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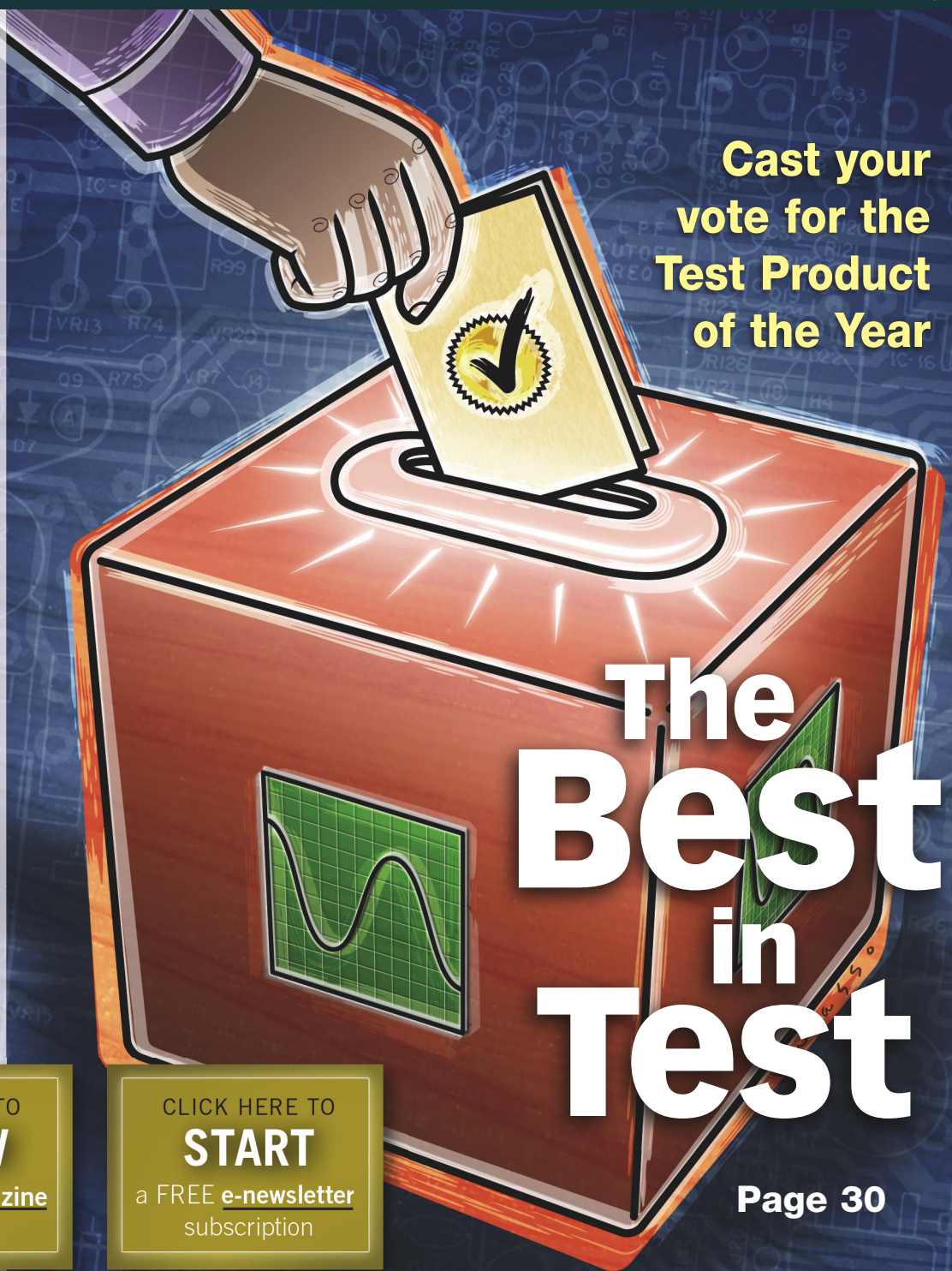

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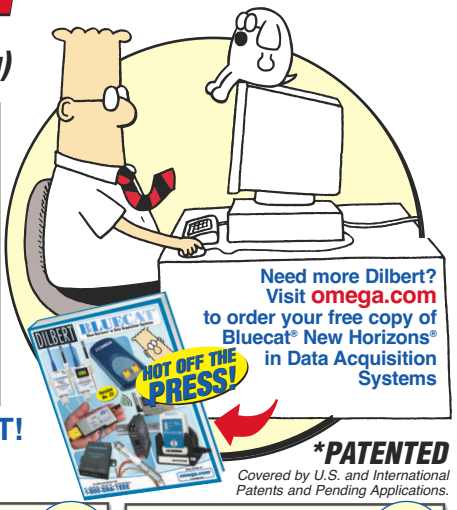

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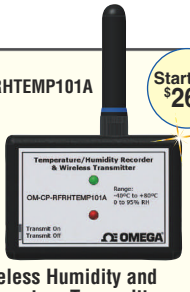

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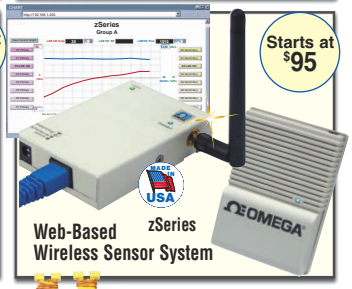

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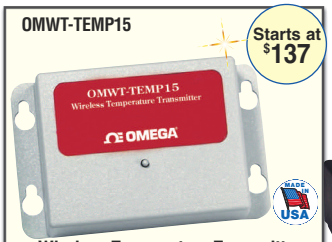

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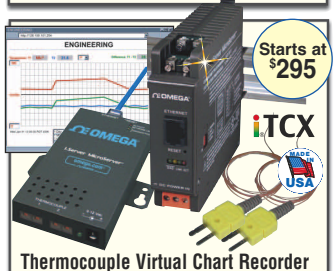

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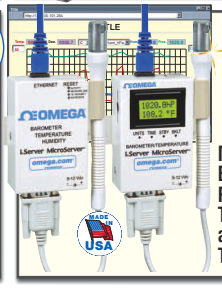

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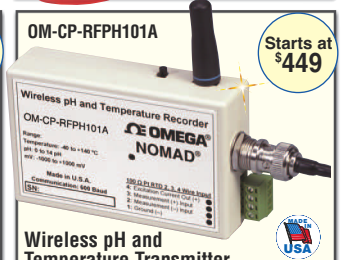

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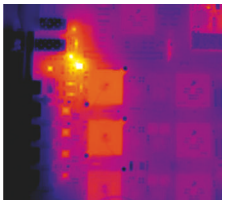

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Guest commentaries

Increasing abstraction makes DFT more effective

IC designers will continue to use mainstream design-for-test (DFT) methods such as scan, test compression, and built-in self test (BIST), but they will need new DFT techniques for deep-submicron devices. Chouki Aktouf of DeFacTo Technologies says RTL DFT offers one solution.

Legacy test systems for PCB test and repair

Mark Harding of Digitaltest says that two major categories of legacy issues predominate in electronics test and repair: the "old legacy system issues," which primarily address repair, and the "new legacy system issues," which center on correlation between test resources at the target volume manufacturing facility and the development center.

Expanding STC's impact with STIX

Steve Wigley of LTX and the Semiconductor Test Consortium (STC) discusses the new Semiconductor Test Interface eXtensions (STIX) initiative, which covers the interfaces that surround the tester.

The need for new ATE interface standards

Klaus Luther of Infineon Technologies and the STC explains that Infineon requires 40 different interfaces to support 16 ATE platforms as well as three wafer-prober and device-handler types. Clearly, standardization is required.

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Blog commentaries and links

Engineering Students at Work

Jessica MacNeil, Contributing Editor

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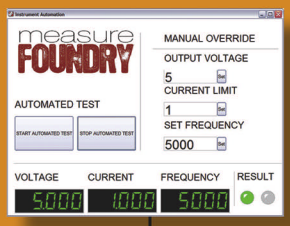

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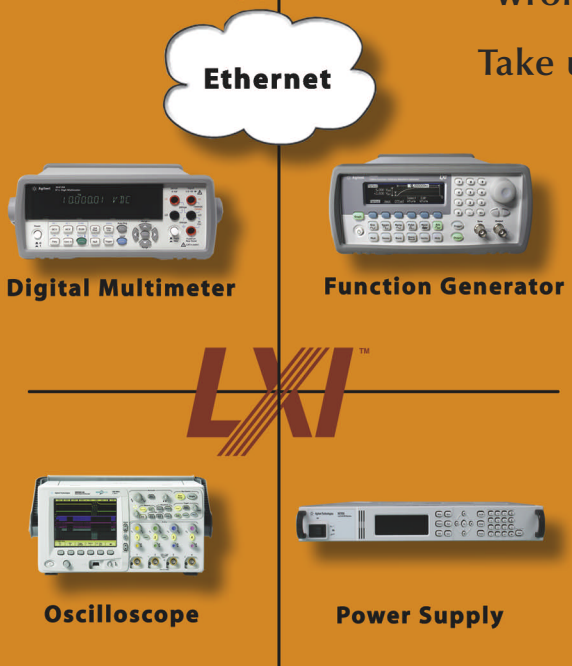

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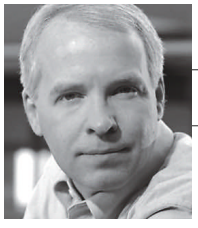
Embedded instruments

Peruse this year's "Best in Test" products beginning on p. 30, and you'll see test-related software as well as oscilloscopes, analyzers, and multimeters. The software that inserts testability structures into designs and that helps analyze test results to improve yield will become increasingly important as traditional instruments lose access to circuit nodes buried within deep-submicron ICs, multichip packages, and BGA-populated printed-circuit boards (PCBs).

Addressing PCBs, Asset InterTech at the International Test Conference (ITC) announced that it has expanded its embedded-instrument support by adding signal-integ-



RICK NELSON, CHIEF EDITOR

rity analysis to its Intel IBIST (interconnect built-in self-test) functionality. Tim Caffee, Asset's VP for design validation, said IBIST-based embedded instrumentation is critical for handling dramatically increased data-transfer speeds on PCBs with dramatically diminished physical-test-probe access. Asset recently augmented its embedded instrument technology with the acquisition of International Test Technologies (p. 11), whose processor-based emulation functionality fits the embedded-instrumentation category.

Software that inserts test structures and analyzes test results is increasingly important.

Inovys chief scientist Al Crouch addressed the migration of instruments into chips in an ITC presentation titled "The Need for Standard and Efficient Interconnection and Access of Embedded-Everything." (See p. 15 for more ITC news.) He's been poking around in other people's chips, he said, and he's found a variety of embedded instruments based on technologies from companies including DAFCA, Cisco, ARM, and ASE.

Such instruments are necessary, Crouch said, to help silicon makers keep up with Moore's law and to serve in applications ranging from debug to yield enhancement to system-level troubleshooting. Dense chips and stacked-die multichip packages, he said, require significant debug infrastructure to get them up and running. As for system-level test, he said that a chip might work fine when it's plugged into a $10,000 load board connected to a $2 million ATE system. But when you pack it onto a 5x5-in. board with 10 other chips and connect it to a $35 power supply, it might turn out not to work so well.

Crouch also said that the proliferation of embedded instruments presents its own problems involving the need to communicate with them effectively. He concluded that the IEEE P1687 internal JTAG initiative can provide an effective way for orderly, standardized embedded-instrument communication and control.

Of course, external testers aren't out of the picture. Verigy's announcement that it is purchasing Inovys (p. 11) signals that the V93000 ATE system will have a role to play in communicating with chips' internal instruments. T&MW

Post your comments at www.tmworld.com/blog.

HIGH-SPEED TEST

Living In Multiple Time Domains

Raising the Value of Test using MTDs

Eric Thacker, Marketing Director
Credence Systems Corporation
eric_thacker@credence.com

New semiconductor devices have several buses operating at various frequencies. Programming methods for many ATE systems do not account for data rate differences between buses, which complicates device debug and places huge demand on pattern memory. You can now successfully optimize test pattern size, debug time, and tester costs using a Multiple Time Domain (MTD) approach, i.e., separating each bus into its own time domain and by programming the test rates for each domain independently.

In spite of scan DFT-based compression algorithms, scan vectors continue to proliferate, especially as new "two vector" fault models are added for better fault coverage. Also, functional test vectors are still required on many devices to elevate quality and yield levels. You can compress ATPG scan patterns, but functional patterns cannot be similarly compressed. This becomes critical since ATE pattern memory depth is limited, often forcing expensive memory upgrades.

Functional patterns from simulation need to be processed before loading in the tester. Signals have to be cyclized, timing aligned, and strobes need to be added – a highly iterative process – and the resultant pattern is then compiled in a tester format. Functional patterns consist of device information for high speed (HS) data and clock buses, low speed (LS) command buses and DC pins. The traditional way for test patterns to be cyclized is to use the smallest period consistent with the event rate of the fastest bus (e.g., a 5ns period) on all pins. This is acceptable for HS pins but not for LS and DC pins. Moreover, the 5ns period is still applied even when the HS bus is not toggling.

The more optimal MTD approach processes each bus at its natural frequency, by separating each into its own time domain. If the HS pin is not toggling at maximum frequency during the entire pattern, you can have two different test periods for one timing domain and then switch between periods on-the-fly. This greatly simplifies test program development, specifically in the set-up of timing and creation of test vectors.

Debug using traditional methods is trickier since you are limited in the adjustment of the strobe and drive edges. The MTD approach offers key advantages:

- *The debug time is reduced, since the pattern doesn't need to be re-generated to move strobes or drive edges.*
- *The waveforms displayed at the tester are easier to understand since the data transfers of each bus are displayed in their own native data rate.*

To be able to fully exploit MTD benefits, the tester must fulfill certain key requirements that enable inter-instrument synchronization, including (1) Coherent, repeatable, test start (2) Per-domain vector sequencing, and (3) Per-domain test period and timing.

Modern ATE architectures share the same pattern memory for both functional and scan-based vectors, requiring that the demand for total vector storage between functional and scan-based vectors be balanced, to avoid purchasing memory upgrades for the tester channels. Platforms such as Credence Systems' Sapphire tester with XTOS software allow engineering teams to easily adopt MTD processing for functional patterns, which:

- *Enables faster debug cycles and better test floor efficiency*
- *Eliminates unnecessary capital expenditures for additional tester memory*

The flexible XTOS software offers further benefits. The XTOS STIL pattern compiler allows each time domain to be a separate STIL vector file. The XTOS Waveform display tool joins these disparate, asynchronous time domains into an integrated display, showing the user-selectable tester channel waveforms in a time-coherent fashion with different period time scales used by each domain.

To read a paper about how a leading IC manufacturer is effectively using a successful MTD approach today, visit *www.credence.com/sapphire*

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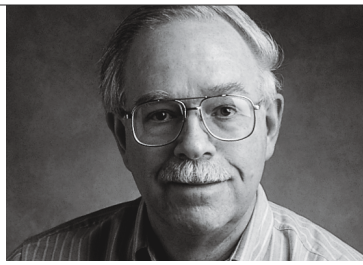

You can't shrink heat

Regular readers may recall that I volunteer at a nonprofit computer recycling facility. Recently, the incoming e-waste stream yielded a batch of approximately 100 castoff HP Model 1530 15-in. LCD monitors. While many still worked, approximately one third showed only black screens.

Shining a flashlight on a typical screen showed faint black characters, indicating that the display's LCD worked but not the backlight. Investigating further, I found a blown fuse that supplied power to the inverter that drives the backlight's fluorescent tubes. Replacing the fuse restored operation, but then the fuse failed again.

I measured a current of 1 A through the 2-A fuse, well within its rating. A current probe showed normal-looking waveforms in both tubes' return leads. In frustration, I jumpered the fuse and waited to see what would happen.

An hour later, the screen went black, and an inverter transistor (a TO-126-packaged Sanyo 2SC5706) released a wisp of smoke, obligingly unsoldered itself from the circuit board, and dropped onto the workbench. I incautiously poked it and received a small burn on my fingertip. Can you say "thermal runaway"? I could and did, along with a few unpublishable words.

I examined several failed displays and noted that the inverter circuit boards, manufactured by BenQ, had discolored areas around the inverter transistors. Mounted close to the board, the 2SC5706s' 7.5-mm^2 collector tabs hardly qualify as convection heat exchangers. Heat produced by the transistors dissipates primarily via the board's copper traces.

The single-sided, low-density printed-circuit board layout crams the transistors next to the inverter's step-up transformers. Finding suitable substitutes for the fast-switching and high-current 2SC5706 proved surprisingly difficult. I wanted to use TO-220-packaged switching transistors in place of the 2SC5706s, but there's barely room for TO-18 transistors and small heat sinks.

Driving fluorescent tubes more closely resembles an art than a science (see sidebar), but in our industry's crazed pursuit of "smaller, cheaper, and faster" electronics, we've evidently forgotten "hotter"—and heat doesn't take kindly to miniaturization. T&MW

CASTING LIGHT ON CCFLS

For useful insights into the complexities of driving cold-cathode fluorescent (CCFL) tubes and analyses of a few reference designs, review AN14 and AN17 at Zetex Semiconductors' Web site:

www.zetex.com/3.0/3-8-1.asp

For an exhaustive collection of CCFL and conventional hot-cathode lamp troubleshooting tips, visit Samuel M. Goldwasser's informative Web site, "Sam's F-Lamp FAQ," at:

members.misty.com/don/f-lamp.html

For additional information, visit Linear Technology's Web site and read application note AN55, "Techniques for 92% Efficient LCD Illumination," by Jim Williams:

www.linear.com/pc/downloadDocument.do?id=4144

UNCOVERING DATA SHEETS AND DEVICE MANUFACTURERS

Finding components can prove surprisingly difficult when you're hunting for data or looking for a few replacements or alternatives. Chances are, long ago you discarded your data books, so you start by launching a part-number query via Google or another search engine. You'll receive hundreds of hits, mostly useless pointers to offshore component brokers.

Short of visiting a specific device manufacturer's Web site or plowing through dozens of brokers' sites, you can use the following Web sites to view a device's data sheet.

www.datasheetcatalog.com

www.alldatasheet.com

www.epanorama.net

To identify a manufacturer from a device's logo, try these sites:

www.xs4all.nl/~ganswijk/chipdir/c/logo.htm

www.elnec.com/support/ic-logos/?method=logo

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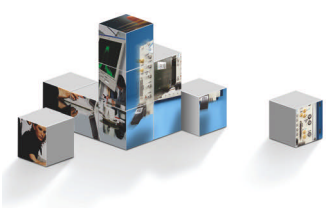

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Teradyne to acquire Nextest

Teradyne and Nextest Systems have announced that they have reached an agreement under which Teradyne will acquire Nextest. As a result of the acquisition, Teradyne will expand its served market into the flash-memory test segment, estimated to be more than $700 million in 2006. Of Nextest's $95.8 million in revenue in calendar year 2006, flash-memory tester sales totaled about $80 million.

Under terms of the agreement approved by both boards of directors, Teradyne will pay $20 per share in cash for all the outstanding shares of Nextest. The aggregate purchase price is expected to be approximately $325 million.

"Nextest brings us a solid flash memory test product line, plus a very capable development and technical support organization," said Michael Bradley, president and CEO of Teradyne (**pictured**). "Their growing presence in the flash memory test market provides a strong addition to our system-on-chip product offerings. This is one of the few business combinations in the test market where customers get products that are so complementary. Nextest's Magnum product line will be backed by Teradyne's global customer support team and will give us a powerful growth engine in the coming years."

Upon the closing of the agreement, which is expected in the first quarter of 2008, Nextest will be run as a business unit within Teradyne's Semiconductor Test Division. www.teradyne.com.

Acquisitions abound in test industry

In addition to Teradyne's acquisition of Nextest Systems (see above), two other major test-company acquisitions were announced in December. First, boundary-scan vendor Asset InterTech announced that it has acquired International Test Technologies (ITT) of County Donegal, Ireland, a supplier of processor emulation technology.

Asset and ITT have had a strategic arrangement for the last three years, during which time they have worked together on product development and marketing. Technologies from the two companies have been integrated into a test system called ScanWorks Extended JTAG Coverage, which combines the functionality of Asset's ScanWorks JTAG structural test system with ITT's µMaster functional test platform.

"With our integrated product platform, we've been able to offer users more test coverage than they could achieve with either ScanWorks or ITT's µMaster on its own," said Glenn Woppman, president and CEO of Asset. "Now, as we move forward as one company, we will take the expertise we've acquired together and apply it in emerging areas like embedded test functionality and instrumentation, as well as design validation of high-speed serial buses." The terms of the acquisition agreement were not disclosed. www.asset-intertech.com.

In another surprising announcement, Verigy and Inovys reported that they have signed a definitive agreement for Verigy to acquire Inovys. Financial details were not disclosed.

The acquisition enables Verigy to provide an integrated time-to-yield offering for semiconductor manufac-

Editors' CHOICE

JTAG platform tests ARM-based PCBs

Intellitech has announced its new PT100 Pro test platform for testing printed-circuit boards (PCBs) with processors based on ARM architectures. The PT100 Pro enables customers to reduce test costs and increase fault coverage by combining mixed-signal test, concurrent IEEE 1149.1 (JTAG) test, and CPU emulation-based functional tests in a single platform for testing up to 32 PCBs at a time.

The PT100 Pro is based on Intellitech's PT100 and its patented CJTAG (concurrent JTAG) technology, which enables massive concurrent JTAG-based test and emulation. The concurrent ARM-based emulation test support enables the tester to go beyond boundary-scan stuck-at faults to include at-speed cluster testing of all of the PCB components, including non-1149.1 devices, on a single tester platform. Power, mixed-signal, and analog testing are achieved through the PT100 Pro's built-in PXI instruments, power supplies, and relays.

The PT100 Pro supports up to 32 JTAG controller ports and up to 1870 analog/digital test pins with a pneumatic- or vacuum-based fixture interface. It includes a PXI chassis and measurement block, dual programmable power supplies, an integrated dual-core Pentium-based computer with RAID drive, a touch-screen monitor, a lockable keyboard, a bar-code scanner, and Intellitech's ScanExecutive production test software.

Price range: $45,000–$80,000. *Intellitech, www.intellitech.com.*

turers. Inovys' products bridge the gap between electronic design automation (EDA) and test, providing a path between design and production.

"Time-to-entitled-yield becomes a critical metric that places the focus squarely on test," said Keith Barnes, chairman, CEO, and president of Verigy. "Verigy's production workhorse V93000 system combined with Inovys' design-for-test and design-for-manufacturing tools have demonstrated significant time-to-yield value for Verigy customers. Inovys' and Verigy's solid track records for technology innovation, quality products, and superb customer service will allow us to raise the bar in delivering world-class solutions to the industry." www.verigy.com.

High-speed Ethernet gains IEEE designation

In early December, the IEEE officially established a designation for the planned 100-Gbps Ethernet communications standard: 802.3ba. With the approval of IEEE P802.3ba, the 802.3 Higher Speed Study Group will become the IEEE P802.3ba HSE Task Force and will develop a standard covering both a 100-Gbps and a 40-Gbps Ethernet interface. The specifications are expected to be ready in 2010. (For more on P802.3ba, see p. 21.) www.ieee802.org/3/ba.

CALENDAR

Optical Fiber Communication Conference/National Fiber Optic Engineers Conference, February 24–28. San Diego, CA. Managed by the Optical Society of America, www.ofcnfoec.org.

Measurement Science Conference, March 10–14, Anaheim, CA. Sponsored by the Measurement Science Conference, www.msc-conf.com.

APEX and IPC Printed Circuits Expo, March 29–April 3, Las Vegas, NV. Sponsored by IPC, www.goipcshows.org.

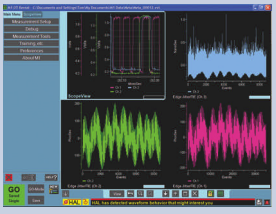
See our complete calendar at www.tmworld.com/events.

Software diagnoses signal anomalies

Editors' CHOICE

Version 5 of the M1 oscilloscope software from Amherst Systems is designed to automatically detect signal anomalies. A feature called "Hidden Anomaly Location" (HAL) helps you find signal problems such as metastability, ringing, and crosstalk using a knowledge base.

The M1 HAL feature analyzes waveform data, looking for signal anomalies. When it finds a signal problem, it guides you to the waveform integrity knowledge base where you can use "agents" that provide technical descriptions of the problem as well as possible solutions. The knowledge base, which is included in the M1 software, is also available online where oscilloscope users can add their own troubleshooting stories and solutions to problems (www.amherst-systems.com/wikb/home-4.htm). Amherst Systems provides updates to M1 subscribers every 8 to 10 weeks; the updates will include the latest pages of the knowledge base for users who don't have access to the online version.



M1 Oscilloscope Tools software works with instruments from Agilent, LeCroy, Tektronix, and Yokogawa. It can control the instruments to get data, or it can read stored data files offline.

Subscription price: $995 to $7995. *Amherst Systems, www.m1ot.com.*

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ITC innovations span RF hardware to test software

> > > International Test Conference, October 21–26, Santa Clara, CA, www.itctestweek.org.

Virage Logic introduced a new version of its Self Test and Repair (STAR) memory system, which has gained a dashboard of options that let users make tradeoffs between test time, die area, and diagnostic resolution. **OptimalTest** demonstrated new features of its OptimalTest Test Management Solutions (OT-TMS) suite of software, including the OT-Reports and Outlier Management tools. OptimalTest also reported that it has sold its OT-TMS software to a European IDM in a multimillion-US-dollar annual licensing deal. **DeFacTo Technologies** announced a design-for-test (DFT) product that analyzes an RTL integrated-circuit design, creates appropriate RTL scan-test structures, and inserts them into the RTL design. The product, HiDFT-Scan, works within existing design flows and with industry-standard synthesis tools.

Cadence Design Systems reported that companies including K-micro, LSI, G2 Microsystems, and IBM have made use of Cadence's timing-aware, power-aware, and small-delay-defect test tools. **Synopsys** announced availability of its TetraMAX small-delay-defect automatic test-pattern generator (ATPG), extended low-power-management capabilities within the Synopsys Galaxy environment, and a new Odyssey DFT yield-management module. **Magma Design Automation** highlighted its new Talus ATPG and Talus ATPG-X (which adds compression) tools. Designed to concurrently target multiple fault models, the multithreaded Talus ATPG is fully integrated into Magma's Talus IC implementation system and leverages the unified data-model architecture to access timing, layout, power, and other design data.

Mentor Graphics highlighted its new TestKompress Xpress technology, which, compared with the original TestKompress product introduced in 2001, increases the achievable level of compression by providing a more efficient way to handle so-called "X-states"—the unknown states that can arise during manufacturing test. **Goepel electronic** demonstrated the upcoming release 4.4.1 of its software platform, System Cascon, which adds improvements in third-party ATE integration while offering improved tools for the automated handling of non-boundary-scan components and clusters.

Asset InterTech expanded ScanWorks' embedded-instrument support to include signal-integrity-analysis applications that support Intel's IBIST (interconnect built-in self-test) embedded instrumentation technology. **Intellitech** demonstrated its new PT100 Pro test platform for testing PCBs with processors based on ARM architectures (p. 11). **Teseda** highlighted its new 512-channel V550 desktop validation and diagnostic platform and announced that Hamamatsu Photonics will adopt Teseda's V-series hardware as an option in its semiconductor-device failure-analysis systems.

Advantest's 12-GHz Model 12GWSGA wideband signal generator/analyzer resides in a T2000 test head and provides 32 RF ports per module.
Courtesy of Advantest.

Representatives of **Inovys** were on hand to tout Sun Microsystems' purchase of multiple Inovys Zero Foot Print (ZFP) test systems that have been coupled with Inovys SpeedScan for high-speed characterization of Sun's UltraSPARC CMT CPUs. **Micro Control Company** exhibited its LC-1 logic burn-in with test system, which can accommodate other vendors' boards that have sizes differing from the standard Micro Control burn-in board dimensions.

Advantest chose Test Week to announce its 2GDM 2-Gbps source-synchronous interface test module and its 12-GHz 12GWSGA wideband signal generator/analyzer module for its T2000 OpenStar platform. **FormFactor** announced a new family of wafer-probe cards designed to address the rising cost and technology challenges associated with testing wire-bond logic and system-on-chip (SOC) devices. T&MW

See the online version of this article at www.tmworld.com/2007_12 for links to vendors and to our complete coverage of the International Test Conference.

Production show highlights electronics inspection and test

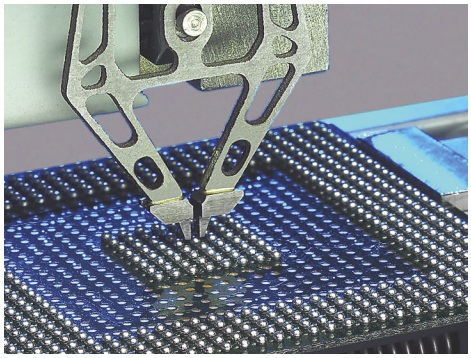
> > > Productronica, November 13–16, Munich, Germany, www.productronica.com.

JTAG Technologies highlighted a new USB version of its JT 3705 Explorer—the JT 3705/USB Explorer provides two boundary-scan Test Access Ports (TAPs), which can be synchronized and are suitable for running a complete battery of board test and programming operations. **Digitaltest** showcased its second-generation Condor 500 flying prober, which is based on a shuttle concept that facilitates front board loading. The company also presented a version of its MTS Lambda in-circuit tester, which doubles throughput.

Aeroflex and **Goepel electronic** announced that the Aeroflex 5800 Series multiconfiguration, multifunction ATE system is optionally available with Goepel's PXI-based ScanFlex JTAG/boundary-scan platform. **Goepel** also announced it has developed a new series of JTAG/boundary-scan controllers with LXI interfaces (see p. 19). **Agilent Technologies** announced a partnership to license certain automotive-network products in the **Elektrobit** FlexRay product line. **Rohde & Schwarz** introduced its SFE100 test transmitter, which targets production test of set-top boxes, TV sets, and other broadcast terminal units, and the company debuted the CMW500 nonsignaling tester for wireless devices operating to 6 GHz.

Teradyne introduced its TestStation Duo concurrent in-circuit tester, which combines two independent test modules inside a single tester frame to enable manufacturers to perform simultaneous testing of two printed-circuit boards (PCBs). **LDS Test and Measurement** highlighted its Dimension 4i data-acquisition system, which combines technologies that LDS gained with its acquisition of Dactron, Nicolet Technologies, and Gould Instruments.

MatriX Technologies debuted the X2.5 addition to its AXI product lineup—the system features a programmable angle-shot capability that, combined with the MatriX Slice-Filter Technology (SFT), provides for 100% test coverage of double-sided PCBs. MatriX also introduced new MIPS_Process software, which adds a module that can correlate inspection points along a PCB manufacturing line. **Dage Precision Industries** introduced an enhanced cold-bump-pull (CBP) bond-testing capability as well as x-ray systems. The second-generation CBP capability for the company's 4000HS high-speed bond tester offers advantages over conventional shear testing. Dage's new XiDAT XD7500NT digital x-ray inspection system offers submicron inspection capability over an 18x16-in. inspection area. Also, the company touted its new XiDAT XD7800 large-board-format digital x-ray inspection system.



The 4000HS bond tester employs a high-speed cold-bump-pull capability to support compliance with JEDEC standards.

Courtesy of Dage Precision Industries.

Yxlon International Feinfocus presented its Y.Cougar Pro x-ray inspection system, its Y.QuickScan fast computed tomography (CT) capability, and its T.FGUI 3.0 software. Y.Cougar Pro supports manual and fully automated 2-D and 3-D inspection. Y.QuickScan shrinks CT scan times to 18 s while supporting 3-D reconstruction in 2 min. Y.FGUI 3.0 software supports real-time x-ray image analysis. **Phoenix | x-ray** showcased its x | act software platform for CAD-based automated inspection of solder joints. Also on display was the microme | x, an AXI-capable inspection system that combines high-quality automated 2-D x-ray inspection and 3-D CT in one system.

Viscom introduced its new S3088-II high-speed AOI system; it includes Viscom's 8M AOI camera technology, which at 20 fps provides up to 25% faster image upload while offering full color capability. Viscom also highlighted the MX family of IR semiconductor inspection systems, which it acquired last summer from Phoseon Technology. **Lloyd Doyle** said it has released its IBIS-Versalea, a new system aimed at silicon-wafer bump inspection. Versalea builds on Lloyd Doyle's recently released IBIS technology, which powers a high-speed interferometer-based system for solder-bump inspection of IC substrates. T&MW

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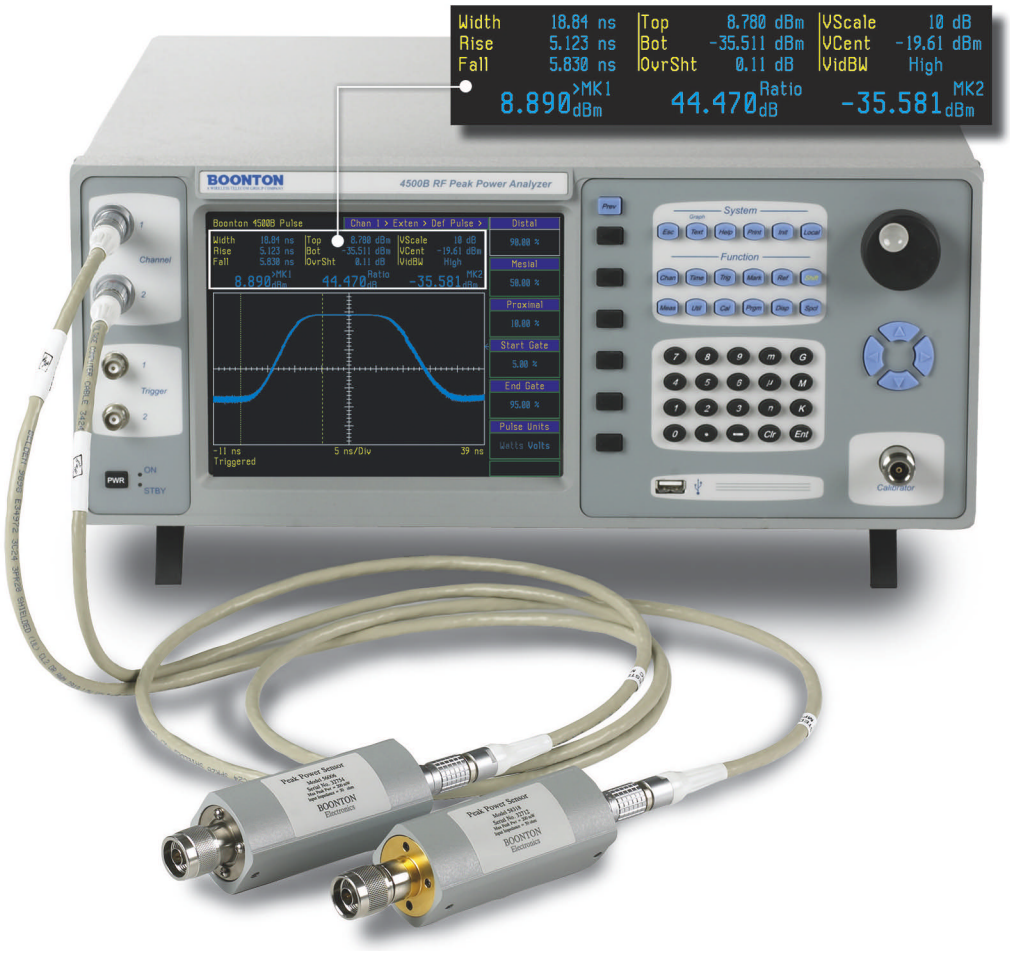

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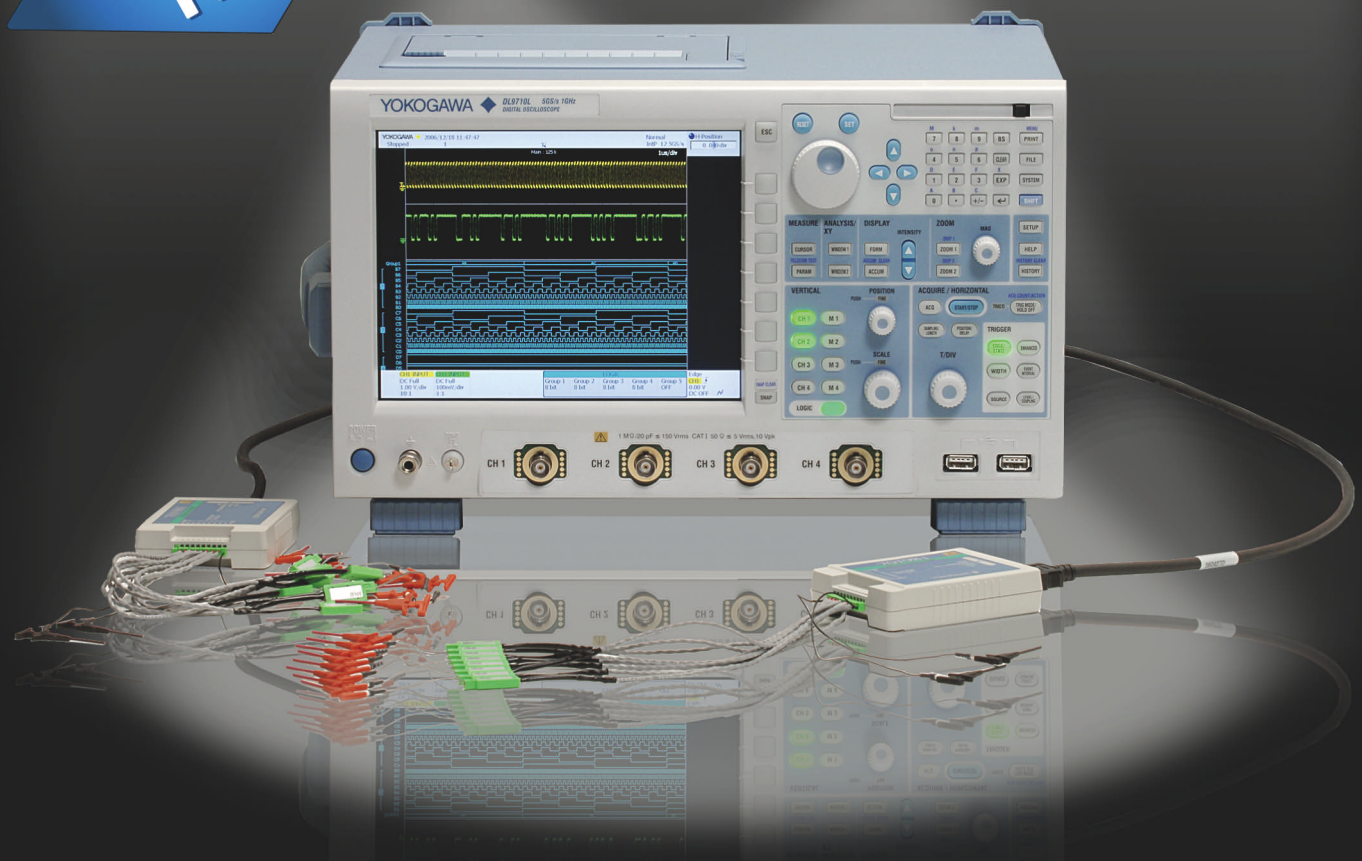

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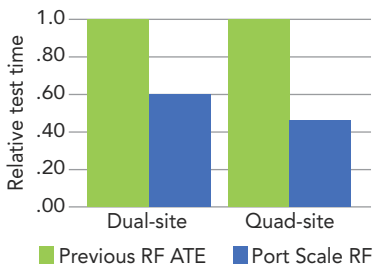
SOC ATE gains RF instrumentation

ATE companies have been responding to RF system-on-chip (SOC) vendors' calls for innovative test approaches with a variety of new test system architectures and instrumentation. Getting a head start on instrumentation, Verigy in June introduced the Port Scale RF option for the V93000 test system; Port Scale RF includes a 6-GHz RF source card, a front-end card that provides 12 RF ports, an RF load-board interface, a 48-port RF calibration kit, and an MB



Verigy's Port Scale RF offers high parallel efficiency to reduce test times in multisite applications.

AV8 card, which provides four arbitrary-waveform-generator cores and four digitizer cores.

In an interview during the International Test Conference, Greg McCarter, RF market development manager at Verigy, said the Port Scale RF combines its test capability into 8x14-in. cards that fit within the V93000 test head, eliminating the size penalty and capital costs associated with fitting rack-and-stack instruments within an ATE mainframe.

McCarter said that Port Scale RF targets chips containing multiple radios that operate at the same time, as well as ones that take advantage of Rx diversity—through MIMO techniques—to improve received signal quality. Port Scale RF can source multiple RF signals in parallel as well as multiple RF digitizers; hardware digital signal processing in each receiver enables simultaneous parallel calculation of measurement results.

McCarter noted that the Port Scale RF provides throughput improvements in single-site tests but added that the most significant throughput improvements occur in multisite test operations, with parallel test efficiency exceeding 85%. He said that the Port Scale RF is readily extensible from 12 to 48 ports to support quad-site tests. He considers 48 ports to be sufficient to handle the majority of RF device requirements within the next few years, although, he added, Port Scale RF is architecturally able to extend beyond that when the market needs it.

Verigy reports success with the Port Scale RF product. "Since June, we've engaged with eight of the top 10 semiconductor providers for the wireless world and have over 25 Port Scale RF systems installed," said McCarter. And in November, Verigy announced that Oki Electric Industry had purchased the Port Scale RF for testing its wireless communications devices for set-top boxes, cell phones, PDAs, and other wireless products; Oki reported it will use the Port Scale RF as part of its test services business as well.

Of course, instrumentation is only part of the multisite-test picture. Addressing another aspect is Advantest, which targets multisite test with an integrated test cell that combines tester and handler, as I recounted in September (Ref. 1). On the instrumentation side, Advantest is not ceding ground to Verigy—in October it introduced its 12-GHz Model 12GWSGA card for its T2000 system (see p. 15). It provides 32 ports per module, and should your need for ports increase dramatically, you can add modules to extend capacity to 128 ports. T&MW

REFERENCE

1. "ATE firm responds to RF chipmaker's call," *Test & Measurement World*, September 2007, p. 19. www.tmworld.com/article/CA6473122.html.

Boundary scan goes LXI-compliant

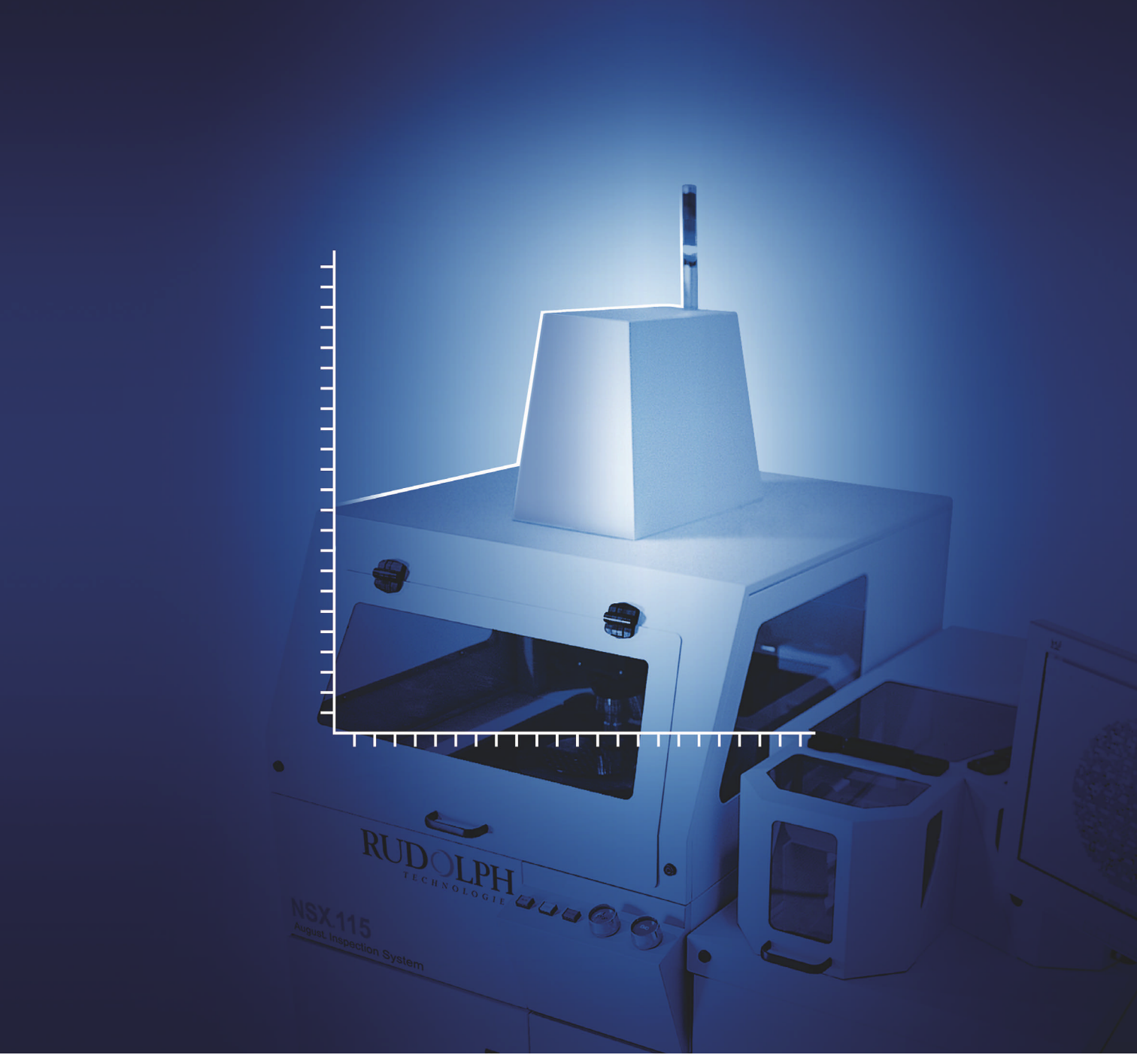
Goepel has announced it has developed a new series of JTAG/boundary-scan controllers with LXI interfaces. Part of the company's ScanFlex series of boundary-scan controllers, the LXI-compliant versions are named SFX/LXI1149-(x) and offer TCK frequencies of 20, 50, and 80 MHz. The SFX/LXI1149-(x) is an LXI Class-C device that supports the implementation of systems with up to eight independent Test Access Ports (TAPs). www.goepel.com

Cobalt 1-GHz/2-Gbps pin electronics for ATE

Semtech's Cobalt E84XX devices integrate two complete channels of ATE pin electronics and operate to 2 Gbps. The devices can serve as ATE building blocks for memory and SOC test. Family members include driver and window-comparator cores, pin parametric measurement units (PPMUs), digital-to-analog converters (DACs), and active/passive load cores. E84XX devices can be configured in software through a 50-MHz SPI interface. www.semtech.com.

AMIS chooses FLEX

Teradyne has announced that AMI Semiconductor (AMIS) has standardized on the FLEX test platform to test the company's automotive devices. As part of the agreement, AMIS purchased multiple microFLEX systems with DC90 and Precision Octal Op-Amp Loop (POOL2) instrumentation for use in its Calamba, Philippines, location and in its test-development centers worldwide. AMIS will use the FLEX platform to test devices used in stability-control, in-vehicle networking, x-by wire, and power-switching applications. www.teradyne.com; www.amis.com.



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100-Gbps Ethernet is coming

On December 5, the IEEE formally established IEEE 802.3ba as the designation for a 100-Gbps and 40-Gbps Ethernet communications standard. Higher-speed Ethernet is being driven by our insatiable appetite for bandwidth. Much of the demand comes from on-demand IPTV, peer-to-peer video, and video-sharing Web sites such as YouTube.

A 100-Gbps Ethernet (100 GbE) link will require multiple transport lanes, but the channel architecture is currently undefined. The standard will likely specify either 4x25-Gbps lanes or 10x10-Gbps lanes (see **figure**), because transmitting a single lane at 100 Gbps isn't possible with today's technology. Specifications for both optical and electrical physical layers are likely to be developed.

Service providers will likely go for 100-Gbps Ethernet links for their core networks. Data-center operators are leaning toward 40 Gbps (Ref. 1). "The people who connect servers, switches, and routers see a need for moving from 10 Gbps to 40 Gbps," said Larry Green, chief technologist at Ixia, "but they won't want 100 GbE right away because the optics are too expensive."

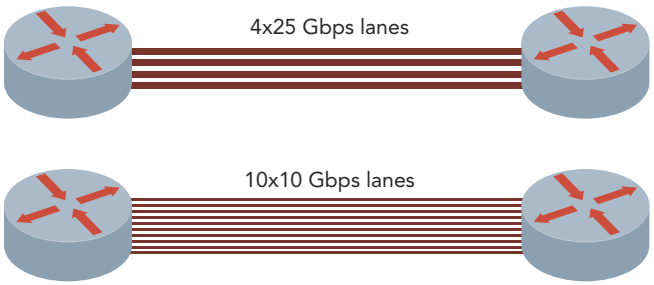
"Ethernet is expected to map over 40-Gbps OC-768 SONET networks," added Greg LeCheminant, senior product marketing engineer at Agilent Technologies. "The IEEE high-speed study group will pursue both 100-Gbps and 40-Gbps specifications in the standard."

Ken van Ormen, product manager at Spirent Communications, commented on transmission distances. "The goal is to get 40 km," he said. Service providers will use the intended 10-km and 40-km links on single-mode fiber. Data centers will look at 100-m links with multimode fiber and 10-m links over copper wire or backplanes.

For several channel architectures and lengths, signal receivers will have to equalize incoming signals to compensate for transmission distortion. "You can't look at the eye diagram of the transmitter to know what a receiver will see," noted LeCheminant. "You have to know the channel and how the receiver must equalize the waveform."

He expects that the transmitter waveform dispersion penalty (TWDP) test, specified in IEEE 802.3aq, may again be an important test (Ref. 2). This test requires you to capture a waveform at the transmitter and digitally process it through a simulated channel. From the results, you can calculate the distortion, or "penalty," in the channel and design an equalizer for the receiver (Ref. 3).

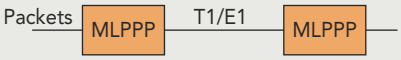
The 100-GbE and 40-GbE specifications will likely be ready by the end of 2010. Interoperability testing will follow. T&MW



100 GbE links will likely use either four or ten data lanes.

T1, E1 protocol analyzer tests PPP links

GL Communications has released software tools that emulate and analyze multi-link point-to-point (MLPPP) traffic on T1 and E1 links. GUI and command-line interfaces let you run manual or automated tests. www.gl.com.



Mini-OTDR tests short-haul fiber networks

Anritsu's MT9090A Network Master Fault Locator mini-OTDR (optical time-domain reflectometer) finds faults in short-haul fiber networks such as fiber-to-the-home (FTTH). It can provide data sampling of 5 cm and dead zones of less than 1 m. www.us.anritsu.com.

IVI-C drivers for function generators

ZTEC Instruments has released IVI-C drivers for its ZT530 series of PCI, PXI, and VXI function-generator cards. The downloadable drivers let you change computing platforms without having to change application code. www.ztecinstruments.com/download-software.

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2. Swenson, Norman L., Paul Voois, Tom Lindsay, and Steve Zeng, "Explanation of IEEE 802.3, Clause 68 TWDP," ieee802.org/3/aq/public/tools/TWDP.pdf.

3. Mazzini, Marco, "Testing and Interoperability Verification of 10GBASE-LRM Optical Interfaces," www.analogzone.com/nett_050707.pdf.

Presentations from the November 2007 meeting of the High Speed Study Group are available at grouper.ieee.org/groups/802/3/hssg/public/nov07.

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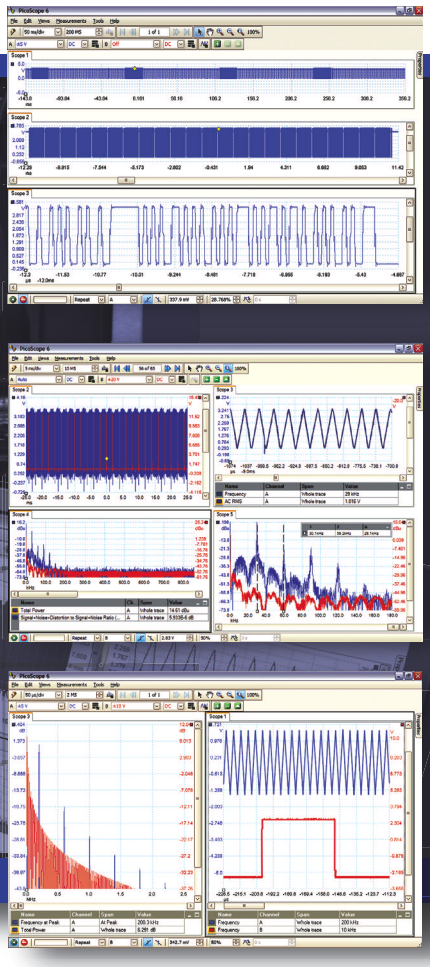

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The ATE industry's hybrid theory

If the first thing you think of when you hear "hybrid theory" is Linkin Park's debut album, then you may be missing the most important trend in automatic test equipment (ATE): the introduction of hybrid systems that employ combinations of GPIB, VXI, PXI, and LXI interfaces.

GPIB, the interface bus from the 1970s, is a low-cost architecture that is still widely used. When VXI was introduced in 1987, many thought its high-channel-count capability would replace GPIB. Yet, the older bus had a huge installed base that continues to grow.

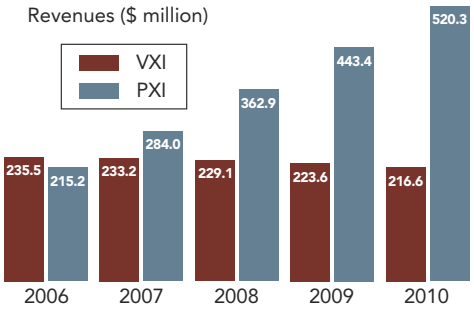
Similarly, when PXI appeared in the 1990s, many predicted the end of VXI. Instead, PXI is exploring new avenues and markets for growth rather than replacing VXI.

LXI, introduced in 2005, is the hot topic now. The technology uses standard Ethernet LAN hardware and software to simplify communications for instrumentation that is now mostly GPIB. LXI will not make GPIB go away, however, but will extend the speed for instrument interconnections and provide synchronizing capabilities not available in the older bus.

Each technology has its own merits and demerits and is suited to different applications. Some companies are promoting a single technology as the ideal bus that meets all application needs. But the most evident truth is that no single bus technology can solve every T&M application. These platforms are not competitive but rather are complementary.

When one size does not fit all, what is the solution? The answer may lie in the convergence of bus standards in hybrid test systems. This trend is likely to shape the future of the ATE market.

Hybrid test systems contain multiple bus-connectivity solutions—GPIB, VXI, PXI, and LXI, as well as PXI Express and USB. Hybrid systems are especially handy when users cannot get the desired instrument capabilities in a preferred form factor. Cost reduction and performance improvements seem to be the main goal of the next-generation software-defined test systems, and the trend toward hybrid test systems has only facilitated this.



PXI revenue worldwide in 2010 will more than double 2006 PXI revenue. VXI revenues will tail off gradually, while the aerospace and defense segment will continue to sustain the market for VXI.

The mix-and-match approach lets users choose instruments based on capabilities and pricing options when designing or upgrading a test system. Hybrid test systems are becoming a reality, and test engineers and equipment vendors should embrace the coexistence of multiple platforms and understand the tradeoffs of the platform options before designing new instruments and test systems. Vendors must cooperate and coexist in order to have a foothold in the future of the industry. T&MW

PCB book-to-bill

The book-to-bill ratios for the North American rigid and flexible printed-circuit board (PCB) industries both climbed to 1.08 in September, as did the combined flexible and rigid book-to-bill ratio. The rigid and combined ratios stood at 1.06 in August, while the flexible circuit book-to-bill ratio stood at 1.07 in August. www.ipc.org.

Broadband may top TV in three years

Within the next three years, more than 16 million US TV households may be using their broadband service more than they use their TV sets today, reports In-Stat, based on the market research firm's survey of US consumers' TV viewing and online habits. Respondents had a broadband connection, a TV set, and were 18 years of age or older. "Today's stable and profitable subscription TV services are facing new competition from online and mobile entertainment services, and from new, high-quality packaged goods, such as HD-DVD and Blu-ray discs," said Gerry Kaufhold, In-Stat analyst. The $3995 report, "US TV Viewer Survey: Online Bids to Usurp Pay-TV," notes that up to 30% of respondents would drop subscription TV and use the Internet for TV. www.in-stat.com.

Semiconductor equipment book-to-bill

North American-based manufacturers of semiconductor equipment posted $1.23 billion in orders in October 2007 (three-month average basis) and a book-to-bill ratio of 0.83. The ratio stood at 0.82 in August and 0.79 in September. "Actual sales of new semiconductor equipment have generally followed the bookings trends, which have declined sequentially since the cyclic peak in early summer," said Stanley T. Myers, president and CEO of SEMI. "However, our expectation remains that 2007 equipment revenues will remain comparable to or slightly above 2006 sales." www.semi.org.

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General Manager
AR Modular RF

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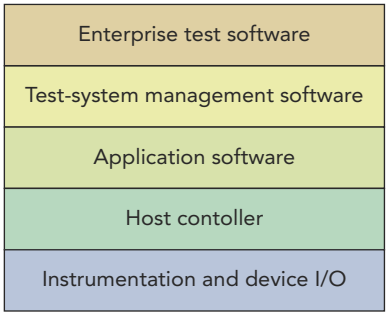
WEBCAST

Enterprise software supports test effort

An enterprise test-management system can support engineers by enabling interactive analysis of frequency, linearity, power-consumption, and error data. Such a system can aggregate test data and make characterization and validation reports available within a department as well as across departments, reports Gricha Raether, director of sales and marketing at VI Technology, in the Webcast "Enterprise Test Management for Electronic Component and Device Designers."

An effective test-management system, Raether says, will alleviate common test problems related to nonconsolidated data, inefficient report generation, cryptic file-naming schemes, and inefficient data searching.

Raether describes three common approaches to enterprise test management. A file-based system makes use of tools commonly available, such as Microsoft Excel and Google search. File-based systems are easy to comprehend and require minimal or no out-of-pocket startup costs. Yet, Raether says, such systems fail to offer concurrency, have security limitations, lack enforceable platform standardization, and can make finding and aggregating data tedious and inefficient.



Enterprise test software works with your existing instrumentation and host controller as well as with test-system-management software like NI TestStand and applications software such as NI LabView.

A second alternative is an enterprise database system, but, says Raether, deployment of such a system requires IT skills not common to engineers, and entry-level startup costs can be high. A more effective alternative, he says, is the third option—a platform system that's scalable and extensible and that can readily work with the hardware and software you already have (**figure**).

The Webcast, sponsored by VI Technology in conjunction with *Test & Measurement World,* was presented live on October 10. The archive is available for viewing on demand at www.tmworld.com/webcasts.

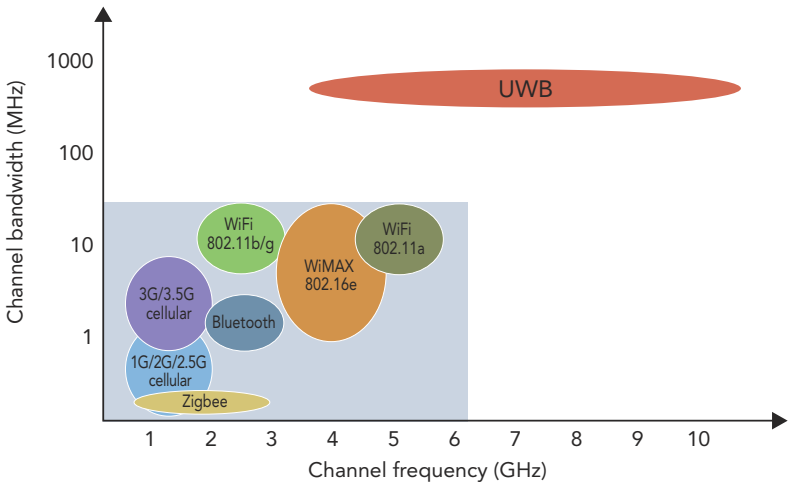
Rick Nelson, Chief Editor

RF TEST

Demystifying production test of UWB devices

Numerous technologies are emerging to meet consumer demands that traditionally wired products "cut the cord" and move into the wireless domain. One example is ultra wideband (UWB), a communications technology for transmitting data over channel frequencies of 3.5 to 10.5 GHz—frequencies that are used for the wireless video and USB 2.0 signals in numerous household products and appliances.

The emergence of UWB technology, however, creates both economic and technological challenges. On the economics side, the addition of the UWB communication interface must not add significant cost to the consumer product (television, DVD player, digital camera, etc.). The initial price target for a four-chip UWB set—including an RF front end, an RF transceiver, a digital baseband IC, and a media access controller (MAC)—is less than $15.



UWB's bandwidth and channel frequencies present significant test challenges, but you can meet them using standard production testers coupled with creative DFT techniques.

On the technology side, UWB has unique attributes—such as its wide range of channel frequencies and its 528-MHz bandwidth—that can make testing these devices in high-volume production very challenging.

In particular, as the ultra-wideband name implies, the modulation band-

Demystifying production test of UWB devices *(continued)*

width that the device employs is an order of magnitude larger than even the latest wireless LAN (WLAN) or WiFi devices. Because the technology has some nontraditional test requirements, it is very difficult to use a traditional production test strategy for UWB devices.

But despite what you may think, you don't need specialized test equipment to test UWB devices. It is possible to meet device manufacturers' test requirements by using a mixture of familiar techniques combined with design-for-test (DFT) creativity. While there are daunting challenges in the testing of UWB devices, a solution can be found on readily available production testers that minimizes the test cost per device. The online version of this article details the test challenges and describes how you can meet them (www.tmworld.com/2007_12).

Adam Smith, Verigy

INSTRUMENT PROGRAMMING

Software wrapper links Matlab to instruments

Matlab is a popular computing environment for electrical engineers. Many use it to analyze data, although they often save the data using another program, then import the data into Matlab. Mike Flaherty, an applications engineer at Agilent Technologies, wanted a direct programming interface from Matlab scripts to generate waveforms with an arbitrary waveform generator (AWG).

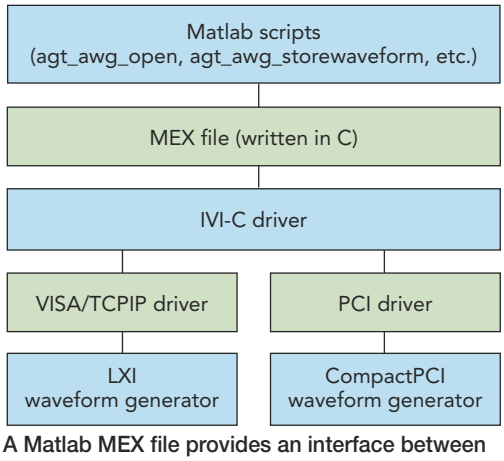
Flaherty needed Matlab scripts that generate numerous waveforms, including 7-bit Barker-coded radar pulses, and multitone signals. The software needed to work with two AWGs: one through Ethernet, the other through CompactPCI.

To provide an easy-to-understand programming interface, Agilent engineers developed several Matlab scripts to control the instruments. They used function names such as *awg_open* and *awg_storewaveform*.

These scripts call a Matlab MEX file, written in C, that in turn calls IVI-C drivers for the instruments. Those drivers then call the protocol stacks for the Ethernet and CompactPCI I/O ports (see **figure**).

"The waveform generators are 100% code compatible with this application," said Flaherty.

Flaherty also developed a user interface that lets users select from a menu of signals, then select specific parameters. Using Matlab and Agilent Vee, he built prototypes of the user interface. He wanted to develop a compiled, standalone executable, though. Because Vee is an interpreted language, Agilent engineers ported the GUI and the control code to Microsoft C#. The waveform engine is still Matlab but is compiled and linked to the application when built.



A Matlab MEX file provides an interface between Matlab and LXI or CompactPCI instrument drivers.

"The key to the application is the Matlab interface," explained Flaherty. "It communicates through a MEX file to an instrument's IVI-C driver. It passes a resource string to a CompactPCI or Ethernet stack."

Martin Rowe, Senior Technical Editor

CAPTURE AT THE SPEED OF BLUE

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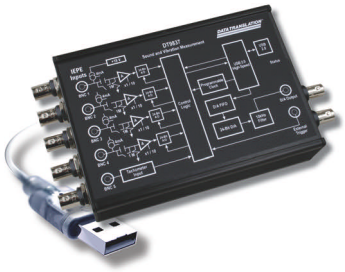

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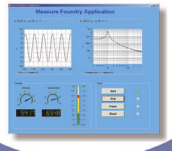

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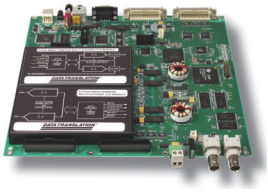

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RF TEST

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DEVICE UNDER TEST

Board-level processor with a GPS receiver and satellite transmitter module used to track locations of cargo trucks and shipboard containers. The board includes a motion sensor, a processor, the GPS receiver, a 2.4-GHz wireless connection, and a 3-to-5-year battery. The satellite module is a 3.5-GHz RF transmitter.

THE CHALLENGE

Measure satellite and wireless transmitter output power, GPS receiver sensitivity, inrush current, and DC power. Verify RF transmitter quality and program microcontroller flash memory.

THE TOOLS

- Agilent Technologies: power supply. www.tm.agilent.com.
- Microchip Technology: JTAG device programmer. www.microchip.com.
- National Instruments: PXI chassis, data-acquisition card, digital I/O card, digital multimeter (DMM) card, graphical programming language, test executive. www.ni.com.
- Pickering Interfaces: power switches and RF switches. www.pickeringtest.com.
- Rohde & Schwarz: spectrum analyzer. www.rohde-schwarz.com.
- Spirent Communications: GPS simulator. www.spirentcom.com.
- Virginia Panel: test receiver. www.vpc.com.

PROJECT DESCRIPTION

Axonn, a manufacturer of GPS tracking modules, needed an automated test stand to perform functional test and device programming. System integrator G Systems (www.gsystems.com) developed a system that programs the devices, simulates GPS signals, and performs power and RF measurements (**figure**).

The system uses a board-level fixture for functional testing and a different fixture for testing the satellite transmitter module. A digital I/O card controls relays that apply power to the module. "We begin testing with a DC power test," said Rick Garza, engineering team lead at G Systems. A DMM card measures inrush current, active current, and sleep current. It also checks for shorts and opens.

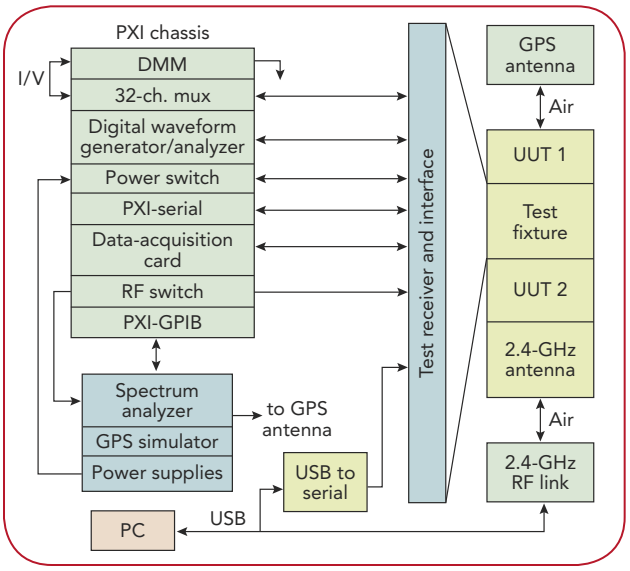
The system applies code to the tracking device's microcontroller so it can communicate over a serial link. The serial link lets the system configure the module and verify that the board works before moving to wireless operation and RF tests. With the module programmed, the tester can set operational parameters and run RF tests. For example, it tests transmitter output power and frequency at 3.5 GHz with the spectrum analyzer.

The tester also runs a series of electromechanical tests. A magnet, placed in proximity to the module, sets its activation bit. To test that function, the tester uses an electromagnet that receives current from a power supply through switches. Another test verifies that the module's programmable alarms function properly.

A 32-channel digital I/O card controls status bits on the module during these tests. A multifunction data-acquisition card provides 16 digital I/O lines for relays that carry power to the module and connect it to the DMM. A power supply simulates a battery and lets the system test for low battery levels. Other digital I/O lines switch the RF signals between the unit under test (UUT) and the GPS simulator and spectrum analyzer. The PXI card's analog I/O channels aren't currently used.

Next, the system programs the module with production code and verifies that the module properly identifies itself and that it receives and sends the correct data.

A solenoid then performs a "thump" test on the UUT, which simulates motion. Upon receiving a bump, the module should update its location from the GPS simulator and transmit its location to its home base. This test also verifies that the module's GPS receiver functions properly. "The GPS simulator test simulates signals from four satellites, which simulates real-world conditions" said Garza. "We adjust the simulator's output power to test receiver sensitivity."



An automated test station simulates GPS signals, measures power consumption, and measures RF power.

LESSONS LEARNED

Garza found that he had to change the sequence of tests from the initial order. Initially, the tester would perform the thump test early in the sequence. But because the board wasn't fully programmed and configured at the time, the vibration from the solenoid would cause a board to reset itself. Moving the test to the end eliminated the unintentional resets. Garza also found that he needed to add relays in series with some of the system's test pins so that only those pins needed for a test would connect to the UUT.—*Martin Rowe, Senior Technical Editor*

BEST in TEST 2008

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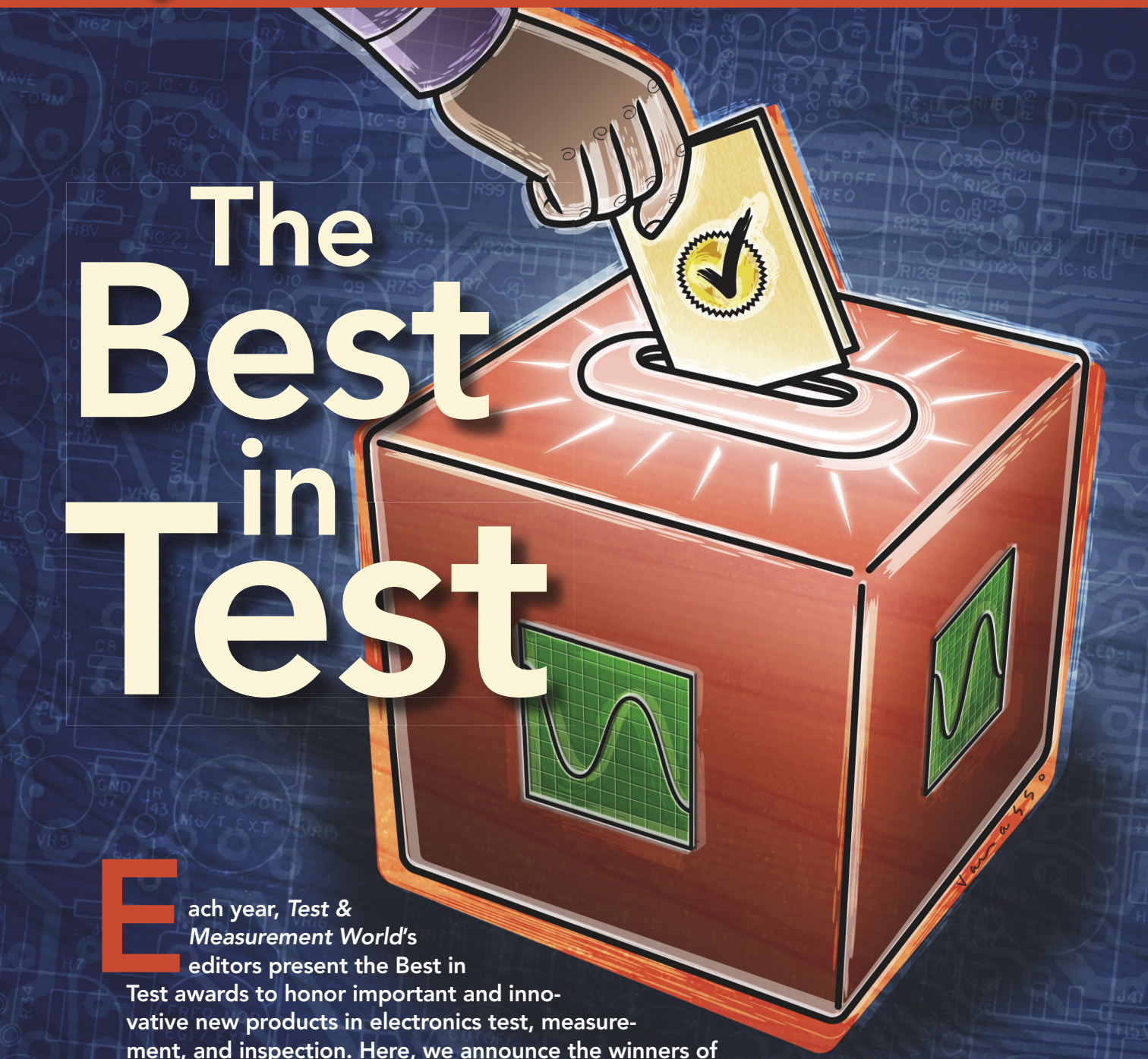


Each year, *Test & Measurement World*'s editors present the Best in Test awards to honor important and innovative new products in electronics test, measurement, and inspection. Here, we announce the winners of the 2008 Best in Test awards and also present 20 products worthy of honorable mention (p. 34). We selected the winners from scores of deserving products, nominated by vendors, that were introduced between November 1, 2006, and October 31, 2007.

You can help determine which of the 12 Best in Test products will become the Test Product of the Year. Visit www.tmworld.com/awards and cast your vote by February 15, 2008. We will announce the winning product on our Website on April 1 and will publish a story about it in our April 2008 issue.

the Test Product of the Year

Deadline: February 15, 2008 WWW.TMWORLD.COM/AWARDS

RF/WIRELESS TEST

CMW270 WiMAX Tester

ROHDE & SCHWARZ, www.rohde-schwarz.com

The R&S CMW270 WiMAX tester ensures maximum throughput in the production of WiMAX chipsets and mobile stations. It combines signal generation and signal analysis in a single box. Three calibrated RF connectors in the RF front end reduce test setup complexity. It generates continuous wave (CW) and orthogonal frequency division multiple access (OFDMA) signals in line with the WiMAX IEEE 802.16e standard for frequency and level calibration. It measures RF power, error-vector magnitude (EVM), adjacent-channel power (ACP), and spectrum flatness; it also includes spectrum mask and I/Q constellation functions.

The tester's nonsignaling mode makes it possible to calibrate the transmitters and receivers of WiMAX mobile stations and to measure the received signal characteristics. A forthcoming signaling mode will support base-station emulation.

MACHINE VISION

Falcon 1.4M100 Area Camera

DALSA, www.dalsa.com

The Falcon 1.4M100 1.4-Mpixel area camera delivers 100 fps at full resolution in a compact body. The Falcon 1.4M100 is suitable for applications in electronics manufacturing and semiconductor inspection that require fast inspection rates and high inspection accuracy.

The camera uses Dalsa's patented CMOS sensor technology to deliver high image quality (57 dB of dynamic range) at high speeds. Programmable via Base mini-Camera Link, the Falcon 1.4M100 incorporates exposure control, windowing, gain and offset adjustment, and flat-field correction. Ease of use is enhanced through direct camera control using Dalsa's CamExpert point-and-click graphical user interface.

Applications include automated optical inspection of electronics, semiconductor wafer inspection, flat-panel display inspection, and general machine vision.

POWER TEST

N6705A DC Power Analyzer

AGILENT TECHNOLOGIES, www.agilent.com

Automatically sequencing power to a board or device often requires engineers to write code for a programmable power supply and then measure voltage and current. The N6705A DC power analyzer combines up to four DC power supplies with digital multimeter (DMM), oscilloscope, arbitrary waveform generator, and datalogger functions. The instrument provides DC power for a UUT and also makes the voltage and current measurements. It can display all channels in oscilloscope or DMM displays on the screen at the same time.

The N6705A accepts up to four modular DC power supplies. Users can configure a power-up sequence using the N6705A's front panel and then save sequences in the instrument for later use.

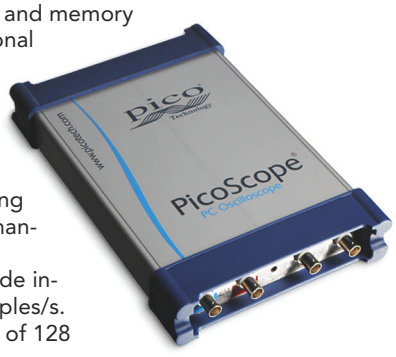
ENRICO VARRASSO

PC-BASED INSTRUMENT

PicoScope 5204 PC Oscilloscope

PICO TECHNOLOGIES, www.picotech.com

The PicoScope 5204 is a USB PC oscilloscope that delivers the bandwidth, sampling, and memory depth of expensive conventional bench oscilloscopes. The instrument provides two channels plus an external trigger, a probe-tip bandwidth of 250 MHz, 8-bit resolution, and a real-time sampling rate of 1 Gsample/s (single channel). For repetitive signals, an equivalent-time-sampling mode increases sampling to 20 Gsamples/s. The 5204 has a record length of 128 Msamples.



The instrument comes with PicoScope 6 oscilloscope software, which lets you use it as an oscilloscope, spectrum analyzer, and meter. It also comes with a carrying case that includes a USB cable, two 250-MHz x1/x10 oscilloscope probes, and a universal power adapter that lets it be used almost anywhere in the world.

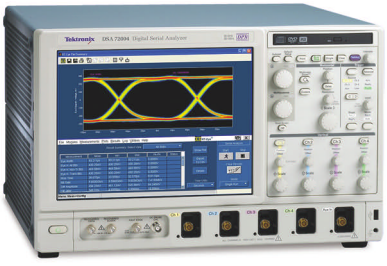
VOTE ONLINE for the Test Product of the Year

OSCILLOSCOPE

DSA70000

TEKTRONIX, www.tektronix.com

The four-channel DSA70000 series digital serial analyzer holds the current bandwidth record of 20 GHz. Models in the series also feature 4-GHz, 6-GHz, 8-GHz, 12.5-GHz, and 16-GHz bandwidths. A user-selectable digital signal processor (DSP) filter lets you reduce the instrument's bandwidth when you don't need the full capacity, thus reducing measurement noise.



The DSA70000 series features 50-Gsamples/s signal capture on four channels simultaneously and a 200-Msample acquisition memory on all four channels. You can use the DSA70000 series to analyze PCI Express, Serial ATA, FB-DIMM, SAS, Fibre Channel, IEEE 1394b, RapidIO, XAUI, HDMI, DVI, Ethernet, and USB 2.0 serial data streams. You can also measure and analyze bit jitter with the instrument's jitter-analysis software.

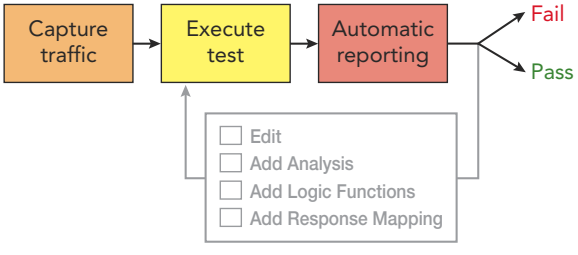
SOFTWARE

iTest Team

THE FANFARE GROUP, www.fanfaregroup.com

iTest Team lets engineering teams automate testing of communications networks, network elements, and test equipment. iTest acts like a test executive for Tcl scripts, letting you develop multithreaded tests. You can use iTest Team to store test sequences and reuse them each time you need to perform regression tests on software or firmware.

Many network elements and test equipment let you control them remotely. iTest Team provides command-line and Web-browser interfaces, plus it provides access to the Windows command line interface (CLI). It lets you capture commands and export them to Tcl. A Tcl shell provides access to Tcl-based programming tools. You can run scripts manually or automatically and use loops and nests to further automate your tests.



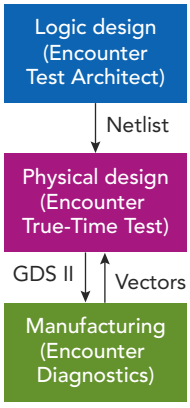
ELECTRONIC DESIGN AUTOMATION

Encounter Test Architect GXL

CADENCE DESIGN SYSTEMS, www.cadence.com

Encounter Test Architect GXL can insert, synthesize, and validate a full-chip, low-power design-for-test (DFT) infrastructure. The software provides for scan insertion using Encounter RTL Compiler's global-synthesis technology. It supports memory built-in self-test (BIST) as well as the inclusion of top-level I/O test structures (including an IEEE 1149.1 boundary-scan controller) and the creation of on-chip compression, allowing a choice of either a multiple-input signature register (MISR) architecture or an exclusive-or (XOR)-based architecture.

Encounter Test Architect GXL automatically uses a designer's power-intent information within the Common Power Format (CPF) to compile and connect all low-power DFT structures into a complete full-chip low-power test infrastructure. In supporting power-aware test, the product employs advanced power-management techniques to limit power consumption during manufacturing test.

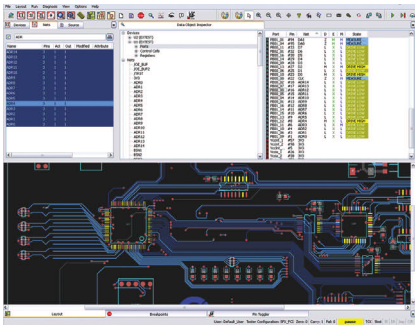


BOUNDARY SCAN

ScanAssist

GOEPEL ELECTRONIC, www.goepel.com

ScanAssist intelligent tools provide for interactive hardware verification in JTAG/boundary-scan applications. The tools enable the activation and analysis of individually defined logic states in real time directly in the target hardware without prior generation of the test program. They accommodate non-boundary-scan logic-device-cluster nets and pins in connectivity tests and automatically identify and prevent the application of potentially unsafe test vectors before execution.



The entire tool set is integrated within Goepel's System Cascon boundary-scan development environment. ScanAssist's interactive Pin-Toggler function, in combination with the Scan Vision III schematic and layout Visualizer, enables net- and pin-specific color coding of logic states and fault states.

SEMICONDUCTOR TEST

Integrated T2000LS/M4841 SOC Test Cell

ADVANTEST, www.advantest.com

Advantest's Integrated High Performance T2000LS Mainframe/M4841 Dynamic Test Handler SOC Test Cell Solution supports parallel testing of 16 high-pin-count consumer devices with throughput of up to 18,500 units per hour.

The OpenStar-compliant and liquid-cooled T2000LS is compact yet flexible enough to test various system-on-chip (SOC) devices. Its 26-slot test head accommodates the instrument modules necessary to test RF, audio, baseband, and data-conversion functions; in addition, the T2000LS can support more than 2000 digital pins.

The M4841 handles a range of packages. It employs technological innovations such as Advantest's Soft Touch handling feature, which uses an electro-pneumatic air-pressure technique to avoid damaging extremely miniaturized parts during touchdown.

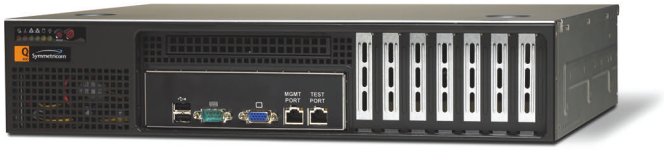
VIDEO TEST

Q-400 IPTV Probe

SYMMETRICOM, www.symmetricom.com

The Q-400 can passively or actively monitor voice and video quality for service providers offering triple-play services. It can assess digital video and voice streams for quality as people perceive it. While monitoring content, the Q-400 detects source quality impairments, encoding/decoding effects, and network-related impairments in unicast or multicast transmissions.

The Q-400 monitors up to 400 standard-definition (SD) or high-definition (HD) IPTV streams and up to 10,000 VoIP streams. It filters content through a human vision system (HVS) model to quantify the impairments caused by packet jitter to video and voice for quality of service measurements.



MILITARY AND AEROSPACE TEST

SMART^E Synthetic Test Environment

AEROFLEX, www.aeroflex.com

The Synthetic Multifunction Adaptable Reconfigurable Test Environment (SMART^E) includes hardware, software, test practices, and support; SMART^E meets the requirements for testing radar, satellite payloads, and T/R (transmit/receive) modules and subsystems for phased-array radar antennas. In this fifth generation, the Aeroflex proprietary synthetic chassis has evolved to accommodate commercial off-the-shelf (COTS) LXI modules; it now supports multiple vendors and multiple industry-standard platforms (including LXI, PXI, cPCI, and GPIB).

SMART^E works with industry-standard software and also features a test library with built-in test-personality customization via user-settable/exposed parameters. It embodies system-level calibration, verification, diagnostics, and test practices without the need to remove and calibrate each individual synthetic module or each separate subsystem.

MULTIMETER

8808A Digital Multimeter

FLUKE, www.fluke.com

The Fluke 8808A 5½-digit multimeter (DMM) provides both the performance and the flexibility required for R&D, development, and service applications. With basic DC accuracy of 0.01%, the 8808A features a dedicated DC low-current leakage measurement capability. Its high-impedance input lets users take current measurements of less than 2000 µA with a resolution of 100 nA without loading the circuit under test. The meter also lets users perform four-wire measurements using only two leads.

The six dedicated setup buttons let you call a complete test procedure. The meter lets you set high/low limits, and it can run pass/fail tests. Setup buttons with the pass/fail test mode provide measurement consistency for manufacturing test applications.

HONORABLE MENTIONS

TestKompress Xpress ATPG tool with embedded compression

MENTOR GRAPHICS, www.mentor.com

Leveraging Mentor's Xpress compactor methodology, the TestKompress automatic test-pattern generation (ATPG) tool provides compression exceeding 100X with no loss in test coverage for advanced process nodes at 65 nm and beyond. TestKompress Xpress achieves this level of compression by providing a more efficient way to handle so-called "X-states"—the unknown states that can arise during manufacturing test. X-states can result in a loss of test coverage if not handled properly and tend to increase the test-pattern size required to test a device thoroughly. TestKompress Xpress permits accurate failure diagnosis from compressed production test results and provides distributed, parallel processing, reducing the time required for pattern generation.

WaveExpert 100H sampling oscilloscope

LECROY, www.lecroy.com

Serving as a complete signal-integrity workstation, the WaveExpert 100H sampling oscilloscope addresses the analysis and compliance requirements of the long serial data patterns required by standards such as second-generation PCI Express, SATA, XAUI, and 10-Gigabit Ethernet. The modular architecture of the WaveExpert 100H accommodates up to four optical or electrical channels with bandwidths of up to 100 GHz, as well as clock recovery and serial pattern generation at up to 13.5 Gbps. The scope also features Eye Doctor, an option that merges the signal and channel responses to accurately measure receiver tolerance and to further view equalized signals as they appear inside the receiver.

NI PXIe modular mixed-signal instrumentation suite

NATIONAL INSTRUMENTS, www.ni.com

Able to sustain high data-streaming rates, this suite of PXI Express modular instrumentation for mixed-signal test applications lets you record signals for analysis and archiving, as well as use both real-world recorded signals and simulated signals for playback. The PXIe portfolio includes the NI PXIe-5122, a 14-bit, 100-Msample/s digitizer; the NI PXIe-6536/7, two digital I/O instruments offering up to 50-MHz clock rates on 32 channels; the NI PXIe-5442, a 16-bit, 100-Msample/s arbitrary waveform generator serving as part of the NI PXIe-5672 RF vector signal generator; and the NI PXIe-5672, which delivers signal generation from 250 kHz to 2.7 GHz with 20 MHz of instantaneous bandwidth.

PT100 Pro concurrent JTAG test platform

INTELLITECH, www.intelllitech.com

Intended for testing printed-circuit boards (PCBs) with processors based on ARM architectures, the PT100 Pro combines mixed-signal test, concurrent IEEE 1149.1 (JTAG) test, and CPU emulation-based functional tests in a single platform that can test up to 32 PCBs at a time. What's more, it comprises a PXI chassis with user-specified PXI instruments, power supplies, and relays, coupled with an open-source Tcl/TK scripting language and a generic fixture interface for compatibility with fixtures from any fixture vendor. The PT100 Pro provides up to 32 JTAG controller ports and up to 1870 analog/digital test pins.

DFT MAX test compression software

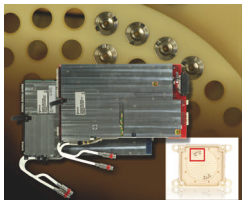
SYNOPSYS, www.synopsys.com

The latest version of DFT MAX delivers push-button test-data compression of up to 100X using adaptive-scan technology to generate an efficient compression architecture that requires very little silicon area. DFT MAX V2007.03 sets up automatic pattern generation through creation of a STIL protocol file. For high defect coverage, DFT MAX allows at-speed testing, tolerating X-states without a loss of test program quality. It also provides design rule checking, including scan, boundary scan, test compression synthesis, integration, and verification capabilities. Flexible configuration of scan channel pairs allows the use of DFT MAX with all available testers.

Port Scale RF cards for SOC test platform

VERIGY, www.verigy.com

Consisting of single-slot cards for the V93000 system-on-chip (SOC) test platform, Port Scale RF delivers the measurement capability required to test emerging 3G, 4G, and high-integration semiconductor devices containing multiple RF radios, mixed-signal circuitry, digital interfaces, power management, and embedded or stacked memory—all with one system. Port Scale RF offers up to eight parallel RF receivers, so four devices can be tested in parallel and two RF ports on each device can be tested concurrently, or up to eight devices can be tested in parallel to maximize throughput and multisite efficiency. Scalable from 12 to 48 RF ports, Port Scale RF comprises one or more RF source card(s), RF front-end card(s), multiband Audio-Video 8 card(s), one RF interface, and one 48-port RF calibration kit.



DL9000 series mixed-signal oscilloscopes

YOKOGAWA ELECTRIC, www.yokogawa.com

To address the increasing complexity of the embedded market, the DL9000 series of mixed-signal oscilloscopes can simultaneously monitor four analog channels and 32 logic inputs, as well as decode two independent serial-bus protocols. The four-model family offers analog frequency bandwidths of 500 MHz and 1 GHz, along with a sampling speed of up to 5 Gsamples/s. For troubleshooting anomalies, you can save captured signals to history memory, which lets you separate individual logic events out of a persisted display. The scopes match sample rate and memory depth between the analog and logic channels, ensuring that signals are correlated and waveform update rate is maintained.

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TEMPpoint temperature-measurement instrument

DATA TRANSLATION, www.datatranslation.com

Available with a USB or an LXI Ethernet port for connecting to a PC, the TEMP stand-alone temperature-measurement box accepts 48 separate thermocouple, voltage, or RTD inputs. Each channel has its own dedicated 24-bit analog-to-digital converter and dedicated cold-junction-compensation circuit to ensure measurement accuracy to within ±0.01%.TEMPpoint provides automatic linearization of B, E, J, K, N, R, S, and T standard thermocouples, while auto-calibration occurs on power-up or by command. To protect signal integrity in harsh environments, TEMPpoint provides 1000 V of channel-to-channel galvanic isolation.

4x4 MIMO RF test system

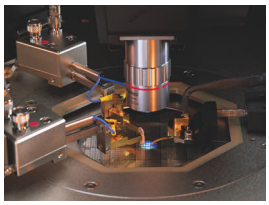
KEITHLEY INSTRUMENTS, www.keithley.com

This multiple-input, multiple-output (MIMO) RF test system offers precise and stable MIMO signal synchronization between any two channels with ±1-ns signal sampler synchronization, less then 1-ns peak-to-peak signal sampler jitter, and less than 1° peak-to-peak RF-carrier phase jitter for R&D and production testing of RF communications equipment and devices. The platform consists of the Model 2920 vector signal generator, Model 2820 vector signal analyzer, Model 2895 MIMO synchronization unit, and Model 280111 WLAN 802.11n MIMO signal-analysis software. You can configure the system into any NxM channel configuration up to 4x4, such as 2x2, 2x3, 2x4, 3x4, and 4x4, or even reconfigure instruments as stand-alone single-input single-output (SISO) instruments.

Tesla power device characterization system

CASCADE MICROTECH, www.cascademicrotech.com

The Tesla measurement system offers an on-wafer solution for over-temperature, low-contact-resistance measurements of power semiconductors up to 60 A and 3000 V over a temperature range of –55°C to +200°C. It also provides triaxial



measurements up to 1100 V. Exclusive chuck technology provides handling for wafers as thin as 100 µm and enables on-wafer measurements for devices up to 75 W. Tesla's high-current parametric probe minimizes thermal runaway at the probe-to-wafer contact, while handling up to 10 A of current in continuous mode and up to 60 A of current in pulsed mode. A high-voltage parametric probe enables breakdown voltage measurements as low as 1 pA at 3000 V.

Pulse Master pulse/pattern generators

TABOR ELECTRONICS, www.taborelec.com

Offering a choice of single-channel and dual-channel configurations, the Pulse Master series of pulse/pattern generators not only provides high-performance pulse-pattern features but also

generates a complete array of standard, arbitrary, sequenced, and modulated waveforms. What's more, it does so in a compact 2U half-rack-sized box. The single-channel PM8571 and dual-channel PM8572 also implement command emulators for both new and discontinued pulse and function generators, providing smooth drop-in replacement for slots vacated by out-of-order instruments from other manufacturers. The Pulse Master units provide 10-ps pulse resolution with 4-ns transition time (3 ns typical).

5000 series portable oscilloscopes

AGILENT TECHNOLOGIES, www.agilent.com

Outfitted with two or four channels, oscilloscopes in the 5000 series combine 1 Mpoint of deep memory with high-resolution waveform acquisition and measurement in a compact, portable package. A fast update rate of up to 100,000 waveforms/s minimizes dead time between acquisitions and helps you find intermittent anomalies. In addition to the real-time update rate, the scopes' MegaZoom III memory and display technology produces a high-definition display with 256 levels of intensity grading, a feature that highlights varying degrees of signal activity. The six-model series offers bandwidths of 100 MHz, 300 MHz, and 500 MHz, as well as USB, LAN, GPIB, and LXI connectivity.

J7000A series random jitter disturbance sources

NOISECOM, www.noisecom.com

The six models in the J7000A series of jitter test systems lets you add random jitter to serial data streams for testing jitter tolerance, clock recovery, and bit-error rate (BER). The instruments inject high-crest-factor Gaussian noise in a way that reflects real-world behavior and enhances digital signal receiver testing by adding precise amounts of white noise to the signal stream, allowing the signal-to-noise ratio (SNR) or carrier-to-noise ratio (CNR) to change to reflect small changes in BER. Noise generators are available in several frequency bands, ranging from 1 MHz to 10 MHz up to 10 MHz to 5 GHz, for testing to such serial data specifications as PCI Express, SATA, and DOCSIS.

XMV12X 10-Gigabit single-blade load module

IXIA, www.ixiacom.com

Running with IxLoad 3.30 converged triple-play test software, the XMV12X 10-Gigabit Ethernet Application & Streams Module is a single-blade load module that emulates line-rate, real-world (stateful) 1-GbE and 10-GbE traffic. Together, the module and software offer a highly scalable, integrated test system that measures the performance of next-generation triple-play networks and devices. You can generate real-

world triple-play traffic that emulates IPTV and triple-play subscribers' network behaviors and associated protocols to ensure subscriber quality of experience. The load module supplies 12 1-GbE ports that can be used individually or aggregated through a 10-GbE port.

PCIe Test Bench compliance tester

SYNTHESYS RESEARCH, www.bertscope.com

The PCIe Test Bench provides the equipment and accessories necessary for performing PCI Express transmitter and receiver physical-layer compliance testing at 2.5-Gtransfers/s and 5-Gtransfers/s rates. Test Bench includes a new model BERTScope signal-integrity analyzer and a BERTScope CRj clock recovery and jitter analyzer. In addition to being able to generate a 5-Gtransfers/s stressed-eye signal using built-in jitter sources, the tester enables the measurement of jitter spectrum to PCIe requirements and allows complete characterization of the 100-MHz clock signal. Test Bench is available with bit rate coverage of up to 7.5 Gbps or optionally 12.5 Gbps.

Halcon 8.0 machine-vision software

MVTEC SOFTWARE, www.mvtec.com

Release 8.0 of Halcon—a standard software library with an integrated development environment for machine-vision applications—provides more than 1300 operators for performing blob analysis, morphology, pattern matching, 1-D measuring, 3-D object recognition, and binocular stereo imaging. With Halcon's 3-D object recognition, industrial robots need only one camera to pick and place. The speed of the library is enhanced by 25%; single operators by up to 500%. The software also features automatic parallelization with multicore processors. Halcon 8.0 works with a wide range of operating systems and provides interfaces for more than 50 frame grabbers and hundreds of industrial cameras, including those with Camera Link, USB 2.0, IEEE 1394, and GigE interfaces.

MSO4000 series mixed-signal oscilloscopes

TEKTRONIX, www.tektronix.com

The MSO4000 family of mixed-signal oscilloscopes offers an all-in-one mixed-signal design validation and debug tool for designers of embedded systems. The series consists of four models with bandwidths of 350 MHz, 500 MHz, and 1 GHz; two or four analog channels; and 16 digital channels. All models have 10 Msamples of waveform memory on all analog and digital channels. The digital channels have a time resolution of 60.6 ps, which corresponds to 16.5 Gsamples/s. You can attain that resolution when you turn on the MagniVu high-resolution signal-acquisition technology, which acquires 10,000 samples centered on the trigger point. Otherwise, you get 500 Msamples/s

Optical Component BER Test System

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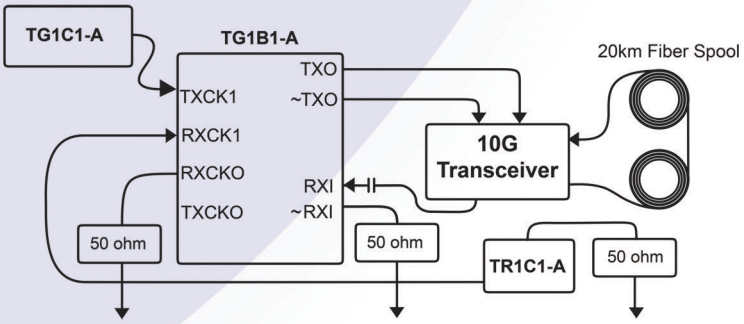

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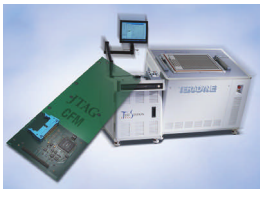
across the entire 10-Msample memory. The MSO4000 scopes feature Tektronix' Wave Inspector waveform search engine and provide comprehensive functions for monitoring, triggering, and decoding parallel and serial buses.

JT 2147 boundary-scan integration module

JTAG TECHNOLOGIES, www.jtag.com

Teamed with the Symphony 228xPLUS boundary-scan controller, the JT 2147 Custom Function Module (CFM) brings boundary-scan testing and in-system programming to Teradyne in-circuit testers. The JT 2147 CFM is specifically designed for use with Teradyne's ICT Custom Function Board (CFB) and simply plugs into a socket on the CFB. The module provides a means of incorporating a boundary-scan Test Access Port (TAP) pod into the in-circuit test system. Two CFMs can be installed on the CFB, which provides ground isolation and also contains a switching matrix to route TAP signals to pins on the test fixture.



GX1034 3U PXI standards module

GEOTEST-MARVIN TEST SYSTEMS, www.geotestinc.com

The GX1034, a 3U PXI standards module, gives PXI system designers and developers an in-system accuracy verification strategy that can recertify a system's source and measure baseband instrumentation without relying on external transfer standards. The GX1034 provides a DC voltage source reference, an AC voltage source reference, eight low-drift resistor references, and a precision 10-MHz frequency reference. An onboard EEPROM ensures standards traceability and accuracy. By incorporating this module as part of an overall system-certification strategy, you can improve logistics for recertifying test systems, enhance integration and make better use of existing test software infrastructure, and lower total costs associated with test system maintenance and support.

Medalist x6000 automated x-ray inspection system

AGILENT TECHNOLOGIES, www.agilent.com

A 3-D inline automated x-ray inspection system, the Medalist x6000 more than doubles the throughput of other systems, while making use of full 3-D capability to find soldering defects common in printed-circuit-board assemblies (PCBAs). The Medalist x6000 not only reduces the number of systems required to meet manufacturing volumes by cutting in half the required capital expenditures, but it also enables complete 3-D inspection of the entire PCBA at inline speeds. In addition, the system uses a development environment that incorporates several automatic test-development features, helping new users create high-quality, high-coverage programs in less time than previously required. T&MW

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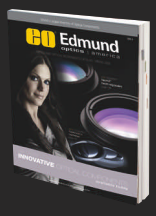

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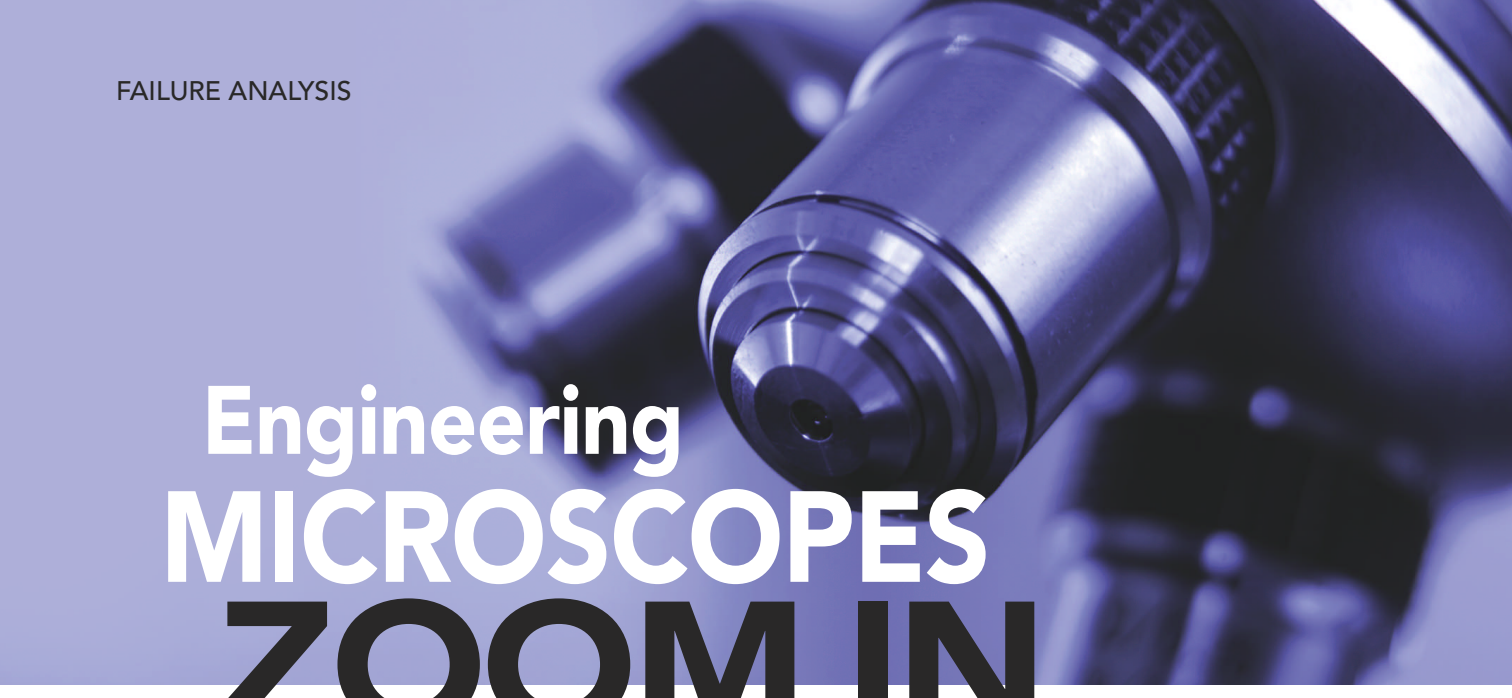


Engineering MICROSCOPES ZOOM IN ON DEFECTS

NEW TECHNIQUES ENABLE MANUFACTURERS TO PERFORM THEIR OWN IMAGING AND ANALYSIS TASKS.

BY ALEX MENDELSOHN, CONTRIBUTING TECHNICAL EDITOR

Ever since 17th century scientist Anton van Leeuwenhoek peered at microbes through a crude optical microscope, the quest for higher performance has been relentless. Just as Leeuwenhoek's microscope impacted the science of his day, today's microscopy systems affect the way engineers develop and test semiconductors and materials as well as technologies such as microelectromechanical systems (MEMS).

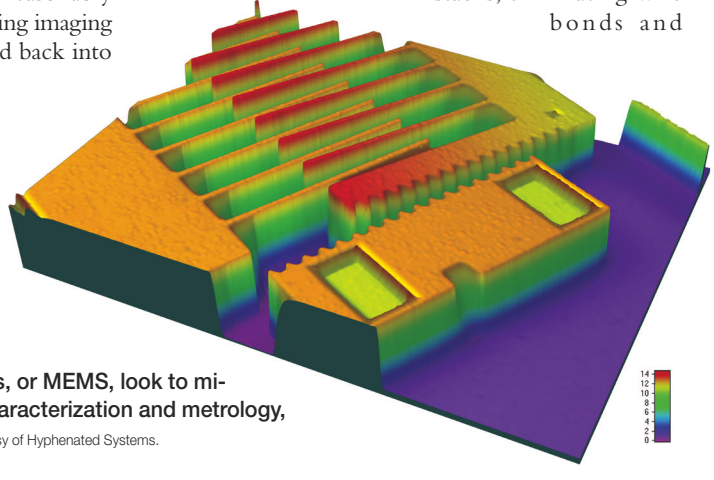
Both destructive and nondestructive microscopy tools now complement and surpass the scanning electron microscope (SEM), an iconic fixture of the well-equipped lab. Newer-generation instruments, some reasonably priced and remarkably user friendly, are moving imaging and analysis tasks that were once outsourced back into the manufacturing environment.

Measure and observe

As semiconductors, electro-optic, and related devices benefit from smaller feature sizes and new materials (such as silicon-germanium, SiGe), more is demanded from microscopes. The ability to measure as well as observe becomes significant.

"3-D imaging is especially critical," explained Terence Lundy, VP and managing director at Hyphenated Systems, a manufacturer of microscopes for wafer-fabrication applications. "Combining 3-D with metrology lets you look at and measure the dimensions of semiconductor features such as trenches and through-silicon vias [TSVs] while measuring attributes like surface edges and roughness."

TSVs are created during wafer fabrication or during subsequent assembly and packaging. TSVs provide the interconnects for die-to-die and wafer-to-wafer stacks, eliminating wire bonds and



Makers of microelectromechanical systems, or MEMS, look to microscopes that can handle 3-D physical characterization and metrology, along with deep-submicron precision. Courtesy of Hyphenated Systems.

resulting in highly dense, small form-factor devices.

To enable engineers to see nanotechnologies such as TSVs, Hyphenated's hybrid HS Series NanoScale Optical Profilers combine conventional white-light optical techniques with a patent-pending approach dubbed Advanced Confocal Microscopy (ACM). ACM, as an open architecture, also supports enhancements.

ACM permits observation of sloped or rough surfaces, buried interfaces in transparent materials, and high-aspect ratio features found in MEMS, ink jets, digital light processors, and electrical test probe cards. Software provides a control interface for the imaging, metrology, and automation functions. In addition, measurement routines extract critical dimensions.

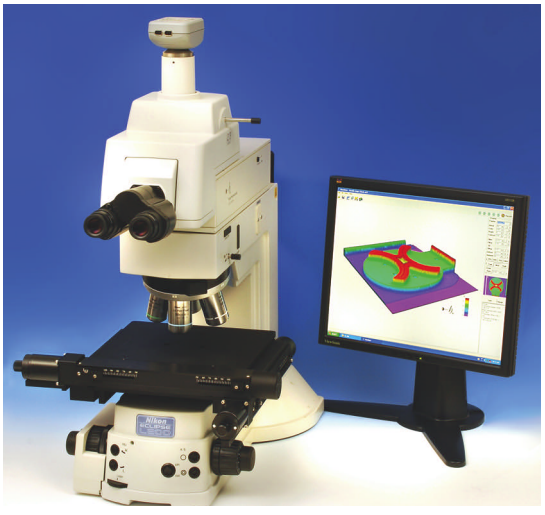
If need be, ACM can meld an atomic force microscope (AFM), spectroscopy, and interferometry, combining these to meet not only imaging and measurement needs but also analysis requirements. Hyphenated's systems range in price from about $75,000 to about $250,000.

Lundy pointed to stacked-multichip technologies as an emerging application for ACM. "IC companies are taking 3-D packaging and interconnect seriously," he said. "Some chip designers are even using hollow TSVs. Air or gas pumped through these flow holes cools the innards of a stack."

In the past, 3-D microscopy may have required a combination of interferometry, SEMs, and AFMs. Unfortunately, a host of inherent disadvantages precluded the use of these technologies on stacked-chip packaging. SEMs, for one, required destructive breaking of devices under test (DUTs), and interferometry required sample DUTs to be perfectly flat.

"In 3-D chip packaging, perfectly flat surfaces don't exist," said Lundy. "In fact, some surfaces are intentionally placed at angles. The limited ability to probe beyond certain depths, and the inability to peer through layers, is a roadblock to 3-D chip observation using interferometry."

Likewise, AFMs, which actually touch DUT samples, can't get inside 3-D structures. "You can see surfaces well enough," said Lundy, "but not structures below the surface."



The HS Series NanoScale Optical Profiler combines 3-D imaging and metrology. Software acquires and renders detailed 3-D models of samples in a matter of seconds, with deep-submicron lateral resolution and near-nanometer vertical resolution. Courtesy of Hyphenated Systems.

In contrast, confocal microscopes require no sample preparation and no tipping or tilting of DUTs, and they can be used through transparent media such as glass. Hyphenated Systems' instruments combine ACM profiling with off-the-shelf Nikon white-light inspection microscopes. The mix ensures z-axis resolution down to 5 nm. Moreover, unlike microscopes that generate ion or electron beams, the company's instruments don't require samples to be placed in tricky vacuum chambers.

"The 5-nm resolution is beyond the wildest dreams of most IC makers," claimed Lundy. "Folks who used to use a SEM or AFM can now use ACM and avoid long preparation times and destructive testing."

Hyphenated Systems' microscopes employing ACM also make measurements from a single optical axis. When the need arises to make subsequent measurements, on-chip x-y coordinates can be accurately relocated.

Inspecting probe marks

In addition to providing 3-D images of ICs, the latest microscopy tools enable engineers to inspect for damage caused by wafer probes, including damage caused by the ultra-small probe tips and cards required for thinner semiconductor materials and ultra-small bonding pads. As chip density skyrockets, wafer probing requires more touch downs. If the pins that touch down on a pad are not coplanar, the probe tips can dig into surface material, damaging the pad or punching through to other layers.

Although a ball can be bonded to a damaged pad, downstream failures are likely to occur after a period of time. "Walking wounded chips can fail after some months," said Lundy, "with balls breaking away from the pads. In an end product, this is disastrous."

Probe marking is also an issue. Probe marks result from physical contact between probe tips and pads, and they're fairly common. But excessive marking diminishes yield and device reliability. As with punch through, large or deep marks or misplaced probe marks can result in poor adhesion with wire bonds, especially in high-density multichip packages.

Supporting development of next-generation products, FEI's desktop-sized Phenom microscope spans millimeters to the nanoscale. Courtesy of FEI.

Some bonding pad layers and posts can also shed material during probing, resulting in conductive particulate contamination. IC makers want to be able to see these potential defects prior to sawing a wafer into dice.

(continued)

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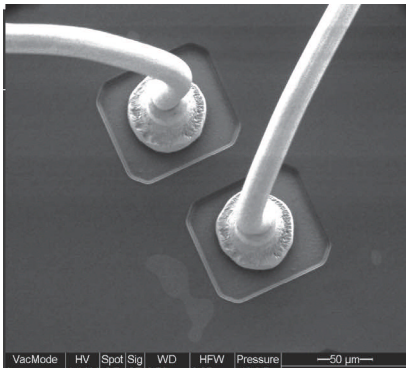
SEMs and AFMs are usually used to inspect for punch through and probe marking, but observation can take hours or even days. That's not optimum for wafer fabs cranking out ICs round-the-clock. "Chip makers want closed-loop metrology," said Lundy. "People want to do trend analysis on-the-fly, with millions of touch downs in probing." ACM supports such analysis.

Making and breaking connections

In addition to performing failure analysis and device characterization, some microscopes offer features that help concurrent development cycles. Focused ion beam (FIB) products from FEI, for example, provide an interactive technique the company calls V600 Circuit Edit.

Circuit Edit lets you identify and correct problems at the nanoscale on a component by breaking and making electrical connections. It can actually produce functional prototypes to allow manufacturers to perform validation for product development in parallel with the production of corrected masks for 65-nm devices and smaller.

Six FIB microscopy products in FEI's product line now embody the Circuit Edit feature. Peter Carleson, product marketing manager at the company, explained that these units offer a range of resolution capabilities. The firm's Expida 1255S wafer DualBeam, intended for failure analysis, combines wafer-level scanning/transmission electron microscope (STEM) sample preparation with high-resolution FIB imaging and analysis.



Depth of field is significant where there's considerable variation in z-height. This image of pads and wire bonds shows how a large depth of field keeps the entire image in focus. Courtesy of FEI.

These multi-technology instruments use focused ions to drill holes in samples, with a typical hole measuring about 10x10 microns. The tool can delve inside the holes with an electron beam to inspect deep layers for shorts and opens. The locations and addresses of the failures are derived from automated test equipment (ATE) test vectors.

"You can cut a cross section with the ion beam and watch with the electron beam at the same time, to localize defects," explained Carleson. "SEMs also use shorter wavelength beams than visible light systems, so resolution is higher."

Another benefit is improved depth of field. "Optical microscopes have a depth of field on the order of a few microns, but SEMs and ion beams have 10-micron to 50-micron depths of field," noted Carleson. Depth of field is significant when inspecting MEMS devices, where there's a considerable variation in z-height. Multi-technology scopes let you see an entire sample with everything in focus at the same time.

If higher resolution is needed, ion-beam microscopes can also slice samples. Typically, a 50-nm-thick slice is placed inside a transmission electron microscope (TEM). Working much like a slide projector, the TEM then dishes up an image with atomic-level resolution.

Finally, an instrument like FEI's Expida 1255S wafer DualBeam can also be used for electrical probing. "This is a fast-growing application area," concurred Carleson.

Bridging the gap

Spreading the adoption of engineering microscopy, FEI's desktop-sized Phenom microscope lays claim to bridging the

DUT excitation for failure analysis

Failure analysis often requires that the device being investigated be powered up and running in order that failure-analysis engineers can obtain meaningful information. That typically has meant that failure-analysis teams must maneuver a big-iron tester near their investigative tools, developing complex fixturing that enables study of the device while allowing it to be connected to the bulky test head of an ATE system.

Hamamatsu Photonics, however, has discovered an alternative to big ATE—a Teseda V-series design for test (DFT) desktop test platform. The laptop-sized tester fits within Hamamatsu's Phemos 1000 emission microscope (**figure**). The tester can control the DUT, while Teseda debug software assists with the failure-analysis process.

ST Microelectronics is one company that has deployed the Phemos-1000 with the integrated Teseda platform. Larry Tullos, ST's director of reliability, reports that the combination has reduced his engineering team's dependence on expensive ATE and has enabled the company to increase its production capacity.—*Rick Nelson, Chief Editor*

Teseda's laptop-sized tester fits easily within Hamamatsu's Phemos 1000 emission microscope.
Courtesy of Teseda.

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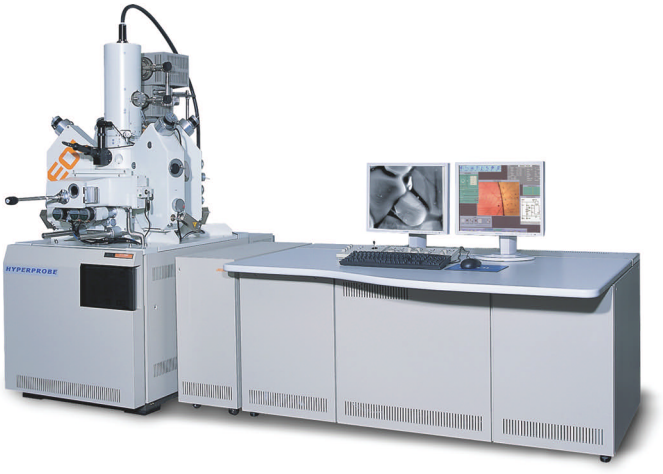
gap between optical microscopes and SEMs. Unlike Hyphenated's ACM that is used for 3-D characterization and metrology of probe marks, probes, and vias, the Phenom is aimed primarily at quality-control applications.

"It's a back-end tool," said Carleson, "letting you prepare samples for other microscopy techniques." Operated by means of a touch screen, a Phenom provides magnification from 10X up to 20,000X (about 20 times higher than optical microscopes).

The product also incorporates an optical camera, which is used for so-called "never-lost" navigation, as well as an electron microscope. Samples are loaded using an automated vacuum technique that sidesteps cumbersome vacuum chambers. External vibration isolation isn't needed, and samples can be loaded in less than 30 s.

Weighing in at just over 120 lbs, a Phenom also provides 12X digital zoom, delivering image resolution as high as 2k-by-2k pixels. Images are saved on USB memory sticks.



JEOL USA recently completed installation and acceptance of its first thermal field emission electron microprobe in the US. Installed at NIST, it is used for developing standards for a range of nanotechnologies.
Courtesy of JEOL USA.

FEI expects the Phenom's SEM-like performance will appeal to shops that can't afford $250,000 or more for a SEM, to say nothing of the cost of specially trained SEM operating personnel and dedicated facilities. A $72,000 Phenom microscope can be used to inspect for packaging defects such as interconnect and whiskering failures.

"These types of faults are microscopic, but you don't necessarily require SEM resolution and magnification to see them," said Carleson. "In many applications, a Phenom can complement a SEM."

Manufacturing precision

Moving beyond SEM technology, at least one charged-particle manufacturer is moving into helium-ion beam microscopy. "There's a paradigm shift in IC

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manufacturing," explained Dr. Dirk Stenkamp, an executive member of the board at Carl Zeiss SMT. "Microscopes must keep pace."

Material advancements and tighter process control is pushing the need for measurements with higher precision in manufacturing, said Stenkamp. "Nowadays, materials are critical factors in IC manufacturing."

Complex materials such as SiGe, high- and low-K dielectrics, and new metals for interconnects demand new types of tools. That's where classical techniques such as SEM run out of steam.

The Zeiss Orion microscope uses a stream of helium ions rather than electrons to generate signals. Helium-ion microscopy offers spatial resolution of 0.2 nm. Courtesy of Carl Zeiss SMT.

Zeiss's Orion microscope is billed by Stenkamp as a breakthrough. Priced at about $1 million, it is now in operation at the National Institute of Standards and Technology (NIST).

Orion microscopes use a stream of helium ions rather than electrons to generate signals. These instruments, able to observe features smaller than a micron, are useful for failure analysis, critical dimensional measurement, defect review, and material identification.

Helium-ion microscopy promises to improve spatial resolution, too. SEM resolution is between 1.5 nm and 2 nm, but helium-ion microscopy achieves 0.2-nm resolution, about an order of magnitude better. "The tool nicely bridges the gap between SEMs and TEMs," said Stenkamp. "It also bridges the gap to the 0.2-nm resolution regime of the TEM."

Stenkamp also pointed to helium-ion microscopy's ability to use back-scattered ions to generate contrast features unobtainable with SEMs. "It lets you clearly see different types of materials in a sample. Helium-ion microscopy also provides a depth of field that's also about an order of magnitude greater than a SEM."

Analyzing nanometric samples

Thermal field emission (FE) electron probe microanalyzers (EPMAs) go even further. JEOL USA's EPMAs combine SEM resolution with x-ray analysis. Priced under $1 million, JEOL's JXA-8500F model uses an in-lens Schottky FE electron gun to provide high probe currents. That results in probe diameters that are a tenth the size of conventional probes. Like Zeiss's Orion microscope, JEOL's product is currently being track tested by NIST for failure analysis and quality-control applications, not just for R&D.

The EPMA's wavelength-dispersive x-ray spectrometer (WDS) is capable of image magnification from 40X to 300,000X. What's more, no ultra-high vacuum chamber is required.

"As dimensions shrink," explained JEOL VP and product manager Charlie Nielsen, "electron-beam penetration must be reduced, and that's where lower voltage systems come into play." He noted that high-voltage predecessor microscopes typically required sample sizes on the order of a cubic micron, but EPMAs can work with samples only 100 nm in size.

JEOL's nondestructive microscope can simultaneously deploy a spectrometer and up to five WDSs. "Vendors working with nanotechnologies, such as MEMS materials and thin films for hard disk pads, can use this technology to migrate microscopy out of the R&D lab, moving it into the realm of quality control," said Nielsen. T&MW

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Fiber-optic power meters let engineers test active and passive components for light levels, insertion loss, and other parameters that can produce bit errors.

OPTICAL POWER MEASUREMENTS *ensure quality bits*

BY MARTIN ROWE, SENIOR TECHNICAL EDITOR

Fiber-optic (FO) power meters have become a workhorse for testing active and passive electro-optic components in engineering and in production. Active components include light sources such as laser diodes, pumps, and amplifiers. Passive components include splitters, combiners, connectors, reconfigurable optical add-drop multiplexers (ROADMs), and the fiber itself. You can also use an FO power meter as part of a system to test optical receivers.

For absolute measurements, such as those made on a light source, you can configure an FO power meter for measurements in watts, milliwatts, or decibels referred to 1 mW (dBm). You can also get results in decibels for relative measurements, such as insertion-loss measurements on passive components.

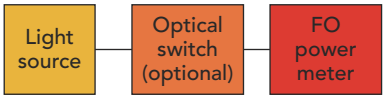


FIGURE 1. An FO power meter measures the power from a light source.

FO power meters come in several configurations. They include stand-alone bench meters, modular systems (chassis and modules), and handheld units. Engineers use bench and modular instruments in the lab and in production, while technicians use handheld FO power meters for installation and maintenance. The online version of this article includes a detailed product chart of bench and modular instruments as well as links to technical resources, www.tmworld.com/2007_12.

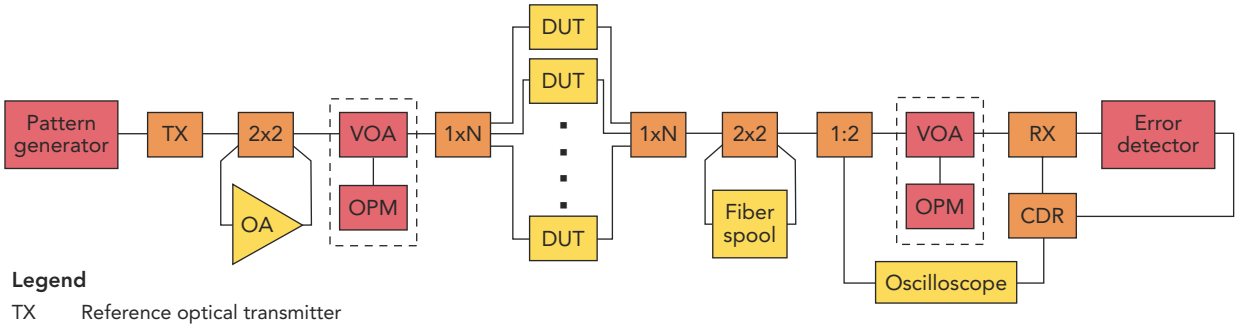
Active power

Laser sources must provide light powerful enough to overcome losses in fibers, connectors, splitters, waveguides, and numerous other components. Engineers use power measurements to monitor the production process for semiconductor-based light sources such as laser diodes.

"You can use light-current-voltage (LIV) measurements to monitor processes from die to package and look for changes," said Thad Orosz, product manager at ILX Lightwave. Early detection of process problems can alert process engineers to problems before a device is packaged. You can perform power measurements using continuous-wave or pulsed signal sources (Ref. 1).

Figure 1 shows a typical test setup for measuring power from a light source. In this setup, an FO power meter measures a light source's output power directly, although you can use an optical switch for testing multiple light sources with one meter.

Figure 2 shows a more complex system that tests multiple FO transponders (transmitter/receiver pairs). It combines two FO power meters with other instruments, optical switches, attenuators, and splitters. The optical amplifier (OA) and attenuators vary the optical power and noise, and the fiber spool attenuates and



Legend

TX	Reference optical transmitter
2x2	2x2 optical switch
OA	Optical amplifier
VOA	Variable optical attenuator
OPM	Optical (FO) power meter
1xN	1xN optical switch
1:2	50/50 splitter
RX	Reference optical receiver
CDR	Clock and data recovery unit

FIGURE 2. A test system for an optical transmitter may consist of several instruments, switches, splitters, and multiplexers. Courtesy of JDSU.

adds dispersion to the signal before it reaches the receiver. The test system measures bit-error rate (BER) while it monitors the optical power with the meters and monitors the eye diagrams with an oscilloscope.

Passive light

Many engineers use FO power meters to make measurements on passive components such as connectors, splitters, couplers, switches, filters, waveguides, and ROADMs. Insertion loss (IL) is the most common measurement. Other measurements include isolation, wavelength-dependent loss (WDL), and polarization-dependent loss (PDL).

An IL test is simple. You measure optical power from a calibrated light source such as a tunable laser without the device under test (DUT) in the circuit, then you insert the DUT and measure power again. Then, the FO power meter can calculate the difference and report it in decibels with the equation below.

$$\textit{Insertion loss (IL)} = 10 \star \log(P_{in}/P_{out})$$

WDL is essentially IL measured across a span of wavelengths. You can perform a WDL measurement on any component, but it's a critical measurement for optical filters and ROADMs, which are designed to filter light based on wavelength. A ROADM, for example, is essentially a tunable notch filter that can drop a specific wavelength from a wavelength-division multiplexed (WDM) signal.

Lighted connections

Regardless of whether you measure optical power in active or passive components, you need to connect your DUT to an FO power meter. Connecting a light source to an FO power meter (whether or not through an optical switch) is called direct coupling. In this case, the fiber carrying light from the DUT goes directly into the power meter or power-meter head and is held in place by a connector (**Figure 3**). Many types of connectors are in use today, so make sure your FO power meter or its optical head will accept the connector you use.

For high-power measurements, typically over 100 mW (20 dBm), you can use an integrating sphere to collect the input light and integrate it into a uniform intensity. A photodetector built into the sphere collects a small portion of the light for measurement in the form of a small electrical current.

An integrating sphere has a highly reflective inner surface to reflect the incoming light, producing uniform light intensity. A detector, mounted on the sphere, contains a photodiode. Typically, integrating spheres are external to an FO power meter, but some manufacturers embed the sphere in the instrument.

FIGURE 3. Fibers can connect directly to FO power meters and FO test heads. Courtesy of ILX Lightwave.

"Integrating spheres are immune to light angles of entering fibers," said Michael Kelly application specialist at Agilent Technologies. That's because the sphere's reflective inner surface produces light of equal intensity throughout the sphere.

If you don't use an integrating sphere, then you must take care to properly align fibers to your power meter. "Ninety-five percent of fiber used today is single-mode fiber," commented Michael Minneman, president of dBm optics, and polarization isn't controlled and is thus random. Polarization loss can lead to measurement errors. *(continued)*

ON TMWorld.com

Product-comparison chart:

FIBER-OPTIC POWER METERS

The online version of this article links to a chart of currently available FO power meters in modular, bench, and mainframe formats. Compiled by our editors, the chart lists manufacturers and model numbers and highlights key features such as wavelength, power range, sensor type, and uncertainty for each instrument.

RESOURCES

The online version of this article also links to additional sources of information about FO power meters and their applications. Included are articles from *Test & Measurement World* as well as online application notes.

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Other sources of measurement error include temperature, WDL, spectral ripple, and noise. Agilent's Kelly explained that spectral ripple occurs from reflected light that returns to a fiber or its cladding, which can add or subtract from incident light. Noise is also an error source at low power levels, and FO power meters must measure the "dark" current of a light detector.

Calibration tool

Telecom test sets and telecom equipment such as switches, amplifiers, and attenuators often contain embedded power meters that require calibration. "Many FO attenuators, amplifiers, and switches monitor their own output power," said Matthew Adams, product line manager for JDSU's test and measurement business. "Embedded power meters require calibration."

For example, Polatis manufactures optical switches that have embedded attenuators and power meters, letting the user set the switching path and output power (Ref 2). The company uses reference FO power meters to calibrate the embedded power meters.

Daniel Shi, a staff test engineer at Coherent, uses power meters to calibrate production-test stations for diode lasers. The test stations use integrating spheres with photodiodes to convert light into current. A data-acquisition card digitizes the current, and a computer displays the measurements. Shi calibrates the system by comparing the station's reading to that of known-good power meters. He then enters calibration constants into the production systems prior to use.

Single-unit and modular FO power meters appear on many engineering benches and in production test systems. They measure the optical output power of active components and they perform relative measurements such as IL. They're also used to calculate other parameters such as BER as a function of signal power. T&MW

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FPGAs IMPROVE VISION PROCESSING

As higher-resolution cameras and faster frame rates push data rates beyond the processing capabilities of many host PCs, acceleration hardware can make up the shortfall.

BY KUMARA RATNAYAKE, DALSA

Machine-vision systems have taken advantage of host PC computing capabilities to handle image processing. Today's applications, however, are pushing the envelope of what a host processor can accomplish as data rates increase and host-processor performance reaches hard limits.

Data rates in vision systems have increased significantly as a result of image sizes that extend beyond 16 Mpixels (4 kpixels x 4 kpixels) and frame rates that reach 1000 fps for high-speed motion capture. Even at the modest 30 fps of standard video, the higher-resolution images yield typical system data rates of nearly 500 Mpixels/s. Simple 8-bit monochrome systems feature a data rate of half a gigabit per second, and color systems, which typically use 24 to 48 bits per pixel (3 to 6 bytes), have a data rate that quickly reaches the multi-gigabits-per-second range.

Such rates stretch host PC performance well past the breaking point. CPU clock speeds are topping out at 5 GHz due to power concerns, and only a portion of total processing power is available for vision tasks, because the host PC must also run the operating system and other applications software.

The mismatch between rising data rates and host PC performance limits points to a need for system acceleration. Switching to a high-performance bus such as PCI Express eliminates one bottleneck, but the processor's limits are not so readily overcome. Even with the highest-performing CPUs, a host PC can only handle relatively simple image-processing functions in real time, and even those need to be at the lower end of the data rate range.

One way to accelerate a vision system and overcome the limitations of CPUs is to employ machine-vision hardware that makes use of field-programmable gate arrays (FPGAs). Many FPGAs also offer the added benefit of flexibility: Because you can reprogram them, you can use a single vision system for multiple applications.

Fixed designs not cost-effective

Each inspection application dictates how much computational power, I/O bandwidth, latency, and determinism a machine-vision system will need. Designing a system to handle only a single application is typically not cost-effective (see "Flexibility for computation and I/O," p. 62).

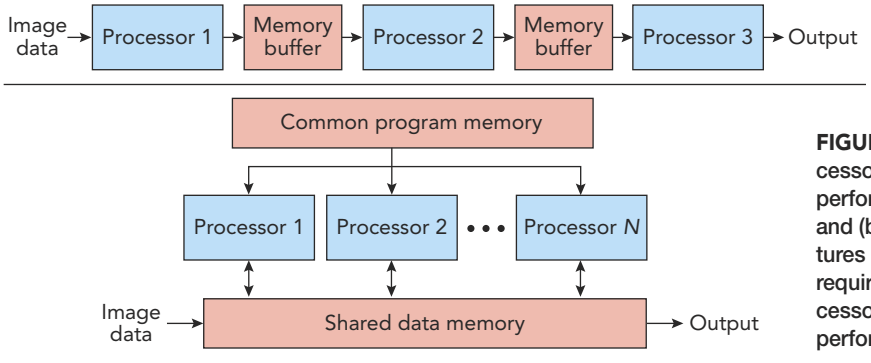

FIGURE 1. Using multiple processors can help boost system performance, but (top) cascaded and (bottom) parallel architectures address different system requirements, and increasing processor count may not increase performance proportionally.

A system capable of handling many different applications will have a larger market, resulting in lower production costs. In addition, the generalized system is easier and less expensive for users to adapt to changing requirements.

When building a vision system, therefore, developers need to keep the design flexible while boosting computational power and I/O bandwidth and controlling latency and determinism. The commonly available choices are to use faster clocks, to switch to a digital signal processor (DSP) architecture, or to use multicore or multiple processors in one of several architectures.

Each of these options has drawbacks. The single-processor approaches, even using a DSP architecture, still face fundamental performance limitations. Processors are also limited by their sequential nature. Only by increasing clock speed can such sequential operations be made faster, but increasing clock speed also increases the power consumption of the logic.

The single processor must also share its capability among several tasks, including running the operating system. While the image-processing tasks may follow a schedule, other system tasks may not. Thus, the need to share processing capability among multiple unscheduled tasks compromises the determinism of image-processing task execution. The need for sharing also applies to the processor's I/O bus, which must handle all of a processor's peripherals and memory access. Sharing of the bus limits the processor design's I/O bandwidth.

A multicore or multiple-processor approach—dedicating one or more processors to the imaging tasks alone—can minimize some of these drawbacks. Possible multiprocessor architectures include cascaded and parallel structures (**Figure 1**).

In a cascaded approach, each processor in a series handles a portion of the imaging task, then passes the results to the next processor. Memory buffers between processors help accommodate the timing differences for each step. This approach can be extended to achieve the computational speeds required, but each extension adds cost and latency to a system.

A parallel-processing implementation separates image data into blocks, processing each block in the same way in its own processor. This approach is limited by cost and board space but in theory can be extended as far as one processor per pixel. While such an approach helps minimize latency, it is not suitable for functions such as feature extraction, for instance, which are extremely difficult to implement with this kind of block-level parallelism.

Acceleration outperforms multiprocessing

Even with the benefits gained by using multiple processors, a system's performance is still limited by the sequential nature of processors. An *N*-fold increase in processor count yields no more than an *N*-fold increase in performance—in fact, the performance increase is often less because of the overhead required for coordinating processor operations. An alternative approach is to combine the host processor with a coprocessor that uses dedicated parallel logic rather than sequential code execution. Such a processing accelerator can provide substantially greater computational performance increases than conventional processors.

One way of creating dedicated coprocessing logic is to develop a custom ASIC. A common example of a coprocessing ASIC is the discrete cosine transform (DCT), which is used to speed system operation in image-compression applications.

Dedicated logic designs can offer substantial performance improvements over processors. Execution of a 5x5 convolution, for instance, can be implemented using 25 multiply-and-accumulate (MAC) structures in parallel, producing a full result after each clock cycle rather than requiring several clock cycles for each step. As a result of this parallelism, the clock speeds needed to achieve a given performance level are substantially less than for processors, with a corresponding reduction in heat generation. The dedicated nature of the logic also ensures that the results are deterministic, and by not having to manage external peripherals to achieve its functions, the ASIC's pins can be dedicated to providing high I/O bandwidth where needed.

What ASICs gain in performance, however, they lose in flexibility. Because their logic is fixed, they are not readily adapted to new requirements. The creation of additional ASIC designs is not practical because of cost. Development of an ASIC, even a derivative one, can require more than a year of design time and hundreds of thousands to millions of dollars in production startup costs.

Despite having some drawbacks, FPGAs offer a cost-effective and flexible alternative to creating custom logic. In terms of performance, FPGAs are typically slower than comparable ASICs, and they also face restrictions in the amount of logic they can embody. While ASICs can be as large as needed to achieve their function, FPGAs typically are available only in set sizes. A design either fits in a given FPGA or it doesn't, and FPGAs typically have much smaller logic capacity than ASICs of the same die area. In the past, such limitations severely reduced the applicability of FPGAs to machine vision.

But recent technology improvements have substantially reduced these limitations. One improvement has been in process technology. Through 65-nm process lithography, newer FPGAs offer greatly increased speed and logic capacity. The equivalent of several million logic gates and clock speeds of several hundred megahertz are now available. *(continued)*

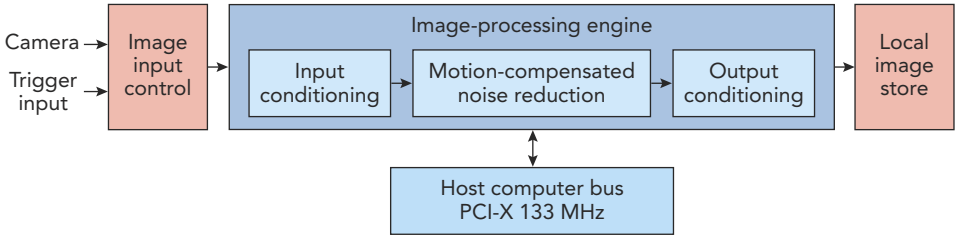

FIGURE 2. Coprocessing offers a variety of benefits, some of which depend on its location in the system, as the XRI-1200 three-stage design demonstrates.

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Another improvement has been the introduction of hard logic cores into the FPGA device. Hard cores, such as DSP blocks and double data rate (DDR) memory interfaces, carry the full performance advantages of ASIC designs, while the surrounding programmable fabric provides design flexibility.

Flexibility a hallmark of FPGA coprocessing

One of the main advantages of the FPGA is that its function is readily changed. Many FPGAs are even reprogrammable in-circuit, giving FPGA-based designs virtually the same degree of flexibility that processors provide, with none of the limitations.

An FPGA-based machine-vision system can be adapted by developers to handle many applications, which means a single hardware design can service many markets. The field programmability of such designs allows customers to customize and adapt a system without installing new hardware. When FPGAs that can be programmed in-circuit are used, machine-vision systems can switch tasks and still offer accelerated performance simply by being loaded with a new logic program.

Thus, the dedicated logic coprocessor can provide the increased computing power, increased I/O bandwidth, and controlled determinism and latency that machine-vision systems require. Implemented in an FPGA, the coprocessor can also offer the design flexibility needed for providing high functionality at low cost. The key to realizing this potential lies in proper application of the technology.

To begin, developers need to analyze the image-processing algorithms they need to execute, looking for parallelism to exploit. The structures for implementing these parallel tasks can then be implemented in the FPGA hardware. That hardware should include significant amounts of memory for buffering image data. Both SRAM-like memory for random access and DRAM memory for streaming and burst access should be made available to the FPGA using dedicated memory interfaces.

Another step in applying the FPGA is to determine the best location within the system for the acceleration to take place. Where latency is a prime concern in an application, the acceleration element should be positioned closer to the camera where it can work directly with raw pixel data as the data is produced. By the time a full image frame has been captured, it has already been processed.

When latency is not as important, and in highly compute-intensive functions, positioning the accelerator in the frame grabber is more appropriate. Whereas resources such as electrical power and physical space are limited in the camera, the frame grabber is able to accommodate much larger designs. In addition, a frame grabber offers more memory and greater mass storage than a camera.

Using multiple FPGAs

Sometimes the optimal choice is to use an FPGA in several places, each designed to handle a range of functions. An example of such a design is Dalsa's XRI-1200, an image-processor board that targets x-ray imaging and uses a three-stage processing design with acceleration at each stage (**Figure 2**).

The first stage of the XRI-1200 provides programmable shading correction and image warping. The shading correction applies offset and gain on a per-pixel basis to data from the camera in order to compensate for variations in light intensity and sensor response across the image. The image warping counters the distortions typically encountered at the edges of the image field of view due to lensing effects. Both functions must be programmable to accommodate system-specific variations, and both can operate on a pixel-by-pixel basis on the data coming from the camera.

(continued)

Flexibility for computation and I/O

Ideally, developers of machine-vision systems should design systems that offer flexibility while still meeting requirements for processing power, high-bandwidth I/O, and well-defined determinism and latency in processing. Consider a typical example: the use of convolution using a programmable mask for filtering, feature detection, and recognition. Working with a 4-kpixel x 4-kpixel image at 30 fps requires that a vision system handle a data rate of 480 Mpixels/s. A typical 5x5 convolution mask has 25 coefficients that need to be multiplied with stored pixel data for every new pixel that comes in. The resulting processing demand, therefore, is at least 12 GFLOPS.

The need for high-performance I/O may be even more critical than computational performance. One example is the simple histogram, in which for each image pixel the system increments a counter corresponding to the pixel's value to build a statistical description of the image's intensity distribution. This task does not require any computation, but it does require fast random access to the counters in memory to build the histogram in real time.

Even more demanding is the rotation of an image by an arbitrary angle. This rotation task requires only a small computation to determine the destination address for the pixel to be moved, but it needs a huge amount of random memory access to read a pixel and write it to its new location. Performing this task in real time demands a memory-access bandwidth that is at least twice that of the image data rate.

In both examples, the memory access must be random, the most I/O intensive type in use. Burst-mode, data streaming, direct-memory access (DMA), and other high-bandwidth memory schemes cannot be employed because the locations being written to are not contiguous.

Along with processing performance and I/O bandwidth, machine-vision systems often require well-defined latency and determinism. Consider, for example, a system inspecting parts moving along on a conveyer belt. Such a system requires low latency to limit the distance a part will travel along a belt between the inspection site and the rejection point, and it needs consistent timing to allow the system to reliably reach its decision in time to reject bad parts.—*Kumara Ratnayake*

At times, nothing could be better than a free port

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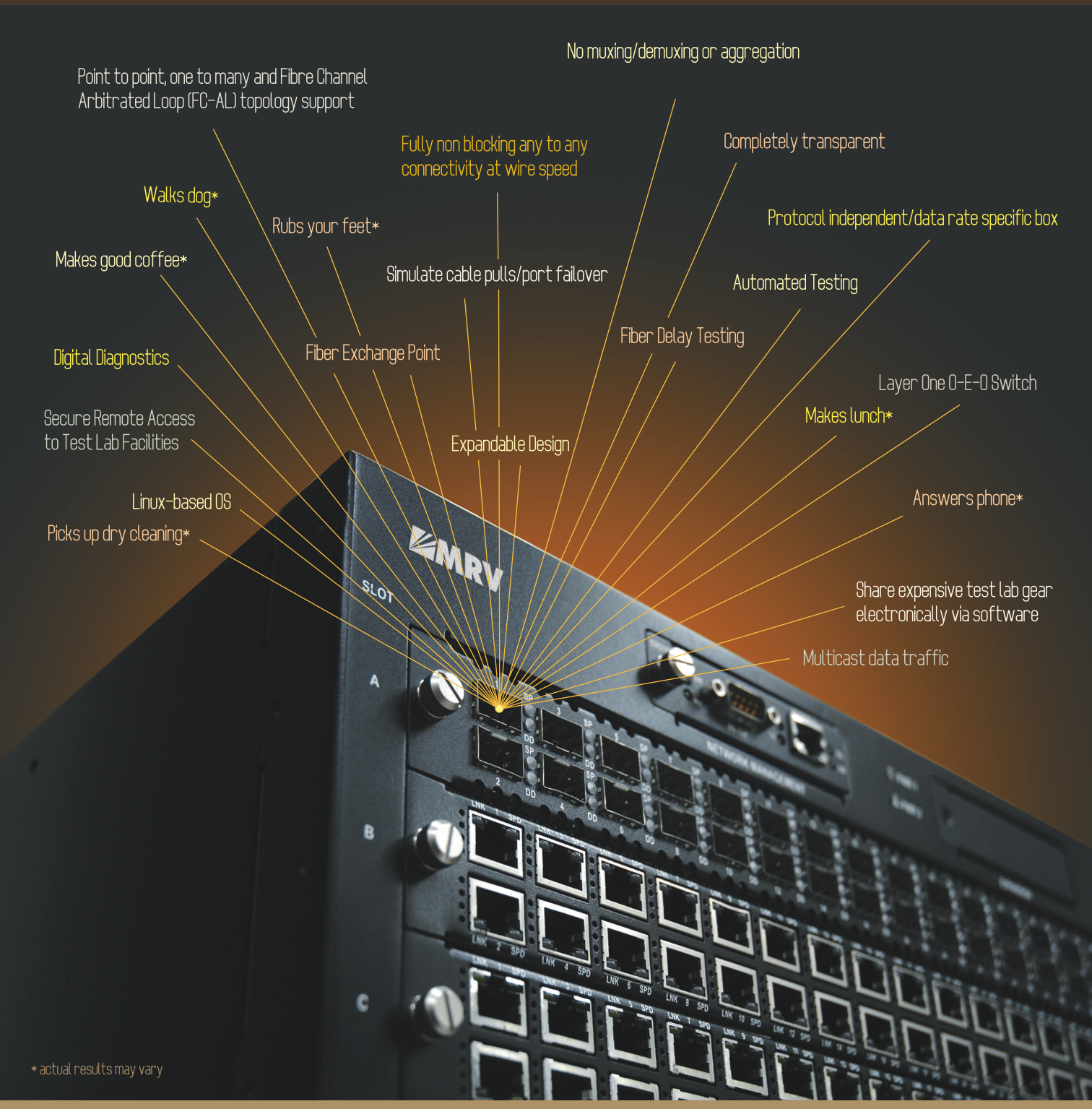

* actual results may vary

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The second stage provides configurable motion compensation to reduce noise in the image. Noise reduction can be achieved by averaging several frames together, but movement of the target during the averaging can result in blurring of the final image. The motion compensation algorithms determine the speed and direction of the target's motion between frames, and then correct for the motion before averaging the frames. This operation requires substantial memory buffering to hold successive images as well as feature detection and motion extraction. Its position in the middle of the system gives it access to the necessary resources.

The third stage provides image rotation in increments of 0.01°, 3x3 programmable filter convolution, and output image conditioning. These tasks require extensive I/O and memory resources to handle the rotation as well as the computational acceleration, and they require a different memory structure from stage 2 because of the random addressing involved in rotation. By separating the functions into different stages, the XRI-1200 is able to address the differences in memory requirements with a simpler design.

The use of FPGA-based coprocessing hardware enables the XRI-1200 to process a 1024x1024-pixel image with 12 bits per pixel in real time at 30 fps—a performance level that is beyond what a conventional processor can provide. Simply implementing the 3x3 filter would require a processor performance of more than 400 MFLOPs.

In addition, the FPGA approach also provides the XRI-1200 design with considerable flexibility, as it gives the user full control over the settings for functions such as tuning the image compensation for the system's specific camera and lens in the first stage, the number of frames to average and motion thresholds in the second stage, and filter parameters and rotation angle in the third stage. The FPGA also allows users to implement custom functions in the system without requiring any hardware changes.

The rise in image resolution and growing user demands for processing capability in applications such as medical imaging are being seen throughout the machine-vision industry. These demands have outstripped what can be accomplished simply with a host PC or programmable processors. Hardware acceleration is essential, and of all the performance-boosting options, FPGAs offer the best blend of performance increases and design flexibility. T&MW

Kumara Ratnayake *is a senior FPGA design architect at Dalsa in Montreal. He holds a Master's degree in electrical and computer engineering from Concordia University, Montreal, and a Bachelor's degree in engineering (first class honors) from the University of Central Lancashire, England. His areas of expertise include reconfigurable computing, image processing, and VLSI architectures for real-time embedded systems.*

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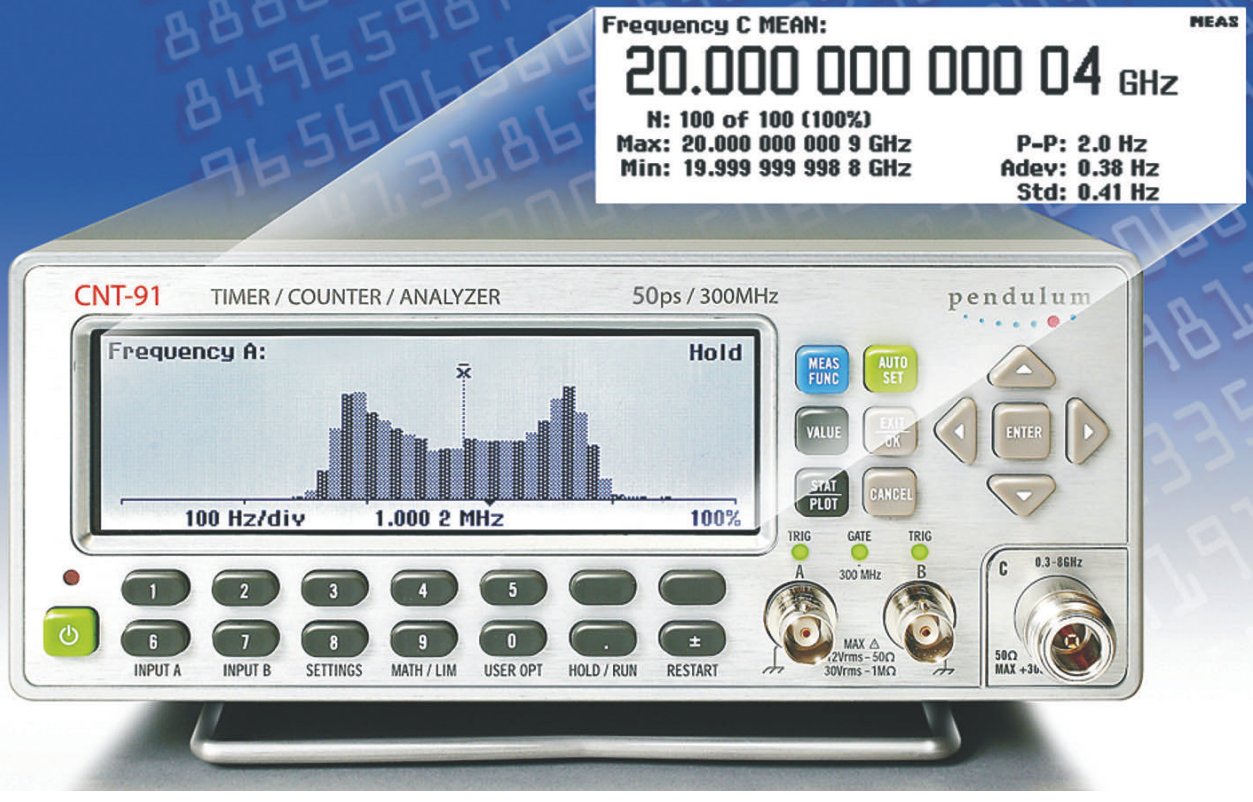

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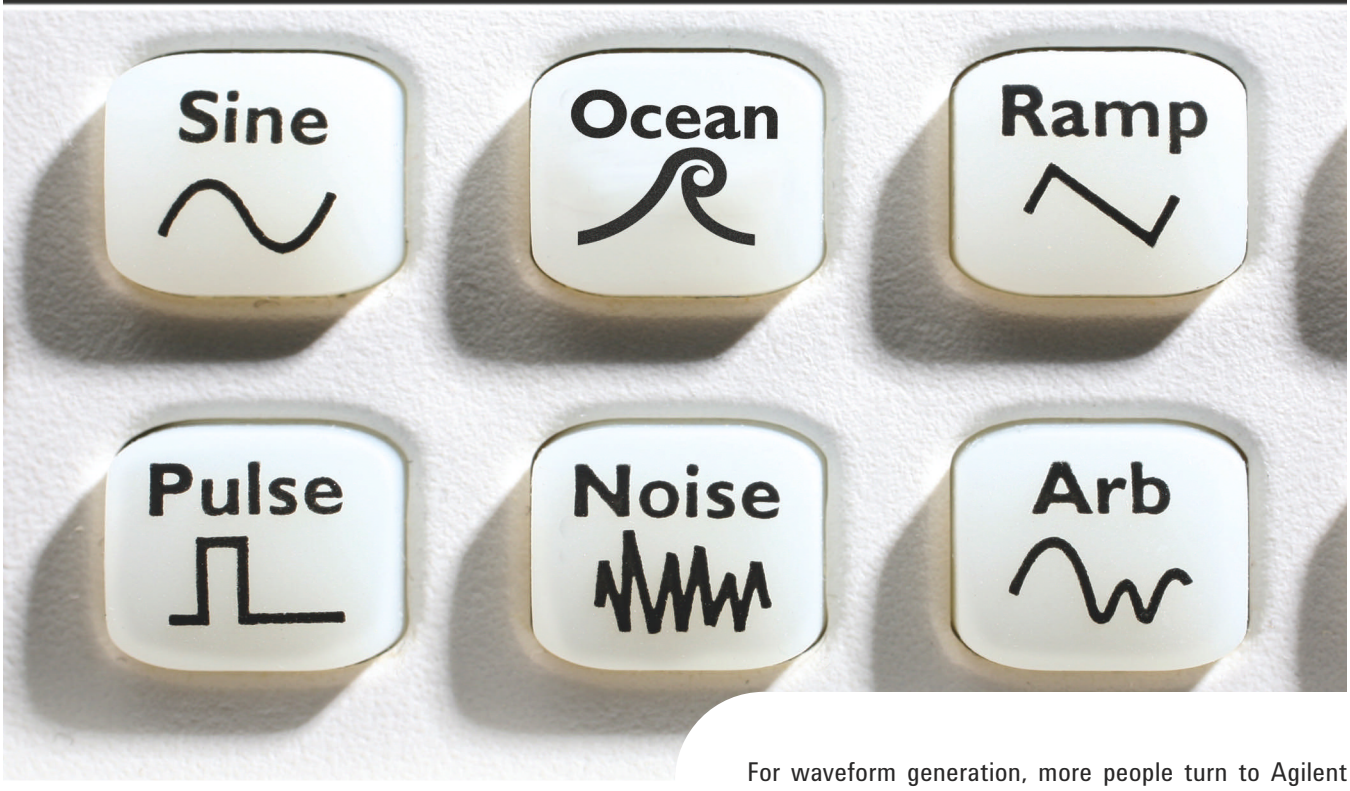

Agilent 33220A Function Generator

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Pulse	*Variable Edge 5 MHz*	*Variable Edge 50 MHz*
Arbitrary Waveforms	*14-bits, 64K points*	*12-bits, 64K points*
Modulation *(Internal / External)*	*AM, FM, PM, FSK & PWM*	*AM, FM & FSK*
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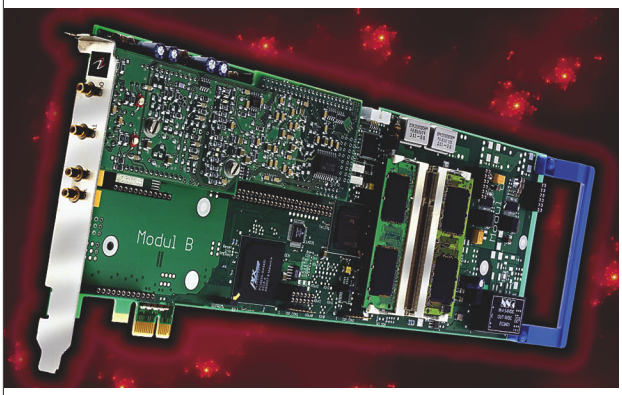


full speed (standard memory depth is 32 Msamples with several other options available). The unit includes options for dual time-base sampling, synchronous digital inputs, and asynchronous digital I/O.

Each analog-input channel has six voltage ranges from ±200 mV to ±10V, a programmable offset of 100%, and input impedances of 50 Ω or 1 MΩ.

Software support includes drivers and programming examples for Microsoft Windows Vista, XP64, XP, and Linux (RedHat, Fedora, SuSe, Sarge). SBench 5.3 oscilloscope software is also included. Software-development kits for Matlab, LabView, Vee, DASYLab, and LabWindows/CVI are available as options.

Base price: $7390. *Strategic Test, www.strategic-test.com.*

Vibration analyzer moves to Windows Mobile

Datastick has ported its Palm OS-based handheld vibration analyzer to the Windows Mobile and Pocket PC platforms. The VSA-1225 hardware module attaches to the HP iPAQ hx2400 or hx2700 series PDAs. The iPAQ provides the processor and 128 Mbytes of data storage, while the Datastick module supplies power to the vibration sensor and iPAQ interface.

You can store test data on up to two 2-Gbyte SD cards. The module's standard BNC connector accommodates and powers almost any ICP-type piezoelectric accelerometer or ICP-type velocity sensor.

Datastick's Spectrum software suite includes Datastick Spectrum and Datastick Review software. It records and shows vibration FFT spectra in acceleration, velocity, and displacement displays. The latest version adds decibel display. You also get time-domain acceleration waveforms with color-coded ISO (or custom) alert levels. To move data to a PC, just copy the Excel-based data from the SD memory card.

Datastick, www.datastick.com.

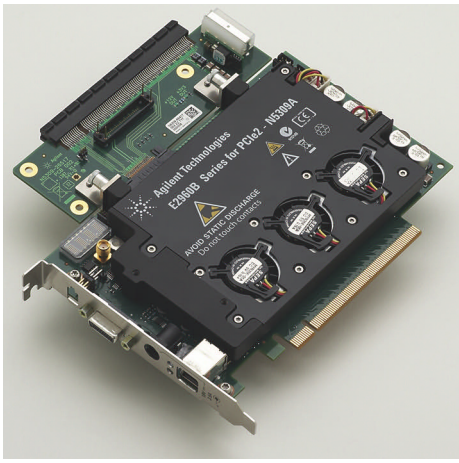
Mathematica gains application add-ons

A newly updated suite of add-ons for Wolfram Research's Mathematica 6 technical computing program extends the mathematical software's reach to image processing, aerospace and defense, and manufacturing applications. Offered for a range of operating system platforms, Mathematica 6 includes a finite-element environment; multi-language, multi-environment numerical code generation; digital image processing; entry-level ray tracing; a machine learning framework; optimized C++ code conversion; a Mathematica link for Excel; model-based design for multi-engineering systems; a parallel computing toolkit; optical design software; schematic capture and symbolic solving of analog and digital systems; application-oriented statistical inference; and a fully integrated environment for time-dependent data analysis.

Wolfram Research, www.wolfram.com/products.

Test card analyzes PCI Express 2.0 traffic

The E2969B Protocol Test Card II PCI Express (PCIe) bus analyzer lets you monitor and exercise bus traffic at speeds up to 5 Gtransfers/s. The card plugs into a x1 to x16 PCIe slot and runs all 22 PCIe compliance tests. With the E2969B-COM option, the card can perform more than 180 PCI-SIG recommended tests: 94 transaction-layer tests, 31 link-layer tests, 57 configuration-space tests, and 1 electrical-layer test. As a bus exerciser, the E2969B can let you test bus timing under controlled conditions.



The E2969B's USB port lets you control the card from another PC while you test the bus on a PC under test. PC software generates test reports in HTML format.

Base price: $8900. *Agilent Technologies, www.agilent.com/find/PTC2.*

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MT2168 - Benchmark Pick & Place Handler

Final test today is under constant cost pressure. At the same time Semi road-map moves to smaller and more complex devices.

The response of ATE companies is to ex-pand the capacity of their testers to higher parallelism and shorter test times. So the test handlers need to keep pace.

The MT2168 is a unique, industry leading concept, which offers

- high test cell efficiency
- a substantial cost of test advantage and
- widest manufacturing flexibility and reliability

Test cell efficiency

The MT2168 optimises the tester utilisation by providing leading technical features:

- throughput up to 20,000 uph
- up to 16 contact sites
- index time 0.38 s
- soak capacity equivalent to 3.5 JEDEC trays

Cost advantage

The MT2168 base unit is scalable from a “engineering” to a “state-of-the-art” to a “high end” configuration optimized for parallelism, test time and throughput requirements.

The contact site pitch and number is flex-ible and can be easily adapted. So existing loadboards and test programs can be used.

The number of parts in the conversion kits for other packages types is minimized resulting in low kit costs and easy set-up.

Manufacturing reliablity

The MT2168 is designed with a minimized number of pick & place transitions. Self-teaching process replace manual adjustments of the user.

Application and packages

The MT2168 covers the whole range of ambient-hot applications for devices from 3x3 mm to 70x70 mm and a thickness from 10mm down to 0.3 mm.

Due to its flexibility and favourable cost structure the MT2168 is the perfect “one-for-all” platform: For integrated device manufactures as well as for subcontractors and for the whole range of applications.

www.multitest.com/MT2168

GigE Vision and frame grabbers

By Steve Scheiber, Contributing Technical Editor

Companies engaged in machine-vision inspection are increasingly adopting the GigE Vision protocol. I asked Dwayne Crawford, product manager at Matrox Imaging, to explain how GigE Vision differs from other interfaces and how it works with frame grabbers.

Q: Why are people migrating toward GigE Vision?

A: The earliest image solution fed camera data into a frame grabber, which reconstructed the image before sending it to the host. The host had to know a lot about the camera configuration and the frame grabber's data format.

Camera Link standardized the data format. IEEE 1394 (FireWire) added another twist, incorporating a higher level of camera communication and allowing commercially available parts to lower costs.

GigE also incorporates commercial parts, but the camera describes itself to the host automatically. The application can now easily determine how the camera will behave. GigE also permits 100-m cable lengths, by far the longest of the available standards.

GigE addresses a variety of applications, but GigE Vision is intended for one and only one purpose—industrial machine vision. Its features are optimized for that task.

Q: How is GigE Vision different from what came before?

A: GigE Vision performs in software what frame grabbers did in hardware. Even protocols like Camera Link use frame grabbers to take some of the burden off the host. GigE Vision takes advantage of the power of current CPUs—in particular, their multicore architectures. The data crunching that image analysis requires would prove too slow in a single-core environment. But today, manufacturers offer dual, quad, or even eight cores in a single device or chipset.

Q: What kind of software is required?

A: A software driver communicates with the camera through the standard GigE Vision protocol and API (application programming interface) layers. It examines the incoming data, sorts it, and decides which is image data, which is command data, and so on. It can then unpack, reassemble, or perform color conversions on the image, presenting it in a suitable format for image-processing software.

Q: How are the drivers implemented?

A: We define three types of drivers. The first, a filter driver, handles all protocols—motion controllers, encoders, and so on—through a single cable, taking advantage of the indigenous Windows protocol stack. It identifies GigE Vision data, passing other data to the host unaltered.

The second, a stack-replacement driver, dedicates a special stack to GigE Vision, independently performing only GigE Vision through its own cable and network interface card (NIC). Its proponents contend that stack replacement saves a few steps and therefore performs better, but it also requires that the Ethernet controllers use GigE Vision cards that are matched and optimized for the particular GigE Vision camera.

We have developed a third type of driver as a compromise (and have incorporated it into our Solios GigE NIC). Like the filter driver, our driver handles all protocols through a single conduit, but we incorporate special hardware on the network card to reconstruct the data, sending it to the host as a single image instead of as a large number of individual packets. This approach gives users the benefits of the filter driver and outperforms the stack-replacement driver. □

Dwayne Crawford
Product Manager
Matrox Imaging
Courtesy of Matrox Imaging.

INSIDE THIS REPORT

EDITOR'S NOTE

Embrace less common techniques

By Steve Scheiber, Technical Editor

Including inspection in a "test" strategy once bordered on the heretical. It wasn't test, after all. It might even have resided in a different department ("manufacturing" rather than "test"), creating a rivalry that often proved counterproductive. Adopting inspection did not mean abandoning traditional steps; it merely meant the addition of a capability with its own strengths (and weaknesses) to improve overall defect coverage and product quality.

The articles in this Test Report address less common inspection techniques. Although the techniques have received press coverage, their proponents often cite a lack of understanding of both their advantages and the economics of their implementation as impediments to adoption.

Most familiar, perhaps, GigE Vision has gained considerable momentum. It treads familiar ground, migrating formerly hardware-bound tasks to software, paradoxically making them both more flexible and more application specific.

Infrared inspection continues in the shadows. According to Chris Bainter, senior science segment engineer at FLIR Systems, misconceptions about its capability and cost largely confine it to the development lab or design verification.

New approaches may sometimes replace older ones, but they may also supplement existing ones. Considering all alternatives encourages the most effective (and cost-effective) strategic choices. □

Contact Steve Scheiber at sscheiber@aol.com.

HIGHLIGHTS

NanoLab selects SEMICAPS' scanning optical microscope

SEMICAPS, a supplier of semiconductor failure-analysis systems, reports that NanoLab Technologies has purchased its SOM 4000 for advanced optical fault location. The SOM 4000 is an inverted scanning optical microscope system that can be used in a stand-alone analytical configuration or docked to an automated tester. It is designed for design debug, product engineering, yield enhancement, and failure-analysis applications.

NanoLab Technologies will use the system in its analytical services for semiconductor manufacturers. NanoLab recently entered into an agreement with Presto Engineering to provide turnkey test and design-analysis services to minimize the cost of bringing products to market.

"During product engineering, fault isolation is a major bottleneck in analyzing defects from designs below 130 nm. Near-infrared technologies are now the only efficient way to physically localize these defects by imaging through the device substrate," said Michel Villemain, CEO of Presto Engineering. "I am very happy that our partnership with NanoLab Technologies brings a capability like the SOM 4000 to our mutual customers." www.semicaps.com.

Vision system offers wafer pre-alignment

The new In-Sight 1820 vision-based wafer pre-aligner from Cognex uses NotchMax alignment technology to perform noncontact measurement of wafer position and orientation. The In-Sight 1820 determines wafer position and orientation in less than half a second, compared to mechanical pre-aligners that often spin wafers for several seconds. NotchMax, part of the Cognex PatMax family of pattern-finding technologies, aligns wafers with a center position accuracy of ±15 µm and an orientation accuracy of ±0.05°.

Marilyn Matz, Cognex senior VP, vision software, commented, "In addition to throughput and accuracy gains, capital equipment manufacturers will appreciate the system's ability to handle changing wafer sizes and types with simple parameter changes, while semiconductor fabs will like the noncontact design that minimizes wafer handling and potential damage to the wafer." www.cognex.com.

EMVA membership surpasses 100 organizations

At the 4th International Vision Night during Vision 2007, European Machine Vision Association (EMVA) president Gabriele Jansen announced that NeuroCheck and Pleora Technologies had become the 100th and 101st EMVA members, respectively.

NeuroCheck of Remseck, Germany, offers turnkey solutions for all fields of automated visual inspection based on flexible, configurable software developed in-house. Pleora, which is based in Kanata, ON, Canada, provides Gigabit Ethernet (GigE) connectivity solutions for high-performance machine-vision, broadcast video, and security and surveillance applications.

The EMVA's members represent 18 countries worldwide. Founded in 2003, the EMVA now represents 92 vision companies, six national associations, and three scientific organizations. The organization supports standardization, gathers statistics, organizes the annual EMVA Machine Vision Business Conference and other networking events, and conducts public relations and marketing. www.emva.org.

Cameras, lights, frame grabbers, and optics debut at Vision 2007

Vision 2007, November 6–8, Stuttgart, Germany, www.messe-stuttgart.de.

Basler Vision Components introduced a new member of its Pioneer series cameras based on Sony's new ICX625 CCD sensor. The piA2400 Gigabit Ethernet (GigE) camera (**pictured**) runs at 12 fps at 2456x2048 resolution. Basler also introduced the ruL2098-10gc tri-linear line-scan camera with GigE Vision. **National Instruments** introduced the NI 1722 and NI 1742 smart cameras—embedded devices that combine an industrial controller with an image sensor and that integrate with NI vision software to offer image processing directly on the cameras.

Stemmer Imaging highlighted release 9.0.2 of its Common Vision Blox (CVB) software, which includes a GigE Vision driver that implements GenICam and includes a grid control that provides access to all camera options. **MVTec** highlighted support for quad-core processors with its Halcon 8.0 software and demonstrated an industrial robot system that detects objects in any 3-D position with only one camera. MVTec also announced that Halcon can interface to uEye GigE cameras from IDS, to microEnable IV Camera Link boards from Silicon Software, and to TXF and TXD cameras from Baumer. For its part, **Baumer** demonstrated its TXG cameras, which add a GigE interface; its FQX FireWire cameras for scientific, medical, and industrial applications; and its VeriSens vision sensors, which inspect part completeness, presence, location, and positioning.

Leutron Vision demonstrated Power over Camera Link (PoCL) versions of its PicSight cameras and frame grabbers, a low-cost sensor module with near infrared (NIR) sensitivity, PicSight GigE cameras with FPGA-based onboard preprocessing, and a line of PicSight smart cameras with a 500-MHz 32-bit RISC processor. **Sony Europe's** Image Sensing Solutions Division announced a new series of IEEE 1394b digital cameras: The XCD line-up ranges from the V60 black-and-white VGA, 90-fps model to the U100CR color UXGA, 15-fps unit. Sony also announced two additions to its XCL-5000 family of Camera Link-equipped camera modules, the XCL-5005 and XCL-5005CR, which feature selectable PoCL capability.

XenICs demonstrated the latest release of its Cheetah PowerPC-based, high-speed imaging system—an InGaAs focal-plane array camera that covers the standard short-wave infrared (SWIR) wavelength area of 0.9 to 1.7 microns. Cheetah includes a 640x512-pixel InGaAs array, which features a read-out integrated circuit (ROIC) with 16 outputs and a 40-MHz pixel rate.

Docter Optics showcased its new STILAR (for Sensor Transmission Image Large Angle Resolution) wide-angle lens for 1.2-in. sensor chips. The company also introduced new reflex-free Auto-Tessar lenses for cameras based on very light-sensitive sensors. **Schott** showcased its high-brightness and high-frequency MaVi-S COLDVision strobe family, which features a xenon bulb and touch-pad control. The company also demonstrated its LLS small-footprint LED-based light source—a hybrid product that combines LEDs with fiber optics. □

See the online version of this article at www.tmworld.com/2007_12 for links to vendors and to our complete coverage of Vision 2007.

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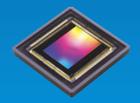

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DALSA

Infrared inspection finds unexpected hot spots

By Steve Scheiber, Contributing Technical Editor

The principles behind infrared inspection of printed-circuit boards (PCBs) are relatively straightforward. Simply stated, a faulty circuit produces more or less heat than a good one does. Assuming you can precisely measure the resulting temperature differences, you should be able to compare the temperature map from a board undergoing infrared inspection with one from a known-good board to accurately pinpoint circuit problems.

So why is the technique rarely implemented, especially in mainline production? Chris Bainter, senior science segment engineer at FLIR Systems, said that the biggest reasons are unfamiliarity with the advantages of infrared inspection and a perception (incorrect) that it would prove more expensive than the available alternatives.

"The biggest obstacle that we encounter," said Bainter, "is that the industry isn't sufficiently aware that infrared inspection can reduce test times and improve product quality, offering a quick return on investment. As a result, you generally find infrared inspection today only on lab benches for design verification and in repair depots."

Bainter does not suggest that the technique is inexpensive. "There is no denying that the initial investment may seem daunting or even prohibitive. The least expensive infrared cameras cost about $10,000, and more elaborate solutions can approach $70,000 apiece. Still, if you factor in reduced test times and improved inspection accuracy, the return on that investment can be enormous.

"General computer makers already use the approach quite frequently. When a customer sends a product back to the manufacturer for repair, infrared inspection can examine an entire board or system in a 30-second snapshot without bed-of-nails fixtures, simulations, or other expenditures that are unique to a particular assembly. The only 'fixturing' required simply keeps the board from moving during image capture."

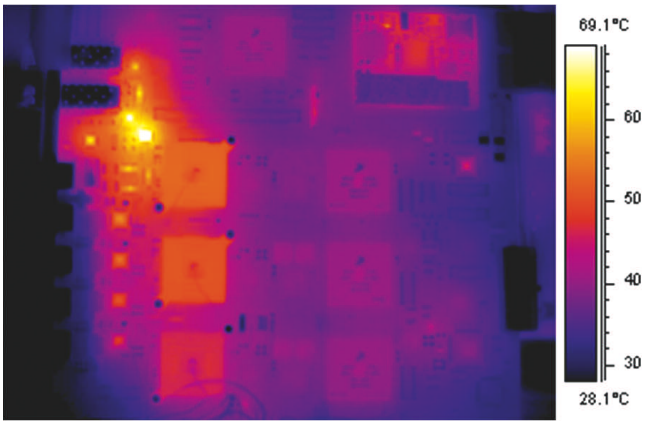

Fig. 1 This low-resolution IR image showed a pattern of heat dissipation on a PCB that differed markedly from the predictions of a design simulation. Courtesy of FLIR Systems.

Getting the whole picture

For verifying designs on the R&D lab bench, IR inspection serves as a holistic alternative to mounting a collection of thermocouples on the board at suspected "hot spots." Thermocouples measure temperature only at individual points. If a board designer fails to anticipate (and therefore neglects to measure) one or more such hot spots, the board may fail at unacceptably high rates either during production or in the field.

Bainter explained, "Unlike thermocouples, infrared thermography does not require knowing where the hot spots are in advance. Instead, it looks at the board as a whole. One PCB manufacturer, for example, had always used board simulations to predict where problems might occur. When a simulation identified certain parts and board locations that might overheat, they [the manufacturer's engineering staff] installed heat sinks and fans to compensate—adding weight and cost and consuming extra power. They then verified correct placement of those items by measuring the resulting temperature at those same locations with thermocouples.

"When we visited their operation, our first image—a fast but low-resolution 320x240 [**Figure 1**]—made their collective jaws drop. It revealed locations on the board that dissipated much more heat than the points that the simulations had predicted. They told us that in five minutes they had learned more about the board design's heat profile than they had in months or years before that."

But the best was yet to come. Bainter's crew followed up with a higher-resolution detector that took a 640x512 image, and the customer received another surprise (**Figure 2**). "The second image had uncovered a previously unknown hot spot in a remote area of the board that no one had even considered before."

Sensitivity, resolution, and throughput

How well a camera can pinpoint heat differences depends on the type of detector, its resolution, the number of pixels in each image, and the pixel size. The primary sensitivity specification for thermal IR cameras is their

noise-equivalent delta-T (temperature difference), or NEdT—the smallest temperature the camera can detect over the "noise" of its own thermal behavior. For lower-cost so-called microbolometer cameras, which operate at room temperature at resolutions up to 640x480, NEdT is 0.08°C. Radiation from the part under inspection heats up the thermal detectors. The inspection system measures the resulting voltage drop as resistance changes.

Higher-resolution analysis requires more elaborate equipment. An indium antimonide (InSb—pronounced "insby") detector can achieve a resolution of 1024x1024 with a smaller pixel size. At the high end of the cost range, these detectors can measure temperature differences below 0.018°C. But to operate, an InSb detector requires cryogenic cooling to a temperature of approximately 77 K, either using a liquid nitrogen pour-fill Dewar flask or a closed-cycle sterling or rotary cryogenic cooler.

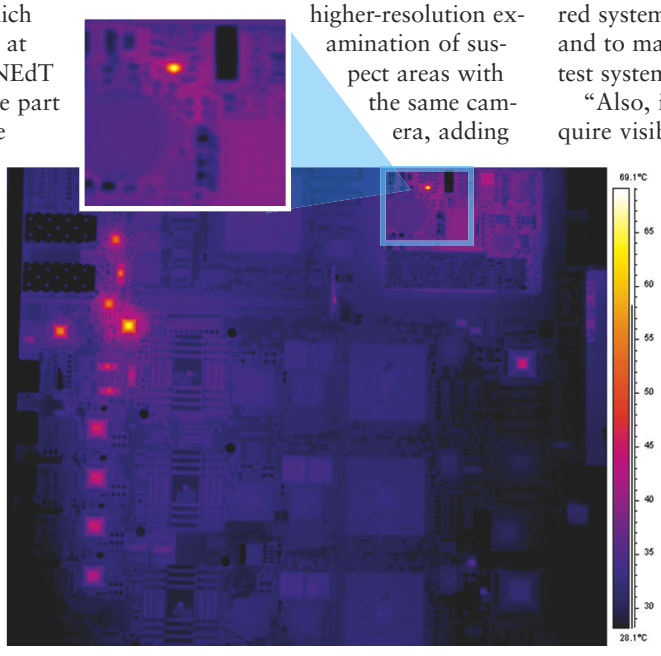

Fig. 2 This higher-resolution IR image of the same PCB as in Figure 1 revealed a "hot spot" in the upper-right corner of the board, where no one had expected any thermal problems. Courtesy of FLIR Systems.

Inspect while the board runs

One aspect of infrared inspection that differs from techniques like automated optical inspection (AOI) and x-ray inspection is that infrared systems look at a board while it is running. "You can power the board up," commented Bainter, "and wait until it reaches steady state before performing the inspection, or you can start cold and measure it as the temperature rises. The latter process can be extremely valuable because some components may heat up excessively before settling back into a normal range.

"A cell-phone battery, for example, might run hotter when a call comes in than when it is idle. With good fixturing to keep the board from moving, you can inspect it both cold and under power, then by image subtraction, look for subtle differences between the two."

Manufacturers generally conduct both an initial inspection and a higher-resolution examination of suspect areas with the same camera, adding magnifiers and other optical accessories to home in on areas of interest. With microbolometer cameras, that second step generally means changing lenses. InSb cameras permit extender rings and spacers that allow the camera to "zoom" in and magnify the area of interest with a single lens. Because lenses often cost $5000 to $10,000, that added cost with the "inexpensive" microbolometer solution sometimes drives manufacturers to migrate toward the higher-end single-lens alternative.

Bainter also explained that infrared inspection offers advantages over more conventional test and inspection steps. "In-circuit test requires mounting the board on a bed-of-nails fixture that by itself can cost more than an entire infrared setup. And that fixture is assembly-specific. IR inspection is often faster, which increases throughput and thereby lowers costs as well. The reduced test time may even permit inspecting every board instead of inspecting only parts of boards or board samples. And infrared systems are generally easier to use and to maintain than more complex test systems.

"Also, infrared cameras don't require visible light to generate a good image. In optical inspection, a passing shadow or other momentary light variation can produce false failures or escapes. Infrared inspection can prove much more consistent because the object being inspected is generating heat—and therefore infrared light—which is not susceptible to visible-light inconsistencies."

Some manufacturers also offer "smart" IR cameras that can inspect entire boards and automatically determine which areas exceed a user-defined temperature threshold. Upon finding such an area, the camera creates a real-time alarm. It can then output a digital or analog signal, giving feedback directly to a PC, programmable logic controller (PLC), or other in-line controller, thereby flagging potentially bad boards for further testing off-line. This level of automation reduces the board-to-board variability of the inspection results and further improves product quality and reliability.

As the capabilities of infrared equipment continue to grow, the costs continue to decline. Bainter commented, "Depending on your specific inspection requirements, some cameras cost less than the $10,000 threshold and can fit in the palm of your hand. Prices are falling to the point where, within five years, we will even be able to address the low-cost, low-margin consumer market." □

PRODUCTS

Wafer-inspection system handles 45-nm lithography

The Applied UVision 3 system from Applied Materials is a deep ultraviolet (DUV) brightfield wafer-inspection tool that offers the sensitivity necessary for 45-nm front end of line (FEOL) and immersion lithography. Compared to the original UVision technology, the UVision 3 system triples the number of laser beams scanning a wafer to provide 40% faster throughput.

Two new imaging modes extend sensitivity to 20 nm, and an automatic defect-classification engine enables faster yield learning and quick access to defects of interest. By coupling laser DUV architecture with a sensitive photomultiplier tube (PMT) and variable polarization, the UVision 3 system also meets the challenges of 32-nm memory devices.

Applied Materials, www.appliedmaterials.com.

AOI system inspects PCB assemblies

Viscom has introduced the S3088-II high-speed automated optical inspection (AOI) system—the successor to the S3088. The S3088-II offers full inspection of printed-circuit board (PCB) assemblies up to 450x350 mm and includes the company's EasyPro3D user interface. The new system also includes Viscom 8M AOI camera technology, which at 20 fps provides up to 25% faster image upload while offering full-color capability.

The 8M technology also provides what Viscom calls OnDemandHR-Operation, a high-resolution capability that delivers selectable resolutions of 11.7 or 23.4 microns/pixel without diminishing image field size and allowing inspection of 01005 solder joints. The Viscom 8M is now available in new S6056 systems as well as in the S3088-II; S6055/S6056 inspection systems can be retrofitted with the 8M technology starting in 2008.

Viscom, www.viscom.com.

3-D metrology system boasts high precision

Designed for researchers working between the limits of conventional optical microscopes and scanning electron microscopes, the LEXT OLS3100 confocal laser scanning microscope from Olympus permits high-resolution 3-D observation and measurement in real time. The LEXT provides a horizontal resolution of 0.12 µm and a magnification range from 120X to 14,400X to meet a diverse range of needs in fine surface-profile measurement.

A 3-D image navigation tool guides users through each step of microscopic observation, and a 3-D image capture is performed with just a single click of a button. The LEXT OLS3100 lets you measure step height, line width, and the distance between two points in a 3-D image. It also presents a variety of standard and novel 3-D image presentation patterns, including surface texture, real color, and wired frame. What's more, time-consuming tasks like setting the upper and lower focal limits are completely automatic.

The LEXT microscope integrates an apochromatic objective lens specifically designed for confocal laser scanning microscopy, with a near-UV (408-nm) laser light.

Olympus, www.olympus-europa.com.

X-ray system recognizes submicron features

The XiDAT XD7500NT digital x-ray inspection system from Dage Precision Industries offers a submicron inspection capability and features sealed-tube technology to minimize maintenance. Its manipulator design provides oblique angle viewing of up to 70° for any point of the 18x16-in. (458x407-mm) inspection area.

The XD7500NT comes standard with the Dage NT x-ray tube, providing submicron feature recognition to 950 nm. It provides real-time 1.3-Mpixel digital inspection with results viewable on a 20-in. flat-panel LCD at system magnification up to 7400X. Optionally, the XD7500NT is available with the Dage XiDAT (x-ray integrated digital acquisition technology) 2.0 image-acquisition system, providing real-time digital inspection at 2.0 Mpixels and viewable on a 24-in. flat-panel LCD. It comes equipped with the company's ImageWizard software.

Dage Precision Industries, www.dage-group.com.

AXI system offers programmable angle-shot capability

MatriX Technologies has expanded its automated x-ray inspection (AXI) lineup with the addition of the X2.5. The X2.5 features a programmable angle-shot capability and is suitable for high-throughput automatic solder-joint inspection of double-sided PCBs.

The company says that the angle-shot capability combined with the MatriX Slice-Filter Technology (SFT) provides for 100% test coverage of double-sided PCBs. SFT, which discerns hidden or overlapped joints, employs a proprietary algorithm to separate image data for each side of a double-sided PCB without requiring the use of 3-D laminography techniques.

MatriX Technologies, www.m-xt.com.

Inspection system employs interferometry

Lloyd Doyle, a maker of PCB inspection equipment, has released the IBIS-Versalea, a system designed for silicon-wafer-bump inspection. Versalea builds on Lloyd Doyle's IBIS technology, which powers a high-speed interferometer-based system for solder-bump inspection of IC substrates.

IBIS uses conventional interferometry combined with massive parallel data processing to create a production-scale inspection tool capable of inspecting and reporting on 3000 bumps per second. The IBIS range now comprises prototype and production units for substrate inspection in the form of IBIS-lab and IBIS, while the Versalea will be capable of handling 300-mm wafers and all combinations of substrates in panel format.

Lloyd Doyle, www.lloyd-doyle.com.

Application development is serious work

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With the Matrox Design Assistant integrated development environment, non-programmers can easily and quickly configure the Matrox Iris E-Series smart camera to solve challenging vision applications. Setup capture, location, measurement, reading, communication and I/O operations as well as a web-based HMI within a single intuitive flowchart-based graphical user interface.

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USB DMM

Keithley's new Model 2100 6½-digit USB digital multimeter simplifies critical measurements, making it ideal for

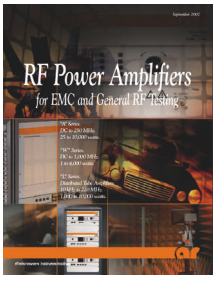
R&D engineers, test engineers, scientists, and students making basic precision measurements. *Keithley, www.keithley.com/at/495.*

Testing laboratory services

The ESSC Testing Services provides A2LA-accredited test services, including temperature, humidity, vibration, thermal shock, altitude, salt spray, cycling-corrosion test, and shock testing. *ESSC Test Laboratory, www.esscinc.com.*

Telecentric lenses

Edmund Optics' Silver Series line of telecentric measuring lenses offers a compact and cost-effective solution for replacing lenses that give inaccurate or inconsistent readings while providing superior image quality and less distortion. *Edmund Optics, www.edmundoptics.com.*



RF amplifier brochure

AR's RF power amplifier brochure highlights the 'A', 'L', and 'W' series RF and tube amplifiers that cover 1–10,000 W and DC–1 GHz. Product photographs, specifications, and performance graphs are included for each model. *AR RF/Microwave Instrumentation, www.ar-worldwide.com.*

Arbitrary/function generator

TEGAM says its 2732 Hybrid Series dual-channel arbitrary/function generator provides the deepest memory, widest bandwidth, and fastest rise time in its price class and includes programmable synchronization at a competitive price. *TEGAM, www.tegam.com.*

Temperature-measurement instruments

TEMPpoint is a series of stand-alone, easy-to-use temperature measurement instruments. Each instrument has been designed to give the highest accuracy, and each offers 48 separate 24-bit inputs for connection to a PC via USB or Ethernet (LXI). *Data Translation, www.Data-Translation.com.*

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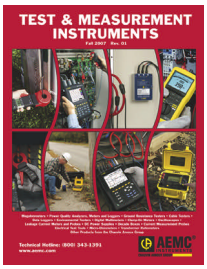
Catalog of portable instruments



New products are featured in AEMC's catalog, which highlights portable instruments, including megohmmeters, ground-resistance testers, power-quality analyzers and meters, cable testers, current probes, multimeters, dataloggers, environmental testers, electrical test tools, and oscilloscopes. *AEMC Instruments, www.aemc.com.*

Clamp-on current probes

Pearson's clamp-on current probes feature a hinged opening for use on a fixed conductor. They also provide accurate AC current measurements of sine waves, pulses, and transients. A typical 3-dB bandwidth is 15 Hz to 20 MHz, up to 200 MHz. *Pearson, www.pearsonelectronics.com.*

GigE Vision products

Matrox Imaging Library (MIL) includes a highly efficient driver for typical GigE Vision acquisition. For the most demanding GigE Vision applications, Matrox says the Matrox Solios GigE, with its processing engine, provides the ultimate acquisition performance. *Matrox Imaging, www.matrox.com/imaging.*

Microwave accessories

Centellax is now offering the TA0L30VA (a 30-kHz to 30-GHz broadband system amplifier with 30 dB gain) and the TD20MCA (a differential DC–20-GHz programmable divide-by-1/2/4 or 8 prescaler). *Centellax, www.centellax.com.*

USB for digital I/O

Sealevel SeaDAC products use a single USB connection to interface a variety of digital I/O components. Combinations include optically isolated inputs, high-current Form C outputs, and TTL digital I/O. *Sealevel Systems, www.sealevel.com.*

Low-profile I/O board

The OMG-PIO-24-LPCI low-profile PCI board provides 24 channels of buffered drive digital I/O, emulating 8255 mode zero. The board can be used for PC-based control and automation of equipment including sensors, switches, and security-control systems. *Omega Engineering, www.omegamation.com.*

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1-Gsamples/s oscilloscopes

The PicoScope 5000 Series oscilloscopes from Pico Technology feature a 1-Gsample/s sampling rate, a 128-Msample record length, a 250-MHz bandwidth, and a wide array of advanced functions that allows users to capture complex waveforms. *Pico Technology, www.picotech.com.*

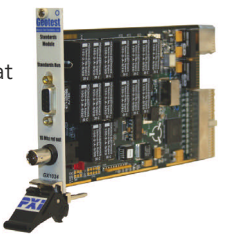
Lab and manufacturing productivity

EXFO's lab and manufacturing-test solutions provide an expressway to productivity. The company offers modular, scalable platforms, turnkey systems, and benchtop instruments optimized for high-performance characterization of optic and transport/datacom devices. *EXFO, www.exfo.com.*

Low offset phase noise

The 2500A series signal generator delivers industry-best offset phase-noise performance and fast frequency switching speeds in a single unit covering 100 kHz to 40 GHz with frequency resolution of 0.001 Hz. *Giga-tronics, www.gigatronics.com.*

PXI standards module



With the GX1034 PXI standards module, systems designers can develop a test-system recertification strategy that employs only internal system resources. The module features NIST-traceable voltage, resistance, and frequency standards. *Geotest–Marvin Test Systems, www.geotestinc.com.*

In-circuit test system

CheckSum's new Agilent 3070-compatible ICT test system includes the hardware and software to reuse existing 3070 test fixtures, even with TestJet, at a much lower cost. *CheckSum, www.checksum.com.*

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PXI signal generator

The 3020 Series PXI modular RF signal generators include an integrated dual-channel arbitrary waveform generator. Their functionality and performance are ideally matched to RF test systems up to 6 GHz. *Aeroflex, www.aeroflex.com.*

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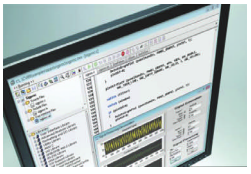

full control over thread management, built-in multithreaded libraries and drivers, thread-safe analysis functions, and advanced debugging tools. *National Instruments, www.ni.com.*

Advances in MSOs

An "Advances in Mixed Signal Oscilloscopes Multimedia Resource Kit" is now available from Yokogawa. The CD includes catalogs, a multimedia presentation, an MSO brochure, and trial software. You can request the CD from scopeinfo@us.yokogawa.com. *Yokogawa Corporation of America, www.yokogawa.com/tm.*

5-Mpixel cameras

You can capture high-quality uncompressed sequences at 10 fps with the SV5C10/SV5M10 color or monochrome 5-Mpixel cameras. Lower resolutions provide higher frame rates. Price: $1095 for camera, cable, frame grabber, and the XCAP-Lite imaging program. *EPIX, www.epixinc.com.*

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Power and visualization

JTAG ProVision and Visualizer are tightly integrated in the latest release. Test developers see boundary-scan results and control nets via Visualizer's graphical display of the target's schematics and layouts. *JTAG Technologies, www.jtag.com.*

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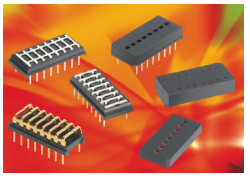
KineticSystems now offers a complete line of PXI/cPCI data-acquisition modules including analog and digital I/O, multiplexers, frequency counters, and digitizers. Typical applications include temperature measurements, powertrain/engine testing, automated test equipment, and general-purpose data acquisition. *KineticSystems, www.kscorp.com.*

Web-based temperature measurements

WEB-TEMP, Measurement Computing's eight-channel temperature input device, supports thermocouples, RTDs, thermistors, and semiconductor sensors and has a built-in Web server. You can read temperatures on your browser from anywhere in the world. *Measurement Computing, www.mccdaq.com.*

Eliminate DIP switches

Aries' RoHS-compliant programmable headers and covers eliminate the need for DIP switches. The Series 680



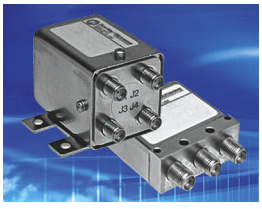
is available preprogrammed, or users can program the headers and covers themselves by using programming tools, such as Aries' T-680. *Aries Electronics, www.arieselec.com.*

Working up to 6 GHz?

JFW offers a wide range of RF components and systems that operate to 6 GHz and beyond, making them ideal for WiFi and WiMAX applications. *JFW Industries, www.jfwindustries.com.*

5 million cycle switches

Dow-Key Microwave has introduced a new series of RF switches. The SPDT (401U- series) and the transfer (411CU-series) switches offer high reliability with the improvement of five times the life. *Dow-Key Microwave, www.dowkey.com.*



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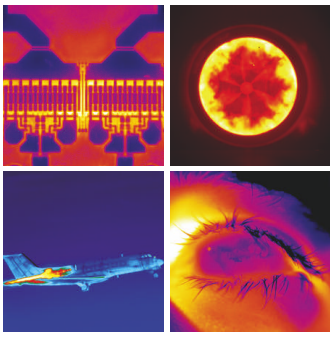

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VIEWPOINT

[An exclusive interview with a technical leader]

DAVID LALLY
VP of Engineering
PCB Piezotronics
Depew, NY

David M. Lally is VP of engineering and one of the principal owners of PCB Piezotronics. With more than 20 years of experience in the sensor industry, Lally began his career as a sensor design engineer and then moved into the positions of vibration group product manager and marketing manager at PCB. He has a Mechanical Engineering degree from Bucknell University and also attended the University of Cincinnati's Structural Dynamics Research Laboratory, specializing in experimental modal/structural analysis.

Contributing editor Larry Maloney conducted an e-mail interview with David Lally on trends in sensor technology for test and measurement applications.

Sensing the needs of test engineers

Q: What is the core technology behind PCB Piezotronics?

A: From its founding in 1967, PCB has specialized in piezoelectric sensors and associated electronics for measurement of dynamic pressure, force, acoustics, and vibration. Our unique expertise was the incorporation of microelectronic signal-conditioning circuitry within these sensors to make them easier to use and more environmentally compatible.

Q: How has this technical focus evolved over the years?

A: Measurement capabilities have expanded to include DC response, variable capacitive, piezoresistive, MEMS, and traditional strain-gage sensing for measurement of load, dynamic strain, torque, acoustics, and pressure. In terms of sensor types, TEDS [transducer electronic data sheets] have become increasingly popular in high-channel-count applications. Our high-temperature accelerometer products have also grown substantially.

Q: What is behind your recent decision to form an automotive division?

A: Increased customer awareness about auto safety and government mandates continues to drive the need for automotive testing. Additionally, with the spread of computer-aided engineering, sensors are increasingly used to test components and complete vehicle prototypes, helping engineers to prove the validity of their computer models. To satisfy customers in this important market, PCB Piezotronics Automotive Sensors division in Novi, MI, is devoted exclusively to R&D, auto component manufacturing, and applications involving vehicle dynamics, crash tests, off highway, motor sports, and engine monitoring.

Q: What other industries are you targeting?

A: Among the major areas are aerospace, defense, equipment protection, worker protection, and environmental noise monitoring. In aerospace and defense, we're involved in such applications as flight test, health and usage monitoring systems (HUMS), and ground vibration testing. Requirements include sensors that are smaller, lighter, lower profile and, in many cases, designed for high-temperature operation.

Q: What role do customers play in shaping your R&D agenda, and what research areas are you pursuing?

A: Our products are shaped by customer demand and feedback from the outset. The design process at PCB is based around a "design for six sigma" approach. This process involves communicating directly with our customer base to take their general requirements and turn them into specific measurable "critical to customer" (CTC) characteristics. From there, these CTCs are transformed into "product design characteristics," which the R&D staff uses during the design process.

Current new developments include a significant investment in MEMS technology. In fact, PCB is currently in the process of releasing a high-g shock accelerometer for use in the defense industry. This is our first miniaturized product to be based on the silicon sensing technology. Other current R&D activities include the development of a MEMS crash accelerometer, which is critical to satisfying customer demand in the automotive market.

Investment in high-temperature sensing technology is also a focus area for our R&D team. This includes the development of both accelerometers and pressure sensors for such applications as aircraft engine vibration monitoring, turbine combustion instability measurements, and health monitoring in the power-generation industry. T&MW

David Lally provides more observations on new sensor products and applications—and discusses PCB Piezotronics' sponsorship of the North American Eagle land speed challenger—in the online version of this interview: www.tmworld.com/2007_12.

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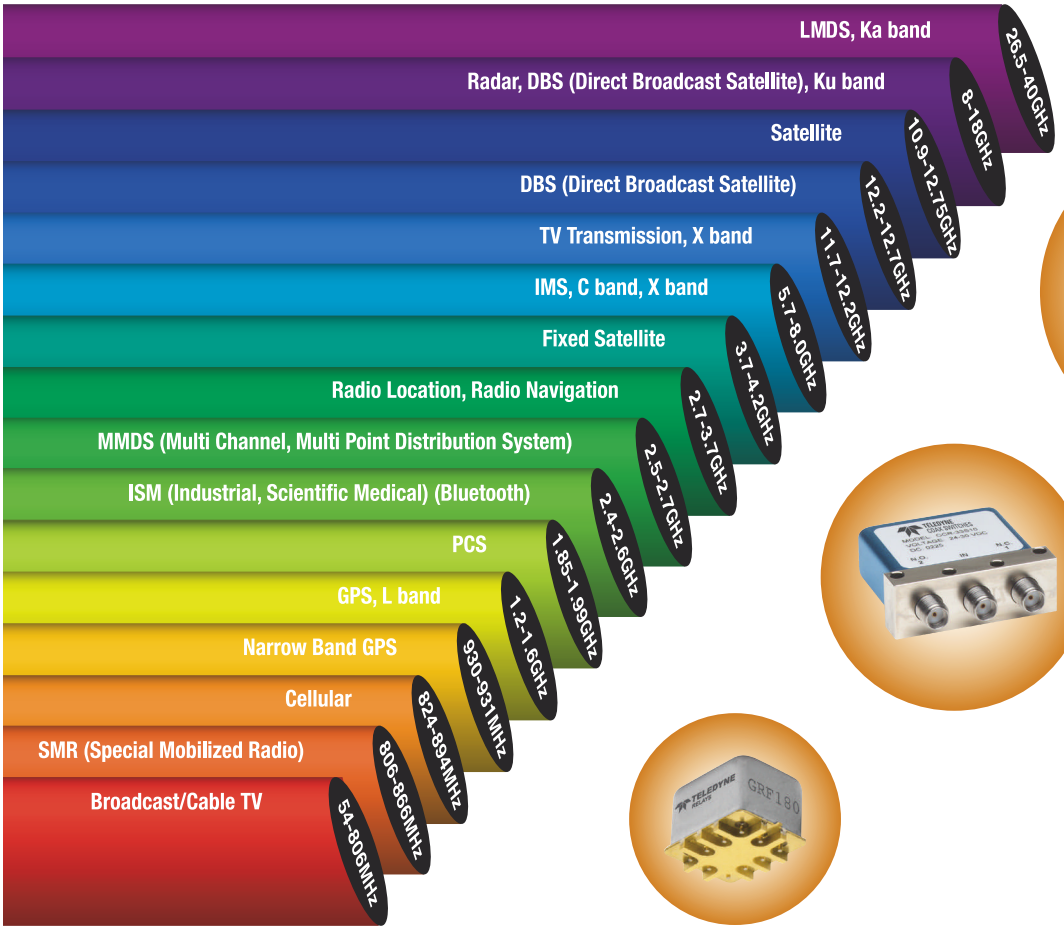

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