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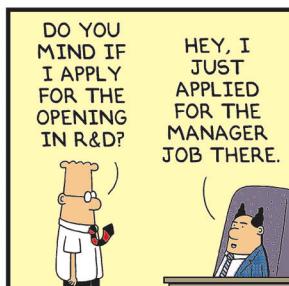
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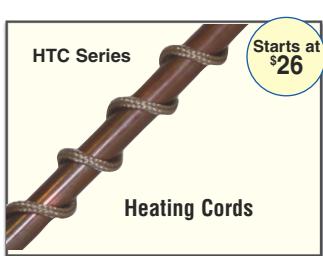
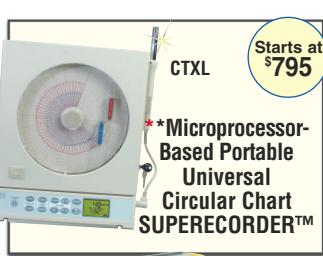
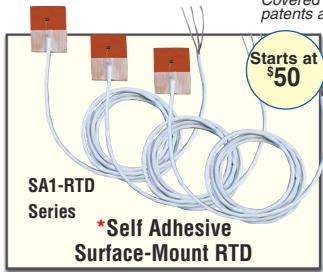
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Laying the foundation for growth

As new technologies open up new opportunities, test-equipment manufacturers prepare for a promising future.

By Lawrence D. Maloney,
Contributing Editor

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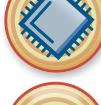
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Guest commentary

PCI Express boosts raw data transfers

PCI Express is an extension to the ubiquitous PCI bus that enables the increased performance required for raw data transfers and open data analysis in an Instrumentation 2.0 test system, reports Murali Ravindran, a product manager for PXI remote controllers at National Instruments. He elaborates on application areas opened up by PCI Express and the PXI Express instrument-focused implementation.

www.tmworld.com/guests

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Martin Rowe, Senior Technical Editor

- How to avoid (cable company) truck roll
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Taking the Measure

Rick Nelson, Chief Editor

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LXI: Instruments and Applications

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Education and Careers

Amy Laskowski, Contributing Editor

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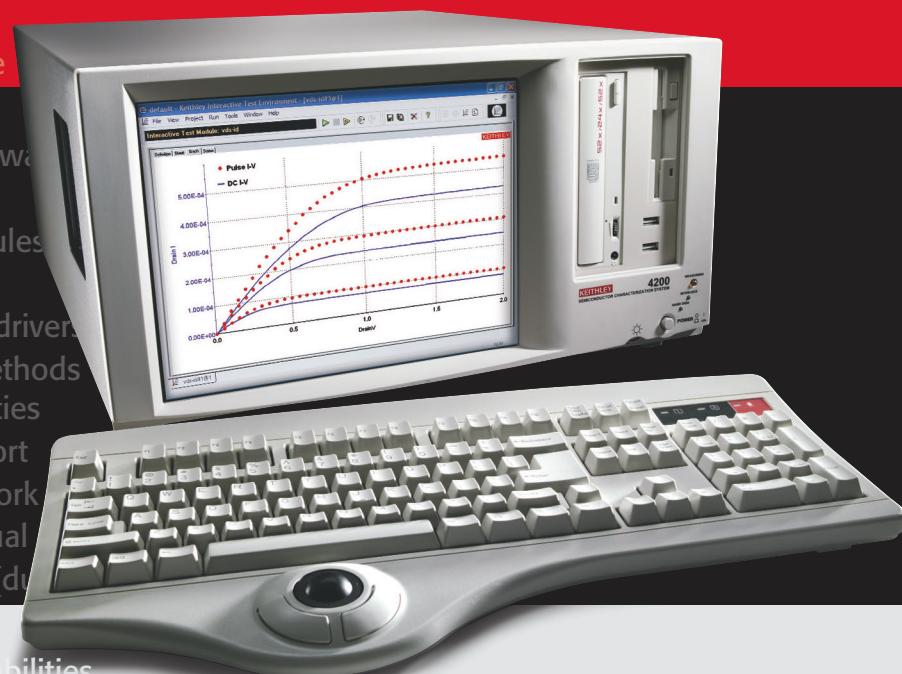
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Technology and values

Technology is neutral; it's how we use it that's good or bad.

That's been the view of various luminaries, including the physicist and engineer Simon Ramo and the management consultant Peter Drucker. Writing in the Winter 2006 edition of *IEEE Technology and Society*, Norman Balabanian collects several versions of the "technology is value-free" aphorism—and then demolishes them, asserting that "this litany of the happy technologist" constitutes an ideology of technology designed to mask the intentions of the political and economic forces behind technology development and deployment.



RICK NELSON, CHIEF EDITOR

The problem, writes Balabanian, is that the "we" to which technology-neutral proponents ascribe responsibility does not exist as a collective entity: "Surely it's some specific minds that shape technology, not an abstract 'mind'." Those minds, he suggests, reside in corporations seeking profit and market share. He cites as an example the refrigerator, whose arrival brought about the demise of neighborhood markets in favor of supermarkets to which people drive to buy a week's worth of perishable goods.

He emphasizes that he is not passing judgment on refrigerators—he's only noting that the neighborhood market is no longer an option for most consumers, and he contends that consumers had no vote in the decision to entrench the supermarket/refrigerator society.

Balabanian advocates a "harmonious technology," which "would be responsive to direct social needs and would not require a hierarchical, exploitative, and alienating relationship among human beings."

What might such a harmonious technology look like? In the Summer 2007 *IEEE Technology and Society*, Jameson M. Wetmore presents a possible picture in "Amish Technology." Wetmore dispels the stereotype that the Amish eschew technology. They adopt it when they collectively decide it will help their community. For example, Amish dairy farmers use electrically cooled and stirred bulk milk tanks to comply with state regulations. Amish adults will not drive cars but will accept rides. In fact, the resistance to cars, Wetmore writes, stemmed in part from a 1907 ad that described them not as modes of transportation but as "the king of sports and the queen of amusements"—luxuries not in keeping with the Amish lifestyle.

Unlike Drucker and Ramo, the Amish ascribe values (usually negative ones) to technology and adopt it way too sparingly. Balabanian suggests the rest of us are forced to adopt it way too rapidly. Unfortunately, he doesn't explain how to achieve his "harmonious technology." Perhaps the best we can do is keep in mind that we are voting whenever we choose to develop, market, or purchase a technological product—and our votes shouldn't be value-free. **T&MW**

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The EMC space

David Brumbaugh is a technical fellow at Boeing Phantom Works (Seattle, WA; www.boeing.com/phantom), the company's advanced research and development unit. Brumbaugh has specialized in electromagnetic compatibility (EMC) since joining Boeing in 1981, and he works on EMC design, analysis, and test. Martin Rowe recently interviewed Brumbaugh by telephone and by e-mail.

Q: What is a technical fellow?

A: Boeing has a technical career path for engineers who prefer to advance their careers as technical contributors rather than go into management.

Q: What projects have you worked on?

A: Since becoming an associate technical fellow and then a technical fellow, I've worked on EMC-related issues for several space-based and ground-based projects. I also consult on EMC issues to other groups within Boeing. I've spent most of my career in space-based systems that include the Sea Launch Company as well as Ground-based Midcourse Defense, part of the National Missile Defense System. I've worked on the International Space Station, and I also provide EMC support to the Navy's P-8A Poseidon, a maritime patrol aircraft currently under development at Boeing.

Q: Please give an example of how you use your EMC knowledge.

A: I've performed analysis of spacecraft power systems. To do that, I modeled the power system using conducted emissions test data taken on the spacecraft's individual systems. I then converted the simulated frequency response into the time domain. I could then calculate ripple on the power bus. Using the results, I can predict if there's enough margin for a new spacecraft component to work in the system. I can also use the model to predict if a new component's emissions will adversely affect other units on the power bus.

Q: Have you worked on electrostatic-related issues?

A: Yes. The environment in space is different from here on earth. A satellite in a geosynchronous orbit can become negatively charged, especially between the midnight and dawn sector of its orbit. If a difference in charge occurs between parts of the satellite, a discharge



of current can occur. I often participate in the electrostatic design that mitigates the effects of discharges.

Q: What is your involvement in EMC measurement?

A: Boeing purchases subsystems and integrates them into spacecraft and aircraft systems. I'm responsible for making sure that a vehicle is safe to fly from an EMC perspective. I test whole systems for conditions such as lightning strikes on aircraft.

Q: How do you perform such a test?

A: We inject a low-level discharge into an aircraft and measure its transfer function in the frequency domain with a network analyzer. We want to see how the discharge transfers current throughout the vehicle. The measurements are converted into the time domain to determine the effects of a full-scale lightning event.

Q: Are you involved in any technical committees?

A: I'm secretary of the IEEE 1688 committee, which is working on an EMC-testing standard for line-replaceable electronic modules [Ref. 1]. I compile meeting notes and minutes and contribute at technical meetings. The committee's goal is to establish EMC test standards that reduce the risk of electromagnetic interference when a system requires a newly designed module. I'm also involved with the SAE AE4 (SAE Aerospace Electromagnetic Environmental Effects) committee on EMC and an AIAA standards committee, which is developing a new EMC standard for space systems. **T&MW**

REFERENCE

1. Rowe, Martin, "IEEE to develop EMI standards for modular electronics," *Test & Measurement World* online, March 23, 2006. www.tmworld.com/article/CA6318250.html.

Every other month, we will publish an interview with an electronics engineer who has test, measurement, or inspection responsibilities. If you'd like to participate in a future column, contact Martin Rowe at mrowe@tmworld.com.

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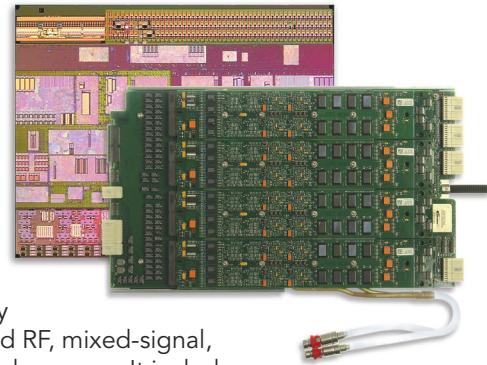
Verigy targets consumer, RF, and nanoelectronic devices

Verigy has introduced instrumentation suites that can be accommodated within a V93000 compact test head to address three key application areas: consumer mixed-signal, RF, and nanoelectronics.

The Consumer Mixed Signal system includes an MB AV8 multi-band audio-video card that addresses professional audio, baseband IQ, and video devices. The system also includes a Pin Scale 400 card (pictured), which provides 100- to 400-Mbps data rates per pin at 224 Mvectors per pin. Also included are DC Scale VI32 and DC Scale DPS32 cards to provide precision voltages and support multiple power domains. Base price: \$600,000 for a 384-pin system.

Verigy's Port Scale RF system provides the RF measurement capability required to test emerging high-integration devices containing integrated RF, mixed-signal, digital, and power-management devices as well as embedded or stacked memory. It includes a 6-GHz RF source card, an RF front-end card that provides 12 RF ports, an RF interface, an MB AV8 card, and a 48-port RF calibration kit that can support up to 10 RF systems. Base price: \$320,000.

The company also introduced its V93000 Nanoelectronics Digital system for structural and functional test for wafer sort and final test of digital ICs fabricated in 65-nm and smaller geometries. The system includes a Pin Scale 400 digital pin card that scales from DC to 533 Mbps as well as a DC Scale DPS 32 card for supporting multiple sites and multiple power domains. Base price: \$499,000. www.verigy.com.



WiMAX Forum designates first certification lab in North America

The WiMAX Forum announced the first North America-based certification test lab on June 19 during the WiMAX Forum Member Conference in Madrid. Operated by AT4 wireless, the lab will be located in Virginia and will become one of five test labs for WiMAX Forum Certified products worldwide.

The lab will conduct WiMAX Forum certification testing and radiated performance testing (RPT), and AT4 wireless will develop certification test beds to match other test beds globally. WiMAX Forum members in the Americas may submit devices for certification at the Virginia facility beginning in October. www.at4wireless.com; www.wimaxforum.org.

Test summit scheduled for Semicon West

At the SEMI Test Summit & Reception at Semicon West in San Francisco, executives from five semiconductor ATE companies will join moderator Rick Nelson, chief editor of *Test and Measurement World*, and host Ashoke Seth, test operations director at Intel, in

a discussion focused on meeting the design, test, and yield requirements for advanced semiconductor manufacturing. Panelists will include R. Keith Lee, president and CEO, Advantest America; Lavi Lev, CEO and president, Credence Systems; Tim Moriarty, presi-

dent, Nextest Systems; Mark Jagiela, president, Teradyne Semiconductor Test Division; and Keith L. Barnes, president and CEO, Verigy.

The summit will take place July 18, at 5:30 p.m. in the Moscone Center. www.semiconwest.org.

Network tester increases productivity

Spirent TestCenter 2.0, a system for testing voice, data, and video networks, increases productivity over version 1.0 by employing new software that helps users cut test-development time. TestCenter consists of a chassis with network-interface cards that generate and analyze traffic for access networks, core networks, switches, routers, and DSLAMs at protocol layers 2 through 7. You can use TestCenter for performance and conformance testing on network equipment in production or on service-provider networks.



The Inspire Architecture software lets you set up tests with a GUI and convert them to Tcl scripts. You can also convert prewritten scripts to GUIs for easy debug. A feature called HyperFilters lets you select data streams based on addresses, protocol tags, and protocol IDs and analyze them for errors.

TestCenter provides test scripts for protocols such as Ethernet at layer 2 and voice and video quality at layer 7. It also includes scripts for intermediate layers such as Internet Protocol (IP) and Multiprotocol Label Switching (MPLS).

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Landrex touts AOI system sale

Landrex Technologies has announced the sale of its Optima II 7301 Express AOI system to Intelligent Manufacturing Solutions (IMS). Jeff Buxton, technical operations manager at IMS, cited the system's quick setup time as a key feature that would benefit IMS's high-mix environment. www.landrex-us.com, www.imscorp-us.com.

T&MW editors seek nominations for Test Engineer of the Year

Each year, *Test & Measurement World* names an outstanding engineer as the Test Engineer of the Year, and we are now accepting nominations for the 2008 award. From the nominations we receive, our editors will select six finalists, whom we will profile in our October issue. Readers will then have a chance to vote for the Test Engineer of the Year, and we'll announce the winner in early 2008.

The recipient of the award will designate an educational institution to receive a grant courtesy of award spon-

CALENDAR

Autotestcon, September 17–20, Anaheim, CA. Sponsored by IEEE. www.autotestcon.com.

International Test Conference (ITC), October 23–25, Santa Clara, CA. Sponsored by IEEE. www.itctestweek.org.

Vision, November 6–8, Stuttgart, Germany. Produced by Messe Stuttgart. www.vision-messe.de.

Productronica, November 13–16, Munich, Germany. Produced by Messe Munchen. www.global-electronics.net/link/de/16407965.

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sors National Instruments and Keithley Instruments. The nomination deadline is August 1. www.tmworld.com/awards.

Mathematica gets an overhaul

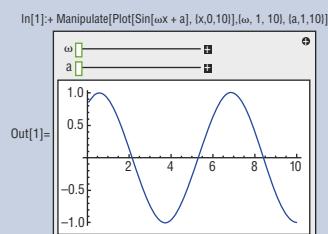
Mathematica 6 lets you import data from remote URLs without requiring you to download and save data files. It accepts data in Excel, OpenOffice, text, binary, and medical-file formats, and also lets you import audio and image files. You can then perform calculations on the data using more than 300 math functions.

You can use the bidirectional-calling feature to call code to and from many programming languages such as C, C++, C#, Java, Python, Visual Basic, and LabView. These languages appear as objects, so you can manipulate data using prewritten code, or applications can use Mathematica for calculations.

With the software's interactive data-visualization tool, you can enter an argument and data parameters with specified ranges and then use sliders to change the data and see how changes affect the plot. The figure shows the syntax for a sine wave with adjustable amplitude and frequency.

The improved FindFit function lets you define a range of data that the function should use to create a curve-fitting equation. You can also edit and plot graphics in real time, as the software applies a stream of data to your equations. Mathematica 6 runs on Windows, Macintosh, Linux, Solaris, and HP-UX.

Base price: \$2495. Wolfram Research, www.wolfram.com.



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RF tools run gamut from EDA to production test

>>> MTT-S International Microwave Symposium, June 3–8, 2007, Honolulu, HI, IEEE Microwave Theory and Techniques Society, www.ims2007.org.

Rohde & Schwarz demonstrated a true differential large-signal measurement technique for balanced active RF and microwave devices. The company also presented the ZVL combined vector network analyzer and spectrum analyzer; the FMU36 baseband spectrum and vector signal analyzer; the AMU200A, which combines signal generators and faders; the NRP-Z81 USB-enabled sensor; and for its 24-GHz ZVA24 and 40-GHz ZVA40 four-port vector network analyzers, the ZVA-Z110 option, which allows the instruments to make measurements between 75 and 110 GHz (W band).

Anritsu debuted its 6-GHz MS2690A and 13-GHz MS2691A signal analyzers. The company also introduced new portable Site Master analyzers for P25 and Tetra systems. **Giga-tronics** displayed its new 2520GTA signal generator. The 20-GHz instrument offers frequency and amplitude switching speeds of better than 350 μ s for any step size over its full frequency range.

Tempronic highlighted its new Mobile-Temp system, which supports the test of standard and high-frequency devices, assemblies, modules, PCBs, and multiple UUTs from -65° to $+200^{\circ}$ C in a compact mobile enclosure lo-

cated at the tester site. **Agilent Technologies** exhibited instruments such as its 10-MHz to 26.5-GHz PNA-X microwave network analyzer, the MXG signal generator and MXA signal analyzer, and a series of LXI (class A-certified) synthetic instruments. Agilent also announced that it is integrating its Electromagnetic Design System (EMDS) full-wave 3-D simulator into the company's Advanced Design System (ADS) EDA software platform.

National Instruments presented its PXI RF switch offerings and demonstrated PXI systems for RFID and other RF measurement applications. **Cascade Microtech** highlighted enhancements to its WinCal XE device-characterization tools. **Aeroflex** demonstrated its 3-Hz to 3-, 13.2-, and 26.5-GHz 3280 series spectrum analyzers, which now offer digital demodulation capabilities for 802.11a/b/g signals.

Peregrine Semiconductor announced that, through a collaborative effort with **Oki Semiconductor**, Oki is shipping in production volumes RFICs employing Peregrine's 0.5-micron UltraCMOS. Peregrine also introduced several flip-chip RF-switch ICs. **T&MW**



The 50-MHz to 18-GHz NRP-Z81 USB-enabled sensor combines an RF detector with analog- and digital-signal-processing capability to add full power-meter functionality to a PC.

Courtesy of Rohde & Schwarz.

EDA firms tackle feature-dependent defects

>>> Design Automation Conference, June 4–8, 2007, San Diego, CA, IEEE, EDA Consortium, and SIGDA, www.dac.com.

Cadence, Mentor Graphics, and Synopsys all said they are pursuing design for test (DFT) along several fronts to accommodate a shift from random fabrication defects to feature-dependent defects. The three EDA companies are offering tools that allow test engineers to perform what some call "volume diagnostics" and others refer to as "defect diagnostics"—these tools gather data on errors found during the test of many devices, then make that data available for engineers to analyze.

The **MathWorks** introduced its Simulink Design Verifier, a software tool that generates tests and proves the design properties of model-based designs. Models can be implemented in Simulink or Stateflow using the Prover plug-in from **Prover Technology**. **National Instruments** highlighted the role of PXI in benchtop semiconductor test. A demonstration system at the NI booth showed how PXI could be used in the test of ICs, including digital and mixed-signal ICs.

Breker Verification Systems released Trek, a functional test synthesis tool that analyzes a verification plan for coverage and then generates test vectors. **ARM** announced the AMBA adaptive verification engine, which extracts and applies traffic profile information to predict how designs will perform. **Anchor Semiconductor** highlighted its NanoScope tool, which uses pattern matching to examine chip layouts.

Knowlent previewed its analog Opal Test Bench Builder, currently in beta test, which leverages the company's Viper test language to capture design specifics and generate simulator-specific test code. **Synplicity** released its Confirma platform, a hardware-assisted verification platform for FPGA-based prototyping of ASIC and ASSP designs. **T&MW**

See the online version of this article at www.tmworld.com/2007_07 for links to vendors and to our complete coverage of the International Microwave Symposium and the Design Automation Conference.

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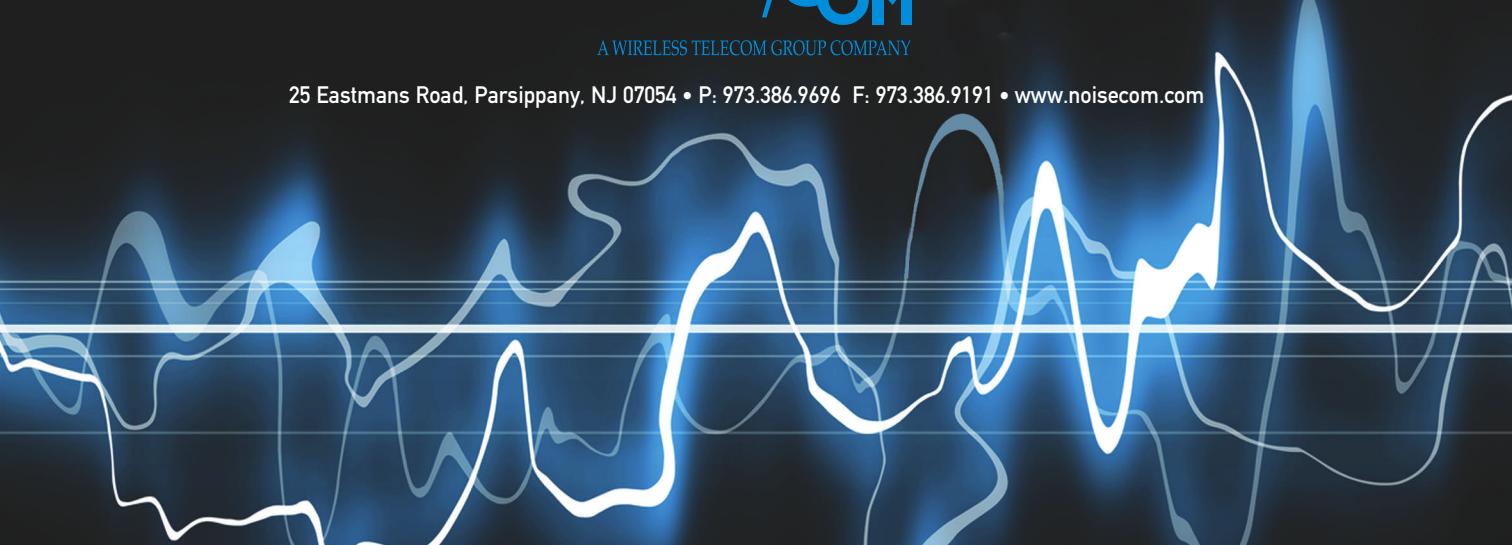
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Fixed-mobile convergence imposes test challenges

Fixed-mobile convergence is spurring on wireless applications, said keynote speaker Anil Kripalani on June 5 at the IEEE MTT-S International Microwave Symposium (IMS) in Honolulu, HI. Kripalani, senior VP for global technology affairs at Qualcomm, predicted that wireless handheld devices will let consumers make purchases, navigate, watch TV, access the Internet, interact with smart buildings, and monitor their health.

As RF applications proliferate, the chips, boards, and products that serve them will present numerous design challenges. Also at the IMS, Guy Sene, a VP and GM at Agilent Technologies, described two key technologies—3GPP Long Term Evolution (LTE) and WiMAX—and Agilent's strategies for addressing them, which include providing products ranging from ADS design-automation software to the MXZ-1000 manufacturing test system for WiMAX consumer premises equipment (CPE) and PC cards. The system supports fixed (IEEE 802.16-2004) and mobile (IEEE 802.16e-2005) systems using a point-to-point or point-to-multipoint architecture.

Along with Agilent, several other vendors at the IMS demonstrated instruments to speed the design and test of RF products. The instruments (see p. 15) ranged from the Rohde & Schwarz FMU36 baseband analyzer, which facilitates design characterization, to the Giga-tronics 2520GTA signal generator, which features switching speeds of better than 350 μ s to speed manufacturing test.

Of course, key to the success of consumer wireless products will be the ability to test the chips that go into them. In a phone interview, Keith Lee, president and CEO of Advantest America, said it's getting easy to drop RF circuitry onto a substrate but that testing

that circuitry is a complex task. Lavi Lev, CEO of Credence Systems, noted in an e-mail exchange that increasing RF integration will require test systems that are flexible and that can be easily adapted to customer requirements. And Mark Jagiela, president of the Teradyne Semiconductor Test Division, said in a phone interview that



The MXZ-1000 WiMAX manufacturing test system combines the Agilent MXA signal analyzer, MXG signal generator, and an interface unit.

Courtesy of Agilent Technologies.

mixed digital and RF devices pose challenges in deciding whether to use an "uber tester" for single-insertion test or to distribute test among multiple test systems.

Lee, Lev, and Jagiela will participate in the SEMI Test Summit during Semicon West in San Francisco, and you can expect RF test to be one of the topics they discuss. Verigy president and CEO Keith Barnes will join them. He didn't comment specifically on RF test in an interview before the event, but Verigy's RF direction is suggested in its June 26 introduction of the Port Scale RF card for the V93000 SOC test platform (see p. 11). The instrument provides the RF measurement capability required to test devices containing integrated RF, mixed-signal, digital, and power-management circuitry as well as memory.

The SEMI Test Summit, which I will moderate, will be held at 5:30 p.m. on July 18 in the Moscone Center West Hall, Level 2. Nextest Systems president Tim Moriarty is also slated to participate. **T&MW**

ScanBooster supports USB 2.0

Goepel electronic has introduced the ScanBooster/USB-FXT controller, which is based on a USB 2.0 interface. The new ScanBooster complements the already existing ScanBooster products, which provide critical TAP access for ATE fixtures and for HASS/HALT applications, supporting JTAG test and in-system programming. ScanBooster/USB-FXT features two separate TAPs and supports programmable TCK frequencies to 16 MHz. www.goepel.com.



LTX shifts manufacturing to Malaysia

LTX has announced plans to transition the manufacturing of its X-Series test systems to Jabil's Penang, Malaysia, facility from its current location in Billerica, MA. The move is designed to reduce LTX's cycle times and to augment its competitiveness in the global marketplace, according to a statement released by the company. The initiative, already underway, is targeted for completion by August 2008. www.jabil.com; www.ltx.com.

Test Equipment Connection offers Huntron gear

Test Equipment Connection has entered into a US distribution sales agreement with Huntron to sell Huntron's Tracker 2700 and 2700S. These benchtop instruments use power-off signature analysis to identify component failures on printed-circuit boards (PCBs). The Tracker 2700S adds the ability to scan and compare up to 40 pins/channel using standard IC clips and cables. www.testequipmentconnection.com; www.huntron.com.

USB. In detail.

USB Data Acquisition

Product Selection Chart

USB Model	Summary	Analog Resolution (bits)			
		# of Channels	Throughput	Resolution (bits)	Notes
DT9871	48 thermocouple inputs, CJC per input, high accuracy, channel-to-channel isolation	48DI	10Hz per channel	24	\pm 1V
DT9805, DT9806	7 thermocouples, 1 CJC, temperature applications, 500V isolation	8DI/16SE	50kHz**	16	\pm 20V
DT9837	4 IEPE (ICP) sensor inputs, tachometer, simultaneous A/Ds	4 IEPE (SE) + 1 Tacho	52.734kHz* per channel	24	\pm 1V
DT9841-VIB	8 IEPE (SE) + 1 Tacho	8IEPE (SE)	100kHz* per channel	24	\pm 1V
	Simultaneous	2SE	2.0MHz* per channel	16	\pm 5V
	16-bit, up to 16 analog inputs, 500kHz, 16-bit, 500kHz	4SE	1.25MHz* per channel	16	\pm 5V
		6 or 12SE	225kHz* per channel	16	\pm 5V
		16SE/8DI	500 kHz*	16	\pm 5V

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Calibrate camera coordinates and colors

Cameras used for metrology or color matching need calibration. Lenses can slightly distort images, and improperly mounting a camera can introduce measurement errors. Improper lighting or ambient light conditions can distort colors.

A machine-vision lens may exhibit barrel distortion, an effect that causes the sides of a square to bow out slightly in an image. This type of distortion can cause a 1–2% error be-



This Digital ColorChecker SG calibration chart provides 140 squares that represent a range of colors, gray scales, and skin tones. Although used primarily to calibrate photography cameras, the chart can calibrate color-vision equipment, too.

Courtesy of X-Rite and GretagMacbeth.

tween edges on an object and those in a camera's image. If your application cannot accept a measurement error within that range, choose machine-vision software that will compensate for barrel distortion or buy a higher-quality lens that can reduce barrel distortion to about 0.1%. (When you talk with lens companies about lens distortion, you may hear a "promille" specification, which means parts per thousand. Thus, 0.1% becomes 1 promille.)

A lens also can cause pincushion distortion that alters the sides of a square in an image so they appear to bow in slightly. This type of effect usually appears in inexpensive telephoto lenses. Again, software could correct for pincushion distortion, or you could move a camera closer to an object or buy a better lens.

A poorly mounted camera can produce perspective or trapezoidal distortion that makes distant objects in the camera's depth of field look closer together. In metrology applications, you must calibrate for this distortion or mount a camera perpendicular to the surface of the object you want to inspect.

To determine the extent of distortion, you can use a standard chart that provides accurately spaced and sized targets. This information also lets you relate an x -mm distance to the number of pixels that represent that distance in an image. An Accu-Place Dot-Distortion Target from Applied Image, for example, gives a camera dimensional targets that range from 2-mm-diameter circles on a 4-mm grid in an outer zone to 0.20-mm dots on a 0.40-mm grid in the center. Engineers can obtain other types of dimensional-calibration targets, too.

You may not need to calibrate your vision system's color measurements if you plan a simple comparison that distinguishes, say, white from red, because qualitative color information will suffice. But if your vision system must compare a color, perhaps on a keyboard or LCD, with a standard, you must calibrate the system's color measurements.

You can buy several types of standard color charts, but the Color-Checker charts from GretagMacbeth provide one of the better ranges of colors in a pattern of squares. The supplier offers a corresponding list of RGB values (daylight illumination) for each square, so you can relate standard colors to the RGB values your camera produces and the RGB values that your vision-system software processes and displays. **T&MW**

FOR FURTHER READING

For more information on barrel and pincushion distortion, go to www.vanwalree.com/optics/distortion.html.

For more information about color calibration, go to www.babelcolor.com/main_level/ColorChecker.htm.

Banner debuts low-angle ring lights

A 150-mm low-angle ring light from Banner Engineering uses three tiers of LEDs for high-intensity, low-angle illumination. The light connects to Banner's PresencePLUS vision sensors or to an external power supply to provide optimal illumination of a part by enhancing the contrast of surface features. Models are available with infrared or visible red LEDs and offer continuous or strobed operation. www.bannerengineering.com.



Camera employs GigE interface

The GC750 machine-vision camera from Prosilica connects to the Gigabit Ethernet port of a host computer and does not require a frame grabber. Built with a progressive-scan CMOS sensor and electronic shutter for capturing high-speed motion events, the GC750 runs at 60 fps with a resolution of 752x480 pixels. The camera comes in monochrome and color versions supporting both 8-bit and 10-bit formats. www.prosilica.com.

System finds macro defects

Rudolph Technologies has begun shipping its NSX 100 automated macro-defect inspection systems that can inspect wafers in sizes of up to 200 mm at throughputs of up to 88 wafers per hour. Rudolph claims that the NSX 100 system is well-suited for processes such as gold-bump inspection, where higher resolution provides little or no benefit but higher throughput lowers cost of ownership. www.rudolphtech.com.

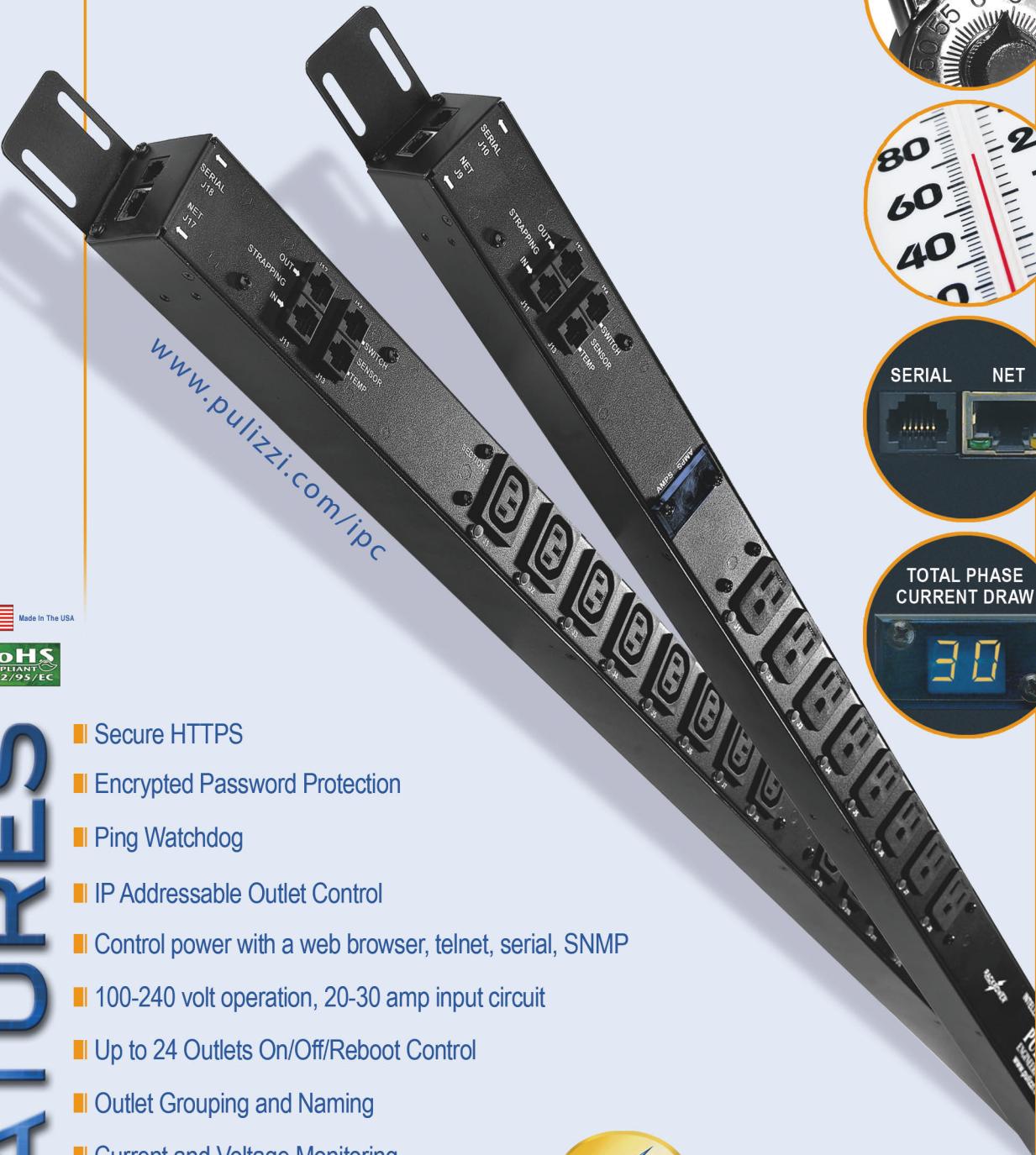
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As new technologies open up new opportunities, test-equipment manufacturers prepare for a promising future.

Laying the FOUNDATION for GROWTH

BY LAWRENCE D. MALONEY, CONTRIBUTING EDITOR

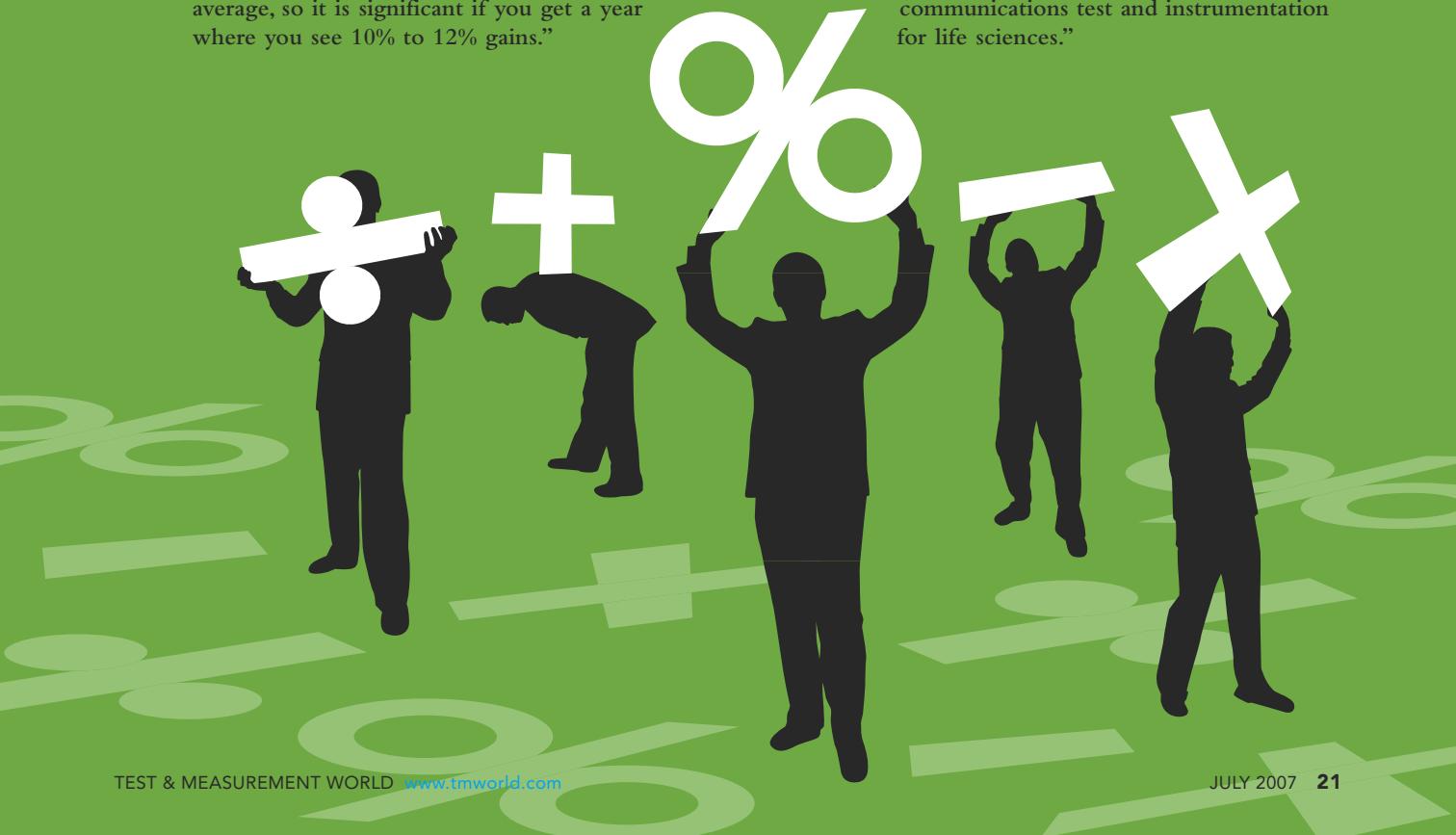
With solid performance almost across the board in 2006, the giant companies that set the pace for the test field finally put the last tech bust behind them. Leveraging new products, sharper market strategies, and fresh opportunities from new technology, half of the industry's top 10 public companies enjoyed double-digit growth last year. Even those with more modest performance saw a jump in orders that set the table for better times in 2007 and beyond.

"Electronic test is a mature field," noted analyst John Harmon of Needham & Company. "Over the long term, annual revenue growth of 6% to 7% is average, so it is significant if you get a year where you see 10% to 12% gains."

Instrumentation in sharper focus

Industry leader Agilent Technologies, whose revenues in 2006 grew by a relatively modest 5% to just over \$3.4 billion in electronic measurement, is nonetheless viewed by analysts as a much tougher competitor, now that it has spun off its semiconductor test and semiconductor products divisions.

"If you analyze Agilent's past history, semiconductor ATE tended to be a negative, because of the cyclical nature of that business," observed senior research analyst S. Vidyasankar of Frost & Sullivan. "Now, the company can concentrate on such promising areas as communications test and instrumentation for life sciences."





In 2007, Agilent's focus is on "Phase II" of its transformation, said president and CEO Bill Sullivan. "We have strategically chosen key growth areas that include voice, video, and data network services, mobile Internet such as Mobile WiMAX and LTE, and the expanding electronics manufacturing market in Asia."

Harmon of Needham already sees signs of a leaner, meaner Agilent, which could pose a stiffer test for competitors. "Three years ago, Agilent was a year late in the product cycle for high-end oscilloscopes versus Tektronix," noted Harmon. "Now, it is a horse race again."

Three times the size of its nearest direct competitor—Tektronix—Agilent simply has a much wider product line to build on, pointed out Kiran Unni, research manager in Frost & Sullivan's Measurement and Instrumentation Group. "It also has a large mind share in the life sciences field." Agilent notched \$1.55 billion in sales from those bio-analytical measurement devices in 2006.

At just over \$1 billion, revenues at Tektronix were essentially flat in 2006, and Unni suggested that the company needs to put a greater focus on broadening its product line and market applications rather than pushing the performance envelope on such products as \$100,000 oscilloscopes.

But Tektronix CEO Rick Wills said that sales were only part of the story in 2006. "Yes, our sales were about flat, but our orders were up nearly 13%." Wills claimed that Tek is now delivering on "the most impressive flow of new products that I've seen in my 27 years with the company." He noted that in the oscilloscope line, the company has replaced every model from \$7000 up to \$150,000.

The Tektronix CEO also pointed to the company's progress in growing newer areas of the business, such as signal sources and spectrum analyzers, which have enjoyed a compound annual growth rate of more than 30% over the last four years. "The short answer is we plan to keep doing what we've been doing," Wills said.



Agilent's Sullivan:
Focus on communications test.

Courtesy of Agilent Technologies.

Top 10 test-and-measurement companies in revenue (publicly traded companies)

COMPANY	2006 RANK	2005 RANK	2006 REVENUES (MILLIONS US\$)	2005 REVENUES (MILLIONS US\$)	PERCENT CHANGE
Agilent Technologies	1	1	3,419.0 ¹	3,265.0	5.0
Advantest	2	2	1,999.0	2,138.0	-7.4
Teradyne	3	3	1,376.8	1,075.2	28.0
Tektronix	4	4	1,039.9	1,034.7	flat
Fluke	5	5	1,011.0 ²	945.0	7.0
Anritsu	6	6	842.0	766.0	9.0
Verigy	7	N/A	778.0 ³	456.0	71.0
National Instruments	8	7	660.4	571.8	15.5
Aeroflex	9	8	551.8	463.4	19.0
Credence Systems	10	9	474.4	429.3	11.0

¹Agilent Technologies revenues include only electronic measurement operations. Instrumentation for bio-analytical measurement totaled \$1.55 billion in 2006.

²Danaher does not report separate figures on its Fluke/Fluke Networks units. Our figures are an estimate, based on the reported 7% business increases in 2006 for its existing electronic test businesses.

³Verigy was spun off from Agilent Technologies in 2006.

Note: Rohde & Schwarz, a privately held company, reported annual sales of 1.3 billion euros in the fiscal year ending June 2006, an 18% increase over the previous year. This would make R&S the industry's third largest in this list, if privately held firms were included.

Thrills and chills in ATE

If the semiconductor automated test equipment (ATE) business is a scary roller-coaster ride, industry youngster Verigy must be enjoying it. In the fiscal year ending October 31, 2006, Verigy's sales rose a whopping 71% to \$778 million. Verigy was spun off from Agilent Technologies during 2006. "Clearly, Agilent sold this business at a high point," noted Harmon of Needham.

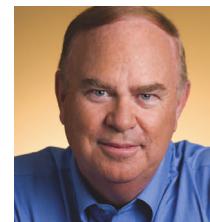
While sales were off slightly for Verigy in the first quarter of 2007 versus the same period in 2006, CEO Keith Barnes said that "Verigy's balanced product portfolio, focused in both SOC and memory device test, helped us continue to deliver solid results even during a cyclically soft period in the semiconductor test industry." Among the most promising growth drivers for Verigy: expansion of its flash memory, high-speed memory, and high-speed I/O areas.

Meanwhile, Japan's Advantest, the industry's semiconductor ATE kingpin, saw sales slip by 7.4% in the fiscal year

that ended in March of 2007, in part because of sluggish sales in nonmemory test systems. Still, the company is predicting overall sales growth of 8.5% this year. "We have a strategy for gaining share in flash memory and pursuing new customers in the DRAM market, in addition to our commitment to long-time memory customers," said R. Keith Lee, president and CEO of Advantest America.

In the second half of 2006, for example, Advantest announced its new T5383 test system for multipurpose memory devices, such as DRAM and SDRAM, as well as for flash memory and multichip packages. Lee claimed that this new system is also a "very cost-effective solution for communications device manufacturers, who face constant downward pricing pressure."

Advantest also is making progress in ramping up its system-on-chip (SOC) test business. The company now enjoys a market share of 30% in nonmemory test, according to Lee, up from just 10% in 2003. What's the biggest priority for Advantest in its new fiscal year? "We see both memory and nonmemory markets picking up in 2007 and 2008," said Lee, "but our biggest priority is continued investment in



Barnes of Verigy:
Counting on a balanced portfolio.

Courtesy of Verigy.

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R&D, which is the key to growth." He cited development of new testers for the RF wireless market as an example.

Certainly, Advantest can't afford to rest on its laurels. Teradyne, a key competitor in the SOC test area, saw its 2006 sales rise by 28% to \$1.38 billion. "Our flagship products, the FLEX [an SOC tester] and the J750 [a parallel tester], were the biggest reasons behind our strong 2006," said CEO Michael Bradley. "By strategically repositioning the company on our test core in the last few years, we've been able to put our collective muscle behind these products."

"Teradyne is very active and is competing well in Asia against Advantest," said Vidyasankar of Frost & Sullivan. One sign of that progress: VLSI Research earlier this year named Teradyne on its 2006 list of "Best Customer-Rated Suppliers in China."



Teradyne's Bradley:
Success from core
products.

Courtesy of Teradyne.

New products: lifeblood of growth

Among other top 10 companies, National Instruments chalked up revenues of more than \$660 million in 2006. But that gain of 15.5% did not impress analyst Harmon of Needham, who pointed to past years where increases of 20% or more were commonplace at NI.

Dr. James Truchard, NI's president and CEO, countered that the company made the strategic decision during the downturn to invest in long-term performance by earmarking 16% of its revenue for R&D. "Today, we are seeing this strategy pay off with a record number of new products released in 2003, 2004, and 2005," said Truchard. "This is the key



Wills of Tektronix:
Order backlog
boosts 2007.

Courtesy of Tektronix.

to achieving a 20% revenue growth."

Frost & Sullivan's Unni also underscores the potential rewards from NI's concentration on new products and emerging applications. She is impressed, for example, with the latest version of LabView (8.2), which includes such features as an FPGA wizard and a Web services wizard.

In general, while the test market can be viewed as mature, analysts still see healthy opportunities, as companies create products to respond to such areas as nanotechnology, wireless communications test, and future generations of ICs.

Said Needham's Harmon: "At their most recent analyst meetings, both Agilent and Tektronix essentially said that we are in the middle of a 10-year economic growth cycle. I don't see anything that would derail the industry from solid growth." **T&MW**

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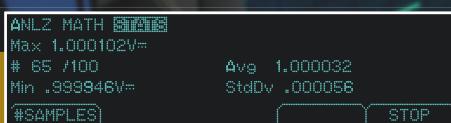
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IN THIS SECTION

- ▷ Stand-Alone Test Instruments, below
- ▷ Modular Instruments, p. 36
- ▷ Sensors, p. 44
- ▷ Software, p. 46
- ▷ Accessories, p. 51
- ▷ Third-Party Suppliers, p. 52
- ▷ Services/Labs/Test Houses, p. 52

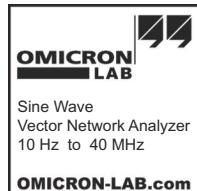
Vendor contact information begins on p. 99.

STAND-ALONE TEST INSTRUMENTS

Analyzers, Logic and Bus

Agilent Technologies
AIM USA
Catalyst Enterprises
FuturePlus Systems
GE Fanuc
GOEPEL Electronics
Intellitech
LeCroy
Tektronix
Thurlby-Thandar Instruments (TTi)
VMETRO

Krohn-Hite
LDS Test and Measurement
Leader Instruments
LeCroy
LMS North America



OROS

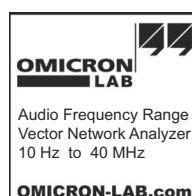
Pendulum Instruments
QualityLogic
Sencore
Signal Recovery
Stanford Research Systems
SyntheSys Research
Tektronix
Vibration Research
Wavecrest
Yokogawa Corp. of America

Attenuators, Electronic

JFW Industries

Audio Test Sets

Agilent Technologies
Audio Precision
Berkeley Nucleonics
Boonton Electronics
Bruel & Kjaer, N.A.
Data Physics
Dewetron
EADS N.A. Defense Test & Services
Fluke
GHI Systems
GOEPEL Electronics
Hioki USA
Hi-Techniques
JDSU



Rohde & Schwarz
Sencore
Tecpel
Tegam
Tektronix

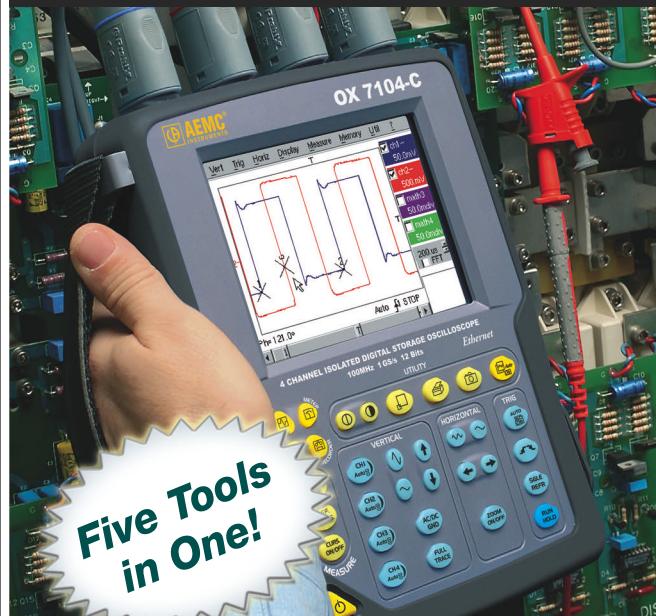
Calibration Standards

Agilent Technologies
Anritsu
Beamex
Boonton Electronics
Clarke-Hess Communication Research
Fluke
Gigahertz-Optik
Guildline Instruments
IET Labs

Krohn-Hite
Newport Electronics
NoiseCom
North Atlantic Industries
Novatech Instruments
Owens Design
Pacific Instruments
Pendulum Instruments
Picosecond Pulse Labs
Precision Test Systems
Pyrometer Instrument
Ross Engineering
Rotek Instrument
Spectracom
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VLSI Standards

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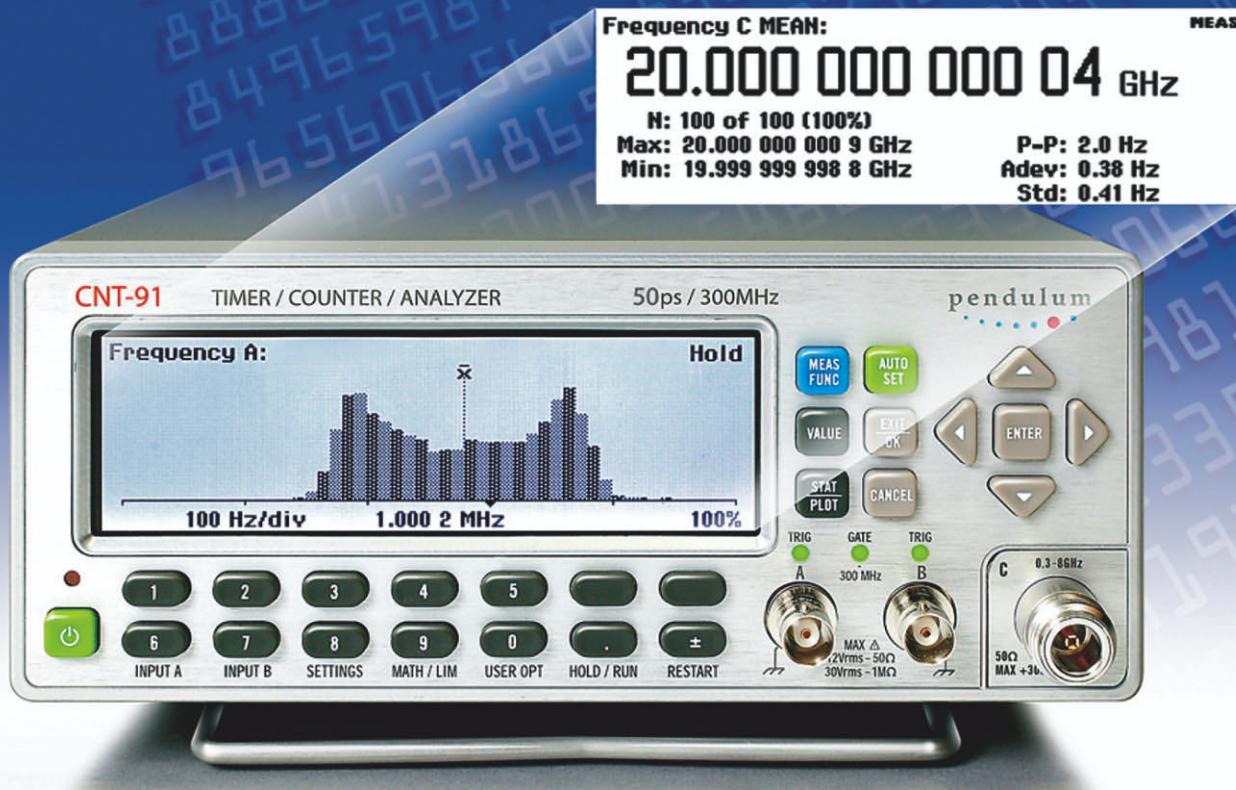


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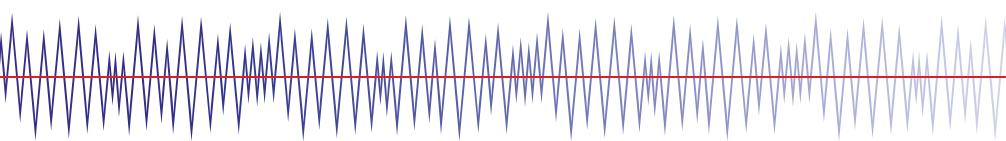
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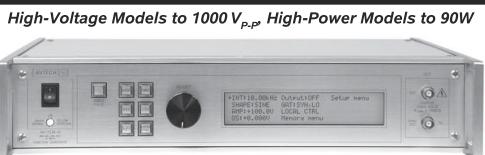
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INSTRUMENTATION

> STAND-ALONE TEST INSTRUMENTS *Continued*

LDS Test and Measurement	VXI Technology	Amprobe	Pacific Instruments	B&K Precision
Linseis	Yokogawa Corp. of America	B&K Precision	Picosecond Pulse Labs	Cablescan
m + p international		Extech Instruments	Precision Filters	CableTest Systems
M/RAD		Fluke	Signal Recovery	Chroma ATE
Measurement Computing	DMMs, Benchtop/System	GMC-I Gossen	Stanford Research Systems	Cirris Systems
Monarch Instrument	Agilent Technologies	Metrawatt		DIT-MCO International
National Instruments		Hioki USA		Electronic Systems of Wisconsin
Newport Electronics	Amprobe	Insteck America		Glassman High Voltage
Omega Engineering	B&K Precision	Linseis		GMC-I Gossen
Onset Computer	Fluke	Newport Electronics		Metrawatt
OptoTest	GMC-I Gossen	Omega Engineering		Hioki USA
Pace Scientific	Metrawatt	Protek Test and Measurement		Hipotronics
Pacific Instruments	Hioki USA	Sencore		Insteck America
Photron	Instek America	Sperry Instruments		Keithley Instruments
Pico Technology	Keithley Instruments	Tecpel		Kikusui America
Rotronic Instrument	Protek Test and Measurement	Tegam		QuadTech
Saelig	Rigol Technologies			Ross Engineering
SOLTEC	Signal Recovery			Seaward Group
Sony Manufacturing Systems America	Tegam	Alligator Technologies		Sefelec
Tecpel	Thurlby-Thandar Instruments (TTi)	DL Instruments		Slaughter
Telatemp	Yokogawa Corp. of America	Frequency Devices		Tecpel
United Electronic Industries	DMMs, Handheld	JDSU		
VMETRO	AEMC Instruments	Kemo	Intermittent Fault Testers/Analyzers	
	Agilent Technologies	Krohn-Hite	CableTest Systems	

High Voltage Function Generators & Amplifiers



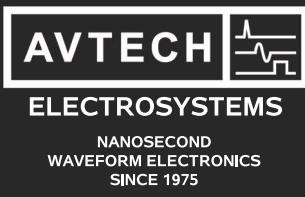
High-Voltage Models to 1000 V_{p-p}, High-Power Models to 90W

Model	Max. Output	BW	Details
AV-151A-B	±500V to 100 kΩ	3 kHz	The AV-151 and AV-153 series of function generators provide medium to high voltage outputs at frequencies as high as 1 MHz.
AV-151J-B	±400V to 10 kΩ	50 kHz	Aside from generating sine, square, and triangle wave outputs from the internal oscillator, all models can also be used as variable-gain linear amplifiers for external inputs. This makes the AV-151 & AV-153 models useful as booster amplifiers for low-voltage arbitrary waveform generators.
AV-151B-C	±200V to 50 kΩ	100 kHz	Many models are available with IEEE-488.2 GPIB and RS-232 ports. Ethernet connectivity is optional on these models.
AV-151G-B	±200V to 50 kΩ	350 kHz	
AV-153AH-B	±200V to 1.2kΩ	300 kHz	
AV-153B	±135V to 500 Ω	50 kHz	
AV-151C-B	±100V to 10 kΩ	200 kHz	
AV-153C-B	±90V to 100 Ω	30 kHz	
AV-151H-B	±50V to 10 kΩ	1 MHz	
AV-151D-B	±30V to 50 Ω	1 MHz	
AV-151E-B	±25V to 20 Ω	20 kHz	

For details about the 151 and 153 families, visit <http://www.avtechpulse.com/function>.

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Pacific Instruments	B&K Precision
Picosecond Pulse Labs	Cablescan
Precision Filters	CableTest Systems
Signal Recovery	Chroma ATE
Stanford Research Systems	Cirris Systems

Electronic Loads

Advanced Power Designs	Electronic Systems of Wisconsin
AMREL	Glassman High Voltage
Autotest	GMC-I Gossen
C&D Technologies	Metrawatt
California Instruments	Hioki USA
Chroma ATE	Hipotronics
Insteck America	Instek America
Keithley Instruments	Kikusui America
Kikusui America	QuadTech
Sencore	Ross Engineering

Electronic Filters

Alligator Technologies	Seaward Group
DL Instruments	Sefelec
Frequency Devices	Slaughter
JDSU	Tecpel
Kemo	
Krohn-Hite	
Micro Lambda	
Wireless	

Generators, Pulse, Function, Arbitrary

Agilent Technologies	LCR Meters/ Bridges
Amprobe	Agilent Technologies
Anritsu	B&K Precision
Applied Signal Technology	Fluke
Avtech Electrosystems	Instek America
B&K Precision	Leader Instruments
Berkeley Nucleonics	Madell Technology
Chase Scientific	Protek Test and Measurement
Data Physics	Sencore
Directed Energy	Tecpel
Fluke	
Highland Technology	
Hioki USA	
Insteck America	
Keithley Instruments	
Kikusui America	
Krohn-Hite	
Leader Instruments	
Madell Technology	
NoiseCom	
Picosecond Pulse Labs	
Rigol Technologies	
Signal Recovery	
Stanford Research Systems	
Tabor Electronics	
Tecpel	
Tegam	
Tektronix	
Thurlby-Thandar Instruments (TTi)	
Yokogawa Corp. of America	

Highland Technology	Oscilloscopes, Benchtop, Analog
Hioki USA	Agilent Technologies
Insteck America	B&K Precision
Keithley Instruments	Fluke
Kikusui America	Instek America
Krohn-Hite	Leader Instruments
Leader Instruments	Madell Technology
Madell Technology	Protek Test and Measurement
NoiseCom	Sencore
Picosecond Pulse Labs	Tecpel
Rigol Technologies	
Signal Recovery	
Stanford Research Systems	
Tabor Electronics	
Tecpel	
Tegam	
Tektronix	
Thurlby-Thandar Instruments (TTi)	
Yokogawa Corp. of America	

Oscilloscopes, Benchtop, Digital, Below 1 GHz

Agilent Technologies	OMICRON LAB
B&K Precision	R, L, C, Q
LeCroy	Impedance Meter
SyntheSys Research	10 Hz to 40 MHz
Tektronix	
Wavecrest	
Yokogawa Corp. of America	
Oscilloscopes, Benchtop, Digital, 1 GHz and Above	OMICRON-LAB.com
Agilent Technologies	
B&K Precision	
LeCroy	
SyntheSys Research	
Tektronix	
Wavecrest	
Yokogawa Corp. of America	
Oscilloscopes, Benchtop, Digital, Below 1 GHz	OMICRON-LAB.com
Agilent Technologies	
Data Physics	
Fluke	
Hameg Instruments	
Hi-Techniques	
Instek America	
LDS Test and Measurement	
LeCroy	
Madell Technology	
Rigol Technologies	
Tektronix	
Yokogawa Corp. of America	

Hipot/Insulation Breakdown Testers

AEMC Instruments	
Associated Research	

Magnetic Field (Gauss/Tesla) Meters

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Lake Shore Cryotronics	
Magnetic Shield	
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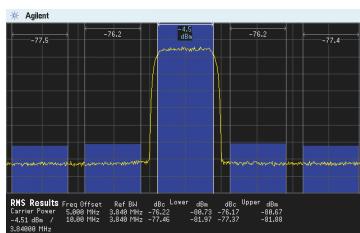
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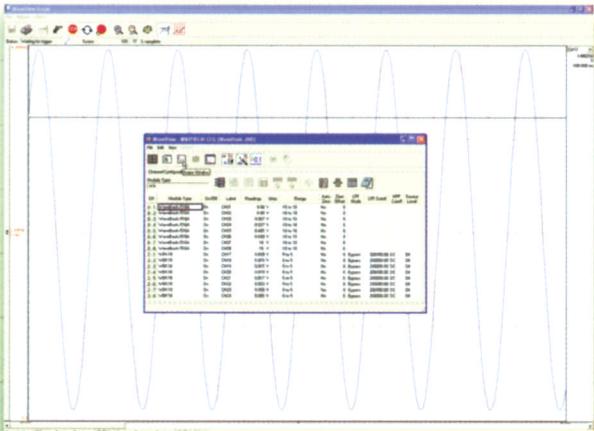
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INSTRUMENTATION

> STAND-ALONE TEST INSTRUMENTS *Continued*

Oscilloscopes, Handheld

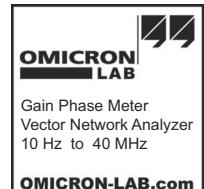
AEMC Instruments
Agilent Technologies
Data Physics
Fluke
Saelig

Pattern Generators, Digital

Agilent Technologies
Anritsu
Berkeley Nucleonics
Centellax
Chroma ATE
Klein Instruments
Leader Instruments
LeCroy
Sencore
SyntheSys Research
Tabor Electronics
Tektronix
VMETRO

Phase Meters/ Phase Angle Voltmeters

Agilent Technologies
Audio Precision
Clarke-Hess Communication Research
Colby Instruments
Extech Instruments
Flex-Core
Hioki USA
Krohn-Hite
North Atlantic Industries



Signal Recovery
Sperry Instruments
Tecpel
Xitron Technologies
Yokogawa Corp. of America

Power Amplifiers

AR, RF/Microwave Instrumentation
AudioControl Industrial
California Instruments
Chroma ATE
Clarke-Hess Communication Research
Elgar Electronics
Extech Instruments
Glassman High Voltage
Hameg Instruments
Hioki USA

Clarke-Hess Communication Research
Data Physics
Krohn-Hite
Ophir RF
Tabor Electronics
Trek

Power Monitors/ Analyzers

Advanced Power Designs
AEMC Instruments
Agilent Technologies
Berkeley Varitronics Systems
Bird Electronic
Chroma ATE
Clarke-Hess Communication Research
Dewetron
Extech Instruments
Flex-Core
Fluke

GMC-I Gossen
Metrawatt
Hioki USA

IOtech
Magtrol
National Instruments
Ross Engineering
Sencore
Spectrum Control
Tektronix
Xitron Technologies
Yokogawa Corp. of America

Power Sources & Conditioners

ABSOPULSE Electronics
Advanced Power Designs
Aeroflex
Agilent Technologies
AMREL
Autotest
B&K Precision
Behlman Electronics
C&D Technologies
California Instruments
Chroma ATE
Clarke-Hess Communication Research
Elgar Electronics
Extech Instruments
Glassman High Voltage
Hameg Instruments
Hioki USA

Hipotronics
Insteek America
Keithley Instruments
Kepco
Kikusui America
Lake Shore Cryotronics
Lambda Americas
Ling Electronics

Pacific Power Source
Pulizzi Engineering
Sens-Tech
Spectrum Control
Spellman High Voltage Electronics
Superior Electric
Tamura Corp. of America

Tecpel
Thurlby-Thandar Instruments (TTI)
Tracewell Systems
Vektrex Electronic Systems
Vicor
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EXFO
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Ixia	Measurement	Level Meters
LeCroy	Macro Sensors	
Syntx	Measurement	AEMC Instruments
SyntheSys Research	Computing	Bruel & Kjaer, N.A.
Tektronix	Microstar Laboratories	Casella USA
VMETRO	National Instruments	Extech Instruments
Wavecrest	Neff Instrument	IET Labs
	Newport Electronics	Leader Instruments
	Omega Engineering	m + p international
	Pacific Instruments	Monarch Instrument
Signal Conditioners	PCB Piezotronics	Protek Test and
Advantech	Pico Technology	Measurement
B & B Electronics	Picosecond Pulse	Sencore
Bruel & Kjaer, N.A.	Labs	Tecpel
C&D Technologies	Precision Filters	Tektronix
Data Physics	R.C. Electronics	Yokogawa Corp. of
Dataforth	Ross Engineering	America
Dataq Instruments	Signal Recovery	
DL Instruments	Spectrum Control	Spectrum
Endevco	Stanford Research	Analyzers,
Flex-Core	Systems	Audio
Futek Advanced	Tabor Electronics	
Sensor Technology	Tegam	Agilent Technologies
Hi-Techniques	Trek	Audio Precision
Keithley Instruments	Yokogawa Corp. of	AudioControl
Kistler Instrument	America	Industrial

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Sound/Audio Level Meters

Sound/Audio Level Meters	Electronic Systems of Wisconsin	Stanford Research Systems
AEMC Instruments	LDS Test and Measurement	Xitron Technologies
Brüel & Kjaer, N.A.	LMS North America	
Casella USA	m + p international	
Extech Instruments	Opticom	
IET Labs	OROS	
Leader Instruments	Sencore	
m + p international	Stanford Research Systems	
Monarch Instrument	Tektronix	
Protek Test and Measurement		
Sencore		
Tecpel		
Tektronix		
Yokogawa Corp. of America		
Spectrum Analyzers, Audio	Tachometers	Temperature Meters, Bench
Agilent Technologies	AEMC Instruments	Pyrometer Instrument
Audio Precision	Data Physics	Rotronic Instrument
AudioControl Industrial	IET Labs	Saelig
Brüel & Kjaer, N.A.	LDS Test and Measurement	Sperry Instruments
Casella USA	Monarch Instrument	Tecpel
Data Physics	Polytec	Tegam
	Protek Test and Measurement	Telatemp
	Tecpel	Testo
		Yokogawa Corp. of America

Time/Frequency/ Phase Standards

Agilent Technologies
Berkeley Nucleonics
Clarke-Hess
Communication
Research
Colby Instruments
Novatech Instruments
Pendulum Instruments
Spectracom
Stanford Research
Systems
Symmetricom
Tabor Electronics

Transformer Testers

Chroma ATE
Clarke-Hess
Communication
Research
Hipotronics
QuadTech
Xitron Technologies

Wattmeters

Bird Electronic
Boonton Electronics
Chroma ATE
Clarke-Hess
Communication
Research
Flex-Core
Tecpel
Xitron Technologies

MODULAR INSTRUMENTS

Bus Interfaces & Extenders

ACCES I/O Products	Measurement Computing
Adlink Technology	MEN Micro
Advanced Vehicle Technologies	Moxa Technologies
Advantech	National Instruments
Agilent Technologies	Pickering Interfaces
ASSET Intertech	PLDA
B & B Electronics	Saelig
Concurrent Computer	Scientific Solutions
Curtiss-Wright	Sealevel Systems
Elan Digital Systems	TAL Technologies
ELMA Electronic	VMETRO
FuturePlus Systems	
Geotest - Marvin Test Systems	
GOEPEL Electronics	
ICS Electronics	CompactPCI/PXI Analog I/O Cards
ines	ACCES I/O Products
Intellitech	Acromag
IOTech	Adlink Technology
JTAG Technologies	Advantech
	C&H Technologies
	Concurrent Computer
	DaqScribe Technologies

Exacq Technologies
GaGe
Geotest - Marvin Test Systems
GOEPEL Electronics
Innovative Integration
KineticSystems
Measurement Computing
MEN Micro
National Instruments
North Atlantic Industries
Strategic Test
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Teradyne Assembly Test Div.
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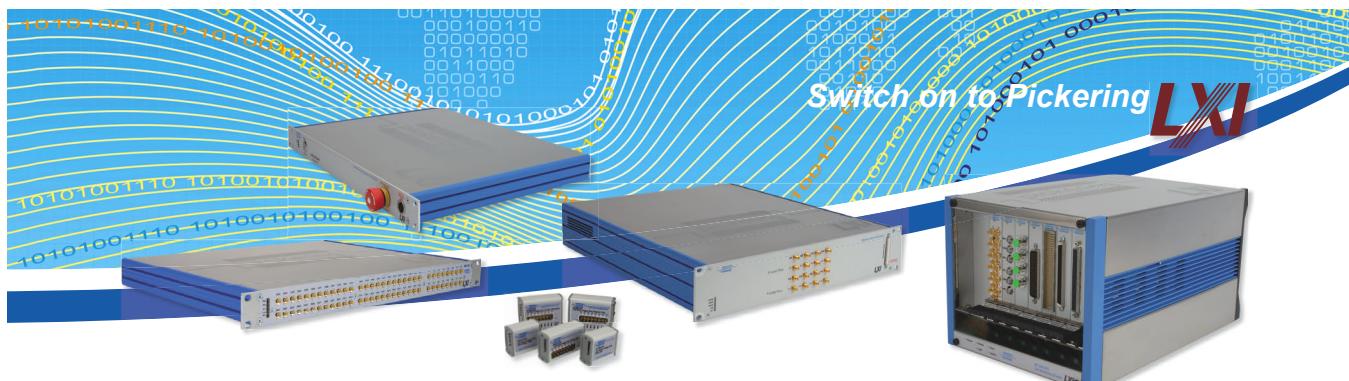


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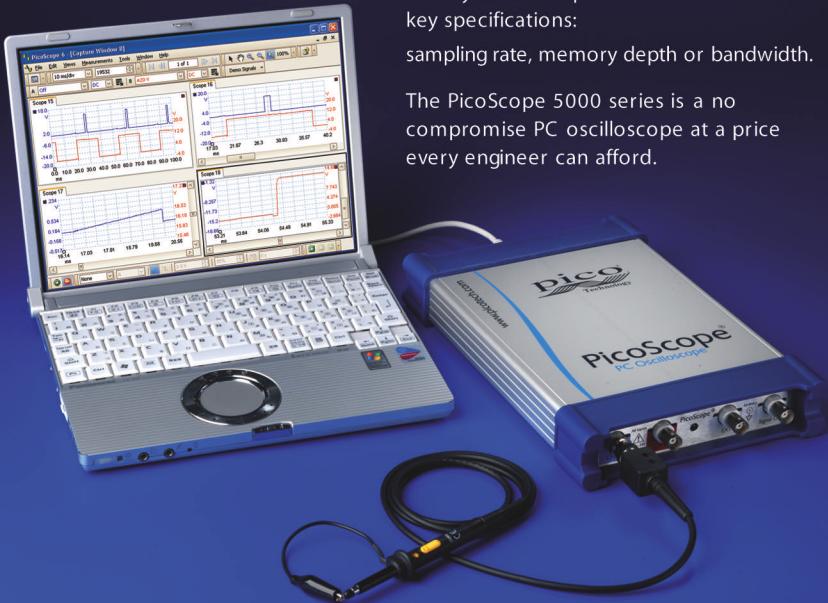
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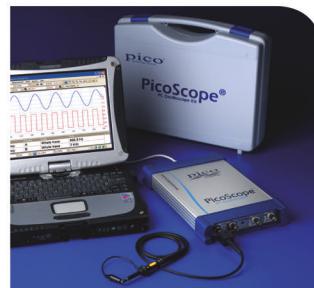
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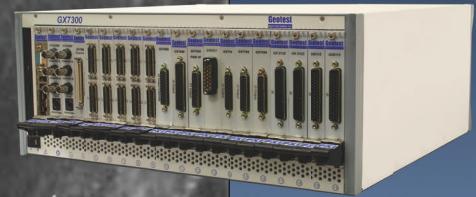
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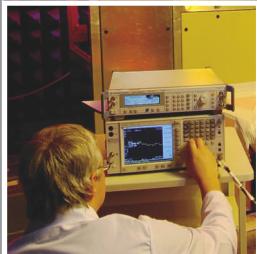
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Geotest - Marvin Test Systems	Pacific Instruments	Advint
GOEPEL Electronics	Scientific Solutions	AssetSmart
ICS Electronics	SigmaQuest	Averna
IET Labs	Syntx	EADS N.A. Defense Test & Services
Integral Vision	TAL Technologies	Northwest Analytical
Intelligent Instrumentation	United Electronic Industries	SigmaQuest
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m + p international	VI Technology	TestEdge
Matrox Imaging	Wavecrest	UGS PLM Software
		VI Technology

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Agilent Technologies	Synergetix	AR, RF/Microwave Instrumentation
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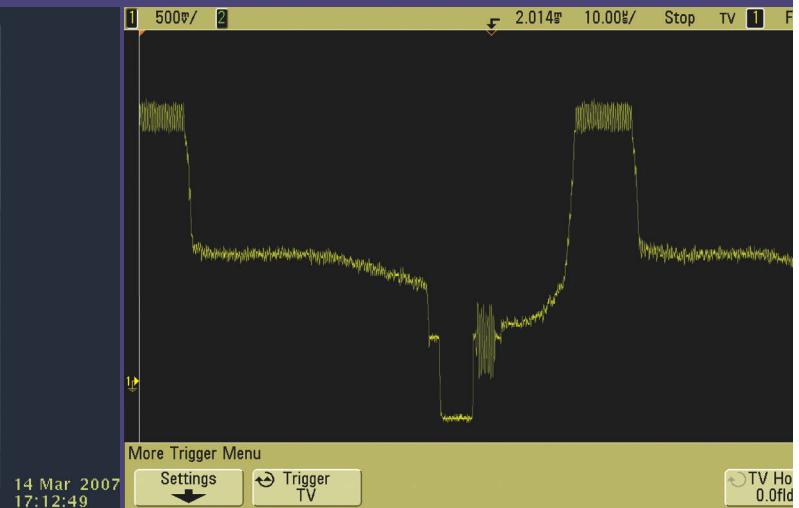
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Memory Depth	10 kpts, max	1 Mpts, max
Channels	2, 4	2, 4
Waveform Update Rate	3,600 wfms/s, max	100,000 wfms/s, max
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**Tektronix TDS3000B Series User Manual 071-0957-04, October 4, 2004.*

****Agilent 5000 Series Oscilloscope data sheet, Pub No 5989-6385EN, April 18, 2007.**

Agilent and Tektronix oscilloscope acquisitions taken at identical settings: horizontal

vertical volts/div = 500 mV/div, connect the dots = on. 10:1 passive probes used for both measurements. Final screen images show both acquisitions zoomed in to 10 μ s/div.



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- ▷ ATE/Production Test/QA, below
- ▷ ATE/DFT/BIST Software, p. 58
- ▷ Accessories, p. 62
- ▷ Third-Party Suppliers, p. 64
- ▷ Services/Labs/Test Houses, p. 66

Vendor contact information begins on p. 99.

ATE/PRODUCTION TEST/QA

ATE, Parametric Testers

Agilent Technologies
CIMTEK
Keithley Instruments
National Instruments
ProductionLine Testers
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Bare Board Testers

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CableTest Systems

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Cirris Systems
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Seica
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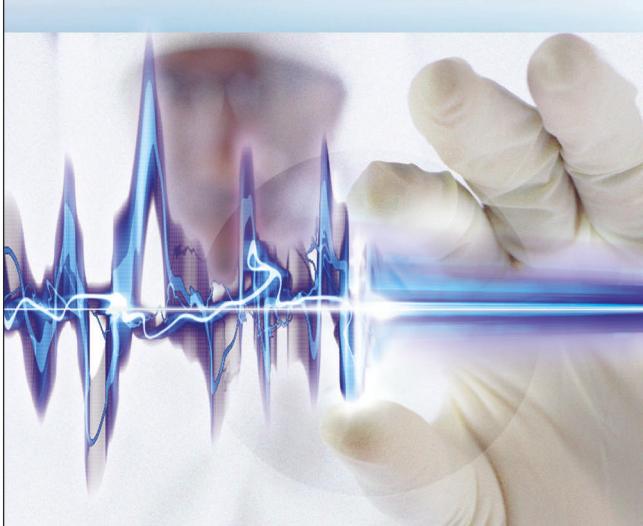
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Vicor	Interconnect Devices
Xantrex Technology	iTEST
Power Supply Testers	Materials Development
ABSOPULSE Electronics	Micromanipulator
Advanced Power Designs	Multiprobe
Autotest	QualiTau
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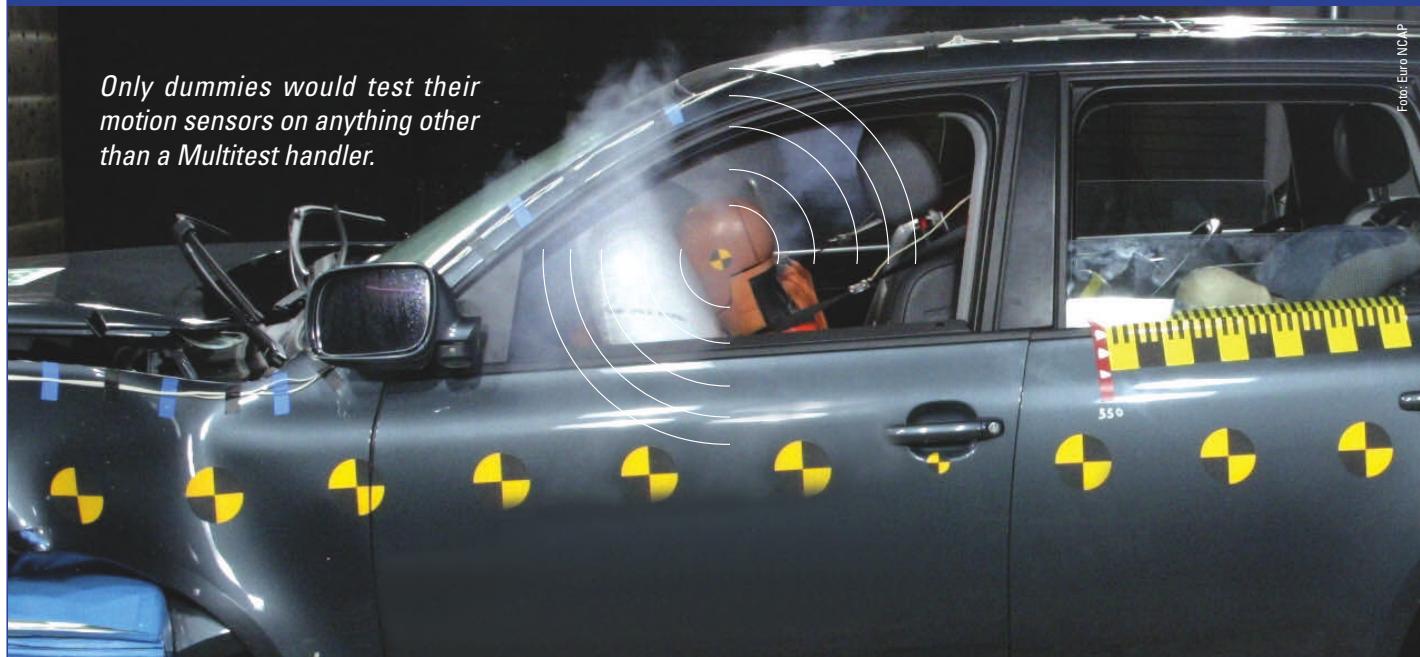
> ATE/DFT/BIST SOFTWARE *Continued*

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GOEPEL Electronics	Acugen Software	Cadence	Texas Instruments	Credence Systems	Assembly Test Div.
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LPKF Laser and Electronics	Credence Systems	GOEPEL Electronics		EADS N.A. Defense	Test Advantage
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Cadence	JTAG Technologies	Altium	OptEM Engineering	ASSET Intertech	Bloomy Controls
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Synplicity	Teradyne	GOEPEL Electronics	Texas Instruments	Data Translation	Multiprobe
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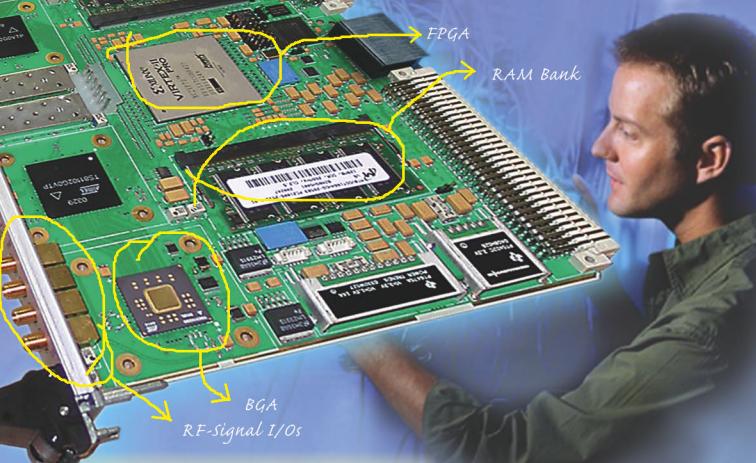
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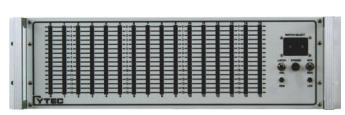
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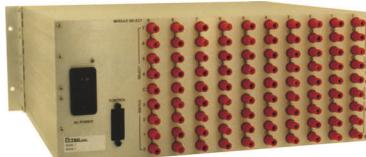
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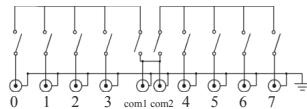
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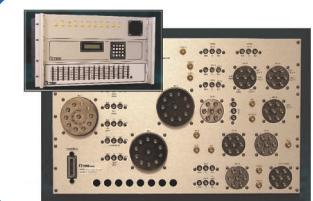
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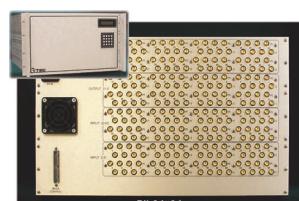
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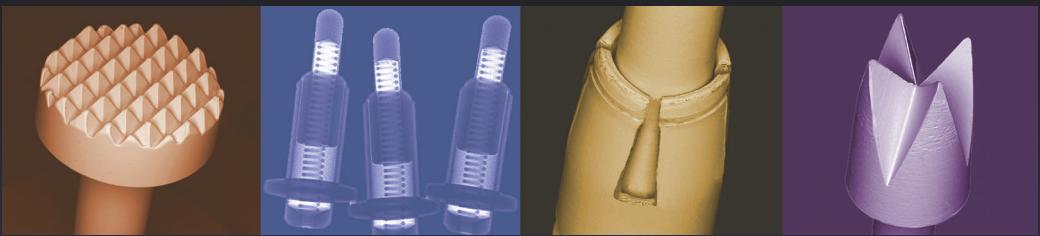
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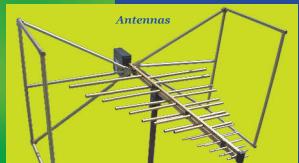
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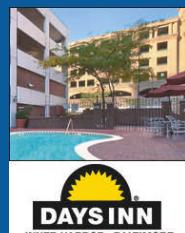
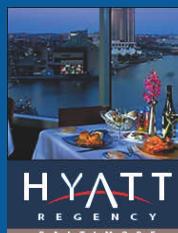
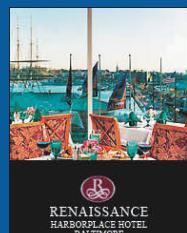
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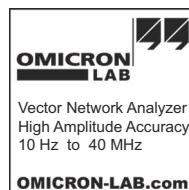
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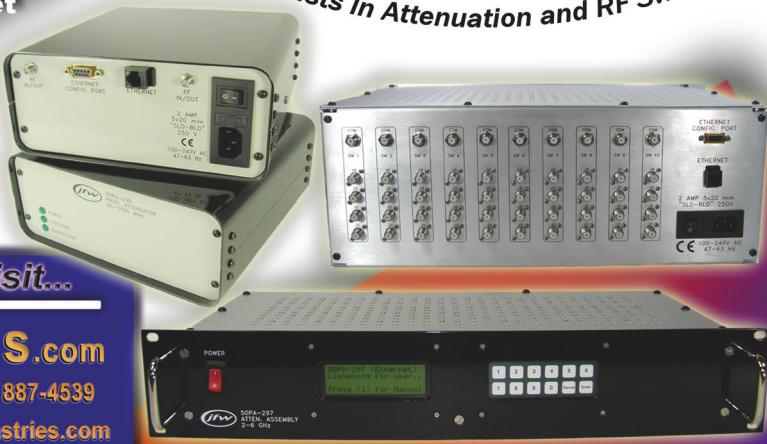
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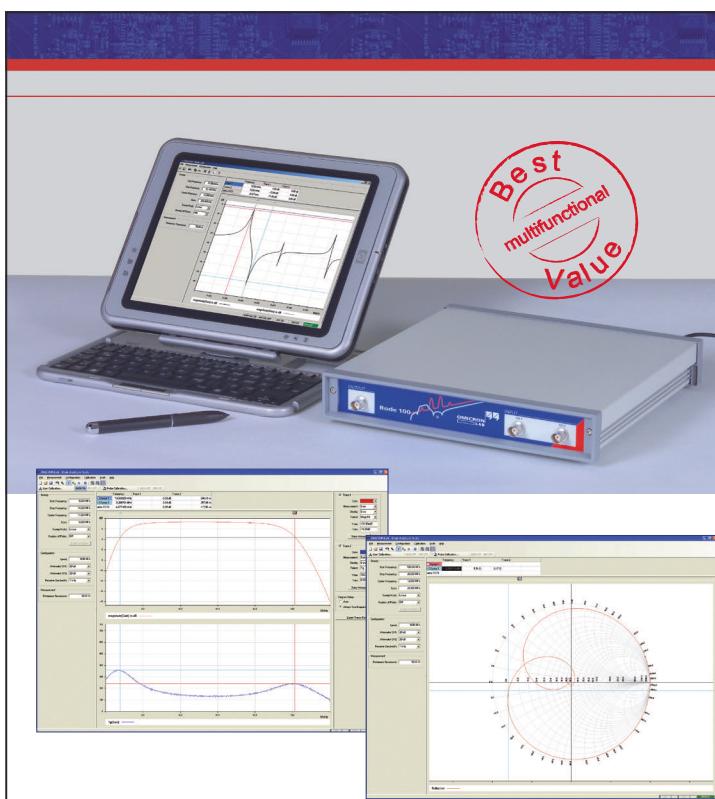
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EXFO
Fluke Networks
JDSU
Leader Instruments
Sunrise Telecom
Innocor
International Data
Sciences
Ixia
JDSU
Network Instruments
QualityLogic
RADCOM
Spirent
Communications
Telinc

Modem Testers, Cable/xDSL

Agilent Technologies
Broadframe
CTC-Megatel
EXFO
Genesys Test
Engineering
Ixia
JDSU
NoiseCom
RADCOM
Spirent
Communications

Return-Loss Testers

Anritsu
DiagnoSYS Systems
EXFO
Fluke Networks
Genesys Test
Engineering
GL Communications
JDSU
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Technologies

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Technologies
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Communications
GL Communications
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RADCOM
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Communications

Protocol Analyzers, LAN and WAN

Agilent Technologies
Anritsu
Benedict Computer

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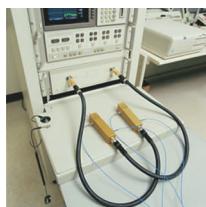


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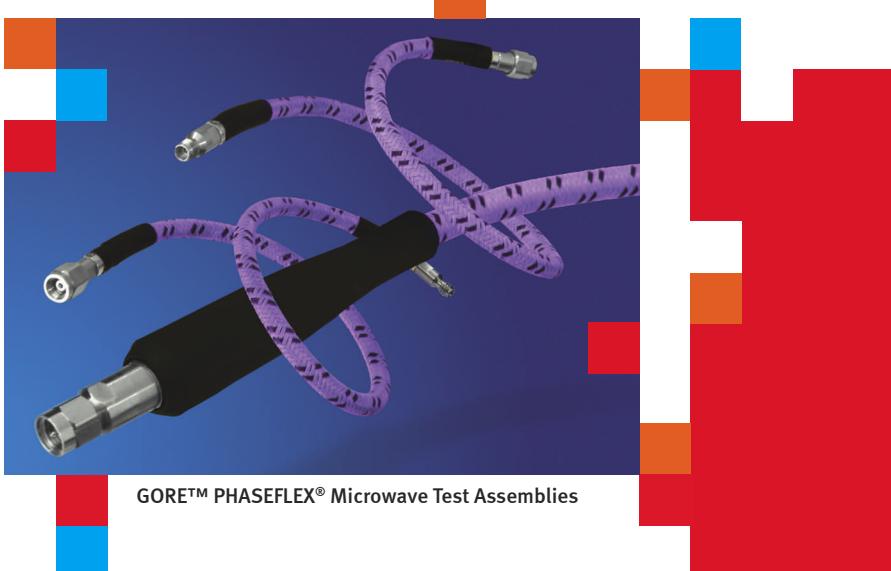


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*Ideally suited for
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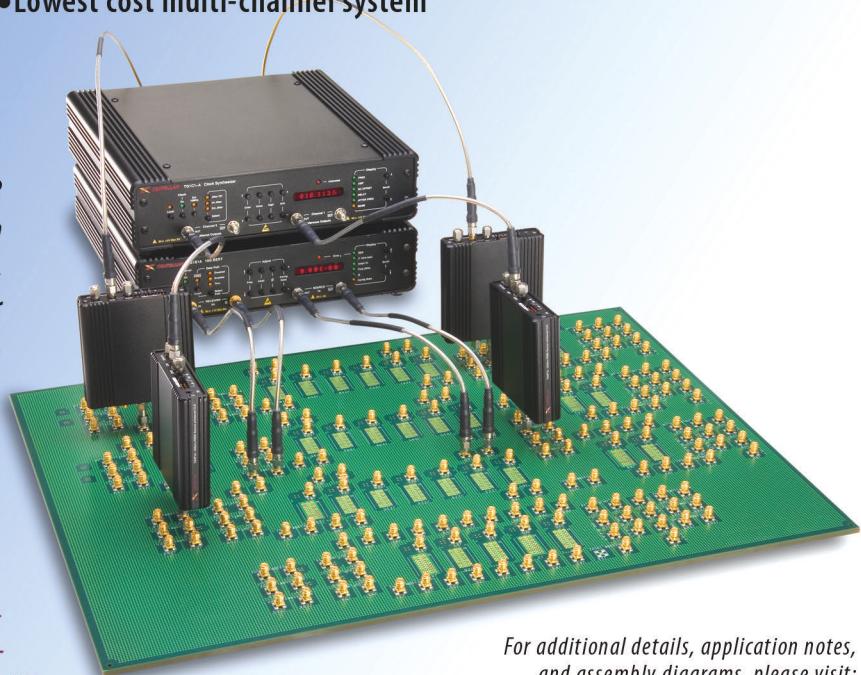


Model No. SP10

System Features:

- Operates from 150Mbps to 12.5Gbps
- Configurable with up to 12 generators or 6 BER testers
- Integrated jitter source for stressed eye generation
- Spread spectrum clocking for compliance testing
- PRBS patterns: 7, 10, 15, 23, 31
- Mark/space density (ratio of 0's to 1's): 1/2, 1/4, 1/8
- Generators are compact and easily placeable remotely
- Lowest cost multi-channel system

SP10 SYSTEM shown measuring BER of differential 20-inch 'victim channel' through FR4 backplane, with four single-ended aggressor channels interfering.



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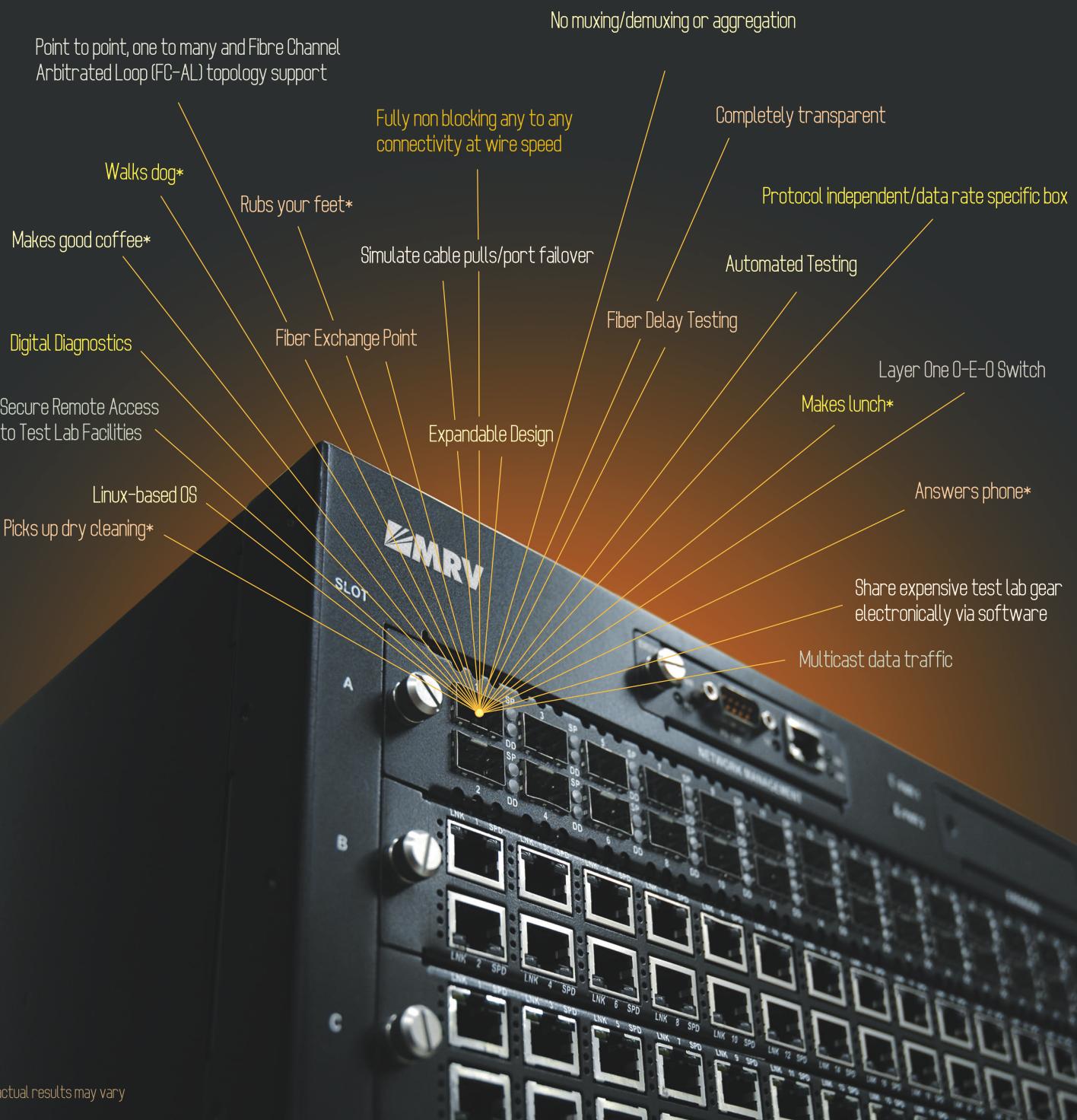
> FIBER-OPTIC/ELECTRO-OPTIC TEST EQUIPMENT *Continued*

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CTC-Megatel	Gigahertz-Optik	Edmund Optics	dBm Optics
dBm Optics	Klein Instruments	EXFO	EADS N.A. Defense Test & Services
EXFO	Newport	Gigahertz-Optik	EXFO
Fiber Instrument Sales	Sencore	International Light	Fiber Instrument Sales
Fluke Networks		JDSU	ILX Lightwave
ILX Lightwave		Keithley Instruments	Ixia
JDSU		Newport	JDSU
Newport		PerkinElmer Optoelectronics	Keithley Instruments
OptoTest		Ultrafast Sensors	MRV Communications
Oz Optics			Newport
Princetel			Omron Electronics
StockerYale			Pickering Interfaces
Terahertz Technologies			Piezosystem Jena
Ultrafast Sensors			Symtx
			Teradyne Assembly Test Div.
			VXI Technology
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Anritsu	Anritsu	Agilent Technologies	AFL
CTC-Megatel	EXFO	Anritsu	Telecommunications
EXFO	Fiber Instrument Sales	dBm Optics	Agilent Technologies
Fiber Instrument Sales	Fluke Networks	EXFO	Anritsu
Fluke Networks	Moritex USA	JDSU	EXFO
Gigahertz-Optik	OptoTest	Luna Technologies	Fiber Instrument Sales
JDSU	Oz Optics	Sunrise Telecom	JDSU
Newport	PerkinElmer Optoelectronics		Luna Technologies
OptoTest	QIOPTIQ Imaging Solutions		Sunrise Telecom
Oz Optics	StockerYale		
Sunrise Telecom	Terahertz Technologies		
Terahertz Technologies			
Loss Test Sets	Optical Power Meters	Photometers & Radiometers	
Anritsu	AFL	Agilent Technologies	AFL
EXFO	Telecommunications	Anritsu	Telecommunications
Fiber Instrument Sales	Agilent Technologies	EXFO	Agilent Technologies
Fluke Networks	Anritsu	JDSU	Anritsu
Gigahertz-Optik	CTC-Megatel	Luna Technologies	EXFO
JDSU	dBm Optics	Sunrise Telecom	Fiber Instrument Sales
Newport	Edmund Optics		JDSU
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Oz Optics	Fiber Instrument Sales		Sunrise Telecom
Sunrise Telecom	Fluke Networks		
Terahertz Technologies	JDSU		
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Fluke Networks	JDSU	Teradyne Assembly Test Div.	Radiant Imaging
Ixia	Luna Technologies	Terahertz Technologies	Terahertz Technologies
JDSU	National Instruments		
Luna Technologies	Newport		
National Instruments	Oz Optics		
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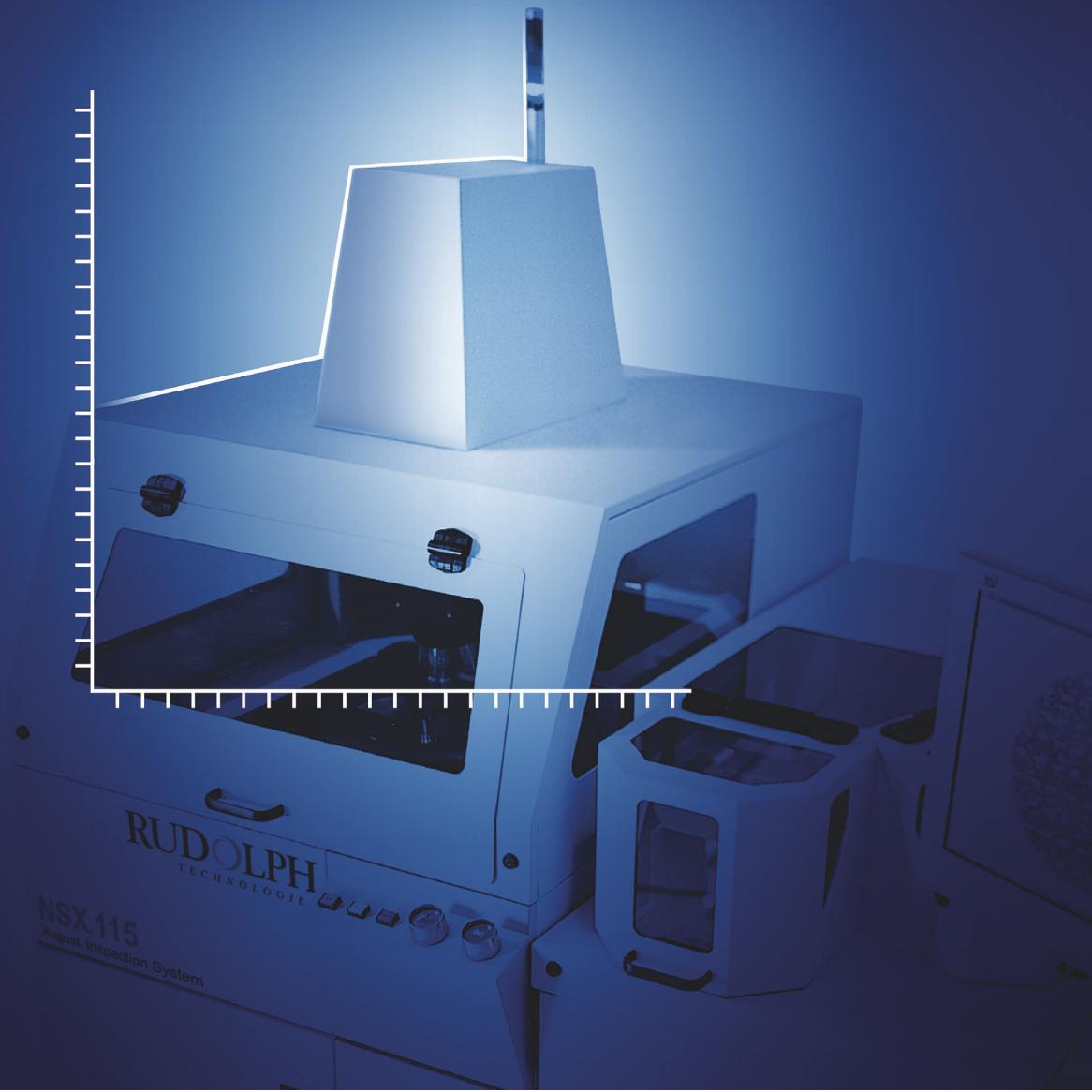
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- ▷ Machine-Vision & Inspection Equipment, below
- ▷ Machine-Vision Software, p. 90
- ▷ Third-Party Suppliers, p. 91
- ▷ Services/Labs/Test Houses, p. 91

Vendor contact information begins on p. 99.

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Landrex Technologies
Machine Vision Products
Metron Optics
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Micro-Vu
Omron Electronics
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Inspection Systems, Thermal/Infrared

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Hamamatsu
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Monarch Instrument
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Smart Sonic
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Teradyne Assembly Test Div.
Test Research
Testronics
View Engineering
Viscom

Vision Engineering
WESCO
X-TEK Group
YesTech

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AccuSentry
Aerotech
Ambios Technology
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Dalsa
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Micromanipulator
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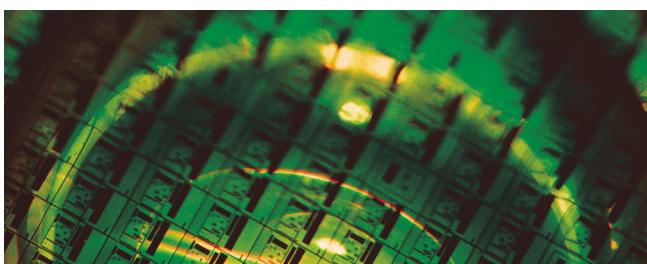
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IN THIS SECTION

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- ▷ Third-Party Suppliers, p. 96
- ▷ Services/Labs/Test Houses, p. 97

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Precision Filters, Ithaca, NY. 607-277-3550. www.pfinc.com.

Precision Test Systems, Essex, UK. +44-845-052-0920. www.ptsyst.com.

Premier Semiconductor Services, Austin, TX. 512-912-3500. www.premiers2.com.

Pressure Systems, Hampton, VA. 800-678-7226. www.pressuresystems.com.

Princetel, Pennington, NJ. 609-895-9890. www.princetel.com.

Prior Scientific, Rockland, MA. 781-878-8442. www.prior.com.

Prism Sound, Rockaway, NJ. 973-983-9577. www.prismsound.com.

Probe Master, El Cajon, CA. 800-772-1519. www.probemaster.com.

ProbeStar, San Jose, CA. 408-435-8378. www.probestar-usa.com.

Product Safety Consulting, Bensenville, IL. 630-238-0188. www.productsafetyinc.com.

ProductionLine Testers, Pleasanton, CA. 925-931-1255. www.productionlinetesters.com.

Professional Testing, Round Rock, TX. 512-244-3371. www.ptitest.com.

Prostat, Bensenville, IL. 630-238-8883. www.prostatcorp.com.

Protek Test and Measurement, Englewood, NJ. 201-227-1161. www.protektest.com.

PTL Test Equipment, Jupiter, FL. 561-747-3647. www.ptltest.com.

Pulizzi Engineering, Santa Ana, CA. 800-870-2248. www.pulizzi.com.

Pyrometer Instrument, Windsor, NJ. 609-443-5522. www.pyrometer.com.

Q

QA Technology, Hampton, NH. 603-926-1193. www.qatech.com.

QIOPTIQ Imaging Solutions, Rochester, NY. 800-430-3041. www.qioptiqimaging.com.

Qmax Test Equipments, Chennai, India. +91-44-24509627. www.qmaxtest.com.

Q-Lab, Cleveland, OH. 440-835-8700. www.q-lab.com.

QRP, Tucson, AZ. 520-790-3533. www.qrpglobes.com.

QuadTech, Maynard, MA. 800-253-1230. www.quadtech.com.

QualiTau, Sunnyvale, CA. 408-522-9200. www.qualitau.com.

QualityLogic, Moorpark, CA. 805-531-9030x35. www.qualitylogic.com.

Quantum Change, Huffman, TX. 281-359-5540. www.quantumchange.com.

Quantum Data, Elgin, IL. 847-888-0450. www.quantumdata.com.

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R.C. Electronics, Santa Barbara, CA. 805-685-7770. www.rcelectronics.com.
RADCOM, Paramus, NJ. 201-518-0033. www.radcom.com.
Radiant Imaging, Duvall, WA. 425-844-0152. www.radiantimaging.com.
Rad-icon Imaging, Santa Clara, CA. 408-486-0886. www.rad-icon.com.
RAM Optical Instrumentation, Rochester, NY. 585-758-1300. www.ramoptical.com.
Ramsey Electronics, Victor, NY. 800-446-2295. www.ramseytest.com.
Real Controls, Salix, PA. 814-487-5195. www.realcontrols.com.
Red Rock Software, Salt Lake City, UT. 801-322-4322. www.redrocksw.com.
Redlake, Tucson, AZ. 520-547-2772. www.redlake.com.
Reinhardt System und Messeletronic, Diessen, Germany. +49-8196-934100. www.reinhardt-testsystem.de.
Reliability Analysis Laboratory, Raytheon, Tewksbury, MA. 800-725-4787. www.reliabilityanalysislab.com.
ReMaTek, St. Laurent, QC, Canada. 514-333-0101. www.rematek.com.
Ricreations, Universal Scan, Gainsville, GA. 678-455-7255. www.universalscan.com.
Rigol Technologies, Monument, CO. 719-488-8306. www.rigolna.com.
Rika Densi America, Attleboro, MA. 508-226-2080. www.testprobe.com.
Robert A. Denton, Rochester Hills, MI. 248-852-5100. www.dentoninc.com.
Robson Technologies, Morgan Hill, CA. 408-779-8008. www.testfixtures.com.
Rocky Mountain Test Equipment, Centennial, CO. 303-693-3322. www.rmte.net.
Rohde & Schwarz, Columbia, Maryland. 410-910-7800. www.rohde-schwarz.com/USA.
Rolyn Optics, Covina, CA. 626-915-5707. www.rolyn.com.
Ross Engineering, Campbell, CA. 408-377-4621. www.rossengineeringcorp.com.
Rotek Instrument, Waltham, MA. 781-899-4611. www.rottek.com.
Rotronic Instrument, Huntington, NY. 631-427-3898. www.rotronic-usa.com.
RS Tech, Phoenix, AZ. 623-879-6690. www.rstechinc.com.
Rudolph Technologies, Flanders, NJ. 973-691-1300. www.rudolphtech.com.
RVSI Inspection, Hauppauge, NY. 631-273-9700. www.rvsi.com.

S

S.R.S. Market Solutions, Eagleville, PA. www.metersuperstore.com.
Saelig, Pittsford, NY. 585-385-1750. www.saelig.com.
ScanCAD International, Morrison, CO. 303-697-8888. www.scancad.com.
Schomandl, Yucaipa, CA. 909-797-0484. www.schomandl.com.
Schott North America, Auburn, NY. 315-255-2791. www.us.schott.com/fiberoptics.
Schroff, Warwick, RI. 888-550-9543. www.schroff.us.
Scientific Instruments, Ottawa, ON, Canada. 613-254-7054. www.scientificmetric.com.
Scienscope International, Chino, CA. 909-590-7273. www.scienscope.com.
Scientific Solutions, Mentor, OH. 440-357-1400. www.scientific-solutions.com.
Scientific Test, Richardson, TX. 972-479-1300. www.scitest.com.
Sealevel Systems, Liberty, SC. 864-843-4343. www.sealevel.com.
Seasolve Software, San Jose, CA. 408-437-9306. www.seasolve.com.
Seaward Group, Tampa, FL. 813-886-2775. www.seaward-groupusa.com.
Sefelec, Yucaipa, CA. 909-797-0484. www.sefelec.com.
Seica, Strambino, Italy, Italy. +39-0125-636811. www.seica.com.
Semitek, Richardson, TX. 972-783-8100. www.semitek.com.
Sencore, Sioux Falls, SD. 605-339-0100. www.sencore.com.
SensArray, Fremont, CA. 510-360-5600. www.sensarray.com.
Sensor Products, Madison, NJ. 973-884-1755. www.sensprod.com.
Sensortechnics, Walpole, MA. 508-660-8823. www.sensortechnics.com.
Sens-Tech, Ruislip, Middlesex, UK. +44-(0)189-630771. www.sens-tech.com.
Sentech America, Carrollton, TX. 972-481-9223. www.sentechamerica.com.
Sharetree Systems, Gloucestershire, UK. +44(0)-145-382-8642. www.sharetree.com.
Siemens, Nashua, NH. 800-468-9503. www.acuitycimatrix.com.
Sigma Systems, El Cajon, CA. 619-258-3700. www.sigmasystems.com.
SigmaQuest, Sunnyvale, CA. 408-524-3180. www.sigmaquest.com.
Signal Recovery, Oak Ridge, TN. 865-482-4411. www.signalrecovery.com.
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Signametrics, Seattle, WA. 206-524-4074. www.signametrics.com.
Silicon Imaging, Troy, NY. 518-279-9098. www.siliconimaging.com.
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Slaughter, Lake Forest, IL. 847-932-3662. www.hipot.com.

Smart Sonic, Canoga Park, CA. 818-610-7900. www.smartsionic.com.
Solarius Development, Sunnyvale, CA. 408-541-0151. www.solarius-inc.com.
SOLTEC, San Fernando, CA. 800-423-2344. www.solteccorp.com.
Sony Electronics, Park Ridge, NJ. 201-930-7000. www.sony.com/videocameras.
Sony Manufacturing Systems America, Lake Forest, CA. 949-770-8400. www.sonySMS.com.
Southwest Research Institute, San Antonio, TX. 210-684-5111. www.swri.org.
Sovtest, Kursk, Russia. www.sovtest.ru.
SPEA, Volpiano, Italy. +39-0119825400. www.spea.com.
Spectracom, Rochester, NY. 585-321-5800. www.spectracomcorp.com.
Spectratest, Mt. View, CA. 800-716-2421. www.spectratest.com.
Spectrum Control, Fairview, PA. 814-474-0333. www.spectrumcontrol.com.
Spellman High Voltage Electronics, Hauppauge, NY. 631-630-3000. www.spellmanhv.com.
Sperry Instruments, Milwaukee, WI. 414-352-4160. www.sperryinstruments.com.
Spirent Communications, Performance Analysis Broadband, Calabasas Hills, CA. 800-927-2660. www.spirent.com.
Stag Programming Solutions, Yucaipa, CA. 909-797-0484. www.stag.co.uk.
Stanford Research Systems, Sunnyvale, CA. 408-744-9040. www.thinkrs.com.
Stanley, N. Andover, MA. 800-225-5370. www.stanleysupplyservices.com.
StataCorp., College Station, TX. 800-782-8272. www.stata.com.
Static Solutions, Marlborough, MA. 508-480-0700. www.staticsolutions.com.
StaticSmart, North Reading, MA. 978-276-0820. www.staticsmart.com.
Statit Software, Corvallis, OR. 800-478-2892. www.statit.com.
StatSoft, Tulsa, OK. 918-749-1119. www.statsoft.com.
Stemmer Imaging, Puchheim, Germany. +49-89-80902-0. www.stemmer-imaging.de.
Stephen Halperin & Associates, Bensenville, IL. 630-238-8883. www.halperinassoc.com.
StockerYale, Montreal, QC, Canada. 800-814-9552. www.stockeryale.com.
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Strategic Test, Woburn, MA. 617-621-0080. www.strategic-test.com.
Summit Instruments, Akron, OH. 330-659-3312. www.summitinstruments.com.
Sun Electronic Systems, Titusville, FL. 321-383-9400. www.sunelectronics.com.
Sunnex, Natick, MA. 800-445-7869. www.sunnexonline.com.
Sunrise Telecom, San Jose, CA. 408-363-8000. www.sunrisetelecom.com.
Sunstone Circuits, Mulino, OR. 503-829-9108. www.sunstone.com.
Superior Electric, Bristol, CT. 860-585-4500. www.superiorelectric.com.
SurplusEq.com, Phoenix, AZ. 602-867-1904. www.surpluseq.com.
Suss MicroTec, Sacka bei Dresden, Saxony, Germany. +49-35240-73-0. www.suss.com.
SV Probe, Santa Clara, CA. 408-727-6341. www.svprobe.com.
Swift Textile Metalizing, Bloomfield, CT. 860-243-1122. www.swift-textile.com.
Symmetricom, Timing, Test & Measurement Division, San Jose, CA. 978-232-1422. www.symmttm.com.
Symtx, Austin, TX. 512-328-7799. www.symtx.com.
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Synergy Software, Reading, PA. 610-779-0522. www.synergy.com.
Synopsis, Mt. View, CA. 650-584-5000. www.synopsis.com.
Symplicity, Sunnyvale, CA. 408-215-6000. www.symplicity.com.
SynTest Technologies, Sunnyvale, CA. 408-720-9956. www.synctest.com.
SyntheSys Research, Menlo Park, CA. 650-364-1853. www.bertscoope.com.
Sypris Test & Measurement, Orlando, FL. 407-678-9748. www.sypris.com/stm.

T

Tabor Electronics, Irvine, CA. (800) 722-2528. www.taborelec.com/us.
TAL Technologies, Philadelphia, PA. 215 496 0222. www.TALtech.com.
Tamar Technology, Newbury Park, CA. 805-480-3358. www.tamarotechnology.com.
Tampa Microwave, Tampa, FL. 813-855-2251. www.tampamicrowave.com.
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Tamura Corp. of America, Temecula, CA. 800-472-6654. www.tamuracorp.com.
Tanisys Technology, Austin, TX. 512-335-4440. www.tanisys.com.
TDK RF Solutions, Cedar Park, TX. 512-258-9478. www.tdkrfolutions.com.
TEAM A.T.E., Denver, CO. 303-628-7722. www.team-ate.com.
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Telatemp, Fullerton, CA. 714-879-2901. www.telatemp.com.
Telco Testing Solutions, Tempe, AZ. 480-603-1828. www.telcotesting.com.
Teledyne Scientific & Imaging, Thousand Oaks, CA. 805-373-4545. www.teledyne-si.com.
Telinc, Mount Laurel, NJ. 800-257-5110. www.telinc.com.
Teltone, Bothell, WA. 800-426-3926. www.teltone.com.
Tempronic, an inTest company, Sharon, MA. 781-688-2300. www.tempronic.com.
Teradyne, Assembly Test Div., N. Reading, MA. 800-837-2396. www.teradyne.com/atl.
Teradyne, Semiconductor Test Div., N. Reading, MA. 978-370-2700. www.teradyne.com.
Terahertz Technologies, Oriskany, NY. 315-736-3642. www.terahertztechnologies.com.
Terra Universal, Fullerton, CA. 714-578-6000. www.terrauniversal.com.
Teseda, Portland OR. 503-223-3315. www.teseda.com.
Teseq, Edison, NJ. 732-225-9533. www.teseq.com.
Test & Measurement Global Exchange, Northborough, MA. 508-393-6060. www.tamge.com.
Test Advantage, Tempe, AZ. 480-337-3377. www.testadvantage.com.
Test Coach, Hoffman Estates, IL. 847-885-4880. www.testcoachcorp.com.
The Test Connection, Owings Mills, MD. 410-526-2800. www.ttc.com.
Test Equipment Connection, Lake Mary, FL. 800-615-8378. www.testequipmentconnection.com.
Test Equipment Solutions Today, Foster City, CA. 888-889-8378. www.testsolu.com.
Test Research, Taipei, Taiwan. +886-2-28328918. www.tri.com.tw.
Test Site Services, Milford, MA. 508-634-3444. www.testsiteservices.com.
TestEdge, San Diego, CA. 858-451-1012. www.testedgeinc.com.
TestEquity, Thousand Oaks, CA. 800-950-3457. www.testequity.com.
Testforce, St. Laurent, QC, Canada. 514-856-0970. www.testforce.com.
TestMart, San Bruno, CA. 650-624-0525. www.testmart.com.
Testo, Flanders, NJ. 973-252-1720. www.testo.com.
Testronics, McKinney, TX. 972-542-3111. www.testronics.com.
Texas Instruments, Dallas, TX. 800-336-5236. www.ti.com.
ThermaCal, Solon, OH. 440-498-1005. www.thermacal.com.
Thermal Product Solutions, Williamsport, PA. 570-326-1770. www.thermalproductsolutions.com.
Thermo Electric, Saddle Brook, NJ. 201-843-5800. www.thermo-electric-direct.com.
Thermo Fisher Scientific, CIDTEC Cameras & Imagers, Liverpool, NY. 315-451-9410. www.thermo.com/cidtec.
Thermo Scientific, Lowell, MA. 978-275-0800. www.thermo.com/esd.
Thermonics, Sunnyvale, CA. 408-542-5900. www.thermonics.com.
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Thurlby-Thandar Instruments (TTI), Cambs, UK. +44-1480-412451. www.tti-test.com.
Tracespan Communications, Ann Arbor, MI. 734-846-0549. www.tracespan.com.
Tracewell Systems, Westerville, OH. 800-848-4524. www.tracewellsystems.com.
Transcat, Rochester, NY. 800-828-1470. www.transcat.com.
Trek, Medina, NY. 585-798-3140. www.trekinc.com.
Trek Equipment, Sausalito, CA. 415-332-1555. www.trekequip.com.
Trio-Tech International, Van Nuys, CA. 818-787-7000. www.triotech.com.
TRS-RenTelco, DFW Airport, TX. 800-874-7123. [Dillard-Des Ormeaux, QC, Canada](http://www.dillard-des-ormeaux.com): 514-683-9400. wwwTRS-rentelco.com.
Tucker Electronics, Garland, TX. 800-527-4642. www.tucker.com.
TUV Rheinland of North America, Newtown, CT. 888-975-3943. www.tuv.com.
TUV SUD America, Danvers, MA. 800-888-0123. www.tuvamerica.com.
Tyrosys, Bonham, TX. 877-897-6797. www.tyrosys.com.
TYX, Reston, VA. 703-264-1080. www.tyx.com.

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UGS PLM Software, Plano, TX. 800-498-5351. www.ugs.com.
Ultrafast Sensors, Thousand Oaks, CA. 866-205-0592. www.ultrafastsensors.com.
UltraTest International, San Jose, CA. 408-433-2244. www.ultratest.com.
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Unisoft, Milford, CT. 888-486-4246. www.unisoft-cim.com.

United Electronic Industries, Canton, MA. 781-821-2890. www.ueidaq.com.
Unitron, Bohemia, NY. 631-589-6666. www.unitronusa.com.
Universal Switching, Van Nuys, CA. 818-785-0200. www.uswi.com.

V

V.J. Electronix, Littleton, MA. 978-486-4777. www.vjelectronix.com.
Vektrex Electronic Systems, San Diego, CA. 858-558-8282. www.vektrex.com.
Verigy, Cupertino, CA. 1-408-864-2900. www.verigy.com.
VI Technology, Austin, TX. 512-327-3348. www.vi-tech.com.
Vibration Research, Jenison, MI. 616-669-3028. www.vibrationresearch.com.
Vicor, Andover, MA. 978-470-2900. www.vicorpowers.com.
Videology Imaging Solutions, Greenville, RI. 401-949-5332. www.videologyinc.com.
View Engineering, Simi Valley, CA. 805-578-5000. www.viewmm.com.
Viewpoint Systems, Rochester, NY. 585-475-9555. www.viewpointusa.com.
Virginia Panel, Waynesboro, VA. 540-932-3300. www.vpc.com.
Viscom, Duluth, GA. 678-966-9835. www.viscom.com.
Vision Components, Hudson, NH. 603-598-2588. www.vision-components.com.
Vision Engineering, New Milford, CT. 860-355-3776. www.visioneng.com.
Vision Systems International, Yardley, PA. 215-736-0994. www.vision1.com/vsi.
VLSI Standards, San Jose, CA. 408-428-1800. www.vlsistandards.com.
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Volpi USA, Auburn, NY. 315-255-1737. www.volpiusa.com.
VXI Technology, Irvine, CA. 949-955-1894. www.vxitech.com.

W

W.L. Gore & Associates, Elkton, MD. 800-311-3060. www.gore.com.
W.M. Hague, Pepperell, MA. 978-433-3777. www.WMHague.com.
Wavecrest, Eden Prairie, MN. 952-831-0030. www.wavecrest.com.
Wentworth Laboratories, Brookfield, CT. 203-775-0449. www.wentworthlabs.com.
WESCO, Western Scientific, San Francisco, CA. 415-826-5732. www.wescomicroscopes.com.
Willtek Communications, Parsippany, NJ. 973-386-9696. www.willtek.com.
Winchester Electronics, Wallingford, CT. 203-741-5400. www.winchesterelectronics.com.
Wintriss Engineering, San Diego, CA. 800-550-7300. www.wecocom.
WITec Instruments, Savoy, IL. 217 351 9705. www.witec-instruments.com.
World Cal, Elk Horn, IA. 712-764-2197. www.world-cal.com.

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Xantrex Technology, Burnaby, BC, Canada. 604-422-8595. www.xantrex.com.
Xilinx, San Jose, CA. 408-559-7778. www.xilinx.com.
Xitron Technologies, San Diego, CA. 858-530-8099. www.xitrontech.com.
X-TEK Group, Tyngsboro, MA. 978-649-6333. www.xtekxray.com.

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Yamaichi Electronics USA, San Jose, CA. 408-715-9100. www.yeu.com.
YesTech, San Clemente, CA. 949-361-2714. www.yestechinc.com.
Yokogawa Corp. of America, Newnan, GA. 770-254-0400. www.yokogawa.com/us.

Z

Zmotion, Portland, OR. 503-253-8871. www.zmotion.com.
ZTEC Instruments, Albuquerque, NM. 866-ztec-now. www.ztecinstruments.com.
Zygo, Middlefield, CT. 860-347-8506. www.zygo.com.

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PROFESSIONAL SOCIETIES & TRADE ASSOCIATIONS

3rd Generation Partnership Project (3GPP), www.3gpp.org. The 3GPP brings together a number of telecommunications standards bodies.

Accellera, www.accellera.org. Accellera's mission is to drive development of standards that enhance a language-based design automation process.

AeA, www.aeanet.org. Formerly the American Electronics Association, AeA is a trade association representing all segments of the technology industry.

American Association for Laboratory Accreditation (A2LA), www.a2la.org. The A2LA is dedicated to accreditation of competent testing and calibration laboratories, proficiency testing providers, and reference materials producers.

American Council of Independent Laboratories (ACIL), www.acil.org. ACIL is a trade association representing independent, commercial scientific, and engineering firms.

American National Standards Institute (ANSI), www.ansi.org. ANSI is a private, nonprofit administrator and coordinator of the US voluntary standardization system.

American Society for Nondestructive Testing (ASNT), www.asnt.org. ASNT promotes nondestructive testing (NDT) as a profession and facilitates NDT research.

American Society for Quality (ASQ), www.asq.org. The ASQ advances learning, quality improvement, and knowledge exchange to improve business results.

American Society of Test Engineers (ASTE), www.astetest.org. The ASTE, a nonprofit corporation, is dedicated to promoting test engineering as a profession.

ASTM International, www.astm.org. ASTM develops and distributes voluntary technical standards for materials, products, systems, and services.

Audio Engineering Society (AES), www.aes.org. The AES is a professional society devoted exclusively to audio technology.

Automated Imaging Association (AIA), www.machinevisiononline.org. The AIA is a trade association for machine-vision imaging suppliers and users. AIA also maintains the Camera Link and GigE Vision standards.

British Standards Institution (BSI), www.bsi-global.com. British Standards is the National Standards Body of the UK, responsible for facilitating, drafting, publishing, and marketing British Standards and other guidelines.

Canadian Standards Association (CSA), www.csa.ca. CSA is a not-for-profit membership-based association serving business, industry, government, and consumers in Canada and the global marketplace.

DSL Forum, www.dslforum.org. DSL Forum is a consortium of telecommunications, equipment, computing, networking, and service-provider companies that promotes the use of DSL technology.

Electronic Industries Alliance (EIA), www.eia.org. EIA represents companies involved in the manufacture of electronic components, parts, systems, and equipment.

ESD Association, www.esda.org. The ESD Association is dedicated to advancing the theory and practice of electrostatic discharge avoidance.

European Committee for Electrotechnical Standardization, www.cenelec.org. CENELEC creates electrotechnical standards, many of them following the mandates of the European Commission.

European Committee for Standardization (CEN), www.cenorm.eu. CEN works to implement voluntary technical harmonization in Europe in conjunction with worldwide bodies and European partners.

European Machine Vision Association (EMVA), www.emva.org. The EMVA works to strengthen the position of its members in worldwide markets, and it hosts the GenICam standard group.

European Telecommunications Standards Institute (ETSI), www.etsi.org. ETSI's mission is to produce the telecom standards that will be used throughout Europe.

Federal Communications Commission (FCC), www.fcc.gov. The FCC is charged with regulating interstate and international communications by radio, television, wire, satellite, and cable.

Fibre Channel Industry Association (FCIA), www.fibrechannel.org. The FCIA aims to develop the market for Fibre Channel products.

Institute of Electrical and Electronics Engineers (IEEE), www.ieee.org. The IEEE is a professional society that advances the theory and practice of electrical, electronics, and computer engineering as well as computer science.

Institute of Environmental Sciences and Technology (IEST), www.iest.org. The IEST is concerned with the effects that natural, indoor, and extreme environments have on equipment and machinery.

Institute for National Measurement Standards (INMS), inms-iennm.nrc-cnrc.gc.ca. The INMS, Canada's national metrology institute (NMI), carries out a wide range of research and service activities.

Institution of Engineering and Technology (IET), www.theiet.org. The IET, a UK-based professional organization, aims to lead in the advancement of engineering and technology by facilitating the exchange of knowledge and ideas.

InterNational Committee for Information Technology Standards, www.incits.org. The INCITS works to produce voluntary consensus standards for storage media, databases, programming languages, multimedia, and communication among computing devices and information systems.

International Electrotechnical Commission (IEC), www.iec.ch. The IEC creates international consensus standards and conformity assessment schemes in the fields of electricity, electronics, and associated technologies.

International Microelectronics and Packaging Society (IMAPS), www.imaps.org. IMAPS is a professional society dedicated to educating engineers in all phases of electronics packaging.

International Organization for Standardization (ISO), www.iso.org. The ISO promotes the development of international standards.

International Society for Optical Engineering (SPIE), www.spie.org. The SPIE is a technical society dedicated to advancing engineering, scientific, and commercial applications of optical, photonic, imaging, electronic, and optoelectronic technologies.

International Telecommunication Union (ITU), www.itu.int. Through the ITU, governments and industries establish and coordinate policies, standards, regulations, and treaties covering global telecommunication networks.

IPC-Association Connecting Electronics Industries, www.ipc.org. IPC is a global trade association that represents all facets of the electronic interconnection industry, including design, printed wiring board manufacturing, and electronics assembly.

ISA, The Instrumentation, Systems, and Automation Society, www.isa.org. ISA is a society of professionals involved in instrumentation, measurement, and control.

Japan Electric Measuring Instruments Manufacturer's Association (JEMIMA), www.jemima.or.jp/english. JEMIMA promotes research and standards to help develop Japan's electric measuring instrument industry.

LXI Consortium, www.lxistandard.org. The LXI Consortium is working to develop the LAN eXtensions for Instrumentation (LXI) standard.

MFA Forum, www.mfaforum.org. The MFA Forum is an association of telecom, networking, and other companies focused on advancing the deployment of multi-vendor, multi-service packet-based networks.

Microelectronics Packaging and Test Engineering Council (MEPTEC), www.meptec.org. MEPTEC is a trade association committed to enhancing the competitiveness of the back-end portion (assembly and testing) of the semiconductor business.

National Cooperation for Laboratory Accreditation (NACLA), www.nacla.net. NACLA's primary mission is to evaluate US laboratory accreditation bodies (ABs).

National Institute of Standards and Technology (NIST), www.nist.gov. NIST promotes US economic growth by working with industry to develop and apply technology, measurements, and standards.

National Society of Professional Engineers (NSPE), www.nspe.org. The NSPE is an interdisciplinary professional engineering society.

National Voluntary Laboratory Accreditation Program (NVLAP), ts.nist.gov/Standards/214.cfm. Administered by NIST, NVLAP provides third-party laboratory accreditation services.

NCSL International, www.ncsli.org. The National Conference of Standards Laboratories, NCSL International, is an association of metrology organizations with a focus on education.

Optical Society of America (OSA), www.osa.org. The OSA is a nonprofit professional society of engineers and scientists in the optics and photonics community.

PC/104 Consortium, www.pc104.org. The PC/104 Consortium disseminates information about PC/104 and serves as a liaison with standards organizations.

PCI Special Interest Group (PCI-SIG), www.pcisig.com. The PCI SIG is committed to the development and enhancement of the PCI standard.

PCMCIA, www.pcmcia.org. PCMCIA is an international standards body and trade association that promotes the interoperability of PC Cards in a variety of products.

PXI Systems Alliance, www.pxisa.org. The PXI Systems Alliance maintains the PXI specification, promotes PXI technology, and ensures multivendor interoperability.

SAE International, www.sae.org. SAE International works to advance the engineering of mobility systems, whether for use on land or sea or in air or space.

Semiconductor Equipment and Materials International (SEMI), www.semi.org. SEMI is an international trade association for equipment and materials suppliers to the semiconductor, MEMS, and flat-panel display industries.

Semiconductor Industry Association (SIA), www.sia-online.org. The SIA is a trade organization that represents US-based semiconductor manufacturers.

Semiconductor Test Consortium (STC), www.semitest.org. The STC oversees the OpenStar (Open Semiconductor Test Architecture) platform.

Society for Information Display (SID), www.sid.org. The SID is devoted to the advancement of electronic display technology, manufacturing, and applications.

Surface Mount Technology Association (SMTA), www.smta.org. The SMTA seeks to advance the industry through education, training, and networking in regards to electronics assembly technologies and related business operations.

Telecommunications Industry Association (TIA), www.tiaonline.org. The TIA is a trade association serving the communications and information technology industries.

Test and Diagnostics Consortium (TDC), www.test-diagnostics.org. The TDC brings together users and suppliers from industries such as medical, automotive, satellite, railroad, trucking, and defense to optimize the test and diagnostic environment.

VMEbus International Trade Association (VITA), www.vita.com. VITA is a nonprofit trade association that promotes the use of open system architectures.

VXIbus Consortium, www.vxibus.org. The VXIbus Consortium develops and promotes the VXIbus instrumentation standard.

WiMAX Forum, www.wimaxforum.org. The WiMAX Forum certifies and promotes the compatibility and interoperability of broadband wireless products based upon the harmonized IEEE 802.16/ETSI HiperMAN standard.

ZigBee Alliance, www.zigbee.org. The ZigBee Alliance works to enable low-power, wirelessly networked, monitoring and control products based on a global standard.

T&MW

PRODUCT FOCUS

The following write-ups were supplied by advertisers in this issue

Bowl-feed option for test handler

The Multitest MT9928 is an established tri-temp octal site gravity test handler. Multitest has recently expanded the load-



ing and unloading options by adding a bowl-feed option; according to the company, the MT9928 is the only octal-site gravity test handler on the market that offers a bowl-feeder module.

*Multitest Electronic Systems
www.multitest.com.*

PCI Express DAQ card series

The Adlink DAQe-2200 series offers the high bandwidth of the PCI Express bus for data transfers up to 500 Mbytes/s. These 64-channel cards include a dif-



ferential mode for 32 analog input channels, analog/digital triggering, two-channel 12-bit analog outputs with waveform-generation capability, 24-channel programmable digital I/O lines, and a two-channel 16-bit general-purpose timer/counter.

*Adlink Technology
www.adlinktech.com.*

Smart cameras for image processing

Vision Components offers programmable smart cameras for machine vision that can replace PC systems in a range of indus-



trial applications. Equipped with high-performance processors, they are suitable for use as stand-alone image-processing systems in measuring tasks and quality checks. Moreover, the compact devices offer new integration possibilities for machine and plant designers.

*Vision Components
www.vision-components.com.*

Thermocouple-to-wireless connector

Omega's Wireless Thermocouple Connector Series features stand-alone battery-powered thermocouple connectors that transmit linearized, cold-junc-



tion compensated measurements to a USB-powered receiver connected to a PC. Each unit can be programmed in the field to work as a type J, K, T, E, R, S, B, N, or C calibration connector. The connector can transmit data continuously at user-selectable time intervals.

*Omega
www.omega.com.*

Network analyzer family

The compact R&S ZVL from Rohde & Schwarz provides features that the company says are otherwise available only in larger and more expensive instruments, such as a wide frequency range from 9 kHz to 3 or



6 GHz, a dynamic range of 123 dB, and a bidirectional two-port measurement architecture. A software option for spectrum analysis is in the pipeline.

*Rohde & Schwarz
www.rohde-schwarz.com.*

NRTL information bank

As a Nationally Recognized Testing Laboratory (NRTL), TÜV SÜD America can determine whether your product meets necessary

US workplace requirements as well as other requirements.



At the company's NRTL information bank, called NRTL Spotlight, you can find information on OSHA, NRTLs, and standards, as well as FAQs, white papers, games, and more.

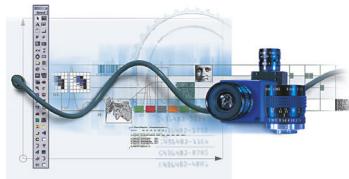
*TÜV SÜD America
www.tuvamerica.com/nrtl.*

PRODUCT FOCUS

The following write-ups were supplied by advertisers in this issue

Libraries for imaging professionals

Common Vision Blox is a software platform for quick and reliable development and implementation of imaging applications. Based on an open ar-



chitecture, it supports all common standards. In addition to an extensive set of standard tools, CVB offers various highly specialized tools and the possibility of integrating your own algorithms easily.

Stemmer Imaging

www.commonvisionblox.com.

ICT test probes

ICT series test probes feature proprietary bifurcated beams that guarantee contact between the plunger and barrel, resulting in low and consistent resistance.



The elimination of the clearance between the plunger and the barrel virtually seals the internal portion of the probes from contaminants. The probes are available in 0.050, 0.075, and 0.100 centers.

Interconnect Devices
www.idinet.com.

Pulse generators offer flexibility

Keithley's Series 3400 pulse/pattern generators provide flexibility without the burden of a complicated front-panel interface. The high repetition rates, tight timing integration, and precision control over parame-



ters such as rise/fall time, offset, amplitude, width, and period make these instruments appropriate for researchers working with new materials and nanotechnology, for semiconductor applications, and for RF design and development departments.

Keithley Instruments
www.keithley.com/products/pulsepatterngenerators.

LXI-compliant power supply

Kepco has introduced its first LXI (LAN eXtensions for Instrumentation) product, the KLP series of power supplies, which are compliant to LXI Class C specifications. Control is sup-



ported through the Ethernet in the KLP-1.2K model. The KLP series delivers 1200 W over an expanded operating range.

Kepco

www.kepcopower.com/klp.htm?tmw.

Double-sided telecentric lenses

Navitar's double-sided telecentric lenses provide both image- and object-side telecentricity. Designed to work with CCD and



CMOS sensors with smaller pixel micro arrays, these lenses allow for telecentricity of less than 0.1% within the depth of field and distortion of less than 0.1% at the field corners.

Navitar

machinevision.navitar.com.

Fast PXI instrumentation amplifier

The Tegam Model 4040A is a fast PXI instrumentation amplifier designed to work with PXI digitizers and oscilloscopes. The Model 4040A offers 100-V differential inputs with 70 dB of CMRR. The bandwidth ranges from DC to 50 MHz with programmable gain, attenuation, offset, and filters.



Tegam
www.tegam.com.

10 new GigE cameras

The new Basler pioneer cameras are equipped with highly sensitive Kodak and Sony CCD sensors. Sensor sizes range from VGA to 5 Mpixels. With its extremely slim design and its foot-



print of 29x44 mm, the pioneer is the smallest camera in its class, according to Basler. All Basler pioneer models are compliant with the GigE Vision and GenICam standard.

Basler Vision Technologies
www.basler-vc.com.

3.0-GHz spectrum analyzer

Insteek's new GSP-830 3.0-GHz spectrum analyzer offers many features such as autoset, a USB interface, and a brilliant TFT



color display in one package at an affordable price. The battery pack option and low noise floor make this unit ideal for the lab or the field.

Insteek America
www.insteek.com.

Amplifiers offer power upgrade

AR's "subampability" concept enables customers to upgrade some of their existing "S" series amplifiers to higher power with-



out purchasing new amplifiers. The Model 20S4G11A (20 W, 4 to 10.6 GHz) can expand to 40, 60, or 80 W, and the Model 35S4G8A (35 W, 4 to 8 GHz) can grow to 60, 90, or 120 W.

AR Worldwide
www.ar-worldwide.com.

Extended JTAG/boundary scan

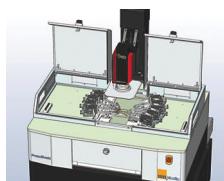
Boundary-scan innovator Goepel recently introduced the VarioCore technology for its ScanFlex I/O modules. Unlike other modules used in automated test equipment for boards and systems, VarioCore-enabled I/O modules are reconfigurable at run-time to support a wide variety of I/O functionality.



Goepel Electronics
www.goepel.com.

Accurate device characterization

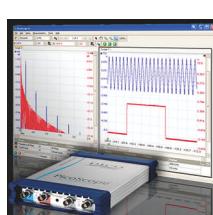
SUSS MicroTec has launched the next generation of ProbeShield Technology for highly accurate device characterization and reliability measurements on wafers up to 300 mm. The system introduces design features that enhance shielding effectiveness, ergonomics, and mechanics to provide a completely safe and accurate probing solution.



Suss MicroTec
www.suss.com/probeshield.

USB 2.0 PC oscilloscope

The 250-MHz, PC-based PS5204 from Pico Technology offers a massive 128-Msample memory buffer for capturing long, complex waveforms and a real-time sampling rate of 1 Gsample/s. Other features include advanced triggering, a 250-MHz spectrum analyzer, and a 12-bit, 125-Msamples/s arbitrary waveform generator.



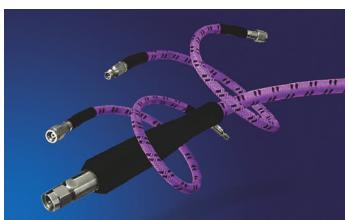
Pico Technology
www.picotech.com/pco393.

PRODUCT FOCUS

The following write-ups were supplied by advertisers in this issue

110-GHz test assemblies

Gore PhaseFlex 110-GHz test assemblies with performance through 110 GHz offer torque and crush resistance, as well as stability with flexure and temperature, all while remaining



flexible. The Gore PhaseFlex 110-GHz test assemblies provide excellent phase and amplitude stability with flexure over a wide temperature range.

W.L. Gore & Associates
www.gore.com.

DAQ logger and instrumentation software

Measurement Computing's new TracerDAQ Pro software package consists of four virtual instrument applications—a high-speed, 32-channel strip chart; a high-speed, four-channel oscilloscope; a 16-channel, multi-waveform function generator; and a 20-channel rate generator—for graphically displaying, analyzing, and storing input data and for generating output signals. Price: \$199.



Measurement Computing
www.mccdaq.com.

Imaging library features metrology

The Matrox Imaging Library (MIL) 8.0 with Processing Pack 3 features the new Metrology module for geometric dimen-

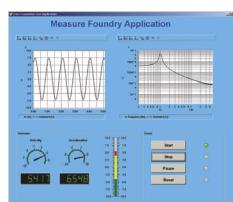


sioning and tolerancing applications. The Metrology module determines the measurements of features such as arcs, circles, line segments, and points. Tolerances can be determined from dimensions, positions, and shape using features such as distances and length, coordinates, angularity, parallelism, and perpendicularity.

Matrox Imaging
www.matrox.com/imaging.

Test and measurement software

Measure Foundry 5.0 is an open test and measurement software application builder. Measure Foundry offers complete support of all system standards including VISA and SCPI. Users can easily and quickly combine various test and measurement instruments to create powerful applications, without writing any code. Standard interfaces such as GPIB, USB, PCI, LXI, PXI/VXI, and RS-232 are supported.



Data Translation
www.measurefoundry.com.

PRBS BER test systems

Centellax offers a 12.5-Gbit flexible frequency serial BERT system and a 40-Gbit BERT system, both perfect for accomplishing PRBS compliance testing for many popular interfaces: PCI Express, SATA, SAS, Fibre



Channel, HDMI, DVI, 10-Gig Ethernet, FBDIMM, Infiniband, DisplayPort, Unified Display Interface, SRIO, Hypertransport, USB 2.0, and SPI 4.2.

Centellax
www.centellax.com.

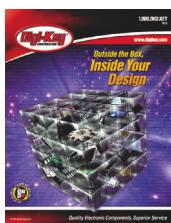
Motion-control and positioning systems

The "Automation Solutions for Electronic Manufacturing, Test and Inspection, and Data Storage" brochure presents Aerotech's motion-control and positioning systems for electronic assembly, pick and place, PCB laser drilling and stencil cutting, wafer singulation, and automated optical inspection. Products include the Automation 3200 software-based controller, linear and rotary nanopositioners, servomotors and drives, robots, actuators, and industry-specific motion systems.

Aerotech
www.aerotech.com.

Thousands of products

Digi-Key's latest 2216-page catalog features more than 300,000 products from more than 350 of the world's top manufacturers.



This catalog includes thousands of new products from new and existing supplier partners. The company's in-stock rate for items featured in the catalog is 90 to 95%. Additional products are available at the Digi-Key Web site.

Digi-Key
www.digikey.com.

Macro defect inspection system

The NSX tool provides automated macro defect inspection with unmatched speed and flexibility throughout the device manufacturing process and is optimized for back-end applications. Defects of 0.5 micron and larger can be created during wafer manufacturing, probing, bumping, dicing, and general handling and can have a major impact on yield.



Rudolph Technologies
www.rudolphtech.com.

10-MHz DDS sweep/function generator

The B+K Precision Model 4017B DDS sweep/function generator combines several functions in a single unit that offers waveform



generation, pulse generation (through variable symmetry), frequency sweep, and a frequency counter. The heart of the instrument is a DDS-based system that produces precision timing for sine, square, or triangle wave generation with frequencies between 0.01 Hz and 10 MHz.

B+K Precision
www.bkprecision.com.

Power quality analyzer

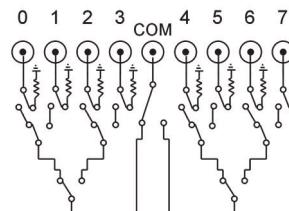
The PowerPad Jr. Model 8230 is an easy-to-use single-phase power-quality analyzer that is intended for electricians and engineers who need to measure and analyze single-phase and balanced three-phase power quality. Users can obtain instant waveforms of the electrical network's characteristics and also monitor their variation over time. All power quality parameters can be recorded.



AEMC Instruments
www.aemc.com.

CATV/cable-modem switch

Cytec manufactures computer-controlled switches for cable TV or cable modems and switches



that are used in automated test, patch panels, or lab tests. New 1x8 or 1x16 modules with bandpass from DC to 1 GHz offer 75- Ω impedance, F connectors, terminated unused positions, and up to 24 dBm of power. Systems with up to 8000 switch points are available.

Cytec
www.cytec-ate.com.

Programmable electronic load

AMREL has released the Zero-Volt eLoad (ZVL) programmable electronic load, which operates at 0 V and draws 120 A in a 4U



half- or $\frac{3}{4}$ -rack benchtop form factor. With voltage and current ratings of 10 to 150 V and 0 to 120 A within 100-, 200-, and 300-W power levels, the Zero-Volt eLoad offers the flexibility to fit your applications.

AMREL
www.amreleload.com.

PRODUCT FOCUS

The following write-ups were supplied by advertisers in this issue

Antenna kit for high frequency

A.H. Systems' Model AK-571-4 antenna kit provides a convenient solution for increased frequency requirements from 700 MHz to 40 GHz. Specifications that require higher test frequencies also require an accurate antenna solution.



This kit includes one SAS-571 horn antenna, one SAS-574 horn antenna, low-loss cables, and adapters in an antenna storage case with several extra cutouts for optional preamplifiers.

A.H. Systems
www.ahsystems.com.

Fixed focal length lenses

Edmund Optics' TechSpec high-resolution fixed-focal-length lenses offer object-space resolution of better than two line-pairs



per millimeter and come in focal lengths of 8.5 and 12 mm. They support sensors as large as $\frac{2}{3}$ -in. and provide superior performance in the visible spectrum. The lenses are designed for high-speed, high-resolution imaging, making them ideal for on-line inspection applications.

Edmund Optics
www.edmundoptics.com.

USB data-acquisition products

Measurement Computing's USB-2500 series boards provide true multifunction performance with up to 32 differential analog inputs, waveform-capable analog outputs, 24 high-speed digi-



tal I/O channels, four counter inputs, and two timer outputs. All boards feature synchronous analog, digital, and counter/timer I/O, guaranteeing deterministic I/O among all signal types. Base price: \$799.

Measurement Computing
www.mccdaq.com.

Measure and analyze out of the box

IOtech's Ethernet-based DaqBook/2000 Series 16-bit, 200-kHz analog-to-digital converters are flexible, configurable, and expandable. Combined with the company's Out-of-the-Box software, the DaqBook/2000 becomes a powerful, easy-to-use



data-acquisition system that provides effortless datalogging and analysis. Over 40 I/O expansion options are available to customize the system for a particular application.

IOtech
www.iotech.com.

Low-ripple high-voltage rack

Spellman's Bertan 205B Series high-voltage power supplies provide regulated outputs from 1 to 50 kV at 15 to 30 W. The low-noise, linear topology results in extremely low output



ripple specifications. The 205B Series units are reversible by design, providing either positive or negative output polarity, along with outstanding stability performance.

Spellman High Voltage Electronics
www.spellmanhv.com/bertan/tmw.

Say What?

Hear thoughts and comments from our editors about test and measurement, economics, globalization, the general engineering profession and much more.

The TMWorld.com Blogs

From the new
TMWorld.com

CATALOGS & PRODUCTS

The following write-ups were supplied by advertisers in this issue.

Microwave amplifier brochure

AR's microwave amplifier brochure highlights the "S" series (1 to 800 W, 0.8 to 20 GHz) and the TWT amplifier series (1 to 16,000 W, 0.8 to 45 GHz). It includes photographs, descriptions, specifications, and performance graphs for each model. AR Worldwide, www.ar-worldwide.com.



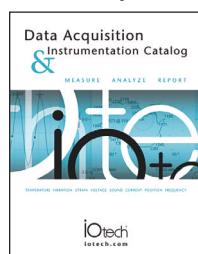
Compact vision sensor

Vision Components' VisiCube camera, which measures only 65x45x45 mm and weighs 170 g, provides a compact image-processing solution for industrial environments. The smart cameras come with measuring lights and an integrated lens. Vision Components, www.vision-components.com.

Environmental testing services

TÜV SÜD America offers complete environmental testing from its laboratories, including climatics (wind, temperature/altitude, humidity, etc.), dynamics (shock, vibration, etc.), package testing (compression, drop, etc.), and HALT/ HASS. TÜV SÜD America, www.tuvamerica.com.

Data-acquisition catalog



iotech's new full-color, 100-page "Data Acquisition & Instrumentation Catalog" is now available. The catalog describes solutions for vibration, temperature,

temperature, and more. The company's Out-of-the-Box software lets you acquire, save, analyze, and view data. iotech, www.itech.com.

Vector network analyzer

Bode 100 combines a PC-controlled vector network analyzer, a gain/phase meter, an impedance meter, and a sine-wave generator in a compact design. The frequency range of 10 Hz to 40 MHz is ideal for many RF and low-frequency applications. Omicron Lab, www.omicron-lab.com.

USB data acquisition

SeaDAC modules connect to a computer's USB port and offer choices including reed and form C relays, optically isolated inputs, a TTL interface to industry-standard solid-state relay racks, and analog-to-digital and digital-to-analog functionality. Sealevel Systems, www.sealevel.com.

Imaging software library

With its supreme flexibility, Common Vision Blox is the software library for image processing. Platform-independent and modular, it offers you the freedom to develop your application your way. Stemmer Imaging, www.commonvisionblox.com.

Electrical push-pull connectors

A catalog from LEMO describes the company's high-quality unipole-multipole connectors. The LEMO manufacturing program has been extended to 40 connector series with specific mating and environmental characteristics. LEMO, www.lemo.com.



Test and measurement catalog

The Rohde & Schwarz "Test & Measurement Products Catalog 2007/2008" is now available, presenting solutions for mobile radio, EMC, and broadcasting, as well as general-purpose and RF test equipment. You can order it from customersupport@rohde-schwarz.com. Rohde & Schwarz, www.rohde-schwarz.com.

GigE Vision and FireWire cameras

The 36 Basler scout camera models feature GigE Vision and FireWire-b interfaces and are equipped with a Sony CCD sensor ranging in size from VGA to 2 Mpixels. All scout models are GenICam compliant. Basler Vision Technologies, www.basler-vc.com.

RF power meter

The 1830A RF power meter achieves the lowest uncertainty RF power measurement available. It replaces the HP432A and is also compatible with

virtually all thermistor-based RF power sensors. TEGAM, www.tegam.com.

Double-sided lenses

Navitar's Double-Sided Telecentric Lenses provide image and object side telecentricity of less than 0.1% within the depth of field and distortion of less than 0.1% at the field corners. Navitar, machinevision.navitar.com.

CD covers RF measurements

Keithley Instruments' free CD, *Making Quality RF Measurements*, is packed with information that can help you configure an RF measurement system. It includes an archived seminar, white papers, articles, application notes, data sheets, and technical notes. Keithley Instruments, www.keithley.com/at/389.

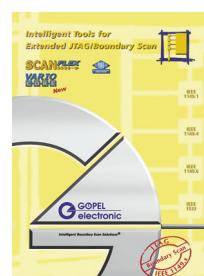


Test sockets

IDI's latest innovations in Synergetix high-performance test sockets include 10+ GHz on 0.4-mm pitch sockets, the only self-adjusting test sockets (XACT sockets), and 0.5-mm Kelvin sockets. Interconnect Devices, www.synergetix.com.

Extended JTAG/boundary scan

Goepel electronic is a world-class vendor of JTAG/boundary-scan systems for electronic components. A catalog from the company covers the extended JTAG/boundary-scan ScanFlex and VarioCore hardware plus System Cascon software. Goepel electronic, www.goepel.com.



300,000 products

Digi-Key's 2216-page catalog features more than 300,000 products from over 350 of the world's top manufacturers. New products include components from several new supplier partners. Digi-Key, www.digikey.com.

(continued)

CATALOGS & PRODUCTS

The following write-ups were supplied by advertisers in this issue.

Intelligent power control

Available in 42-in. or 70-in. lengths with on/off control of up to 24 outlets, a configurable power-distribution unit from Pulizzi offers many features, making it ideal for data centers or remote site management. *Pulizzi Engineering*, www.pulizzi.com.

Programmable switching systems

Cytec's 80-page catalog of programmable switching systems for ATE and

communications covers automated production and lab or environmental testing. It includes communication switches and programmable patch panels. Custom configurations are also available. *Cytec*, www.cytec-ate.com.

10-MHz sweep/function generator

The 4017B is the latest addition to B+K Precision's 4000 series of function generators. It is the first true function generator in its line to offer direct digital synthesis (DDS) technology, allowing the 4017B to generate very precise and accurate waveforms with little distortion. *B+K Precision*, www.bkprecision.com.

Web-based temperature measurements

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

High-voltage power supply

Spellman's Bertan 225 Series HVPS provides regulated outputs from 500 V to 50 kV at 15 W to 30 W. An IEEE 488 digital interface permits comprehensive power-supply control. Low noise and a linear topology result in extremely low output ripple. *Spellman High Voltage Electronics*, www.spellmanhv.com/bertan/tmw.



Digital microscope

The new iVista digital imaging system is dedicated for semiconductor probing applications. The system is based on an ultra-high-resolution concept to provide sharp images and a unique multi-view function. *Suss MicroTec*, www.suss.com/ivista.

100-Gbytes/s modulator driver

The OA5MVM is a 100-Gbytes/s broadband amplifier for driving optical modulators. It makes an excellent modulator driver for developing 100G Ethernet products. *Centellax*, www.centellax.com.

Automation products

Omega is adding a new line of automation products to meet today's changing manufacturing landscape. Products include sensors, PLCs, HMI, enclosures, motion systems, power products, and more. *Omega Engineering*, www.omega.com/omegamation.

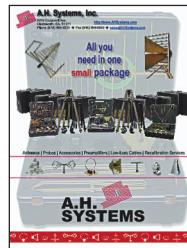


Macro inspection system

Over 500 NSX macro inspection systems have been installed in fabs around the world, providing high throughput and repeatable advanced macro defect inspection during wafer manufacturing, probing, burning, and general handling. *Rudolph Technologies*, www.rudolphtech.com.

Antennas and accessories

A.H. Systems offers EMC antennas, accessories, and calibration services for global testing. The company's catalog includes broadband antennas from 25 MHz to 40 GHz. *A.H. Systems*, www.ahsystems.com.



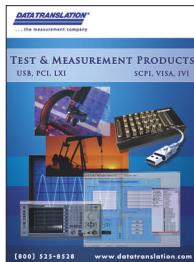
PC-based oscilloscope

The PicoScope 5000 series of high-performance PC-based (USB 2.0) oscilloscopes feature 1-Gsample/s real-time sample rates, a 128-Msam-

ple record length, and a 12-bit, 128-Msample/s programmable arbitrary waveform generator. *Pico Technology*, www.picotech.com/pco392.

USB and PCI products

Data Translation's free 2007 product guide offers details on the company's USB and PCI data-acquisition test and measurement products. You can choose from a range of low-cost, simultaneous, and high-performance hardware and software products. *Data Translation*, www.datx.com/productguide.



Power products

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Instek's new test and measurement catalog is a valuable source of technical information and displays the company's entire line card. Users can compare instruments and determine the right spec for their application. *Instek America*, www.instek.com.

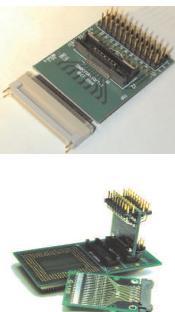
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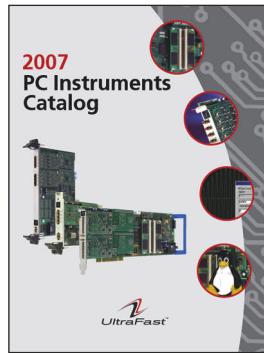


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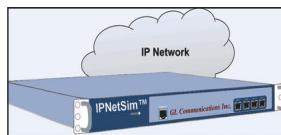
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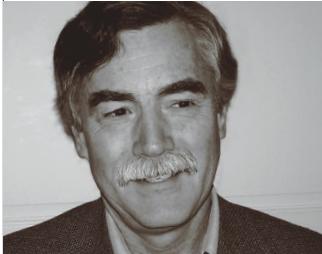
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MICHAEL J. SULLIVAN

VP and CTO
Astro-Med
West Warwick, RI

Michael J. Sullivan joined Astro-Med in 1983 and assumed responsibilities as CTO in August 2000. Prior to his service with Astro-Med, he held engineering positions with the Naval Underwater Systems Center and Rhode Island Hospital, where his biomedical research was included in government and academic publications. Sullivan holds several patents pertaining to thermal printing and data-acquisition recording. He is a graduate of the University of Rhode Island with a BSEE and an MSEE.

Contributing editor Larry Maloney spoke with Sullivan about data-acquisition trends in a recent telephone interview.

Data acquisition hits the road

Q: Astro-Med is involved in data acquisition, neurological instruments, and label printing. What ties these technologies together?

A: The neurological business, which includes EEG systems for monitoring patients with sleep disorders, is really a specialized form of data acquisition, relying on such technologies as analog-to-digital converters, isolation techniques, sampled data streams, and digital filters. Our label printer connection began when our T&M products focused on chart recording with thermal technologies. The label printer and T&M product groups have become much more diverse, but they still share key technical elements, such as hybrid design [mixing analog and digital], use of microprocessor firmware to embed functionality, and complex graphic presentations of data.

Q: What distinguishes your data-acquisition products?

A: Streaming large amounts of sampled data directly to a disk drive is something we introduced and continue to perfect. This approach avoids the limits that Windows places on typical data-acquisition products. The field recorder, a strong niche for us, gives a user everything he or she needs for data acquisition and review in a compact, rugged package that can be used almost anywhere. Our user interface combines large LCDs with touch panels and icons that create a distinctive look and make our products easy to use. We also believe that we are the best people to go to when you need a real-time chart recorder, which we typically sell as a peripheral to our data-acquisition products.

Q: Can you cite some other technical advances that Astro-Med has pioneered?

A: We added data acquisition to our products well before the PC was introduced. At that time, we used small amounts of static memory to augment our chart recorders. We introduced high-speed streaming of sampled waveforms direct to disk drive and

continue to increase the bandwidth of this approach. Before that innovation, you had to decide between high sample rates and long captures. Now, you can have both. In addition, we were one of the first to use DSPs to provide real-time filters and other functions as part of a data-acquisition product. Our Dash2 and Dash4 products were among the first data recorders designed for field use, including operation from battery.

Q: What application areas are responsible for your biggest customer volume?

A: We are very strong in aerospace, where our data-acquisition products test new aircraft on the ground and via telemetry. Similarly, engineers rely on our equipment for test and evaluation of automotive components. Other key applications include field service for monitoring processes in steel, aluminum, and paper mills, as well as the monitoring of power-generating equipment.

Q: What are the most important features that test engineers want to see in data-acquisition systems?

A: The ability to "grab and go" and have multiple functions in one package. They also want simplicity of operation. An engineer may not use the product every day and cannot afford a long learning curve before collecting data. Connectivity and multimedia are becoming more important as well. Engineers need to get acquired data "out of the box" so they can edit it, combine it with other data, and produce reports. We provide the interfaces and software to help with this. Finally, the demand always exists for more channels, higher sample rates, and smaller size. **T&MW**



Michael Sullivan comments on the importance of telemetry and networking in data acquisition, as well as trends affecting product development, in the online version of this interview: www.tmworld.com/2007_07.



HIGH-SPEED TEST

(Loop)back to the future

New test methods tackle $\geq 6.4\text{Gbps}$ data rates



Rudy Garcia, Member of Technical Staff

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*Manufacturers of microprocessors and high-end graphics chipsets are now employing high-speed serial buses like PCI Express and HyperTransport to deliver data and I/O rates up to 6.4Gbps. By 2010, 10Gbps and above may be the norm.**

Test, as always, will play a critical role in delivering these exponentially higher speeds at not-much-higher cost. However, faster serial buses introduce tough challenges, where traditional functional test and simple design-for-test (DFT) methodologies fall short. Older “functional” test flows on high-end ATE platforms offer the most thorough fault coverage, but these time-tested methods prove increasingly prohibitive in terms of cost, complexity and cycle times. Moreover, cost per pin rises with bus speed in high-speed data applications, making functional testing even less viable.

Manufacturers have thus turned to loopback techniques (i.e., using the device to source the test data and receive it back into the device for recognition) that enable cost optimized testing of today’s high-speed buses. Loopback testing can be very effective, but the manner in which it is implemented is especially critical, considering the typical loss budget for high-speed signals. This loss budget, which determines the magnitude of acceptable signal degradation, typically has three components—contributed by the transmitter, receiver, and interconnect—all of which could degrade the signal “eye” over the loopback path and thus impact coverage.

To date, alternative DFT techniques like “near-end loopback” have already introduced cost efficiencies (via ease of programming and reduced capital investment in ATE) in testing devices for high-end consumer and computing applications. Near-end loopback techniques can be self-contained within the DUT with pathways created between the I/O pins. However, the inherent cost savings and simplicity carry stiff tradeoffs in terms of coverage. There are no parametric measurements, a lack of signal control, and lower likelihood of catching faults related to signal integrity or bit errors. For example, a simple internal, or load board loopback, would allow a marginal receiver to “hide” in the shadow of a robust

transmitter and pass the loopback test screen. While these uncertainties can be worked around at lower speeds, compromising coverage at $\geq 6.4\text{Gbps}$ is way too risky.

Far-end Loopback: Less Jittery, Lower Cost

Between the two extremes, innovative techniques such as far-end loopback combine the flexibility of DFT with the more in-depth diagnostics of functional testing. Lengthening the feedback path by placing the DUT in communication with an intelligent but still cost-effective tester makes production-level testing of high-speed buses viable for the first time. Even more compelling, far end loopback with programmable signal degradation can be employed to cut costs and speed time-to-market while introducing unprecedented coverage.

This type of loopback offers significant advantages:

- Provides signal control to stress the eye
- Increased coverage in detecting sensitivity to signal integrity issues and bit errors
- Addition of circuitry enabling jitter to be injected and measured
- Covers all three parts of the loss budget
- Rx and Tx channels can be used to deliver test vectors to the core logic and protocol stack
- Access to device pins for full DC parametric testing

Clearly, exponentially faster bus speeds are driving fundamental shifts across the board, from design through production. Test companies can play an important leadership role in this fast-paced environment, by delivering innovative products and solutions that enable customers to optimize and accelerate their latest test methodologies at lower cost, while minimizing risk.

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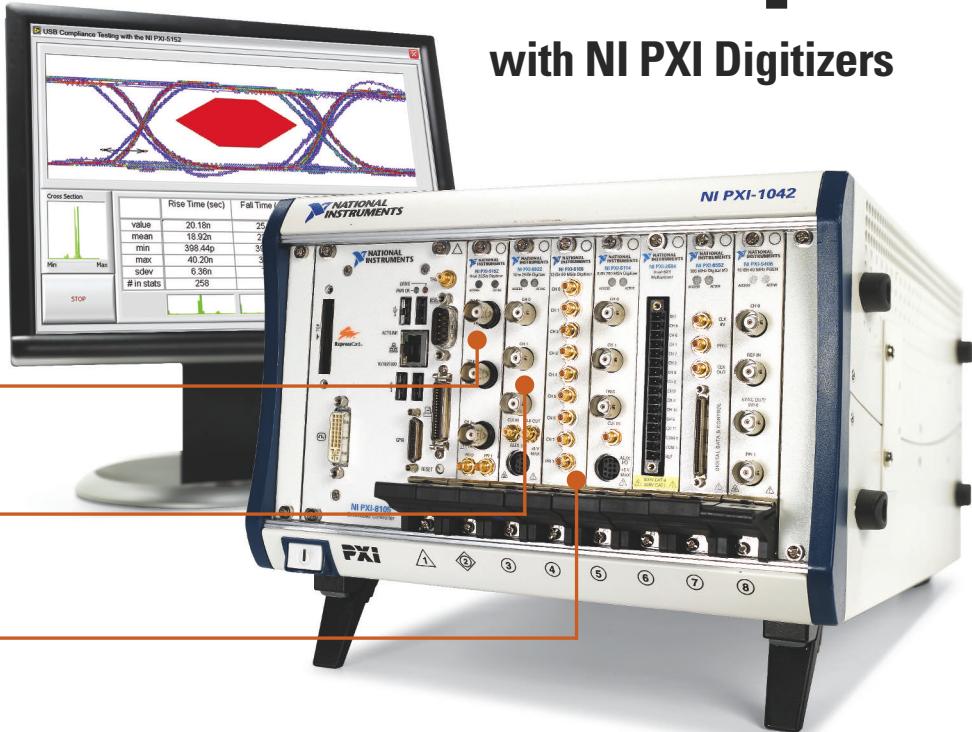
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