-753 can deliver up to 2.8 A into a load. The output resistance of the module can be programmed for values up to 1.15 Ω to simulate the effect of battery output resistance when connected to time-varying loads. To protect the device under test, the unit can be configured to shut down if the sense wires become disconnected; alternatively, it can be configured to regulate front-panel voltage if the sense lines become disconnected.

Pickering Interfaces, www.pickeringtest.com.

Spectrum analyzers for bench and field tests

The DSA1000 series spectrum analyzers from Rigol Technologies let you measure RF spectra and see your measurements on an 8.5-in.-wide VGA display screen. The series has two models, with bandwidths of 100 Hz to 2 GHz (DSA1020) and 100 Hz to 3 GHz (DSA1030). Each model has a 100-Hz resolution bandwidth.

The instruments have auto-setup, auto-range, auto-scale, and auto-couple features, which let you start taking measurements and then adjust the settings for best results. You can store your setups in memory for recall. A front-panel USB port lets you save setups and data to an external flash drive or hard drive. You can also configure your measurements with an external PC through the instruments' USB and LAN ports or though an optional USB-to-GPIB interface.

For remote measurements, you can add a battery pack that will power the instrument for up to 3 hr. Other accessories include a carrying case, an arm for lifting the instrument off your bench, and a rack-mount kit. The DSA1030 also has an optional tracking generator that provides an excitation signal for making frequency-response measurements.

Base price: $2999. *Rigol Technologies, www.rigolna.com.*

DFTView and Verdi target DFT engineers

SpringSoft and Source III have announced the availability of Source III's new DFTView tool and its integration with SpringSoft's Verdi automated-debug system. Using the two products together, DFT engineers and test engineers can graphically view and debug the contents of test files in the industry-standard WGL and STIL (IEEE 1450.1999) formats.

In addition to graphically displaying the STIL or WGL files, DFTView checks the syntax of these files and generates error messages when they contain errors. The tool maintains a correspondence between the vector lines in the WGL or STIL source file and waveform positions in the waveform display.

DFTView uses the same WGL and STIL reader technology used by Source III's VTRAN vector-translation program. The product also allows users to edit the source files and see the immediate effects on the waveforms. It is available on 32- and 64-bit Linux and Solaris platforms. Users must have a SpringSoft Verdi/nWave software license to run DFTView. The product is available from Source III as an option for Verdi users.

SpringSoft, www.springsoft.com; Source III, www.sourceiii.com.

EMI receiver runs compliance tests

EMI test labs need receivers for verifying a product's conformance to regulatory standards. Labs also need signal analysis when a product's emissions exceed limits. The N9038A MXE EMI receiver from Agilent Technologies helps with both tasks.

The receiver complies with CISPR 16-1-1-2010, which specifies a receiver bandwidth from 9 kHz to 18 GHz. The instrument includes peak, quasi-peak, average, and RMS average detectors (required by CISPR 16-1-1), and it also contains measurement limits for compliance testing. Because the N9038A MXE EMI receiver is also an X-series signal analyzer, you can use it to troubleshoot EMI problems and to evaluate signals for parameters such as phase noise. The receiver also contains other diagnostic tools such as signal and measurement lists, marker functions, span zoom, zone span, and spectrogram displays. Measurement accuracy is ±0.78 dB, and sensitivity is –163 dBm at 1 GHz.

Prices: N9038A-508 (20 Hz to 8.4 GHz)—$90,038; N9038A-526 (20 Hz to 26.5 GHz)—$120,159. *Agilent Technologies, www.agilent.com/find/MXE.*

IMS emulator supports 10 million subscribers

EXFO's proxyFlex test suite emulates the CSCFs (call session control functions) of IMS (IP Multimedia Subsystem) networks, supporting 10 million subscribers per chassis to enable comprehensive device and end-to-end testing. Housed in the InterWatch R14 and QualityAssurer QA-604 platforms, proxyFlex can emulate the entire IMS core and the subscriber with the same application when combined with the sipFlex and hssFlex test suites.

High-performance IMS networks need to be verified in the lab to ensure that they will meet capacity and performance expectations as well as expectations for the quality of the customer experience. The proxyFlex test suite lets network equipment manufacturers and network service providers emulate the IMS P-CSCF, S-CSCF, and I-CSCF. The software also supports various call flows for registration, call processing, and session control to test any service deployed over an IMS core. In addition, the software offers the flexibility to modify forwarding rules of various proxies.

EXFO, www.exfo.com.

Network analyzers measure group delay over long distances

Rohde & Schwarz has developed a new method for measuring group delay and phase linearity on satellite links. With the new R&S ZVA-K10 software option, available for the R&S ZVA and R&S ZVT high-end network analyzers, users can perform measurements using two network analyzers located at separate sites. In open-area tests, for example, the analyzers can bridge long distances between a transmitter and a receiver. The new R&S ZVA-K10 option supports test of complete transmission systems or individual components such as transmitters, receivers, mixers, or up- and downconverters.

The R&S approach supports open-area measurements across distances of several hundred meters while avoiding the cable losses, signal-to-noise degradation, and phase errors that would occur when using lengthy RF cables to connect DUT input and output to an analyzer. In a test setup with the R&S ZVA-K10 software option, the user connects one network analyzer to the transmit port and one to the receive port. The two network analyzers communicate with each other and synchronize the test sequence between each other via a LAN connection.

In addition, the two network analyzers do not need local-oscillator access when measuring frequency-converting DUTs, thereby permitting test of devices with integrated local oscillators that not accessible to external test equipment. To eliminate the need for local-oscillator access, Rohde & Schwarz developed a two-tone method in which an R&S ZVA stimulates the DUT with a two-tone signal and measures the phase difference between the two carriers at the input and the output.

From the phase difference, the R&S ZVA calculates the group delay and the relative phase of the DUT's transfer function. Any changes in the local oscillator's frequency and phase have an identical effect on both carriers and are eliminated by the difference measurement.

Rohde & Schwarz, www.rohde-schwarz.com/product/zva.html.

Ametek extends output options of DC supplies

Ametek Programmable Power has expanded its Sorensen SG series of programmable high-power DC power supplies with the addition of four new output-voltage offerings of 10 V, 15 V, 20 V, and 30 V, extending the series' previous range of 40 V to 800 V. These lower-voltage units have output power specifications ranging from 4 kW to 15 kW.

The 20-VDC, 15-kW model can supply up to 750 A in a standard 3U package, while the 10-VDC, 12-kW can deliver up to 1200 A in the same 3U form factor. Depending on the output voltage, one to six modules can be configured in a single chassis to deliver 5 kW to 30 kW of power. What's more, they can easily be paralleled to achieve up to 150 kW of total power.

All of the models in the SG series are available with either intelligent (SGI) or analog (SGA) control. Units with SGI control combine onboard intelligent controls with the power electronics common to all SG series supplies. These controls enable sophisticated sequencing, constant power mode, and save/recall of common setups, making the SGI suitable for repetitive testing using complex or compliance waveforms.

Units with SGA control are intended for users who require simple front-panel or remote analog control. Along with the same power electronics as the SGI, the SGA provides 10-turn potentiometers for setting voltage and current, a 3.5-digit LED readout, and front-panel OVP (overvoltage protection) preview/adjustment and reset.

Ametek Programmable Power, www.programmable-power.com.

SwissRanger 3-D cameras get Halcon interface

MVTec Software and Mesa Imaging have released a new interface for connecting Mesa Imaging's SwissRanger SR4000 TOF (time-of-flight) 3-D cameras to MVTec's Halcon machine-vision software. With the interface, the SR4000 industrial-grade camera and Halcon software can measure complex 3-D objects at a high resolution in real time. The new interface now allows for the acquisition of the calibrated 3-D data, such as distance, amplitude, or Cartesian x/y/z coordinates, for subsequent manipulation within Halcon, thereby enabling application of the Halcon library's functionality related to operators for morphology, 3-D matching, or 3-D measuring.

The compact SR4000 commercial TOF cameras come in industrial-grade housings and are available in configurations with Ethernet or USB interfaces.

MVTec Software, www.halcon.com/image-acquisition; Mesa Imaging, www.mesa-imaging.ch.

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VOL. 31, NO. 4

Subscription Policy: Test & Measurement World® (ISSN 0744-1657) is published monthly except January by UBM Electronics, 600 Community Dr., Manhasset, NY 11030-3825. Periodicals postage paid at Manhasset, NY, and additional mailing offices. SUBSCRIPTIONS: Free to qualified subscribers as defined on the subscription card. Rates for nonqualified subscriptions, including all issues: 1 yr. $150, 2 yrs. $250, 3 yrs. $300. Except for special issues where price changes are indicated, single copies are available for $10 (US orders) and $15 (foreign orders). Buyer's Guide issue is available for $35 (US orders) and $40 (foreign orders). For telephone inquiries regarding subscriptions, call 763-746-2792. E-mail: tmw@omeda.com. CHANGE OF ADDRESS: Notices should be sent promptly to P.O. Box 47461, Plymouth, MN 55447. Please provide old mailing labels as well as new address. Allow two months for change. NOTICE: Every precaution is taken to ensure accuracy of content; however, the publishers cannot accept responsibility for the correctness of the information supplied or advertised or for any opinion expressed herein. **POSTMASTER: Send address changes to Test & Measurement World, P.O. Box 47461, Plymouth, MN 55447. Canada Post: Publications Mail Agreement 40612608. Return undeliverable Canadian addresses to: BleuChip International, P.O. Box 25542, London, ON N6C 6B2.**

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VIEWPOINT

[An exclusive interview with a technical leader]

ROD TAYLOR
Managing Director
Seaward Group
Peterlee, County Durham, UK

Rod Taylor is co-founder and managing director of the Seaward Group of companies, which include Seaward Electronic, Clare Instruments, and Rigel Medical. Established in 1982, Seaward specializes in test-and-measurement products for health and safety applications. Prior to starting Seaward, Taylor held marketing positions with the Sperry Rand Group. He received his electrical engineering degree from Nottingham University and is a fellow of the UK's Institute of Electrical Engineers. Taylor also is past chairman of the North East Confederation of British Industry.

Contributing editor Larry Maloney conducted a phone interview with Rod Taylor on new test solutions for meeting safety and compliance standards.

Getting a handle on electrical safety

Q: What is the Seaward Group's niche in test and measurement?

A: The short answer is that, wherever electricity is used, one of our products has an application. All across our companies, the major focus is on the safety of electrical products and systems. We provide test-and-measurement tools to engineers and technicians from the point of power generation through its distribution and finally into the use of that power in a very broad range of products, from portable appliances to medical devices.

We provide high-voltage test equipment, such as resistance-measurement devices, for utility companies, as well as test devices for electrical contractors and installers. Our safety and compliance analyzers also are used in the design and manufacture of electrical products. For example, Airbus uses our instruments to ensure that airframes have the required electrical protection.

Q: What are the key features that your customers want to see in electrical safety and compliance devices?

A: Our customers want instruments that are easy to use and that will allow them to do safety and compliance tests as quickly as possible for maximum productivity. At the same time, there is an overriding concern today for documentation and traceability. There's no point in doing safety and compliance testing unless you can demonstrate that you actually performed such tests, if an accident were to arise. Most of our instruments feature added memory to store test records, as well as wireless capability to transfer test data to computers for storage.

Q: Can you cite an important Seaward product that embodies such requirements?

A: A good example is the ClareHAL 104 safety analyzer. This single multifunction device addresses the safety and compliance issues associated with the majority of international product standards. The analyzer combines the performance of a production-line safety tester with load and power-factor measurement for product energy consumption and ratings assessment. It incorporates AC/DC hipot and insulation testing, ground- and earth-bond testing, load switching, and leakage testing.

Applications range from avionics and appliances to lighting and defense. You can use it as a manually operated, stand-alone tester, or you can network it in automated manufacturing systems and control it remotely by PC or PLC. Finally, its powerful internal memory allows storage of up to 6000 test results and 20 configurable test routines. Those are the kinds of value-added features that customers want, beyond just taking an accurate measurement.

Q: Which of your application areas is growing the fastest?

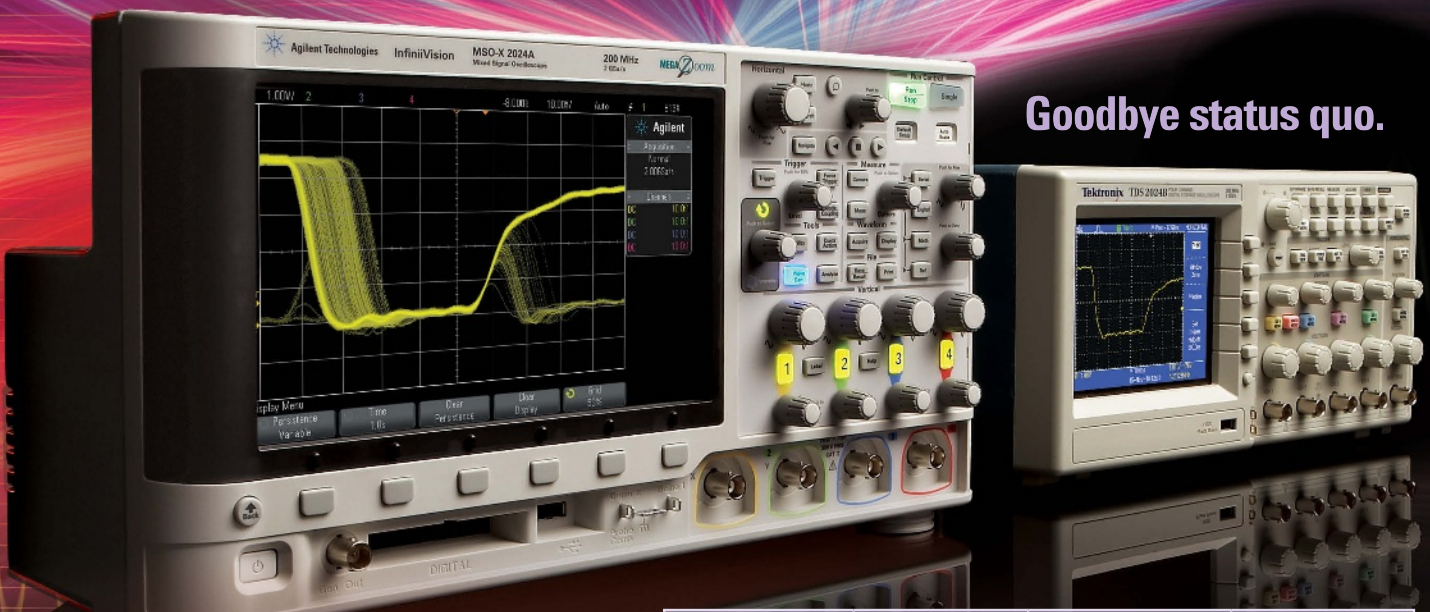
A: Medical is a very big area all over the world, and it falls under a whole range of safety and compliance regulations issued through such organizations as the IEC (International Electrotechnical Commission). Medical manufacturers, as well as hospitals and equipment rental firms, must take great care to ensure that any electrical device that comes into contact with a patient is safe and is maintained according to prescribed standards.

Another key growth area is alternative and renewable energy, particularly the manufacture and installation of photovoltaic systems. Solar is such a new industry that international standards and regulations are still trying to catch up. A recent report from the French government indicated that perhaps as much as 60% of the photovoltaic installations in France could be potential hazards from fire or electrical shock. T&MW

Rod Taylor discusses more safety test issues and appliance failure research in the online version of this interview: www.tmworld.com/2011_05.

To read past "Viewpoint" columns, go to www.tmworld.com/viewpoint.

Hello future.



Goodbye status quo.

	Agilent 2000 X-Series (MSO and DSO)	Tektronix TDS2000C Series (DSO)	Agilent 3000 X-Series (MSO and DSO)	Tektronix MSO/DPO2000 Series
Bandwidth (MHz)	70, 100, 200	50, 70, 100, 200	100, 200, 350, 500	100, 200
Max sample rate	2 GSa/s	2 GSa/s	4 GSa/s	1 GSa/s
Max memory depth	100 kpts	2.5 kpts	4 Mpts	1 Mpt
Max update rate (waveforms/sec)	50,000	200**	1,000,000	5,000
Fully upgradable	Yes	No	Yes	No
Function Generator	Yes	No	Yes	No
Notes:	**Refer to Agilent Pub 5989-7885EN for update rate measurements Data for competitive oscilloscopes from Tektronix publications 3GW-25645-0 and 3GW-22048-1 Measurements taken on same signal using Agilent MSOX2024A and Tektronix TDS2024B Screen images are actual screen captures and scopes are shown to scale			

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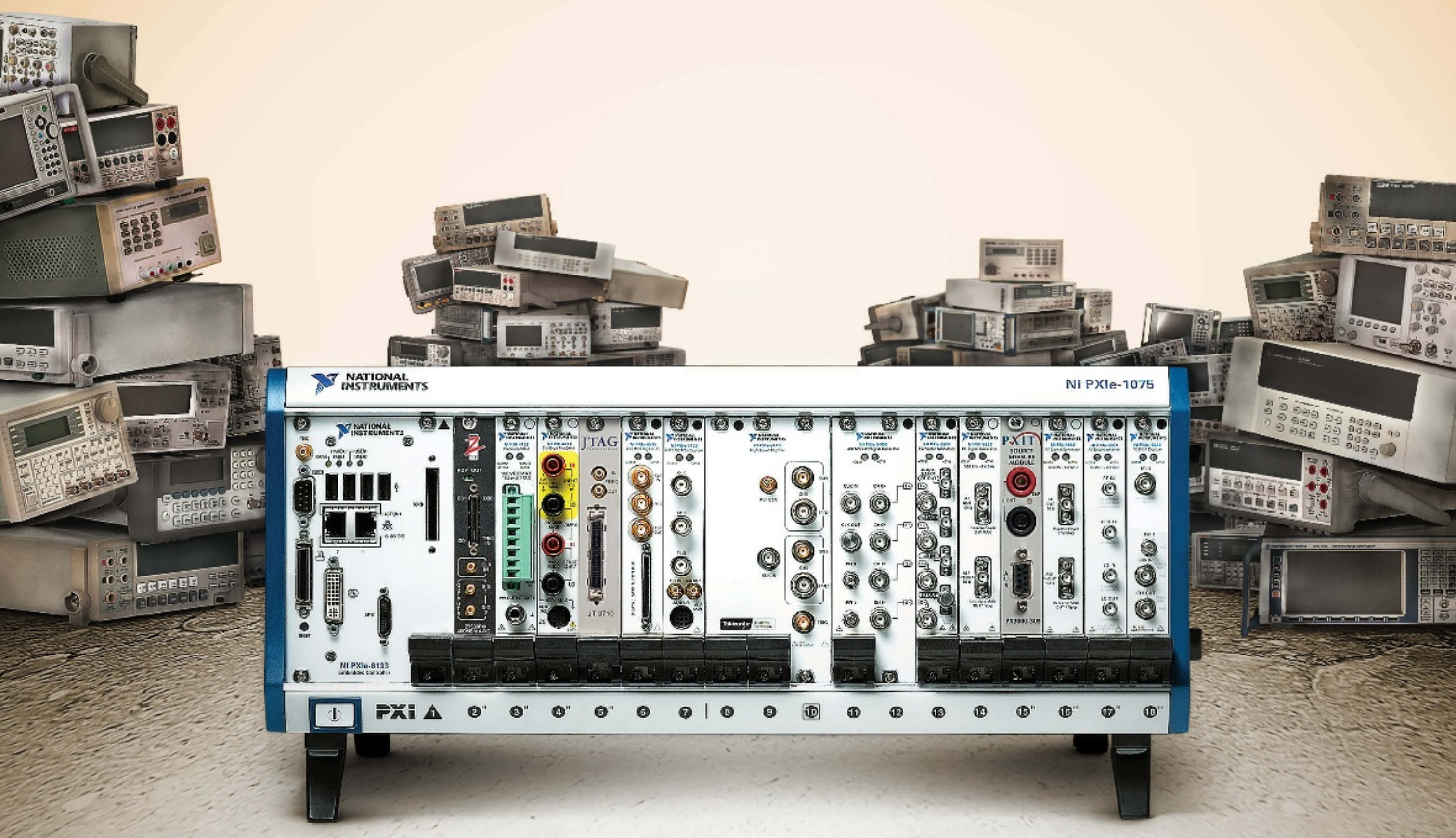

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