

Welcome to your Qmags edition of Control Solutions International

Your Qmags edition of Control Solutions International immediately follows this introductory letter. Just read the simple instructions below to learn how to navigate your Qmags Edition and enjoy its special enhancements.

How to Navigate the Magazine

At the bottom of each page of the magazine you will see a navigation bar with 7 buttons. The buttons have these functions:



Arrows: There are left and right facing arrows on either end of the toolbar buttons. Mouse clicking on either of these will turn your pages forward or backwards.



TOC: Clicking on the TOC button wherever you happen to be in the magazine will take you back to the table of contents page.



Zoom In: Clicking on the button with the small magnifying glass will zoom in to the top of that page. Use the “page down” key on your keyboard to move down to the bottom half of that page.



Zoom Out: Clicking on this button will take you from a zoomed single page to the double page view. OR simply place your cursor in the left margin of the single page and click to return to double page view.



Cover: Clicking on the “house” will take you to the cover.



Find: Clicking on “magnifying glass” button will allow you to do a full search of the magazine.

Alternatively, you may use the standard Acrobat Reader tools located in the toolbar above the magazine pages to navigate through the magazine or adjust many of the custom settings available.

Introducing ultrasonic sensors that **think** as well as they **hear**.



U-GAGE®: Banner's Industry-leading Technology for Ultrasonic Sensors



Extremely Accurate Measurement

- ▶ Ranges from 30 mm to 8 m.
- ▶ Sensing resolution from 0.1% to 0.25% of sensing distance.
- ▶ Sophisticated microprocessor control ensures consistent performance.
- ▶ Temperature compensated models available.

Incredibly Easy to Use

- ▶ Fast push-button programming of custom sensing windows.
- ▶ Can be programmed remotely via TEACH wire.
- ▶ Configuration for direct liquid level control available.



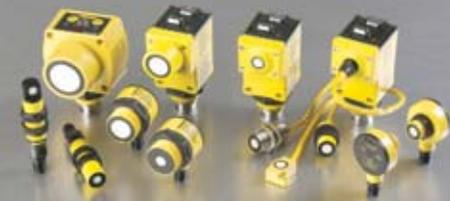
Amazingly Versatile

- ▶ Microprocessor sets an infinite number of ranges and sensing windows.
- ▶ One model can replace hundreds of older style ultrasonics.
- ▶ Variety of analog and discrete outputs available.
- ▶ Unique housing styles and mounting options for your application.



Solve Difficult Sensing Problems

- ▶ Inherently immune to color differences and light interference.
- ▶ Designed to survive hostile environments.
- ▶ Ideal for clear material applications.



Learn more at:
www.bannerengineering.com/ugage

1.763.544.3164



more sensors, more solutions

© 2003 Banner Engineering Corp., Minneapolis, MN

bannerengineering.com

Circle 50 on Control Solutions International RS Card

control solutions international

- ^ 26. Don't blame the control system before checking your smart transmitters
- ^ 29. Mechanical factors often take center stage in prox selection
- ^ 31. Corporate Profiles



Batch Control

^ 12. Special Report

Quality Sensors



at Direct Prices, Shipped the Same Day

Proximity Sensors

AutomationDirect VS. Competition

AutomationDirect	Allen-Bradley
5 mm three-wire DC shielded with pico Q/D \$31.00	871C-D1NP5-P3 \$92.00
18 mm three-wire NPN DC shielded with 2 m cable \$19.00	872C-DH5NN18-E2 \$66.00
18 mm AC shielded with 2 m cable \$27.00	872C-A5N18-A2 \$77.00
30 mm shielded capacitive with 2 m cable \$64.00	875C-D10NN30-A2 \$150.00

AutomationDirect wins!

All prices are U.S. list/publication prices. AutomationDirect's prices are from Volume 8 Desk Addendum August 2003. Prices and specifications may vary by dealer and configuration. Allen-Bradley sensor prices from Publication C114-PL001C-EN-P November 2002. Prices subject to change without notice.

An automatic control system would be useless without sensors that provide the information necessary to make process decisions. *AutomationDirect* has the proximity, photoelectric, limit switches and encoders you need to sense the presence and position of objects in a variety of applications. Our high-quality switches come from high-tech manufacturers with years of experience developing and supplying reliable sensors under their own name and several brand names.

Proximity Sensors

- Inductive and capacitive technology
- 3 mm to 30 mm round with standard sensing distance
- 8 mm to 30 mm round with double/triple sensing distance
- Rectangular formats
- Stainless steel round models
- AC and DC supply voltages available
- 2-, 3-, and 4-wire output configurations
- Embedded cable and quick-disconnect styles



Starting at **\$15**

Starting at **\$30**

Photoelectric Sensors

- 18 mm threaded round, metal or plastic with diffuse, polarized retroreflective, through-beam or background suppression sensing
- Fiber optic capability
- Straight or right-angle optics
- Rectangular formats with diffuse, retroreflective, through-beam or background suppression sensing
- 5 mm threaded round in diffuse or through-beam styles
- 12 mm models offer teach-in calibration mode



Limit Switches

- IEC switches with eight standard actuators
- Heavy-duty die-cast aluminum models
- Double-insulated PBT non-metal body models
- Miniature PBT non-metal body models
- Six interchangeable combinations of contact blocks



Starting at **\$12**

Starting at **\$78**

Encoders

These highly reliable encoders perform angle, length-measuring, and position sensing in major industrial machinery and equipment worldwide.

- Incremental models from 3 to 2,500 pulses per revolution
- Absolute models from 32 to 1,024 pulses per revolution



Circle 1 on Control Solutions International RS Card

AutomationDirect

1-800-633-0405 www.automationdirect.com

Call or go online for your **FREE 1,300 page, product-packed catalog!**

For current specifications and pricing, check out our catalog or go online at www.automationdirect.com/sensors

© Copyright 2004 AutomationDirect, Cumming, Georgia. All rights reserved.

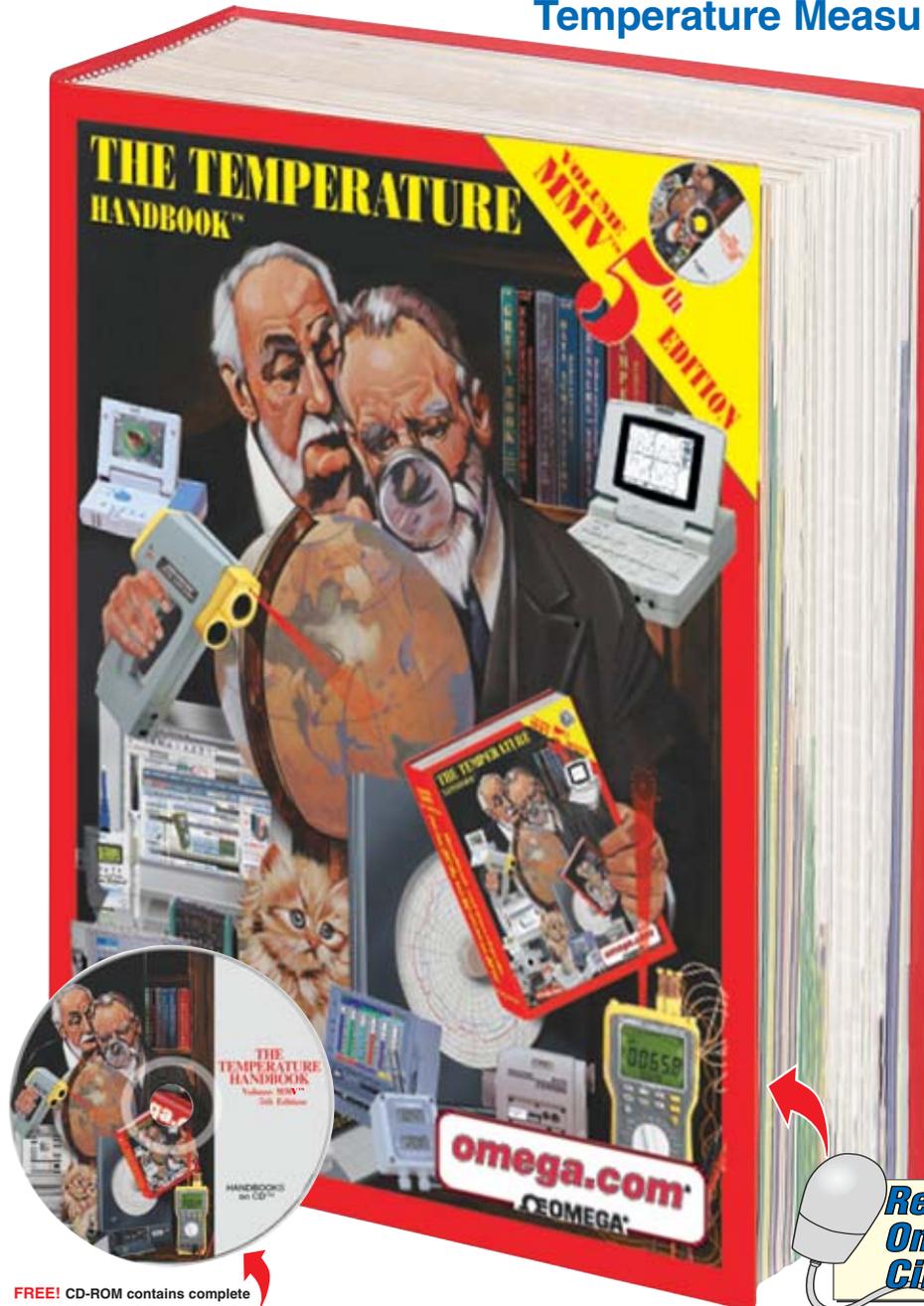
What's **NEW** at **omega.com**[®]

Featuring the Latest Technology and New Products in
Temperature Measurement and Control

Request your

FREE!

copy today!



- ✓ Thermocouples
- ✓ RTD's
- ✓ Thermistors
- ✓ Infrared
- ✓ Embedded Internet Controllers
- ✓ Paperless Recorders
- ✓ Test Equipment
- ✓ Calibration Services
- ✓ Handheld Instruments
- ✓ New Connector Designs
- ✓ Thermocouple Wire
- ✓ Data Acquisition
- ✓ Humidity
- ✓ Transmitters
- ✓ Panel Meters and Displays
- ✓ Technical Books and Articles

Request Literature Online: controllerdepot.com
Circle Number: 2

FREE! CD-ROM contains complete OMEGA[®] Library & Technical Data

Circle No. 3

omega.com[®]
Ω OMEGA[®]

Shop Online at
omega.comSM
Over 100,000
Products Online!

International Phone:
203-359-1660
International Fax:
203-359-7700



www.omega.com
info@omega.com



www.omega.ca
info@omega.ca



www.omegaeng.nl
sales@omegaeng.nl



www.omegaeng.cz
info@omegashop.cz



www.omega.fr
sales@omega.fr



www.omega.de
info@omega.de



www.omega.com
espanol@omega.com



www.omega.co.uk
sales@omega.co.uk

© COPYRIGHT 2004 OMEGA ENGINEERING INC. ALL RIGHTS RESERVED. Handbook Cover Art: Reproduced by permission of the Norman Rockwell Family Agency, LLC



- 4 Events
- 8 Sensor Update

NEWS OF THE WORLD

- 10 Sulzer AG chief to become ABB CEO in January 2005
- 10 New-age simulation engine from Singapore, new class of sensors from Europe to enhance factory operations, precision measurements
- 10 OMAC Packaging Guidelines could save P&G \$15 million/year
- 10 CSA and UL adopt expanded Memorandum of Understanding

EDITORIALS

- 6 **Editor's Notebook**
On past and future conversations
- 44 **Control Software Upload/Download**
Linux above and below the board

control solutions international

March 2004, Vol. 77, No. 3

Lyle Hoyt	VP/Group Publisher
Bill Cariello	Publisher
Ron Kuhfeld	Associate Publisher/Editor in Chief
Wayne Labs	Senior Technical Editor
Chris Mc Loone	Web Editor
Stephen M. Brown	Contributing Editors
Douglas J. Smith	
Matthew Peach	European Editor
Duane DaPron	Presentation Editor
Simon Lian	Editor, CSI China, Hong Kong
Carla Pitchlynn	Production Manager
Johann Bylek	Germany
Linda Thomas	Circulation Manager

Phone: +01-918-832-9254
Email: lindat@pennwell.com

Subscriber Service
Phone: +01-847-559-7501
Email: incs@omeda.com



POSTMASTER: Send address changes to Control Solutions International, P.O. Box 3298, Northbrook, IL 60065-3298.

REPRINTS: Control Solutions International articles are available on a custom printing basis at reasonable prices. For details contact Sherry Humphrey, PennWell Corp., 1421 S. Sheridan Rd., Tulsa, OK 74112. Telephone: 800-216-2079. © 2004, PennWell Publishing Co. **PERMISSION TO PHOTOCOPY** for internal use or the internal use of specific clients is granted by PennWell Publishing Company for libraries and other users registered with the Copyright Clearance Center (CCC), provided that the base fee of \$1.00 per copy of the article, plus 25 cents per page is paid directly to the CCC, 222 Rosewood Drive, Danvers, MA 01923. Special requests should be addressed to Ron Kuhfeld. (1074-2328 \$1.00+25 cents). **OUT-OF-PRINT COPIES** are available in complete volumes as positive microfilm copies from Bell & Howell Information & Learning, Inc., 300 N. Zeeb Road, Ann Arbor, MI 48106, 734-761-4700.

The Gale Group: This publication is included in a reference system from The Gale Group in one or more of the following formats: CD-ROM, microfilm, and on-line. For information regarding availability of this publication in The Gale Group products, call toll-free 800-227-8431 (U.S. only), or 650-378-5000, or write Information Access Co., Rights & Permissions Dept., 352 Lakeside Drive, Foster City, CA 94404. **Control Solutions International (ISSN 1532-1274) is published monthly by PennWell Publishing Co., 1421 S. Sheridan, Tulsa, OK 74112.** Periodical postage paid at Tulsa, OK and additional mailing offices. **Control Solutions International** is circulated free in the United States to qualified individuals. Nonqualified U.S. subscription rate is \$65.00 per year, \$120.00 for two years. Foreign and Canada rate is \$99.00 per year, \$198.00 for two years. We make portions of our subscriber list available to carefully screened companies that offer products and services that may be important for your work. If you do not want to receive those offers and/or information, please let us know by contacting Kelli Smith at List Services, 1421 S. Sheridan Rd., Tulsa, OK 74112.



{table of contents}

FEATURES

- 12 **SPECIAL REPORT—Batch Control**
Automated batch scheduling and MES integration ...
The author offers guidelines on implementing this integration using a hierarchical-based, batch control software architecture.
- 21 Machine Safety: Standards harmonization continues
- 26 Don't blame the control system before checking your smart transmitters
- 29 Mechanical factors take center stage in prox selection
- 31 Corporate Profiles
This Special Section details the product lines and capabilities of a number of key suppliers of instrument and control equipment, systems and software.
- 50 Photoelectric sensors: A solution for every application
- 54 Transformer monitoring system and wireless link tie legacy serial devices to Ethernet networks
- 57 Automated water management system reduces engine test bench shutdowns

OTHER DEPARTMENTS

- 60 Product Focus
- 62 New Products
- 63 Advertisers Index

control solutions international

MARCH 2004 • VOLUME 77

Batch Control
12 Special Report

COVER:

Today's automated batch control systems can offer end users improvements in product quality, reduced cycle time, and overall return on investment. Shown is such a system as applied at Harpoon Brewery—New England's largest craft brewer—located in Boston, MA. Harpoon installed a DeltaV automation system, from Emerson Process Management, to help it improve its brew house production efficiency and consistency without sacrificing its well-known hand-crafted quality. For more on the DeltaV, go to www.EasyDeltaV.Com. For more on current trends in batch control technology, turn to the article that begins on p 12.

ENGINEERS WANTED.



REGISTER NOW
Invensys & Microsoft®
Plant Intelligence
Conference
www.invensys.com/plantintel

TRY
ArchestrA[®]
TECHNOLOGY
ON-LINE
at www.invensys.com/ArchestrA

Fire up the PC today and test drive ArchestrA technology online.

Put the “engine” back into engineering. Take the hottest new industrial plant software out for a spin. You’ve heard how the ArchestrA™ software architecture accelerates application development. How it significantly increases scalability, flexibility and efficiency. Now test drive it for yourself—at home or anywhere, anytime you want—with our free online demo. Rev up your engineering skills by completing FactorySuite A²™ examples Built on ArchestrA™.



*Every system in your plant,
working in concert.™*

Wait until you get your hands on ArchestrA technology. You’ll not only accelerate application development, you’ll increase your edge whether you’re an automation or information engineer, SI, VAR or OEM. Pull out in front of the pack. Shift your career—and all your industrial apps—into high gear. With ArchestrA technology under the hood, there’s no limit to what you can do. Where you’ll go. Or how fast you’ll get there. **So start your engines at www.invensys.com/ArchestrA.**

invensys®

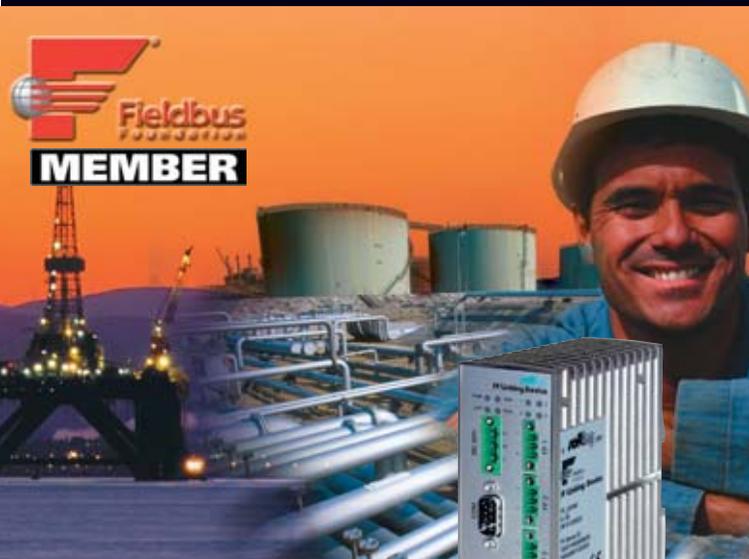
Circle 4 on Control Solutions International RS Card

©2004 Invensys Systems, Inc. All rights reserved. ArchestrA, Built on ArchestrA, Wonderware, FactorySuite, FactorySuite A², APV, Avantis, Eurotherm, Foxboro, SimSci-Esscor and Triconex are trademarks of Invensys plc, its subsidiaries and affiliated companies. All other brands may be trademarks of their respective owners.

control solutions
international



Be a Leader ...



... with Softing's Know-how and Experience

By counting on Softing, you select the premier communication solution that already powers a huge number of field devices on the marketplace.

Our proven and certified stacks for Field Devices or Link Masters feature even the most recent Fieldbus enhancements.

- Modular and scalable architectures for all design options.
- State-of-the-art engineering that meets your requirements and reduces integration time.

Softing is also a well-known supplier of high-performance Fieldbus components.

Our latest innovation includes a *FF Linking Device*, the world's first Linking Device supporting the complete set of features specified by the Fieldbus Foundation. Its advanced and system-independent Design allows

- extendet communication throughput in any control architecture and
- brings unprecedented flexibility to your system design.

Contact us.

Circle 5 on Control Solutions International RS Card

Softing AG
Industrial Automation
Richard-Reitzner-Allee 6
D-85540 Haar (Germany)
Contact Europe and Asia:
Phone : +49 (89) 4 56 56-340
info.automation@softing.com
www.softing.com
Contact USA:
Phone : +1 978 499 9650
info.usa@softing.com
www.softing.us

Competence in Automation

{events}

Hannover Fair includes Interkama, Factory Automation, plus much more

This year Interkama has been combined with the Hannover Fair 2004 to create a truly blockbuster



Deutsche Messe AG
Hannover · Germany

event. Also adding to the excitement will be seven more shows: Factory Automation, Digital Factory, Surface Technology plus PCE Powder Coating Europe, MicroTechnology, Subcontracting, Energy, and Research & Technology. The show will bring 6,150 exhibitors to more than 344,000 visitors. It all takes place in Hannover from Monday through Saturday, 19-24 April 2004.

INTERKAMA+ is set to play its part as a catalyst for growth as the EU trends towards expansion from 15 to 25 member states. Historically a Düsseldorf-based, standalone event, this trade fair for the process industry will this year debut under the Hannover Fair, generating synergy benefits between the production automation and process automation display areas.

The Fieldbus FOUNDATION™ and Hannover Messe are planning a major exhibition of FOUNDATION™ technology and applications at Interkama 2004. In addition to the live device "Wall of Fame," member host system kiosks and "Solutions Centre," an extensive program of key events and activities are planned. The Fieldbus Foundation will hold its European End User Council (EEUC) meeting on Wednesday 21st April, to which end users, systems integrators and engineering contractors are invited to attend. EUC meetings provide a vendor-neutral forum in which end users can discuss technology issues, share implementation experiences, exchange practical tips and voice any concerns.

For details, visit <http://www.hfusa.com> or <http://www.hannovermesse.de>. ■■■

MAY

12-16 ITM 2004: 18th Malaysian Intl Tradefair,

Putra World Trade Center, Kuala Lumpur, Malaysia, itm@oesallworld.com.

16-19 World Batch Forum, Chicago, IL, www.wbf.org

JUNE

16-18 Design Engineering & Manufacturing Solutions,

Tokyo, Japan, 81 3 3349 8501, www.reedexpo.co.jp/dms

15-18 Automatica, New Munich Trade Fair Centre,

Germany, <http://www.automatica-muenchen.de/>

REGISTER NOW
Invensys & Microsoft
Plant Intelligence
Conference
www.invensys.com/plantintel



Another giant step.
Plant intelligence without limitations.
We'll change the way you view panels and tablets.

Now you can extend the power of Wonderware everywhere.
Save a bundle with our new industrial tablets and touch panel computers.

Extend the power of Wonderware in places you never thought possible with our new industrial tablets and touch panel computers. They're rugged, inexpensive, and bundled with the feature-rich InTouch® HMI and extensive I/O connectivity. Loaded with 8 times more memory and 2-4 times more processing power than ordinary displays, you'll get unlimited plant intelligence for the price of a dumb panel.

Now you only have to deal with one operating system, one powerful software toolset, legendary ease of use, and one trusted vendor for all of your plant display needs. As a result, our solutions are 50% easier to support and maintain. And because each offering integrates

into the Archestra® software architecture, you'll gain maximum room for future growth—while benefiting from high engineering productivity and application software re-use.

More functionality. Higher productivity. Future-ready. Low bundled price point. It doesn't take a rocket scientist to see why Wonderware is the intelligent choice everywhere.

Seeing is believing. Visit promos.wonderware.com/5C3 for a presentation that will change the way you view panels and tablets. Then, take the next giant step and call your local Wonderware distributor.



Wonderware Touch Panel Computer (on left).
 Wonderware Industrial Tablet (docking unit not shown).

promos.wonderware.com/5C3



Circle 6 on Control Solutions International RS Card

©2004 Invensys Systems, Inc. All rights reserved. Invensys, Wonderware, Archestra and InTouch are trademarks of Invensys plc, its subsidiaries and affiliated companies. All other brands and product names may be the trademarks of their respective owners.

Powering intelligent plant decisions in real time.

On past and future conversations

Ron Kuhfeld, Editor in Chief

W

hen I began working for this magazine in 1975, I knew little about instruments and controls and less about engineers. Back then, anyway, engineers had the reputation of being introverted, singularly focused, and of always coming equipped with a slide rule that they never let out of their sight. But I had no first-hand knowledge of any of this, and was at least smart enough to ignore stereotypical characterizations.

In the past three decades I've had the pleasure of working for, and with, engineers on our editorial staff, and of getting to know a number of you—our engineer readers. Moreover, I've had the opportunity to interview countless product and system design engineers, application specialists, and engineering managers from a host of instrument and control vendor organizations. I've come away from these experiences with a very different picture of those of you who diligently practice the science (and art) of engineering.

Far from being introverted, most of you are quick with a handshake and first on the bus headed for the evening's social event at seminars and conferences. And as for your being singularly focused (or technology consumed), well, that's just nonsense. You're an extremely bright group of individuals with interests as varied as they come. Music, art, economics, sports, politics and, yes, more politics are always hot topics at the confer-

ence luncheon tables. Granted, if the topic of discussion is a technology that's near and dear to you, the level of detail you're willing to provide has been known to exceed a listener's "setpoint." However, your enthusiasm is so refreshing, who would dare to dampen your spirit by requesting the *Reader's Digest* version?

Which brings me to one of your most impressive traits—dedication to your profession and the pursuit of engineering truths. In a poll recently conducted of a few thousand members of The Institute of Electrical and Electronic Engineers (IEEE)/IEEE-USA, in conjunction with the *IEEE Spectrum*, only three percent of those surveyed (including working engineers and other technical professionals and student members) said that money was their most significant reward. Three out of four respondents said that what really turned them on was inventing, building, and designing new technologies. Of almost equal importance was solving real-world problems.

One out of five said that they enjoyed how their profession allowed them to "have a positive influence on the environment." Some 40% of the working members said that they had volunteered in the community by talking to students in a classroom or helping at a science fair. Two out of three student members said that they had done so. And on average, one out of every three members surveyed said that they had volunteered as a mentor to young people.

All in all, you are an incredible group of individuals who care deeply about what you do for a living as well as the world around you. You love to help others, and thrive on challenge.

My association with you through the years is something I will cherish forever (yes, even the times when you wrote in to correct the math in my columns). Sadly, that association must end for now. The continued slowdown in the manufacturing industries has taken its toll on this 76-year-old magazine, and PennWell is suspending publication of *Control Solutions International* indefinitely. Hopefully, our paths will cross again in the near future and we can begin anew our conversations about the fascinating world of instrumentation and control. In the meantime, keep those slide rules handy (oh, I know many of you still have them stashed away, just in case), and thank you for your loyalty and, in so many cases, friendship. Take care....



{editor's
notebook}

Automation & Control

Simply more advanced

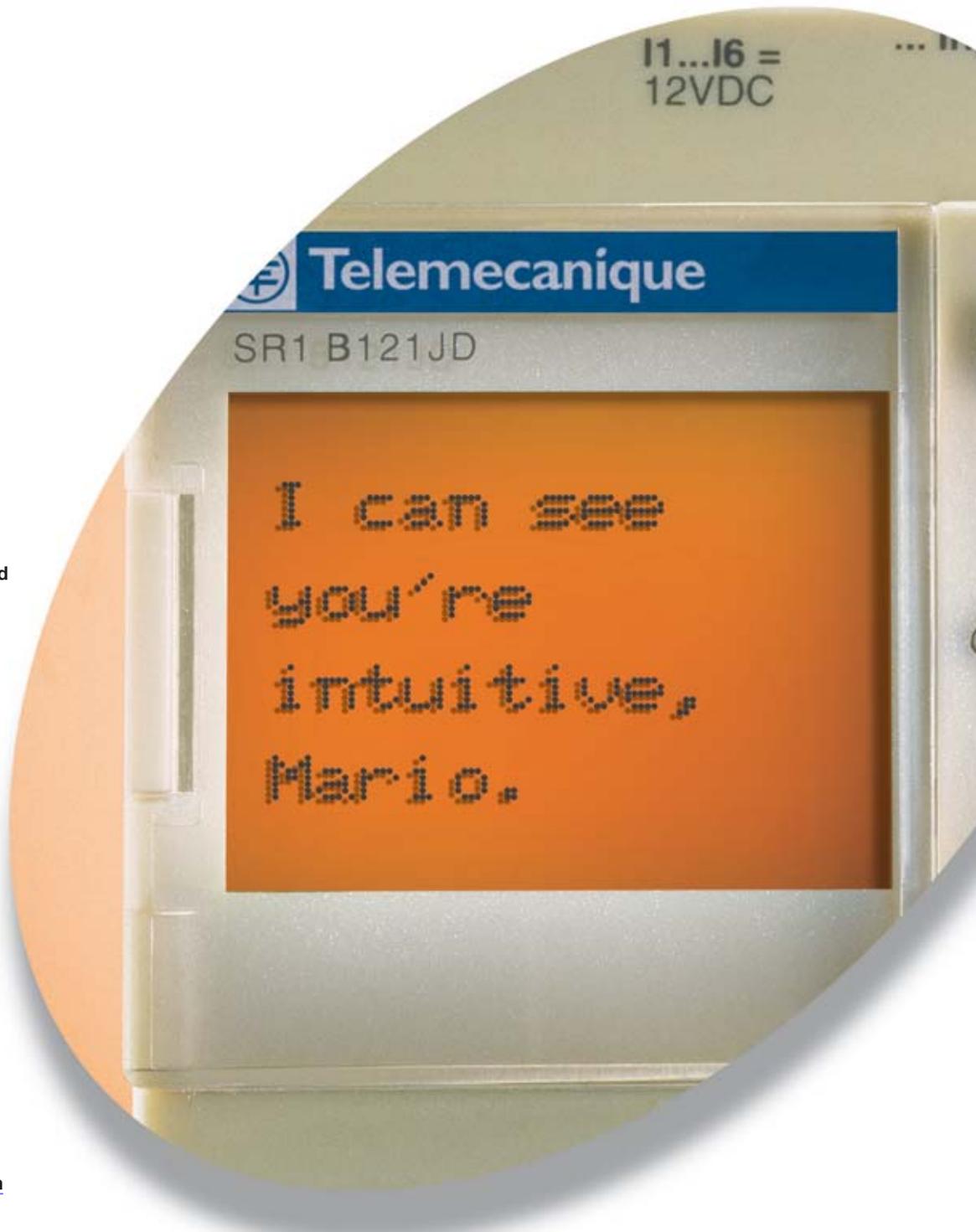
Simply Smart

all the simplicity you need
with Telemecanique.

Simplicity is a basic feature
of Telemecanique's
Simply Smart components:

- easy selection among a limited number of references, optimum and cost-effective offers for standard needs
 - easy-to-understand products for all users, from electricians to automation specialists
 - intuitive programming, with easy data entry.
- Simply Smart like the Telemecanique Zelio Logic smart relay. Program directly using familiar contact symbols, manage applications using SMS messages...

www.telemecanique.com



Circle 7 on Control Solutions International RS Card



Prox has extended range

The E2A sensor is available in more than 220 models, allowing users to choose the exact configuration they need. Sensors come in M8, M12, M18 and M30 sizes in shielded or unshielded construction, NPN or PNP output, a range of barrel sizes and materials, and a choice of wiring options. Sensing distances range from 2.0 mm to 30 mm. The sensor's thicker housing minimizes damage from over-torquing during installation, and fully vacuum-potted construction eliminates air pockets that can cause thermal, moisture or vibration failure.



—Omron Electronics LLC, www.omron.com.

Circle 120 on Control Solutions Int'l RS Card

13 mm pressure sensor

The 13 mm Series stainless steel isolated pressure sensors are designed for high pressure applications, and are well suited for the measurement of hostile media, such as corrosive liquids or gases in harsh industrial environments. They are designed for, but are not limited to, industrial and hydraulic controls and tank pressure measurement applications. The sensors are available with pressure ranges from 500 psi through 5,000 psi, and can be used with voltage or current supplies.



—Honeywell Sensing, www.honeywell.com/sensing/promo/pr13SS.

Circle 121 on Control Solutions Int'l RS Card

Submersible low pressure transducer

The PXM79 Series transmitter is a submersible low pressure transducer suitable for liquid level and depth measurement. Its stainless steel housing and Inconel® diaphragm make it suitable for immersion in most industrial fluids. A 15 meter (50 ft) vented cable (longer lengths available) provides an atmospheric reference. Each transducer is shipped with a moisture trap that prevents moisture from entering the vent tube.

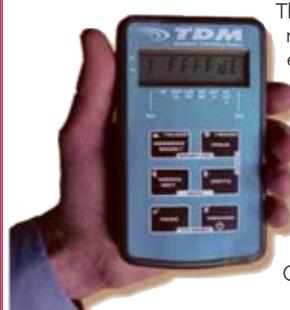


—Omega Engineering, www.omega.com/pptst/PXM79.html.

Circle 122 on Control Solutions Int'l RS Card

{sensor update}

Radiotelemetry for strain gages



The TDM is a completely portable, precision instrument packaged in a small, robust IP65/NEMA 4 enclosure with a radio transceiver for communicating with all the company's remote telemetry strain gage devices. It reads gross/net and offers peak and trough capture and various calibration modes. The transceiver can select up to 20 instruments, meets IP65/NEMA 4 specs, has 7½ digit LCD display with eight status annunciations, provides up to ten updates/second, and is compatible with UK, USA, and Canada radio specifications.

—Celsum Technologies Ltd., www.celsum.com.

Circle 123 on Control Solutions Int'l RS Card

FM-approved TDR level gauge

The FM-approved Microflex BM 102 level gauge—a two-wire time domain reflectometry (TDR) device—is suited to liquid and solid applications in chemical, water and waste water, and all process industries. It has a measuring range of 80 feet on liquids with an accuracy of ±0.4 in. of measured value, and 40 feet on granulates and powders with an accuracy of ±0.8 in. of measured value. It is immune to dust, vapors, temperature, pressure, and product density or stratification changes.



—KROHNE, <http://www.krohne.com>

Circle 124 on Control Solutions Int'l RS Card

Submersible absolute linear encoder

The Spherosyn® IP67-rated absolute linear encoder offers accuracy to 3.0 microns and resolutions to 0.1 micron. With a travel length of 9.25 meters and a travel rate of up to 60 meters/s, the encoder is suited to linear motor and other high velocity measurement applications, including CNC feedback, pick and place machines, automotive transfer lines, packaging machines, printing machines, PC-based systems (no interface cards required), and more.

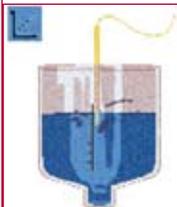


—Newall Measurement Systems, Ltd., www.newall.co.uk.

Circle 125 on Control Solutions Int'l RS Card

Level measurement for solids, pastes

TRUE level sensors work in containers and pipes of metal or conductive material and sense levels of liquids, pastes, and bulk goods. The system consists of a KFS-1 sensor and a KFA-1 electronic evaluation unit, and automatically compensates for changing dielectric constants. The sensor probe can be used with temperatures from -40° C up to +200° C. Products with dielectric constants greater than 1.2 (including coarse-grained material) can be measured. The sensor measures 16 or 20 mm (PTFE) dia and is also available up to 2 m in length.



—Rechner Industrie-Elektronik GmbH, www.rechner.de.

Circle 126 on Control Solutions Int'l RS Card

Portable trace oxygen analyzer

The battery powered Series 3520 portable trace oxygen analyzer features a long life electrochemical sensor. Measuring ranges from 0-10,000 PPM to 0-50 PPM are available. The analyzer may be equipped with a number of options including: sample pump, in-line filter, pressure regulator, block and bleed, and flow meter. The Series 3520 is lightweight and ideal for spot measurements. Applications include gas manufacturing, heat-treating, chemical and petrochemical production, welding, etc.

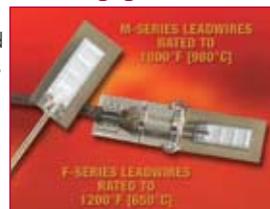


—Alpha Omega Instruments, www.aoi-corp.com.

Circle 127 on Control Solutions Int'l RS Card

High-temperature weldable strain gages

These high-temperature weldable strain gages are optimized for testing applications, such as stress analysis, with a temperature rating up to 980 °C (1800°F). They are free-filament wire devices that have been pre-bonded to shim stock with flame-sprayed alumina. As a result, the new gages are easy to install in the field, especially on large structures, through welding to the test structure with a capacitive discharge spot welder. All configurations feature nominal resistance of 120 ohms, a sensor gage length of 0.25 in., a shim length of 0.50 in., and a shim width of 0.30 in.



—Vishay Measurements Group, www.vishay.com.

Circle 128 on Control Solutions Int'l RS Card

control solutions international

Automation & Control

Automatically more open



Simply Smart all the openness you need with Telemecanique.

Openness is a basic feature of Telemecanique's Simply Smart components:

- compliance with fieldbus, connection system and software standards
- remote supervision via the Internet with "Transparent Ready" products.

Simply Smart like the Telemecanique TeSys model U, the first product that combines both motor starter and control functions, adapts to standard buses and allows you to monitor applications transparently over the web...

www.telemecanique.com

Circle 8 on Control Solutions International RS Card



{news of the world}

Sulzer AG chief to become ABB CEO in January 2005

Zurich, Switzerland

Fred Kindle will become the next chief executive officer of ABB Group, replacing Jurgen Dormann. Kindle, who is currently chief executive of Swiss-based technology company Sulzer AG, will join ABB on 1 September, 2004



and formally take over as CEO in January 2005.

Dormann, who has been CEO since September 2002, will revert to the

role of chairman in January.

As CEO of Sulzer AG, Kindle led the company through a period of strategic realignment. He has been with Sulzer AG since 1992. In 1999 he became responsible for Sulzer Industries, before being appointed CEO of Sulzer AG two years later. ■■■■

New-age simulation engine from Singapore, new class of sensors from Europe to enhance factory operations, precision measurements

United Kingdom and Palo Alto, CA

A new-age simulation engine that remotely controls factory processes in real time using data from sensors is likely to be the next big thing in assembly line operation management, says a new analysis by Technical Insights (<http://www.Technical-Insights.frost.com>), a business unit of Frost & Sullivan.

The engine's visualization tool helps cut interferences from human errors, inadequate materials, or logistic planning gone awry by virtually representing the manufacturing facility for itemized monitoring.

The sensors read the changes on the factory floor and convert them into data for a configuration event analyzer that converts it into

3-D animation events. To facilitate system improvements, the engine's Singapore-based inventors have also built a new visualization device that enables even novice users to operate the machine.

For the system to be fully effective, discrepancies in the visualizers' predictions and the data relayed by the engine will have to be sorted out. Interaction techniques are vital because the modifications made on the simulated model will be carried out on the actual factory floor.

"Scientists are working on new techniques that will display confirmed, predicted, and corrected states in a single cyber model," says Technical Insights Analyst Anand Subramanian.

Meanwhile, in Europe, a new class of sensors called contactless capacitive angular-position sensors with accuracy of up to 0.03 degrees variation over a full-circle range has given industrial precision applications a shot in the arm. These sensors can detect angular positions for any application, and even measure linear positions by combining linear movement and angular sensing.

With capacitive sensors using superior dielectric rotors, researchers are considering them as an alternative to the more prevalent optical encoders in select applications. The easy design of the electronic interface also permits uncomplicated production, as it can be assembled using off-the-shelf components. ■■■■

OMAC Packaging Guidelines could save P&G \$15 million/year

Orlando, FL

During a talk at the OMAC



(www.omac.org) 2004 meeting in Orlando, Procter & Gamble's Skip Holmes, associate director for power, control and infor-

mation systems, said that his group's involvement with the OMAC Packaging Guidelines could save P&G \$15 million annually by increasing reliability, quality, capacity, and speed to market.

He then challenged the users

group to continue to focus on solving business problems, to communicate the benefits broadly and in business terms, to expand the number of participating companies, and to drive the Guidelines toward industry standards. ■■■■

CSA and UL adopt expanded Memorandum of Understanding

Toronto and Northbrook, IL

CSA International and UL adopted an expanded Memorandum of Understanding (MoU) and completed the first phase of a mutual acceptance program for

electrical components, the first milestones of an agreement the organizations signed 10 Nov. 2003.

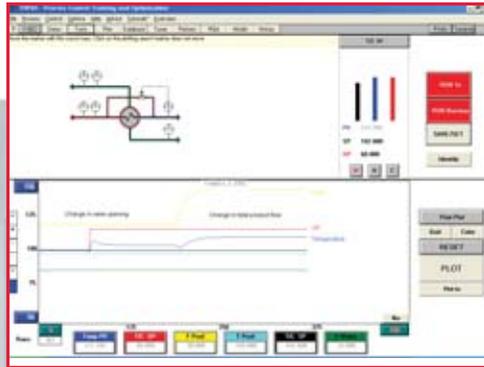
The expanded MoU covers 50 additional component and 11 additional end-products categories, plus

the 13 product categories covered in the original 1996 MoU, allowing manufacturers to obtain both UL and CSA certification and listing with a single product test conducted by either company. ■■■■

TOPAS

Process Control Assistant and Know-how Resource

The most comprehensive, award winning toolset that has proven to enable better results in shorter time, for training and for daily, practical work. Main functions: Operating data import & performance analysis, process parameter estimation, PID tuning / optimization / troubleshooting, decision aid single loop / cascade / MV control.



ACT

actgmbh@compuserve.com
<http://www.act-control.com> (see "tools")

A 7400 Oberwart, Austria
Brussels office: Madeliefjeslaan 13,3080 Tervuren, Belgium
Phone and fax (32)-2-767-0895

TOPAS is an excellent training aid that has been proven to cut training time and improve the results—all at the same time. It helps newcomers learn process dynamics, signal treatment and feedback control. It enables experienced users who haven't yet applied Advanced Control to explore its potential and put their theoretical knowledge to effective, practical use.

Study different process types in depth and learn how to control them, including the effect of key process variables, equipment size, valve characteristics, measurement locations, etc. Current process examples include flow, level (vertical/horizontal drum), temperature, pressure, pH, ratio, a generic SISO process, and 2x2 interacting process. Many built-in demonstrations show process and loop behavior under

the various influences and provide advice regarding controller selection and tuning. Choose between analog or digital control, different sampling/control intervals, or linear/nonlinear filter. Explore bumpless mode transfer, the use of clamps (absolute/speed), etc.

TOPAS helps experienced users, in a much shorter period of time, to:

- ▶ Optimize the performance of existing controllers, test them for disturbances (impossible to do on the real process).
- ▶ Bring underperforming or decommissioned loops back to work.
- ▶ Develop new high payout standard or advanced controls and find the best approach in a safe, productive environment.
- ▶ Refresh and practice seldom used or more difficult techniques.
- ▶ Present their achievements in hard

incentive figures!

TOPAS provides a wealth of features not found in any other tool:

- ▶ Process parameter estimation—from both open and closed loop tests.
- ▶ Performance measurement—run a test of imported plant data and calculate ITAE, standard and average deviation, consumption of the resource, etc.
- ▶ Calculation of the credits from improved control: Present your achievements in hard money figures!
- ▶ A PID Tuner with several methods for different scenarios and requirements (setpoint/load tuning, tight or average level control).
- ▶ Relative Gain Analysis (RGA) for interacting processes.
- ▶ Expert advice on controller selection, tuning and troubleshooting.
- ▶ An extensive Glossary.

Circle 9 on Control Solutions International RS Card

Automated batch scheduling and MES integration ...

after years of advancement in the batch control industry, today's automated batch control systems offer end users improvements in product quality, reduced cycle time, and overall return on investment. However, benefits derived from automated batch scheduling and MES integration have thus far gone largely untapped in the actual control system. In general, batch scheduling and MES integration have been left to customized solu-

tions developed on a site-by-site basis (due to both plant variability and lack of support in the underlying control system).

This article will address recently developed technologies that begin to incorporate the batch scheduling and integration layers in the control system, while maintaining the flexibility needed for customization of the existing hierarchical architecture. Along with a description of the solution, we'll show real-world examples, including the results and lessons learned.

S88 and S95

The benefits of standards such as ANSI/ISA-88.01-1995¹ and ISA-95.00.01-

2000² are well documented and understood by users and vendors alike. Both have had a substantial influence on the direction of batch process control technology development and its implementation. Over the past several years, suppliers of all types of control systems have incorporated the ideas and models defined in S88, which has allowed batch control projects to be completed and validated in a much more cost-effective, consistent, and timely manner. S88 goes a long way toward providing the batch industry with a firm foundation for mapping the physical plant model to the logical and functional hierarchy seen in most user production facilities (see Fig. 1). This mapping has found its way into almost every modern day control system, witnessed by the inclusion of common terms such as unit procedure, operation, equipment phase, and process cell in the typical configuration and run-time operator interface tools provided by these systems.

Control systems have yet to have the same type of success or vigor in including the S95-defined higher-level functionalities like production scheduling and enterprise system integration. One of the many reasons for this is the relative newness of the S95 standard—but the fact remains somewhat surprising, since these higher level functions can often lead to substantial productivity improvements and cost savings.

Batch production scheduling advancements

The automation included in today's batch control systems usually involves converting one or more master recipes into a

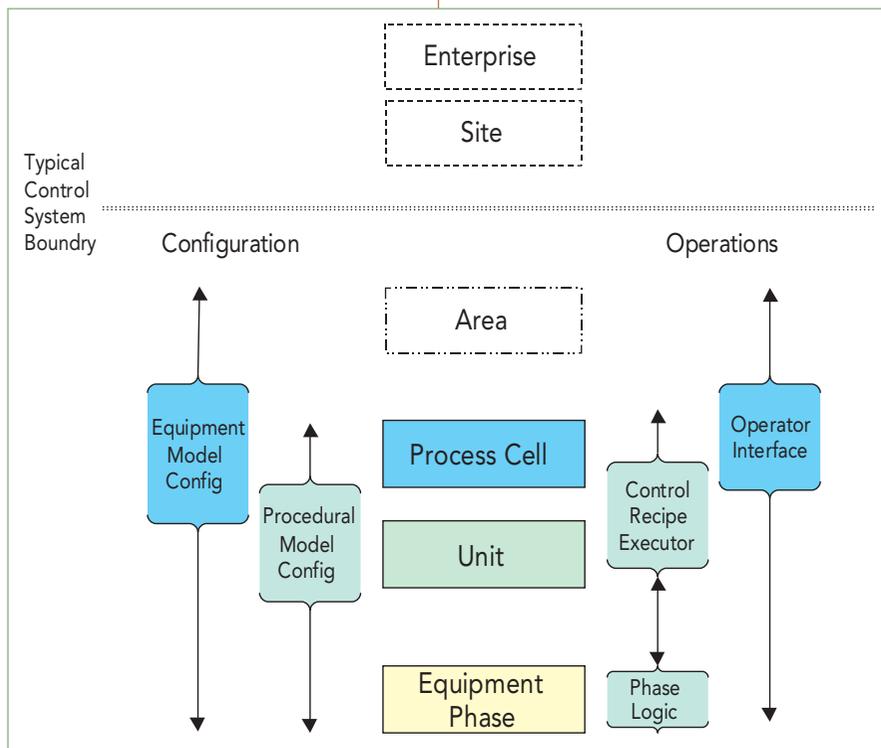


FIG. 1: Typical mapping between S88 Physical/Procedural Models and current control systems.

Nathan Pettus, Senior Principal Engineer, MSE,
Emerson Process Management, Austin, Texas 78746
Dieter Wolf, Information Scientist, Senior Head of Dept., Process Control Systems,
Heinrich Huppmann GmbH, Kitzingen, Germany

... using a hierarchical-based, batch control software architecture.

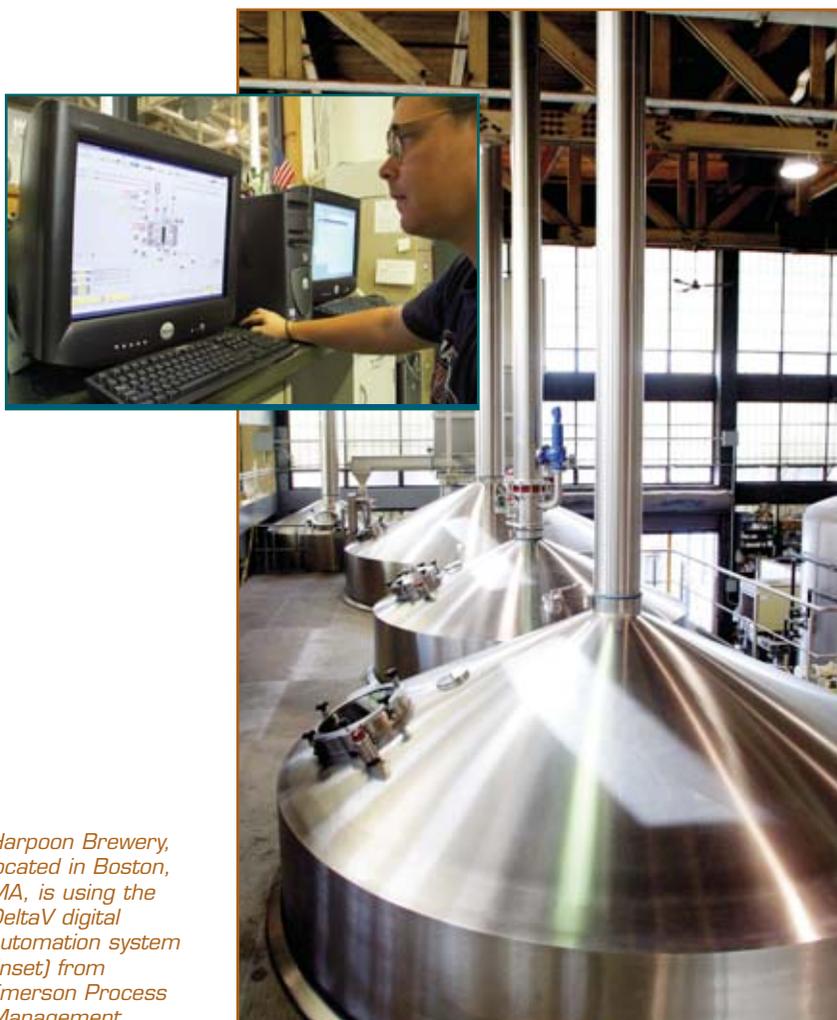
loaded and running control recipe(s), and coordinating the execution of the recipe's operations across the underlying physical equipment of the plant. The extent of production scheduling capability usually revolves around plant operators translating written production orders into manually instantiated batches running under the supervision of the control system across production lines.

Batches are usually started and monitored manually via control system displays, and the decisions regarding equipment selection and execution order are typically made by humans, either at runtime by operators or during configuration of the master recipe by plant engineers. Other than features like operator prompting and dynamic unit selection, typical batch execution provides little out-of-the-box capability in regard to higher-level production scheduling.

Campaign management

Many users take advantage of the concept of campaigns (i.e., a logical grouping of individual batches typically based on a common recipe) for both scheduling and material tracking purposes. In fact, one of the most frequently developed custom applications on top of the underlying batch automation software is some type of campaign management support system. Considerable effort is devoted to building these custom applications, all of which usually include one or more of the following features:

- Higher-level grouping of batches



Harpoon Brewery, located in Boston, MA, is using the DeltaV digital automation system (inset) from Emerson Process Management.

{special report}

{special report}

having common characteristics (recipe, lot, ID, etc.);

- Provides scheduling capability of batches based on production capability (readiness of resources, material availability, start/end time, etc.);
- Tracks additional information regarding campaign events in Batch History;
- Interfaces to other production systems for material tracking.

All of the above require a lot of custom development, which leads to extensive testing and validation by the application team. Due to its commonality and because of the cost savings associated with project execution time, the campaign management and scheduling concept is a perfect candidate for inclusion in the control system itself. One such implementation, which leverages the existing hierarchical structure of an S88-based control system, is shown in Fig. 2. As you can see, the campaign management module resides above the batch executive layer and, therefore, can raise the realm of the batch

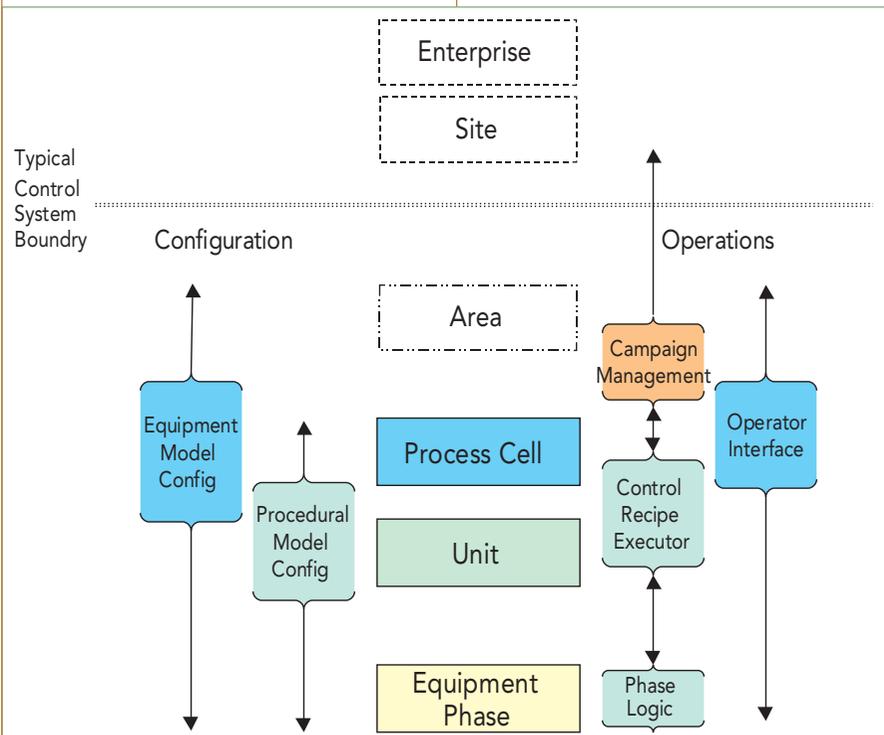


FIG. 2: Extended control system functionality to the above area level using campaign management.

control sub-system up one level in the S88 hierarchy by managing campaigns across executives and/or areas.

The inclusion of campaign management in the control system advances the batch control architecture in several ways. First, as Fig. 2 shows, it advances the

reach of the batch system one level higher in the S88 hierarchy. Whereas most control systems preside over the process cell and lower equipment levels, having a software module above the recipe executor allows the batch subsystem to extend up to, and slightly above, the Area level of

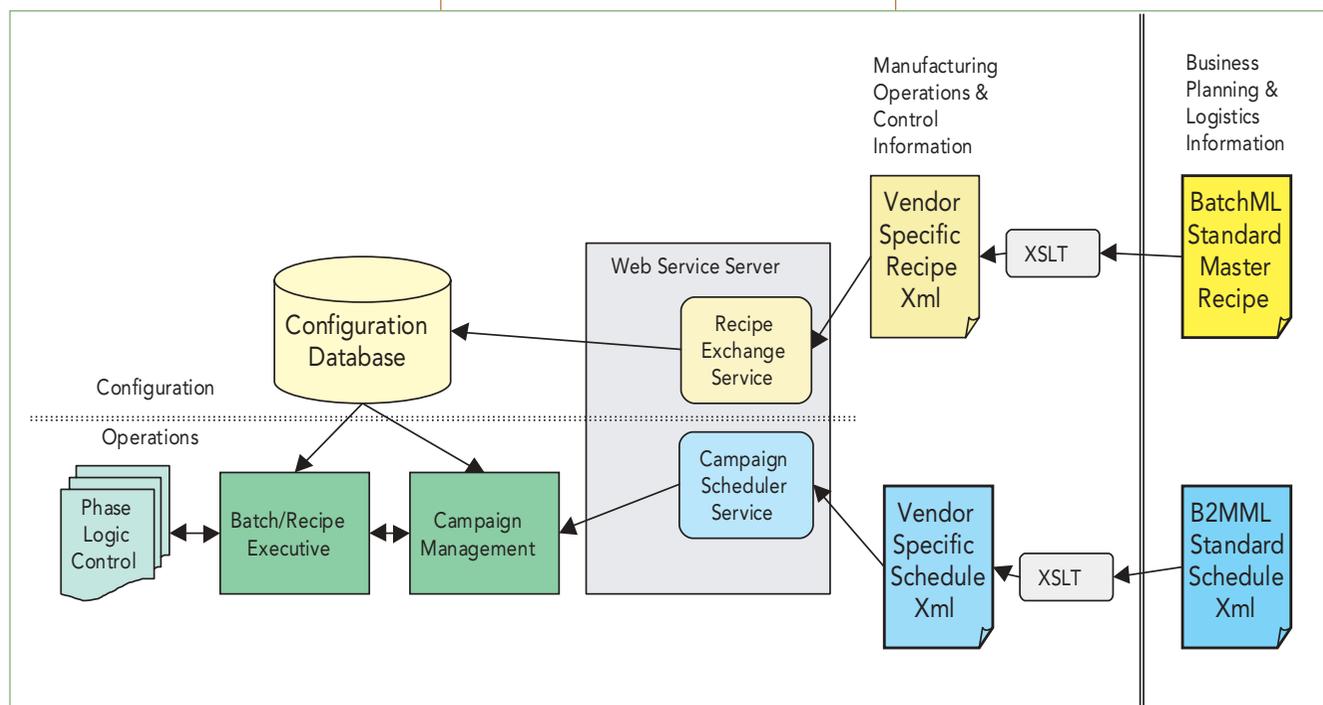


FIG. 3: Graphical depiction of example integration strategy using BatchML/B2MML documents and Web services.

{special report}

the model. This step allows more flexible recipe design, including bridging areas of the plant previously left disconnected.

In fact, if you think of a campaign as a "batch of batches" rather than simply a collection of like batches, the campaign management module can easily be seen as a batch executive coordinator. Under this scenario, the higher-level of coordination can quickly open up an extremely powerful, new level of recipe, which begins to work much more like a transaction-based manager of interrelated steps that involve an almost limitless type of operations (e.g. pager/email notifications, material database and tracking capabilities, human resource integrations, etc.).

In addition, the module introduces an automatic, production scheduling capability into the control system. Typically, the control recipe executor is managed by a human operator who manually creates batches based on written production schedules, then manually starts each batch when told to do so. Once the batch has completed, it is up to the operator to repeat the process in a similar, yet potentially less-than-optimal, manner.

With the higher-level campaign management module in place, several new campaign auto-modes are introduced. By default, all campaigns are created in a manual mode, which, like the standard practice, leaves all batch creation, execution, and removal to the operator's command. In this case, other than the grouping of batches into a campaign, little is different from what was possible before.

However, campaigns can be placed into automatic modes, in which batches are automatically created, started, removed, or any combination thereof by the campaign manager so that the batches in the campaign are completed in the most efficient manner possible from a temporal perspective. Having this process done automatically insures that as little dead time as possible is incurred, thus minimizing unavailable capacity. It also maximizes the use of equipment by giv-

ing control to the underlying recipe executor's equipment arbitration scheme as quickly as possible. Finally, as will be discussed in the following sections, the campaign management level functionality can be exposed and opened for customization by way of a programmable Application Programming Interface (API). This customization has allowed even greater flexibility to develop still higher-level

scheduling intelligence on top of the campaign module's existing capabilities.

Implementation of higher-level production scheduling algorithms

One of the biggest benefits of incorporating campaign management and its associated basic scheduling capability directly into the control system is that it allows further development around production



Vaisala's HMP230 Series of 1% RH, fixed Humidity and Temperature Transmitters

For spot-checking and field calibration of fixed instruments – grab Vaisala's HM70 Hand-Held Humidity and Temperature Meter

- choice of probes
- graphical/numerical display
- data logging
- high chemical tolerance
- accurate, reliable, stable
 - even in extreme conditions

Call, E-mail or visit our website for details.

www.vaisala.com

Vaisala Inc.
 Toll Free: 1-888-VAISALA (824-7252)
 Fax: 781-933-8029
 E-mail: incsales@vaisala.com



Circle 10 on Control Solutions International RS Card



{special report}

scheduling, since the basics are automatically provided. Because the control system exposes all of the functionality and features provided by the campaign management module through a programmable API, plant application engineers can concentrate on even higher-level scheduling layers, rather than the more mundane details of campaign management support. This is exactly what was done with the batch automation solution for breweries discussed below³.

The advanced brewing scheduler is

brew lines, one batch will be started a fixed time after the previous batch was created and instantiated. This allows for better equipment usage, and somewhat minimizes the amount of time any one batch waits unnecessarily for required processing.

- **Minimized delay:** In this mode, the next batch to be started is run as soon as the equipment vessel it is waiting for becomes available. This provides the optimum in regard to minimizing the wait time for shared equipment vessels.
- **Rule-based CIP Batches:** The advanced production capability

prise Resource Planning (ERP) integration standpoint. Here is where the more recent S95 and accompanying XML schemas and documents provide the most value. Like S88 before it, the S95 standard gives vendors a common and complete model for the way in which many facilities manage the various functions that make up batch production. In particular, the BatchML⁴ and B2MML⁵ documents provide a means for vendors to begin exposing XML-based tools that allow information to be incorporated into both the configuration and run-time side of the control system. Coupled with technologies like web services, these new features allow users to take advantage of control system capabilities with very little customization effort, and with absolutely zero API-level coding involved.

OPC and custom APIs—first generation integration

Obviously, third-party applications and services have been layered on top of control systems for many years, to which the success of many real-time historians, production schedulers, advanced control systems, and maintenance integration packages can attest. Over the last five to ten years, this layered integration has relied primarily on some type of API-based interface to the underlying control system's data. Depending on the system, the API might require/allow any number of programming languages to be used, but invariably and by definition, API interfaces require extensive programming. Typically, this programming is not of a trivial nature, and, therefore, often needs one or more knowledgeable professionals to carry out the work of development, testing, and validation. To make matters worse, usually each vendor would have its own proprietary API, which could change between releases, thus breaking any previously-developed integration strategies.

In the mid-1990s, with the development of OLE for Process Control (OPC)⁶, the integration of control systems took a step forward due to a standard interface regardless of vendor or release. However, even with these advancements, the programming effort remained substantial, and

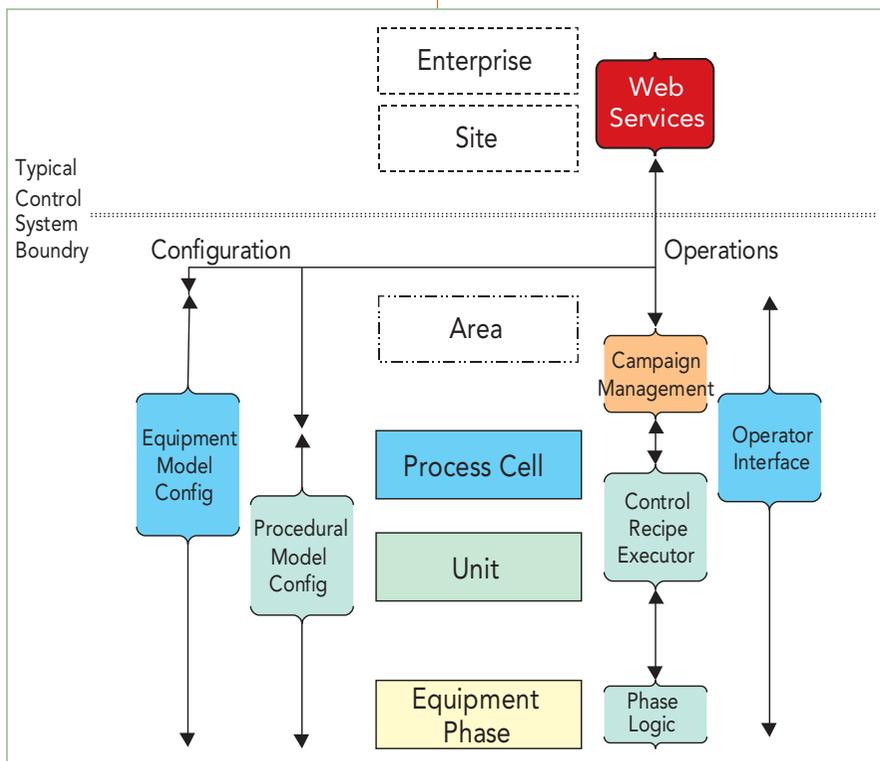


FIG. 4: Extended control system to the site/enterprise level using Web services.

tightly integrated into the underlying control system by way of the provided API on top of the campaign management module. This allows the overall solution to extend the scheduling capability of the control system by adding several advanced, higher-level modes:

- **Fixed delay:** Depending on the brewing vessel with the longest process time (normally, the lauter tun) or depending on required synchronization between several

allows cleaning batches to be added to the production schedule by using generic rules (e.g. perhaps automatic insertion of a CIP batch 'x' after every 'n' brews on vessel 'y').

Integration advancements

With the previously noted advancements in the control systems' capability to perform higher-level scheduling, similar developments are enabled from a Manufacturing Execution System (MES)/Enter-

{special report}

in some respects became even more difficult. (One of the side-effects of standard interfaces is that rules must be followed, and in the case of OPC, many users and vendors found the rules very difficult to understand and adhere to consistently.)

Integration problems such as these are not unique to the control industry. As a result, for many of the same reasons, companies have strived for, and developed, a better solution over the past few years. The next generation integration capability will leverage what are called web services, and it is this type of technology that is beginning to make control system integration much more readily accessible.

XML and Web services—Next generation integration

With the proliferation of the Hyper-Text Transport Protocol (HTTP) and XML, software integration has taken a dramatic turn toward a new technology built on these premises called web services⁷. Essentially, web services allow organizations to expose all types of functionalities to any other interested party simply by exchanging XML documents.

Using this technology to facilitate control system integration is the next logical step to ease some of the problems discussed in the previous section. Combined with web services, the S95 standard, the BatchML document, and the B2MML common schema provide almost all of the necessary tools to open up the underlying control systems scheduling and production capability with minimal programming effort. For example, Fig. 3 depicts a real-world implementation of these technologies being used together to bridge what the S95 standard terms the Manufacturing Operations & Control Information (MO&C) and the Business Planning & Logistics Information (BP&L).

As can be seen in the figure, at some level of the enterprise, an ERP system(s) generates two S95 standard based XML documents—the Batch ML master recipe document and the B2MML pro-

duction document. Because these standard XML documents are fixed and known to conform to a set of released schemas, all that is required to rearrange the information into the vendor specific documents is to pass the standard XML through two vendor-provided XML Style sheet Transformations (XSLT)⁸. Once in the vendor specific format, the information is passed directly to individual web services, one to handle recipe exchange and the other to actually schedule a campaign for production.

The recipe exchange web service allows for master recipes developed in an external tool or application to be imported into the control system's configuration database with no programming other than that required to generate the XML document. Once the BatchML recipe document has been translated by the associated XSLT transformation, the recipe exchange web service adds the recipe to the control system's database and then can download the recipe to the batch executive for run-time operations (this step can be configured to require manual intervention if wanted).

Thermal-Ribbon RTD's fast response surface sensing



Thin, flexible resistance temperature detectors • Wire wound or thin-film • Pt, Cu, Ni, Ni-Fe curves • 0.1 second time response • Rugged laminated construction • -200 to 220°C range • Many sizes & styles in stock

Stable, accurate, dependable measurement • Install with self-stick backing, tapes, or cements • Avionics • Process lines • Medical devices • Aircraft windows • Stator windings • Thermal processing equipment

MINCO

Minco Products, Inc.

7300 Commerce Lane / Minneapolis, MN 55432-3177 U.S.A.

Tel: 1-763-571-3121 / Fax: 1-763-571-0927 / www.minco.com

Circle 12 on Control Solutions International RS Card

STRESSED OUT ABOUT YOUR MOTION CONTROL SYSTEM?



AT LEAST WHEN YOU PURCHASE
AN ENCODER FROM EPC, IT WILL BE
ONE LESS THING TO WORRY ABOUT.

PUT YOUR MIND AT EASE

CALL THE FRIENDLY STAFF AT EPC TODAY AND FIND OUT JUST
HOW EASY IT IS TO GET THE ENCODER YOU NEED, AND FAST.

800-366-5412

 **Encoder Products Company**
"Your Encoder Solution For Over 30 Years"

464276 Highway 95 South • PO Box 249 • Sagle, ID 83860
Fax 208-263-0541 • www.encoder.com • sales@encoder.com

Circle 11 on Control Solutions International RS Card

{special report}

The campaign scheduler service accepts B2MML production schedule documents (after a XSLT transformation) and uses the campaign management API to create and possibly start a newly-defined campaign of batches. To further increase production scheduling functionality, a v2.0 of the advanced brewing scheduler service can also be integrated

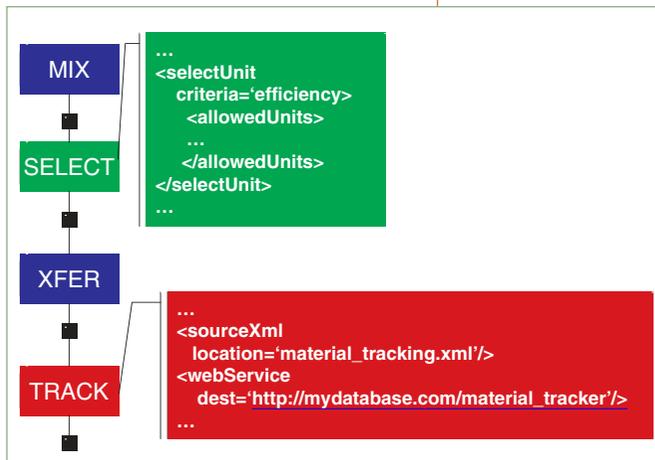


FIG. 5: Web services can be incorporated into recipe structure to provide almost limitless integration capability with only XML based programming required.

using an XML approach and, thus, provides an even greater amount of advanced scheduling and online optimization opportunities such as:

- Predictive Delay: For those occasions when a jam or bottleneck occurs at the end of the brewing process (perhaps in the wort cooling), earlier process steps such as mashing and lautering can be delayed if wanted.
- Integrated Scheduling: Link brewhouse scheduler with cellar, filtration, and packaging scheduler.
- Optimized Scheduling: Use adaptive methods and predictive maintenance on request for overall schedule optimization.

With these web services and others like them, the control system can quickly reach to the highest levels of the S88 and S95 standards, as shown in Figure 4 on page 16.

Conclusion

Batch control has progressed significantly over the last decade. Standards such as ANSI/ISA-88.01-1995 and ISA-95.00.01-2000 have facilitated many of these progressions because they allow vendors to develop and incorporate features into their systems that will be applicable to the widest user group. In particular, these two standards have allowed for higher-level features such as production scheduling and MES integration to be built into the control system itself. As the control system's reach expands, so, too,

does its ability to provide real returns on investment due to improvements in run-time optimization and cost savings seen during start-ups when MES/ERP integrations are required.

With the standards as their basis, new technologies like XML-based web services

(Fig. 5) can truly begin to lower the entry-level effort previously required when integrating ERP and control systems. As these technologies continue to evolve, higher-level functions and decisions can be made within the control system out-of-the-box, thus providing financial returns seen in the continuous control world via advanced control and online optimization routines. ■■■

(This article was originally presented at World Batch Forum's North American Conference, 13-16 April 2003, in Woodcliff Lake, NJ. It is presented here by special arrangement with the World Batch Forum; www.wbf.org.)

References

- ¹Instrument Society of America [ISA]. ANSI/ISA-88.01-1995, Batch Control Part 1: Models and Terminology. Research Triangle Park: ISA; 1995 October.

- ²Instrument Society of America [ISA]. ISA-95.00.01-2000, Enterprise-Control System Integration Part 1: Models and Terminology. Research Triangle Park: ISA; 2000 May.

- ³Beck, R, et al. A New Approach to Batch Process Automation for the Brewing Industry. 2002 Master Brewers Association of the Americas. October 2002. vol. 39, no. 2, pp. 74-88.

- ⁴World Batch Forum [WBF]. Batch Markup Language, BatchML, Version 1. 2002 April.

- ⁵World Batch Forum [WBF]. Business To Manufacturing Markup Language, B2MML, Version 01. 2002 April.

- ⁶OPC Foundation. OPC Specification Version 1.0A. 1997 July.

- ⁷World Wide Web Consortium [W3C]. Web Services Architecture, W3C Working Draft 14 (<http://www.w3.org/TR/2002/WD-ws-arch-20021114/>). 2002 November.

- ⁸World Wide Web Consortium [W3C]. XSL Transformations (<http://www.w3.org/TR/1999/REC-xslt-19991116>). 1999 November.

About the authors

Nathan Pettus is a senior principal engineer within Emerson Process



Management, where he works in the Process System's software development group. He has worked in the process control industry for more than eight years, both in the areas of batch and advanced

control. For the last five years, Mr. Pettus has been exclusively focused on batch product development, but he also has experience developing and implementing model-based predictive control for the utility and pulping industries. He is currently leading the development of Emerson Process System's next generation batch software.

Mr. Pettus holds a master's degree in controls from the University of Texas at Austin. He received his bachelor of science in mechanical engineering from Tennessee Technological University in Cookeville, Tennessee.

Machine safety: Standards harmonization continues

John D'Silva, Business Development Manager—Safety Integrated (NAFTA)
Siemens Energy & Automation Inc., Troy, Michigan 48083

Europe and the U.S. maintain distinct machine safety standards, but a migration between these regions is beginning.

the goal of safety technology is to keep the potential hazards for people and the environment as low as possible by applying and using the appropriate technology. Moreover, this goal needs to be achieved without imposing unnecessary restrictions on industrial production and the use of machines.

In regions around the globe, there are different legal requirements regarding what has to be proven and how when determining whether there's sufficient safety. Likewise, the assignment of levels of responsibility can vary considerably.

For example, in the European Community (EC) there are requirements, placed on both the manufacturer of a plant or system and on the operating company, that are regulated using the appropriate European Directives, Laws and Standards.

In the United States, requirements may differ both at the regional and local levels. However, throughout the country, there is a basic principle that an employer must guarantee a safe place of work. In the case of damage as the result of a product liability, manufacturers can be made liable due to the association with their product or products.

What manufacturers of machines and plant construction firms must understand is that the legislation and/or rules of the location in which the machine or plant is being operated always apply.

For example, the control system of a machine that's operated in the United States must fulfill U.S. requirements even if the machine manufacturer (i.e., OEM) is based in Europe. Even though the technical concepts with which safety is to be achieved are subject to clear technical principles, it is still important to find out whether legislation or specific restrictions apply.

“What manufacturers of machines and plant construction firms must understand is that the legislation and/or rules of the location in which the machine or plant is being operated always apply.”

In the following, we will compare and contrast some of the standards and regulations in Europe and the U.S. as they apply to machine safety. However, given the broad scope of this topic, we can only touch on some of the key standards. For a more detailed examination, go to www.safetylink.com.

Some basic differences

In the U.S., the two most influential safety related agencies/organizations are the Occupational Safety and Health Administration (OSHA) and the American National Standards Institute (ANSI). Other industry-related organizations, such as the Robotics Industries Association (RIA), The Association for Manufacturing Technology (AMT), the Precision Metal Asso-

ciation (PMA), and so on, act as administrators/facilitators and provide support to groups such as ANSI. In addition, corporations as well as local and state regulatory agencies generate and/or oversee safety standards.

OSHA, which was enacted by the U.S. Congress in 1970, is intended to help ensure the safety of workers and the protection of the nation's environment. The provisions of this act are mandatory and legally binding in the U.S. In terms of automatic machine safeguarding, OSHA has referenced safety standards written by the American National Standards Institute (ANSI) and the National Fire Protection Association (NFPA).

For several years now, a number of organizations throughout Europe have been involved in the development and/or enforcement of machine safety standards. As a result, European standards have been described as being more stringent and safety conscious than those in the U.S. While this may have been the case ten years ago, today the consensus is that the U.S. has largely caught up with Europe in regards to the tightness of its safety regulations. U.S. standards are viewed as being application-oriented standards, as contrasted with Europe's product-oriented standards. However, they are regarded as being no less stringent and as effective as those of the European Community.

Functional safety

The differentiation between electrical safety and functional safety is reflected in the most recent standards—to the

{applying
technology}

{applying technology}

extent that there are special standards involved specifically with functional safety. The area of machinery safety addressed in EN 954 deals specifically with safety-relevant parts of control systems; therefore, it concentrates on functional safety. The IEC handles functional

safety of electrical, electronic, and programmable electronic (E/E/PE) systems, independent of any specific application in the pilot standard IEC 61508 .

In IEC 61508, functional safety is defined as “part of the overall safety relating to the EUC [equipment under control] and the EUC control system which depends on the correct functioning of the E/E/PE safety-related systems, other technology safety-related systems and external risk reduction facilities.” To

achieve functional safety of a machine or a plant, the safety-relevant parts of the protective and control devices must function correctly, and, when a fault or failure occurs, the plant or system must remain in a safe condition, or be brought into a safe condition.

To realize this, proven technology is required that fulfills the demands specified by the relevant standards. The requirements to achieve functional safety are based on the following goals: avoid systematic faults, control systematic faults, and control random faults or failures.

The measure for the level of achieved functional safety is the probabil-

Economic globalization is resulting in safety systems that meet a variety of regional standards. For example, the Siemens SIMATIC S7 failsafe Safety PLC programmable safety controller has received UL's 508, NRGFE23916 (ref. IEC 61508 and NFPA 79, 2002) listing for functional safety. The listing covers control equipment that incorporates software for use in safety-related functions.



{applying technology}

ity of the occurrence of dangerous failures, the fault tolerance, and the quality that should be guaranteed by avoiding systematic faults. In the standards, this is expressed using various terms. For example, in IEC 61508 it's *Safety Integrity Level* (SIL), in EN 954 it's *Categories*, and in DIN V 19250 and DIN V VDE. 0801 it's *Requirement Classes* (AK).

Current requirements in the EC

The requirements placed on health and safety at the workplace in the EC are based on Article 137 of the EC Contract. The Master Directive "Health and Safety of Personnel at the Workplace" (89/391/EC) specifies minimum requirements for safety at the workplace. The actual requirements are subject to domestic legislation and can exceed the requirement of these Master Directives. The requirements are involved with the operation of products (e.g., machines) and not with their implementation.

Machinery Directive 98/37/EC

With the introduction of a common European market, a decision was made to harmonize the national standards and regulations of the EC Member States. This meant that the Machinery Directive, as an internal Directive, had to be implemented in the domestic legislation of the individual Member States. In Germany, the contents of the Machinery Directive were implemented as the 9th Decree of the Equipment Safety law. For the Machinery Directive, this was realized with the objective of having unified protective goals and to reduce trading barriers.

The area of application of the Machinery Directive corresponds to its definition—that being, "Machinery means an assembly of linked parts or components, at least one of which moves..."—which encompasses a wide scope. With the Change Directives, the area of application has been subsequently extended to "safety compo-

ments" and "interchangeable equipment." The Machinery Directive involves the implementation of machines.

Machinery is also defined as "an assembly of machines that, in order to achieve the same end, are arranged and controlled so that they function as an integral whole." The application area of

"U.S. standards are viewed as being application-oriented standards, as contrasted with Europe's product-oriented standards."

the Machinery Directive thus ranges from a basic machine to a complete plant.

The Machinery Directive has 14 Articles and seven Annexes. The basic health and safety requirements in Annex 1 of the Directive are mandatory for the safety of machinery. In selecting the most appropriate methods, the manufacturer must apply the following principles in the order given (Annex 1 Paragraph 1.1.2):

a) "The machine design must guarantee that operation, equipping and maintenance, when the machine is correctly used, does not represent any potential danger to personnel."

"The measure must exclude any risk of accident..."

b) "When selecting the appropriate solutions, the manufacturer must apply the following basic philosophy, and, more specifically, in the specified sequence:

- Eliminate or reduce the risks as far as possible (integrating the safety concept into the development and the construction of the machine);
- Take the necessary protective measures against risks that cannot be eliminated.
- Inform users of the residual risks due to any shortcomings of the protection measures adopted."

The protection goals must be responsibly implemented in order to fulfill the demand for conformance with the Directive.

The manufacturer of a machine must prove that the basic requirements have been fulfilled. This proof is made easier by applying harmonized standards.

A certification technique is required for machines listed in Annex IV of the Machinery Directive, which represent a more significant hazard potential. (Recommendation: Machinery which is not listed in Annex IV can also represent a high potential hazard and should be appropriately handled.) The precise "technique to define whether compliance exists" with the goals is defined in Chapter II of the Directive.

Standards

To sell, market or operate/use products, these products must fulfill the basic safety requirements of the EC Directives. Standards can be extremely helpful when they involve fulfilling these safety requirements. In this case, a differentiation must be made between harmonized European standards and other standards that, although ratified, have still not been harmonized under a specific Directive, as well as other technical rules and regulations that are also known as "National Standards" in the Directives.

Ratified standards describe recognized state-of-the-art technology. This means that by proving it has applied them, a manufacturer can prove that it has fulfilled what is a recognized state-of-the-art technology.

Generally, all standards that have been ratified as European standards must be included, unchanged, in the domestic (national) standards of the Member States. This is independent of whether they are harmonized under a particular Directive or not. Existing national standards, handling the same subject, must then be withdrawn. Thus, within a period of time in Europe, a unified set of regulations will be created (without any contradictions).

Occupational Safety and Health Administration (OSHA) Standards

As we mentioned earlier, a significant difference between the legal require-

{applying technology}

ments for safety at work between the U.S. and Europe is that, in the former, there is no unified legislation, across the country, which is applicable for the safety of machines, and which fully covers the responsibility of the manufacturer/supplier. However, there is a general requirement that the employer provide a safe place of work. This is regulated with the Occupational Safety and Health Act (OSHA) of 1970. OSHA uses regional inspectors, who check whether the workplace fulfills the applicable regulations. The regulations, relevant for safety at work, of OSHA are defined and described in OSHA 29 CFR 1910.xxx (OSHA Regulations [29 CFR] PART 1910 Occupational Safety and Health). (CFR: Code of Federal Regulations). The core requirements of OSHA are listed in Section 5 (a) General Duty Clause.

Each employer must set up a safety and health program to manage workplace safety and health to reduce injuries, illnesses, and fatalities by systematically achieving compliance with OSHA standards and the General Duty Clause. If it is not possible for the employer to comply immediately, the employer must develop a plan for coming into compliance as promptly as possible, which includes setting priorities and deadlines, and tracking progress in controlling hazards.

Any hazard identified by the employer's hazard identification and assessment process that's covered by an OSHA standard or the General Duty Clause must be controlled as required by that standard or that clause, as appropriate.

The application and use of various Standards is regulated in 29 CFR 1910.5 "Applicability of standards." The concept is similar to that in Europe. Product-specific standards have priority over general standards as long as the associated aspects are actually handled there. When the standards are fulfilled, the employer can assume that he has ful-

filled the core requirements of the OSHA Act regarding the aspects actually handled in the standard.

Also per 1910.5 (f) "An employer who is in compliance with any standard in this part shall be deemed to be in compliance with the requirement of section 5(a)(1) of the Act, but only to the extent of the condition, practice, means, method, operation, or process covered by the standard."

OSHA: Minimum requirements

The OSHA regulations define minimum requirements to guarantee safe places of employment. However, they should not prevent employers from applying innovative methods and techniques, e.g. state-of-the-art protective systems in order to maximize the safety for employees.

For specific applications, OSHA

"...a significant difference between the legal requirements for safety at work between the U.S. and Europe is that, in the former, there is no unified legislation, across the country, which is applicable for the safety of machines, and which fully covers the responsibility of the manufacturer/supplier."

specifies that all of the electrical devices and equipment, which are used to protect the employee, be authorized for the application by a nationally recognized testing laboratory (NRTL), which has been authorized by OSHA.

In CFR 29 1910.6: "Incorporation by Reference," OSHA lists the non-government organizations that have developed standards that can be considered as mandatory OSHA requirements. In fact, 1910.6 spells out specifically that "organizations which are not agencies of the U.S. government which are incorporated in this reference in this part, have the same force and effect as other standards in this part." In other words, in the

absence of OSHA standards, non-conformance to an ANSI guideline could result in an OSHA violation.

Application and use of additional standards

NFPA 70 (known as the National Electric Code) and NFPA 79 (Electrical Standard for Industrial Machinery) are two especially important standards regarding safety in industry. Both of these describe the basic requirements placed on the features and the implementation of electrical equipment. The National Electric Code (NFPA 70) predominantly applies to buildings, but also for the electrical connections from machines and parts of machines. NFPA 79 applies to machines.

NFPA 79

NFPA 79 is valid for the electrical equipment of industrial machines with rated voltages of less than 600V. (A group of machines that operate together in a coordinated fashion is considered to be a machine.)

The new Edition of NFPA 79 - 2002 includes some basic requirements for programmable electronics and buses, if these are used to execute safety-relevant functions. If these requirements are fulfilled, electronic controls and buses can also be used for Emergency Stop functions of Stop Categories 0 and 1 (refer to NFPA 79 - 2002 9.2.5.4.1.4). Contrary to EN 60204-1, NFPA 79 specifies that, for Emergency Stop functions, the electrical power must be disconnected using electromechanical devices.

Requirements placed on programmable equipment and devices (refer to NFPA 79 - 2002 11.3.4) include:

- Software and firmware-based controllers, which are used for safety-relevant functions, must be listed for such an application (this means, certified by an NRTL).

In a note, a statement is made that IEC 61508 specifies the requirements to design such controllers.

ANSI B11

ANSI B11 is a consensus series of standards developed by consensus bodies

{applying technology}

such as the Association for Manufacturing Technology (AMT), National Fire Protection Association (NFPA), and the Robotic Industries Association (RIA).

Risk assessment is a process used to evaluate the hazards of a machine. The risk assessment is an important requirement as specified in NFPA79 - 2002, ANSI/RIA 15.06 1999, ANSI B11.TR-3 and SEMI S10 (semiconductor).

With the documented results of the risk assessment, one can then choose the appropriate safeguarding technique based on the given safety category of the application.

The specific ANSI guidelines, which are of importance to the automatic machine safeguarding industry, are the ANSI B11 series. Of these, ANSI B11.19 - 1990 (Revised 1999): "Performance Criteria for the Design, Construction, Care, and Operation of Safeguarding when Referenced by the Other ANSI B11 Machine Tool Safety Standards" has traditionally been of the most significance.

In recent years, two other very important ANSI guidelines have taken on a great deal of significance. These are ANSI/RIA R 15.06-1999: "Industrial Robots and Robot Systems—Safety Requirements" and ANSI B11 TR3-2000: "Risk Assessment and Risk Reduction—A guide to Estimate, Evaluate and Reduce Risks Associated with Machine Tools." ANSI B11 TR 3-2000 is actually designated as a technical report by ANSI, but its impact has been, and will continue to be, significant.

Risk assessment analysis

Release of ANSI RIA 15.06- 1999 and of ANSI B11 TR 3-2000 brought about the potential for a trend towards increased use of third parties to accomplish these services. While part of current ongoing requirements, the full force of 15.06 and TR 3 have yet to be felt.

Users, vendors and third-party service providers alike are gearing up for

this application-oriented approach to machine safeguarding. Risk assessment is intended to provide application-oriented evaluation of risk and reduction prior to an application being put into service. It also spreads the risk associated with machine safety among the manufacturer, third-party service provider (if any) and the user. In the past, the user had ultimate liability responsibility, although the manufacturers and third-party service providers were certainly not entirely immune to it.

Finally, it appears that the acceptance of international standards will be directed more towards compliance with procedures (such as risk assessment and industry consensus standards) that can be met with existing products, perhaps with some associated certification.

The second trend, risk assessment

"The typical view among the most knowledgeable persons in the field of machine safety, including those who sit on safety committees or are representatives of these, is that there may never be a single set of standards that will be acceptable to all nations."

analysis, will only require product modifications if certain product classes or types are not compatible with risk reduction. This is not seen as likely because risk assessment is already underway and there have been no such indications.

More harmonization ahead

The typical view among the most knowledgeable persons in the field of machine safety, including those who sit on safety committees or are representatives of these, is that there may never be a single set of standards that will be acceptable to all nations. However, they see international standards being developed that will be conditionally accepted, and will form the foundation of all other standards. They expect to see this harmonizing of standards because it is in the best inter-

ests of major users, such in the automotive, appliance, and aerospace industries. These individuals are working diligently on the various committees to make this happen. ■■■

About the author

John D'Silva is an electrical and electronic engineer and is currently the business



development manager—safety integrated (NAFTA), for Siemens Energy & Automation Inc.. He also is a distinctive example of the Siemens "Global Network of Innovation," since he has

been working with Siemens worldwide.

One major contribution to his credit occurred in October 2003, when Siemens' SIMATIC S7 Distributed Safety, including the S7 failsafe safety PLC, received Underwriters Laboratory's (UL) 508, NRGF.E232916 (ref. IEC 61508 and NFPA 79, 2002) Listing for Functional Safety. It had previously received the TUV Listing for Functional Safety.

Using his application knowledge acquired over the course of 12 years, and a thorough understanding of the North American & European Standards for Machine Safety, he also trains safety consultants and system integrators on doing Risk Assessments and assists in system designs with Safety Integrated Solutions, for compliance with North American Standards.

As a part of the Siemens Safety Team, (comprised of those who sit on the various safety committees, ANSI, NFPA 79, RIA 15.06, etc.), Mr. D'Silva also has experience coordinating with OSHA (USA) and Ministry of Labour (Canada) for compliance related specific safety applications.

He is also on the editorial team for the Safety Integrated Application Book, which explains worldwide standards related to machine safety, complete with approved circuit diagrams to meet the required safety categories. The book also has in-depth technical and application knowledge of safety systems.

Mr. D'Silva can be reached via e-mail at john.dsilva@siemens.com; on the Web, Siemens Energy & Automation can be found at <http://www.sea.siemens.com/safety>. Phone: 248 797 3772.

Don't blame the control system before checking your smart transmitters

Michael Brown, Michael Brown Control Engineering,
Johannesburg 2029, South Africa

You cannot control if your measurement is incorrect.

The first law of process control could be said to be: you cannot control if your measurement is incorrect. I know this won't come as earth-shattering news to any of you, but it's one of those basics that you can't emphasize enough. In fact, I make a point of using it in the slide presentations incorporated in the courses we teach on control.

On one occasion, a student protested that I was insulting the class's intelligence by putting up a slide with such an obvious statement. Certainly, I had no intention of insulting anyone. As I indicated above, we all know this law. However, the question is: Do we always remember it in the heat of the moment? Professionals, no matter how knowledgeable, can always stand a refresher on the basics.

My experience has been that too many instrument engineers and technicians—particularly those with gut feelings that have developed over years of uncertainty in the practicalities of process control—will try to solve all problems by playing with the magic tuning knobs P , I , and D . Likewise, if anything goes wrong in the plant, the first thing the process people tend to do is blame the control system for the problem, and ask someone to retune the controller. In our courses, we teach people that tuning is the last thing you should touch.

Smart can do no wrong, right?

Still other difficulties stem from the fact

that a number of us tend to have a tremendous amount of confidence in our measuring instruments, especially if these are smart transmitters or smart sensors (that is, microprocessor-based). One of the great fallacies in control is that computers can overcome all problems.

Some of us seem to believe that computers can even override natural laws of physics. To site an example, I was called to a petrochemical refinery where operators were having trouble with a flow loop. They were using an orifice plate and differential pressure transmitter as the measuring system, and were trying to control the flow at 10%. When I told them that you can't use an orifice plate-based measurement at such a low point in the range, one of the advanced control engineers took issue with my statement. He told me that there shouldn't be a problem because they were using a smart transmitter with a square root extractor in it.

He had forgotten the basic principles of such a measurement—principles that even a computer can't get around. Generally, with this type of measuring system, one should never work with a flow below 25% minimum. (One point of clarification: before I receive a flood of emails from angry instrument suppliers, I am aware that there are now a few very special smart transmitters that provide an

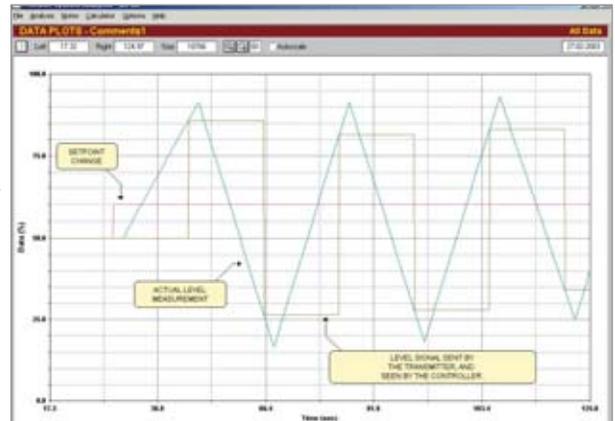


FIG. 1: In this example, a smart level transmitter samples the level every 15 s, but the controller needs to be updated every 0.5 second.

8:1 rangeability on orifice plate measurements. However, the transmitter in this particular application wasn't one of these.)

In addition, more instrument people are beginning to rely on their suppliers to set up their measuring systems. In some cases, the plant staff may not understand as much as they should about the instrument—how it works, its specifications, its limitations, etc. On more than one occasion, I asked engineers or technicians with whom I was working to get out the manual for a given instrument, only to be told that they didn't have one or couldn't find it.

In one plant, the staff was able to come up with the manual, but upon opening it I discovered that there were 18 user adjustments, most of which I couldn't understand. Moreover, I couldn't find a single person in the plant who had even read the manual, or who knew anything about the calibration of the instrument.

I'm not saying that this is typical of

{applying
technology}

{applying technology}

today's plants. However, we all need to remember that, if we rely on a measurement for good control, it is essential that we become completely familiar with the measuring device, and understand all of its various ins and outs to ensure that we are satisfied the measurement is correct.

Let's now look at three points concerning the use of smart transmitters. They focus on scan rates and the aliasing of noisy signals.

Get familiar with smart

First, the scan rate (output update repetition rate) of the device should be fast enough to follow process changes to allow the controller to react correctly. It must be remembered that the controller acts on the signal received from the transmitter. So, if we have a process that can change very quickly, and if the transmitter does not scan quickly enough to send changes to the controller, instability can result.

I found an example of this at a mining plant where the operators could manually control the level in a fast flotation tank. As soon as they put the system into automatic operation, it became unstable. Upon investigating the loop, I found that the ultrasonic level transmitter had a scan rate of some 15 seconds. During this period the level could move quite a few percent. As a result, the controller, which was scanning every half a second, was receiving out-of-date information. This resulted in an unstable cycle, as illustrated in Figure 1.

In the figure you can see the true level being sampled by the transmitter every 15 seconds. This resulted in the controller taking violent action on every new scan to correct the error, and causing the valve to reverse.

Passing info at different rates

Second, with today's microprocessor-based systems we may have several smart devices passing information along

the line. For example, you may be feeding a signal from a smart transmitter to a PLC. The smart transmitter has a scan rate. The PLC may have a set of analogue input cards with their own scan rates. The controller in the PLC will also have its own individual scan rate.

It is a generally accepted rule that digital devices should sample at a rate at least twice as fast as the next downstream digital device, or instability can occur (provided their scans are not simultaneously synchronized). A general rule of thumb, however, is that the upstream device should be at least five times faster than the downstream unit. Once again, the reason behind this is to prevent the controller from receiving "out of date" information from smart transmitters.

In reality, neither of the above will affect a system if the process is slow. However, in fast processes there is no doubt that instability can occur as a result of these factors.

Noisy signals

My third point concerns the aliasing of noisy signals from smart transmitters. Aliasing can occur when a controller with a relatively low scan rate receives noisy process signals. Figure 2 illustrates a signal with a frequency component of 0.7 Hz being received by a controller with a scan rate of 1 second.

The controller switches on every second, and uses the value of the PV at that instant. It then "goes back to sleep" for another second before repeating the process. The figure shows how the effective signal that the controller is now working on has been changed, or "aliased." The alias contains frequency

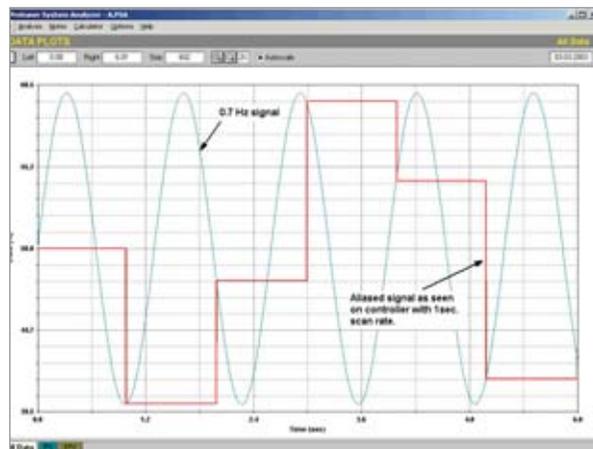


FIG. 2: Noise can affect the quality of the signal that the controller sees from sensors and transmitters.

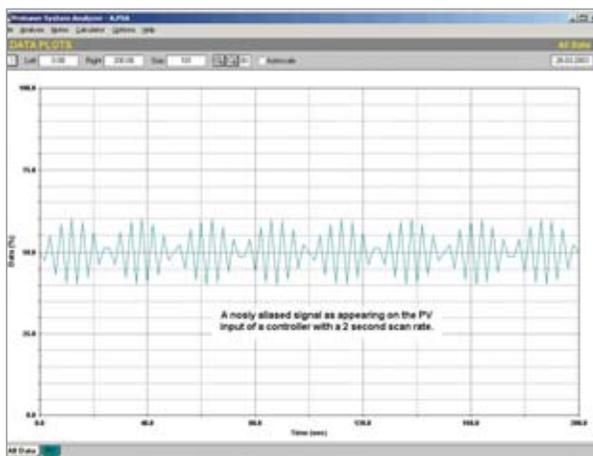


FIG. 3: Aliased signals can contain low frequency harmonics, causing control systems to react in strange ways.

components now in the region of one third and less than the original signal.

Unfortunately, feedback control loops generally cannot cope well with low frequency noise. Higher frequency noise passes through the controller and does not cause a controlled valve to react to it. However, the valve can start responding to lower frequency signals. If it does, it can not only shorten the valve life, but also can increase control variance.

Aliased signals may contain many lower frequency harmonics, and cause strange things to happen. Figure 3 shows how a signal with a strong sinusoidal component of 0.7Hz will be aliased by a controller with a scan rate of 2 s.

Note that there are some really low frequency components in the alias. A control loop in automatic mode can easily start responding to these elements, and can actually cause a loop to oscillate as if

{applying technology}

it was unstable. This is illustrated in Figure 4, which shows a recording of a loop running in automatic mode that is cycling.

The instability is caused by the loop following a low frequency sinusoidal component caused by a signal alias. The tuning is, in fact, very stable.

Ensure correct measurements

This article has stressed how important it is to ensure that measurements are correct. During the course of writing this article, a classic example of the apparent refusal to believe that measurements can be wrong occurred at a paper plant where I was optimizing the controls on a paper machine.

One of the most critical loops on the machine, the basis weight control, was behaving badly and fluctuating around limits on an intermittent basis, literally once or twice a shift for about an hour. Analysis revealed that the problem was occurring because the flow measurement was fluctuating intermittently. It was very easy to prove that it was not the controller causing the problem when we placed it in manual mode. The fluctuations could, in fact, have been due to actual changes in flow, or due to a problem in the magnetic flow transmitter. (At the time of this writing, the cause had not been resolved, but it would appear likely to have been the flowmeter, as other process variables which would have been affected by actual flow fluctuations remained steady).

The fluctuations were so bad that in automatic control they caused the valve to swing around far too much, severely affecting control variance. I explained to the operators that until the I&C department could sort the problem out, when these fluctuations occurred, they should run the loop on manual until they disappeared.

They refused to believe this. As far as they were concerned, we had

been working on the system doing tuning, and it must have been something we had done—even though they had experienced the same problem before we started our work. Although I spent time with them explaining the findings, they complained to various supervisors, and changed tuning parameters overnight. (Another new mystery: How did they get through the security codes to change tuning parameters?).

knowledge of the process be assigned to work with me. Unfortunately, these people are rare, and have heavy workloads and demands placed upon them. As a result, very seldom is my request granted. But when it is granted, optimizations are more successful, take less time, cause less disruption to production, and help break down parochial barriers. As a result, the process people happily accept, and actually welcome, properly optimized control systems. ■■■

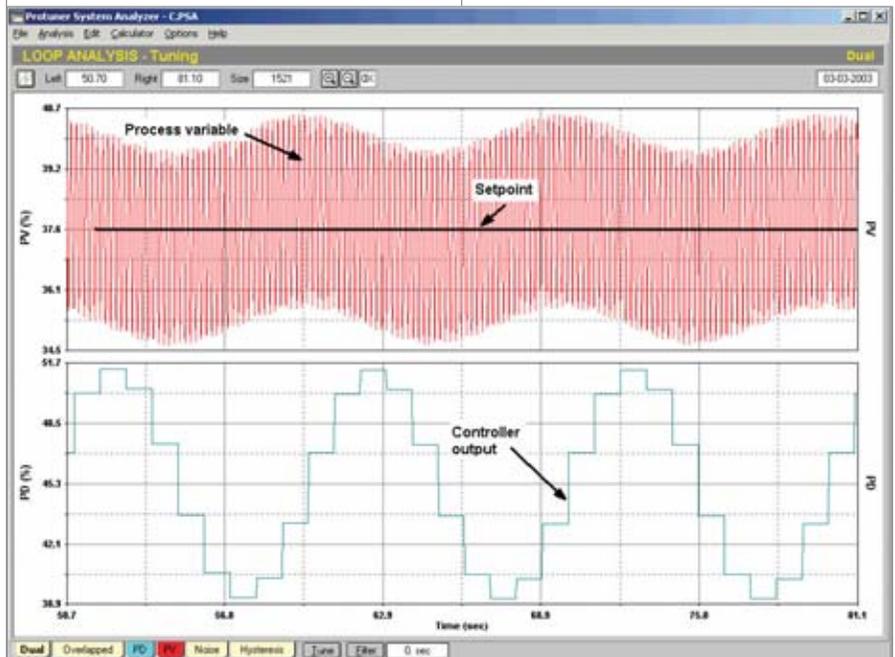


FIG. 4: A control loop in automatic mode can go into oscillation when it reacts to low frequency components.

Eventually, the production manager came storming down “to sort us out.” Fortunately, once I was able to calm him down and explain everything to him, he fully understood and got everyone else to cooperate until the problem could be solved. (The first step in the solution was to install a new magnetic flowmeter during the next plant shutdown).

Work together on these issues

This illustrates a point I always stress, both in the articles I write and in my courses: it is essential for both process and I&C people to work as a team when performing optimization. When optimizing a plant, one of my first requests is to have someone with a really excellent

About the author

Michael Brown graduated from the University of the Witwatersrand as an electrical engineer. He is a specialist in control loop optimization, with more than 30 years experience in process control instrumentation. His main activities are consulting and teaching practical control loop analysis and optimization. He has worked on optimizing loops in more than 300 plants in Southern Africa, Europe, UK, USA and Cyprus, and has presented courses in countries around the world. For more info, please visit his Web site at www.controlloop.co.za/default.htm. He can be contacted at: phone (011) 486-0567; e-mail michael.brown@pixie.co.za.



Mechanical factors take center stage in prox selection

Pam Naylor, Senior Product Manager, Sensors, Schneider Electric, Raleigh, NC

Though electrical specs are important, meeting them is the easy part.

Electronic sensors have been a staple in the industrial world for decades, and their use continues to grow at a healthy pace. Proximity, photoelectric and ultrasonic sensors are commonplace in industrial machine processes that require counting, monitoring, positioning or measuring of any number of targets. Of all the different means of sensing, however, the most mature product, the inductive proximity sensor, remains the most chosen in machine building applications.

So, who determines what sensor is needed and what capabilities it should have? You may think it's the electrical engineer who chooses a sensor based on its electrical merits, but that's the easy part of the selection process. Most sensor manufacturers design electrical capabilities into their products to meet a wide variety of specifications.

Mechanical considerations

It is the sensing distance, body size and style, enclosure material, and connection method that most often determine which sensor will fit the machine's available space and environment (Fig. 1). Consequently, it is usually the mechanical engineer who must find the right sensor.

Knowing this, sensor manufacturers have been concentrating on designing smaller, more robust bodies, improved sensing ranges and, most recently, advanced sensing capabilities such as self-teaching to improve sensor versatility and provide optimum performance.

Tubular proximity sensors have long been the standard because of their simple mounting requirements (usually only mounting nuts are needed), and standard body sizes that allow interchangeability.

In a focus group of engineers we conducted to study rectangular versus tubular body styles, one engineer summed up the simplicity of installing a tubular prox: "It's a no brainer...it can't be assembled crooked. There are only two ways it can go in the hole." Perhaps



FIG. 1: The Telemecanique Osiprox family of proximity sensors comes in standard body sizes and styles to fit a range of machine applications.

for this reason, tubular bodies between 8 mm and 30 mm in diameter make up the bulk of all proximity sensors sold.

Rectangular-bodied sensors are also becoming standardized in the marketplace, and will often have identical mounting footprints. Although they have not caught up with the popularity of tubular sensors, sensor manufacturers continue to expand their lines of rectangular body sizes to complement their exten-

sive tubular lines.

Another emerging standard is the quick connector versus the molded cable. One first-time investment of a sensor with a connector-cable assembly means that future sensor replacements are lightning fast and less expensive. Because there's no possibility of miswiring, a licensed electrician is not required to make replacements. Most manufacturers price cabled sensors at the same level as connector versions. Automotive and large volume OEMs, in particular, are seeing the time-saving value of quick connectors and are driving the trend.

Metal body proximity sensors are more often installed than plastic, while stainless steel is usually seen only in hostile environments or in the food and beverage industry. When installing tubular sensors, exceeding torque tolerances often results in cracked enclosures, which destroys the sensor. Consequently, plastic bodies take a back seat to metal in both quality and price.

Electrical output considerations

Although sensing technology continues to advance at a record pace, some basic electronic operational and application rules remain unchanged. Despite years of application, however, many mechanical engineers still have questions about basic sensing technologies.

Most frequently asked questions include the consequences of leakage current and voltage drop, whether to wire in series or in parallel, NPN versus PNP in dc circuits (Fig. 2), and the suitability of inductive or resistive loads.

{applying
technology}

{applying technology}

Leakage current & voltage drop

Solid state devices must be powered at all times. When in the open state, 3-wire dc devices have a certain amount of leakage current flowing through the load—either in microamps or milliamps—depending on their technology. When feeding detection information to a PLC, which is most often the case, leakage current must typically be less than 1.7 mA when the sensor's switch is off. This represents the standard PLC threshold for the OFF state for this input circuit. If the leakage current of the sensor is greater than 1.7 mA, the PLC would see the sensor as on all the time, regardless of the condition of the switch.

Whether in a closed state or conducting, 2-wire sensors have a voltage drop across the load. Depending on the technology and the amount of current conducted, this voltage drop can be several millivolts, up to several volts. Although this is usually well within the operating range of the load, it must always be considered when using multiple sensors in an application.

Wiring in series and in parallel

Connecting 2-wire proximity sensors in parallel is not recommended. In a configuration of alternate operation, when one sensor is in the on state, the sensor in parallel is “shorted out” and is no longer supplied with power. As the first sensor switches to the off state, the second will become energized and will be subject to its power-up delay. When all sensors are off, the sum of the leakage currents must be less than the holding current of the load. But there's no restriction on using three-wire sensors in parallel (Fig. 3).

When placing two or more 3-wire sensors in series, these points should be considered. When conducting its load, the first sensor will carry the leakage currents of all other sensors in the circuit. Each sensor will produce a maximum voltage drop of 2.6 V. Sensor two will be able to function only when sensor one is on and

has passed its power-up delay.

PNP versus NPN

Three wire dc sensors are identified by the transistor output as being either NPN (sinking) or PNP (sourcing). These terms, often a source of confusion to the installer, describe the path of the current as it powers the sensor (see Fig. 2). In other words, when a sinking device is on, current flows from the load, first into the device's output and then to ground, sinking current to the ground. When a sourcing device is on, current flows from the device's output into the load, sourcing current to the load. To simplify this puzzle, just remember that the middle letter of the acronym indicates what the load is connected to!

A power source is not a load

According to our technical support engineers, testing electronic sensors without an appropriate load is a common occurrence. For example, consider that a solid state device can not be connected direct-

ly to an ac power source because of in-rush currents that can be 6 to 10 times the amount the sensor can handle.

Immediate destruction of the sensor is guaranteed, and danger to the operator is possible on devices without short circuit protection. One way to prevent this is to

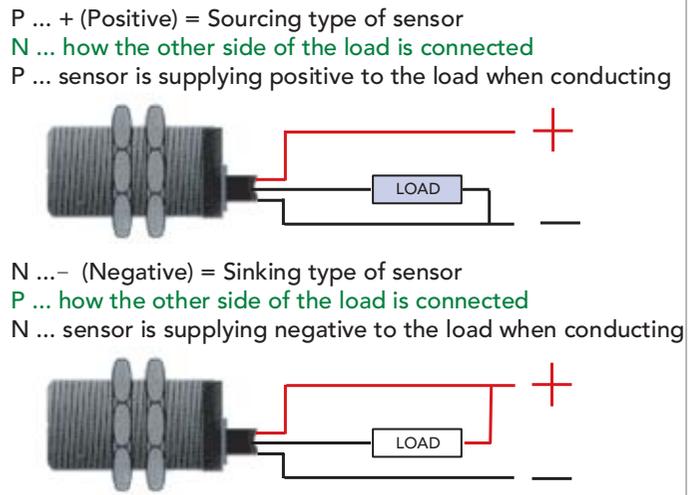


FIG. 2: Typical connections for 3-wire PNP and NPN proxies.

connect an interposing relay between the sensor and the power source.

Don't be afraid to ask questions!

Some applications are tricky and may need to address engineering issues such as sensing speed, time delay, interference, or environmental concerns. To provide technical guidance, most sensor companies offer tech support via online or toll-free phone numbers. The information these specialists provide can help you determine how to apply sensing products to most everyday mechanical and electrical applications to get the most out of the application without damaging the sensor. ■■■

About the author

Pam Naylor is a senior product manager for sensors at Schneider Electric, where she has worked for 27 years. She has devoted the last 11 years to sensors and limit switch product management. Pam can be reached at 919-266-8804, or via email at pam.naylor@us.schneider-electric.com.

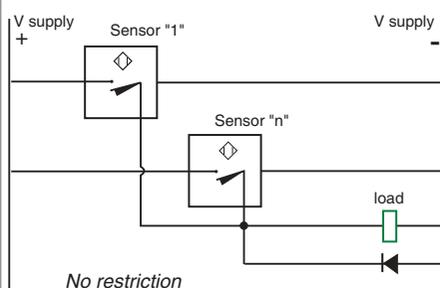


FIG. 3: The use of 2-wire proximity sensors wired in parallel either between themselves or together with mechanical contacts is not recommended. When one of the sensors is in the ON state, the sensor in parallel is “shorted out” and, thus, no longer supplied. There is, however, no such restriction with 3-wire proxies.



control solutions
international



Corporate Profiles



AutomationDirect®

AutomationDirect®, originally founded as PLCDirect in 1994, has quickly grown from a tiny PLC company to a well-recognized name in the industrial automation market. As the first industrial controls company to successfully use a direct sales model to market their PLC products, AutomationDirect provides customers an online e-commerce store and toll-free number for quick order and delivery, while also providing unsurpassed sales and technical support and the lowest prices in the industry.

AutomationDirect was established as a privately held corporation that is a subsidiary of Koyo Electronics (a part of the multi-billion dollar Koyo Seiko group of companies). Koyo had designed and manufactured PLCs for some of the world's largest PLC companies, including General Electric, Texas Instruments, and Siemens. However, the future plans of these companies and Koyo were not compatible. Tim Hohmann, founder and company captain of AutomationDirect, established the company in January 1994 as the first entity within the Koyo Seiko group to concentrate on the micro PLC market. At its inception, PLCDirect consisted of a handful of people working out of a tiny leased building. The company's first catalog consisted of 200 pages, featuring about 200 PLC products. For the first five years the company focused on practical ways to deliver quality PLCs to customers at prices that were typically half the price of products sold by traditional automation companies.

In 1997, the company moved into a new facility, and completed an expansion in March 1998. In April 1999, the company made the decision to add several new product lines to their offering and changed their name to AutomationDirect. They also launched their e-commerce site at www.automationdirect.com. Only five years later, the company's catalog contains over 5,000 name brand and private label products (as of the release of their 2004 catalog in April). Brand name products come from companies such as Eaton Cutler-Hammer, FUJI Electric and Hubbell/Wiegmann. The company also offers their own AutomationDirect brand products, which are either selected or custom-designed to meet the needs of customers.



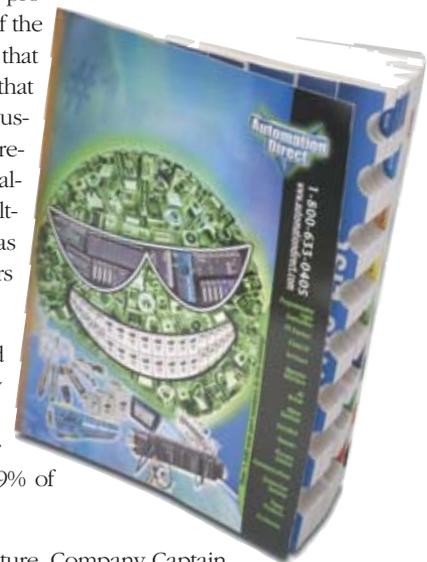
There are many factors that have contributed to the success of AutomationDirect. The company was one of the first in the industrial automation industry to successfully employ direct marketing strategies to reach its customers. These strategies include advertisements, direct mail, a direct sales catalog and an online store. The company's ability to sell high-technology automation

products for very low prices depends on the efficiencies inherent in their direct marketing model. The Cumming, Georgia headquarters facility is the sole location in the United States, and the office and warehouse space have been designed for maximum performance. For example, the company's sales team handles hundreds of phone orders every day from the privacy of well-equipped individual offices, which promote productivity and efficiency. Each member of the technical support team works in a private office that includes a full array of the company's products that can be used to duplicate problems and assist customers in resolving them. The company's ware-

house operation has been improved several times in the past three years. The installation of a PC-based control system and bar code identification equipment has resulted in an order shipping accuracy of 99.98%. The company is able to take orders as late as 4 p.m. EST and ship them the same day, for next day delivery if customers request it.

In addition to great products and efficient operations, the company is also focused on top quality service. An independent Control Design magazine reader's survey ranked AutomationDirect number one for service and support in PLC programming software (2001-2003) and hardware (2002-2003). AutomationDirect's own customer surveys consistently rank the company's service as better than other suppliers. 99% of their customers say they would recommend AutomationDirect to someone else.

AutomationDirect celebrates their 10-year anniversary this year. Looking to the future, Company Captain Tim Hohmann predicts growth through the continued introduction of new product lines and customers' increased use of the company's Web and e-commerce sites for business and information transactions. "As a direct company, we are in a great position to stay a step ahead of the competition on e-commerce initiatives. However, we want to make sure that the expanding dependence on the Internet doesn't mean we become impersonal. Our goal has always been to delight the customer, and we're dedicated to thinking up new ways to do that in every facet of the business."



Circle 14 on Control Solutions International RS Card

Top 5 reasons to use AutomationDirect



AutomationDirect is committed to bringing you the best automation products at prices that won't break your budget, backed by superior technical support and highly efficient business operations. It all adds up to the best value in automation today.



1 Award winning products

AutomationDirect offers over 3,500 industrial automation products for your electrical control system, including PLCs, operator interfaces, AC drives, sensors, motor controls, pushbuttons, connection systems, enclosures and more. Our PLC products have won Editors' Choice Awards from Control Engineering magazine three out of the last six years, the latest being our DL06 micro PLC.

2 Best prices every day

Our direct business model allows us to offer high-quality products and cut out the excess. We pass the savings on to you with our low everyday prices. Our prices are typically 50% below the list price of leading traditional automation manufacturers. Check out our catalog or Web site for documented price comparisons.

3 Voted #1 for customer service for 3 years

AutomationDirect has once again been voted best in service! Check out the October 2003 (as well as 2002 and 2001) issues of Control Design magazine to see the Reader's Choice survey they hosted to select the best products and service in the industry. AutomationDirect was voted #1 in service over all those other multi-billion dollar companies in the areas of PLC hardware, operator interfaces and terminal blocks.

4 Same-day shipping

We can take your order as late as 4 p.m. EST and ship it the same day. (For in-stock orders with approved credit. Does not include some enclosures or AC drives over 40 hp. Shipping extra.)

5 Satisfied customers

It is important for us to get feedback in order to serve our customers better, so we send out satisfaction surveys for many of our sales and technical support calls. At www.automationdirect.com/you_talk you can see what our current customers are saying about us.

Call or go online today to get our FREE catalog. We'll show you how you can pay half the typical industry list price for thousands of high-quality industrial control products, and still get the best service and delivery in the industry.

Circle 13 on Control Solutions International RS Card

- PLC Hardware
- Field I/O
- PC-based Control Products
- Industrial PC Products
- Software Products
- Operator Interfaces
- Enclosures
- AC Drives / Motors
- Process Controls
- Motor Controls
- Relays / Timers
- Pushbuttons / Switches / Indicators
- Stacklights
- Sensors / Encoders
- Connection Systems
- Communication Products
- Electrical Power Products



AutomationDirect
1-800-633-0405 www.automationdirect.com

Call or go online for your FREE 1,300 page, product-packed catalog!

© Copyright 2004 AutomationDirect, Cumming, Georgia. All rights reserved.



+GF+SIGNET

- Sensors • Instrumentation for Industrial Process Control
- Plastic Pipes • Fittings • Valves • Actuators • Rotameters
- Fusion Machines • Secondary Containment • Tank Linings
- Heat Exchangers • Custom Products

GEORGE FISCHER SIGNET, INC.

George Fischer Signet, Inc., is known worldwide for its +GF+ SIGNET brand of instrumentation and sensors for fluid measurement, and is a division of Swiss-based Georg Fischer AG, a world leader in technologies and products in the fields of manufacturing, plant engineering, automotive, and the development of sophisticated, corrosion-resistant and ultra-pure piping systems and components. Their collective product offering includes plastic pipes, fittings, valves, actuators, rotameters, fusion machines, secondary containment, tank linings, heat exchangers, custom products, sensors and instrumentation for industrial process control.

Trusted for their reliability and quality of manufacture, +GF+ SIGNET products are simple to operate and can provide multiple solutions for virtually all fluid processing requirements. Efficiency is increased, and replacement and maintenance costs reduced. Typically, these products provide faster solutions for system design and improved performance. With today's global sensitivity to maintaining continuous standards, +GF+ SIGNET can be counted on as a dependable partner. Every sensor, transmitter, controller, monitor, and even the simplest products, such as fittings, are characterized by this inherent commitment to quality. All +GF+ SIGNET products are manufactured under registered ISO9001 and ISO14001 manufacturing and material quality standards.

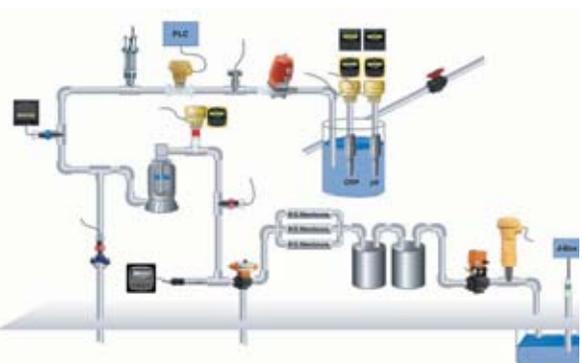
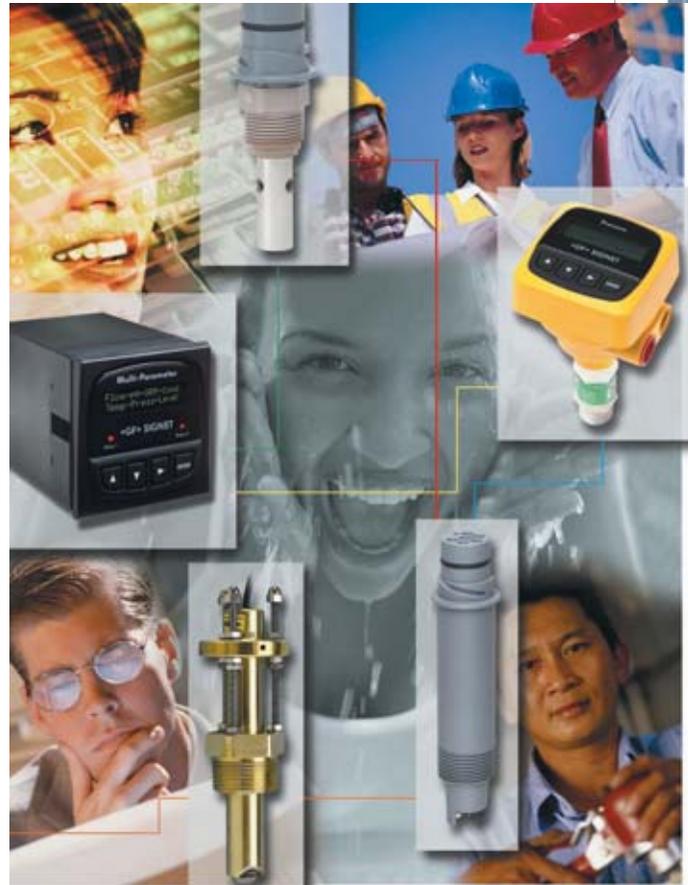
Smart Solutions For Automation

George Fischer Corporation and +GF+ SIGNET are providing total system solutions for the needs of automation worldwide. From detailed schematics for customized products, pre-wired system components that save time and money, on-site training or calibration services, the company's collective capabilities are positioned to work closely with the customer's automation planning and future requirements. Through the evolving technology of Digital Connectivity, +GF+ SIGNET is introducing a new breed of "smart," multi-channel and multi-parameter system units.

These new products are developed to provide a new, expanded capability for use in the rapidly emerging fields of automation, particularly those in fluid management or control, and monitoring of fluid characteristics. Among the most recent examples of this type of product is the 8900 Multi-Channel, Multi-Parameter Controller. Designed to perform as an all-in-one controller, the 8900 is suitable for use in virtually any application where more than one single-channel or single parameter instrument is required. The 8900 display can be programmed in any of six (6) international languages; English, German, French, Spanish, Italian and Portuguese. These display options are user-selectable in the field, creating a "universal controller" for global installations and operator ease-of-use.

The strategic expansion of several product lines that complement automation applications include the ProcessPro™, a full-range of transmitters and controllers for flow, pH, ORP, Conductivity, Temperature, Pressure and Level applications, available in integral configurations for in-line installations, with sensors such as temperature, pressure, flow and conductivity types. The new 8150 Flow Totalizer is designed for use in applications where battery-powered operation is most effective, ideal for remote uses. Applications include wastewater flow accumulation, water treatment systems, remote or mobile treatment and distribution systems, irrigation, filtration, and a number of process flow and cooling uses.

For added simplicity and lower system costs, a new family of "Blind" Transmitters is available with temperature, pressure, pH/ORP and conductivity monitoring when a local display isn't necessary or practical, and the expense would greatly increase station and system costs.



World Class Services

The +GF+ SIGNET brand has earned a distinct reputation as a leader in the fields of customer service, technical support and responsiveness with representatives and distributors in over 50 countries worldwide. This same level of excellence in consistent product manufacture and personal service and response is indigenous to the overall George Fischer organization

For further information, contact George Fischer Signet, Inc., 3401 Aerojet Avenue, El Monte, CA 91731. Phone: (626) 571-2770; Fax: (626) 573-2057. E-mail: info@gfsignet.com Web site: www.gfsignet.com.

Circle 15 on Control Solutions International RS Card

The Power Of Choice Has Arrived



Featuring S³L™

- Signet Sensor Serial Link
- Digital Communication
- To find out more visit our website at www.gfsignet.com/S3L



Introducing The 8900 Multi-Parameter Controller

Not since the Swiss Army™ Knife has one product delivered so many possibilities! +GF+ SIGNET's new 8900 Multi-Parameter controller takes the concept of modularity to the extreme. This all-in-one unit boasts 4 sensor input channels from any of 7 process parameters - flow, pH, ORP, conductivity, level, temperature, pressure. To experience the 8900, check out the interactive demo on our web site.

Customize your 8900 by choosing any of these plug-in modules:

- 2 or 4 channel input
- Up to 8 relays
- Up to 4 Analog outputs
- AC line-voltage or DC power

Then, enjoy absolute versatility in the field

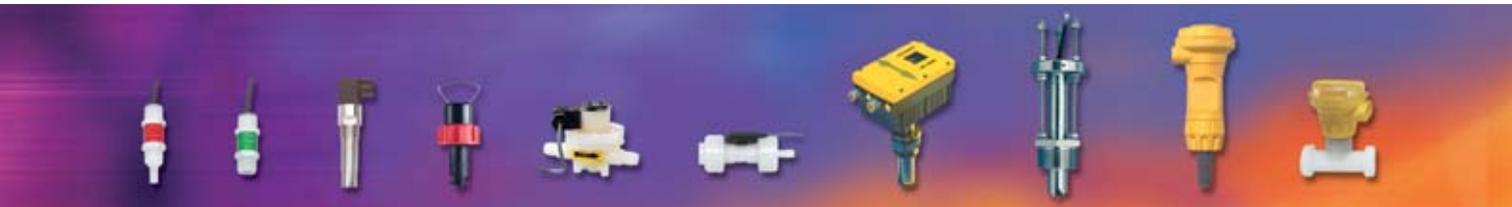
- Input types: Flow, pH, ORP, Conductivity, Resistivity, Temperature, Pressure, Level
- Mix and match up to 4 sensor types freely
- Modify and expand capabilities anytime

Other powerful features include:

- Compact 1/4 DIN enclosure
- Backlit LCD or Vacuum Fluorescent Display



www.gfsignet.com/8900



+GF+ SIGNET

For Sales and Service, visit our website: www.gfsignet.com • Or call (800) 854-4090
 GEORGE FISCHER +GF+ Piping Systems

Circle 16 on Control Solutions International RS Card

IDEC Corporation

IDEC is a leading manufacturer of industrial control and automation products throughout the international market place. We have subsidiaries in Canada, Europe, Asia and Australia, and have a strong sales network that also covers Latin America.

Products for Today and Tomorrow

IDEC specializes in creating products that automate your systems, make them safer, more efficient and easier to use. The goal of our research and development teams is to provide you with components that will satisfy both your current needs, and will allow you to remain prepared for developing technologies. We are constantly striving to create the safest, most efficient, productive interaction between man and machine possible. Our award winning products are not only practical but are also created in a beautiful, sleek design. We care and our products show it.

A Large Selection to Choose From

We offer a large selection of high quality control automation solutions that address a wide range of control applications across a large variety of markets. We know our solutions will meet your needs and help complete your panel. Since 1975 IDEC has developed a reputation in the market place for having an extensive assortment of quality industrial components like Relays, Pushbuttons, Power supplies, Micro PLCs, Smart Relays, Photoelectric switches, and sleek Industrial O/Is. We have also developed a wide selection of industrial safety devices such as; safety interlock switches and three position grip switches (required per ANSI standards for robotic manufacturers). With over 500,000 possible switch combinations available, IDEC offers the broadest choice of pushbuttons, pilot lights and selector switches in the market. Our renowned E-stops, including IDEC's proprietary HW Unibody E-stop, meet international and safety standards. Our goal is to meet our customers' ever-changing needs with the most dependable high quality products available, while maintaining a competitive price.

An Example of the Best

Recently we have added to our O/I Touchscreen family by adding the **TFT Color HG4F 12"** and **HG3F 10" Touchscreens**, which are IP66, NEMA 4, 4X and 13 rated, comes with a built in Ethernet Port that supports ModBus TCP/IP protocol. If an IDEC PLC can not be used, many drivers are available to communicate to other manufacturers' PLCs.

We have also introduced the extremely competitive **SA1E Series of miniature photoelectric switches**. These advanced sensors, rated IP67 (NEMA 6), have the electronics completely molded into the casing providing water-resistance protection for the sensors. Also CE marked, their slim design allows them to be used in tight spaces and with their advanced interference protection circuitry they can be mounted very close together without affecting each other's operation.



If it's power you're looking for, IDEC has increased its line of power supplies by adding three **PS5R Slim Line Power Supply** models. These new award winning power supplies come with all the features and power of traditional power supplies, but only occupy **half the space**. You save valuable DIN rail space with the **30W** (H3.74 in X W1.42 in X D4.25 in), **60 W** (H3.74 in X W.42 in X D4.25 in), or **90 W** (H4.53 in X W1.81 in X D4.76) while still filling your power needs. PS5R Slim Line models are UL508-listed, UL1604 for hazardous locations, and also UL1310 tested for NEC Class 2 rating (30 W and 60 W only). The incredibly slim footprint of the PS5R Slim Line series makes them the perfect fit for your application, your panel, and your budget.

IDEC products fulfill a wide variety of uses and offer a limitless range of possibilities. From the simplest of switches, like an on/off key switch, to the complex functions of our programmable logic controllers, IDEC can provide you with the solution. Give us a call at 800-262-IDEC (4332) or visit our web site at www.idec.com.

Circle 17 on Control Solutions International RS Card



It only takes one touch to get the ball rolling!



HG1X
text message displays



HG1B
monochrome touchscreen

IDEC's brings multiple levels of control to your fingertips with the HG Family of seven operator interfaces. The HG3F and HG4F have 256 color and 8 megabytes of memory. Both are RS-232, RS-485 and RS-422 compatible, have a built-in 10BaseT Ethernet connection and support Compact Flash memory. The 6 inch HG2F has 2MB of memory and a 256

color touchscreen. It's also available with a CC Click overlay. There are three displays in the HG1X series; 8 line, 20 char, 4 lines, 20 char and 2 lines with 16 char. The HG1B is a monochrome touchscreen with bitmap and graphic display capabilities. Use IDEC touchscreens to control production with just the touch of a finger.



HG4F 12.1" and HG3F 10.4"
TFT touchscreens



HG2F and CC Click
6" color touchscreen

Circle 18 on Control Solutions International RS Card

800-262-IDEC (4332)



www.idec.com



MAKING NETWORKS WORK BETTER.

PLUG & PLAY *Work* Network Systems.

Connectorized fieldbus systems offer system-wide "plug-and-play" convenience for all input and output devices on the network. They allow extremely rapid changeovers to a connectorized network, often in 15 minutes or less.

Fully-connectorized tees and junctions along with pre-molded cables offer the fastest and most flexible method of installing sensors and actuators on the network.

These rugged components work reliably in almost all environments, allowing remote I/O to be mounted directly on the machine or in the elements, thus eliminating the need for separate water-tight or remote control boxes. They are also ideal for difficult processing environments, including intrinsic safety, hazardous areas and volatile processes.



Plug-and-play versatility is shown with an IP67 tee and junction using standard cordsets and connectors.

The optimum design of a fieldbus system must consider the inherent benefits of the technology, including the significant reduction of wiring, installation labor and changeover time, plus stream-lined maintenance procedures.

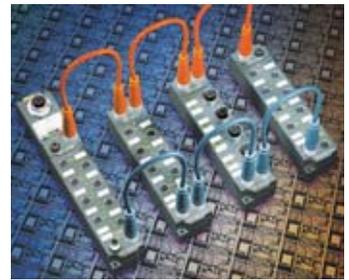


Advanced I/O Spanner Module

Product Innovation for Real Solutions.

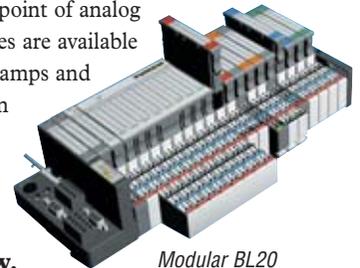
InterlinkBT[®] is quick to respond to customer demands for unique and better fieldbus solutions to meet application requirements. Their product portfolio consists of a complete product family of Advanced I/O Modules (AIM[™]) including modules with flexible I/O configurations and enhanced diagnostics, spanners and repeaters, analog coupling modules, e-stop modules, and unique modules for motor control enclosures.

Network I/O Systems are also available to solve specific design requirements. The *piconet*[®] network family offers smaller products that are needed for mounting on smaller machines. *piconet* provides all the required functionality and performance, but in a smaller footprint. One housing size handles a wide range of functions and I/O configurations. Snap-on or screw-on *picofast*[®] connectors allow machine designers to quickly develop tools and material handling systems in time for rapid development products. With an IP67 rating, *piconet* modules can be mounted directly on the machine, eliminating the need for additional enclosures.



piconet modules connected with fiber optic cordsets.

For applications when an enclosure is used, the BL20 I/O System represents a flexible, open, and quality approach to network installations. The gateway allows you to choose your fieldbus, while I/O modules are available from 1 point of analog to 32 points of digital. Wiring bases are available with screw terminals or tension clamps and the pin and socket interconnection provides a reliable electrical connection for uninterrupted network communication.



Modular BL20 I/O System

Realize Cost Savings Now.

There are basic benefits realized when designing around a fieldbus network. Those benefits include greatly reduced costs by eliminating traditional point-to-point wiring, with fewer terminations, cabinets and connections. Plus, faster startup by utilizing fully-connectorized hardware, resulting in fewer circuit checks, less wire numbering and less documentation. Also, reduction in downtime and maintenance costs by having visible, status indicating LED's, short circuit detection and dedicated diagnostics on the machine.

Take Advantage of Expertise, Training and Support.

InterlinkBT makes certain you get the best network products. Plus they provide advanced technical support for all major open device-level networks with an in-house staff of network experts and more than 2,000 field distribution specialists.

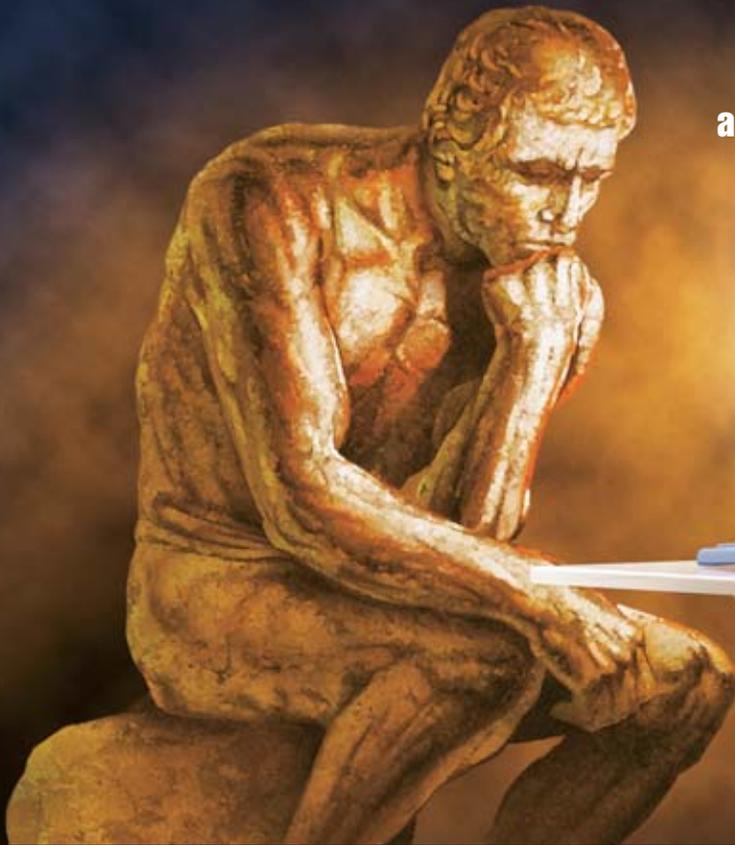
interlinkBT[®]
We make networks work

Call 1-888-546-5880 www.interlinkbt.com

3000 Campus Drive, Mpls, MN 55441 • Tel: 763.694.2300 • FAX 763.694.2399

Circle 19 on Control Solutions International RS Card

Still waiting for tomorrow's big advancement in network connectivity?



Real Solutions. Right Now.

There's always a new network technology just around the corner, and when it's real, *InterlinkBT* will be one of the first to bring it to market. Until then, our advanced bus networks are cost-saving solutions you can implement today.

More Products. With over 3,000 products, *busstop*® is your single source for every major fieldbus. And because *busstop* is not tied to any one fieldbus technology, we recommend the best network and hardware for your application.

More Innovation. We lead the industry with firsts, like our rugged IP67 network I/O modules for every major fieldbus. The first on-the-machine I/O modules. The first miniature fieldbus modules. The first industrial Ethernet switch. The list goes on, and so do our success stories.

More Expertise, Training and Support. We make certain you get the best network and products to help you achieve your cost, quality and productivity objectives. Plus we train more people than anyone and provide

Circle 20 on Control Solutions International RS Card



advanced technical support for all major open networks with an in-house staff of experts and more than 2,000 field distribution specialists.

Realize Cost Savings Now.

With *InterlinkBT*, you'll eliminate traditional point-to-point wiring, utilizing all plug-in hardware. And quickly benefit from significant reductions in wiring, installation labor, changeover time and system maintenance.

Go to www.interlinkbt.com or call 1-888-546-5880 to learn how we bring you real network solutions today.

One stop for every bus.



interlinkBT[™]
We make networks work

National Instruments

Since 1976, National Instruments has revolutionized the way engineers and scientists measure and automate the world around them through the innovative concept of virtual instrumentation.



Virtual instrumentation combines commercial PC-based technologies with easy-to-integrate software - such as the NI LabVIEW™ graphical development environment - and modular hardware - such as PCI eXtensions for Instrumentation (PXI) modules for data acquisition, instrument control, and machine vision. Engineers, scientists, and technical professionals around the world use virtual instruments (VIs) to create flexible, user-defined solutions, as opposed to closed, fixed-function, vendor-defined systems.

Because NI™ systems are based on the open PC platform, users can take advantage of new commercial technologies as they emerge, such as .NET, Ethernet, and wireless communications.

Powerful Software

As performance and flexibility requirements for measurement and automation systems continue to rise, software design has become more important. By investing in flexible, easy-to-use software that consistently delivers optimal performance, companies can dramatically reduce development time and simplify application development, maintenance, and integration of their measurement and automation systems.

Engineers and scientists can use the intuitive, logical-flow diagrams of NI LabVIEW to easily develop custom applications while taking advantage of the PC for processing, display, and device connectivity. With LabVIEW 7 Express, engineers can create measurement and control applications in minutes. This technology delivers configuration-based development tools such as Express VIs and interactive measurement assistants, plus features such as automatic code generation.



LabVIEW 7 Express also introduced functionality that ranges from industrial PCs to handheld and embedded devices. For years, engineers have used the LabVIEW Real-Time Module with rugged FieldPoint™ and PXI hardware to develop industrial data acquisition, machine condition monitoring and custom embedded control systems. With LabVIEW 7 Express, NI extended LabVIEW capabilities to Palm OS and Microsoft Pocket PC handheld PDAs, embedded FPGAs on NI reconfigurable hardware, and industrial NI Compact Vision Systems.

Modular Measurement Hardware

As a market leader in PC-based data acquisition, NI offers data acquisition devices for desktop, portable, and networked applications on several buses, including PCI, PXI, PCMCIA, USB, and FireWire. Digital I/O and analog output modules extend the reach of PC-based data acquisition to mission-critical industrial applications, and innovative NI-DAQ™mx software delivers dramatic improvements in I/O performance and ease of use.



By integrating commercial PC-based technologies and investing in innovative research and development, NI data acquisition prices continue to track industry trends while improving system performance, accuracy, and reliability. NI recently added more value for its data acquisition customers by substantially reducing prices worldwide for 13 of its most popular DAQ modules.

NI measurement hardware gives engineers the flexibility to create custom automated systems on a variety of industry-standard computer platforms. PXI combines the high-speed PCI bus with integrated timing and synchronization to deliver a more than 10X performance improvement over older architectures. NI also offers a variety of rugged, modular PXI hardware, including a new 100 MS/s mixed-signal test suite.

In addition, NI offers an entire line of rugged I/O for process automation. For measurement, industrial control, or data logging applications that involve a diverse array of sensors and actuators, engineers can use NI FieldPoint and Compact FieldPoint to perform process automation, even in electrically or environmentally harsh environments.

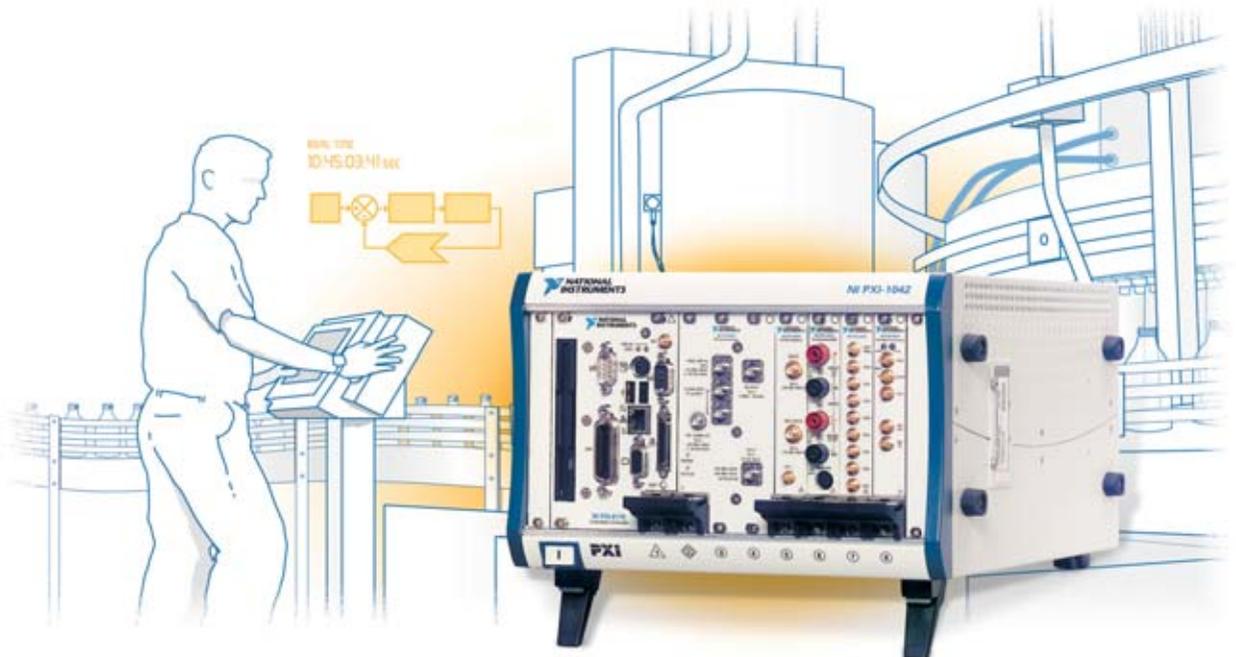
Also ideal for harsh environments, the NI Compact Vision System facilitates several simultaneous inspections by offering the processing power of multiple smart cameras and delivering three IEEE 1394 ports for connectivity to numerous imaging sensors, including high-speed and high-resolution cameras. Engineers can use the Compact Vision System with NI Vision Builder for Automated Inspection software and NI LabVIEW code-generation tools to create highly customized applications without programming.

Revolutionizing Measurement and Automation

From testing DVD players to researching advanced medicines, customers use NI software and hardware to build a diverse range of systems and products. Whether their application requires data acquisition, analysis, advanced control, machine vision, or motion control - engineers and scientists can speed development time, reduce costs, and increase flexibility and accuracy with NI products.

Circle 21 on Control Solutions International RS Card

PAC Programmable Automation Controller



Expand your PAC measurement functionality with NI PXI and LabVIEW™ Real-Time

National Instruments PACs combine the flexibility of PC-based software with the reliability of industrial hardware running a real-time operating system. LabVIEW Real-Time lets you quickly develop your application to accurately measure analog signals, perform floating-point calculations, implement custom control algorithms, log data, and then easily share the information.

PXI delivers the processing speed and performance you need for faster control loops and custom calculations. With PXI and LabVIEW Real-Time, you can quickly develop custom algorithms for reliable industrial control and monitoring systems that include data acquisition, motion control, and image acquisition. In addition, the modularity of PXI makes the systems easy to configure, reconfigure, and repair.

Use powerful NI PACs to perform advanced tasks such as:

- Vibration analysis, image processing, motion control, and CAN in real time
- Implementing control of PID with autotuning or PID with gain scheduling, fuzzy logic
- Communicating using the built-in Web server, FTP server, and e-mail capability

Features	Industrial PCs	PXI
System real-time support	–	✓
Extended operating temperatures up to 55 °C	–	✓
Suitable for extended shock and vibration	–	✓
Rugged IEC pin-and-socket connection architecture	–	✓
Optimized cooling architecture	–	✓
Wide availability of devices and vendors	✓	✓
High channel count, number of slots	✓	✓
Low mean time to repair (MTTR)	–	✓
Internal triggering for device synchronization	–	✓

ni.com/info

To view a technical web event and learn more about PXI for industrial control and measurement, visit ni.com/info and enter **dw65au**.

Circle 22 on Control Solutions International RS Card

NATIONAL INSTRUMENTS™

(800) 891-2755

Fax: (512) 683-9300 • info@ni.com

Active Touch

a high performance touchscreen panel features a 32-bit RISC 240MHz CPU, built-in screen/script design software and multi-media web capabilities. Active Touch® provides simultaneous monitor and control functions for multiple vendors' PLCs, USB or RS-232C barcode readers and remote I/O.

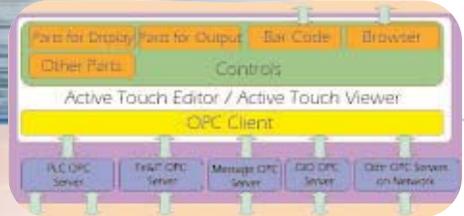


ACTIVE TOUCH

Easy Set-up

Screen editing and control parameters can be set with Contec's built-in screen/script software - functions needing more complex logic can be formatted with "eStep"-tree structure dialog boxes

Data Link to OPC Server



Powerful Communication Capabilities

Active Touch® employs OPC communication technology, permitting data exchange with network nodes such as SCADA or process control systems



Japan's Largest DAQ Manufacturer

TEL: 800-888-8884

www.contecusa.com

Circle 24 on Control Solutions International RS Card



CONTEC Microelectronics USA Inc.

Japan's Largest DAQ Manufacturer

For over two decades CONTEC has developed and manufactured automation control systems to meet the growing demands of today's factory and laboratory environments. CONTEC's diverse line of PC-based data acquisition and industrial computers gives customers a total solution to their process control and factory automation needs.

From design to purchasing - through manufacturing and distribution; the need for seamless integration of these processes continues to grow. CONTEC has made a commitment to meeting this demand through ongoing development of new products and continuing refinement of existing lines.



C = the integrated solution offered by CONTEC

n = the degree of heightened productivity that can be realized through the utilization of these solutions. Together they are a visual representation of CONTEC's diverse and quality products.

CONTEC is committed to expanding their existing strength of product in **I**ndustrial **T**echnology while focusing on a continued development of products for integrated **I**nformation **T**echnology.

www.contecusa.com

Tel: 800-888-8884

Circle 25 on Control Solutions International RS Card

Mass flow meters for every process



Visit us at INTERKAMA 2004, Booth E55, Hall 6

Mass Flow Meter Performance

- >> True mass flow measurement with Coriolis or thermal sensing
- >> Wide flow range
(Liquid: 0.1 to 1900 lb/min;
Gas: 0.0062 to 1850 SCFM)
- >> High accuracy
(Liquid: $\pm 0.1\%$ reading;
Gas: $\pm 1\%$ reading)
- >> Fast response
(Liquid: 150 msec; Gas: <2 seconds)

Sample Applications

- >> Aeration digester or biogas flow
- >> Fuel flow test stands
- >> Flare gas monitoring
- >> Ingredient dosing
- >> Batch processing
- >> Real-time density measurement

>> FCI. The mass flow experts.

FCI's thermal and Coriolis mass flow meters offer a wide range of liquid and gas flow measurement solutions. Whether dirty or sanitary applications, FCI meters feature unmatched accuracy, reliability, turndown and communication capabilities. Easy installation and minimal maintenance result in low cost of ownership.

Call FCI toll free today at 1-800-863-8704 for a free CD Catalog and Applications Guide created for your specific industry.

>> fluidcomponents.com

FCI FLUID COMPONENTS
INTERNATIONAL LLC



Circle 26 on Control Solutions International RS Card

Headquarters: 1755 La Costa Meadows Dr., San Marcos, CA 92069 USA | 800-863-8704 | 760-744-6950 | Fax 760-736-6250

Corporate Profile

FCI. The Process Industry Flow Measurement Standard.

Fluid Components Intl is recognized across the process control industry for precision calibration services and highly reliable flow metering instrumentation. From early designs, FCI has focused on replicating field conditions in a controlled laboratory environment. This assures the highest installed accuracy and minimum metering uncertainty. Today, we operate a state-of-the-art flow calibration lab with the versatility to transition quickly through a wide range of calibration fluids, line sizes, and process connections. We feature automation and data collection capabilities that offer unmatched proprietary calibration solutions that balance throughput efficiency with traceability and reliability.



FCI's calibration lab features gas flow calibration capabilities ranging as low as 0.001 SCFM (.00017 NCMH) to ranges that exceed 5000 SCFM (8500 NCMH) and higher for line sizes in excess of 10 in. (250 mm). Calibrations for applications with temperature ranges from -100 to +1000°F (-73 to +538°C) and pressure ranges from 0 to 1000 psig (0 to 68 atmospheres) are commonly performed for many fluid services.

New Fuel and Sanitary Flow Stands

With a continuous investment in 2003, our cal lab now includes a Fuel Flow Stand for aviation fuels (JP4, JP5, JP8, Jet A, Stoddard Solvent) as well as coolants, lube and hydraulic fluids (ethylene glycol, PAO-synthetic oil). It operates over a flow range of 0.1 to 100 gpm (+0.25% accuracy), at temperatures from -40 to 220°F. Additionally, FCI commissioned a Sanitary Flow Stand in late 2003 that is ideal for a wide range of food, beverage and pharmaceutical products.

NIST-ISO 9001 Certification-AS9000 Compliance

FCI calibrations are performed utilizing only NIST traceable equipment and instrumentation. We pride ourselves on meeting MIL-STD-45662A, ANSI/NCSS Z-540 requirements and for continuously maintaining ISO 9001 certification and AS9000 compliance.

AVAL Sizing Software and Instrument Selection Services

FCI has sizing and specification software to make selection of thermal mass and Coriolis mass flow instruments quick and reliable. FCI AVAL and ASAP software will ensure customers are fully aware of process conditions that can potentially produce installed uncertainty.

Circle 27 on Control Solutions International RS Card

THINK YOU'VE GOT A TOUGH PROBLEM? WE'VE GOT A TOUGHER SOLUTION.

MORE THAN 80 NEMA-RATED PRODUCTS!

- ▶ Desktop Keyboards
- ▶ Panel Mount Keyboards
- ▶ Backlit Keyboards
- ▶ Rackmount Keyboards
- ▶ OEM Keyboards
- ▶ Flat Panel Displays
- ▶ Pointing Devices

Call **1.800.866.6506** to order our
2004 Industrial Products Catalog

IKEY Industrial Peripherals
2621 Ridgpoint Dr. suite 235
Austin, TX 78754



Circle 28 on Control Solutions International RS Card



1.800.866.6506 ▶ www.ikey.com

Corporate Profile

IKEY

The Company

Formerly Texas Industrial Peripherals, IKEY began in 1989 with the goal of filling a market need for rugged computer peripherals. Today, IKEY manufactures the most complete line of NEMA rated industrial keyboards, computer pointing devices and flat panel displays in the industry.

The Products

Featuring more than eighty desktop, panel mount, rackmount, and OEM models, IKEY offers an extremely wide range of sizes, styles and features. Whether your application requires waterproofing or backlit keys, small footprint or stainless steel, an integrated pointing device or a sunlight-readable screen, IKEY has the product to accommodate.

The Innovations

Among its many industry milestones, IKEY was the first company to produce an industrial keyboard that featured an integrated pointing device. IKEY also introduced the first industrial, illuminated mobile keyboard, as well as the first NEMA 4X rated keyboard enclosed in an ABS polycarbonate case. In 2004 IKEY continues its trend of innovative designs, with the introduction of the first industrial keyboard/pointing device to feature less than an inch in height, as well as the first wireless, industrial keyboard.

The Service

IKEY was founded on the principles of innovation, quality and, most importantly, service. The company prides itself on quick follow-up, short lead times, and an easy ordering process. IKEY's in-house repair department allows for rapid turn around, while its engineering, technical support, and sales teams, bring years of experience to the very unique issues involved in harsh environment applications.

The Solutions

In the business of rugged peripherals, you speak to customers facing challenging issues on a daily basis. At IKEY, creating solutions to those issues is always the number one goal. Moving into its 15th year of designing and manufacturing innovative and reliable products, IKEY's industrial peripherals can be found all over the world, in many industries, and as part of thousands of applications.

To learn more about IKEY, call 1.800.866.6506, or visit us online at www.ikey.com

Circle 29 on Control Solutions International RS Card

When You're Looking for Value... Look to Lake.

Simply the Best!



Flow Transmitters, Flow Meters & Flow Alarms

- Low Cost
- NEMA Type 4X Enclosures
- High Pressure up to 6,000 PSIG
- Electronic Feedback including 2-wire 4-20mA
- Numerous Porting Options
- 5-Year Warranty
- Private Branding Available

For more information, contact Lake today.

800.850.6110 414.671.3577 www.lakemonitors.com

Circle 31 on Control Solutions International RS Card



Corporate Profile

Lake Monitors

Lake Monitors is one of today's leading manufacturers of inline flow meters, flow switches/alarms, flow transmitters and hydraulic system analyzers for closed loop piping systems. Lake's high-quality monitors can be utilized in either compressed gas or liquid systems to ensure proper volumetric flow rates of coolants, purge gasses and lubricants.

Founded in 1989 by Jack E. Lake, Lake Monitors continually provides the industry with high-quality, low-cost and virtually maintenance-free flow monitoring products. Incorporating more than 20 innovative and unique design features, Lake Products are—dollar for dollar—superior in quality to any other monitor available on the market.

Lake Monitors is so confident in the reliability and continuous operation of its monitors, the company backs all its monitors with a five-year warranty. That's one of the best warranties in the industry today! As far as innovation goes, Lake currently holds several patents and has patent protection on more than 8,000 configurations for monitors, flow alarms, flow sensors and hydraulic system analyzers.

Although Lake stocks a wide variety of product configurations, its customers frequently require products that are customized to meet their special applications. And Lake delivers. Its technical services department will work with engineers to develop exactly the right monitor to meet specifications and provide the best flow monitoring solution.

Contact Lake today for more information about product applications, servicing or technical assistance.

Lake Monitors Inc.
2013 South 37th Street
Milwaukee, Wisconsin 53215
Phone: 800.850.6110 Fax: 414.671.5253
www.lakemonitors.com



Circle 30 on Control Solutions International RS Card

Experience HMI Design with Qlarity

- **Qlarity™** – Object-based Graphic Terminal Language
- Simple Application Design and Deployment
- Windows® Programming Environment
- Customize the Hardware to Fit *Your* Application
- Numerous Terminal Configurations Available
- Serial, Ethernet and Power-over-Ethernet
- Touch Screen, Keypad, PS/2 Keyboard
- Environmentally-hardened
- NEMA-4, CE-Certified



Qlarity™
by QSI Corporation
Object-Based Programming

cs.qlarity.com

2212 South West Temple #50 • Salt Lake City, Utah 84115 • 866-466-8159

QSI
CORPORATION

Circle 32 on Control Solutions International RS Card

Corporate Profile

QSI Corporation

QSI Corporation designs and manufactures operator interface terminals for industrial, commercial and vehicle applications. Our products go by many names, such as: terminal, operator interface, human-machine interface, graphical user interface, vehicle control head, pendant, programming or teach pendant, etc.

We specialize in making both graphical and character terminals for applications where high reliability and excellent durability are a necessity. QSI customers have used our terminals in many applications, such as industrial machine tools, control panels in high-volume production plants, plant floor data collection terminals, commercial public-access terminals, driver mapping and dispatch, wireless vehicle maintenance, process control such as in a petroleum refinery, and many, many more.

You have likely seen or used QSI terminals without knowing it: most of our products are customized for a specific application, and are “private labeled” with our customer’s name. QSI supplies terminals that meet our customer’s requirements for style, ruggedness, sealing and functionality, with their logo and name, and often within days of receiving their specification.

QSI Corporation’s terminal programming language, called Qlarity, is an object-based language designed by QSI for our intelligent graphic terminals. Qlarity uses objects to display information on the screen, accept user input and communicate with other devices. While being object-based, it uses simple BASIC-like programming features such as conditional logic (IF-ELSE), looping (WHILE, FOR-NEXT), a rich set of logical and arithmetic operators and built-in functions to access the terminal hardware. Qlarity (pronounced “Clarity”) allows QSI and our customers the ability to quickly design custom applications and communication protocols to interface and control most hardware.

QSI can provide semi-custom terminals in small quantities and with short lead times, and, for larger volume applications, we can design and provide an all-custom operator interface. Our extensive engineering experience and comprehensive environmental test facility, including thermal and humidity chambers, vibration and shock tables, spray chambers, wind-blown rain and sand tunnels, dust chambers, EMI and EMC test equipment, ESD test equipment, etc., give us the capability to design and produce rugged and reliable terminals that will meet your functional, aesthetic and environmental requirements. —QSI Corporation, www.qsicorp.com

QSI
CORPORATION

Circle 33 on Control Solutions International RS Card

Photoelectric sensors: A solution for every application

Ed Myers, Product Manager; Jeff Allison, Product Manager; Gary Frigyes, Product Manager, Pepperl+Fuchs, Twinsburg, OH

Forget what type of photoelectric sensor will do the job? Here's a quick refresher course!

as the manufacturing world becomes more and more automated, industrial sensors have become the key to increasing both productivity and safety. These sensors come in all sizes, shapes, and technologies—with the most common technologies being inductive, capacitive, photoelectric, magnetic, and ultrasonic. Each technology has its own strengths and weaknesses, so the requirements of the application must determine the technology to be used.

This article focuses on photoelectric sensors. It provides a brief refresher on what they are, spells out their advantages, and outlines basic modes of operation.

Photoelectrics: A few basics

Photoelectric sensors detect a change in light intensity. Typically, this means either nondetection or detection of the sensor's emitted light source. The type of light and method by which the target is detected varies, depending on the specific sensor being used.

The sensors are made up of a light source (LED), a receiver (phototransistor), a signal converter, and an amplifier. The phototransistor analyzes incoming light, verifies that it's from the LED, and appropriately triggers an output (*Fig. 1*).

The advantages of this sensing technology compared to others are many. For example, sensing ranges for photoelectric sensors far surpass that of inductive, capacitive, magnetic, and ultrasonic tech-

nologies. In addition, their small size versus sensing range and variety of housings available make them a perfect fit for almost any application. Finally, with continual advances in technology, photoelectric sensors are price competitive with other sensing technologies.

Photoelectric sensors provide three

Target reflectivity

Material	Reflective Index
Aluminum, untreated	140%
Automobile tires	1.5%
Beer foam	70%
Black foam carpet backing	2%
Black neoprene	4%
Black plastic	14%
Black, anodized aluminum	115%
Black, extruded anodized aluminum	50%
Clean pine wood	75%
Clear plastic bottles	40%
Cork	35%
Extruded aluminum	105%
Newsprint	55%
Opaque white plastic	87%
Polished stainless steel	400%
Testcard standard gray	18%
Testcard standard white	90%
Transparent brown plastic bottles	60%
White paper	80%
Wooden pallets—clean	20%

Note: The values in this table are intended only as guidelines, as a variety of factors determine the exact sensing range in an application.

primary methods of target detection: diffused, retro-reflective and thru-beam. In the material that follows, we'll look at the modes of operation, benefits, and drawbacks of each of these.

Diffused Mode

In diffused mode sensing, sometimes

called proximity mode, the transmitter and receiver are in the same housing. Light from the transmitter strikes the target, which reflects light at arbitrary angles. Some of the reflected light returns to the receiver, and the target is detected. Because much of the transmitted energy is lost due to the target's angle and ability to reflect light, diffused mode results in shorter sensing ranges than are attainable with retro-reflective and thru-beam modes.

The advantage is that a secondary device, such as a reflector or a separate receiver, is not required. Factors that can have an impact on diffused mode sensing range include the target's color, size, and finish because these directly affect its reflectivity and, therefore, its ability to reflect light back to the sensor's receiver. The table (*left*) illustrates the effect of the target on the sensing range for diffused mode sensing.

The *diffused convergent beam mode* is a more efficient method of diffused mode sensing. Here, the transmitter lens is focused to an exact point in front of the sensor, and the receiver lens is focused to the same point. The sensing range is fixed and defined as the focus point. The sensor is then able to detect an object at this focal point, plus or minus some distance, known as the "sensing window." Objects in front of or behind this sensing window are ignored. The sensing window is dependent on the target's reflectivity and the sensitivity adjustment. Because all of the emitted energy is focused to a single point, a high amount of excess gain is available, which enables the sensor to easily detect narrow or low

{applying
technology}

{applying technology}

reflectivity targets (Fig. 2).

The *diffused mode with background suppression* detects targets only up to a certain cut-off distance, but ignores objects beyond that distance. This mode also minimizes sensitivity to a target's color among the diffused mode variations. One main advantage of diffused mode with background suppression is the ability to ignore a background object that may be incorrectly identified as a target by a standard diffused mode photoelectric sensor.

Diffused mode with background suppression can operate at a fixed distance or at a variable distance. Background suppression can be accomplished technically in two ways, either mechanically or electronically.

With the *diffused mode with mechanical background suppression*, there are two receiving elements in the photoelectric sensor—one receives light from the target and the other receives light from the background. When the reflected light at the target receiver is greater than that at the background receiver, the target is detected and the output is activated. When the reflected light at the background receiver is greater than that at the target receiver, the target is not detected and the output doesn't change state. The focal point can be mechanically adjusted for variable distance sensors (Fig. 3).

In *diffused mode with electronic background suppression*, a position sensitive device (PSD) is used inside the sensor instead of mechanical parts. The transmitter emits a light beam, which is reflected back to two different points on the PSD from both the target and the background material. The sensor evaluates the light striking these two points on the PSD and compares this signal to the pre-set value to determine whether the output changes state (Fig. 4).

Retro-reflective mode

Retro-reflective mode is the second primary mode of photoelectric sensing. As

with diffused mode sensing, the transmitter and receiver are in the same housing, but a reflector is used to reflect the light from the transmitter back to the receiver. The target is detected when it blocks the beam from the photoelectric sensor to the

Retro-reflective mode photoelectric sensors are available with or without polarization filters. A polarization filter only allows light at a certain phase angle back to the receiver, which allows the sensor to see a shiny object as a target and not

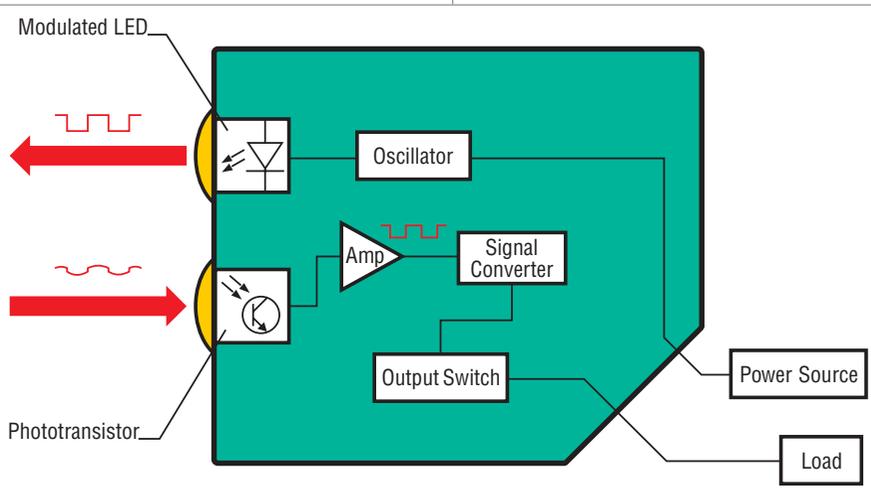


FIG. 1: Basic construction of a photoelectric sensor with light source and receiver plus electronics.

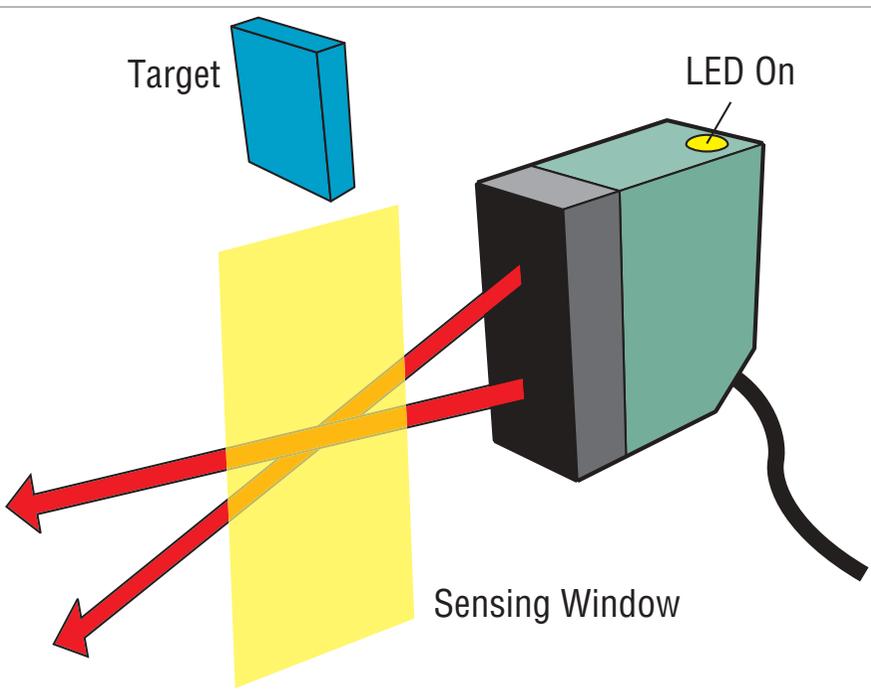


FIG. 2: Diffused convergent mode sensor.

reflector. Retro-reflective mode typically allows longer sensing ranges than diffused mode due to the increased efficiency of the reflector compared with the reflectivity of most targets. The target color and finish do not affect the sensing range in retro-reflective mode as they do with diffused mode.

incorrectly as a reflector. This is because light reflected from the reflector shifts the phase of the light, whereas light reflected from a shiny target does not. A polarized retro-reflective photoelectric sensor must be used with a corner-cube reflector, which is a type of reflector with the ability to accurately return the light energy,

{applying technology}

on a parallel axis, back to the receiver. Polarized retro-reflective sensors are recommended for any application with shiny targets (*Fig. 5*).

Non-polarized retro-reflective photoelectric sensors usually allow longer sensing ranges than polarized versions. However, they can falsely identify a shiny target as a reflector.

Retro-reflective mode for clear object detection photoelectric sensors use a low hysteresis circuit to detect small changes in light that commonly occur when sensing clear objects. The clear object mode sensors use polarized filters on both the sensor transmitter and receiver to reduce false responses caused by reflections from the target.

Retro-reflective mode sensors with foreground suppression will not falsely identify glossy targets as the reflector when they are within a certain distance, or dead zone. This mode is suited for detecting shrink-wrapped pallets, whereas a standard retro-reflective mode sensor can mistake the glossy covering for a reflector and not change state. Optical apertures in front of the transmitter and receiver elements in the sensor housing produce a zone to eliminate erroneous detection of reflective material.

Thru-beam mode

Thru-beam mode—also called opposed mode—is the third and final primary method of detection for photoelectric sensors. This mode uses two separate housings, one for the transmitter and one for the receiver. The light from the transmitter is aimed at the receiver; when a target breaks this light beam, the output on the receiver is activated. This mode is the most efficient of the three, and allows the longest possible sensing ranges.

Thru-beam mode sensors are available in a variety of styles. The most common includes one transmitter housing, one receiver housing, and one light beam between the two housings.

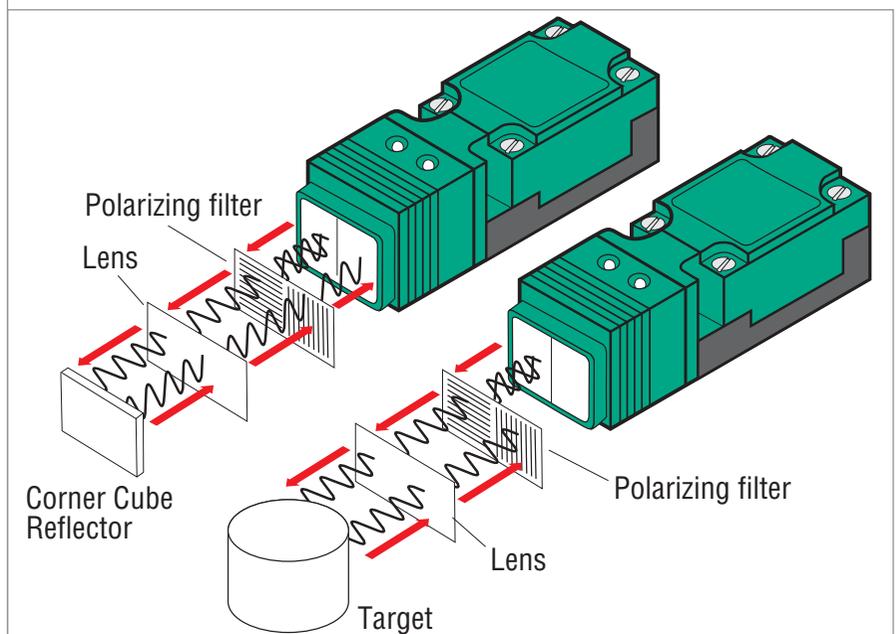
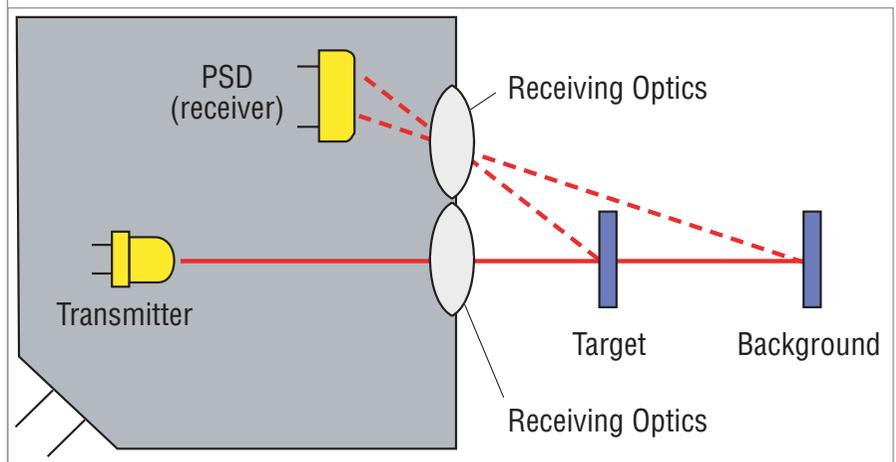
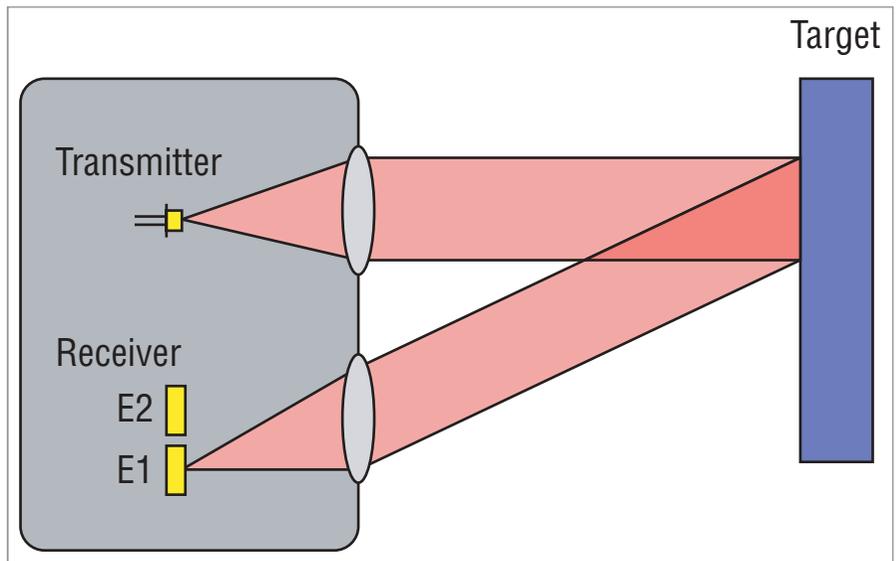


FIG. 3 (top): Diffused mode with mechanical background suppression. FIG. 4 (middle): Diffused mode with electronic background suppression. FIG. 5 (bottom): Retro-reflective mode photoelectric sensors are available with or without polarization filters.

{applying technology}

Another type is “slot” or “fork” photoelectric sensors that incorporate both transmitter and receiver into one housing, with no alignment required. Light grids are arrays of many different transmitters in one housing and many different receivers in another housing, which, when aimed at each other, create a virtual “sheet” of light beams.

Fiber optic sensing

Fiber sensors guide the light from the transmitter through either plastic or glass cables called fiber optic cables. In applications involving small targets or unfavorable conditions, fiber optic cables may be the optimum solution. Fiber optic cables allow either diffused mode or thru-beam mode sensing.

Glass fiber optic cables are constructed from tiny strands of glass that are bundled together inside an application-specific sheath. Glass fiber optic cables are typically more rugged than plastic versions, more efficient in light transmission (resulting in longer sensing ranges), and work well with both visible red and infrared light.

Plastic fiber optic cables are manufactured from a light conductive plastic monofilament material and are housed in a protective PVC jacket. They are typically more flexible and cost-effective than glass versions, can be cut to length, and work only with visible light.

Conclusion

As you can see, opting to use photoelectric sensors is just the first step in the selection process. Because of the wide variety of photoelectric technologies and modes of operation available, you must carefully think through the demands of the application, and select the exact technology and mode that best meets those demands. The good news is, with such an array of offerings, there is undoubtedly a solution that's a perfect fit. ■■■



About the authors

Ed Myers is an alumnus of Case Western Reserve University with a degree in biomedical engineering. He has been with Pepperl+

Fuchs for more than six years, and has been a photoelectric sensor product manager for three years.

Jeff Allison has been a photoelectric sensor product manager for Pepperl+Fuchs for three years. He has been with Pepperl+Fuchs for



more than seven years in various engineering capacities. Allison earned a BS in electrical engineering from the University of Akron.



Gary Frigyes heads P+F's photoelectric sensors division, and oversees the applications engineers. He graduated from the University of Akron (BSEE) and has eight years at P+F.

Application-specific photoelectric sensors

In addition to the standard modes of operation for photoelectric sensors, there are several application-specific sensors. These are used to solve nontraditional photoelectric applications, such as to detect changes in a target's color, porous targets, and invisible markings on products.

Here are examples of these sensors:

Color—Color sensors are available in a wide variety of styles and options. The most basic color sensors are single channel units, which can be programmed to detect a single color. More advanced units can detect up to ten unique colors and allow multiple shades to be programmed on the same channel. One application would include quality control where different colors are marked on the product, as a stage of production is complete. Another would be to program multiple shades of a color on the same channel. These colors could indicate the manufacturers acceptable range of color variance for a finished product in a dyeing or injection molding application.

Contrast—Contrast sensors are used to detect a difference in two colors or media. The sensor is first taught two different conditions. Next, it evaluates the current conditions. If the current target's reflected light is closer to the first condition, the output will remain off. If the current target's reflected light is closer to the second condition, the output will change state. A typical application for contrast sensing is registration mark detection before cutting or converting paper in the packaging industry.

Luminescence—Luminescence sensors are used to detect inks, greases, glues, paints, chalks and other materials with luminescent properties. Marks on irregular backgrounds and clear or invisible markings are easily sensed using an ultraviolet light source. Typical applications for luminescence sensors include detecting the clear tamper-proof seals on medicine bottles, and detecting a defective product that's been marked with chalk (i.e. a knot in a piece of wood).

Light grids—Light grids are used to create a grid or sheet of light. There are many variations, sizes and applications for light grids. Miniature, high-resolution light grids can be used for small parts counting. Larger grids can be used to ensure part ejection from a press before the next press cycle. Safety light grids are used to create a safe “perimeter” around a machine so that operators are protected from potentially dangerous parts of the machine.

Passive infrared—Passive infrared sensors are used to detect movement of an object within a defined sensing area or zone. The term passive is used because the sensor does not emit any light, but instead detects infrared emissions from an object with a temperature that is different than the surrounding environment. A typical application for passive infrared sensors is controlling automatic doors or lights.

Zone scanners—Much like passive infrared sensors, area scanners are used to detect the presence or movement of an object within a defined sensing area or zone. The main difference is that active infrared sensors emit light and are able to detect movement of an object in the area when the temperature of the target cannot be determined. A typical application could be detecting vehicles approaching an overhead door in a warehouse.

New!

LOSE THE WIRES... NOT THE SIGNALS

Transmit Analog and Digital Signals with Phoenix Contact Wireless Interface Modules.

Now you can monitor and control level, flow, pressure, temperature, alarms, etc., while eliminating costs for cable, conduit, trenching and boring.

- One way for monitoring, two-way for control with expandable I/O. Up to 34 analog or 68 digital signals.
- Reliable transmission up to 1000 feet—no line of sight. Transmits up to 20 miles.
- Frequency Hopping Spread Spectrum tolerates high-interference environments. No FCC license needed.
- Compact, robust packaging. No programming required.



Circle 34 on Control Solutions International RS Card

Visit our website at www.phoenixcon.com/wireless or call 1-800-322-3225



© 2004 Phoenix Contact Inc.

Transformer monitoring system and wireless link tie legacy serial devices to Ethernet networks

Don Neas, Technical Manager, Cirronet Inc. and Sylvain Lapointe, Product Manager, GE Energy

Monitoring mission-critical data from the components of a nation's power grid is not only essential to providing good customer service, but also has become an issue of public safety and national security. In today's world, our dependence on electricity has made it a necessity. At the same time, providing power is, of course, a business, and making economically-sound decisions is the key to serving customers and shareholders alike.

Monitoring electrical transformers doesn't just entail checking voltage and current. A number of key areas, such as leakage, temperature, acoustic emissions, tap position, solar radiation, and even the local weather condition, all need to be monitored in real time. As it turns out, getting that data from substations—which are often located in remote areas—to a central location can be costly as well as unreliable.

An example of this was a project GE Energy worked on in which it was approached by a major power supplier in the southeastern United States with a significant need to monitor transformers at a number of remote substations. GE Energy's T-MAP™ (Transformer - Maintenance Action Planner) product line was an ideal solution for collecting the data at the transformer, and viewing the

data at the customer's headquarters. However, getting the data back to the customer's corporate network posed some challenges.

Wireless versus wireline solutions

Not all substations are alike and, thus, their needs are different. T-MAP™ systems have built-in microprocessors that compare, compute, and relate the gathered data to user-set parameters. They then generate visual alarms, alarm signals and exception reports for immediate action when data levels exceed set parameters, making them ideal for the task. In this particular installation, the T-MAP™ 3100 collects transformer data from HYDRAN® 201Ti and AQUAOIL® 400 detectors, along with more than thirty other digital and analog sensors, while the T-MAP™ 2230 collects information related to the local substation's weather conditions.

Each T-MAP™ cabinet supports two transformers and a weather station. For small substations with a single cabinet, a cellular wireless transport back to the central monitoring location was an option. The downside to the cellular option was recurring monthly charges in excess of \$500 (USD) per month per cabinet. Another option was to run a wired telephone line to the cabinet to allow a dial-up connection. However, because of the need to protect the line

{applied solutions}

{applied solutions}

from the high electromagnetic fields that are present in a substation, the installation cost approached \$20,000.

Larger substations typically have an equipment shed with a high-speed wireline connection to a VPN. In these installations, the existing transformers already have wired connections to the shed in place. The issue is whether or not there is room for additional cabling in the trays. When there is room, this is the best option. However, when there is not, or when additional transformers must be added, cabling is not an option. In some instances, the ground may have been contaminated previously and, therefore, cannot be disturbed. Even without contamination, burying cable channels is difficult due to the ground grid that must be negotiated. In these instances, a wireless solution is the obvious choice. For this particular customer, using wireless communications was not only technologically feasible, it also was economically attractive.

Identifying a reliable wireless solution

A manager at the energy company had been researching wireless technology using products from Cirronet in Atlanta, GA. He was investigating the use of a wireless data link of approximately 1000 feet to connect the transformer monitoring equipment to the company's corporate wide area network. The communication link has to be reliable, easy to implement, and highly configurable, in addition to being affordable. Finally, since equipment is typically installed outdoors or in unconditioned environments, a wide operating temperature range is also a requirement.

It was decided that frequency hopping spread spectrum (FHSS) technology should be used to provide superior jamming and interference immunity in the difficult radio environment of an electrical substation. Reliability was of

paramount importance with the communications link, and by using FHSS with Automatic Retransmit Request (ARQ), reliable, transparent, error-free transmission was assured by the manufacturer.

GE Energy ordered a developer's kit from Cirronet, and spent several months testing the Transformer Monitoring System (TMS) with the radios prior to going on-site for a survey. It immediately found that because of existing obstructions, wireless communications would not be possible with the radios mounted in the T-MAP™ cabinet. An externally-mounted remote radio transceiver with an integrated patch antenna situated high enough to clear the obstruction solved the problem. In

addition, by using the remotely-located transceiver, long RF cable runs were avoided. As it turned out, a RF cable wouldn't have fit in the existing conduit, but the baseband cable fit easily.

Link overcomes interference

The initial testing was performed with two HopNet HN-3010 serial, weatherproof modems—one at the T-MAP™ cabinet and one at the equipment shed. The HN-3010 has a NEMA 4X (IP 66) rated enclosure, an internal 6-dB patch antenna, and operates between -30°C and +70°C.

Once the HN-3010 was mounted, it was simply pointed in the general direction of the receiving device. The HN-3010 at the equipment shed was con-



Industrial-Strength Wireless Ethernet



RUGGED. Designed for industrial applications, the SEM family of Industrial Wireless Ethernet Bridges is the latest group of wireless industrial communication products from Cirronet. With an extruded aluminum enclosure and wide-range input power supply, the SEM products can handle harsh industrial and factory floor environments. The SEM family of products is Class 1 Div 2 certified for use in hazardous environments.

RELIABLE. Built around Cirronet's proven frequency-hopping spread spectrum radio technology, SEM products send data reliably in the noisy, heavy multi-path environments in industrial plants and factories. SEM products use Cirronet's proven 2.4GHz radio technology that embodies 15+ years experience in industrial and factory floor wireless communications.

RAPID. With up to 1.23Mbps over the air data rate, SEM products have the bandwidth to support the data loads in full-duplex, multi-point networks with a minimum of latency. Bridging functions limit unnecessary traffic over the wireless links, saving the bandwidth for the important data.

Call Cirronet at +1 678.684.2000 to find out how to put our 15+ years experience to work for you or visit our website at www.cirronet.com.



www.cirronet.com • tel: +1 678 684 2000 • fax: +1 678 684 2001

Circle 35 on Control Solutions International RS Card

{applied solutions}

nected to a PC that collected the data, and a dial-up connection was made between the central monitoring location and the on-site PC. The data was then transferred to a server on the customer's network. Testing proved the robustness of the wireless link across the substation,

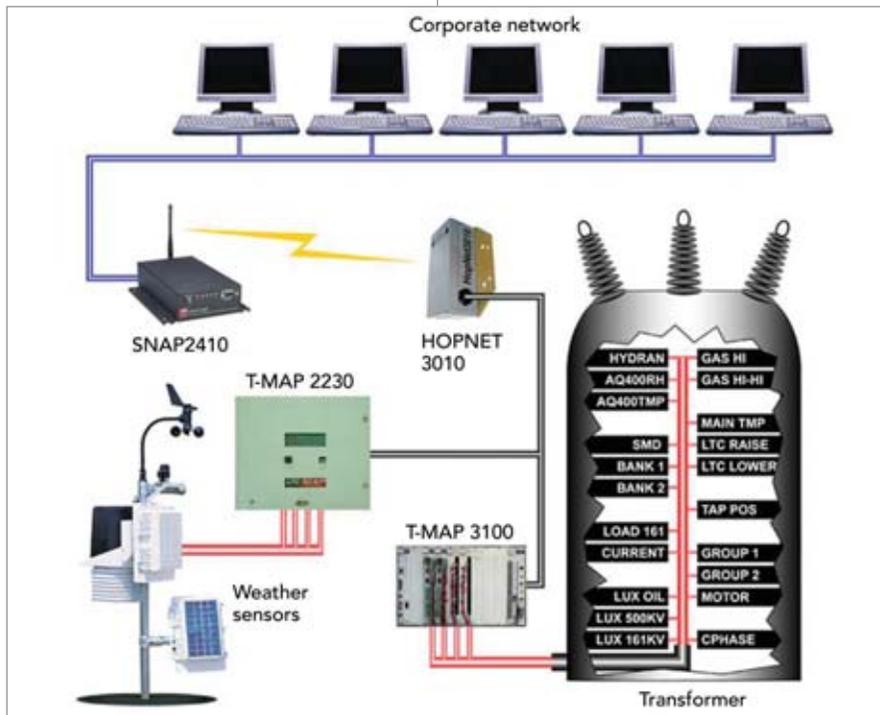
datagram, and transmits it on an Ethernet network to server-based or client-based applications. For data flow from devices on an Ethernet network, the SNAP extracts the payload data from the Ethernet datagram and transmits it to the appropriate non-Ethernet remote device based on the Ethernet destination address. The SNAP causes non-Ethernet remote devices to appear as nodes on the network with either individual IP addresses, or as individual port

work connection. A T-MAP™ 2230 used to monitor local substation weather data (that is, temperature, relative humidity, wind speed and direction, precipitation and solar radiation) is also running on the same link. The SNAP is connected to the VPN link in the equipment shed and appears as a node on the customer's network. Data from the T-MAP's is sent from the SNAP to GE Energy's monitoring application program running on a SQL server in the customer's central monitoring location. The application makes this information available to authorized users on the network. The SNAP is set up to use port numbers to address each remote T-MAP, thus requiring a single IP address for each substation—an important consideration of the customer's IT department.

GE Energy's equipment analysis software was used to pre-configure sensors and diagnostics. The T-MAP's monitoring software application—running on a SQL server connected to the corporate network—gathers data from the more than thirty digital and analog sensors, and makes it available online, either periodically or for polling whenever needed. The real-time data, alarm information, and parameters collected by T-MAP™ technology are viewed remotely from a PC on the corporate network hundreds of miles away. The diagram on p 54 shows how GE Energy's TMS systems interfaced with the Cirronet radios to link up with the corporate Ethernet.

Leveraging the technology

TMS and wireless radios to provide future Currently, the system is monitoring roughly five percent of the power company's transformers. Now that the capability of GE's TMS, coupled with that of Cirronet's wireless radios, has been demonstrated in the challenging RF environment of an electrical substation, it is expected the power provider will leverage this technology to monitor additional transformers at other substations. Clearly, GE Energy has provided its client with a reliable and cost-effective solution to a critical business need. ■■■



This diagram shows how the GE Energy's TMS T-MAP™ (Transformer-Maintenance Action Planner) systems interfaced with the Cirronet SNAP2410 radios to link up with the corporate Ethernet.

even with the high electromagnetic fields and other interference present. However, getting data from the serial output T-MAP™ to the corporate network was far from seamless.

Having determined that the RF performance was reliable, GE Energy began investigating the SNAP2410 access point from Cirronet. The SNAP2410 allows non-Ethernet serial devices to be seamlessly connected to Ethernet networks—which is exactly what was required for this application. The SNAP takes unformatted serial data from non-Ethernet remote devices, encapsulates the data in an Ethernet

numbers under the IP address of the SNAP. While testing was taking place, Cirronet released TCP/IP firmware for the SNAP that allowed it to work with standard Winsock routines, eliminating the need for any modification to existing network-based applications.

Cirronet's SNAP2410X network access point communicates with a HopNet 3010 remote radio transmitting the RS-232 serial communications from GE Energy's T-MAP™ 3100 system over a 460-kbps data link. The SNAP2410X remote transceiver is housed in a NEMA 4X (IP 66) rated enclosure, and can be mounted up to 300 feet from the net-

Automated water management system reduces engine test bench shutdowns

Guenter Randolf, Ph.D., Manager and Susanne Spiessberger, Ph.D., Technical Executive, GRandalytics, Gmunden. Austria

The challenge faced by the Austrian Magna subsidiary company Engineering Center Steyr GmbH & Co. KG was that of automating the monitoring and control of two coolant circulation systems for engine test benches. All operations of the water treatment plant, such as surveillance of the water level and water supply, switching the softener container, and initiating regeneration, needed to be registered and controlled by the new system.

The solution they chose was a system based on National Instruments' FieldPoint 2000 intelligent, distributed I/O and LabVIEW Real-Time software. The system ensures stability and enhances reliability and compactness due to the

capability it provides to directly integrate sensors without signal conditioning. Continuous data acquisition offers complete documentation, and the system can be monitored at any workstation via Ethernet and a Web browser.

Reasons behind the change

Engineering Center Steyr decided to install its new water management system because of the high utilization of its existing coolant facility. In test benches for combustion engines, water cooling is essential for operating the heat exchanger of the main cooling system and the eddy current brake. Closed or semi-closed cooling cycles reduce water consumption and increase economic efficiency. However, in semi-closed systems, additives and particles evaporate more slowly than water, causing the water's impurity and electrical conduc-

tivity to increase. At certain levels of conductivity, some water has to be replaced by conditioned water (desalination).

Cooling systems, such as micro controller-equipped units for softening or conductivity control, are widely spread throughout the facility. However, these stand-alone solutions will not act together sufficiently. Therefore, an innovative, overall control setup was designed that meets the given demands.

The new system

FieldPoint 2000 was selected to ensure high reliability and expandability of the controlling unit, and because it offered a short code development time. Each bank consists of one dual-channel terminal base with 4x PT100, 4x 4-20mA, and 2x 0-10V input channels, and one 16x digital output module. The user can save data locally on the control unit, provid-

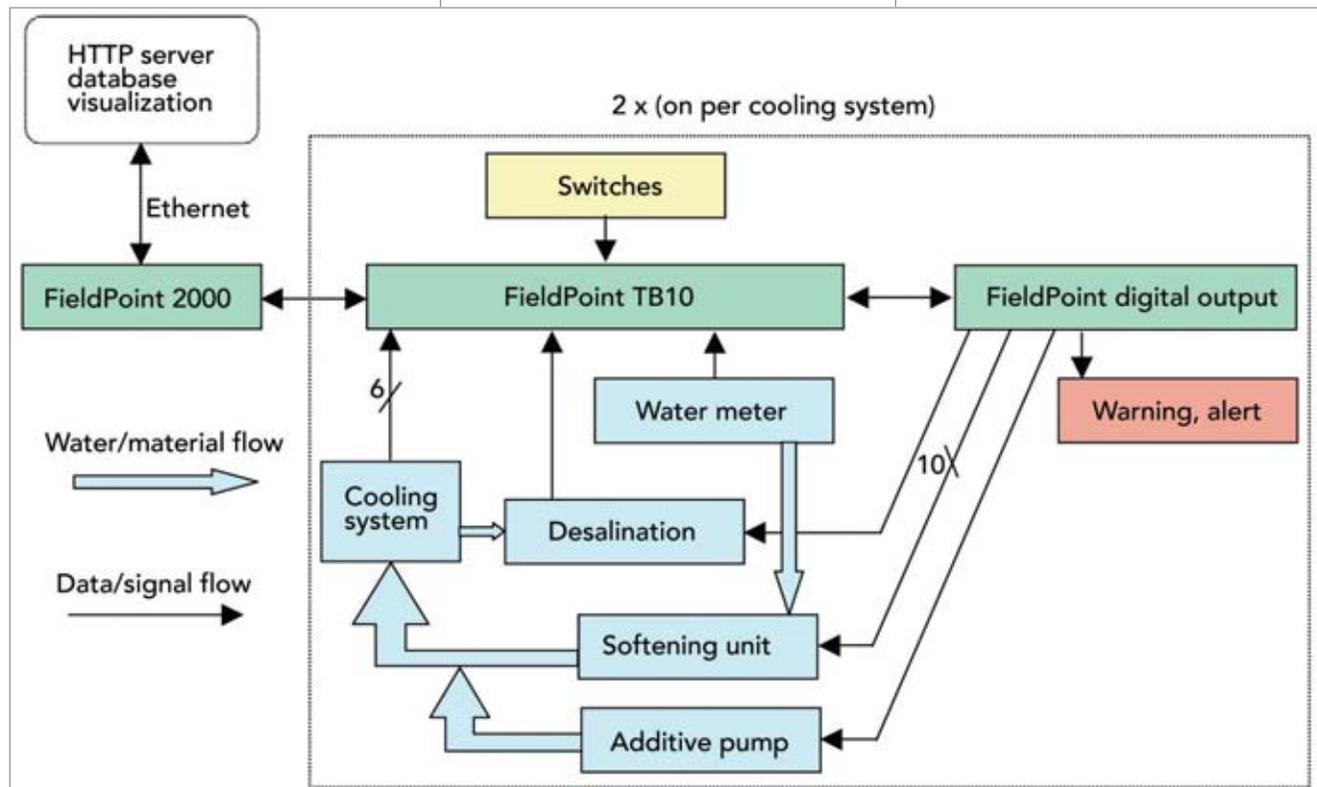


FIG. 1: Block diagram of the water management system.

ing an easy data upload to a local server. A user interface runs on the local server to provide information about the current and historical status, and can be used to request an upload or download of data. Figure 1 shows the block diagram of the setup.

The control unit that was developed performs several tasks, including monitoring of water level, temperature, pump pressure, conductivity, the supply of softened water, water hardness control, and regeneration of the softening unit. The same master unit controls both of the independent cooling cycles, and in case of emergency, each water treatment unit can supply both cooling systems. All relevant measurement data is logged automatically, which enables the deduction of important trends like the connection between water consumption and temperature.

Each cooling unit is equipped with sensors for conductivity, water con-

sumption, water level (ultrasonic), temperature, and pressure. Additional sensors (e.g., hardness and pH-value) can be embedded easily.

To guarantee high-quality refill water, each facility uses a twin tank alternating softening system. If one tank is substantially depleted after dispensing the specified water volume, it is switched to a regeneration status while the other tank continues to supply water. Since the required amount of refill water varies with cooling power, temperature, and so on, the capacity of the softening unit must consider even peak requirements. By using a new innovative controlling system, the unit can be scaled down to cover the average need.

Unlike many of the conventional controlling units, the new system enables subsequent regeneration only if the brine is ready. If a sufficient amount of time isn't provided for regeneration of the brine, hard water will enter the sys-

tem, causing fatal consequences such as calcification of the pipes and hot surfaces on the breaks and heat exchangers. Settings for either one or two brine barrels provide the fastest regeneration without any risk of overrunning the system. The required hardness of feed-water can be achieved through calculating the overall water hardness and operating a bypass valve accordingly.

Software features

A watchdog function periodically checks the regeneration process and valves. If a measurement channel provides out-of-range data, a warning or error condition arises. In this case, a snapshot of all parameters is stored and an alarm (flashing light and horn) is activated. The optical/acoustical signal is latched until it is acknowledged. To prevent loss of information due to a power failure, important data like regeneration phase or valve positions are periodically stored in a

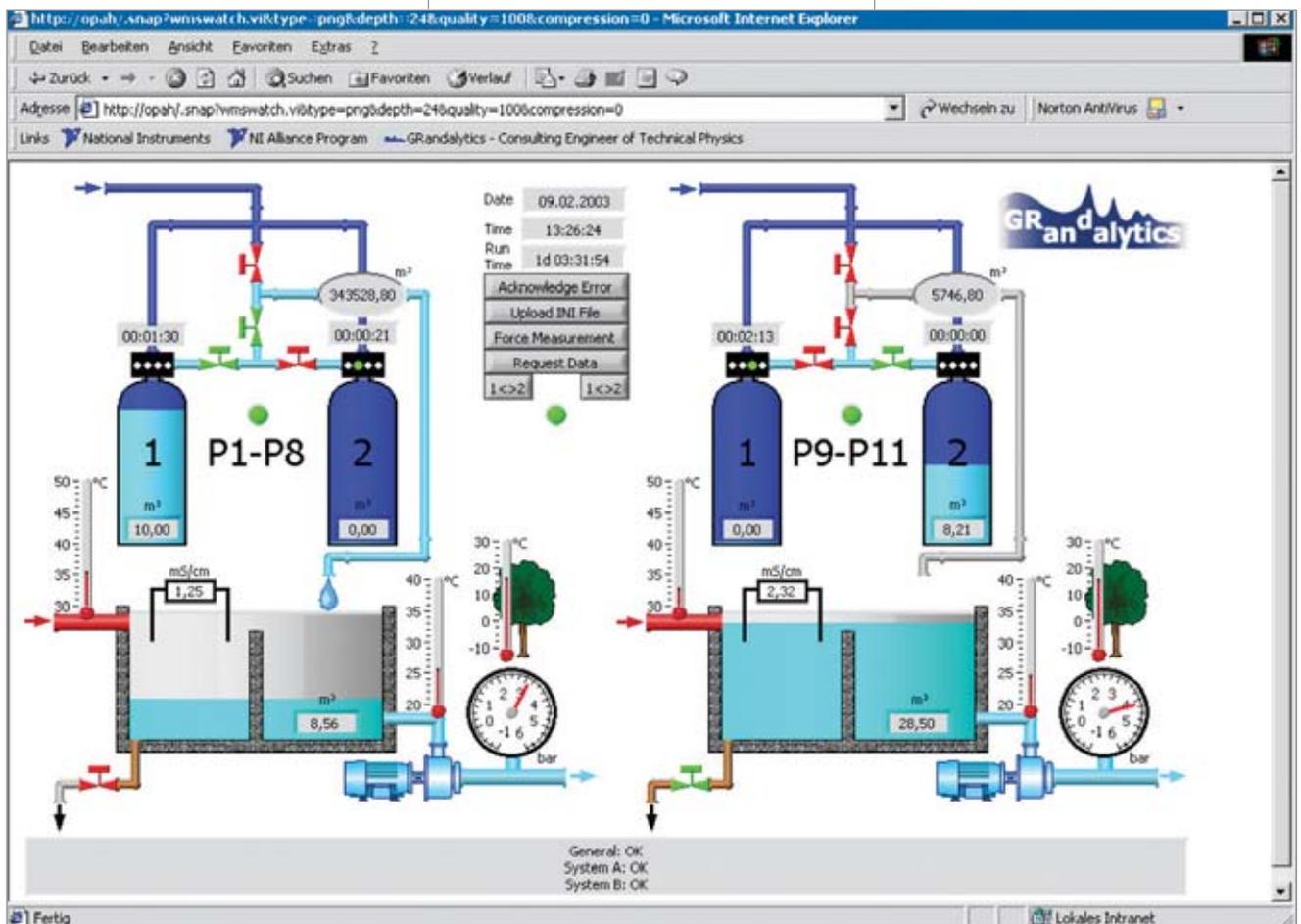


FIG. 2: Screen capture of the user interface.

{applied solutions}

temporary file on the flash RAM of the controller. After the device has been rebooted, the temporary file supplies all the information to the controller, which continues operating at the point of interruption. The internal error is cleared after each software cycle.

The online user interface (Figure 2) enables monitoring of data, which is provided by the controller via DataSocket. In online mode, the interface shows the actual status of all channels, error messages, regeneration information, and valve status. In offline mode, it displays charts and trends of historical data stored in the database. By performing a request-for-data, the latest information is uploaded from the FieldPoint 2000 flash RAM to the database. Through the LabVIEW HTTP server and CGI, both interfaces can be operated by a Web browser at any workstation.

Several calibration parameters and limits are stored in an initialization file. Changes to settings are made at the local server; thereafter, the user can request a download of the new file to the controller. The controller sends a request-for-file with a local and remote file name to the server, which transfers the file via FTP, followed by an OK tag. The controller checks the file for validation and replaces the old initialization file, which allows a safe update without interrupting the controller. The upload of measurement data is done similarly. For convenience, a new file is created each month, and data compression and automatic size check prevent an out-of-memory on the controller.

An innovative solution

This new network-based water management system works well, and provides an innovative overall solution to replacing the previous noninteracting controllers. The reliability of the FieldPoint controller, together with software safety features, prevents system crashes that can cause a considerable loss of pro-

duction time. Fully automated measurements make the operation much more convenient. In addition, they make it more time and cost effective by lowering personnel costs and downtime.

The new system supports higher water capacity at a good quality, reducing the number of shutdowns and fatal consequences caused by high water hardness. It also enhances flexibility as

each water treatment unit can supply both cooling systems by cross switching. Water is saved because the new system prevents the complete draining of the cooling basins. Furthermore, the modular setup of the system allows future, low-cost expansion and adaptation with regard to other facilities. Considering all these factors, the user saves up to ten percent of total costs. ■■■

World's Broadest Range of Ethernet HMI Solutions



Complete Range programmed by one software package!

Custom embedded solutions

Ethernet Solutions

- For the whole UniOP family
- For your Intranet & the Internet
- Multi-server, Multi-client networking
- Share information among UniOps
- Tiny Webserver
- Dual Protocol bridging
- Dual Network bridging
- OPC server for SCADA or low cost data acquisition
- Ethernet drivers for:
 - Ethernet IP (Contrologix & more)
 - A-B Ethernet (SLC500 and more)
 - Modbus TCP and much more...
- Lowest cost ethernet solutions



Handheld pendant for robotic applications and more...



PH: 513.874.0900
FX: 513.874.2707
info@exor-rd.com
www.exor-rd.com

Circle 36 on Control Solutions International RS Card

QUALITY STARTS HERE

OTEK™
"VIRTUAL WIRE"
TR550

8 CHANNEL WIRELESS
 ANALOG I/O

For Wireless Data Transfer and
 wireless on-off control of any
 variable converted to V/mADC.



- * Can be used as stand alone wired Data Transmitter
- * Receiver has OFFSET, SCALE, HI-LO limits and FAIL-SAFE
- * Also available in Sanitary and Explosion Proof housings.



NEMA 4X Mount

Other Models:

TR500-510 Analog I/O
 TR530 (8) Relays I/O
 TR540 (8) Analog In/Relays Out

LIFETIME WARRANTY!

OTEK™

www.otekcorp.com
sales@otekcorp.com

TEL: 520-748-7900 FAX: 520-790-2808
 Toll Free: 866-227-6835

Circle 40 on CS Int'l Reader Service Card

MaxStream™ Wireless Modems

have what WiFi,
 Bluetooth & other
 RF solutions do not...

RANGE

**MAXIMIZE
 YOUR RANGE** **The Best**

With up to -114 dBm receiver sensitivity, MaxStream has up to 64 times the range of WiFi and Bluetooth, and up to 8 times the range of competing RF solutions.

**LONG RANGE
 AT LOW POWER** ↓

MaxStream's output power hits a sweet spot for wireless systems demanding long range at low power (Sleep modes to 20 µA).

**LONG RANGE
 FOR LOWER COST** \$

Cover more ground with fewer radios! MaxStream has the most compelling performance-to-cost ratio in the wireless device networking market.



MaxStream™
 The long range leader.™

Order your development
 kit at 866-765-9885
www.maxstream.net

FREE unlimited support

Circle 38 on CS Int'l Reader Service Card

Circuit Specialists, Inc.

Since 1971

**PC-Based Measurement &
 Automation**

Plug ADLINK, Play LabVIEW™

Fully compatible with National
 Instruments™ easy-to-use LabVIEW™
 hardware programming interface.



Largest Selection
 of PCI BUS

Big Selection &
 Low Prices !

1-800-528-1417

Fax: 480-464-5824

Details & Ordering @

www.CircuitSpecialists.com

Circle 37 on CS Int'l Reader Service Card

Quick Connection for Field Devices

The time consuming task of assembling field wireable connectors to sensors or cordsets is eliminated with Quickon-One, a two-piece, screwless connection system that utilizes industrialized IDC contacts. The integrated IDC contacts, which provide a gas tight connection, eliminate the potential for lost screws or stray copper strands during the assembly process.



Phoenix Contact Inc.
 800-322-3225

www.phoenixcon.com
info@phoenixcon.com

Circle 41 on CS Int'l Reader Service Card

Counter/Totalizer/Event Dataloggers

The OM-CP-PULSE101 is a low-cost recording device that will sense a pulse input or contact closure from external sources such as transducers or pulse initiators (gas, water, and electric meters) and transforms those inputs into engineering units. In addition, the device allows storing user defined units such as gallons/min as well as scale factors and offset values. This enables the user to easily linearize and scale any transducer that provides a pulse or contact closure output to any user required units automatically. Price is \$199.00.



Omega Engineering, www.omega.com/DAS/pdf/OM-CP-PULSE101.pdf

Circle 39 on CS Int'l Reader Service Card

{product focus}

Distributed Data Acquisition !

webDAQ/100™



Now with Modbus protocol and limit alarms!

complete system in a box with computer, DAQ, ethernet, web server, FTP, e-mail 500 KHz, 32 Channels, 12 Bits plus 8 waveform outputs

\$ 995



Call 1-800-234-4232 or visit us at www.cectp.com/cos

Circle 42 on CS Int'l Reader Service Card

Ethernet I/O Made Easy

- Significantly lower cost than a PLC or I/O cards for M2M applications.
- Takes only minutes to set-up.
- No programming required.
- All software and communication drivers included.



The JNIOR ("junior") easily connects digital, analog and serial signals to your Ethernet network that can be viewed and controlled via a web browser or from your own application.

Visit us at <http://www.integpg.com> for more information.

INTEG process group, inc.
11279 Perry Highway, Suite 502
Wexford, PA 15090
724-933-9350, sales@integpg.com.

Circle 44 on CS Int'l Reader Service Card

POWERFUL NEW

Silver Series

Graphic Touchscreen HMIs



- Ethernet Ready*
- Compact Flash*
- Pop-up Windows
- Macros & Recipes
- High Speed Animation
- Supports 85+ Controller Families
- Superior Graphics



Prices Start **\$495**

Quantity discounts available!



maple-systems.com

425.745.3229

* Available on most models

Circle 45 on CS Int'l Reader Service Card

FLAT PANEL MONITORS

Flat panel monitors for process and industrial control.

Available in a variety of sizes and configurations including touch screens. Direct connection to



any PC or Workstation platform. No special software, hardware, cables required. Full industrial ratings. ISA booth 2057 new products include Class I Division 2 ratings and NFI touchscreens.

Christensen Display Products
www.christensendisplay.com, 425-222-3800,
FAX: 425-222-3802.

Circle 43 on CS Int'l Reader Service Card

Benchtop Controller with Ethernet

The CSI8D Series Benchtop Controller is built around OMEGA's iSeries family of meters and controllers, and features optional Ethernet connectivity.

This pre-wired ready-to-go unit features a portable, rugged, metal case with tilting handle. Its totally programmable color displays feature larger than normal digits that indicate setpoint and process simultaneously. The universal sensor input is field programmable to work with most standard T/Cs, RTDs and voltage or current signals. The unit operates on 90 to 240 VAC at 50/60 Hz. Price starts at \$685.



Omega Engineering, Info@omega.com
www.omega.com, 203-359-1660.

Circle 46 on CS Int'l Reader Service Card

Connect pushbuttons to DeviceNet

The FDN20 DeviceNet station connects pushbuttons to a DeviceNet™ network. The FDN20-4S-4XSG-E is the perfect pushbutton solution. It is

compact, rugged, and inexpensive, and has a built-in DeviceNet eurofast® connector. The device easily fits into any standard pushbutton enclosure. Mounting the FDN20 is easy. Simply drill a hole in the center of the bottom of the pushbutton enclosure. The FDN20's DeviceNet™ eurofast connector is then inserted into the hole and the lock nut is tightened.



Interlink BT, 763-694-2300, 888-546-5880.
www.interlinkbt.com

Circle 60 on CS Int'l Reader Service Card

Miniature Electronic Ice Point

The MCJ converts thermocouple voltages into 0°C referenced signals, for use with DMMs, voltage recorders and other electronic devices. The signals from the MCJ

can be converted to temperatures, using the standard temperature-mV tables. It is compatible with any standard thermocouple connector or jack; use ordinary copper wire to connect from the MCJ to any instrumentation for precise ice point referenced readings. Additional features include: ±1°C stability over entire 10 to 45°C operating range is assured through the computer designed solid state circuit; Weight < 2 oz (57 g), and dimensions: 75 H x 25 W x 13 mm D (2.94 x 1 x 0.5").



Omega, <http://www.omega.com/ppt/pptsc.asp?ref=MCJ&Nav=temk05>.

Circle 47 on CS Int'l Reader Service Card

{product focus}

new products}

The BX Controller fills gap for low- to mid-range machine control

The IP20 rated BX Controller is positioned between Beckhoff's IP20 rated BC and CX controllers in both price and functionality, and uses the same type of low-cost bus terminal I/O modules. The complete line, including high-end PC based systems, is programmed with TwinCAT IEC1131-3 PLC and Motion software. Other highlights of the new controller include: standard fieldbus port for Profibus, DeviceNet, Ethernet TCP/IP, CANopen, and RS232/RS485; standard RS232/RS485 port; built-in SSB bus for peer to peer and HMI communications; built-in display with navigation button for diagnostics, troubleshooting and configuration; real-time clock; and multitasking capability.



Beckhoff, www.beckhoffautomation.com.

Circle 101 on Control Solutions Int'l RS Card

Industrial Ethernet switch is tough enough for the military

The EB-GT-8ES-1EP is an extended power, 8-port switch rated for MIL-STD-1275. These Ethernet switches offer protection against over voltage, power dips, and power spikes as large as 250 V. The packaging is IP67 rated against water, oil, dust, and is vibration and corrosion resistant. It has been certified for marine and offshore use, is reliable in conditions of -40 to 60°C, and provides 1 million hours MTBF. This fieldbus style, real-time Ethernet switch mounts directly onto a machine or vehicle, with no additional enclosure required. This allows for a number of mounting possibilities and provides reduced installation costs and deterministic control.



SIXNET, www.sixnetio.com.

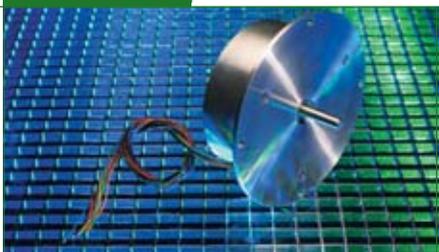
Circle 102 on Control Solutions Int'l RS Card

Low-profile, high-efficiency brushless dc motor

The 000-0362 high-performance brushless dc motor is suitable for applications where high power needs to be efficiently produced in very limited space. Designed with an operating voltage of 28 V, this motor is capable of delivering in excess of 45 oz-in of continuous torque. This is accomplished in a 1.85-in. profile and a motor diameter of 4.2 inches. The motor, which can achieve an efficiency of 85% at its load point, uses Hall-Effect sensors, though other drive-specific commutation methods can be used.

Servo Magnetix Inc., www.servomag.com.

Circle 103 on Control Solutions Int'l RS Card



Microsoft .NET Connected Global Enterprise Asset Management solution

Avantis.PRO Release 4.0 combines asset management with Microsoft-based technologies to deliver asset intelligence across enterprises that span multiple locations and geographies—supporting business units that operate both autonomously and collaboratively within the global enterprise. Consolidated operations and maintenance business intelligence over the entire enterprise enables efficiencies and cost savings in the areas of maintenance, inventory, procurement and invoicing. Avantis Release 4.0 offers a rich user interface and the functional depth of traditional client-server desktop solutions with the low-cost deployment of Web-based applications.

Invensys' Avantis, www.avantis.net.

Circle 104 on Control Solutions Int'l RS Card

Self-contained, 100A current monitor

In many applications you need to know if a load is active or not, and provide this information to an indicator or PLC for further processing. In the past, an auxiliary power supply and a current transformer were used. Now, this can be done with the DIA53 Series current monitoring relay with a solid-state output. In a DIN rail mount housing 17.5 mm wide with a 12mm through-hole, the DIA53 is self-powered and capable of monitoring up to 100A ac with an isolated transistor output. Current monitoring ranges are available for: 2-20A, 5-50A and 10-100A ac. To minimize inventory, it can be wired for NPN or PNP switching. A red LED visually indicates an alarm condition.

Carlo Gavazzi, www.gavazzionline.com.

Circle 105 on Control Solutions Int'l RS Card



Multi-functional, configurable safety relay

The new Telemecanique® Preventa™ XPS-MCA multifunctional, configurable safety relay complies with global machine safety standards. The unit is said to be a practical and affordable alternative to safety PLCs because it doesn't require replacing legacy PLCs to achieve compliance. The safety relay, which is designed for applications requiring multiple simultaneous safety functions, features 22 certified safety functions for applications that must conform to category 4 of EN 954-1. These functions, which include monitoring of emergency stops, guards, two-hand control, coded magnetic switches, zero speed detection, safety mats or security light curtains, can be configured with XPS MCWIN software running under Windows. Two versions of the relay are available—with either 16 or 32 safety inputs and eight outputs. It is available with plug-in connectors fitted with either screw or spring terminals.

Schneider Electric, www.us.SquareD.com, www.us.telemecanique.com or www.us.schneider-electric.com.

Circle 106 on Control Solutions Int'l RS Card



Expert system gives access to Greg Shinskey's know-how

A new expert system, the Control Consultant, is now an integral part of ExperTune's PlantTriage product. The system has captured the know-how of process control expert Greg Shinskey, allowing engineers to tap into and gain the benefit of his experience. Explains Expertune founder and president John Gerry: "Many of our clients have very subtle and often misleading symptoms from their automation systems, and often don't have enough time to solve many of the problems found in operating plants. We developed the Control Consultant to assist them in getting the right answers as fast as possible, and tests have shown that it is invaluable for engineers and managers seeking to wring the last drop of profit out of plants of all ages and types."

ExperTune Inc., www.expertune.com.

Circle 107 on Control Solutions Int'l RS Card

control solutions
international

{ad index}

Company	Page	Phone	Email/Web site	Reader Service
AutomationDirect	32,33,C2	800-633-0405	info@automationdirect.com/www.automationdirect.com	13,14,1
Banner Engineering Corp.	42,C4	888-373-6767	sensors@bannerengineering.com/www.bannerengineering.com	23,50
Capital Equipment Corp.	61,26a-b	603-472-1068	info@cec488.com/www.cec488.com	42
Christensen Display Products	61	425-222-3800	info@christensendisplay.com/www.christensendisplay.com	43
Circuit Specialist, Inc.	60	800-528-1417	jr@cir.com/www.CircuitSpecialists.com	37
Cirronet	55	678-684-2000	indust@cirronet.com/www.cirronet.com	35
CONTEC Microelectronics USA Inc.	43	800-888-8884	sales@contecusa.com/www.contecusa.com	24,25
Encoder Products Co.	19	800-366-5412	sales@encoder.com/www.encoder.com	11
EXOR	59	513-874-0900	info@exor-rd.com/www.exor-rd.com	36
Fluid Components International	44	800-863-8703	info@fluidcomponents.com/www.fluidcomponents.com	26,27
+GF+ SIGNET	34,35	626-571-2770	www.gfsignet.com	15,16
ACT	11	32-2-767-0895	www.act-control.com/actgmbh@compuserve.com	9
*Honeywell Process Solutions	Insert		www.honeywell.com	
IDEC Corporation	36,37	800-262-4332	www.idec.com/usa	17,18
IKEY	45	800-866-6506	www.ikey.com	28,29
INTEG Process Group	61	724-933-9350	sales@integpg.com/www.integpg.com	44
InterlinkBT	38,39,61	888-546-5880	www.interlinkbt.com	19,20,60
Invensys/ArchestrA	3,5	866-746-6477	www.invensys.com/ArchestrA	4,6
ITAC Systems, Inc.	C3	972-494-3073	sales@itacsystems.com/www.itacsystems.com	49
Lake Monitors	46	800-850-6110	sales@lakemonitors.com/www.lakemonitors.com	30,31
Maple Systems Inc.	61	425-745-3229	maple@maple-systems.com/www.maple-systems.com	45
MaxStream	60	866-765-9885	info@maxstream.net/www.maxstream.net	38
Minco Products, Inc.	19	763-571-3121	info@minco.com/www.minco.com	12
National Instruments	40,41	800-891-2755	info@ni.com/www.ni.com	21,22
Omega Engineering	1,60,61	203-359-1660	info@omega.com/www.omega.com	2-3,39,46,47
Otek Corporation	60	520-748-7900	sales@otekcorp.com/www.otekcorp.com	40
Phoenix Contact	54,60	800-322-3225	info@phoenixcon.com/www.phoenixcon.com	34,41
QSI Corporation	49	866-466-8159	info@qsicorp.com/www.qsicorp.com	32,33
Schneider Electric	7,9	33-1-41-29-85-00	www.schneider-electric.com	7,8
Softing AG	4	49 (89) 4 56 56-340	info.automation@softing.com/www.softing.com	5
Vaisala Inc.	15	781-933-4500	incsales@vaisala.com/www.vaisala.com	10

* partial run

{US Sales Offices}

Northeast & Southeast US, Michigan, Ohio, Indiana, Eastern Canada, ME, NH, VT, MA, RI, CT, NY, NJ, PA, DE, VA, NC, SC, GA, FL, WV, TN, KY, AL, MS

Mitch Plotnick
1009 Bradley Court
Mt. Laurel, New Jersey 08054
Phone: +01-856-638-0361
Fax: +01-856-638-0360
E-mail: mitchp@pennwell.com

Western & Southwest US, Western Canada, IL, MN, WI, IA, MO

Cheryl Gonsalves
11116 Wayfield Road
Riverside, California 92505
Phone: +01-909-689-2577
Fax: +01-909-689-1030
E-mail: cherylg@pennwell.com

AR, OK, LA

Bill Cariello
1421 South Sheridan Road
Tulsa, Oklahoma 74112
Phone: +01-918-831-9105
Fax: +01-918-832-9201
E-mail: bcariello@pennwell.com

{International Sales Offices}

China, Hong Kong

Adonis Mak
Act International
Room 3401, 34/F
Hopewell Centre
183 Queen's Road East
Wanchai, Hong Kong
Phone: 852-2-838-6298
Mobile: 852-9018-2962
Fax: 852-2-838-2766
E-mail: adonism@actintl.com.hk

France, Belgium, Netherlands, Spain

Luis Matutano
ADECOME+
48, rue de l'Alma
92600 Asnieres sur Seine
France
Phone: 33-(0)1-47-91-70-11
Fax: 33-(0)1-55-02-03-85
E-mail: luism@pennwell.com

Germany, N. Switzerland, Austria, Eastern Europe

Johann Bylek
Verlagsbuero Johann Bylek
Dornacher Strasse 5
D-85622 Feldkirchen
Phone: 49-89-904-80-144
Fax: 49-89-904-80-145
Email: johannb@pennwell.com

Japan

Manami Konishi
Japan Advertising Comm.(JAC)
Three Star Building
3-10-3 Kanda Jimbocho
Chiyoda-ku, Tokyo 101-0051
Phone: 81-3-3261-4591
Fax: 81-3-3261-6126
E-mail: mkonishi@media-jac.co.jp

Italy, Slovenia

Jean-Pierre Bruel, Managing Dir.
Medias International
Via Trieste 17-22066
Mariano Comense
Italy
Phone: 39-03-1751494
Fax: 39-03-1751482
E-mail: medias@pcbrianza.net

United Kingdom, Scandinavia

Michael Wolf
PennWell Corporation
Ecclesbourne Reading Road
Wallingford, Oxon
OX10 9DT
Phone: +44 (0)1491 824 233
Mobile: +44 (0)7766 226 320
Fax: +44 (0)1491 826 875
E-mail: michaelw@pennwell.com

Taiwan

Infocomm, Inc.
Arco
7F-1, No. 5, Sec. 1
Pa-Te Road
Taipei, Taiwan R.O.C. 100
Phone: 886-2-2396-5128
Fax: 886-2-2395-9571
E-mail: vicky@arco.com.tw

Korea

Mr. Song YJ
Chom Dan, Inc.
353-4 Chom Dan Building
Seokyo-dong, Mapo-ku
Seoul, Korea 121-210
Phone: 82-2-322-0525
Fax: 82-2-323-5324
E-mail: songyj@chomdan.co.kr

Linux above and below the board

Wayne Labs
Senior Technical Editor

tired of endless security updates, new virus definitions—sometimes three in 36 hours, proprietary code that can't be fixed until the vendor decides it's time to patch it?

One alternative is Linux. This less-vulnerable operating system is beginning to get some well-deserved respect from both the enterprise level and the embedded level, and there's even some adoption at the desktop level, where illicit user software add-ons, screensavers, and infected email reign supreme.

During his LinuxWorld 2004 keynote address, Ross Mauri, IBM vice president technology and strategy explained why his company embraced this open source OS. "In 2000," said Mauri, "IBM saw the potential of Linux to disrupt the IT industry. Linux was modular, it was elegant and it ran on any hardware architecture. To developers and the customers who were drawn to it, Linux represented freedom...freedom from lock-in, from any one vendor controlling the industry's destiny and the choices available to customers."¹

Mauri went on to cite statistics from the various research groups that indicate Linux is, without question, on the move. Gartner, he said, reported that 45% of mid-sized businesses are using Linux or experimenting with it. IDC projected that Linux server shipments will grow at a CAGR of 28% through 2007. A SG Cowen survey of more than 500 IT users in North America

found Linux was in use at nearly 80% of their sites—with 72% on servers and 15% on desktops.

Besides normal number crunching applications, Linux finds use in a host of other powerful applications. For example, Locus Pharmaceuticals conducts research and drug design for HIV, AIDS, and other viral infectious diseases. They have an existing 2.3 teraflop supercomputing infrastructure, and when they need more, they tap into Linux clusters at IBM's Deep Computing Capacity on Demand center.

At the other end of the Linux world is the embedded device. You may be familiar with TiVo, the set-top TV recorder that runs on Linux. In addition, Linux is showing up in PDAs, handhelds, cell phones, wireless gear, media players, radar systems, airplane navigation, and is finding its way into industrial devices as well. Check out Opto 22's recent SNAP-ARL-ASDS OEM I/O family, which is based on a Linux I/O processor. Not that Opto is the only game in town. Sixnet's SixTRAK IPm Open DCS controller (www.sixnetio.com) is another example that I covered in this column in November, 2002, and Charlie Breen, recently retired CEO of Comark Corp., showed me a few years ago an I/O controller with an embedded Linux OS.

Opto is seriously committed to Linux. Says its vice president of engineering, Mark Engman, "The SNAP OEM I/O hardware clearly reflects Opto 22's commitment to using standard, open technologies in developing its products. By providing complete user programmability for the I/O interface, along with multiple process support and diverse communications capabilities, SNAP OEM I/O can effectively augment, or in some cases even replace, the functionality of a PC or PLC in many environments."

The United States Postal Service uses more than 6,000 Linux computers running OCR to read envelope addresses. Mercedes-Benz AG uses Linux to develop new electronic systems for Mercedes cars like ESP (Electronic Stability Program). And my point to all of this is, you could be using Linux to, well, you tell me. The possibilities in industrial automation and control—possibilities both above and below the board level—are only limited by your imagination. ■■■

¹LinuxLine, February, 2004, IBM: <http://www-1.ibm.com/linux/linuxline/feb04/unstoppable.shtml>.

{control software
upload/download}

Got Dirt?



Whether you need commercial grade reliability combined with reduced RSI risk in the control room, out and out ruggedness with outstanding precision, or a mouse that can simply handle just about any environment imaginable, there is a MOUSE-TRAK™ to fit your needs.



MOUSE-TRAK Professional

Thousands delivered with systems in control rooms throughout the world. Outstanding reliability and ergonomics designed to reduce the risk of Repetitive Stress Injuries.

MOUSE-TRAK Professional offers good ergonomics and a considerable step up in reliability over consumer mice and trackballs. This is why some of the biggest suppliers in the process automation industry ship MOUSE-TRAKs with their systems.



MOUSE-TRAK Industrial

Thousands installed in process control applications where the environment is tougher than the average control room.

Retaining the ergonomics features of the MOUSE-TRAK Professional and adding a super tough Xenoy plastic case and conformally coated circuit assembly, the MOUSE-TRAK Industrial is so tough that our President threw one out of a private plane from 500 feet to prove that it would still work.

It did.



Sealed Dome MOUSE-TRAK

ITAC'S newest solution to user input needs where the environment is just too tough for anything else.

It's less precise than our trackballs, but this unit can handle whatever you want to spill on it. Provides more tactile feedback than other sealed input devices. NEMA 4 capable when it leaves our factory and still NEMA 4 capable after you have installed it.

Designed to be mounted in a control panel and will work at any mounting angle.

Visit our web site today to learn more and to enter our Notebook PC Contest.

ITAC Systems, Inc. 800-533-4822 or 972-494-3073

www.itacsystems.com

Circle 49 on Control Solutions
International RS Card

© Copyright 2002 ITAC Systems, Inc. 3113 Benton Street Garland, Texas 75042

Introducing ultrasonic sensors that **think** as well as they **hear**.



U-GAGE®: Banner's Industry-leading Technology for Ultrasonic Sensors



Extremely Accurate Measurement

- ▶ Ranges from 30 mm to 8 m.
- ▶ Sensing resolution from 0.1% to 0.25% of sensing distance.
- ▶ Sophisticated microprocessor control ensures consistent performance.
- ▶ Temperature compensated models available.

Incredibly Easy to Use

- ▶ Fast push-button programming of custom sensing windows.
- ▶ Can be programmed remotely via TEACH wire.
- ▶ Configuration for direct liquid level control available.



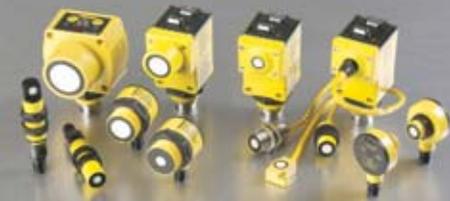
Amazingly Versatile

- ▶ Microprocessor sets an infinite number of ranges and sensing windows.
- ▶ One model can replace hundreds of older style ultrasonics.
- ▶ Variety of analog and discrete outputs available.
- ▶ Unique housing styles and mounting options for your application.



Solve Difficult Sensing Problems

- ▶ Inherently immune to color differences and light interference.
- ▶ Designed to survive hostile environments.
- ▶ Ideal for clear material applications.



Learn more at:
www.bannerengineering.com/ugage

1.763.544.3164



more sensors, more solutions

© 2003 Banner Engineering Corp., Minneapolis, MN

bannerengineering.com

Circle 50 on Control Solutions International RS Card