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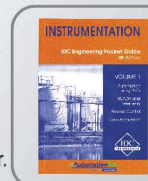


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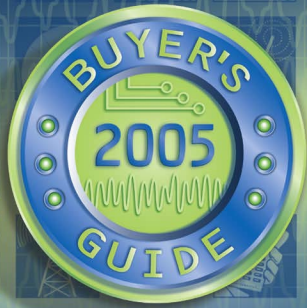
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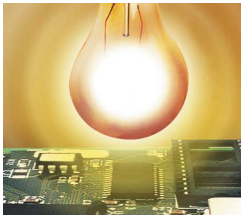


## CONTENTS



### DEPARTMENTS

- 5 Editor's note
- 9 Test voices
- 11 News
- 15 Show highlights
- 112 Viewpoint
- 5 Editorial staff
- 110 Business staff
- 108 Advertiser index



- 102 Catalog/Product listings
- 104 Product focus



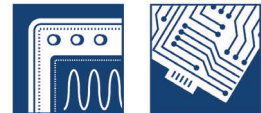
### TECH TRENDS

- 17 Semiconductor test
- 19 Machine vision

## 2005 BUYER'S GUIDE

### 21 Instrumentation

- 21 Stand-Alone Test Instruments
- 30 Cards and Modules
- 40 Sensors
- 41 Software
- 42 Accessories
- 43 Third-Party Suppliers
- 44 Services/Labs/Test Houses



### 47 Machine Vision & Inspection

- 47 Machine-Vision & Inspection Equipment
- 52 Machine-Vision Software
- 54 Third-Party Suppliers & Services



### 57 Communications Test

- 57 RF/Microwave & Wireless Test Equipment
- 57 Telecom/Datacom Test Equipment
- 60 Fiber-Optic/Electro-Optic Test Equipment
- 64 Third-Party Suppliers
- 65 Services/Labs/Test Houses



### 67 ATE/DFT/BIST

- 67 ATE/QA/Production Test Equipment
- 72 Software
- 79 Accessories
- 80 Third-Party Suppliers
- 81 Services/Labs/Test Houses



### 85 Electrical & Physical Environmental Test

- 85 Environmental Test Equipment
- 86 EMC Test Equipment
- 88 ESD Control/Protection
- 89 Third-Party Suppliers
- 90 Services/Labs/Test Houses



### 92 Vendor Contact Information

### 100 Societies and Standards Organizations



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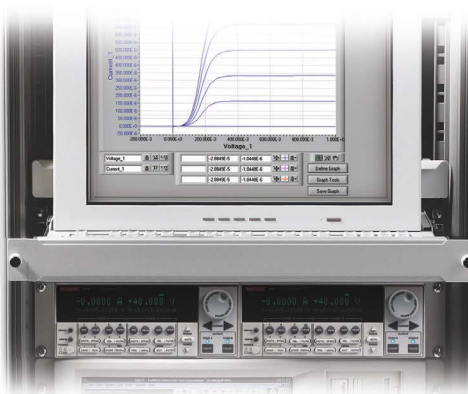
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## Science and respect

Many readers responded to my May Editor's Note on the difficulty of encouraging engineering careers. They generally agreed with the factors I cited, ranging from lack of recognition (which I addressed last month) to the financial insecurity attendant to a technical career in the midst of an outsourcing rage and in the aftermath of the dot-com bust. Read some of these comments in my new blog column appearing at [www.tmworld.com/blog](http://www.tmworld.com/blog).



In the May column, I also alluded to a political environment that promotes hostility to science that doesn't

### RICK NELSON, CHIEF EDITOR

support an ideological agenda. One reader asked for examples, and I'm happy to point to other publications offering a ready supply.

An article in the June *Scientific American* ("Doubt Is Their Product," p. 96) provides several examples in which political pressure or industry lobbying attempted to undermine research. In one instance, a pharmaceutical company mounted a legal attack on a group of scientists who had concluded, in a study approved by drug manufacturers and the FDA, that one of the company's over-the-counter medicines contributed to strokes. The article quotes a one-time FDA head as saying that the "hassle and harassment" the scientists suffered would discourage further participation in such studies.

In another, high profile, example reported in the *New York Times*, a White House official and former petroleum industry lobbyist "edited" government scientists' reports on climate change to de-emphasize the relationship between greenhouse-gas emissions and global warming. (I put "edited" in quotes because his edits seem to be the addition of qualifying adverbs and adjectives—competent editors are trained to take out such words.)

There may be legitimate scientific debate about the extent of global warming, its causes, and what to do about it. Further, it's entirely appropriate that actions taken or not taken on global warming should result from the political process, with politicians and voters acting in light of the best scientific evidence placed before them. What should not be part of the political process is the establishment of that evidence.

We don't vote on the value of  $\pi$  or on the configuration of the solar system. Most of us could probably get by quite nicely believing that  $\pi$  equals three and that the earth is the center of the universe. But if our leaders encourage such self-deceit and suggest there is virtue in it, then it's not surprising that enterprising young people avoid the hard work—and attendant unpopularity—of determining what scientific truth really is. T&MW

Contact Rick Nelson at [rnelson@tmworld.com](mailto:rnelson@tmworld.com).

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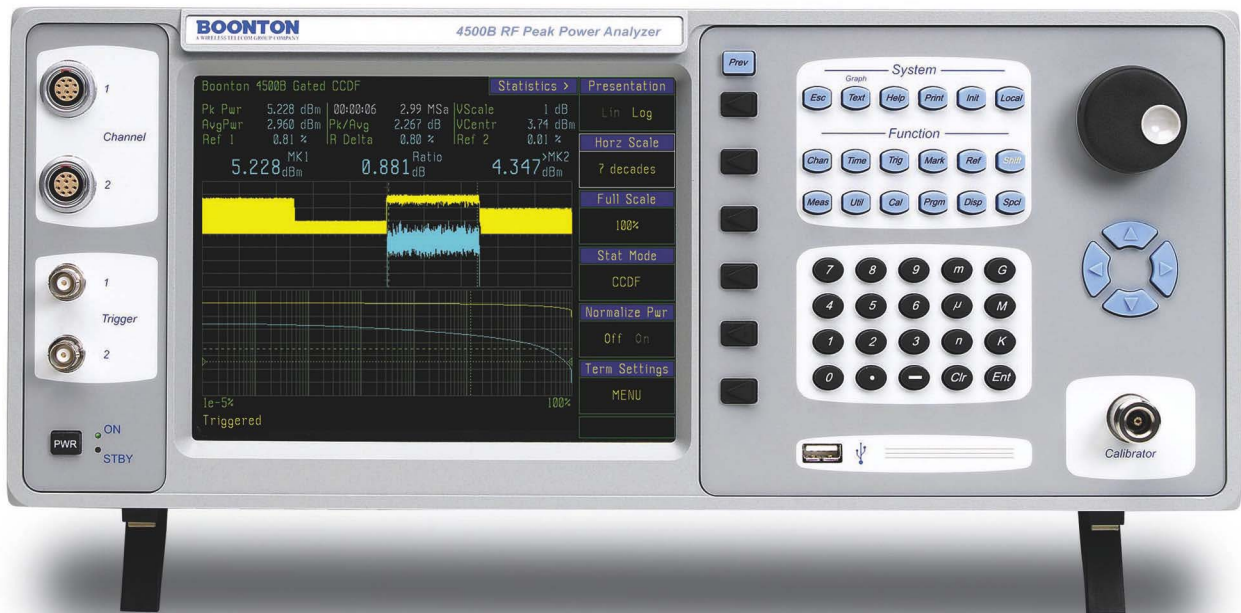
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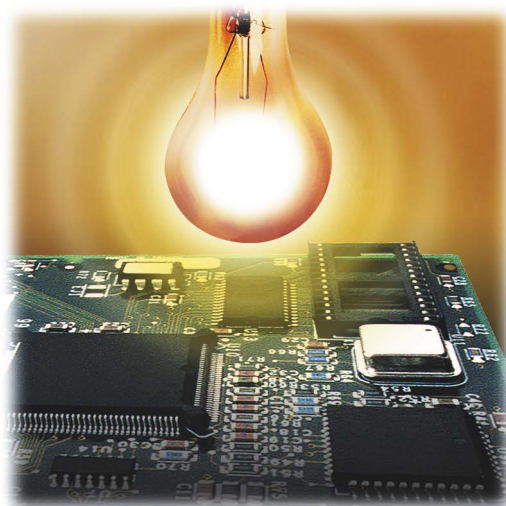
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[An exclusive interview with a test engineer]

## We have the technology

**K**evin Parmenter is the field applications engineering director for distribution and EDMS (electronic design manufacturing services) at Fairchild Semiconductor (Tempe, AZ). His group of engineers helps customers with their designs, often by providing test services. The group specializes in power electronics, working on devices that range in power from milliwatts to kilowatts and that go into products from guitar amplifiers to welders.



**T&MW: What kind of support does your group provide to designers?**

**Parmenter:** We recommend parts, provide paper designs, and provide reference designs that include test data based on measurements in our lab. We also provide technical support for customers who have problems with their designs. We often meet with customers and help them with measurements.

**T&MW: What kind of problems does your group solve?**

**Parmenter:** Many of our customers design power circuits for products that must operate in a standby, low-power mode to comply with Energy Star and other requirements. Most requirements call for standby power consumption of under 1 W.

Many customers try to make measurements with whatever equipment they have, which is often just a handheld DMM. But standby power generates complex, aperiodic waveforms with frequencies in the kilohertz range that DMMs can't accurately measure: Their sampling rate is too slow, and they can't synchronize voltage and current measurements. We use power analyzers from Voltech and Yokogawa that have wide dynamic range, fast sampling, and synchronization of the voltage and current measurements. It's possible to make these measurements with an oscilloscope if it has the right software, but most engineers don't have that.

Engineers designing power circuits may not have the equipment they need to properly test their designs. They usually lack electronic loads or variable AC power sources. Instead, they build home-made test loads from several resistors, or they perform tests using the power circuit's intended load circuit. We have programmable loads and AC power sources that let us test power circuits under a wide range of conditions. We often use the elec-

tronic loads to test the dynamics of a customer's power-circuit design. For stability measurements, we use an AP Instruments analyzer, which is designed for the noisy environment of power supplies. Stability problems aren't always caused by an IC; they also occur at the system level. For example, a customer may not have designed a circuit's magnetics properly or may not have measured the effective series resistance of a capacitor. Board layout can also introduce problems.

**T&MW: What kind of measurement questions do you ask your customers?**

**Parmenter:** We ask engineers, "What happens if you run this design at full load at 85°C?" We also ask if they've tested their DUT over various loads and input voltages. Many engineering labs don't have temperature chambers. I've seen engineers try to run temperature tests by placing the DUT in a shoe box with a light bulb inside. It's amazing how creative people can get when their boss won't let them have the right equipment.

**T&MW: Why do so many engineers lack the test equipment they need?**

**Parmenter:** Management tells engineers to get by with equipment they already have. And it's difficult for engineers to come up with return-on-investment numbers, which makes it difficult to get approvals for new equipment until something goes wrong—a new-product introduction is late or a product fails in the field. After that, it's easy to get approvals for more equipment. **T&MW**

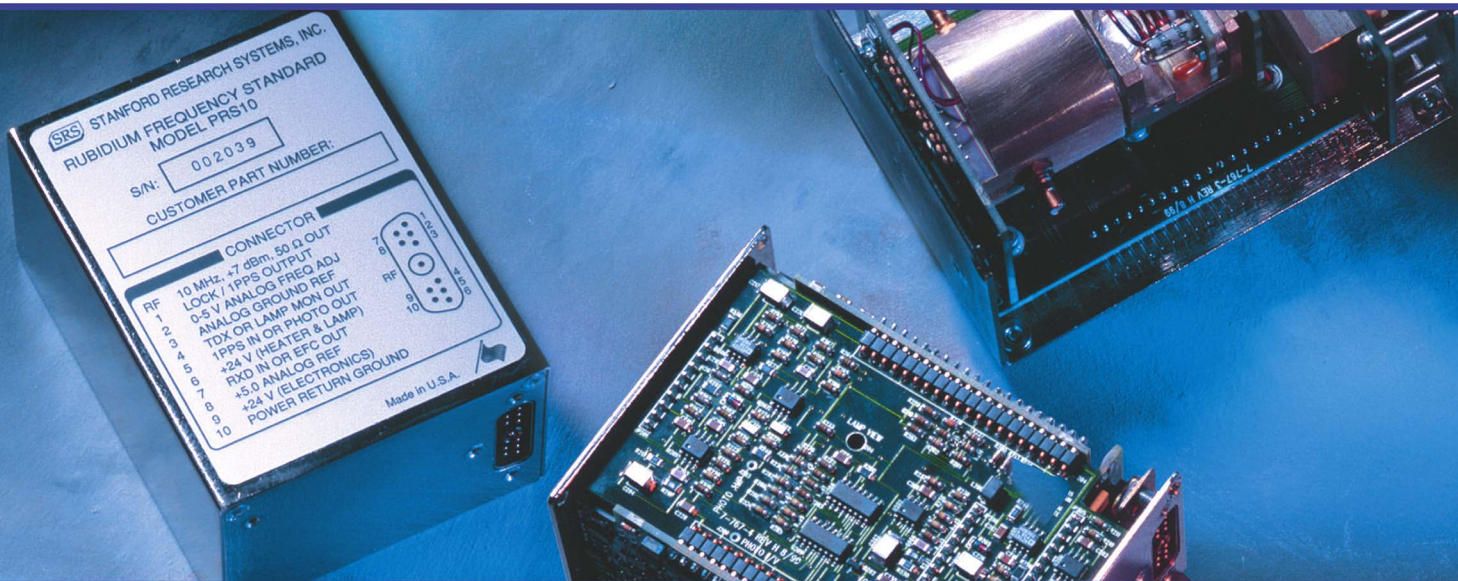
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Every other month, we will publish an interview with an electronics engineer who has test, measurement, or inspection responsibilities. If you'd like to participate in a future column, contact Martin Rowe at [mrowe@tmworld.com](mailto:mrowe@tmworld.com).



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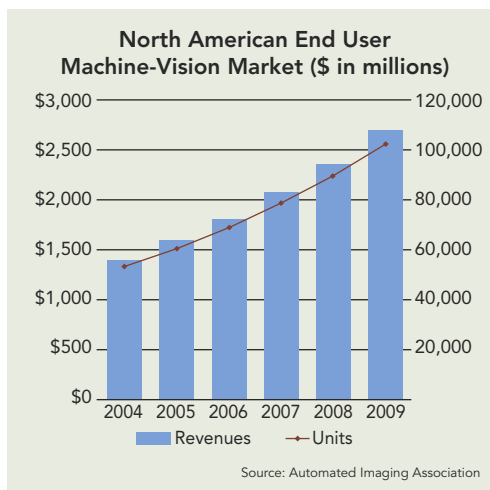


## AIA study shows 2004 recovery

Semiconductors and electronics together accounted for 46% of 2004's total North American machine-vision sales revenue, according to the Automated Imaging Association's recently released annual market study, *Machine Vision Markets: 2004 Results and Forecasts to 2009*. Nevertheless, the study found negative cumulative annual growth rates (CAGRs) in the semiconductor and electronics segments (p. 17). The industry's overall positive CAGR in both revenue and in unit volumes, the study suggests, comes from strong performance in other sectors, including the wood, printing, pharmaceutical, container, food, and fastener industries.

The study indicates that 2004 was a strong year for North American machine-vision companies, with 2004's total North American revenues at \$1.863 billion, including a \$488 million value-added contribution attributed to OEMs and system integrators. World-wide revenues were approximately \$8.1 billion, including value-added contributions.

The 352-page study predicts robust growth for the North American end-user market, to \$2.7 billion, without value-added contributions, in 2009. It also sees the North American components market (optics, lighting, and cameras) extending to \$417.6 million in 2009, vs. \$1.184 million in 2004. It cautions, however, that machine-vision sales are sensitive to business cycles and that the industry recovery could be fragile. (Revenues shown in the figure exclude value-added contributions). [www.machinevisiononline.org](http://www.machinevisiononline.org).



## Consortium to address silicon debug

Representatives of the design, manufacturing-test, and silicon-debug supply chain announced the formation of the Design for Debug (DFD) Consortium during this year's Design Automation Conference (June 11–18, Anaheim, CA). The goal of the consortium is to address tool-interoperability and methodology issues.

Charter members include Corelis, DAFCA, First Silicon Solutions (FS2), Intellitech, JTAG Technologies, Novas Software, and consultant Fidel Muradali. The consortium plans to define and promote the products, design methodologies, and industry standards required for efficient functional debug of "in situ" silicon devices. Efforts will center on identifying data- and file-format standards that can simplify and accelerate the functional debug of chips mounted in silicon prototypes or systems.

According to Muradali, "The time needed to track down functional problems once a chip is in its prototype system is unpredictable and costly today, mainly because a broad set of silicon debug and diagnosis solutions is not yet

publicly available. This cross-company consortium is valuable because it brings the focus needed to define practical so-

lutions and methodologies that can bridge the design and manufacturing test domains." [www.designfordebug.org](http://www.designfordebug.org).

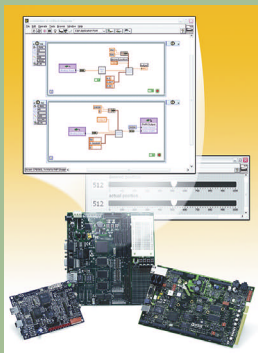
## Graphical programming for embedded design

The NI LabView Embedded Development Module extends LabView to any 32-bit embedded microprocessor, providing scientists and engineers with a graphical approach to algorithm design as well as the simulation, prototyping, and deployment of custom

designs for embedded systems. In addition to permitting the programming of applications using a graphical data-flow language, the Embedded Development Module allows engineers to use LabView front-panel controls and indicators to help interactively experiment with and debug their embedded code.

The module includes more than 400 analysis functions that address signal processing, linear algebra, curve fitting, statistics, and calculus. In addition to providing out-of-the-box measurement functionality for integrating real-world data early in the development process, the module also features a framework for integrating I/O drivers and board-support packages for taking advantage of specific processors. Users can develop their applications in LabView and then automatically generate C code to integrate with their chosen processor toolsets.

Base price: \$9995. National Instruments, [WWW.NI.COM](http://WWW.NI.COM).



EDITORS' CHOICE

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### Acterna acquired by JDS Uniphase

JDS Uniphase, a maker of optical network equipment, has announced that it will acquire Acterna, a maker of telecom and cable test equipment. JDSU will pay approximately \$760 million, in a combination of cash and common stock.

Acterna began its life as Telecommunications Techniques. The company merged with Wavetek Wandel Goltermann to become Acterna. Headquartered in Germantown, MD, Acterna manufactures test equipment used in the deployment and maintenance of optical telecom networks and cable networks. [www.jdsu.com](http://www.jdsu.com).

### Aeroflex purchases UbiNetics T&M division

Aeroflex has purchased the SPG test-and-measurement division of UbiNetics Holdings for approximately \$81 million in cash. SPG, headquartered in Melbourn, England, is a developer, manufacturer, and integrator of wireless test-and-measurement products for commercial wireless-product-development organizations and service operators.

SPG's products address infrastructure testing and mobile handset testing. SPG

## CALENDAR

**EMC Symposium**, August 8–12, Chicago, IL. Sponsored by IEEE, EMC Society. [www.emc2005.org](http://www.emc2005.org).

**Autotestcon**, September 26–29, Orlando, FL. Sponsored by IEEE. [www.autotestcon.com](http://www.autotestcon.com).

**International Robots & Vision Show**, September 27–29, Chicago, IL. Sponsored by Automated Imaging Association. [www.machinevisiononline.org](http://www.machinevisiononline.org).

**International Test Conference (ITC)**, November 6–11, Austin, TX. Sponsored by IEEE. [www.itctestweek.org](http://www.itctestweek.org).

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### Logic analyzers get faster and easier

The portable TLA7012 and benchtop TLA7016 logic-analyzer mainframes provide a 3X speed increase over previous models, letting you zoom, search, filter, and trigger faster than ever before. A Gigabit Ethernet port on the instruments lets you transfer large data files across networks.

The TLA7012 can hold two logic-input modules, the same modules used in previous models. It has a 15-in. display, larger than the display on previous models. The benchtop TLA7016 supports up to six input modules, up from five.

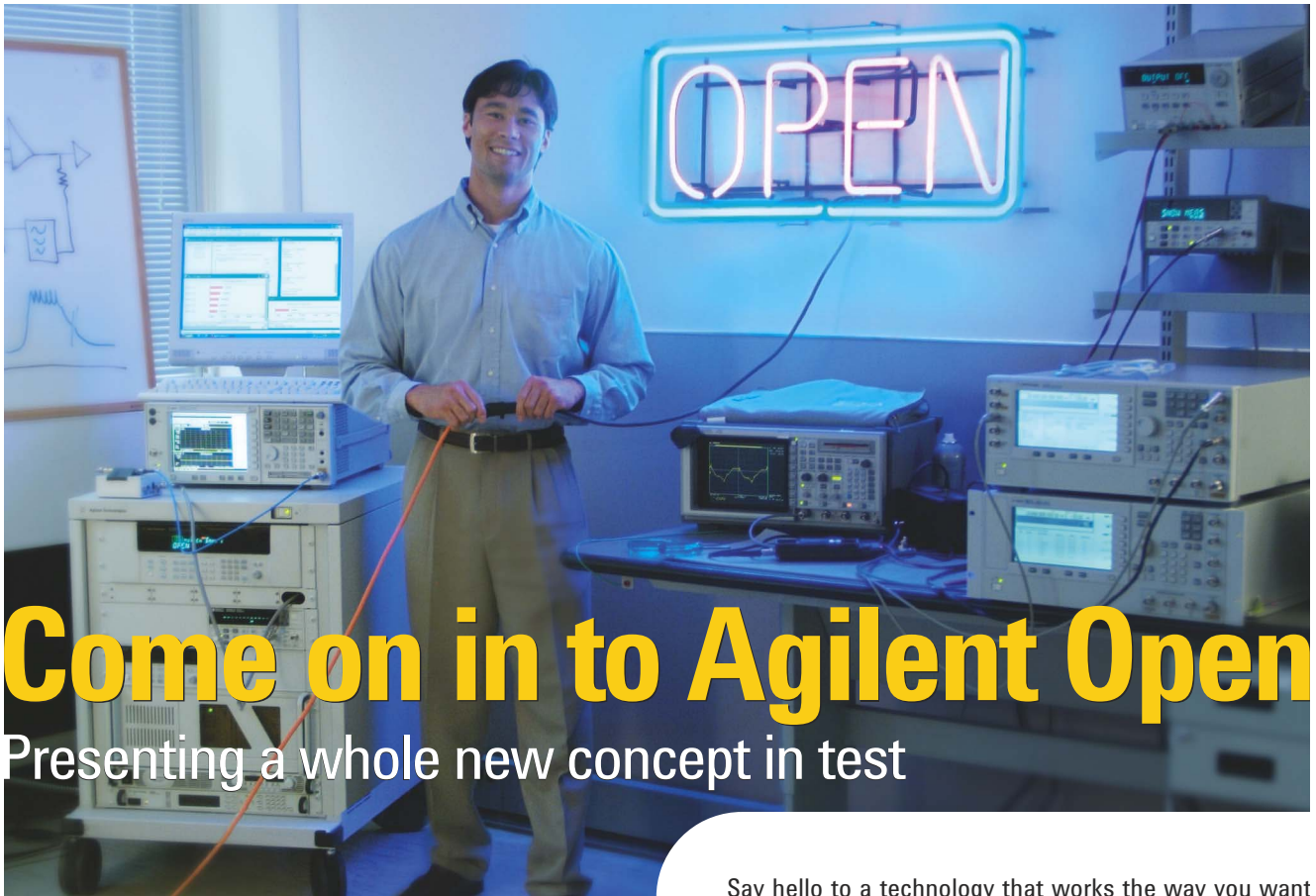
Both models run Windows XP on Intel Pentium M processors, and they include TLA software version 5.0. This new software lets you control the instrument and adds features such as automated measurements, remote hosting, and drag-and-drop setup. With the remote hosting feature, you can perform full analysis over a network. You also can download the software and use it with TLA5000 and TLA700 series instruments.

Prices: TLA7012—\$14,000; TLA7016—\$16,000. Prices do not include logic-input modules. Tektronix, [WWW.TEKTRONIX.COM](http://WWW.TEKTRONIX.COM).



EDITORS' CHOICE





# Come on in to Agilent Open

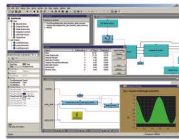
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# Keep an eye on it.



## The R&S® FSL Spectrum Analyzer: to see it is to want it.

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## Machine-vision components and connectivity

>>> [The Vision Show West, May 17–19, San Jose, CA, www.machinevisiononline.org.](http://www.machinevisiononline.org)

**Sony Electronics** ([bssc.sel.sony.com](http://bssc.sel.sony.com)) introduced two IEEE 1394b cameras—the XCD-V50 B&W model and the XCD-V50CR color model—as well as its XCI-SX1, the first member of the company's new Smart Camera suite. **Cognex** ([www.cognex.com](http://www.cognex.com)) introduced two new products: its FireWire acquisition software, which enables direct connection of IEEE 1394-compliant FireWire cameras to the vendor's PC-based vision systems, and its MVS-8600 series of Camera Link frame grabbers, which support 12-bit image acquisition.

**Pleora Technologies** ([www.pleora.com](http://www.pleora.com)) introduced its iPORT PT100-VB off-the-shelf board for adding Gigabit Ethernet connectivity to industrial cameras. **Point Grey Research** ([www.ptgrey.com](http://www.ptgrey.com)) unveiled its Ladybug2 IEEE 1394b-compliant spherical video camera, which delivers 360° real-time views at up to 30 frames/s.

**Schott** ([www.us.schott.com](http://www.us.schott.com)) introduced the iQ421 LED lighting controller, the Mini LED Ringlight, and new members of its DCR light series. **Leutron Vision** ([www.leutron.com](http://www.leutron.com)) de-

buted its PicPort-Express-CL series PCI Express Camera Link frame grabbers, which employ 85-MHz Camera Link receivers, are available in x1 and x4 PCI Express configurations, support area-scan and line-scan cameras, and offer single or dual (mono or stereo) Camera Link connectors.

In presentations, Steve Kinney of **JAI Pulnix** ([www.jaipulnix.com](http://www.jaipulnix.com))—chair of the AIA's Camera Link committee—provided an overview of Camera Link and described efforts to adopt a specification for a miniature Camera Link connector and a smaller cable. Arndt Bake of **Basler** ([www.basler-vc.com](http://www.basler-vc.com)) described the importance of color in line-scan-camera applications.

Drew Buttress of **Lumenera** ([www.lumenera.com](http://www.lumenera.com)) touted high-resolution area-scan cameras such as his firm's new LW620, a 6.6-Mpixel (3000x2200 pixels) product. Simon Stanley of **StockerYale** ([www.stockeryale.com](http://www.stockeryale.com)) discussed the application of LED illumination to line-scan applications and described his company's Cobra (Chip On Board Reflective Array) line-scan illuminator. T&MW



The Ladybug2's camera head unit holds six 1024x768-pixel color CCD sensors. Five point horizontally, and one points vertically.

Courtesy of Point Grey Research

## ZigBee buzzes through Chicago

>>> [Sensors Expo & Conference, June 6–8, Chicago, IL, www.sensorexpo.com.](http://www.sensorexpo.com)

The buzz around the 2005 Sensors Expo was about ZigBee, a protocol specification that promises to produce wireless sensor networks. If ZigBee lives up to its hype, you'll be able to build a robust measurement and control system without wires.

**Crossbow Technology** ([www.xbow.com](http://www.xbow.com)) showed 802.15.4-compliant RF modules for embedded systems. **Ember** ([www.ember.com](http://www.ember.com)) exhibited an IC that adds IEEE 802.15.4 and ZigBee-compliant networking to electronic devices and systems. **Texas Instruments** ([www.ti.com](http://www.ti.com)) introduced a frequency-hopping, spread-spectrum UART chipset for use in short-range wireless sensing applications.

**Maxstream** ([www.maxstream.net](http://www.maxstream.net)) exhibited XBee RF modules for embedded systems. **ANT** ([www.thisisant.com](http://www.thisisant.com)) exhibited proprietary wireless networking software. **Cirronet** ([www.cirronet.com](http://www.cirronet.com)) demonstrated a ZigBee wireless modem. **Wireless Plug** ([www.helicomm.com](http://www.helicomm.com)) showed a line of ZigBee-compliant networking terminals. **Innovative Wireless Technologies** ([www.iwtwireless.com](http://www.iwtwireless.com)) showed IEEE 802.15.4 and ZigBee-compliant transceivers.

Not all companies were focused on wireless technologies. **Colibrays** ([www.colibrays.com](http://www.colibrays.com)) exhibited MEMS capacitive accelerometers. **PCB Piezotronics** ([www.pcb.com](http://www.pcb.com)) dis-

played a portable TEDS reader/writer that uses a PDA to let you read and write data to IEEE 1451-compliant sensors.

**Crossbow Technology** ([www.xbow.com](http://www.xbow.com)) showed a navigation and servo-control board for use in radio-controlled vehicles. **Endevco** ([www.endevco.com](http://www.endevco.com)) announced a high-resonance piezoresistive crash sensor that captures high-frequency ringing that can occur in crash tests.

**National Instruments** ([www.ni.com](http://www.ni.com)) gave presentations on graphical programming and displayed the CompactRIO configurable real-time controllers as well as data-acquisition hardware. **Dexter Research** ([www.dexterresearch.com](http://www.dexterresearch.com)) announced the ST60 and ST60R infrared thermopile detectors. **Sypris Test & Measurement** ([www.calibration.com](http://www.calibration.com)) displayed current sensors, and company representatives discussed the CalWeb calibration services. **Summit Instruments** ([www.summitinstruments.com](http://www.summitinstruments.com)) exhibited accelerometers.

**FISO Technologies** ([www.fiso.com](http://www.fiso.com)) announced the FOP-MA, a fiber-optic pressure sensor for acoustic applications. **Sensor Synergy** ([www.sensorsynergy.com](http://www.sensorsynergy.com)) showed its network-enabled equipment monitor. **Honeywell Sensor Products** ([www.magneticsensors.com](http://www.magneticsensors.com)) displayed a three-axis magnetic sensor hybrid. T&MW

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\*Source: iSuppli, Nov. 2004



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## Silicon's luster dimming for vision firms?

Inspection plays a key role in the production of semiconductors, checking for defects and assisting in wafer alignment for a variety of production and test tasks. For example, Suss Microtec's MicroAlign technology for its

ProbeShield automated analytical-probing test environment targets test pads measuring less than 40x40 microns—pads that are too small to permit the use of a cantilevered probe card, because needle scrub lengths can



Machine vision plays a key role in ReAlign technology, which automates tests occurring over repeated cycles at varying temperatures while compensating for the thermal drift that could cause pad-to-probe-tip misalignment.

Courtesy of Suss Microtec.

exceed pad dimensions. A vertical probe card offers an alternative but comes with its own limitation: It prevents a clear view through the card to facilitate wafer alignment.

To compensate, MicroAlign employs multiple cameras, including a horizontal one that controls contact height to optimize over-travel margins. In April, the company enhanced MicroAlign, introduced in March 2004, by adding ReAlign, a feature that realigns pads and probe tips after temperature changes to account for thermal drift.

Other examples of inspection's role include wafer-bump and wire-bond inspection (see "Keep your eye on the metal bumps" and "X-ray inspection—not all black or white" in our June and

April issues, respectively). Nevertheless, the semiconductor industry could become less attractive to machine-vision component vendors. According to a recent Automated Imaging Association study of the North American machine-vision market, the semiconductor industry retains the largest slice of the machine-vision-applications pie, but that slice has been shrinking while revenue in other areas—notably pharmaceuticals—is growing.

In an interview, Dr. Robert J. Shillman, Cognex chairman and CEO, characterized semiconductor and electronics business as slow: "It's not going down, that's the good news. The bad news is it's at a fairly low level, although we are still able to make money even at that level now." Such sluggishness, he said, has prompted

Cognex to increasingly focus on end users instead of OEMs.

Of course, there's a fine line between end-user and OEM products. Philip Colet, sales and marketing VP for Dalsa Coreco, said his company nominally divides its offerings into OEM and end-user segments but that there is considerable overlap. You can be sure makers of optics, lighting, frame grabbers, cameras, and image processors aren't going to ignore the semiconductor industry, and many vendors who pursued end users at the Vision Show West in May (p. 15) will be out in force at this month's Semicon West wooing semiconductor OEMs.

The AIA's study predicts growth in the semiconductor machine-vision market through 2009. Perhaps the results of an increased end-user emphasis by machine-vision vendors will be an explosion of easy-to-use vision components that OEMs can more readily integrate into their increasingly sophisticated semiconductor test and inspection equipment. T&MW

### Memory tester goes global

With its two-station configuration, Advantest's new T5588 memory tester supports 512 devices (twice the capacity of its predecessor, the T5593). The T5588 targets the high-volume production of high-speed, double-data-rate DRAM (DDR2-SDRAM) devices, and it offers a maximum test speed of 800 Mbps in its DDR mode. [www.advantest.com](http://www.advantest.com).

### ProMOS selects parametric tester

Agilent Technologies has announced that ProMOS Technologies, a memory provider headquartered in Hsin-chu, Taiwan, has selected the Agilent 4072B parametric tester for its 12-in. wafer-fab facility at the Central Taiwan Science Park. The 4070 Series provides DC and RF measurement capabilities to test 65- and sub-65-nm process technologies. [www.agilent.com](http://www.agilent.com).



### Taiwan operations combined

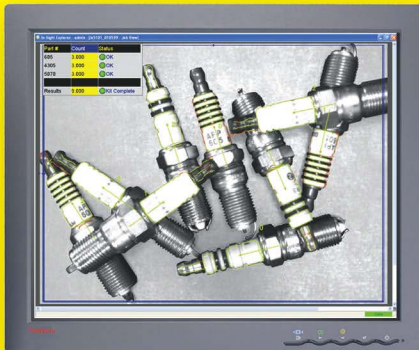
Credence Systems and Spirox, a provider of IC design, fabrication, and assembly and test for the semiconductor and TFT-LCD high-tech industries, have announced that they will combine Credence's Taiwan operations with Spirox's T1 test division to form Credence Spirox Integration Corp. This jointly owned corporation will be dedicated to supporting Credence products in the Taiwan region. [www.credence.com](http://www.credence.com).

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Techniques for Part Finding





## How do you make your mark?

**E**lectronic products often carry symbols, or marks, such as bar codes, optical-character-recognition graphics, and patterns of binary information. This encoded information identifies manufacturing lots,

software versions, and other product characteristics. Symbols may appear on labels, or manufacturers may produce the symbols as part of a product, such as by etching a Data Matrix symbol onto a device (see **figure**).

Forming these symbols or placing a label on a part requires engineers to answer the following questions:

**1. How will you use the information?** If you plan to track PCBs during production, for example, do you want



A laser can etch a permanent Data Matrix symbol and alphanumeric characters into a component. Symbols can conform to several size standards.

Courtesy of Microscan.

to know the PCB lot number, or do you need additional information about something such as a firmware version? Planning for the quantity of information will help you establish both the types of symbols you can use and their physical requirements.

**2. What symbol should you adopt?**

After you determine how much information your symbol should contain, you can choose a standard 1-D symbol, such as Code 128 or Interleaved 2-of-5, or a 2-D symbol, such as Data Matrix or PDF417. International standards define symbol characteristics, and groups such as Semiconductor Equipment Materials International (SEMI) and the Electronic Industry

Association (EIA) promote industry-related standards.

**3. Do you need permanent information?** An IC might need to carry a permanent symbol from production to consumer. On the other hand, a PCB for a handheld game may require only a temporary sticker that remains in place until final assembly. In either case, you must investigate how to integrate symbol production and reading in a manufacturing flow. Who will add or attach the symbol, and who will monitor its quality?

**4. Must you secure proprietary information?** Anyone with a scanner and software can extract information from a standard symbol. To keep information confidential, use encryption software or scramble the data before you create a symbol.

**5. How will you read the symbols?** If you already use machine-vision software, the software may include symbol-reading algorithms you can add to current inspection tasks. Fixed and handheld scanners tailored to a specific type of symbol quickly read and extract information. The speed of a production line, the orientation of symbols, and the quality of the symbols—which can degrade during production processes—will all affect scanner choices.

**6. Are symbol requirements compatible with production processes?** You may want to avoid placing a thick solder mask over symbols etched on a PCB. Also, reconsider sending stick-on paper labels through a reflow oven.

For more information about direct-part marking and symbol reading, I recommend, “Guidelines for Direct Part Mark Identification,” a 38-page booklet from Microscan, a supplier of scanners ([www.microscan.com/e-learning](http://www.microscan.com/e-learning)). T&MW

### Camera works fast

Test engineers who study the motion of objects can use the Redlake MotionPro HS-4 camera to acquire images at 5000 frames/s at a resolution of 512x512 pixels; the camera can operate even faster at lower vertical resolutions. The MotionPro HS-4 operates with either a Macintosh or a Windows PC that runs add-in software for LabView or Matlab. A USB interface connects the camera to its host computer. [www.redlake.com](http://www.redlake.com).

### Workstation manipulates MEMS

A workstation from Polytec lets engineers who work with MEMS devices analyze their motions, measure their electrical characteristics, and repair their defects. The MSA-400 Micro System Analyzer can operate under ambient atmospheric conditions or in a vacuum. In either environment, engineers can contact, cut, heat, shake, stimulate, and encapsulate MEMS devices. [www.polytec.com](http://www.polytec.com).



### NI updates Vision Builder

Vision Builder for Automated Inspection (2.6) now lets engineers use ActiveX controls to extend its capabilities and to integrate LabView virtual instruments into inspection scripts. The ActiveX controls help engineers customize user interfaces, access acquired images, and communicate inspection results through languages such as Visual Basic, LabView, and TestStand. The software also introduces algorithms that include color measurements, geometric matching, and object classification. [www.ni.com](http://www.ni.com).

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15-0

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## IN THIS SECTION:

- ▷ Stand-Alone Test Instruments, below
- ▷ Cards and Modules, p. 30
- ▷ Sensors, p. 40
- ▷ Software, p. 41
- ▷ Accessories, p. 42
- ▷ Third-Party Suppliers, p. 43
- ▷ Services/Labs/Test Houses, p. 44

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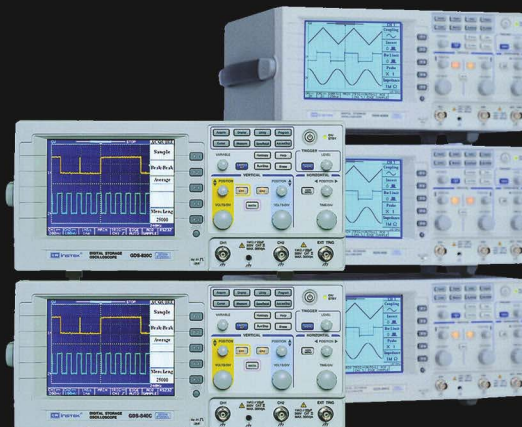
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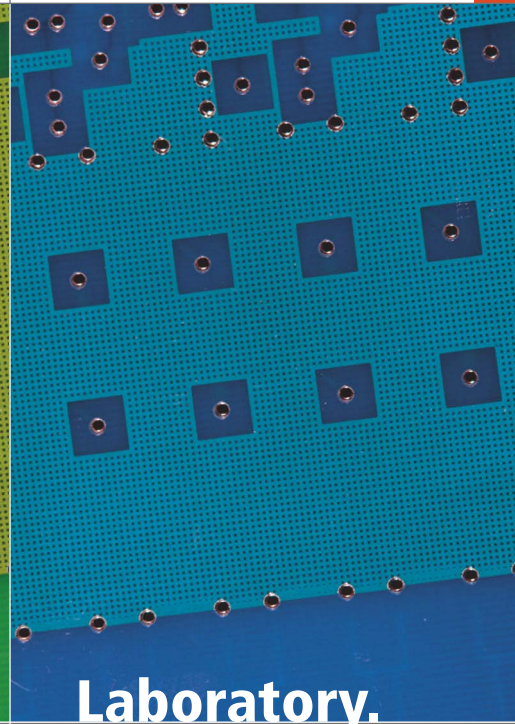
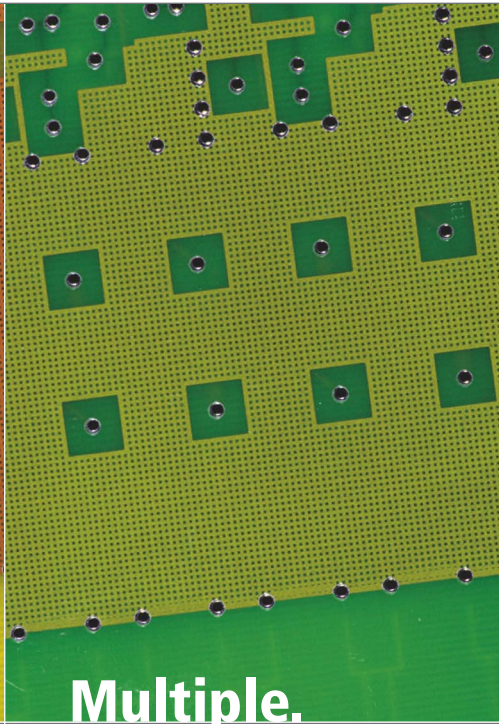
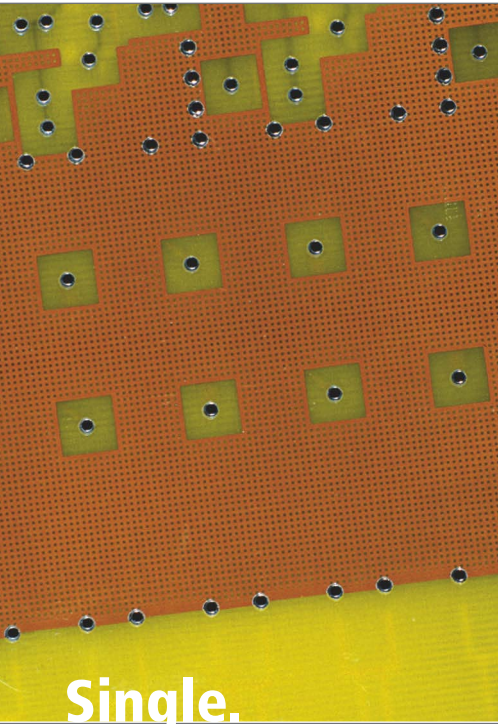
  
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- ▶ Embedded controller for auto-sequence
- ▶ Ethernet, GPIB, RS232, analog interfaces

## Multiple.

- ▶ Up to 8 outputs, 160W to 2.4kW
- ▶ Modular and expandable
- ▶ Extensive software, protection features

## Laboratory.

- ▶ Single, dual, triple outputs, 30W to 840W
- ▶ Auto-ranging output with PowerFlex
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> STAND-ALONE TEST INSTRUMENTS *continued*

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dataTaker  
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Fiberbyte

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GOEPEL Electronics  
HBM  
Hi-Techniques  
IMC DataWorks  
Innovative Integration  
Intelligent Instrumentation  
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IOtech  
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LeCroy  
LMS Instruments  
Measurement Computing  
MI Technologies  
Microstar Laboratories  
Monarch Instrument  
Neff Instrument  
Nomadics  
Novx  
OROS

Pacific Instruments  
Photron  
Pico Technology  
Racal Instruments  
Saelig  
Sciometric Instruments  
Scientific Solutions  
SensArray  
SOLTEC  
TAL Technologies  
TiePie engineering  
United Electronic Industries  
Vibration Research  
VXI Technology

**Data-Acquisition Systems, Stand-Alone**

Advantech  
Alligator Technologies  
Analogic  
Applied Signal Technology  
Astro-Med  
B & B Electronics

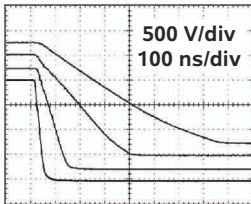
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Beptech  
Campbell Scientific  
Capital Equipment  
Computer Aided Solutions  
Condor Engineering  
Conduant  
Dalsa Coreco  
DAQ Systems  
Data Physics  
Data Translation  
Dataq Instruments  
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Dewetron  
DGH  
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Fluke  
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Hioki USA  
Hi-Techniques  
IMC DataWorks  
InHand Electronics  
Innovative Integration

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IOtech  
LDS Test and Measurement  
LMS Instruments  
Macro Sensors  
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SensArray  
SOLTEC  
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AEMC Instruments  
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# Compact Data Recorders For Capturing Dynamic Environments

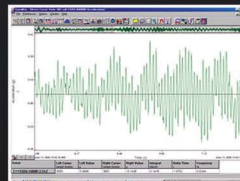
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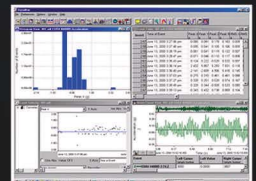
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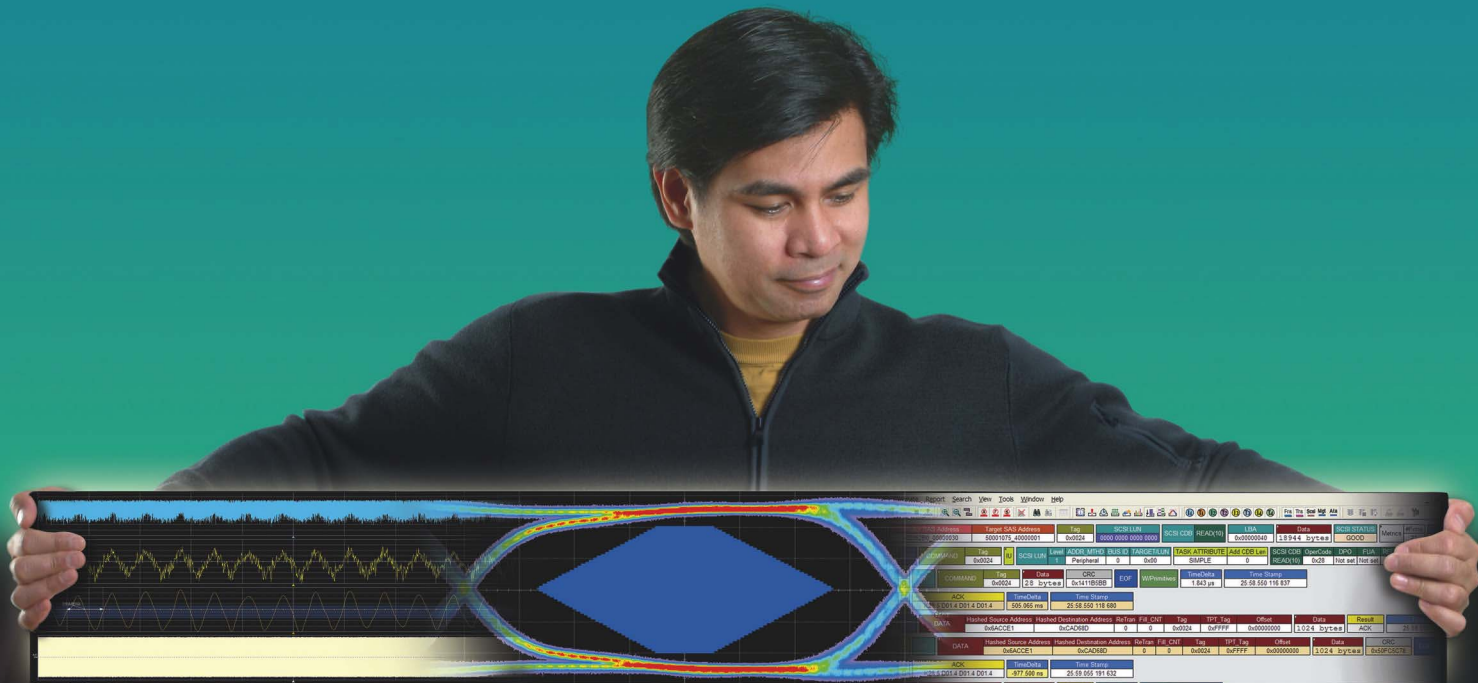
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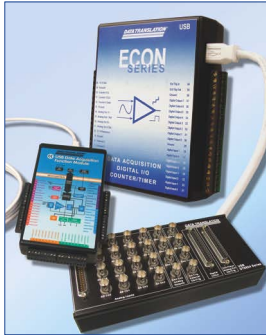
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Global Specialties  
Instek America  
Leader Instruments  
Madell Technology  
Protek Test and Measurement  
Sencore  
Tecpel

#### Oscilloscopes, Benchtop, Digital, 500 MHz & Below

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Agilent Technologies  
B&K Precision  
Dewetron  
Fluke  
Hioki USA  
Instek America  
LDS Test and Measurement  
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#### Oscilloscopes, Benchtop, Digital, Above 500 MHz

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Agilent Technologies  
LeCroy  
Tektronix  
Wavecrest  
Yokogawa Corp. of America

#### Oscilloscopes, Handheld

AEMC Instruments  
Fluke  
Tektronix

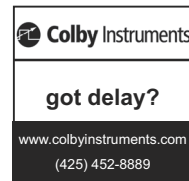
#### Pattern Generators, Digital

Agilent Technologies  
Anritsu  
Berkeley Nucleonics  
Chroma ATE  
Interface Technology

Klein Instruments  
MicroImage Video Systems  
Sencore  
SyntheSys Research  
Tabor Electronics  
Tektronix

#### Phase Meters/ Phase Angle Voltmeters

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Audio Precision  
Clarke-Hess  
Communication Research  
Colby Instruments



Exttech Instruments  
Flex-Core  
Hioki USA  
Krohn-Hite  
North Atlantic Industries  
Signal Recovery  
Tecpel  
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Xitron Technologies  
Yokogawa Corp. of America

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California Instruments  
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Data Physics  
Dynamic Solutions  
Krohn-Hite  
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Tabor Electronics  
Trek  
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Advanced Power Designs  
AEMC Instruments  
Agilent Technologies  
Bird Electronic

Chroma ATE  
Clarke-Hess  
Communication Research  
Dewetron  
Exttech Instruments  
Flex-Core  
Fluke  
GMC Instruments  
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Pacific Power Source  
Prior Scientific  
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Spectrum Control

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#### Signal Conditioners

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Data Physics  
Dewetron  
Endevco  
Flex-Core  
Frequency Devices  
Futek Advanced Sensor Technology  
IMC DataWorks  
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LDS Test and Measurement  
Macro Sensors  
Measurement Computing  
Neff Instrument  
Newport Electronics  
Omega Engineering  
Pacific Instruments  
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Pico Technology  
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Data Physics  
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Marsh Bellofram  
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Tecpel

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Fluke  
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Lake Shore  
Cryotronics  
Monarch Instrument

Newport Electronics  
Omega Engineering  
Pyrometer Instrument  
SensArray  
Simpson Electric  
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### Temperature Meters, Handheld

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AEMC Instruments  
Beamex  
Casella USA  
Computer Aided Solutions  
Everest Interscience  
Extech Instruments  
Fluke  
Hioki USA  
Linseis  
Monarch Instrument  
Newport Electronics  
Nomadics  
Omega Engineering  
Prostat  
Protek Test and Measurement  
Pyrometer Instrument  
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Clarke-Hess Communication Research  
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Newport Electronics  
Novatech Instruments  
Pendulum Instruments  
Spectracom  
Stanford Research Systems  
Symmetricom  
Tabor Electronics  
Xitron Technologies

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Clarke-Hess Communication Research  
Hipotronics  
QuadTech  
Xitron Technologies

### USB Testers/Debuggers

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GOEPEL Electronics  
LeCroy  
Tektronix

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Chroma ATE  
Fluke  
Leader Instruments  
MicroImage Video Systems  
Noise Com  
Photon  
Quantum Data  
Radiant Imaging  
Sencore  
SyntheSys Research  
Tektronix

### Wattmeters, Bench

Boonton Electronics  
Chroma ATE  
Clarke-Hess Communication Research  
Flex-Core  
Global Specialties  
Xitron Technologies

### Wattmeters, Handheld

Bird Electronic  
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## CARDS AND MODULES

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Advantech  
Agilent Technologies  
Capital Equipment  
Concurrent Computer  
Geotest - Marvin Test Systems  
GOEPEL Electronics  
ICS Electronics  
ines  
Intellitech  
IOtech  
Keithley Instruments  
Measurement Computing  
MEN Micro

National Instruments  
Scientific Solutions  
TEAM Solutions  
TransEra

### Bus Controller, Parallel (PC, PCMCIA, etc.)

ASSET Intertech  
B & B Electronics  
Curtiss-Wright Controls  
Elan Digital Systems  
Geotest - Marvin Test Systems  
GOEPEL Electronics  
ICS Electronics  
Intellitech

JTAG Technologies  
Keithley Instruments  
Measurement Computing  
National Instruments  
TEAM Solutions

### Bus Controller, Serial (RS-232C, RS-422, etc.)

Adlink Technology  
Advanced Vehicle Technologies  
Advantech  
B & B Electronics  
Concurrent Computer  
Curtiss-Wright Controls  
Diamond Systems



Elan Digital Systems  
 GOEPEL Electronics  
 ICS Electronics  
 IOtech  
 Keithley Instruments  
 M3 Electronics  
 Measurement Computing  
 MEN Micro  
 National Instruments  
 Saelig  
 Sealevel Systems  
 TAL Technologies  
 TEAM Solutions  
 Viewpoint Systems

**Bus Extenders**

ACCES I/O Products  
 Concurrent Computer  
 FuturePlus Systems  
 Geotest - Marvin Test Systems  
 ICS Electronics  
 IOtech  
 Moxa Technologies  
 National Instruments

**Bus Translators, CompactPCI/PXI to IEEE 488, Serial, or Ethernet**

Adlink Technology  
 Geotest - Marvin Test Systems  
 ICS Electronics  
 Measurement Computing  
 MEN Micro  
 National Instruments  
 Sealevel Systems  
 TEAM Solutions

**Bus Translators, PC-to-CompactPCI/PXI**

Adlink Technology  
 Concurrent Computer  
 Geotest - Marvin Test Systems  
 Measurement Computing  
 Pickering Interfaces

**Bus Translators, USB/LAN to IEEE 488**

ICS Electronics  
 Measurement Computing  
 National Instruments

**CompactPCI/PXI Analog I/O Cards**

Acromag  
 Adlink Technology  
 Advantech  
 Alligator Technologies  
 Analogic  
 C&H Technologies  
 Computer Aided Solutions  
 Concurrent Computer  
 DaqScribe Technology  
 Exacq Technologies  
 Frequency Devices  
 Gage Applied Technologies  
 Geotest - Marvin Test Systems

GOEPEL Electronics  
 Innovative Integration  
 Interactive Circuits and Systems  
 KineticSystems  
 Kontron  
 Measurement Computing  
 MEN Micro  
 North Atlantic Industries  
 National Instruments  
 Strategic Test  
 TEAM Solutions  
 Teradyne  
 Assembly Test Div.  
 TiePie engineering  
 United Electronic Industries

**CompactPCI/PXI Arbitrary Waveform Generators**

Adlink Technology  
 Advantech  
 C&H Technologies

DaqScribe Technology  
 Exacq Technologies  
 Geotest - Marvin Test Systems  
 GOEPEL Electronics  
 Interactive Circuits and Systems  
 LeCroy  
 National Instruments  
 Pickering Interfaces  
 PXIT  
 Strategic Test  
 Tabor Electronics  
 TEAM Solutions  
 United Electronic Industries  
 Ztec

**CompactPCI/PXI Counters/Timers**

Acromag  
 Adlink Technology  
 Advantech  
 B & B Electronics  
 Concurrent Computer  
 Exacq Technologies

Geotest - Marvin Test Systems  
 KineticSystems  
 MEN Micro  
 National Instruments  
 Spectracom  
 United Electronic Industries  
 Ztec

**CompactPCI/PXI Digital I/O Cards**

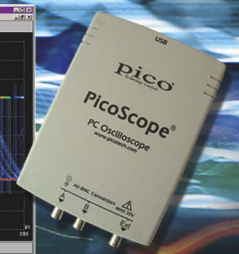
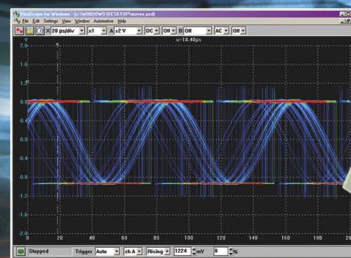
Acromag  
 Adlink Technology  
 Advantech  
 Analogic  
 C&H Technologies  
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 Condor Engineering  
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 Geotest - Marvin Test Systems

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- Compact & portable
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Sampling rate (single shot)	50MS/s	100MS/s	200MS/s
Channels	2+Ext trigger	2+Ext trigger/Sig gen	2+Ext trigger/Sig gen
Oscilloscope tim ebases	5ns/div to 50s/div	2ns/div to 50s/div	1ns/div to 50s/div
Tim ebase accuracy	50ppm	50ppm	50ppm
Spectrum ranges	0 to 25MHz	0 to 50MHz	0 to 100MHz
Buffer memory size	256KB	512KB	1MB
Resolution / accuracy	8 bits / 3%		
Ranges	±100mV to ±20V		
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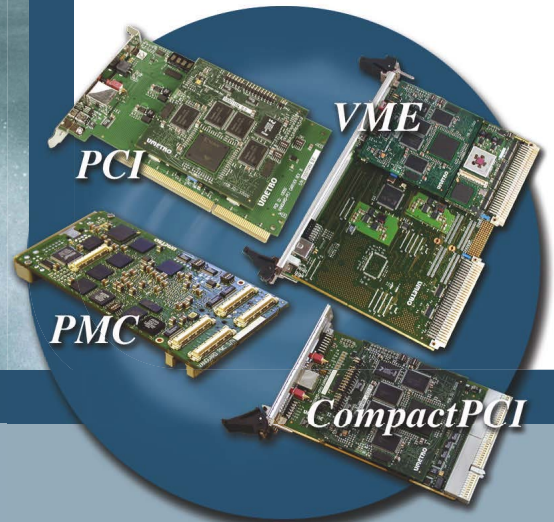
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- Provides a trace buffer of 256 bits x 2MSamples

## Flexible

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- Available for PCI/PCI-X, PMC, CompactPCI and VME bus architectures

## Easy to Use

- Full Decoding and Demultiplexing of Bus Traffic
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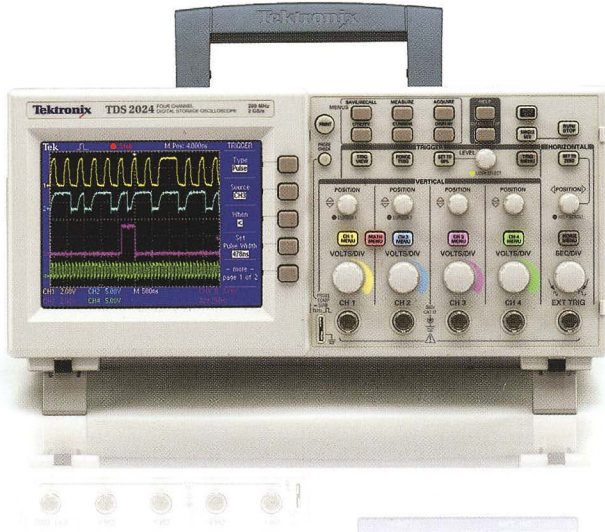
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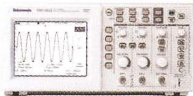
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Kontron

Measurement Computing

MEN Micro

National Instruments

Navatek Engineering

PLD Applications

Strategic Test

Teradyne Assembly Test Div.

United Electronic Industries

**CompactPCI/PXI Digitizers/Oscilloscopes**

Acqiris USA

Adlink Technology

Advantech

DaqScribe Technology

Exacq Technologies

Gage Applied Technologies

Geotest - Marvin Test Systems

KineticSystems

LeCroy

Measurement Computing

National Instruments

Strategic Test

TEAM Solutions

TiePie engineering

Ztec

**CompactPCI/PXI DMMs**

ASCOR

Exacq Technologies

Geotest - Marvin Test Systems

MEN Micro

National Instruments

Pickering Interfaces

Signametrics

TEAM Solutions

**CompactPCI/PXI DSP Cards**

Analogic

DaqScribe Technology

Exacq Technologies

Innovative Integration

Interactive Circuits and Systems

MEN Micro

VMETRO

**CompactPCI/PXI Logic Analyzers**

Exacq Technologies

Geotest - Marvin Test Systems

National Instruments

VMETRO

**CompactPCI/PXI Multifunction I/O Cards**

Acromag

Adlink Technology

Advantech

Analogic

Ballard Technology

Concurrent Computer

Condor Engineering

DaqScribe Technology

Exacq Technologies

Geotest - Marvin Test Systems

GOEPEL Electronics

KineticSystems

Kontron

National Instruments

Pickering Interfaces

PLD Applications

Sealevel Systems

TEAM Solutions

Teradyne Assembly Test Div.

United Electronic Industries

**CompactPCI/PXI RF Measurement Cards**

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National Instruments

Pickering Interfaces

Ztec

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Analogic

DaqScribe Technology

Frequency Devices

MEN Micro

National Instruments

Pickering Interfaces

Teradyne Assembly Test Div.

United Electronic Industries

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Exacq Technologies

Interactive Circuits and Systems

National Instruments

TEAM Solutions

TiePie engineering

**CompactPCI/PXI Switches/Multiplexers**

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Advantech

ASCOR

Chroma ATE

Cytec

Digalog Systems

Exacq Technologies

Geotest - Marvin Test Systems

GOEPEL Electronics

KineticSystems

MEN Micro

National Instruments

Pickering Interfaces

Signametrics

TEAM Solutions

Teradyne Assembly Test Div.

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KineticSystems

MEN Micro

National Instruments

Spectracom

Symmetricom

United Electronic Industries

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Adlink Technology

Advantech

Alligator Technologies

Analogic

C&H Technologies

Capital Equipment

Computer Aided Solutions

Concurrent Computer

Curtiss-Wright Controls

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Data Translation

Dataq Instruments

Diamond Systems

Elan Digital Systems

Exacq Technologies

Frequency Devices

Gage Applied Technologies

GE Fanuc Automation

Geotest - Marvin Test Systems

Highland Technology

ICS Electronics

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Innovative Integration

Intelligent Instrumentation

Interactive Circuits and Systems

IOtech

Keithley Instruments

KineticSystems

Kontron

Lawson Labs

LMS Instruments

Measurement Computing

MEN Micro

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Adlink Technology  
Advantech  
C&H Technologies  
Capital Equipment  
Concurrent Computer  
Exacq Technologies  
Geotest - Marvin Test Systems  
KineticSystems  
Kontron  
Measurement Computing  
MEN Micro  
National Instruments  
Neff Instrument  
Racal Instruments  
United Electronic Industries  
Yelo-USA  
Ztec

**Instrument Cards, Digital I/O**

ACCES I/O Products  
Acromag  
Adlink Technology  
Advantech  
AIM USA  
Analogic  
C&H Technologies  
Capital Equipment  
Computer Aided Solutions  
Concurrent Computer  
DaqScribe Technology  
Data Translation  
Diamond Systems  
Elan Digital Systems  
Exacq Technologies  
Frequency Devices  
Gage Applied Technologies  
GE Fanuc Automation  
Geotest - Marvin Test Systems  
GOEPEL Electronics  
ICS Electronics  
ines  
Innovative Integration  
Intelligent Instrumentation  
IOtech  
JTAG Technologies  
Keithley Instruments  
KineticSystems  
Kontron

Measurement Computing  
MEN Micro  
Microstar Laboratories  
National Instruments  
Navatek Engineering  
Neff Instrument  
Pacific Instruments  
Pentek  
Racal Instruments  
Scientific Solutions  
Sealevel Systems  
Strategic Test  
TransEra  
United Electronic Industries  
Viewpoint Systems

**Instrument Cards, Digitizers, Oscilloscopes**

Acqiris USA  
Adlink Technology  
Alacron  
Analogic  
Chase Scientific  
Dewetron  
Exacq Technologies  
Gage Applied Technologies  
Geotest - Marvin Test Systems  
Keithley Instruments  
KineticSystems  
Measurement Computing  
MEN Micro  
National Instruments  
Pacific Instruments  
Pickering Interfaces  
Pico Technology  
PXIT  
Racal Instruments  
Saelig  
Strategic Test  
TEAM Solutions  
TiePie engineering  
United Electronic Industries  
Ztec

**Instrument Cards, DMM**

Data Translation  
Exacq Technologies  
Geotest - Marvin Test Systems  
ines  
Keithley Instruments  
MEN Micro  
National Instruments  
Pickering Interfaces

Racal Instruments  
Signametrics  
TEAM Solutions

**Instrument Cards, DSP**

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Computer Aided Solutions  
Concurrent Computer  
DaqScribe Technology  
Data Translation  
Exacq Technologies  
Innovative Integration  
Interactive Circuits and Systems  
LMS Instruments  
MEN Micro  
Microstar Laboratories  
National Instruments  
Pentek  
Ztec

**Instrument Cards, Freq., Time, Synchro-Resolver**

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Concurrent Computer  
Diamond Systems  
Exacq Technologies  
GE Fanuc Automation  
Geotest - Marvin Test Systems  
GuideTech  
Highland Technology  
Keithley Instruments  
KineticSystems  
Measurement Computing  
MEN Micro  
North Atlantic Industries  
Pacific Instruments  
Racal Instruments  
Spectracom  
Symmetricom  
Yelo-USA

**Instrument Cards, Logic Analyzers**

Exacq Technologies  
Geotest - Marvin Test Systems  
National Instruments  
NCI  
TEAM Solutions  
TiePie engineering

**Instrument Cards, MIL-STD-1553/ARINC**

AIM USA  
Ballard Technology  
Condor Engineering  
Curtiss-Wright Controls  
Geotest - Marvin Test Systems  
KineticSystems  
Pickering Interfaces

**Instrument Cards, Prototype**

C&H Technologies  
Diamond Systems  
Geotest - Marvin Test Systems  
Interface Technology  
KineticSystems  
MEN Micro  
National Instruments  
Pacific Instruments  
Pickering Interfaces  
Racal Instruments

**Instrument Cards, Signal Sources**

Adlink Technology  
Analogic  
C&H Technologies  
Chase Scientific  
Data Physics  
Data Translation  
Exacq Technologies  
Frequency Devices  
Geotest - Marvin Test Systems  
Highland Technology  
Keithley Instruments  
LMS Instruments  
Measurement Computing  
MEN Micro  
National Instruments  
Novatek Instruments  
Pacific Instruments  
Pentek  
Pickering Interfaces  
Racal Instruments  
Signametrics  
Strategic Test  
TEAM Solutions  
United Electronic Industries  
Yelo-USA

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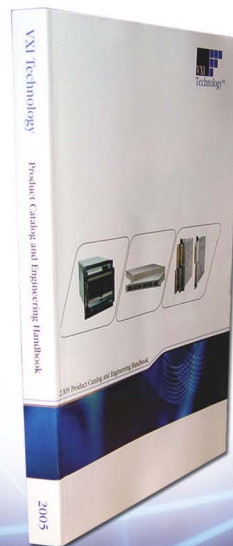
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Dewetron  
Exacq Technologies  
Morrow Technologies  
National Instruments  
Pico Technology

Saelig  
TEAM Solutions  
TiePie engineering

**Instrument Cards, Switches, Multiplexers**

Adlink Technology  
Advantech

Analogic  
C&H Technologies  
Chroma ATE  
Cytec  
Exacq Technologies  
Geotest - Marvin Test Systems  
ICS Electronics  
Keithley Instruments

KineticSystems  
National Instruments  
Neff Instruments  
Pacific Instruments  
Pickering Interfaces  
Racal Instruments  
Signametrics  
TEAM Solutions  
Universal Switching

VXI Technology  
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**Instrument Cards, Video Test**

Acqiris USA  
Exacq Technologies  
National Instruments  
Racal Instruments  
Videology Imaging Solutions

**Instrument Controllers/Computers**

Acromag  
Adlink Technology  
Agilent Technologies  
Geotest - Marvin Test Systems  
IOtech  
KineticSystems  
MEN Micro  
National Instruments  
Newport Electronics  
Onset Computer  
PFU Systems  
Racal Instruments  
TEAM Solutions  
Tektronix  
United Electronic Industries  
Yelo-USA

**Instrument Mainframes/Chassis**

Acqiris USA  
Adlink Technology  
Agilent Technologies  
Dewetron  
ELMA Electronic  
Frequency Devices  
Gage Applied Technologies  
Geotest - Marvin Test Systems  
IMC DataWorks  
Keithley Instruments  
KineticSystems  
Kontron  
Neff Instrument  
Pacific Instruments  
Pickering Interfaces  
Precision Filters  
Racal Instruments  
TEAM Solutions  
Tegam  
Tektronix

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United Electronic Industries  
Western Graphtec  
Yelo-USA

**PC Card (PCMCIA) Modules**

ACCESS I/O Products  
Alligator Technologies  
B & B Electronics  
Ballard Technology  
Capital Equipment  
Condor Engineering  
Data Physics  
Data Translation  
FuturePlus Systems  
GOEPEL Electronics  
ICS Electronics  
Keithley Instruments  
Measurement Computing  
National Instruments  
Pickering Interfaces  
Sealevel Systems  
Spectracom  
TAL Technologies  
TEAM Solutions

**PXI Embedded Controllers**

Conduant  
Geotest - Marvin Test Systems  
GOEPEL Electronics  
KineticSystems  
MEN Micro  
National Instruments  
TEAM Solutions  
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**PXI Mainframe Interconnects (Receivers)**

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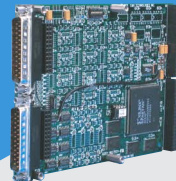
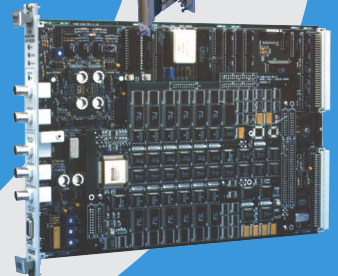


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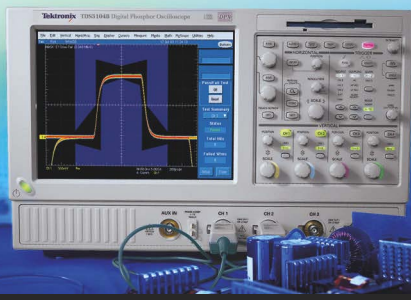
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TEAM Solutions  
Teradyne  
Assembly Test Div.  
Tracewell Systems  
United Electronic  
Industries

**VXibus  
Amplifiers,  
Attenuators**

Agilent Technologies  
Alligator Technologies  
Frequency Devices  
Kemo  
KineticSystems  
North Atlantic  
Industries  
Racal Instruments  
VXI Technology

KineticSystems  
Pentek  
Racal Instruments  
Teradyne  
Assembly Test Div.  
VXI Technology

**VXibus  
Digitizers,  
Oscilloscopes**

Acqiris USA  
Agilent Technologies  
Analogic  
KineticSystems  
Racal Instruments  
Teradyne  
Assembly Test Div.  
VXI Technology  
Ztec

**Signal-  
Conditioning  
Modules &  
Boards**

ACCES I/O Products  
Acromag  
Advantech  
Alligator Technologies  
Analogic  
DaqScribe  
Technology  
Data Translation  
Dataforth  
Dataq Instruments  
Dewetron  
DGH  
Endevco

**VXibus Analog  
I/O**

Alligator Technologies  
C&H Technologies  
Frequency Devices  
Highland Technology  
KineticSystems  
Pentek  
Racal Instruments  
Summit Instruments  
VXI Technology

**VXibus  
Frequency or  
Time  
Measurement  
Instruments**

Agilent Technologies  
ASCOR  
C&H Technologies  
Highland Technology  
Interface Technology  
KineticSystems  
Racal Instruments  
Spectracom  
Symmetricom  
VXI Technology  
Ztec

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Spectrum, Logic,  
Network**

Agilent Technologies  
Data Physics  
Morrow Technologies  
Racal Instruments  
VMETRO

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Communication  
Modules**

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AIM USA  
C&H Technologies  
Condor Engineering  
ICS Electronics  
KineticSystems  
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Teradyne  
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VXI Technology

**VXibus  
Mainframes/  
Chassis**

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Racal Instruments  
Teradyne  
Assembly Test Div.  
Tracewell Systems  
Virginia Panel  
VXI Technology

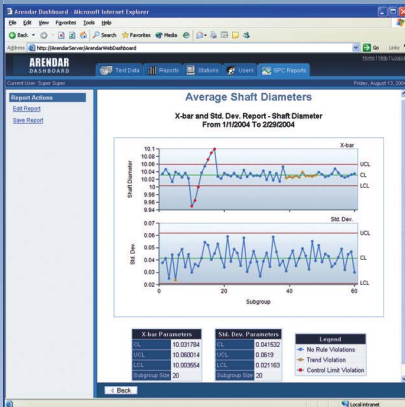
**VXibus  
Digital I/O**

Agilent Technologies  
ASCOR  
C&H Technologies  
ICS Electronics  
Interface Technology  
JTAG Technologies

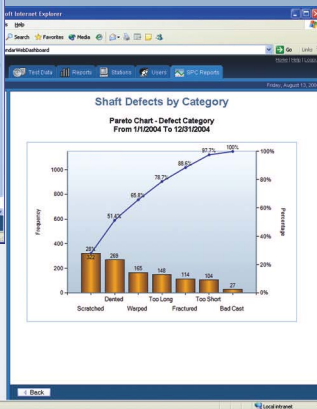
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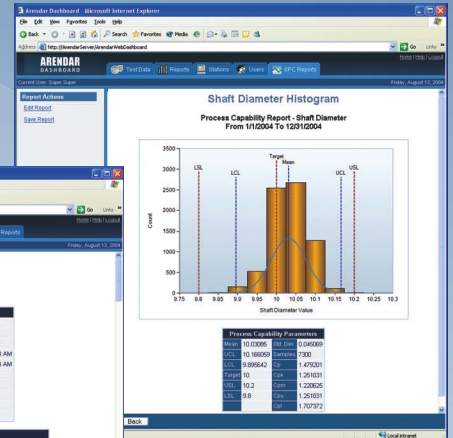
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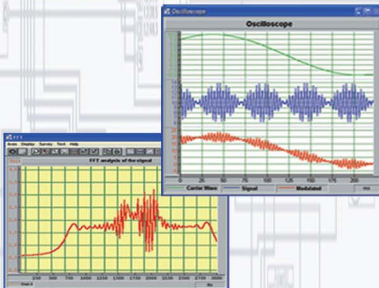
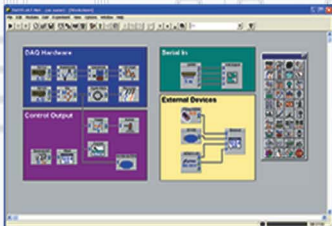


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Advanced Power Designs  
Agilent Technologies  
Boonton Electronics  
Chroma ATE  
Giga-tronics  
Highland Technology  
Kepeco  
Tracewell Systems

### VXIbus Signal Sources

Aeroflex  
Agilent Technologies  
Analogic  
C&H Technologies  
Frequency Devices  
Giga-tronics  
Highland Technology  
Interface Technology  
KineticSystems  
Noise Com  
Racal Instruments  
Spectracom

Symmetricom  
Teradyne  
Assembly Test Div.  
VXI Technology

### VXIbus Switches, Multiplexers

Agilent Technologies  
Analogic  
ASCOR  
C&H Technologies  
Cytec  
KineticSystems  
Pickering Interfaces  
Racal Instruments  
Teradyne  
Assembly Test Div.  
Universal Switching  
VXI Technology

### VXIbus System Controllers, Slot 0

Agilent Technologies  
KineticSystems  
National Instruments  
Racal Instruments  
VXI Technology

### VXIbus Telecom-Test Instruments

Agilent Technologies  
Flextronics Test  
Noise Com

Pentek  
Racal Instruments  
Teradyne  
Assembly Test Div.

## SENSORS

### Accelerometers

Bruel & Kjaer, North America  
Endevco  
IMV  
Instrumented Sensor Technology  
Kistler Instrument  
MSI Sensors  
Omega Engineering  
PCB Piezotronics  
Polytec  
SOLTEC  
Summit Instruments

Flex-Core  
GMC Instruments  
GMW Associates  
Hioki USA  
Ion Physics  
Marsh Bellofram  
Pace Scientific  
Pearson Electronics  
Sypris Test & Measurement

### Force & Strain Sensors

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MSI Sensors  
Newport Electronics  
Omega Engineering

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MSI Sensors  
Newport Electronics  
Omega Engineering  
Onset Computer  
Pace Scientific  
Reinhardt System und  
Messelectronic  
Rotronic Instrument  
Saelig  
SensArray

### Magnetic Field Sensors

Credence  
Technologies  
ETS-Lindgren  
GMW Associates  
Ion Physics  
Lake Shore  
Cryotronics  
Magnetic Shield  
Sypris Test &  
Measurement

### Position Sensors

GMW Associates  
Macro Sensors  
MSI Sensors  
MTI Instruments  
North Atlantic  
Industries  
Polytec  
SOLTEC  
Sony Precision  
Technology America  
Sypris Test &  
Measurement  
Ultrafast Sensors

### Pressure Sensors

Bruel & Kjaer, North  
America  
Endevco  
Futek Advanced  
Sensor Technology  
Kistler Instrument  
Marsh Bellofram  
MSI Sensors  
Newport Electronics  
Omega Engineering  
Pace Scientific  
PCB Piezotronics

Pressure Systems  
Sensor Products  
Sensortech  
SOLTEC  
Tekscan

### Sound Sensors

AEMC Instruments  
Bruel & Kjaer, North  
America

### Temperature Sensors

AEMC Instruments  
B & B Electronics

### SOFTWARE

#### Agilent VEE Add-ins

Corelis  
Data Translation  
Exacq Technologies  
ICS Electronics  
ines  
m + p international  
Measurement  
Computing  
Symtx  
United Electronic  
Industries

#### C/C++ Libraries

Agilent Technologies  
Dalsa Coreco  
Data Translation  
EPIX  
Euresys  
Exacq Technologies  
ICS Electronics  
Intelligent  
Instrumentation  
JTAG Technologies  
Matrox Imaging  
Measurement  
Computing  
MVTec Software  
National Instruments  
Pacific Instruments  
Pentek  
Rad-Icon Imaging  
Scientific Solutions  
Symtx  
TAL Technologies  
TestQuest  
United Electronic  
Industries  
Vektrex Electronic  
Systems  
VI Technology

BetaTHERM Sensors  
Electronic  
Development Labs  
Everest Interscience  
Extech Instruments  
Hioki USA  
Iacon  
Kurz Instruments  
Lake Shore  
Cryotronics  
Marsh Bellofram  
National Instruments  
Newport Electronics  
Nomadics  
Omega Engineering

#### Calibration Management Software

American Quality  
Systems  
AssetSmart  
Beamex  
Blue Mountain Quality  
Resources  
Cascade Microtech  
CyberMetrics  
Data Physics  
Euresys  
Symtx

#### Calibrator-Control Software

Beamex  
Data Physics  
Euresys  
Fluke  
Novx  
Symtx

#### Data-Analysis Software

Advantech  
Alligator Technologies  
Analogic  
Applied Signal  
Technology  
Aptech Systems  
Autotest  
Condor Engineering  
Dalsa Coreco  
Credence Systems  
Data Physics  
Data Translation  
Dataq Instruments  
Dewetron  
DSP Development  
DYNFLOW

Onset Computer  
Pace Scientific  
PerkinElmer  
Optoelectronics  
Pico Technology  
Reinhardt System und  
Messelectronic  
Rotronic Instrument  
SensArray  
Sensor Products  
Tecpel  
Telatemp  
Thermo Electric  
Total Temperature  
Instrumentation

Electroglas  
Focus Microwaves  
Gage Applied  
Technologies  
GHI Systems  
GOEPEL Electronics  
Golden Software  
GraphPad Software  
IMC DataWorks  
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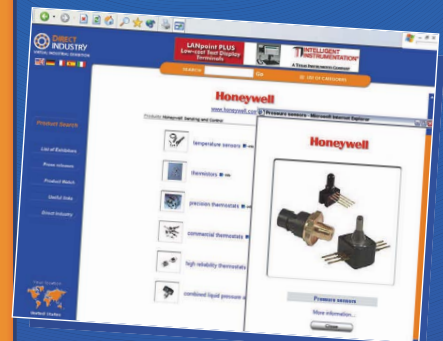


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StatSoft  
Symtx  
Synergy Software  
TAL Technologies  
TDA Systems  
Tektronix  
Test Advantage  
TestEdge  
UGS  
Unholtz-Dickie  
VI Technology  
Wavecrest  
Western Graphtec

#### **EMC Test Software**

AR Worldwide  
ETS-Lindgren  
Instruments for Industry  
Mentor Graphics  
Quantum Change  
Rohde & Schwarz  
TDK RF Solutions  
Tektronix

#### **Instrument Control Software, Stand-Alone Executables**

Analogic  
Autotest  
Capital Equipment  
Dewetron  
Geotest - Marvin Test Systems  
Giga-tronics  
ICS Electronics  
Intelligent Instrumentation  
IOtech  
Keithley Instruments  
Kinesys Software  
KineticSystems  
Materials Development  
Measurement Computing  
MI Technologies  
Microstar Laboratories  
National Instruments  
Neff Instrument

Northwest Analytical  
Novx  
Pace Scientific  
Pacific Instruments  
Quantum Change  
Racal Instruments  
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Symtx  
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Western Graphtec

#### **LabView Add-ins**

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Pacific Instruments  
Racal Instruments  
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TestQuest  
United Electronic Industries  
Vektrex Electronic Systems  
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#### **Software, Distributors**

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B & B Electronics  
DaqScribe Technology  
Intellitech  
Vektrex Electronic Systems

#### **Statistical Process-Control Software**

Aptech Systems  
Capital Equipment  
CyberMetrics  
Electroglas  
Integrated Sciences Group  
JMP  
The MathWorks  
Mitutoyo America  
National Instruments  
Northwest Analytical  
Novx  
Pintail Technologies  
SigmaQuest  
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StatSoft  
Symtx  
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#### **Visual Studio Add-ins**

Agilent Technologies  
Aptech Systems

Data Translation  
Dataq Instruments  
Integral Vision  
Keithley Instruments  
Matrox Imaging  
Measurement Computing  
National Instruments  
Pacific Instruments  
Scientific Software Tools  
Symtx  
TAL Technologies  
TestQuest  
United Electronic Industries  
Vektrex Electronic Systems  
VI Technology

#### **Web-Based Collaboration Software**

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Northwest Analytical  
Racal Instruments  
SigmaQuest  
Statit Software  
TestEdge  
VI Technology

### ACCESSORIES

#### **Connectors/Clips/Cables**

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B & B Electronics  
Briel & Kjaer, North America  
Cablescan  
Cal Test Electronics  
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Micro-Coax  
Mill-Max Mfg.  
National Instruments  
ODU-USA  
OptoTest  
Plastronics  
Pomona Electronics  
Rika Denshi America  
Spectrum Control  
Storm Products



Superior Electric  
Synergetix  
Virginia Panel  
W.L. Gore &  
Associates  
Yamaichi Electronics  
USA

### Eyewear Viewers

GOEPEL Electronics  
MicroOptical

### Instrument Carts

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Tektronix  
Terra Universal  
Tyrosys

### Instrument Enclosures/Containers

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Emcor Products  
Fieldtex Products  
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### Probes, Instrument

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FuturePlus Systems  
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Huntron  
Instek America  
Ion Physics

Lake Shore  
Cryotronics  
LeCroy  
Micromanipulator  
National Instruments  
Newport Electronics  
OAI  
Omega Engineering  
Owens Design  
Pearson Electronics  
Pomona Electronics  
Probe Master  
Ross Engineering  
Suss MicroTec  
Sypris Test &  
Measurement  
Tecpel  
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Kontron  
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Racal Instruments  
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### Manuals

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Selectron  
Tektronix  
W.J. Ford Surplus  
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Bell Electronics NW  
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Measurement Group  
Electro Rent  
Industrial Resources  
Instrumented Sensor  
Technology  
Krohn-Hite  
Lake Shore  
Cryotronics  
MetricTest  
Microlease  
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Bode Enterprises  
Equipment Reliability  
Institute  
Geotest - Marvin Test  
Systems  
JTAG Technologies  
MI Technologies  
Viewpoint Systems

### Training— Software

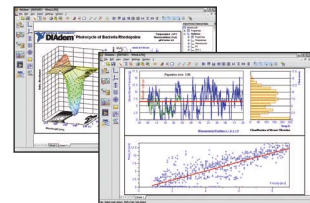
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NEA  
ORIX USA  
Selectron  
Spectratest  
TestEquity  
TRS-RenTelco

#### Used Equipment—Stand-Alone Test Instruments

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Advanced Test Equipment  
Allied Resources  
Atlantic Coast Instruments  
Avalon Equipment  
Bell Electronics NW  
CableTest Systems  
Comware Technical Services  
Continental Resources  
DoveBid Test & Measurement Group  
EXFO  
IET Labs  
Industrial Resources  
Instrumented Sensor Technology  
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Anritsu  
Boonton Electronics  
Cincinnati Sub-Zero  
Comware Technical Services  
Dynamic Solutions  
Electronic Development Labs  
Endevco  
Envirotronics  
ETS-Lindgren  
Exttech Instruments  
Fluke  
Guildline Instruments  
Keithley Instruments  
MetricTest  
Microlease  
Mindready Solutions  
Mitutoyo America  
Nevada Automotive Test Center  
Newport  
Newport Electronics  
Noise Com  
OAI  
Opto-Cal

Robert A. Denton  
Ross Engineering  
Symtx  
Sypris Test & Measurement  
Test Equipment Connection  
Test Site Services  
TestQuest  
Thunder Scientific  
Total Temperature Instrumentation  
Transcat  
Tucker Electronics  
Unitek Instruments  
VLSI Standards

#### Repair Services

Agilent Technologies  
Cincinnati Sub-Zero  
Comware Technical Services  
Dynamic Solutions  
Electronic Development Labs  
Envirotronics  
ETS-Lindgren  
Fluke  
MegaPhase  
MI Technologies  
OAI  
Omron Electronics

Premier Semiconductor Services  
Qualmark ACG Dynamics  
Qualtest  
Robert A. Denton  
Sypris Test & Measurement  
Test Equipment Connection  
Transcat  
Tucker Electronics  
Unitek Instruments  
V.J. Electronix

#### SPC/Quality Consultants

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Global QA  
National Quality Assurance—USA  
QualityLogic  
Real Controls  
Statit Software  
Sypris Test & Measurement  
TestQuest  
TUV America

#### Standards Documents

Agilent Technologies  
Sypris Test & Measurement

#### Web-Based Collaboration Subscription Services

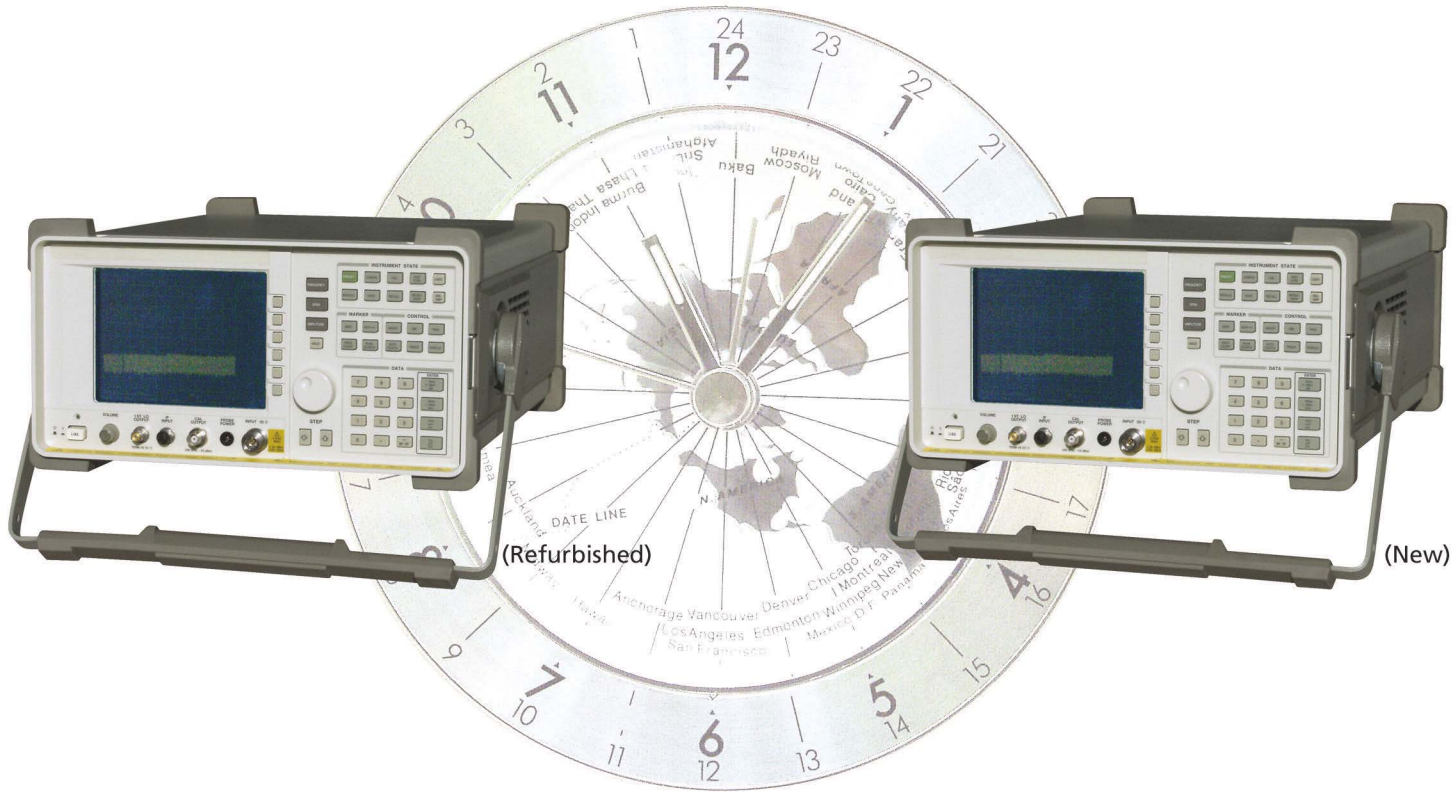
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## IN THIS SECTION:

- ▷ Machine-Vision & Inspection Equipment, below
- ▷ Machine-Vision Software, p. 52
- ▷ Third-Party Suppliers & Services, p. 54

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#### CAD Navigation Tools

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Unisoft

#### Camera Cables

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Intercon 1  
National Instruments  
Sentech America

#### Cameras, Area Scan

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Basler Vision Technologies  
Dalsa

DRS Technologies  
EPIX  
Hamamatsu Photonic Systems  
Hitachi Denshi America  
Illunis  
The Imaging Source  
Imperx  
KAPPA opto-electronics  
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NAC Image Technology  
National Instruments  
Panasonic Digital Communications

Photron  
Point Grey Research  
Radiant Imaging  
Rad-ikon Imaging  
Redlake  
Sentech America  
Silicon Imaging  
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Vision Components  
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#### Cameras, Line Scan

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Dalsa

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JAI Pulnix  
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Sentech America  
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JAI Pulnix  
KAPPA opto-electronics  
NAC Image Technology  
Nikon Instruments  
Olympus Industrial Optonics  
Panasonic Digital Communications  
Photron  
Redlake  
Sentech America  
Silicon Imaging

Thales Optem  
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#### Coordinate/Dimensional Measuring Equipment

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MicroImage Video Systems  
Micro-Vu  
Mitutoyo America  
Optical Gaging Products  
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Solaris Development  
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 Dage Precision Industries  
 Dalsa Coreco  
 DiagnoSYS Systems  
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 Electro Scientific Industries  
 FeinFocus USA  
 Hypervision  
 Integral Vision  
 Micromanipulator  
 Micro-Vu  
 OptoMetrix  
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 PPT Vision  
 Prior Scientific  
 RVSI Inspection  
 Smart Sonic  
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 V.J. Electronix  
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### Inspection Systems for PCBs/Hybrids

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 Chroma ATE  
 DiagnoSYS Systems  
 Edmund Industrial Optics  
 FeinFocus USA  
 GOEPEL Electronics  
 GSI Lumonics  
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### Inspection Systems for Wafers/Dies

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 Dalsa Coreco  
 Edmund Industrial Optics  
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 Keyence  
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 Tamar Technology  
 Thales Optem  
 V.J. Electronix  
 View Engineering  
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 Ircan  
 Monarch Instrument  
 Nomadics  
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 August Technology  
 Carl Zeiss  
 Dalsa Coreco  
 DVT  
 Edmund Industrial Optics  
 Image Labs International  
 KAPPA opto-electronics  
 Keyence  
 Matrox Imaging  
 Meiji Techno America  
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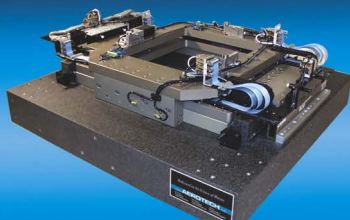
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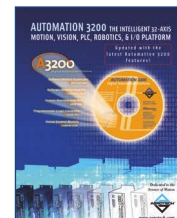
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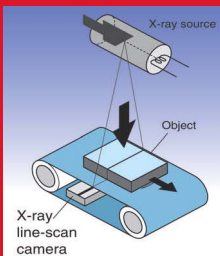
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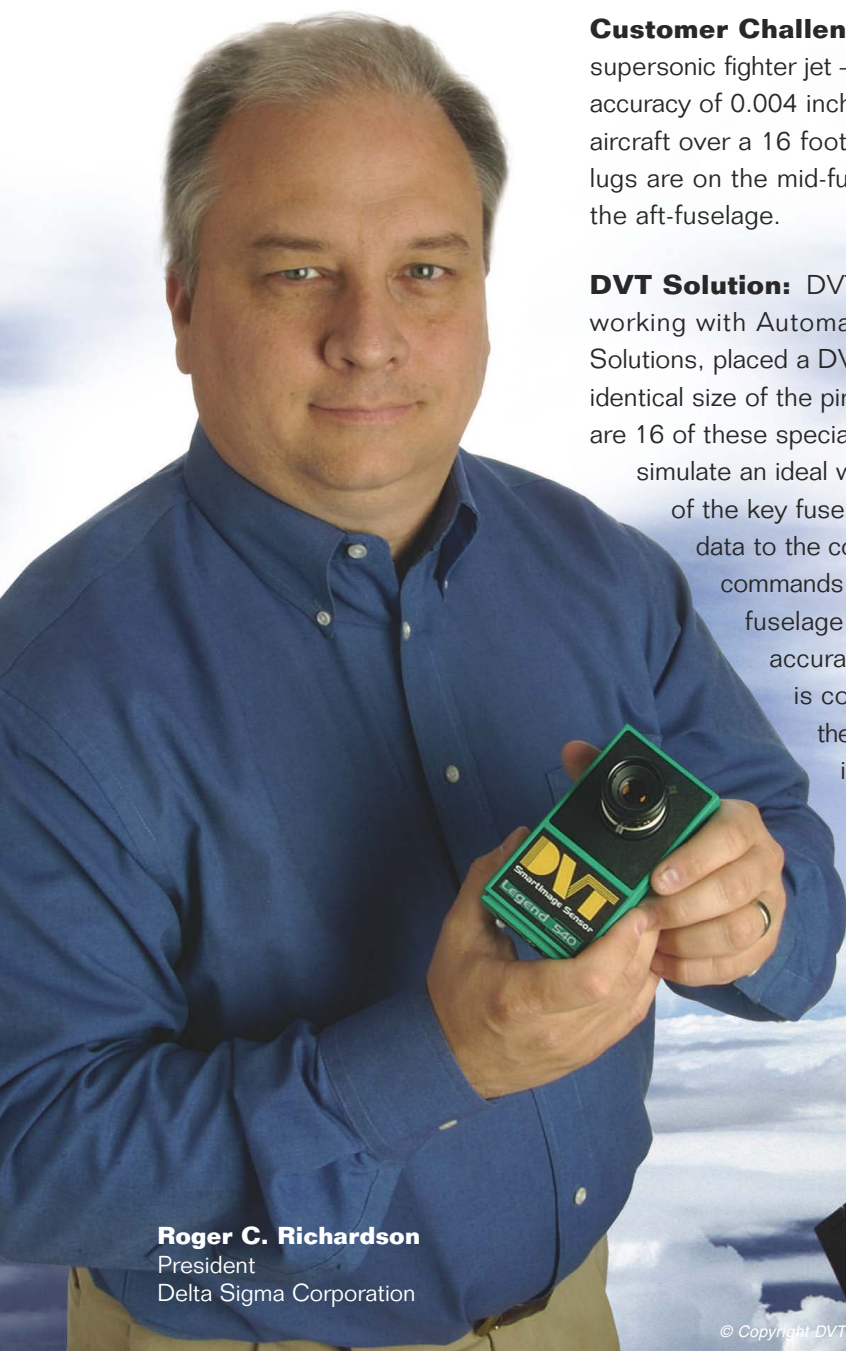
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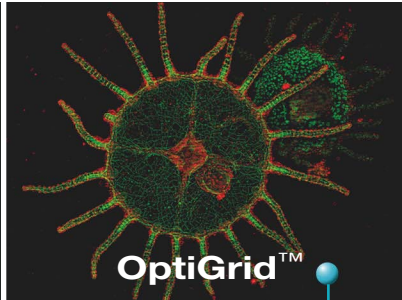
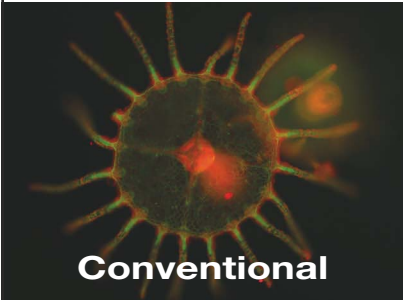


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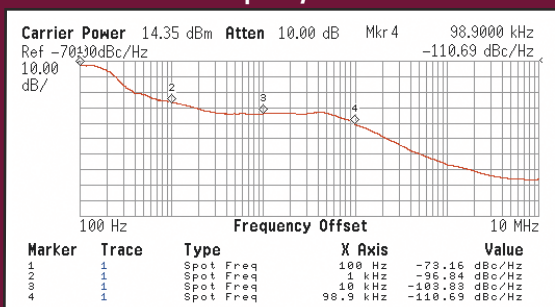
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This series of frequency synthesizers offer standard wideband tuning ranges covering 2-20 GHz and 1-22 GHz in standard models. RF Output power levels of +20 dBm and +17 dBm are offered respectively. Standard models provide output power leveling over the range of  $\pm 20$  dB with 0.1 dB resolution. Frequency step size of 1 Hz is standard, but is programmable with software for customer specific requirements. External reference frequency of 10 MHz is utilized, but 5 to 50 MHz are offered as options.

Excellent phase noise performance of -73 dBc/Hz at 100 Hz offset, -96 dBc/Hz at 1 kHz offset, -103 dBc/Hz at 10 kHz offset, -110 dBc/Hz at 100 kHz and -131 dBc/Hz at 1 MHz is provided at 20 GHz. The units operate from +15V and +5V supply lines and frequency control is via a 5-wire serial (SPI & busy) input protocol.

Options include second RF output covering 4-11 GHz which can be used for down conversion, a low noise 2nd L.O. output tunable over specified frequencies and an auxiliary input to add an additional frequency input within the units range – into the synthesizer switch matrix. All units measure 5"x7"x2" and weigh 57 oz.

## FEATURES

- 2.0- 20.0 GHz, 1.0 –22.0 GHz, Frequency Bands
- Excellent Phase Noise
- 1 Hz Step Size
- Output power Leveling / 0.1 dB resolution
- Fundamental RF Output available for downconverting

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WIRELESS, INC.**





## IN THIS SECTION:

- ▷ RF/Microwave and Wireless Communications Test Equipment, below
- ▷ Telecom/Datacom Test Equipment, below
- ▷ Fiber-Optic/Electro-Optic Test Equipment, p. 60
- ▷ Third-Party Suppliers, p. 64
- ▷ Services/Labs/Test Houses, p. 65

## RF/MICROWAVE AND WIRELESS COMMUNICATIONS TEST EQUIPMENT

### Calibration Sets, Microwave

Boonton Electronics  
Cascade Microtech  
Focus Microwaves  
Rohde & Schwarz  
Storm Products

### Calibrators, Antenna

A.H. Systems  
Credence Technologies

### Channel Simulators

Anite Group  
Micronetics  
Wireless Valley Communications

### Frequency Counters, RF/Microwave

Aeroflex  
Agilent Technologies  
Anritsu  
B&K Precision  
Credence Technologies  
Fluke  
Global Specialties  
Instek America  
Leader Instruments  
National Instruments  
Pendulum Instruments  
Pickering Interfaces  
Precision Test Systems  
Protek Test and Measurement  
Racal Instruments  
Tabor Electronics  
Tegam  
Tektronix

### Network Analyzers, RF/Microwave

Acterna  
Agilent Technologies  
Anritsu  
Avcom-Ramsey Technologies  
Cascade Microtech  
Giga-tronics  
National Instruments  
Omicron  
PXIT  
Rohde & Schwarz  
Saunders & Associates  
Tektronix

### Power Meters, RF/Microwave

Aeroflex  
Agilent Technologies  
Anritsu  
AR Worldwide  
Bird Electronic  
Boonton Electronics  
Credence Technologies  
ETS-Lindgren  
Focus Microwaves  
Giga-tronics  
Global Specialties  
Micronetics  
National Instruments  
OPHIR RF  
Praxsym  
Precision Test Systems  
Protek Test and Measurement  
Racal Instruments  
Rohde & Schwarz  
Suss MicroTec  
Tektronix

### RF Field Strength Meters

AR Worldwide  
Bird Electronic  
Credence Technologies

ETS-Lindgren  
Lake Shore  
Cryotronics  
Precision Test Systems  
Sencore  
Tektronix

### Signal Analyzers, RF

Aeroflex  
Aeroflex  
JcAIR Test Systems  
Agilent Technologies  
Anritsu  
Boonton Electronics  
Interactive Circuits and Systems  
Keithley Instruments  
MI Technologies  
National Instruments  
Opticom  
Pickering Interfaces  
Precision Test Systems  
Protek Test and Measurement  
Rohde & Schwarz

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Sencore  
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### Signal Sources, RF/Microwave

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Agilent Technologies  
Anritsu  
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### Spectrum Analyzers, RF/Microwave

Acterna  
Aeroflex  
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Avcom-Ramsey Technologies  
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Berkeley Varitronics Systems  
Credence Technologies  
Global Specialties  
Instek America  
Interactive Circuits and Systems  
Morrow Technologies  
National Instruments  
Precision Test Systems  
Rohde & Schwarz  
Sencore  
Tektronix  
Willtek Communications

### Switching Matrices, RF/Microwave

ASCOR  
Cytec  
Ducommun  
Geotest - Marvin Test Systems  
Keithley Instruments  
National Instruments  
Racal Instruments  
Rohde & Schwarz  
Symtx  
Universal Switching  
VXI Technology

### Wireless Communications Testers

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Anritsu  
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Racal Instruments  
RADCOM  
Rohde & Schwarz  
Spectracom  
Tabor Electronics  
Tektronix  
Willtek Communications  
Wireless Valley Communications  
Ztec

## TELECOM/DATACOM TEST EQUIPMENT

### Bit-Error-Rate Testers

Acacia Protocol  
Acterna  
Aeroflex  
Agilent Technologies  
ANCOT  
Anritsu  
Connecticut Technology Products  
Consultronics  
CTC Union Technologies  
Electron Parametrics  
EXFO  
Finisar  
Frontline Test Equipment

GL Communications  
Innocor  
International Data Sciences  
Ixia  
NetTest  
Noise Com  
PXIT  
Spirent Communications  
SyntheSys Research  
Tektronix  
Telebyte Technology  
Telinc  
Wavecrest  
Wireless Valley Communications

### Communication Cable Testers (Metal and Optical)

Acterna  
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Anritsu  
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CTC Union Technologies  
EXFO  
Fluke Networks  
PXIT  
Tektronix

continued >

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## Stage: Construction

### Solution: FOT-930 MaxTester Multifunction Loss Tester

The ultimate handheld PON construction testing tool.

- Measures link length, loss, ORL, connector backreflection, macrobend-induced loss
- Fiber transposal detection
- Also available as an FTB-400 platform module, the FTB-3930 MultiTest Module



## Stage: Troubleshooting

### Solution: FOT-7300D PON OTDR

**During construction (inactive network):** accurately locates fiber breaks or macrobends.

- Tests anywhere on the link and at any wavelength (1310, 1490 or 1550 nm)

**In service (live network):** identifies and characterizes breaks or macrobends that can affect only one specific branch of a splitter while others remain active.

- Tests at 1650 nm, using a broadband filter, avoiding the “blinding” effect of low-power, 1490/1550 nm incoming signals



## Stage: Activation and Maintenance

### Solution: PPM-350B PON Power Meter

Flexibility at your fingertips.

- 10 user-configurable threshold sets, for testing at the ONT, the OLT, the FDH, etc.
- Provides pass/fail results anywhere on the network, with simultaneous measurement and display of all signals—voice, data and video

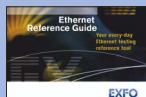
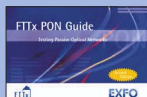


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> TELECOM/DATACOM TEST EQUIPMENT *continued*

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Genesys IBS

**Frame-Relay Testers**

Acacia Protocol  
Acterna  
Catapult Communications  
Consultronics  
CTC Union Technologies  
Fluke Networks  
GL Communications  
RADCOM  
Spirent Communications

**ISDN Testers**

Acacia Protocol  
Acterna  
Agilent Technologies  
AMREL  
Anritsu

Catapult Communications  
Consultronics  
CTC Union Technologies  
Flextronics Test  
Fluke Networks  
GL Communications  
Microtronix Systems  
NetTest  
RADCOM  
Spirent Communications  
Teltone

**Modem Testers, Cable/xDSL**

Acterna  
Agilent Technologies  
Broadframe  
Consultronics  
CTC Union Technologies  
Electron Parametrics  
Genesys IBS  
Ixia  
Noise Com  
RADCOM

Spirent Communications  
Symtx  
Teradyne Assembly Test Div.  
Tracespan Communications

**MPEG Test Equipment**

Opticom  
RADCOM  
Rohde & Schwarz  
Tektronix

**Packet Generators**

GL Communications  
Innocor  
Ixia  
RADCOM  
Spirent Communications  
Tektronix  
Warwick Control Technologies  
Wireless Valley Communications

**Protocol Analyzers, LAN and WAN**

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Acterna  
Agilent Technologies  
Benedict Computer Broadframe  
Connecticut Technology Products  
CTC Union Technologies  
EXFO  
Finisar  
Fluke Networks  
Frontline Test Equipment  
GL Communications  
Innocor  
International Data Sciences  
Ixia  
NetTest  
Network Instruments  
QualityLogic  
RADCOM  
Spirent Communications

Tektronix  
Telebyte Technology  
Telinc  
Warwick Control Technologies  
Wireless Valley Communications

**Return-Loss Testers**

Acterna  
AMREL  
Anritsu  
Consultronics  
DiagnoSYS Systems  
EXFO  
Fluke Networks  
Genesys IBS  
GL Communications  
JDS Uniphase  
Microtronix Systems  
Spirent Communications  
Tektronix

**SDH/PDH/SONET Testers**

Acterna  
Agilent Technologies  
Anritsu  
Consultronics  
EXFO  
Flextronics Test  
GL Communications  
Innocor  
Ixia  
Pendulum Instruments  
RADCOM  
Spirent Communications  
Tektronix  
Teradyne Assembly Test Div.

**Telecom Switch/Router Testers**

Acacia Protocol  
Agilent Technologies  
Consultronics  
DiagnoSYS Systems  
EXFO

*continued* >



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> TELECOM/DATACOM TEST EQUIPMENT *continued*

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Ixia  
RADCOM  
Spirent  
Communications  
Symtx  
Tektronix  
Teltone

### Telephone Line Simulators

Advent Instruments  
Catapult  
Communications  
DiagnoSYS Systems  
Electron Parametrics  
Fluke Networks  
Genesys IBS

GL Communications  
Gordon Kapes  
Micro Seven  
Microtronix Systems  
QualityLogic  
RADCOM  
Rochelle  
Communications

Spirent  
Communications  
Telinc  
Teltone  
Yelo-USA

### Transmission Testers

Acterna  
Agilent Technologies  
AMREL  
Anritsu  
Applied Signal  
Technology  
B&K Precision  
Connecticut  
Technology Products  
Consultronics  
CTC Union  
Technologies  
DiagnoSYS Systems  
Microtronix Systems  
NetTest  
PXIT  
Spirent  
Communications  
Tektronix  
Wireless Valley  
Communications

### Voice Over Packet Testers

Acterna  
Agilent Technologies  
Consultronics  
EXFO  
Fluke Networks  
GL Communications  
Ixia  
Microtronix Systems  
Network Instruments  
Opticom  
RADCOM  
Spirent  
Communications  
Tektronix



### Tabor's 2571/2 leading features:

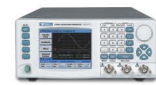
- Single/Dual-channel 250MS/s waveform generator
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- 16 Bit LVDS parallel output
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### FIBER-OPTIC/ELECTRO-OPTIC TEST EQUIPMENT

#### Display Testers

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Keithley Instruments  
Klein Instruments  
Microvision  
National Instruments  
Radiant Imaging  
Sencore

Fiber Instrument Sales  
Fluke Networks  
ILX Lightwave  
JDS Uniphase  
Newport  
Noyes  
OptoTest  
Oz Optics  
Princeton  
Prior Scientific  
Radiant Imaging  
StockerYale Canada  
Terahertz Technologies  
Ultrafast Sensors

#### Electro-Optics Testers

CIMTEK  
ETEC  
EXFO  
Flextronics Test  
Gigahertz-Optik  
JDS Uniphase  
Keithley Instruments  
National Instruments  
Newport  
Racal Instruments  
Symtx

#### Fiber-Optics Testers

Acterna  
Agilent Technologies  
Anritsu  
Conec  
dBm Optics  
DIT-MCO  
International  
ETEC  
EXFO

#### Fiber-Optic Laser Sources

Acterna  
Agilent Technologies  
Anritsu  
Berkeley Nucleonics  
Calmar Optcom  
dBm Optics  
EXFO

Fiber Instrument Sales  
Flextronics Test  
Fluke Networks  
Ixia  
JDS Uniphase  
Luna Technologies  
National Instruments

*continued* >



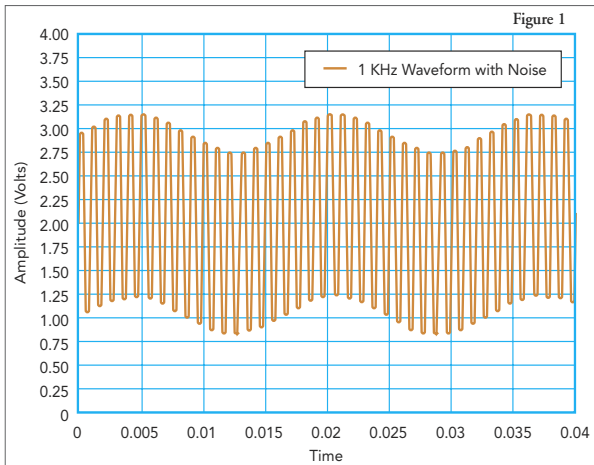
# THE DATA DETECTIVE

## Stay Out of the Loop

**E**ngineers know they must provide a complete circuit in measurement systems because current flow requires a return path. People who work with electronic devices may forget, though, that a ground-return circuit has resistance and a voltage can develop between ground points in electronic equipment. The resulting voltage can “ride” on signals you want to measure and throw off test results.

An example shows how currents can arise in a “ground” loop. Consider a function generator connected to an oscilloscope through a piece of coaxial cable. The cable provides a signal path and a ground, or return path. Both instruments reference their input or output to the ground in their building’s electrical supply, which can create a long loop or independent circuit. Voltages of from several tens of millivolts to hundreds of millivolts, usually at the power-line frequency (Figure 1), can occur between the grounds in the two instruments. This sort of ground loop will add unwanted signals to measurement results.

You can eliminate ground loops or reduce their effects through careful design of measurement systems. To start,



ensure that your schematic diagrams include all signal paths, including power-line grounds. Highlighting ground connections and paths may let you identify potential ground loops.

Next, carefully match sensor outputs and instrument inputs. Divide signal sources into grounded and ungrounded categories and then choose an appropriate type of input. Inputs fall into three categories, single ended (ground reference), single ended (non-ground reference), or differential.

Grounded signal sources or sensors work well with differential inputs that reject common-mode signals from ground loops or from induced noise. Rejection comes at a cost, though: Each signal requires two inputs that go through a multiplexer to the

+ or - input of an instrumentation amplifier.

A pseudo-differential input, or non-references single-ended (NRSE) input also reduces ground loop noise, and it requires only one input per signal. NRSE inputs multiplex one side of a sensor to the + input of an instrumentation amplifier. Instead of referencing the amplifier’s - input to local ground, that input connects to the other side of the sensor circuits.

Avoid connecting grounded sensors to single-ended inputs because they produce a ground loop. If you must make such a connection, you may need an isolation amplifier in the circuit to break the ground loop.

Ungrounded, or floating, signal sources inherently eliminate ground loops and they work well with either single-ended or differential inputs. Take care to ensure the common-mode volt-

## The Elusive Noise

Glenn has set up a data-acquisition system to monitor several dozen sensors. For the most part, the acquired data looks good. But the results from one sensor show an underlying low-frequency signal that Glenn knows the sensor cannot produce. Unfortunately, he doesn’t know where the signal does come from.

Can you help Glenn track down the underlying signal added to the sensor’s output and determine how to eliminate it?

<http://rbi.ims.ca/4394-501>

age level of the signal, with respect to the measurement system ground, remains within the common-mode input range of the measurement device.

Bias currents on instrumentation-amplifier inputs can push the voltage on these “floating” terminals outside their specified range. A high-resistance path from the inputs to ground will “anchor” the voltage to a local reference. Resistors from about 10 k $\Omega$  to 100 k $\Omega$  work well with low-impedance sources such as thermocouples or signal-conditioning modules. The resistors do alter the input impedance of the differential inputs slightly, but usually not enough to affect final measurement values. (Always ground unused differential inputs.)

If you run into an elusive ground loop, do not eliminate it by disconnecting their power-line ground (the green wire) to “float” otherwise-grounded instruments. This condition puts users at risk of a lethal shock.

### For further reading

“Ground Loops and Returns,” National Instruments. [zone.ni.com](http://zone.ni.com).



Go to <http://rbi.ims.ca/4394-501> to solve the challenge!

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

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Photon  
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Radiant Imaging  
Symtx  
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EXFO  
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Flextronics Test  
Ixia  
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Symtx

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Oz Optics  
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Fluke Networks  
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Newport  
OptoTest  
Oz Optics  
Terahertz Technologies

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Fiber Instrument Sales  
Fluke Networks  
Geotest - Marvin Test Systems  
OptoTest  
Oz Optics  
StockerYale Canada  
Terahertz Technologies

**Handheld Loss Test Sets**

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Fiber Instrument Sales  
Fluke Networks  
Oz Optics  
Terahertz Technologies

**Light and Illumination Meters, Bench**

EXFO  
Gigahertz-Optik  
Newport

**Light and Illumination Meters, Handheld**

EXFO  
Gigahertz-Optik  
Klein Instruments  
Sencore

**Optical Attenuators**

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CTC Union Technologies  
dBm Optics  
EXFO  
Fiber Instrument Sales  
JDS Uniphase  
Newport  
Nomadics

Oz Optics  
Photon  
Princeton  
PXIT  
Racal Instruments  
Symtx  
VXI Technology

**Optical Detectors**

Acterna  
dBm Optics  
Edmund Industrial Optics  
EXFO  
Gigahertz-Optik  
International Light  
Keithley Instruments  
Newport  
PerkinElmer  
Optoelectronics  
Radiant Imaging  
Ultrafast Sensors

**Optical Dispersion Testers**

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dBm Optics  
EXFO  
Luna Technologies  
NetTest

**Optical Power Meters**

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Anritsu  
CTC Union Technologies  
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EXFO  
Fiber Instrument Sales  
Fluke Networks  
Gigahertz-Optik  
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JDS Uniphase  
Newport  
Noyes  
OAI  
OptoTest  
Oz Optics  
PXIT  
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Terahertz Technologies

**Optical Spectrum Analyzers**

Agilent Technologies  
dBm Optics  
EXFO  
Instrument Systems  
Newport

**Optical Switches**

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dBm Optics  
EXFO  
Fiber Instrument Sales  
ILX Lightwave  
Ixia  
JDS Uniphase  
Keithley Instruments  
Newport  
Nomadics  
Omron Electronics  
Piezosystem Jena  
Racal Instruments  
Symtx  
Teradyne  
Assembly Test Div.  
VXI Technology

**Optical Time Domain Reflectometers**

Acterna  
Agilent Technologies  
Anritsu  
EXFO  
Fiber Instrument Sales  
Luna Technologies  
NetTest  
Noyes

**Photometers & Radiometers**

Agilent Technologies  
EXFO  
Gigahertz-Optik  
Instrument Systems  
International Light  
Klein Instruments  
Newport  
OAI  
Photon  
Pyrometer Instrument  
Radiant Imaging  
Terahertz Technologies

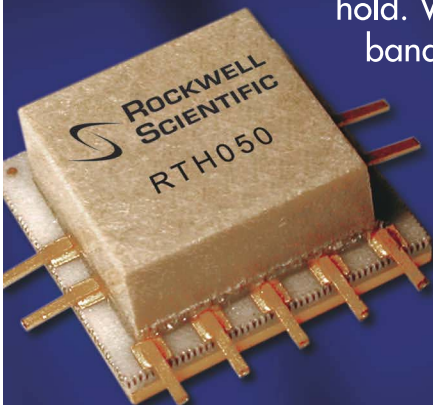
**Wavelength Meters**

Agilent Technologies  
EXFO  
Newport

*continued* >

# 15GHz Direct Down Conversion

Rockwell Scientific introduces the RTH050, its newest dual track and hold. With 15GHz small signal bandwidth, 1GS/s operation and longer hold time, it enables capture of wideband signals at multi GHz carrier frequencies with greater flexibility than before.



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Jensen Tools  
MetricTest  
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continued >



# Test and measurement solutions for 3GPP WCDMA

An application-oriented product guide for

- ◆ Chipset and reference design
- ◆ Product design and verification
- ◆ Production and service
- ◆ Network planning, installation and optimization



**ROHDE & SCHWARZ**

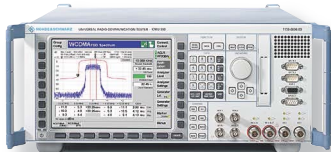


## Selected products



**Universal Radio Communication Tester R&S® CMU 200**

- ◆ Multiprotocol mobile station test platform supporting all major 2G/3G standards as well as Bluetooth™
- ◆ Ready for future expansions such as HSDPA and cdma2000 1xEV-DV
- ◆ Only currently available solution that meets the requirements of acoustic measurements for 3GPP and 3GPP2
- ◆ Optimized for production and R&D; high-speed testing, excellent accuracy and extraordinary flexibility



**Universal Radio Communication Tester R&S® CMU 300**

- ◆ Compact base station test platform
- ◆ High-speed testing in production and R&D (regression testing)
- ◆ Realtime layer-1 handling (coding/decoding) in R&D
- ◆ Comprehensive spectrum analyzer and signal generator



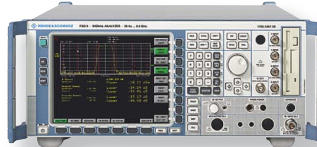
**Protocol Tester for WCDMA/HSDPA R&S® CRTU-W**

- ◆ Protocol test system approved by the Global Certification Forum (GCF)
- ◆ Verification of protocol-stack implementation
- ◆ 2G/3G intersystem handover testing
- ◆ Radio resource management verification
- ◆ Application and data testing
- ◆ Layer-1 testing
- ◆ Flexible programming interface for user-specific and test case scenarios



**Handheld Spectrum Analyzer R&S® FSH**

- ◆ Spectrum analysis up to 3 GHz (R&S® FSH 3) or 6 GHz (R&S® FSH 6)
- ◆ Ideal solution for rapid, high-precision and cost-effective signal investigation
- ◆ Perfect tool for Node B antenna maintenance and repair – even on active elements
- ◆ Available with internal tracking generator, VSWR bridge and channel power measurements with predefined settings for 3GPP-FDD; DTF function
- ◆ Four hours of battery operating time



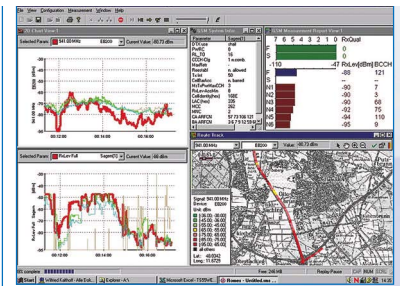
**Signal Analyzer R&S® FSQ**

- ◆ Supports all 3G standards
- ◆ Multicarrier-capable code domain analyzer
- ◆ High-performance spectrum analyzer
- ◆ High-speed vector signal analyzer
- ◆ Excellent dynamic range
- ◆ Baseband inputs



**Analyzer/Power Supply R&S® NGMO 1/2**

- ◆ Highly stable output voltage due to fast load regulation
- ◆ High-resolution current measurement for detecting leakage currents when UE is in off state
- ◆ Current-transient recorder with high time and magnitude resolution for isolating faults in UE and for optimizing switching
- ◆ Long-term power consumption analysis for determining and optimizing UE operation



**Coverage Measurement Software R&S® ROMES 3**

- ◆ Acquisition, analysis and visualization of network quality data
- ◆ Support of test mobile phones, Rohde & Schwarz test receivers and navigation systems
- ◆ Support of interference measurements
- ◆ Standard-independent software platform, allowing highly flexible use
- ◆ Multitechnology platform



**Vector Signal Generator R&S® SMU 200 A**

- ◆ Up to two complete generators in one unit
- ◆ Unrivalled flexibility with four realtime code channels
- ◆ Very short frequency setting times
- ◆ Electronic attenuator up to 6 GHz
- ◆ Intuitive user interface with graphical display of signal flow
- ◆ Fading simulation with up to 40 paths



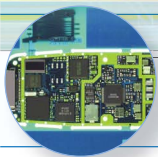
**Vector Signal Generator R&S® SMV 03**

- ◆ Cost-effective all-round instrument with outstanding signal quality
- ◆ Frequency range from 9 kHz to 3.3 GHz with 0.1 Hz resolution
- ◆ High output level of +13 dBm
- ◆ I/Q modulator (>50 MHz I/Q bandwidth) with high vector accuracy
- ◆ Wear-free due to electronic attenuator

**Radio Network Analyzer R&S® TSMU**

- ◆ UMTS PN scanner for multiband measurements on up to 12 bands at a time – ideal for benchmarking
- ◆ CW operation with up to 3000 measurements per second for gap-free coverage measurements
- ◆ Frequency range from 80 MHz to 3 GHz
- ◆ Extremely compact and lightweight: 150 mm x 80 mm x 170 mm, 1.5 kg
- ◆ Very low power consumption: typ. 8 W





# Chipset and reference design

Application	Highlights of our solutions	Recommended products or service
<b>Development of baseband and RF components</b>	<ul style="list-style-type: none"> <li>• Highest dynamic range in phase noise measurement</li> <li>• Bit error ratio (BER) and block error ratio (BLER) measurement</li> <li>• Measurement on I/Q signals</li> <li>• Noise figure measurements</li> </ul>	<b>R&amp;S®FSP</b> General-purpose spectrum analyzer <b>R&amp;S®FSQ</b> High-end vector signal analyzer <b>R&amp;S®SMU 200 A</b> High-end vector signal generator
<b>Development of amplifiers and receivers for UE and Node B</b>	<ul style="list-style-type: none"> <li>• Measurement of adjacent channel leakage ratio (ACLR) on amplifiers with 84 dB dynamic range</li> <li>• Signal generation with 70 dB dynamic range</li> <li>• Realtime signal generation with noise and fading simulation</li> <li>• AM/AM and AM/PM conversion measurements</li> <li>• Bit and block error insertion</li> <li>• Fading simulation with up to 40 paths</li> <li>• Accurate measurement of average power regardless of bandwidth and modulation</li> <li>• Power measurement with 90 dB dynamic range</li> </ul>	<b>R&amp;S®FSP</b> General-purpose spectrum analyzer <b>R&amp;S®FSQ</b> High-end vector signal analyzer <b>R&amp;S®FSU</b> High-end spectrum analyzer <b>R&amp;S®NRP</b> Power meter <b>R&amp;S®SMU 200 A</b> High-end vector signal generator <b>R&amp;S®ZVB</b> Fast vector network analyzer
<b>Development of UE signalling unit and protocol stack</b>	<ul style="list-style-type: none"> <li>• Verification of protocol stack implementation and RF performance</li> <li>• Flexible application programming interface (API) for easily creating customer-specific test scenarios</li> <li>• Tree and tabular combined notation (TTCN) test case concept</li> <li>• Interoperability and handover tests</li> <li>• Easy creation of application, data and customer-specific tests</li> <li>• Multistandard test platform</li> </ul>	<b>R&amp;S®CMU 200</b> Universal radio communication tester <b>R&amp;S®CRTU-W</b> WCDMA protocol tester <b>R&amp;S®TS 8955</b> RF precompliance test system for RX, TX and performance tests
<b>Proof of design, quality assurance, regression testing</b>	<ul style="list-style-type: none"> <li>• Performance of protocol and RF conformance tests including tests for interoperability, handover and radio resource management</li> <li>• Extremely accurate measurements of spurious emission</li> </ul>	<b>R&amp;S®ABFS</b> Baseband fading simulator <b>R&amp;S®CRTU-W</b> WCDMA protocol tester <b>R&amp;S®FSQ</b> High-end vector signal analyzer <b>R&amp;S®FSU</b> High-end spectrum analyzer <b>R&amp;S®TS 8955/8950 GW</b> Precompliance/full-compliance RF and protocol test systems
<b>Creation of a product test solution for reference design</b>	<ul style="list-style-type: none"> <li>• Complete test solution for chipset customers</li> </ul>	We can develop a production test solution, optimized for the <b>R&amp;S®CMU 200</b> and <b>R&amp;S®TS 7180</b>
<b>Manufacture of chips and components</b>	<ul style="list-style-type: none"> <li>• Very short switchover and setting times</li> </ul>	<b>R&amp;S®FSQ</b> High-end vector signal analyzer <b>R&amp;S®SMU 200 A</b> High-end vector signal generator <b>R&amp;S®ZVB</b> Fast vector network analyzer <b>R&amp;S®FSP</b> General-purpose spectrum analyzer



Product design and verification

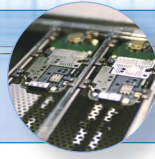
WCDMA  
HSDPA

# Product design and verification

Application	Highlights of our solutions	Recommended products
<b>Development of UE and associated components</b>	<ul style="list-style-type: none"> <li>• Flexible RF multistandard platform</li> <li>• Easy creation of customer-specific test scenarios</li> <li>• Verification of protocol stack implementation</li> <li>• Application and data tests</li> <li>• Flexible application programming interface (API)</li> <li>• TTCN test case concept</li> <li>• Interoperability and handover tests</li> <li>• Radio resource management verification</li> <li>• RF precompliance tests</li> <li>• Orthogonal channel noise simulation</li> <li>• Fading simulation with up to 40 paths</li> </ul>	<p><b>R&amp;S® ABFS</b> Baseband fading generator  <b>R&amp;S® CMU 200</b> Universal radio communication tester  <b>R&amp;S® CRTU-W</b> WCDMA protocol tester  <b>R&amp;S® FSP</b> General-purpose spectrum analyzer  <b>R&amp;S® SMU 200 A</b> High-end vector signal generator  <b>R&amp;S® TS 8955 GW</b> RF precompliance test system for RX, TX and performance tests  <b>R&amp;S® ZVB</b> Fast vector network analyzer</p>
<b>Development of base stations and their components</b>	<ul style="list-style-type: none"> <li>• Testing of time-critical layer-1 signalling procedures and checking of RF properties in realtime</li> <li>• Measurement of ACLR with up to 84 dB dynamic range</li> <li>• Seamless capture of up to 100 frames</li> <li>• Real-world tests with 4 user-configurable UEs plus up to 64 additional UEs</li> <li>• Fading simulation with up to 40 paths</li> </ul>	<p><b>R&amp;S® ABFS</b> Baseband fading simulator  <b>R&amp;S® CMU 300</b> Universal radio communication tester  <b>R&amp;S® FSQ</b> High-end vector signal analyzer  <b>R&amp;S® FSU</b> High-end spectrum analyzer  <b>R&amp;S® SMU 200 A</b> High-end vector signal generator  <b>R&amp;S® ZVB</b> Fast vector network analyzer</p>
<b>Verification and conformance test for proof of design and quality assurance for components and UE, regression testing</b>	<ul style="list-style-type: none"> <li>• Performance of protocol and RF conformance tests including tests for interoperability, 2G/3G handover and radio resource management</li> <li>• Validated test cases for protocol, RF and audio</li> <li>• Verification of protocol stack implementation and RF performance</li> <li>• Multichannel test and filter measurements</li> <li>• Acoustic measurements on UE</li> <li>• Fading simulation with up to 40 paths</li> </ul>	<p><b>R&amp;S® CMU 200</b> Universal radio communication tester  <b>R&amp;S® CMU 300</b> Universal radio communication tester  <b>R&amp;S® CRTU-W</b> WCDMA/GSM protocol tester  <b>R&amp;S® FSQ</b> High-end vector signal analyzer  <b>R&amp;S® FSU</b> High-end spectrum analyzer  <b>R&amp;S® SMU 200 A</b> High-end vector signal generator  <b>R&amp;S® TS 8955 GW</b> RF precompliance test system for RX, TX and performance tests  <b>R&amp;S® TS 8950 W</b> WCDMA RF test system  <b>R&amp;S® TS 9976</b> Test system for spurious emissions  <b>R&amp;S® UPL/UPV</b> High-end audio analyzers</p>
<b>EMC test</b>	<ul style="list-style-type: none"> <li>• Reliable determination of the cause and effect of electromagnetic interference</li> <li>• Unrivalled spectrum of powerful test equipment and systems for standard-conforming measurements</li> </ul>	<p><b>R&amp;S® ESCI</b> Full-compliance EMI test receiver  <b>R&amp;S® ESIB</b> Full-compliance EMI test receiver  <b>R&amp;S® ESPI</b> Precompliance EMI test receiver  <b>R&amp;S® TS 998x</b> EMC turnkey systems</p>



Production



Service

# Production and service

Application	Highlights of our solutions	Recommended products
<b>Production of mobile phones and mobile radio modules</b>	<ul style="list-style-type: none"> <li>• Maximum throughput due to high speed and precision</li> <li>• Implementation of reference designs</li> <li>• Application support</li> <li>• Turnkey production test solutions</li> <li>• Universal PXI platform for board and component test</li> <li>• Extremely fast spectrum, level and code domain power measurements</li> <li>• Multimode testing including Bluetooth™</li> </ul>	<p><b>R&amp;S® CMU 200</b> Multistandard radio communication tester for module test and final test</p> <p><b>R&amp;S® FSP</b> General-purpose spectrum analyzer</p> <p><b>R&amp;S® NGMOx</b> Power supplies optimized for mobile radio</p> <p><b>R&amp;S® TS 7180</b> Turnkey test system for mobile phone production</p> <p><b>R&amp;S® TS 7110</b> Universal shielded test fixture</p> <p><b>R&amp;S® TSVP</b> Modular PXI production test platform for board and component test</p>
<b>Chip manufacturing</b>	<ul style="list-style-type: none"> <li>• Very short frequency setting times, e.g. &lt;math&gt;&lt;450 \mu\text{s}&lt;/math&gt; in list mode</li> <li>• High output power</li> <li>• Wear-free electronic attenuator</li> </ul>	<p><b>R&amp;S® FSP</b> General-purpose spectrum analyzer</p> <p><b>R&amp;S® SMU 200 A</b> High-end vector signal generator with wear-free electronic attenuator and long calibration interval</p> <p><b>R&amp;S® ZVB</b> Fast vector network analyzer</p>
<b>Creation of a product test solution for reference design</b>	<ul style="list-style-type: none"> <li>• Complete test solution for customers of chipset manufacturers, derived from cooperations with leading chipset manufacturers</li> </ul>	<p>We can develop a production test solution, optimized for the <b>R&amp;S® CMU 200</b> und <b>R&amp;S® TS 7180</b></p>
<b>Production of base station modules</b>	<ul style="list-style-type: none"> <li>• Checking of RF properties with realtime receiver, e.g. measurement of power, modulation accuracy, carrier suppression and harmonics</li> <li>• Tuning and calibration of modules</li> </ul>	<p><b>R&amp;S® CMU 300</b> One-box radio communication tester</p> <p><b>R&amp;S® FSQ</b> High-end vector signal analyzer</p> <p><b>R&amp;S® FSU</b> High-end spectrum analyzer</p> <p><b>R&amp;S® SMU 200 A</b> High-end vector signal generator</p>
<b>Quality assurance and sample test</b>	<ul style="list-style-type: none"> <li>• High-precision RX, TX and signalling tests</li> <li>• Simulation of ambient conditions</li> <li>• Acoustic measurements according to 3GPP specifications</li> </ul>	<p><b>R&amp;S® CMU 200/CMU 300</b> Radio communication testers for UE or base stations for RX, TX and signalling tests</p> <p><b>R&amp;S® E-Line</b> System for testing wireless components under environmental stress</p> <p><b>R&amp;S® FSQ</b> High-end vector signal analyzer</p> <p><b>R&amp;S® FSU</b> High-end spectrum analyzer</p> <p><b>R&amp;S® TS 7180</b> Complete system for high-precision RX, TX and signalling tests with high repeatability</p> <p><b>R&amp;S® UPL</b> Audio analyzer for acoustic tests</p>
<b>Repair of UE</b>	<ul style="list-style-type: none"> <li>• Multistandard platform for high throughput</li> <li>• Go/NoGo test and fault localization</li> <li>• Reference/component test</li> <li>• Checking of battery loading</li> </ul>	<p><b>R&amp;S® CMU 200</b> Multistandard radio communication tester</p> <p><b>R&amp;S® FSH 3/6</b> Handheld spectrum analyzers</p> <p><b>R&amp;S® FSP</b> General-purpose spectrum analyzer</p> <p><b>R&amp;S® NGMOx</b> Power supplies optimized for mobile radio</p> <p><b>R&amp;S® SMV</b> Favourably priced vector signal generator</p>



Network planning



Network rollout and commissioning



Optimization / Quality of service

# Network planning, installation and optimization

Application	Measurement tasks optimally supported by our products	Recommended products
<b>RF Network planning</b>	<ul style="list-style-type: none"> <li>• Generation of modulated RF signals for site planning</li> <li>• Calibration of planning tools with CW signals</li> <li>• Frequency planning</li> </ul>	<b>R&amp;S®FSP</b> General-purpose spectrum analyzer <b>R&amp;S®ESPI</b> Precompliance EMI test receiver <b>R&amp;S®SMU 200 A</b> High-end vector signal generator <b>R&amp;S®TS 995x</b> Various drive test systems <b>R&amp;S®TSMU</b> Extremely compact and fast radio network analyzer/test receiver
<b>Operation of test lab (center of competence)</b>	<ul style="list-style-type: none"> <li>• Compatibility tests between the different network components</li> <li>• Checking of test equipment</li> <li>• Quality of service (QoS) by checking traces and handover</li> <li>• Checking of data quality</li> <li>• Regression testing</li> <li>• Fading simulation with up to 40 paths</li> </ul>	<b>R&amp;S®CMU 300</b> Universal radio communication tester for Node B <b>R&amp;S®FSQ</b> High-end vector signal analyzer <b>R&amp;S®FSH3/6</b> Handheld spectrum analyzers <b>R&amp;S®SML</b> Favourably priced signal generator <b>R&amp;S®SMU 200 A</b> High-end vector signal generator <b>R&amp;S®TSMU</b> Extremely compact and fast radio network analyzer/test receiver
<b>Installation and acceptance test</b>	<ul style="list-style-type: none"> <li>• Antenna measurements (VSWR, DTF, spectrum)</li> <li>• Base station tests (RX/TX)</li> <li>• Function tests (RX/TX)</li> </ul>	<b>R&amp;S®CMU 300</b> Universal radio communication tester for Node B <b>R&amp;S®FSH 3/6</b> Handheld spectrum analyzers <b>R&amp;S®FSP</b> General-purpose spectrum analyzer <b>R&amp;S®TSMU</b> Extremely compact and fast radio network analyzer/test receiver
<b>Network management and optimization</b>	<ul style="list-style-type: none"> <li>• Pseudo-noise measurements (PN scanning)</li> <li>• Interference measurements</li> <li>• Data quality measurements</li> <li>• Video quality measurements</li> <li>• Verification of test mobile phones</li> <li>• Acquisition of calibration data for planning tools</li> </ul>	<b>R&amp;S®CMU 200</b> Universal radio communication tester for UE <b>R&amp;S®ESPI</b> Precompliance EMI test receiver <b>R&amp;S®ROMES 3</b> Coverage measurement software <b>R&amp;S®SMU 200 A</b> High-end vector signal generator <b>R&amp;S®TS 995x</b> Various drive test systems <b>R&amp;S®TSMU</b> Extremely compact and fast radio network analyzer/test receiver
<b>Operations and maintenance of RF networks</b>	<ul style="list-style-type: none"> <li>• On-site measurements, repairs, maintenance on Node B and antenna systems</li> <li>• Antenna measurements (VSWR, DTF, spectrum)</li> <li>• Function tests (RX/TX)</li> </ul>	<b>R&amp;S®CMU 300</b> Universal radio communication tester for Node B <b>R&amp;S®FSH 3/6</b> Handheld spectrum analyzers <b>R&amp;S®FSP</b> General-purpose spectrum analyzer <b>R&amp;S®TSMU</b> Extremely compact and fast radio network analyzer/test receiver <b>R&amp;S®NRT</b> Power reflection meter



**Test Platform for Mobile Phone Production**  
R&S® TS 7180

- ◆ Scalable solutions from low-cost standard system up to turnkey production test solutions
- ◆ For all production steps including PCB testing, functional and final tests
- ◆ Multiprotocol test capability for 2G and 3G mobile phones
- ◆ Modular and configurable shielded RF test fixture for integrating RF, power, keypad and acoustic tests as well as optical display inspection



**RF Test Systems R&S® TS 8950/55 GW**

- ◆ Fully validated conformance test system (R&S® TS 8950 GW)
- ◆ Precertification solution (R&S® TS 8955 GW)
- ◆ 3GPP WCDMA FDD1 + FDD2
- ◆ GSM Quad Band GSM850, GSM900, GSM1800, GSM1900
- ◆ GSM Circuit Switched, GPRS, EGPRS, AMR
- ◆ Scalable solutions from benchtop setups to fully integrated high-accuracy test racks
- ◆ Further frequency bands possible



**Vector Network Analyzer R&S® ZVB**

- ◆ Network analyzer with up to four test ports for multipoint and balanced measurements
- ◆ Frequency range from 300 kHz to 8 GHz
- ◆ High dynamic range (>123 dB) and fast sweep speed
- ◆ Fast data transfer and remote control, optimized for production applications
- ◆ Modern user interface with easy-to-use measurement and calibration wizards

# T&M solutions for the 3GPP WCDMA value chain

Broadband mobile radio methods such as 3GPP WCDMA place extremely high demands on T&M equipment. Physical values must be measured with unprecedented accuracy and dynamic range, and the wide variety and complexity of the interlocked data services demand comprehensive protocol analyses. The Rohde & Schwarz product spectrum provides you with optimum tools every step of the way during the development, validation, and production of components, mobile phones and base stations. In addition, we provide extensive support services that enable you to reach your goals. Our sales engineers will gladly help you put together a custom-tailored package that precisely meets your needs.





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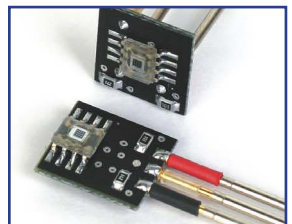
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## IN THIS SECTION:

- ▷ ATE/QA/Production Test Equipment, below
- ▷ ATE/DFT/BIST Software, p. 72
- ▷ Accessories, p. 79
- ▷ Third-Party Suppliers, p. 80
- ▷ Services/Labs/Test Houses, p. 81

### ATE/QA/PRODUCTION TEST EQUIPMENT

#### Acoustic Emission/PIND Testers

B&W Engineering  
National Instruments

#### ATE, Digital IC

Advantest  
Aehr Test Systems  
Agilent Technologies  
BP Microsystems  
Chroma ATE  
Corelis  
Credence Systems  
ETEC

Geotest - Marvin Test Systems  
GOEPEL Electronics  
Inovys  
Intellitech  
LTX  
Micro Control  
SPEA  
Symtx  
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Yelo-USA

#### ATE, Linear & Mixed-Signal IC

Advantest  
Agilent Technologies  
Chroma ATE  
Credence Systems  
DiagnoSYS Systems  
Eagle Test Systems  
ETEC  
Geotest - Marvin Test Systems  
LTX  
Racal Instruments  
Reinhardt System und Messelectronic

SPEA  
Symtx  
Teradyne  
Semiconductor Test  
Yelo-USA

#### ATE, Microwave Device

Advantest  
Boonton Electronics  
Credence Systems  
Eagle Test Systems  
Flextronics Test  
LTX  
Symtx  
Teradyne  
Semiconductor Test

#### ATE, Parametric Testers

Agilent Technologies  
CIMTEK  
JDS Uniphase  
Keithley Instruments  
National Instruments  
QualiTau  
Seica

SPEA  
Symtx

#### ATE, Process Reliability Testers

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CIMTEK  
Electronic Systems of Wisconsin  
JDS Uniphase  
QualiTau  
Racal Instruments  
SPEA  
Symtx  
W.M. Hague

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Caris Network Solutions  
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 Advanced Testing Technologies  
 Advint  
 Automatic Measurement Systems  
 CableTest Systems  
 Chroma ATE  
 CIMTEK  
 Digitaltest  
 Electronic Systems of Wisconsin  
 ETEC  
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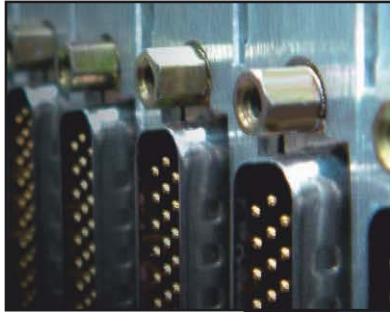
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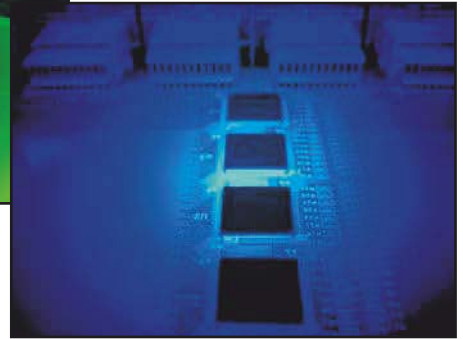
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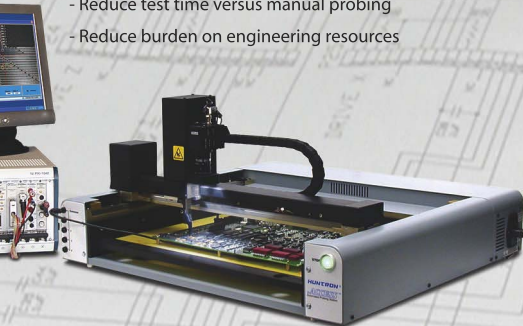
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## ATE/DFT/BIST

> ATE/QA/PRODUCTION TEST EQUIPMENT *continued*

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### In-Circuit Testers

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### Memory Testers

Advantest  
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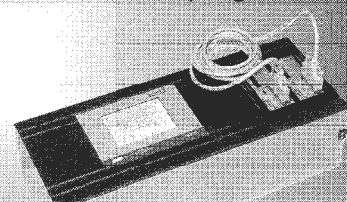
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Credence Systems  
JTAG Technologies  
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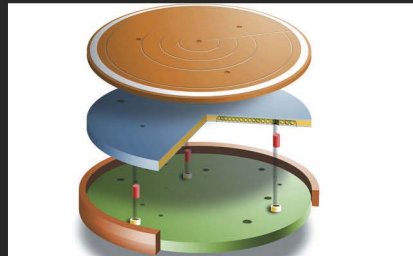


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## Probing Products

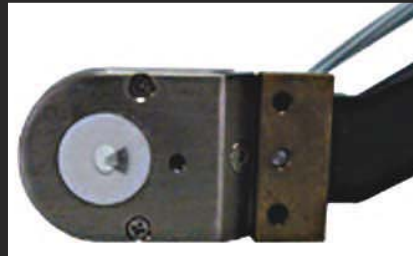
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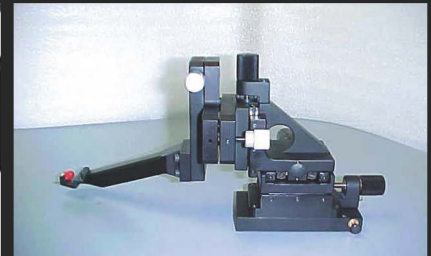
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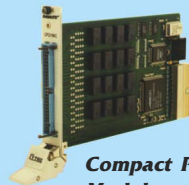
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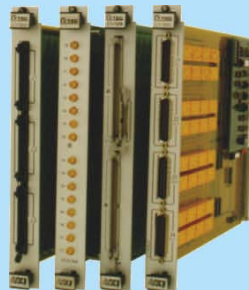
Fiber Optic Matrix



Compact PCI Modules

## Custom solution options

- Signal and power switches in one box
- Wire out systems to any connector type
- Embedded functionality
- Custom switch module layouts
- Large combination systems
- Custom labeling or logo's

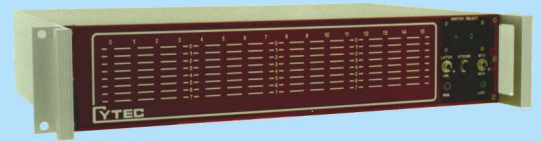
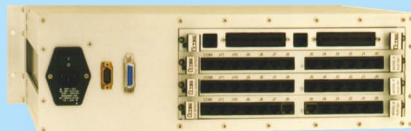


VXI and VME Bus

## Additional Features

- LED Displays for visual confirmation of Switch Status.
- Optional Manual Controls available on all systems.
- Status feedback for programmatic relay checking.
- Software support for common programming platforms.

Network Test  
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General Purpose Test Switch



32x32 RF or Video Matrix

## Applications Include

- Automated Production, Environmental, or Lab Tests.
- Programmable Patch Panels or Interconnects.
- Stand Alone Data Acquisition.
- Fan-out Test Equipment to multiple locations.

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- Telco -- Modems, ISDN, T1, T3, V.35
- EIA530 Subsets -- RS232, 422, 485, etc.
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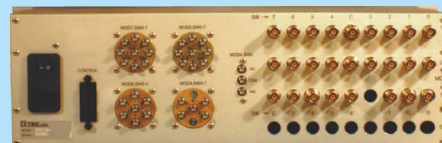
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- VI Technology

- GOEPEL Electronics
- Intusoft
- LPKF Laser and Electronics
- Mentor Graphics
- National Semiconductor
- TestQuest
- Texas Instruments

**DFM/DFY Software**

- Inovys
- LogicVision

**DFT Board Software**

- A.T.E. Solutions



- Acculogic
- Acugen Software
- ASSET Intertech
- Corelis
- Credence Systems
- Flynn Systems
- GOEPEL Electronics
- Intellitech
- JTAG Technologies
- LogicVision
- Router Solutions
- SPEA
- Teradyne
- Assembly Test Div.
- UGS

**DFT Device Software**

- A.T.E. Solutions
- Acugen Software
- Credence Systems
- Flynn Systems
- GOEPEL Electronics
- Inovys
- LogicVision
- Mentor Graphics
- Synopsys
- SynTest Technologies

**Electronic Simulation Software, Board**

- Accenia
- Altium
- ANSOFT

**Electronic Simulation Software, Device**

- Accenia
- Acugen Software
- ANSOFT
- Global Specialties
- Intusoft
- LPKF Laser and Electronics
- Mentor Graphics
- National Semiconductor
- Synopsys
- TestQuest
- Texas Instruments

**Manufacturing Defect Analysis Software**

- August Technology
- Autotest
- Credence Systems
- Data Physics
- Electroglas
- Euresys
- Ironcon
- Mentor Graphics
- MVTec Software
- Northwest Analytical
- SigmaQuest
- Statit Software
- Test Advantage
- UGS
- VI Technology

**Programming Languages, Textual**

- Aptech Systems
- Autotest
- DSP Development
- Geotest - Marvin Test Systems
- IMC DataWorks
- National Instruments
- Racal Instruments
- Symtx
- Telelogic
- Teradyne, Semiconductor Test

*continued* >

**SEMICON WEST  
BOOTH #7347**

# Is Lead-Free Test a Pain?



**The Problem:**

Your existing contacts won't provide the life you want and the performance you need. Yields are decreasing, costs are sky-rocketing. Now what?

**The Solution:**

Johnstech's new ROL Technology with the new Eco™-1 non-plated precious metal contacts will increase yields, require less cleaning, preserve load boards, and *lower the cost of test*.



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Production Test**

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**Johnstech®**

# HOW PREPARED ARE YOU FOR NANOMETER DESIGN?



INTEGRATED SYSTEM DESIGN + DESIGN FOR MANUFACTURING + ELECTRONIC SYSTEM LEVEL DESIGN + FUNCTIONAL VERIFICATION

## Design-for-Test | Prepare for the worst if you use traditional DFT methodologies

at 130nm and below. The tests needed to detect all of the defects at smaller geometries can increase test data volumes by 5X or more, escalating test costs. TestKompres<sup>®</sup> is the proven embedded compression solution that's easily integrated into any standard design flow with no disruption to the core design. It supports all fault models and pattern types needed to detect nanometer defects up to 100X reduction in test data volume and time, for cost effective, high-quality tests with no tradeoffs. Register for a mini workshop at [mentor.com/dft/wshop](http://mentor.com/dft/wshop).

**Mentor  
Graphics**<sup>®</sup>

THE EDA TECHNOLOGY LEADER



> ATE/DFT/BIST SOFTWARE *continued*

TransEra  
Vektrex Electronic Systems

**Programming Languages, Visual**

Agilent Technologies  
Aptech Systems  
Autotest  
Capital Equipment  
Data Translation  
Dewetron  
Intelligent Instrumentation  
The MathWorks  
Measurement Computing  
National Instruments  
Quantum Change  
Racal Instruments  
Symtx  
Telelogic  
Teradyne  
Semiconductor Test  
Vektrex Electronic Systems

**Semiconductor Yield-Enhancement Software**

August Technology  
Bloomy Controls  
ChipMD  
LogicVision  
Mentor Graphics  
Multiprobe  
Pintail Technologies  
Test Advantage  
VI Technology

**Test Development Software, Digital Board**

Acculogic  
Acugen Software  
ASSET Intertech  
Autotest  
Capital Equipment  
Corelis  
Credence Systems  
Flynn Systems

Geotest - Marvin Test Systems  
GOEPEL Electronics  
Intellitech  
Interface Technology  
JTAG Technologies  
National Instruments  
Navatek Engineering  
Racal Instruments  
Scientific Solutions  
SPEA  
Symtx  
Telelogic  
Teradyne  
Assembly Test Div.  
TestQuest  
UGS  
Unisoft  
Universal Synaptics

**Test Development Software, Digital Device**

Acculogic  
Acugen Software  
Autotest  
Capital Equipment

Credence Systems  
Flynn Systems  
Geotest - Marvin Test Systems  
Intellitech  
Interface Technology  
LTX  
Mentor Graphics  
National Instruments  
Racal Instruments  
SPEA  
Symtx  
Synopsys  
Telelogic  
Teradyne  
Semiconductor Test  
Test Advantage  
TestQuest  
UGS  
Universal Synaptics

**Test Development Software, Mixed-Signal Board**

Autotest  
Capital Equipment  
Corelis  
Credence Systems  
Exacq Technologies  
Geotest - Marvin Test Systems  
GOEPEL Electronics  
JTAG Technologies  
National Instruments  
Racal Instruments  
Scientific Solutions  
SPEA  
Symtx  
Telelogic  
Teradyne  
Assembly Test Div.  
TestQuest  
TYX  
UGS  
Universal Synaptics

**Test Development Software, Mixed-Signal Device**

Autotest  
Capital Equipment  
Credence Systems  
Data Translation  
Geotest - Marvin Test Systems  
LTX  
National Instruments  
Racal Instruments  
SPEA  
Symtx  
Telelogic  
Teradyne  
Semiconductor Test  
Test Advantage  
TestQuest  
TYX  
Universal Synaptics

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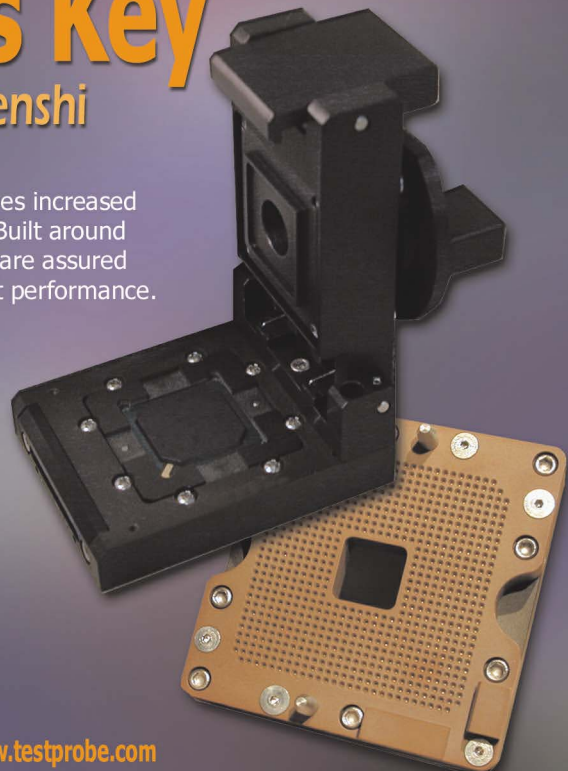
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- Cycle Life** > 500,000
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# Highly Adaptable to your Testing Environment.



**Wireless Testing with PCB.**



**Organized InterConnect.**



**Fixture Ready.**

# S6

The **S6** provides **robust, reliable and repeatable testing capabilities** for small and intermediate size test applications. With easy glide docking created by the smooth motion of the engagement handles, it is fixture ready with up to 1440 contact point availability within a **1U height**. The S6 has many configuration possibilities such as signal, power, coax, pneumatic, thermocouple, twinaxial, and fiber optic. The S6 **low-profile solution** is also capable of achieving wireless interconnection through the use of PCB.



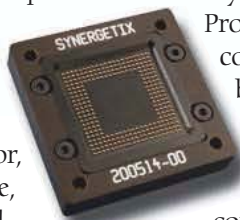


# Only One Company Builds Probes in a Class 10,000 Clean Room.

**Why?** Why such an extraordinary step? Because results from our world-class laboratory to the customer's test floor prove that IDI's uniquely clean probes are more reliable.

This kind of reliability is what it takes to get our probes specified in environments where a single failure can mean the difference between life or death—like in a heart defibrillator, the firing pin of a missile, or at the heart of a hand-held military radio.

This fail-safe reliability pays off on the test floor where our customers report the lowest and



most consistent resistance ever measured. Increasing first pass yields may not directly save lives, but it can add huge savings to your bottom line.

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plating techniques, wireless fixturing and test socket design. Find out more about new breakthroughs in probe technology. Visit [www.idinet.com](http://www.idinet.com) and request these latest updates:

- ICT Titanium Pro Probe Series Catalog
- IDI 8th Edition Catalog and Sourcebook, published fall, 2005
- Synergetix Test Socket Brochure
- Test Lab Brochure
- Class 10,000 Clean Room Brochure
- Board Test Today Magazine





## ACCESSORIES

## Adapters

Advanced  
Interconnections



Agilent Technologies

Anritsu

Aries Electronics

Autotest

Avcom-Ramsey  
Technologies

B & B Electronics

Bird Electronic

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MegaPhase

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Robson Technologies

SPEA

Storm Products

Tektronix

Testronics

Virginia Panel

VMETRO

W.L. Gore &  
Associates

Yamaichi Electronics

Yelo-USA

Y-tek

Zmation

## IC Probes

Accuprobe

Aehr Test Systems

Cal Test Electronics

Connect2it



**Board-Test  
Fixtures &  
Probes**

Advanced

Interconnections

Autotest

CheckSum

Circuit Check

Connect2it



Corelis

Data Physics

Digalog Systems

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Development Labs

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GOEPEL Electronics

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Intrinsic Quality

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Messelectronic

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SPEA

Suss MicroTec

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**IC Test Fixtures &  
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Advanced

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Cascade Microtech

Circuit Check

Dimensions Consulting

Everett Charles  
Technologies

Gryphics

Kulicke & Soffa

Robson Technologies

SPEA

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## IC Test Sockets

Advanced

Interconnections



Aries Electronics



## Innovative Test Systems for Next Generation Device Characterization

At SUSS, we're striving to continually develop new products that enable you to get the most reliable characterization data on any device—even at 4K!

### Easily Test with Vertical Probecards

SUSS' unique MicroAlign™ option for our ProbeShield™ is the only method for automating analytical tests with vertical probecards. It enables precise alignment and constant contact monitoring while testing bump arrays or pads as small as 30x30 μm.

### Characterize Devices at Cryogenic Temperatures

Only SUSS has a precision probe system capable of low signal measurements at temperatures down to 4K.

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SUSS MicroAlign's unique realign function automatically compensates for thermal drift when temperatures change, making it ideal for automated testing at different temperatures.

For more information on our complete line of DWC test innovations visit: [www.suss.com/DWCtest](http://www.suss.com/DWCtest)

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continued >

> ATE/DFT/BIST SOFTWARE *continued*

Armel Electronics  
 DFT Microsystems  
 Dimensions Consulting  
 Emulation Technology  
 Everett Charles Technologies  
 Gryphics  
 Ironwood Electronics  
 Johnstech International  
 Kulicke & Soffa  
 3M Electronics  
 Plastronics  
 Precision Contacts  
 Rika Denshi America  
 Robson Technologies  
 Synergetix  
 Wells-CTI

**Pressure-Sensing Film**

Sensor Products

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 Advantest  
 Aehr Test Systems  
 Dimensions Consulting  
 Everett Charles Technologies  
 FuturePlus Systems  
 Keithley Instruments  
 Kulicke & Soffa  
 Lake Shore  
 Cryotronics  
 Micromanipulator  
 Pacific Western Systems  
 SPEA  
 Suss MicroTec  
 Tektronix  
 Teradyne  
 Semiconductor Test  
 VMETRO  
 Wentworth Labs

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**Distributors—Accessories**

Jensen Tools  
 K.J. Marketing Services  
 MetricTest  
 Miller Industrial  
 TestMart  
 Transcat  
 Tucker Electronics

**Distributors—ATE**

Allied Resources  
 Comware Technical Services  
 Denver Test Systems  
 Huntron  
 Jensen Tools  
 KineticSystems  
 The Test Connection  
 TestMart  
 W.M. Hague

**Rental/Lease—ATE/Production Test Equipment,**

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 Continental Resources  
 Credence Systems  
 K.J. Marketing Services  
 LTX  
 Microlease  
 Rocky Mountain Test Equipment  
 The Test Connection  
 TestEdge  
 TRS-RenTelco

**Training—ATE/Production Test/QA**

A.T.E. Solutions  
 ASSET Intertech  
 Circuit Check  
 Corelis  
 Geotest - Marvin Test Systems

GOEPEL Electronics  
 Intellitech  
 JTAG Technologies  
 K.J. Marketing Services  
 LTX  
 Northwest Analytical  
 SPEA  
 Technology Training  
 TUV America  
 Unisoft

**Training—BIST/Testability,**

A.T.E. Solutions



ASSET Intertech

Corelis  
 GOEPEL Electronics  
 Intellitech  
 JTAG Technologies  
 LogicVision  
 SynTest Technologies

**Used Equipment—ATE,**

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 Agilent Technologies  
 Allied Resources  
 TES Division  
 Comware Technical Services  
 Credence Systems  
 Denver Test Systems  
 JMC  
 K & Us Equipment  
 K.J. Marketing Services  
 NEA  
 Rocky Mountain Test Equipment

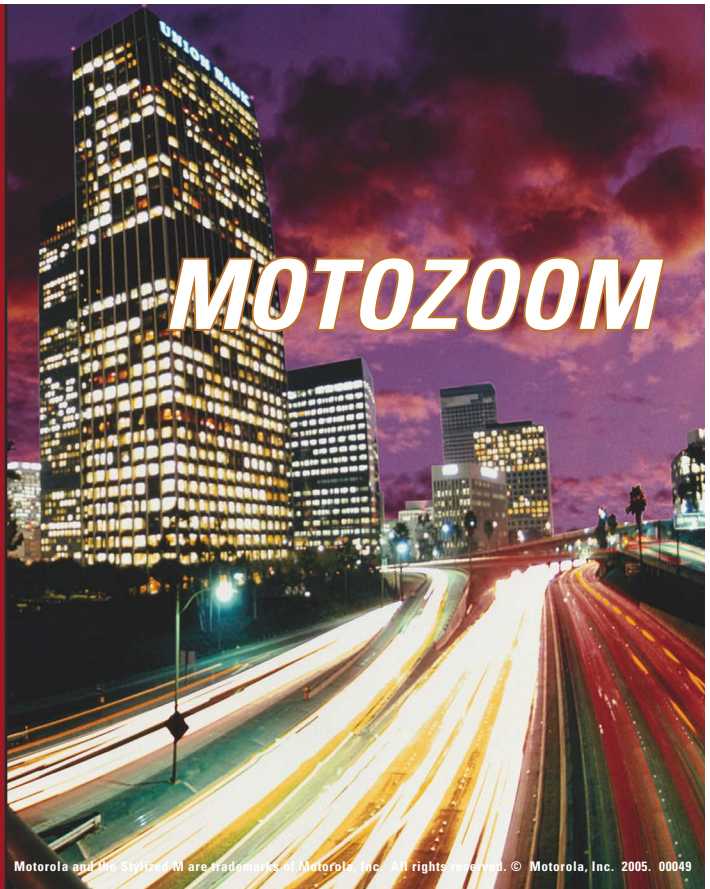


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 Assembly Test Div.  
 Test Advantage  
 The Test Connection  
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 Aerospace Electronics  
 Bloomy Controls  
 Corelis  
 Electro Product Management  
 Elite Electronic Engineering  
 ETEC  
 ETS-Lindgren  
 Garwood Laboratories  
 Geotest - Marvin Test Systems  
 GOEPPEL Electronics  
 Hartman Associates  
 Intellitech  
 Intertek ETL Entela

Intrinsic Quality  
 Invisar  
 JTAG Technologies  
 MegaPhase  
 MET Laboratories  
 Mindready Solutions  
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 Oneida Research Services  
 Premier Semiconductor Services  
 Product Safety Consulting  
 QualiTau  
 Southwest Research Institute  
 Stephen Halperin & Associates  
 Sypris Test & Measurement  
 Telco Testing Solutions  
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HF TEST SYSTEMS

Only the IZI Probe  
 Can Overcome  
 Height Differences  
 of 50  $\mu$ m

Now Available  
 for Multiport  
 Measurements

IZI Probe's patented contact springs touch down perfectly even with extreme pad height differences. Its contact reliability makes it ideal for automated stepping and it is the only probe that performs the same at 4K as it does at 300°C. Plus, you can rely on its robust design from one touch-down to one million.

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digitaltest

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- o **Accurate** - Pin-point precision to 2 mils - Repeatable results
- o **Quick** - Fast program development - Hi-speed/20 tests per second
- o **Easy** - Incomparable functionality - ICT/Functional & Boundary Scan



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 Email: [sales@digitaltest.net](mailto:sales@digitaltest.net) [www.digitaltest.net](http://www.digitaltest.net)

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**More Performance...** Aries ultra high frequency sockets have a mere 1 dB signal loss at up to 40 GHz!!! Center probe and Microstrip sockets deliver more than a half million insertions with no loss of electrical performance.

**More Choices...** Aries offer a full range of sockets for handler-use, manual test and burn-in...for virtually every device type, including the highest density BGA and CSP packages. Choice of molded or machined sockets for center probe and Kapton interposer models, too!

**Less Cost...** in addition to extremely competitive initial cost, Aries replacement parts and repair costs beat the competition, assuring you of lowest total cost of ownership.

**Less Wait...** Aries can deliver the exact sockets you need within 6 weeks.

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TestQuest  
TUV America



TUV Rheinland of  
North America  
VI Technology

**Failure Analysis  
Services**

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Solutions  
Agilent Technologies  
Amkor Technology  
BAE Systems  
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Credence Systems  
dBm Engineering  
Electro Product  
Management  
ETEC

FeinFocus USA  
Geller Microanalytical  
Lab  
Intellitech  
Intertek ETL Entela  
National Technical  
Systems  
Nevada Automotive  
Test Center  
Oneida Research  
Services  
Reliability Analysis  
Laboratory  
Siemens EMC  
Southwest Research  
Institute  
Sypris Test &  
Measurement  
TestQuest  
TUV America  
Warwick Control  
Technologies

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Solutions  
Agilent Technologies  
Amkor Technology

Artest  
C&H Technologies  
Cablescon  
Checksum  
Circuit Check  
dBm Engineering  
Digalog Systems  
Dimensions Consulting  
Electro Product  
Management  
EST Testing Solutions  
ETEC  
Garwood Laboratories  
Hartman Associates  
Instrumentation  
Engineering  
Intrinsic Quality  
Invisar  
K.J. Marketing Services  
M/RAD  
Mindready Solutions  
National Technical  
Systems  
ProbeStar  
ReMaTek  
Symtx  
TEAM

The Test Connection  
TestEdge  
Testronics  
VI Technology  
W.M. Hague  
Wentworth Labs  
Y-tek  
Zmation

**System  
Integrators**

A.T.E. Solutions  
Accolade Engineering  
Solutions  
Agilent Technologies  
B & B Technologies  
Bloomy Controls  
C&H Technologies  
CIMTEK  
CMT Engineering  
Comware Technical  
Services  
Custom Systems  
Integration  
Geotest - Marvin Test  
Systems  
Intrinsic Quality  
Invisar

m + p international  
Materials  
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MegaPhase  
MI Technologies  
Microstar Laboratories  
Microsys Technologies  
Mindready Solutions  
Omron Electronics  
The Pilot Group  
ProbeStar  
Real Controls  
Scientific Software  
Tools  
Sharetree Systems  
SofTest Designs  
Suss MicroTec  
Symtx  
TDK RF Solutions  
Teradyne  
Assembly Test Div.  
Thales Optem  
Thermotron Industries  
Tracewell Systems  
Vektrex Electronic  
Systems  
VI Technology  
Viewpoint Systems

Warwick Control  
Technologies  
Zmation

**Test Consultants**

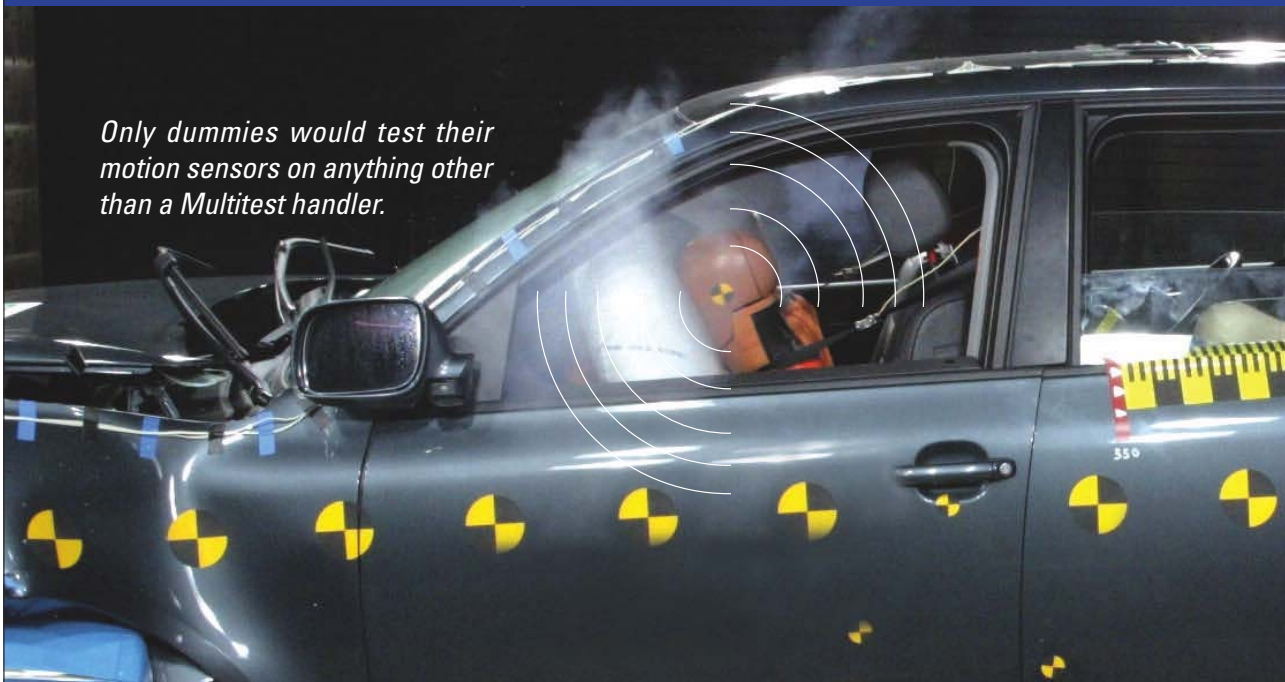
A.T.E. Solutions



Accolade Engineering  
Solutions  
Acculogic  
Advanced Testing  
Technologies  
Agilent Technologies  
Alion Science &  
Technology  
Amkor Technology  
Artest  
ASSET Intertech  
Autotest  
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HALT&HASS Systems  
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Hobbs Engineering  
Instrumentation Engineering  
Intellitech  
Intertek ETL Entela  
Intrinsic Quality  
Invisar  
JTAG Technologies  
LTX  
m + p international  
MegaPhase  
MET Laboratories  
MI Technologies  
Mindready Solutions  
Motorola Product Testing Services  
National Technical Systems  
Nevada Automotive Test Center  
Northwest EMC  
OptEM Engineering  
PMG Technologies  
Premier Semiconductor Services  
ProbeStar

Product Safety Consulting  
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Scientific Software Tools  
SofTest Designs  
Southwest Research Institute  
Spirent Communications  
Stephen Halperin & Associates  
Suss MicroTec  
Symtx  
Sypris Test & Measurement  
TDA Systems  
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The Test Connection  
Test Site Services  
Test Software Systems  
TestEdge  
TestQuest  
TUV America  
Unisoft  
Vektrex Electronic Systems  
VI Technology  
Viewpoint Systems  
Vision Systems International  
Y-tek

### Test Programming Services

A.T.E. Solutions  
Accolade Engineering Solutions  
Acculogic  
Acugen Software  
Advanced Testing Technologies  
Agilent Technologies  
Amkor Technology  
Artest  
ASSET Intertech  
Autotest  
B & B Technologies  
Bloomy Controls  
Checksum  
Circuit Check  
Comware Tech. Svcs.  
Corelis  
DaqScribe Technology  
Digalog Systems  
Electro Product Management  
ETEC

Flynn Systems  
Geotest - Marvin Test Systems  
GOEPEL Electronics  
Hartman Associates  
Intellitech  
Intrinsic Quality  
Invisar  
JTAG Technologies  
K.J. Marketing Services  
LTX  
m + p international  
Mindready Solutions  
Nevada Automotive Test Center  
PMG Technologies  
Premier Semiconductor Services  
Product Safety Consulting  
QualityLogic  
Real Controls  
SofTest Designs  
Source Electronics  
Spirent Communications  
Symtx  
Teradyne  
Assembly Test Div.  
Test Advantage  
Test Coach  
The Test Connection  
Test Software Systems  
TestEdge  
TestQuest  
Testronics  
Unisoft  
VI Technology  
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### Only LRM+ Delivers Absolutely Symmetrical Measurements

SUSS' LRM+ uniquely defines each port individually, thus accurately calibrates using even asymmetrical customized standards. This means you can calibrate right up to the DUT without lengthy and complicated de-embedding. It's only available in SussCal, which supports more VNAs than any other calibration software.

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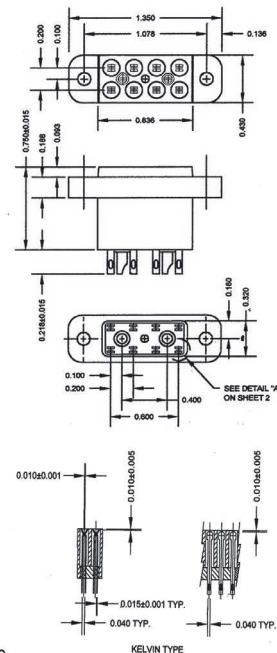
In Molded DAP bodies are NOW AVAILABLE from ARMEL. Please call 800 840-0666 or E-Mail [info@armel.us](mailto:info@armel.us). For detailed information regarding these and a complete line of Mil-Spec and Mil-COTS connectors, sockets, terminals and custom hardware.

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INSULATION MATERIAL:  
DIALLYL ORTHO PHTHALATE PER MIL-M-14

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## IN THIS SECTION:

- ▷ Environmental Test Equipment, below
- ▷ EMC Test Equipment, p. 86
- ▷ ESD Control/Protection, p. 88
- ▷ Third-Party Suppliers, p. 89
- ▷ Services/Labs/Test Houses, p. 90

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Ironwood Electronics  
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ESPEC



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Electro-Tech Systems

Environmental Specialties  
Envirotronics  
ESPEC



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Rotronic Instrument  
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Sharetree Systems  
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Telatemp  
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ThermoLab  
Thermotron Industries  
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Tempronic  
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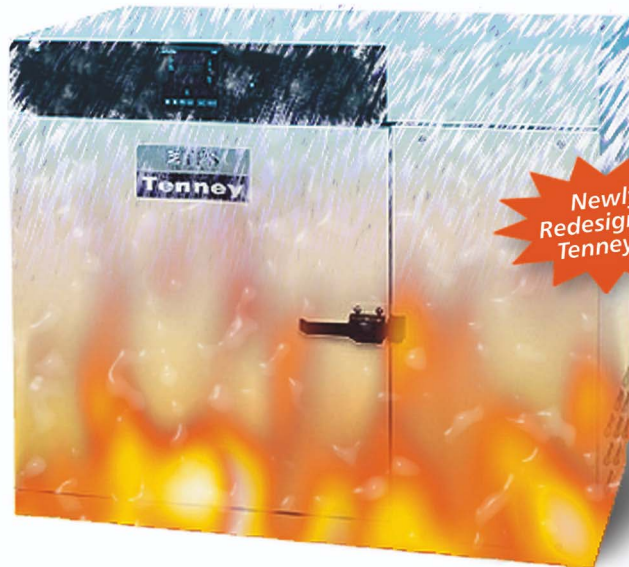
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**Firstsight Vision**, Tongham, Surrey, UK. +44(0)-1252-780000. <http://www.firstsightvision.co.uk>.  
**Flexco**, Tuscumbia, AL. 800-633-3151. <http://www.flexcofloors.com>.  
**Flex-Core**, Columbus, OH. 614-889-6152. <http://www.flex-core.com>.  
**Flextronics Test**, Oakland, NJ. 201-651-1111. <http://www.FlexTest.com>.  
**FLIR Systems**, N. Billerica, MA. 800-464-6372. <http://www.flirthermography.com>.  
**Fluke**, Everett, WA. 425-347-6100. <http://www.fluke.com>.  
**Fluke Networks**, Everett, WA. 425-446-4519. <http://www.flukenetworks.com>.  
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**Futek Advanced Sensor Technology**, Irvine, CA. 949-465-0900. <http://www.futek.com>.  
**FuturePlus Systems**, Colorado Springs, CO. 719-278-3540. <http://www.futureplus.com>.

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**Gage Applied Technologies**, Lachine, QC, Canada. 514-633-7447. <http://www.gage-applied.com>.  
**Garwood Laboratories**, Pico Rivera, CA. 562-949-2727. <http://www.garwoodtestlabs.com>.  
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**Genesys IBS**, Monmouth, S. Wales, UK. +44-1600-710300. <http://www.genesysibs.com>.  
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**MAC Panel**, High Point, NC. 336-861-3100. <http://www.macpanel.com>.  
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**Titan**, Advanced Products & Design Division, San Diego, CA. 858-527-6100. <http://www.titan.com>.  
**Total Temperature Instrumentation**, Williston, VT. 802-863-0085. <http://www.tti-global.com>.  
**Tracespan Communications**, Ann Arbor, MI. 734 846 0549. <http://www.tracespan.com>.  
**Tracewell Systems**, Westerville, OH. 800-848-4524. <http://www.tracewellsystems.com>.  
**Transcat**, Rochester, NY. 800-828-1470. <http://www.transcat.com>.  
**TransEra**, Orem, UT. 800-666-3216. <http://www.HTBasic.com>.  
**Trek**, Medina, NY. 585-798-3140. <http://www.trekinc.com>.  
**Trek Equipment**, Sausalito, CA. 415-332-1555. <http://www.trekequip.com>.  
**Trio-Tech International**, Van Nuys, CA. 818-787-7000. <http://www.triotech.com>.  
**TRS-RenTelco**, DFW Airport, TX. 800-874-7123. <http://www.trs-rentelco.com>.  
**Tucker Electronics**, Garland, TX. 800-527-4642. <http://www.tucker.com>.  
**TUV America**, Danvers, MA. 800-TUV-0123. <http://www.TUVamerica.com>.  
**TUV Rheinland of North America**, Newtown, CT. 888-975-3943. <http://www.tuv.com>.  
**Tyrosys**, Plano, TX. 877-897-6797. <http://www.tyrosys.com>.  
**TYX**, Reston, VA. 703-264-1080. <http://www.tyx.com>.

## U

**UGS**, Portsmouth, NH. 603-431-9411. <http://www.ugs.com>.  
**Ultrafast Sensors**, Thousand Oaks, CA. 866-205-0592. <http://www.ultrafastsensors.com>.  
**UltraTest International**, San Jose, CA. 408-433-2244. <http://www.ultratest.com>.  
**Underwriters Laboratories**, Northbrook, IL. 847-272-8800. <http://www.ul.com>.  
**Unholtz-Dickie**, Wallingford, CT. 203-265-3929. <http://www.udco.com>.  
**Unisoft**, Milford, CT. 888-486-4246. <http://www.unisoft-cim.com>.  
**United Electronic Industries**, Canton, MA. 781-821-2890. <http://www.ueidaq.com>.  
**Unitek Instruments**, Columbus, OH. 614-291-9909. <http://www.unitekinst.com>.  
**Unitron**, Bohemia, NY. 631-589-6666. <http://www.unitronusa.com>.  
**Universal Switching**, Van Nuys, CA. 818-785-0200. <http://www.uswi.com>.  
**Universal Synaptics**, Ogden, UT. 801-731-8508. <http://www.usynaptics.com>.

## V

**V.J. Electronix**, Bohemia, NY. 800-858-9729. <http://www.vjelectronix.com>.  
**Vektrex Electronic Systems**, San Diego, CA. 858-558-8282. <http://www.vektrex.com>.  
**Vena Engineering**, Watsonville, CA. 831-724-5738. <http://www.vena.com>.  
**VI Technology**, Austin, TX. 512-327-3348. <http://www.vi-tech.com>.  
**Vibration Research**, Jenison, MI. 616-669-3028. <http://www.vibrationresearch.com>.  
**Vibration Test Systems**, Aurora, OH. 330-562-5729. <http://www.vts2000.com>.  
**Vicor**, Andover, MA. 978-470-2900. <http://www.vicorpower.com>.  
**Videology Imaging Solutions**, Greenville, RI. 401-949-5332. <http://www.videologyinc.com>.  
**View Engineering**, Simi Valley, CA. 805-578-5000. <http://www.vieweng.com>.  
**Viewpoint Systems**, Rochester, NY. 585-475-9555. <http://www.viewpointusa.com>.  
**Virginia Panel**, Waynesboro, VA. 540-932-3300. <http://www.vpc.com>.  
**Viscom**, Norcross, GA. 678-966-9835. <http://www.viscomusa.com>.  
**Vision Components**, Hudson, NH. 603-598-2588. <http://www.vision-components.com>.  
**Vision Engineering**, New Milford, CT. 860-355-3776. <http://www.visioneng.com>.  
**Vision Systems International**, Yardley, PA. 215-736-0994. <http://www.vision1.com/vsi>.  
**VitreK**, San Diego, CA. 858-689-2755. <http://www.vitreK.com>.

**VLSI Standards**, San Jose, CA. 408-428-1800. <http://www.vlsistandards.com>.  
**VMETRO**, Houston, TX. 281-584-0728. <http://www.vmetro.com>.  
**Volpi USA**, Auburn, NY. 315-255-1737. <http://www.volpiusa.com>.  
**VXI Technology**, Irvine, CA. 949-955-1894. <http://www.vxitech.com>.

## W

**W.J. Ford Surplus Enterprises**, Smith's Falls, ON, Canada. 613-283-5195. <http://www.testequipmentcanada.com>.  
**W.L. Gore & Associates**, Elkton, MD. 800-311-3060. <http://www.gore.com>.  
**W.M. Hague**, Pepperell, MA. 978-433-3777. <http://www.WMHague.com>.  
**Walter G. Legge**, Peekskill, NY. 914-737-5040. <http://www.leggesystems.com>.  
**Warwick Control Technologies**, Kenilworth, UK. +44(0)1676 536010. <http://www.warwickcontrol.com>.  
**Wavecrest**, Eden Prairie, MN. 952-831-0030. <http://www.wavecrest.com>.  
**Wavetek Meterman Test Tools**, Everett, WA. 877-596-2680. <http://www.metermantesttools.com>.  
**Wells-CTI**, Phoenix, AZ. 623-581-5330. <http://www.wellscti.com>.  
**Wentworth Laboratories**, Brookfield, CT. 203-775-0449. <http://www.wentworthlabs.com>.  
**WESCO**, Western Scientific, San Francisco, CA. 415-826-5732. <http://www.wescocomicroscopes.com>.  
**Western Graphtec**, Irvine, CA. 949-770-6010. <http://www.westerngraphtec.com>.  
**Wiltek Communications**, Indianapolis, IN. 317-595-2021. <http://www.wiltek.com>.  
**Wintriss Engineering**, San Diego, CA. 800-550-7300. <http://www.weco.com>.  
**Wireless Valley Communications**, Austin, TX. 512-821-1560. <http://www.wirelessvalley.com>.  
**WiTec Instruments**, Savoy, IL. 877-948-3201. <http://www.witec-instruments.com>.

## X

**Xantrex Technology**, Burnaby, BC, Canada. 604-422-8595. <http://www.xantrex.com>.  
**Xitron Technologies**, San Diego, CA. 858-530-8099. <http://www.xitrontech.com>.  
**X-TEK Systems**, Tyngsboro, MA. 978-649-6333. <http://www.xtekxray.com>.

## Y

**Yamaichi Electronics USA**, San Jose, CA. 408-456-0797. <http://www.yamaichi.us>.  
**Yelo-USA**, Portsmouth, NH. 603-427-6816. <http://www.yelo-usa.com>.  
**Yokogawa Corp. of America**, Newnan, GA. 770-254-0400. <http://www.yokogawa.com/us>.  
**Y-tek**, Raleigh, NC. 800-707-9835. <http://www.Y-tek.com>.

## Z

**Zmation**, Portland, OR. 503-253-8871. <http://www.zmation.com>.  
**Ztec**, Albuquerque, NM. 505-342-0132. <http://www.ztec-inc.com>.  
**Zygo**, Middlefield, CT. 860-347-8506. <http://www.zygo.com>.

**Red** indicates an advertiser in this issue. (See Advertiser Index.)





# VENDOR CONTACT INFORMATION

For a brief description of each organization, visit the Professional Groups & Societies Directory on the *Test & Measurement World* Web site: <http://www.tmworld.com/society>.

**Accellera**, Napa, CA. 707-251-9977. <http://www.accellera.org>.

**AeA**, Santa Clara, CA. 800-284-4232. <http://www.aeanet.org>.

**American Association for Laboratory Accreditation (A2LA)**, Frederick, MD. 301-644-3248. <http://www.a2la.org>.

**American Council of Independent Laboratories (ACIL)**, Washington, DC. 202-887-5872. <http://www.acil.org>.

**American National Standards Institute (ANSI)**, New York, NY. 212-642-4900. <http://www.ansi.org>.

**American Society for Nondestructive Testing (ASNT)**, Columbus, OH. 614-274-6003. <http://www.asnt.org>.

**American Society for Quality (ASQ)**, Milwaukee, WI. 414-272-8575. <http://www.asq.org>.

**American Society of Test Engineers (ASTE)**, Nutting Lake, MA. <http://www.astetest.org>.

**ASTM International**, W. Conshohocken, PA. 610-832-9585. <http://www.astm.org>.

**ATM Forum**, San Francisco, CA. 415-561-6275. <http://www.atmforum.com>.

**Audio Engineering Society (AES)**, New York, NY. 212-661-8528. <http://www.aes.org>.

**Automated Imaging Association (AIA)**, Ann Arbor, MI. 734-994-6088. <http://www.machinevisiononline.org>.

**British Standards Institution (BSI)**, London, UK. +44(0)208-996-9000. <http://www.bsi-global.com>.

**Canadian Standards Association (CSA)**, Toronto, ON, Canada. 416-747-4000. <http://www.csa.ca>.

**DSL Forum**, Fremont, CA. 510-608-5905. <http://www.dslforum.org>.

**Electronic Industries Alliance (EIA)**, Arlington, VA. 703-907-7500. <http://www.eia.org>.

**ESD Association**, Rome, NY. 315-339-6937. <http://www.esda.org>.

**European Committee for Electrotechnical Standardization (CENELEC)**, Brussels, Belgium. +32-2-519-68-71. <http://www.cenelec.org>.

**European Committee for Standardization (CEN)**, Brussels, Belgium. +32-2-550-08-11. <http://www.cenorm.be>.

**European Telecommunications Standards Institute (ETSI)**, Sophia-Antipolis Cedex, France. +33(0)4-92-94-4200. <http://www.etsi.org>.

**Federal Communications Commission (FCC)**, Washington, DC. 888-225-5322. <http://www.fcc.gov>.

**Fibre Channel Industry Association (FCIA)**, San Francisco, CA. 415-561-6270. <http://www.fibrechannel.org>.

**IEEE**, Piscataway, NJ. 732-981-0060. <http://www.ieee.org>.

**Institute for National Measurement Standards (INMS)**, Ottawa, ON, Canada. 613-998-7018. <http://inms-ienm.nrc-cnrc.gc.ca/>.

**Institute of Environmental Sciences and Technology (IEST)**, Rolling Meadows, IL. 847-255-1561. <http://www.iest.org>.

**Institution of Electrical Engineers (IEE)**, London, UK. +44(0)20-7240-1871. <http://www.iee.org>.

**InterNational Committee for Information Technology Standards (INCITS)**, Washington, DC. 202-737-8888. <http://www.incits.org>.

**International Electrotechnical Commission (IEC)**, Geneva, Switzerland. +41-22-919-0211. <http://www.iec.ch>.

**International Microelectronics & Packaging Society (IMAPS)**, Washington, DC. 202-548-4001. <http://www.imaps.org>.

**International Organization for Standardization (ISO)**, Geneva, Switzerland. +41-22-749-01-11. <http://www.iso.org>.

**International Society for Optical Engineering (SPIE)**, Bellingham, WA. 360-676-3290. <http://www.spie.org>.

**International Telecommunication Union (ITU)**, Geneva, Switzerland. +41-22-730-5111. <http://www.itu.int>.

**IPC-Association Connecting Electronics Industries**, Bannockburn, IL. 847-615-7100. <http://www.ipc.org>.

**ISA, The Instrumentation, Systems, and Automation Society**, Research Triangle Park, NC. 919-549-8411. <http://www.isa.org>.

**Japan Electric Measuring Instruments Manufacturer's Association (JEMIMA)**, Minato-ku, Tokyo, Japan. +81-3-3502-0602. <http://www.jemima.or.jp/english/index.htm>.

**LXI Consortium**, San Diego, CA. <http://www.lxistandard.org>.

**Microelectronics Packaging and Test Engineering Council (MEPTEC)**, Mt. View, CA. 650-988-7125. <http://www.meptec.org>.

**MPLS and Frame Relay Alliance**, Fremont, CA. 510-608 5910. <http://www.mplsforum.org>.

**National Cooperation for Laboratory Accreditation (NACLA)**, Lake Mary, FL. 407-333-3327. <http://www.nacla.net>.

**National Institute of Standards and Technology (NIST)**, Gaithersburg, MD. 301-975-6478. <http://www.nist.gov>.

**National Society of Professional Engineers (NSPE)**, Alexandria, VA. 703-684-2800. <http://www.nspe.org>.

**National Voluntary Laboratory Accreditation Program (NVLAP)**, Gaithersburg, MD. 301-975-4016. <http://www.nist.gov/nvlap>.

**NCSL International**, Boulder, CO. 303-440-3339. <http://www.ncsl.org>.

**Open Data Acquisition Association (ODAA)**, Stamford, CT. 203-359-7808. <http://www.opendaq.org>.

**Optical Society of America (OSA)**, Washington, DC. 202-223-8130. <http://www.osa.org>.

**PC/104 Consortium**, San Francisco, CA. 415-243-2104. <http://www.pc104.org>.

**PCI Special Interest Group (PCI-SIG)**, Portland, OR. 503-291-2569. <http://www.pcisig.com>.

**PCMCIA**, San Jose, CA. 408-433-2273. <http://www.pcmcia.org>.

**PXI Systems Alliance**, San Diego, CA. 619-297-1213. <http://www.pxisa.org>.

**SAE International**, Warrendale, PA. 724-776-4841. <http://www.sae.org>.

**Semiconductor Equipment and Materials International (SEMI)**, San Jose, CA. 408-943-6900. <http://www.semi.org>.

**Semiconductor Industry Association (SIA)**, San Jose, CA. 408-436-6600. <http://www.sia-online.org>.

**Semiconductor Test Consortium (STC)**, San Diego, CA. 619-297-1210. <http://www.semitest.org>.

**Society for Information Display (SID)**, San Jose, CA. 408-977-1013. <http://www.sid.org>.

**Standard Commands for Programmable Instrumentation (SCPI)**, San Diego, CA. 619-297-1210. <http://www.scpiconsortium.org>.

**Standards Council of Canada**, Ottawa, ON, Canada. 613-238-3222. <http://www.scc.ca>.

**Surface Mount Technology Association (SMTA)**, Edina, MN. 952-920-7682. <http://www.smta.org>.

**Telecommunications Industry Association (TIA)**, Arlington, VA. 703-907-7700. <http://www.tiaonline.org>.

**Test and Diagnostics Consortium (TDC)**, Lakehurst, NJ. 732-323-7963. <http://www.test-diagnostics.org>.

**VMEbus International Trade Association (VITA)**, Fountain Hills, AZ. 480-837-7486. <http://www.vita.com>.

**VXibus Consortium**, San Diego, CA. 619-297-1213. <http://www.vxibus.org>.

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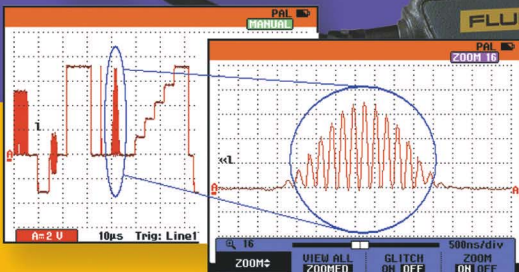
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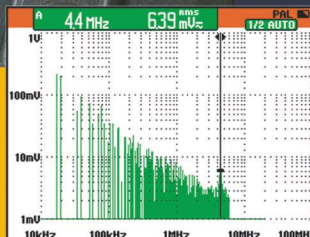
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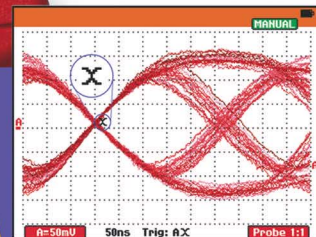
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**Fig. 1** Thanks to the deeper memory, very small parts of the waveform can be studied in full detail using 'zoom'.



**Fig. 2** Frequency Spectrum shows an overview of frequencies contained in a signal.



**Fig. 3** Dual-slope triggering used to capture the eye-pattern on a digital datastream.

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

## Test system integration

Instrumentation Engineering's capabilities brochure provides test system integration guidance for the military and aerospace, communications, medical, industrial, automotive, and office-automation markets. *Instrumentation Engineering (IE)*, Oakland, NJ. 201-651-1111; [www.ietest.com](http://www.ietest.com).



## Programmable switching systems

CYTEC provides programmable switching systems for ATE, data-acquisition, and communications LAN, telephony, microwave, and RF systems. Products include matrices, multiplexers, and discrete relays. Custom and O.E. DC to 18-GHz systems are available. *CYTEC Corp.*, Penfield, NY. 800-346-3117; [www.cytec-ate.com](http://www.cytec-ate.com).

## Device programmer

BP Microsystems is a global supplier of engineering and production device programmers and is a leading supplier of automated programming systems to the semiconductor and electronic industries. *BP Microsystems*, Houston, TX. 713-688-4600; [www.bpmicro.com](http://www.bpmicro.com).

## Low-priced boards

IOtech's new DaqBoard/500 series sets a new price/performance benchmark at just \$199 in five-piece quantities. IOtech says these multifunction, 16-bit/200-kHz boards are priced at up to 33% less than the lowest priced 16-bit competitors. *IOtech*, Cleveland OH. 440-439-4091; [www.iotech.com](http://www.iotech.com).

## Power-distribution units

Spectrum Control offers the AC SmartStart Jr. and DC SmartStart power-distribution units. These products are designed to extend remote testing and experimentation capabilities, with maximum system uptime. *Spectrum Control*, Erie, PA. 814-474-4362; [www.specpower.com](http://www.specpower.com).

## Sensor for LED testing

Designed for use in testing LEDs for a wide range of applications, the Smart FINN sensor delivers full color and intensity readings for a broad spectrum of LEDs. *Test Coach Corp.*, Hoffman Estates, IL. 847-885-4880; [www.testcoach.com](http://www.testcoach.com).

## USB data acquisition

USB-inSync technology enables synchronous data acquisition with multiple distributed USB devices. The DAQ-2500X combines USB-inSync with real-time I/O, enabling what Fiberbyte says is unprecedented performance and expansion flexibility in demanding distributed test environments. *Fiberbyte*, Adelaide, CA. 415-543-6859; [www.fiberbyte.com/products\\_daq.htm](http://www.fiberbyte.com/products_daq.htm).

## Probe catalog

IDI's Eighth Edition Catalog and SourceBook will be published in the Fall of 2005, with 15 new probe designs and expanded tip options for the ICT Series Probes. *Interconnect Devices Inc.*, Kansas City, KS. 913-342-5544; [www.idinet.com](http://www.idinet.com).

## Frame grabbers and software

BitFlow's new R64e PCI Express Camera Link frame grabber offers compatibility with today's base-, medium-, and full-configuration cameras, and it works seamlessly with the company's ImageWarp software. *BitFlow*, Woburn, MA. 781-932-2900; [www.bitflow.com](http://www.bitflow.com).

## Test and measurement products

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*, Chino, CA. 909-591-8358; [www.instek.com](http://www.instek.com).

## Wireless data acquisition

CEC has launched a mobile acquisition device, the btDAQ/100, with a 14-bit analog input ADC that is wire-

less and battery powered and can be used as a peripheral to any Bluetooth-enabled laptop, Pocket PC, or PDA. *Capital Equipment Corp.*, Bedford, NH. 800-234-4232; [www.cec488.com](http://www.cec488.com).

## Power products

AMREL/American Reliance manufactures a wide selection of power products. The company's eLoad programmable air/water-cooled electronic loads and ePower programmable linear/switching power supplies are available with closed-case calibration and interfaces for Ethernet, USB, GPIB, and RS-232. *AMREL/American Reliance*, El Monte, CA. 800-654-9838; [www.amrel.com](http://www.amrel.com).

## 2005 product catalog

B&K Precision's 2005 full-color catalog features more than 50 new and best-selling products including IC testers, device programmers, power supplies, cable testers, environmental instruments, video monitor testers, and a full line of accessories. *B&K Precision Corp.*, Yorba Linda, CA. 714-921-9095; [www.bkprecision.com](http://www.bkprecision.com).

## Mass interconnect

The G12 Mass InterConnect offers 12-connector module positions in a low-profile solution for rapid connectivity between instrumentation and devices under test. It's ideal for contract manufacturing, automotive, and other high-volume testing environments. *Virginia Panel Corp.*, Waynesboro, VA. 540-932-3300; [www.vpc.com](http://www.vpc.com).

## Probes and test leads

Probe Master's catalog features 500-MHz oscilloscope probes and a new series of differential probes. Other products include DMM test leads, BNC cables, probe test clips, and SMD probes and grippers. *Probe Master*, El Cajon, CA. 619-258-7412; [www.probemaster.com](http://www.probemaster.com).

## Toolkits and accessories

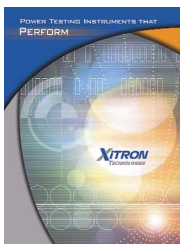
The Contact East/Jensen Tools Master Catalog features JTK toolkits and cases, test and measurement equipment, telecom and fiber-optic equip-



ment, hand and power tools, hard-to-find specialty tools, soldering and desoldering equipment, and electronic production supplies. Contact East/Jensen Tools, N. Andover, MA. 978-682-9844; [www.contacteast.com](http://www.contacteast.com); [www.jensentools.com](http://www.jensentools.com).

## Quality and reliability

Xitron manufactures a full range of analyzers and meters, including phase-angle voltmeters, motor testers, ballast analyzers, ballast load chassis, power-supply testers, and accessories. Xitron Technologies, San Diego, CA. 858-530-8099; [www.xitrontech.com](http://www.xitrontech.com).



## Optical and imaging components

Edmund manufactures optical and imaging components for OEM and research applications. Products include lenses, prisms, filters, mirrors, optomechanical equipment, lasers, electronics, and systems. The company's Website has a complete catalog of products and a technical library. Edmund Industrial Optics, Barrington NJ. 800-363-1992; [www.edmundoptics.com](http://www.edmundoptics.com).

## Generator and measuring instruments

Tabor Electronics' 2005 catalog provides complete specifications for all instruments, including generators, amplifiers, and counters. A brochure describing the new Wonder Wave series high-sample-rate arbitrary waveform generators is also available. Tabor Electronics, Global Test Solutions, Yucaipa, CA. 909-797-0484; [www.taborelec.com](http://www.taborelec.com).

## Updated development software

Geotest has released version 6.0 of ATEasy, a rapid application-development framework for functional test, ATE, data-acquisition, process-control, and instrumentation systems. ATEasy provides the necessary tools

for developing software components, from instrument drivers to complex test programs. Geotest—Marvin Test Systems, Irvine, CA. 949-263-2222; [www.geotestinc.com](http://www.geotestinc.com).

## Interconnection shortform catalog

A catalog from Aries Electronics covers interconnection and packaging products, including side-stackable PinBall BGA sockets, Correct-A-Chip adapters for converting virtually any package type or footprint to any other without board redesign, RF test sockets, cable jumper assemblies, and programming devices. Aries Electronics, Frenchtown, NJ. 908-996-6841; [www.arieselec.com](http://www.arieselec.com).

## Test and measurement catalog

A new test and measurement catalog from Test Equipment Connection features equipment from Agilent, Tektronix, Fluke, Keithley, and many others. The company offers sales, rentals, and repairs, as well as savings of 30% to 70%. Test Equipment Connection, Lake Mary, FL. 800-615-8378; [www.testequipmentconnection.com](http://www.testequipmentconnection.com).

## WLR and MEMS test

Micromanipulator provides a complete line of WLR and MEMS test systems. Stations, thermal chucks, and versatile holders, plus a wide variety of MEMS micro-tools for assembly, test, and packaging are available. The Micromanipulator Co., Carson City, NV. 775-882-2400; [www.micromanipulator.com](http://www.micromanipulator.com).

## Antennas and accessories

A.H. Systems provides EMC antennas, accessories, and calibration services for global testing. The company's new broadband antennas handle 25 MHz to 40 GHz. A.H. Systems, Chatsworth, CA. 818-998-0223; [www.ahsystems.com](http://www.ahsystems.com).

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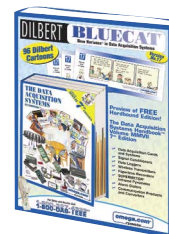
engineers and technicians. High-volume production, test, and burn-in sockets and adapters are available in every package style. Emulation Technology, Santa Clara, CA. 408-982-0660; [www.emulation.com](http://www.emulation.com).

## Product testing services

Motorola offers third-party technical services and specializes in providing product testing, including compliance, environmental stress and reliability, and performance testing. The company focuses on consumer electronics and information technology equipment. Motorola Product Testing Services, Lawrenceville, GA. 770-338-3795; [www.motorola.com/testservices](http://www.motorola.com/testservices).

## Data-acquisition systems

"BlueCat New Horizons in Data Acquisition" features Omega's latest data-acquisition cards and systems, Web-enabled devices, signal conditioners, multifunction instruments, portable dataloggers, wireless devices, paperless recorders, alarm dialers, communication products, and converters. Omega Engineering, Stamford, CT. 203-359-1660; [www.omega.com](http://www.omega.com).



## Communications products

Willtek's new 2005 catalog includes information about all of the company's products and services. It also includes a useful reference chart that explains what technologies each product supports. Willtek Communications, Indianapolis, IN. 317-595-2021; [www.willtek.com](http://www.willtek.com).

## Refurbished test equipment

Allied Resource is a leading provider of high-quality new, used, and refurbished electronic and optical test and measurement equipment from all leading manufacturers, including Advantest, Agilent, Anritsu, Keithley, Rohde & Schwarz, and Tektronix. Allied Resource, TES Division, Santa Barbara, CA. 805-967-6260; [www.alliedtes.com](http://www.alliedtes.com). (continued)

## CATALOGS & PRODUCTS

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

### Modular test analyzer

Designed for distributed switching applications, the Model 2650.MTA holds 1500 test points (maximum) per module. You can choose stand-alone modules placed around the unit under test or rack-mount units for concentrated applications. *DIT-MCO International, Kansas City, MO. 800-821-3487; www.ditmco.com.*

### Electronic manufacturing automation

Aerotech's brochure, "Automation Solutions for Electronic Manufacturing, Test and Inspection, and Data Storage," presents motion-control and positioning solutions for electronic assembly, pick-and-place, PCB laser drilling and stencil cutting, wafer singulation, optical inspection, and more. *Aerotech, Pittsburgh, PA. 412-963-7470; www.aerotech.com.*



### RF probe

SUSS MicroTec's new Multi IZI Probe offers up to seven RF channels. It can be individually configured for testing RF and DC together on one probe. *SUSS MicroTec Test Systems, Dresden, Germany. +49(352)4073-0; www.suss.com.*

### Testability guidelines

The Testability Director provides design-for-testability guidelines in a spreadsheet format, allowing you to score the testability of ASICs, boards, and systems. It offers guidance on making designs testable to save you thousands in test and support costs. *A.T.E. Solutions, Los Angeles, CA. 310-641-8400; www.besttest.com.*

### Reliability CD

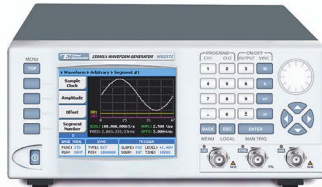
Keithley's "Understanding Measurements: Essential Reliability Testing Techniques" CD includes four informative seminars, plus application notes, white papers, useful Web links, and a glossary. Free. *Keithley Instruments, Cleveland, OH. 440-498-2747; www.keithley.com/at/198info.html.*

## PRODUCT FOCUS

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

### Arbitrary waveform generators

The Wonder Wave series of arbitrary waveform generators from Tabor Electronics provides flexi-



ble signal design and creation for every application at an affordable price. The series includes single- and dual-channel instruments at 50 Msamples/s, 100 Msamples/s, and 250 Msamples/s, and a single-channel box at 1.2 Gsamples/s.

*Tabor Electronics, Yucaipa, CA. 909-707-0484; www.taborelec.com.*

### Programmable power products

AMREL/American Reliance manufactures the eLOAD programmable, air- and water-cooled



electronic loads, which supply from 800 W to 100+ kW (600 VDC and 1500 ADC). The company's ePOWER programmable linear and switching power supplies provide from 20 W to 900+ kW (800 VDC and 2700 ADC). The ePOWER and eLOAD lines offer external analog programming, closed-case calibration, and Ethernet, USB, GPIB, and RS-232 interfaces.

*AMREL/American Reliance, El Monte, CA. 800-654-9838; www.amrel.com.*

### Synchronous USB data acquisition

USB-inSync technology enables synchronous data acquisition with multiple distributed USB devices. Fiberbyte's DAQ-2500X combines USB-inSync with real-time I/O, enabling expansion flexibility in demanding distributed test environments.



Features include four independent, 16-bit resolution, 100-ksamples/s, simultaneous sampling analog input channels, multichannel 1-Mbyte/s data throughput, programmable digital I/O, and triggers.

*Fiberbyte, Adelaide, CA. 415-543-6859; www.fiberbyte.com/products\_daq.htm.*

### 3U PXI digital I/O card

The GX5280 Series are high-performance, cost-effective 3U PXI dynamic digital I/O boards with 32 TTL input or output channels and 32 LVDS input or



output channels. The GX5280 Series offers an industry-leading 256 Mbytes of onboard memory and allows test rates up to 100 MHz. The single-board design supports both master and slave functionality without the use of add-on modules.

*Geotest—Marvin Test Systems, Irvine, CA. 949-263-2222; www.geotestinc.com.*

## SMUs for multi-channel applications

Keithley's Series 2600 System SourceMeter instruments are scalable, cost-effective solutions

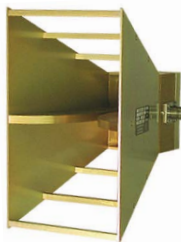


for precision DC, pulse, and low-frequency AC testing. An embedded Test Script Processor (TSP) allows the programming and executing of high-speed test sequences independently. Together with TSP-Link, an inter-unit communication bus, TSP lets one program control multiple SMU channels.

Keithley Instruments, Cleveland, OH. 800-588-9238; [www.keithley.com](http://www.keithley.com).

## 700-MHz to 18-GHz horn antenna

The A.H. Systems SAS-571 horn antenna is a broadband antenna that offers excellent performance over the frequency range of 700 MHz to 18 GHz. With high gain, low VSWR, input-handling capability of up to 800-W CW, and a rugged design, this horn antenna handles both immunity and emissions testing. A.H. Systems also provides 18-GHz low-loss cables for use with the SAS-571 horn antenna.



A.H. Systems, Chatsworth, CA. 818-998-0223; [www.ahsystems.com](http://www.ahsystems.com).

## Configurable signal conditioners

The DRF series DIN rail signal conditioners accept a broad range of input signals, such as AC and



DC voltage, current, frequency, and temperature (thermocouple and RTD). The units provide standard process outputs of either 4–20 mA or 0–10 VDC. Easily mounted on standard 35-mm DIN rails, the DRF series is suited for industrial applications. Starting at \$170.

Omega Engineering, Stamford, CT. 203-359-1660; [www.omega.com/DAS](http://www.omega.com/DAS).

## MEMS test module

Multitest has released a new MEMS module for handling and stimulating rate sensors in a temperature-conditioned environment. The device is moved in two axis (440° and 90°), and constant speed and sinusoidal stimuli can be applied. The company's MEMS modules operate in combination with its Multitest MT93xx with up to four parallel contact sites.



Multitest Elektronische Systeme, Rosenheim, Germany. +49-8031-406-0; [www.multitest.com/eng/Products/MEMS/](http://www.multitest.com/eng/Products/MEMS/).

## High-performance digital oscilloscope

Instek's GDS-800 series 60/100/150/250-MHz digital storage oscilloscopes are designed for those who demand perfor-



mance, reliability, and affordability. In addition to providing 125k points of waveform memory and up to 25 Gsamples/s for repetitive waveforms, the GDS-800 series offers 15 auto-measurements, roll mode, go/no-go, and an auto setup sequence.

Instek America, Chino, CA. 909-591-8358; [www.instek.com](http://www.instek.com).

## Single-line power filters

Spectrum Control offers feed-thru AC and DC single-line power filters for up to 500 A, with



attenuation of 4–90 dB from 1 MHz to 1 GHz. UL- and Semko-approved, these power filters feature voltage ratings of 130 VDC and 250 VAC. The rugged bolt-in styles mean easy installation.

Spectrum Control, Erie, PA. 814-474-1571; [www.specemc.com](http://www.specemc.com).



# PRODUCT FOCUS

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## Telecentric lenses

Edmund's MVO Telecentric Measuring Lenses offer a compact solution for replacing standard fixed-focal-length lenses. Telecentric lenses correct perspective errors that yield variations in magnification through the depth of field, and they create less distortion than conventional fixed-focal-length lenses. This design yields more symmetrical images for software-integrated measurements. The lenses offer a simplified non-focusing mechanical design with adjustable iris control.

Edmund Optics, Barrington, NJ.  
800-363-1992;  
[www.edmundindustrialoptics.com](http://www.edmundindustrialoptics.com).



## Programmable DC power supply

The Model 9121 offers a programmable output of 0–20 V, 0–5 A, with clean, reliable power and excellent performance. At



\$689, it is ideal for educational settings, service

and maintenance applications, R&D lab verification, manufacturing, and other applications that require clean, reliable power.

B+K Precision, Yorba Linda, CA.  
714-921-9095;  
[www.bkprecision.com](http://www.bkprecision.com).

## High-speed, high-accuracy prober

Conventional “pad hoppers” offer speed but at the cost of accuracy, resulting in unreliable tests and damage to bonding pads. SUSS MicroTec's new BlueRay prober sets a new standard in accuracy,



increasing throughput by giving you confidence in test results

and avoiding costly pad damage and time-consuming probe mark inspections.

SUSS MicroTec Test Systems,  
Dresden, Germany. +49(352)4073-0;  
[www.suss.com](http://www.suss.com).

## 500-MHz high-performance probes

Probe Master's new 500-MHz oscilloscope probe has been designed to meet the requirements of Tek, HP, and other scopes. The gold contacts ensure positive low-resistance connections. This 14-piece kit includes accessories for those hard-to-reach test points, a high-frequency ground, and a black storage case.



Probe Master, El Cajon, CA.  
[www.probemaster.com](http://www.probemaster.com).

## Product testing services

Motorola Product Testing Services offers expert third-party technical services. The company specializes in providing product testing, including compliance, environmental stress and reliability, and performance testing. Motorola offers product testing and diversified technical services to companies that manufacture products for a wide range of industries, including consumer electronics and information technology.

Motorola Product Testing Services,  
Lawrenceville, GA. 770-338-3795;  
[www.motorola.com/testservices](http://www.motorola.com/testservices).

## Portable DSP engine

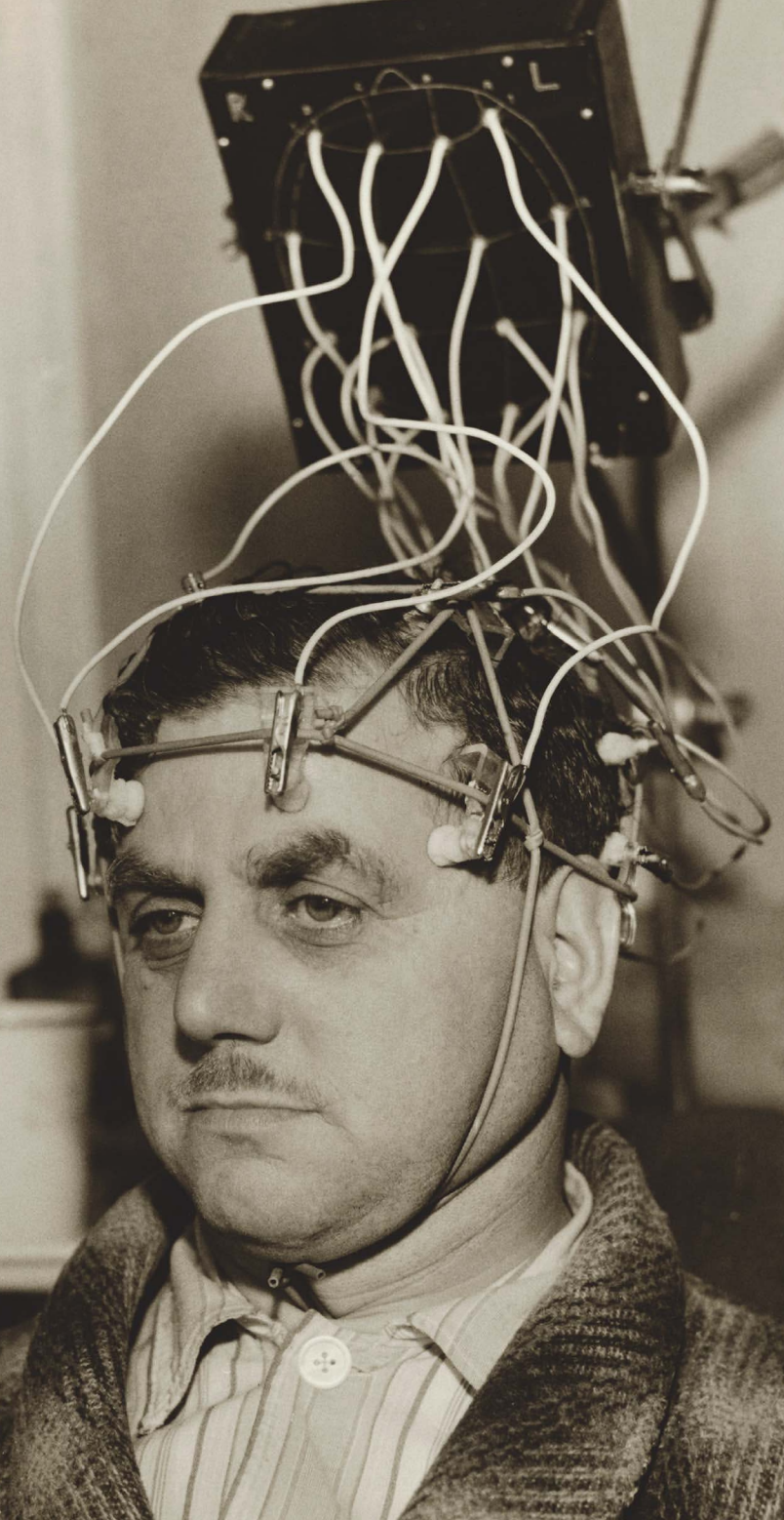
Data Physics has introduced Quattro, a portable DSP engine that connects to a PC using USB 2.0 and is bus powered.

Offering four inputs, two outputs, and one tachometer



channel, Quattro is designed for advanced modal testing. With its rugged design and the ability to record data on all channels at 204.8 ksamples/s, Quattro can tackle data acquisition in aircraft, in vehicles, and in industrial environments.

Data Physics, San Jose, CA. 408-437-0100; [www.dataphysics.com](http://www.dataphysics.com).



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ADVERTISER	PAGE	ADVERTISER	PAGE	ADVERTISER	PAGE
A Comm Electronics	108	EPIX	48	Pearson Electronics	24
A.H. Systems	87	ESD Association	90	Pico Technology	31
A.T.E. Solutions	108	ESPEC	86	Probe Master	40
Advantech	2	ETS Lindgren	85	Professional Testing	88
Advantest	16	EXFO-Electro Optical Engineer	58	Racal Instruments	37
Aerotech	49	E-Z Hook	109	Ramsey Electronics	111
Agilent Technologies	12, 13	Fiberbyte	33	Rika Denshi America	76
Allied Resource	38, 108	Fluke	101	Rockwell Scientific	62
AR Worldwide	84	FTS Systems	109	Rohde & Schwarz Gmbh	14, 65-A-H
Amrel	27	Garwood Labs	88	Sealevel Systems	111
Anritsu	C-3	Geotest	36	Sony Electronics	51
Aries Electronics	81	Gordon Kapes	65	Spectrum Control	91
Armel Electronics	83	Hamamatsu Photonics System	52	Stanford Research Systems	10
Ascor	29	Highland Technology	22	Strategic Test	109, 111
Avalon Equipment	108	Huntron Instruments	70	Suss MicroTec	79, 81, 83
Avtech Electrosystems	24	Instek America	21	Sypris	50
B&K Precision	20	Instrumentation Engineering	68	Tabor Electronics	60
Bitflow	47	Instrumented Sensor Technology	25	Team ATE	109
BP Microsystems	66	Interconnect Devices	78	Techrecovery	111
Capital Equipment	40, 110	Johnstech International	74	Test & Measurement World	107
CheckSum	72	Keithley Instruments	4, 109	Test Coach	65
Circuit Specialists	111	LeCroy	26	Test Equipment Connection	45
Cirris Systems	70	M3 Electronics	110	TestMart/Decibel	33-A/B, 42, 44
Cognex	18	Madell	110	Thales Optem	54
Contact East	38	Matrox Imaging	46	TPS Thermal Prod Solutions	89
Cytec	73	Measurement Computing	34, 111	Underwriters Laboratories	6, 7
Data I/O	71	Mentor Graphics	75	Universal Switching	69
Data Translation	28	Micro Lambda	56	V METRO	32
Digitaltest	81	Micro-Coax Component	63	VI Technology	39
Direct Industry	41	Micromanipulator	72	Virginia Panel	77
DIT-MCO International	67	Motorola	80	VXI Technology	35
DRS Data & Imaging Systems	110	Multitest Elektronische	82	Wells-CTI	111
DVT	53	National Instruments	C-4, 43, 61	Willtek	59
Ebay	55	Noise Com	8	Xantrex	23
Edmund Industrial Optics	50, 109	Omega Engineering	1	Xitron Technologies	30
Emulation Technology	110	Omicron	64	Yokogawa Corp. of America	C-2

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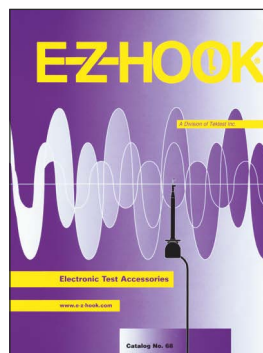
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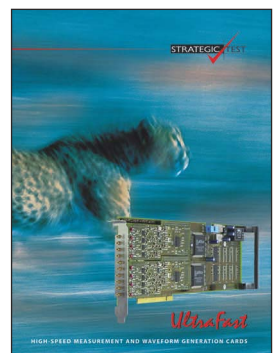
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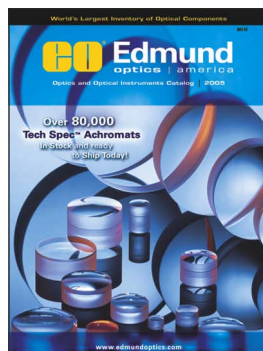
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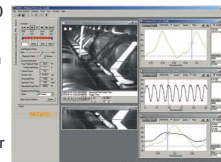
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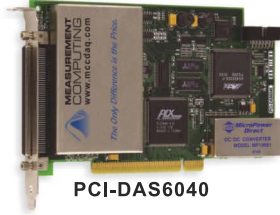
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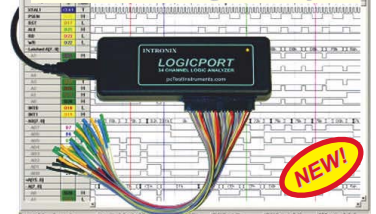


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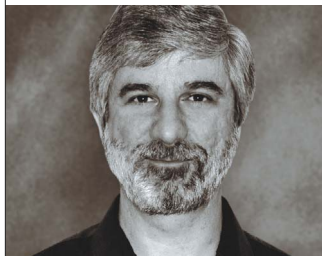
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[An exclusive interview with a technical leader]

**DAVID GRAEF**

VP & CTO  
LeCroy Corp.  
Chestnut Ridge, NY

David Graef joined LeCroy Corp. 16 years ago. He was named CTO of the instrumentation firm in 2003 and a LeCroy VP in 1999. Before joining LeCroy, he served with Data Device Corp., a manufacturer of data-conversion interface products. Graef earned his BS in electrical engineering from the University of Bridgeport.

► The online version of this interview includes more Q&A with David Graef on such topics as innovation, customized products, and Web-based instruments:

[www.tmworld.com/archives](http://www.tmworld.com/archives)

## Exploring the roots of innovation

Through the years, LeCroy has battled much larger test equipment manufacturers in pioneering cutting-edge features for oscilloscopes and other bench instruments. In an interview with *Test & Measurement World*, CTO David Graef discussed his company's long-time focus on innovation.

**T&MW:** How important is innovation at LeCroy?

**Graef:** The drive to innovate is deeply rooted in our corporate culture. People here are passionate about finding useful new solutions to help customers, and it has been that way since Walter LeCroy started the company in 1964.

**T&MW:** Can you cite some technologies that demonstrate the company's strength as an innovator?

**Graef:** The new WaveSurfer oscilloscope (winner of the 2005 *T&MW* Test Product of the Year award) combines a small bench footprint with a large display and easy connectivity. It really makes you want to start turning the knobs. Although the scope does have some analysis capability, we are aiming this product at the broad marketplace, including test technicians.

Another example is our X-Stream processing methodology, which allows much faster processing of very long, complex waveforms. Also significant is our digital bandwidth interleave (DBI), a technology that splits and then recombines signals in the frequency domain. For instance, DBI preprocesses the signal in the analog domain and routes the processed signal into multiple scope channels. As a result, we can increase both the bandwidth and the sample rate of the instrument.

**T&MW:** Could you explain the role of your Accelerated Throughput Architecture?

**Graef:** It's a combination of technologies that allows a sampling oscilloscope to have much faster throughput and longer acquisition memory. ATA also incorporates X-Stream processing. Our new WaveExpert digital oscilloscopes are the first to incorporate this combination of technology.

These scopes come to market with 100-GHz bandwidth and signal application speeds 100 times faster than conventional sampling scopes.

**T&MW:** How do you foster creativity in your development team?

**Graef:** We try to give engineers the time and space to be creative, but the reality is that we are under the same intense time pressures that our customers face. It really comes down to hiring the best people. They need to fit into our corporate culture of innovation. And they need to have not just technical depth but also technical breadth because of the wide variety of technical challenges that our customers must tackle. So, we look for people who can demonstrate an ability to think creatively. Finally, we want engineers who are passionate about solving customer problems and designing circuits, particularly high-frequency chips.

**T&MW:** What role does customer feedback play in the creative process?

**Graef:** We have a number of processes for collecting customer input, and we use that information to drive next-generation products or enhancements to existing products. But we also insist that engineers get out into the field to talk to customers. Invariably, they are very charged up when they come back from these meetings. They like seeing how their products and ideas are used by engineers in the real world. The exercise not only gives our team the impetus to develop new solutions but also provides the context for that development. Artists don't need a context for their work; they can do anything they want. But engineers must target their creativity toward solving specific problems and applications. **T&MW**

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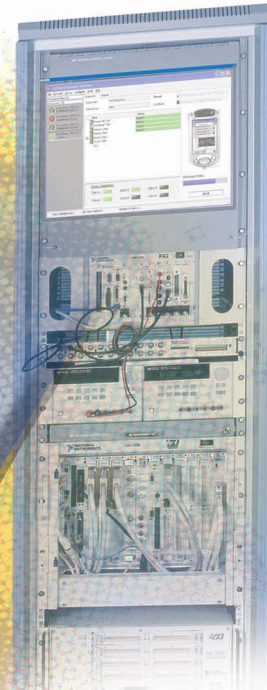
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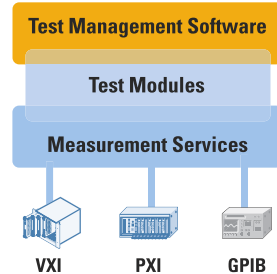
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\* EB300, *Electronic Business*, 2003

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