

Your guide to practical products, technologies and applications

# Automation NOTEBOOK

Spring 2014

ISSUE 28

Cover Story

## Beyond the Machine: OEMs Provide System Integration

New Product Focus

IronHorse® GSD Series DC Drives -  
1/50 HP to 3 HP



Tech Thread  
Improving Pneumatic  
Energy Efficiency

Student Spotlight

What a Drag!

CO2 powered drag strip teaches  
students the science of speed

User Solutions

An Affordable Retrofit Prevents  
Expensive Replacements

# C-more<sup>®</sup> around your plant!

Practical, Powerful and Priced Right

## C-more operator touch panels offer:

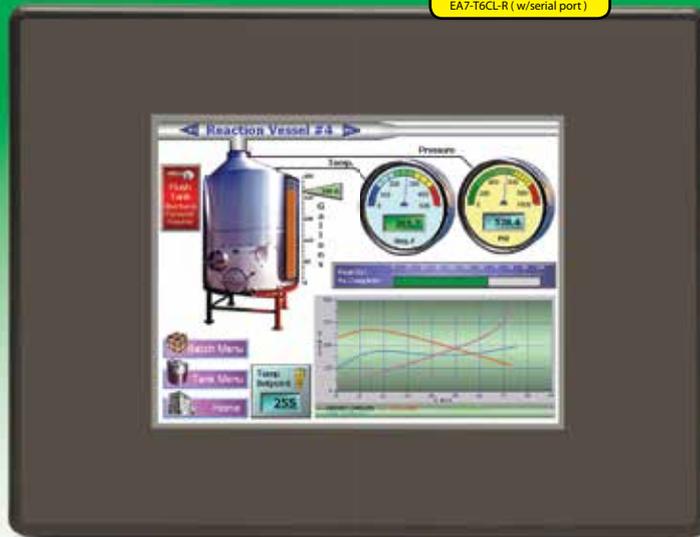
- Clear TFT 65K color displays with 6 to 15-inch screens (6-inch STN models also available)
- Analog touch screen for maximum flexibility
- Easy-to-use software

Our C-more remote HMI application, for iPad<sup>®</sup>, iPhone<sup>®</sup> or iPod touch<sup>®</sup>, is available on the App Store for \$4.99. It provides remote access and control to a C-more panel for mobile users who have a wi-fi or cellular connection.



6" TFT Touch Panel

starting at:  
**\$540.00** U.S.  
EA7-T6CL-R (w/serial port)



C-more touch panels in 6" to 15" screen sizes are a practical way to give plant personnel easy access to controls and data. Check out the powerful yet easy-to-use configuration software by downloading a demo version at:

<http://support.automationdirect.com/demos.html>

### ALL C-MORE PANELS INCLUDE:

- Analog resistive touch screen with unlimited touch areas
- One USB A-type and one USB B-type port
- Serial communications interface

### FULL-FEATURED MODELS ADD:

- 10/100Base-T Ethernet communications
- CompactFlash slot for data logging

### REMOTE ACCESS AND CONTROL BUILT-IN

- No Additional Hardware required. The C-more Remote Access feature resides in all panels with Ethernet support, and requires no option modules. Access real-time data or initiate an action on a control system from anywhere, any time. (Requires software and firmware version 2.4 or later\*, and an Ethernet C-more panel)

### CONNECT TO CONTROLLERS WITH DRIVERS FOR:

- All AutomationDirect programmable controllers
- Allen-Bradley - ControlLogix<sup>®</sup>, CompactLogix<sup>®</sup>, MicroLogix<sup>™</sup> Ethernet, SLC Series, FlexLogix, SLC<sup>®</sup> 5/05 Ethernet<sup>™</sup>
- Modbus RTU and TCP/IP Ethernet
- GE SNPX
- Omron Host Link Adapter (C200/C500), FINS Serial and Ethernet
- Selected Mitsubishi FX Series, Q Series
- Siemens S7-200 PPI and S7-200/300 Ethernet (ISO over TCP/IP)

Research, price, buy at:

[www.automationdirect.com/c-more](http://www.automationdirect.com/c-more)

## C-more<sup>®</sup> touch panel family:

6-inch STN grayscale	6-inch TFT 65,538 colors	8-inch TFT	10-inch TFT	12-inch TFT	15-inch TFT
Starting at: \$432 (serial)	Starting at: \$540 (serial)	\$1,081	\$1,727	\$2,051	\$2,484
\$540 (adds Ethernet)	\$757 (adds Ethernet)	8 to 15-inch units include both serial and Ethernet ports			

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# Automation NOTEBOOK

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For those who prefer to speak with us in person, please call 1-800-633-0405 x1845. Thanks for your interest, and we look forward to hearing from you.

## Editor's Note

What a winter we've had. Now we're on the cusp of spring and I don't think anyone in America is complaining about that. With each spring, new life emerges from the earth. That new life means new opportunities lay ahead. Those opportunities provide us choices. If we make the right choice, then we experience progress. The wrong choices teach us lessons that can help us improve for the next opportunity.

Here at AutomationDirect, we seize every opportunity with gusto. We listen to our customers and we strive for ways to provide more quality products for their variety of applications. It's because of this approach that AutomationDirect remains tops in customer service.

This issue is another opportunity we have each quarter. We provide technical information in informative, easy-to-understand ways to help our readers learn more about our products and how others use them in their unique ways. We also include informative articles about the latest trends in the industrial control industry. For example, in this issue, Christine Lesher shares our cover story about how machine builders are now offering system integration services using technologies and expertise that once were provided only by system integrators and engineering firms. Our User Solutions article shares how a water facility in California improved its system's performance while maintaining its existing SCADA and communication network investment.

There's plenty more crammed inside. Of course, the ever-popular Break Room has challenging Brainteasers for you. By the way, did you know that many of our readers read that section first? Go ahead, give it a try. Then check online to check your answers at: [www.automationnotebook.com](http://www.automationnotebook.com).

So, now it's time to sit back, relax, and turn the page...TJ Johns

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# New Product Focus

What's New



## IronHorse® GSD Series DC Drives - 1/50 HP to 3 HP



AutomationDirect's IronHorse line of motors and drives now includes the GSD series of DC drives.

IronHorse GSD1 series DC drives are high-performance Pulse-Width-Modulated (PWM) controllers for 12 to 36 volt battery/solar-powered equipment providing smooth control with high-efficiency operation. Design features include adjustable maximum/minimum speed, current limit, I.R. compensation, and acceleration. The adjustable current-limit feature protects the control, battery, and motor from sustained overloads. GSD1 series DC drives, available up to ¼ hp, are available in open-frame and NEMA 4X enclosed styles, and all come standard with a speed pot, knob, and dial

plate; an optional 0-10VDC analog input signal card is also available.

IronHorse GSD3 series drives are general-purpose, economical variable speed controllers for small DC and universal motor applications up to 1/3 hp. Open-frame and NEMA 4 enclosed models are available with dual input voltages (12/24 VAC or 120/240 VAC) with a DC output current rating of 2 Amps, adjustable trim pot settings, and quick-connect terminal pins.

GSD4 series drives provide cost efficient, reliable control for permanent

offered in open-frame and NEMA 4/12 enclosed models.

The reliable, versatile, and economical GSD6 DC drive is the most fully-featured IronHorse analog DC drive, offering many standard features typically offered as options by other DC drives. An excellent off-the-shelf control device, the GSD6 series drives feature dual input voltage (120/240 VAC and 50/60 Hz) via slide selector, adjustable horsepower settings up to 3 hp, full-wave bridge supply, 50:1 speed range, transient voltage protection, DC tachometer feedback, and more.

The IronHorse GSD7 series DC drives, available up to 2 hp, are designed for instant reversing, quick stopping, and rapid cycling to outperform other dynamic braking and reversing drives by utilizing unique zero-speed detection and dynamic braking circuits; the zero-speed detect circuit also eliminates motor plug reversing problems. Additional features include 0.5-second fixed acceleration, automatic dynamic braking on power loss, line voltage compensation, and more.

IronHorse GSD series DC drives are backed by a one-year warranty and prices start at \$59. Additional accessories such as speed potentiometer kit, analog current and voltage input cards, digital potentiometer, and manual reverse switch are available.

magnet, shunt-wound, and universal motors up to 2 hp. The drives, offered in dual voltage 120/240 VAC or 24/36 VAC models, incorporate up-to-date design and engineering in a compact package. Installation and field adjustments are facilitated using a barrier type terminal strip and large, easily adjustable trim pots to adjust horsepower ranges. GSD4 series drives feature an inhibit circuit for start-stop operation, and 1% speed regulation over a 50:1 speed range.

IronHorse GSD5 series DC drives offer superb flexibility, reliability, and value. This general purpose, economical line of drives, rated to 2 hp, provides the ultimate in standard features and versatility. With dual input voltage (120/240 VAC and 50/60Hz), GSD5 series drives are

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"If you want your children to turn out well, spend twice as much time with them, and half as much money."

– Abigail Van Buren

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"The only way to do great work is to love what you do."

– Steve Jobs

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# DC drives for efficient control

**DC motors and drives provide several advantages over AC-powered devices. Our new Ironhorse DC drives are suitable for many control applications, all at prices that won't break your budget.**

- Inexpensive – DC drives are typically less expensive than AC drives
- Low speed performance – DC drives and motors provide excellent low speed control and stability
- Low speed power – DC motors provide exceptional low speed torque and power
- Simple – our DC drives are typically configured with potentiometers – no parameters or programming needed



STARTING AT:

**\$59** U.S.  
GSD3-240-2CL



## GSD1 Series starting at: \$115

High-performance Pulse-Width-Modulated (PWM) controllers for 12 to 36 volt battery/solar-powered equipment - up to 1/2 HP

- Low Voltage PWM
- 12/24/36VDC input
- Up to 20A output current



GSD1-12-10C



GSD1-12-10N4X

## GSD4 Series starting at: \$65

Cost efficient, reliable SCR control for permanent magnet, shunt wound, and universal motors - up to 2 HP

- Economical, general purpose
- 24/36VAC, 120/240VAC input
- Up to 10A output current



GSD4-240-10N4X



GSD4-240-1C

## GSD6 Series starting at: \$330

Most fully-featured IronHorse analog SCR drive with features not typically found in drives in this price range - up to 3 HP

- Advanced features offer flexibility
- 120/240VAC input
- Up to 15A output current



GSD6-240-15C

## GSD3 Series starting at: \$59

Compact, economical variable speed SCR controllers for small DC and universal motor applications - up to 2/3 HP

- Small, compact
- 12/24VAC, 120/240VAC input
- Up to 2A output current



GSD3-240-2CJ



GSD3-240-3N4

## GSD5 Series starting at: \$135

General purpose SCR drives rated to 2 HP

- General purpose, many enclosed options
- 120/240VAC input
- Up to 10A output current



GSD5-240-10C



GSD5-240-10N4

## GSD7 Series starting at: \$160

Instant reversing, quick stopping & rapid cycling SCR drive utilizing unique zero-speed detect and dynamic braking circuits - up to 2 HP

- Reversing
- 120 or 240VAC input
- Up to 10A output current



GSD7-120-10CR30



GSD7-120-1CR3

Also check out our AC and DC motors.

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# Product Snapshots

Press Releases



## Air-to-Air Heat Exchangers for Enclosure Cooling



Stratus® air-to-air heat exchangers are closed-loop cooling systems that exchange heat from an electrical enclosure to the outside. Air-to-air heat exchangers offer low operating costs and low maintenance. Prices start at \$1,028; models are available for use with NEMA 4 and 4X enclosures.

## Ultrasonic Liquid Level Sensors and Transmitters



Flowline EchoPod®, EchoSonic® II, Echotouch™, EchoSpan® and EchoSwitch® are innovative ultrasonic liquid level sensor families that replace conventional float, conductance and pressure sensors. Capabilities include continuous level measurement and control. PC software configured and new pushbutton configured models are available. Prices start at \$260.

## NITRA® NFPA Cushioned Pneumatic Air Cylinders



NITRA D-Series double-acting heavy-duty air cylinders now include new models with adjustable cushions for end-of-stroke deceleration. These pneumatic air cylinders have a 250 psi operating pressure and are constructed with high-quality aluminum components and a magnetic piston with PTFE wear band. The series includes bore sizes from 1½ inch to four inches and stroke lengths from 1 to 24 inches. Prices for NITRA cushioned air cylinders start at \$164.

## FC Series Potentiometer and Bipolar Signal Conditioners



The FC-P3 signal conditioner converts a 24 VAC/VDC potentiometer input to an isolated analog 4-20 mA output. Additional FC series signal conditioners include bipolar and unipolar models. The units are cULus listed, CE marked and have a one-year warranty. Pricing starts at \$115.

## 30mm FW Series Photoelectric Sensors



FW series photoelectric sensors have all-metal housings with 30mm mounting bases. FW series diffuse sensors have sensing distances to 800mm and FW series polarized retro-reflective sensors have a sensing distance up to 15 meters. The sensors start at \$55 and are CE, RoHS, and cULus compliant.

## GH15 Series IEC Motor Controls / Contactors / Overloads



The GH15 series of electric contactors now includes larger frame sizes with contactor ratings up to 315 Amps. Contactors are 35mm DIN-rail or panel mountable (larger sizes) and are CE marked, cULus listed, RoHS and REACH compliant. Prices start at \$43.50.

## More WERMA visual signal devices

AutomationDirect offers a wide range of incandescent, LED and Xenon beacon lights / signaling devices from WERMA for either panel installation or surface mount applications. Modern designs and



the latest in LED technology provide exceptionally clear and bright signaling. WERMA installation beacons are designed for mounting in panels or enclosures. WERMA freestanding beacons offer a range of modules including: permanent, blinking, flashing, LED EVS, and LED rotating. New items include 57/58mm beacons - surface, bracket, tube mount, short and tall lens options; 75mm beacons - surface & bracket mount; 98mm beacons - surface mount; and the new FlatSIGN wall mount signal light. Prices for WERMA light beacons start at \$15.00

WERMA beacon and flat signal devices are backed with a two-year warranty.

## Wenglor Laser Distance Sensors



OPT series distance sensors are available with either Class 1 or Class 2 laser options. With sensing ranges from 30 to 660mm, OPT short-range diffuse distance sensors use CMOS line array technology. OPT short-range sensors start at \$319. OPT long-range sensors use transit time for distance measurement. Diffuse styles have up to a 10 meter range; retro-reflective styles sense up to 100 meters. OPT long-range sensors start at \$249. Analog and switch output models are available. With

a one-year warranty, OPT distance sensors are CE, RoHS, and cULus compliant.

## Do-more T1H Series Stackable PLCs



The new Do-more T1H series PLC CPUs utilize the proven Terminator field I/O form factor for flexible I/O configurations. A T1H CPU can support up to 256 I/O points in the local stackable I/O chain. Ethernet-based remote I/O can add hundreds of additional points. The T1H-DM1 CPU is \$359; the T1H-DM1E CPU with an added Ethernet port is \$459. Do-more Designer programming software is free.

## Point of View SCADA / HMI Software



Point of View is powerful Windows PC visualization software for SCADA and HMI projects. Animated HMI screens give a graphical view of the process. Integrated modules include alarms, events, trends, recipes, reports, logic, and a database interface. Development / Runtime packages start at \$495.

## SureGear® Precision Gearboxes for Small NEMA Motors



SureGear PGCN series maintenance-free gearboxes are available in NEMA 17, 23, and 34 sizes and offer a wide range of gear ratios. Features include low backlash and a 20,000 hour service life. With a 1-year warranty, SureGear gearboxes start at \$209.

## NITRA® Pneumatic Solenoid Process (Pipeline) Valves



AutomationDirect's NITRA solenoid pipeline valves are two-position, normally-closed, spring return styles with 24VAC, 24VDC or 120 VAC solenoids. Valves are offered with port sizes from 1/8-inch to one-inch FNPT. Media-separated diaphragm styles are also available. Valve prices start at \$20, with a one-year warranty.

Continued, p. 8 >>

# Product Snapshots Cont.

*Press Releases*

Continued from, p. 7

## Solenoid Locking, Tongue Interlock Safety Switches



Starting at \$159, these solenoid locking safety switches are available in 3 mounting profiles, have multiple actuator entry points and offer adjustable heads with 90-degree and 180-degree options. Anti-tamper manual release keys and actuator keys in many styles are sold separately, starting at \$6.50.

## ProSense® Line Now Includes Float Level Switches



ProSense float level switches provide a low-cost general purpose solution for monitoring of liquid level in a variety of applications. The float switches are available in several different material constructions for compatibility with many types of liquids, and offer wide temperature and system pressure ranges. Vertical and horizontal mounting styles are available for ease of installation. For long and trouble-free service, powerful internal permanent magnets actuate a highly reliable hermetically sealed reed switch. The switches have both AC and DC voltage ratings and are configured for normally closed operation; most models can be easily converted to normally open

operation in the field. ProSense float level switches start at \$9.50 and have a one-year warranty. Float level switch kits starting at \$159.00 and float level tilt switches (\$29.00) are also available.

All ProSense float level switches are backed with a one-year warranty.

## SHIMPO Handheld tachometers



The new DT-100A series battery-powered handheld tachometers offer superior accuracy and capabilities for measuring and recording rotational and linear speed as well as linear travel. Priced at \$236, units are constructed of rugged die-cast aluminum; the series features large five-digit displays and quick retrieval of stored data. The DT-200LR series combination contact/non-contact tachometers incorporate laser technology that enables precise RPM measurement up to 20 feet away. The series is priced at \$258. The PT-110 non-contact tachometer, priced at \$115, is a simple-to-use, ergonomic, rugged optical laser ideal for rotational machine inspection and process speed analysis. This battery-powered device automatically records maximum, minimum, and last value, as well as up to 96 data points during testing.

## SHIMPO Stroboscopes

DT-300 series stroboscopes (AC-powered or rechargeable) measure rotational and reciprocating speeds with the same precision as an electronic digital tachometer. The DT-311A heavy duty, AC-powered stroboscope provides the illusion of "stopped motion" by



adjusting the strobe's flash rate, causing the equipment to appear to be standing still or in slow motion. The DT-315A heavy duty, rechargeable battery powered stroboscope has the same great features of the DT-311A with the added convenience of total portability via its own internal power supply. The quick recharge battery provides up to two hours of full continuous usage at its high intensity flash rate. The DT-326 is a portable stroboscope utilizing super bright LEDs in a robust, durable all-metal design. The DT-326's unique LED array provides an accurate, stable strobe light. The innovative LED design allows for a longer flash life (5 times longer than traditional xenon flashtubes). The DT-326 is designed for speed (RPM) and frequency (Hz) measurements in motion and vibration analysis. Starting at \$503, rugged, lightweight aluminum construction provides unequaled reliability in harsh environments. The DT-725 portable stroboscope with rechargeable battery possesses many of the same features as the DT-300 Series, but is lighter in weight. Constructed of strengthened high-impact plastic, these rugged units are exceptionally reliable and withstand the same harsh conditions as more expensive units. These units feature bright LED displays and allow visual analysis of rotating and reciprocating objects. DT-725 stroboscopes are priced at \$476. The Shimpo ST-1000 is a combination Stroboscope-Tachometer with LED flash technology. This velocity analyzing and measuring device is ideal for rotational machine inspection. The SHIMPO ST-1000 is priced at only \$219 and is ideal for rotational machine inspection.

# See things from a new Point of View

## HMI/SCADA Software for PC-based visualization



Point of View is powerful software for developing HMI, SCADA, and OEE/Dashboard projects for your control system that can be deployed anywhere. Create graphical screens that are easily understood, plus show data, alarms, trends, and more. You get all this capability for a very practical price, no matter how small or large the system.

### Save time

View your process from your desk or Web-enabled mobile phone using a standard browser (Internet/intranet including XML support)

### Save money

Develop once and deploy on many Microsoft supported platforms

### Clear information

Multi-language (UNICODE) so operators understand immediately

### Fix problems fast

Understand alarms quickly, visually on-screen, or via E-mail, PDA, mobile phones or Web browsers

### Reduce downtime

Use open technologies (ActiveX, .NET) to visualize documentation, repair videos or audio messages

### Enterprise integration

Easily tie into ERP and "back-office" systems using built-in relational database connectivity

### Flexibility

Contains 18 built-in drivers for connection to the most popular industrial controllers: AutomationDirect's Productivity3000 and DirectLogic; plus many Allen-Bradley, Omron, Siemens, GE and Mitsubishi series. Also includes a driver for Modbus communication.

Starting at:  
**\$225 .00**  
PV-500-DEV  
(Development only package)



Intuitive software gives you the tools to create dynamic objects and screens, easily saved and re-used to speed development. If you need alarms, events, recipes, schedulers, database interface - it's all available!

Each Point of View package includes one thin client, one secure view thin client, and one mobile thin client license. (Additional licenses are available separately.)

Three software packages are available in 500, 1000, and 5000 tag count versions:

- **Complete Package** - Development + Runtime  
starting at: \$495.00 [PV-500]
- **Development Package** - Development Only  
starting at: \$225.00 [PV-500-DEV]
- **Runtime Package** - Runtime Only  
starting at: \$345.00 [PV-500-RT]

If your project gets bigger than expected, smaller versions can always be upgraded to the next larger tag count.

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# Cover Story

*OEM Integration Services*

## Beyond the Machine: OEMs Provide System Integration

**Machine builders use technologies and expertise to provide system integration services that were once the realm of systems integrators and engineering firms.**

By Christine Leshner

As automation systems become more integrated, the design, installation and commissioning of machines and robots on the factory floor can be a complex process. The machines must interact not only with existing production lines, but also with more advanced automation and business systems and networks such as CMMS, MES and more.

Many end users have lost staff in recent years due to retirement and strict budgets, increasing the need for outside assistance. Some go to engineering firms or system integrators for help, but many others are going to the machine builders themselves.

### Machine Builders Provide Experience

Many machine and robot builder OEMs have expertise beyond the workings of their own products and systems. They know that most of their products will be working as part of an integrated system, and they can help with the flow and layout of the production line.

In the Control Design December 2013 cover story “System Integration Break Through,” John Martin, vice president of engineering at ARC Specialties in Houston, Texas explains that companies like his work closely with their customers to understand their needs.

“For instance, a customer might want a system with semi-automatic part loading, like a crane loading a pipe onto

a gravity-fed pipe rack with an automatic singulator, fully automatic welding, automatic out-feed conveying and manual unloading,” says Martin. “We can custom-design production lines based on whether customers want production to be fully automatic, semi-automatic or manual.”

### Determining the Best Approach

OEMs know the manner in which their solutions are best applied. They thoroughly understand the capabilities and the optimal methods for integrating their machines with their own and with other manufacturers’ equipment.

In the cover story, Matt Wicks, vice president of controls and software engineering at Intelligrated, in Mason, Ohio, elaborates: “We’re a builder of conventional and hybrid palletizers, and we manufacture a wide variety of other types of material handling equipment, such as conveyors, sortation products and robotic tooling.” (Figure 1)

ment cycle to streamline the integration process. By having the right information in the beginning, we can reduce overall costs and implementation schedules.”

Research group Frost & Sullivan sees a trend toward outsourcing integration, including OEMs fulfilling this role. In the same article, Muthuraman Ramasamy, research analyst, Frost & Sullivan states: “The industry is heavily gravitating toward a one-stop solution due to the decline in the skilled workforce and its inability to retain a relevant workforce in-house.”

Ramasamy notes that end users are looking for solution providers that can provide integrated solutions, not single products. He believes OEMs can often fill this need by offering a total solution approach, lower maintenance costs and better operational efficiencies.

### Specific Expertise

OEMs that sell specialized machinery often have the greatest understanding of how to implement their machines to work



**Figure 1: OEM Intelligrated provides services including installing their Alvey robotic layer depalletizing system and integrating it with other material-handling equipment, such as in this chain-driven live roller pallet conveyor. (Courtesy of Control Design December 2013 cover story “System Integration Break Through”).**

He adds that in addition to their equipment, Intelligrated also has extensive software tools used during development to determine the best integrating strategies for their material-handling solutions. Wicks continues, “This knowledge is then included in the product develop-

best in certain industries. These OEMs have very in-depth knowledge of the equipment and processes required for the best solution.

Another contributor to the cover story, USNR, an OEM of wood-processing equipment in Woodland, Wash.,



**Figure 2:** OEM machine builder CMD designed this packaging system which integrates a SCARA robot with a single-roll gripper assembly. The system can insert more than 1,650 rolls of garbage bags into retail or bulk packaging boxes per hour, while removing out-of-spec rolls and ensuring product uniformity to reduce bottlenecks. (Courtesy of Control Design December 2013 cover story “System Integration Break Through”).

fabricates machinery for every aspect of wood processing, from panel and plywood processing to manufacturing lumber, fingerjointed components and glulam beams.

As a result of its extensive product line and expertise, USNR is able to deliver comprehensive solutions for various levels of automation.

“From a single machine center all the way to integrating an entire modern sawmill encompassing more than 30 machine centers that cover an area larger than two football fields, we can do it all” explains Paul Streb, controls engineering manager, USNR.

Another example of an OEM with highly specialized capabilities is CMD, an Appleton, Wisconsin, a manufacturer of converting equipment for the blown-film and flexible packaging industries (Figure 2).

Chris White, project manager at CMD, explains, “Many times when an outside integrator steps in to integrate multiple pieces of equipment, they will not fully understand the manufacturing process.” Not grasping the intricacies of a certain type of functionality or industry will typically lead to poor results.

### One Stop Shop

Production lines for cutting-edge products often require custom automation to meet the new and unique requirements of the application. In some cases equipment from several suppliers along with custom mechanisms must be integrated.

Owens Design in Fremont, Calif., is an OEM of equipment for the electronics industry that has successfully navigated these situations. The company builds a wide range of production tools, including those used for wet processing, metrology, precision assembly, substrate-handling automation and vision inspection (Figure 3).

The company uses many off-the-shelf automation components as well as a variety of robots which are integrated into its systems. Furthermore, it creates custom applications when required by a customer, along with designing the control system and writing the software for all tools that Owens builds.

In addition to its wide range of production capabilities, Owens is an example of an OEM that conducts extensive testing. And it’s not alone, as more OEMs are building and supporting thorough in-house test environments. By controlling all phases of a project, including the design and integration of control systems and software for each system along with testing, OEMs are giving their customers added value as well as single-source accountability.



**Figure 3:** OEM Owens Design supplied a combination of components designed in-house and off-the-shelf robotics to optimize performance of this off-axis solar processing tool. (Courtesy of Control Design December 2013 cover story “System Integration Break Through”).

Continued, p. 12 >>

# Cover Story Cont.

## *OEM Integration Services*

### Continued from, p. 11

Bob Fung comments about Owens Design's very skilled engineering and program-management group, whose members have strong design backgrounds. "Our engineers average more than 20 years experience in the area of complex tool design and build," he says. He concludes by saying the ability to apply critical design expertise and in-house expertise positions their company to deliver superior tool design and installation support.

The increasing complexity of today's businesses has driven many companies to cut down on the number of vendors with whom they interact. They want one number to call, whether they need to buy a machine or have it integrated with an existing production line. These same companies often want one purchase agreement, not multiple invoices. These customers take advantage of OEMs that bundle the purchase and implementation price as a selling feature (Table 1).

### No Turning Back

The continuing evolution to more automated and integrated systems will only increase the need for OEMs that can provide control systems integration services. Fortunately, with their thorough knowledge of their machinery, many OEMs are well positioned to take on these changes.

Not all OEMs are suited to offer integration services or care to make it part of their business models, but there will be a growing market for OEMs that don't simply supply equipment, but will also help their customers achieve the optimum efficiency from their machines and processes. 

## Benefits from OEMs That Provide Integration

- |    |  |
|----|--|
| 1. | <b>Thorough knowledge of their equipment</b>                           |
| 2. | <b>Understanding of how their machines work with other vendors</b>     |
| 3. | <b>Specialized knowledge of the intricacies of vertical industries</b> |
| 4. | <b>Single source responsibility</b>                                    |
| 5. | <b>In house testing</b>  |

Table 1: Benefits from OEMs That Provide Integration

---

"Middle age is when your age starts to show around your middle."

– Bob Hope

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"We can't help everyone, but everyone can help someone."

– Ronald Reagan

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# Best prices on pneumatics

Buy direct and save on high-quality components

## Heavy Duty NFPA Tie Rod Pneumatic Cylinders - "D" Series

The NITRA D-Series tie rod cylinders include bore sizes from 1-1/2" to 4" and stroke lengths from 1" to 24" to meet a broad range of applications where abusive conditions exist.

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- Double-acting cylinders
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**More cylinder series also interchangeable with popular brands**

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- start at: \$94.00 (E12M010MD-M)

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- Eight bore sizes from 12mm to 63mm
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### Compact Pneumatic Cylinders - "C" Series

- start at: \$35.00 (C090025D)

- Cylinder bore sizes from 9/16" to 3"
- Cylinder stroke lengths from 1/4" to 4"
- Double-acting mini air cylinders
- Interchangeable with other mini actuator, flat cylinder or pancake cylinder brands



### Non-repairable Pneumatic Cylinders - "A" Series

- start at: \$10.50 (A07005SN)

- Cylinder bore sizes from 7/16" to 2"
- Air cylinder stroke lengths from 1/2" to 18"
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- 3 pneumatic cylinder mounting configurations
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# Tech Thread

*Pneumatic Efficiency - Reducing costs*

**Improving Pneumatic Energy Efficiency**  
**Following these tips and techniques can reduce pneumatic system energy costs by as much as 35 percent.**

By Pat Phillips, Product Manager, AutomationDirect

Reducing energy consumption is a priority in manufacturing plants and other industrial facilities as electricity bills continue to rise due to green power and other government mandates. No company can afford to waste money by using machines or processes that consume too much energy. Since pneumatic systems are ubiquitous throughout manufacturing and can consume a large share of a plant's power costs, ensuring they consume only the air required is extremely important.

Unfortunately, many have the mindset that pneumatic systems are inherently inefficient, and this belief can lead to higher energy costs as opportunities for savings are overlooked. In addition, some OEMs supplying machines and robots to industrial facilities focus on the ability of their pneumatics systems to perform their intended functions, and sometimes neglect their customers' operating costs.

These OEMs should instead recognize that their customers are becoming more concerned with total cost of ownership (TCO), of which energy use is a major component. These customers know that energy usage can account for up to 75 percent of their machines' and robots' TCO, and they're looking for suppliers that will partner with them to reduce energy usage.

OEMs that understand their customers' needs and build more energy efficient machines and robots will be more successful than those who neglect TCO. The old business model of only caring about performance and not about efficiency is dying, and OEMs who include energy



**Figure 1: Pneumatic systems offer an untapped area for improving energy efficiency and cutting costs.**

efficiency as part of the overall performance of their pneumatic systems will be the ones that beat out the competition (Figure 1).

Fortunately, the energy efficiency of pneumatic systems can be improved by both OEMs and their customers, from the design stage to making adjustments on existing systems. There are many sources of inefficiencies in pneumatic systems, yet implementing certain tactics can reduce energy consumption by as much as 35 percent (Table 1).

### Start with Compressors

According to statistics published by the U.S. Department of Energy, manufacturers spend over \$5 billion each year on energy for compressed air systems. By optimizing these systems, companies can reduce their compressed air energy consumption by anywhere from 20 to 35 percent.

## How to Improve Energy Efficiency in Pneumatic Systems

1. **Make sure compressors are efficient**
2. **Correctly size components**
3. **Optimize air pressure**
4. **Shut off or reduce air to offline systems**
5. **Supply only the necessary psi for the return stroke**
6. **Fix leaks**

**Table 1: How to improve energy efficiency in pneumatic systems**

Continued, p. 16>>

# Process Sensing

from top to bottom

## PRESSURE

ProSense pressure switches and sensors monitor hydraulic, pneumatic and other process applications reliably and accurately. A wide selection of models are available:

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# Tech Thread Cont.

## *Pneumatic Efficiency - Reducing Costs*

### Continued from, p. 14

While describing in detail how compressors can be made more efficient is beyond the scope of this article, the Department of Energy offers guidelines ([http://www.energystar.gov/buildings/sites/default/uploads/tools/compressed\\_air1.pdf](http://www.energystar.gov/buildings/sites/default/uploads/tools/compressed_air1.pdf)) for determining the cost of compressed air in a plant, as well as tips (<http://industrial-energy.lbl.gov/files/industrial-energy/active/0/LBNL-43888.pdf>) on how to reduce compressor energy usage.

### Right Size Components

Correctly sizing the pneumatic system's components helps cut costs in a variety of ways as each component's size can affect other parts of the system. For example, undersized control valves may be initially cheaper, but they will require the air compressor to work harder to get the proper pressure to the actuators.

While some over sizing is necessary to compensate for pressure fluctuations and air losses, components that are grossly oversized account for one of the biggest energy drains in a pneumatics system. For example, if an engineer simply over sizes from a two-inch to a three-inch cylinder, more than double the volume of air will be required. Correctly sizing a cylinder can reduce its air consumption by at least 15 percent, which becomes even more significant as many cylinders will operate thousands of times over their operating life.

In general, most loads and speeds require only 25 percent additional capacity to ensure correct operation. While there are many calculations and considerations that go into properly sizing components—such as if the load is rolled or lifted—there are software packages, online calculators and even an iPhone app that can assist with computations. By spending a little more time in the design phase, OEMs can offer substantial savings in energy costs to their customers.

By rightsizing the pneumatic components in new and existing designs, OEMs will increase customer satisfaction while cutting their own expenses. Larger

and heavier components use more energy and create a larger footprint, which no manufacturer likes, and they cost more for the machine builder to purchase.

### Optimizing Pressure

A certain amount of air pressure will be lost due to usage fluctuations, line and valve flow resistance, and other factors. But many of these losses occur simply because the distance between the air compressor or air supply point and the actuator is longer than necessary.

By designing a system that uses the shortest length tubing possible, OEMs can help their customers reduce energy consumption as well as cycle times. Typically, tubing running between control valves and cylinders should be less than 10 feet. If the distance is longer, more pressure is required so that the ability to position the load correctly isn't compromised.

Another method for eliminating unnecessary consumption is making sure the actuator uses only the pressure needed to perform the task. Unfortunately, many designers go the overkill route, and often develop systems that deliver more pressure than needed to the actuator.

Sometimes the reason the actuator uses more pressure than necessary occurs on the plant floor. Some operators increase supply pressure thinking it improves performance. However, all this does is waste energy and money. Implementing sensors that monitor pressure and pressure regulators that maintain correct values can ensure pressure remains between the minimum and maximum parameters.

Pressure regulators for pneumatic cylinders regulate the amount of pressure dispensed, thereby increasing energy efficiency. In many instances, savings of up to 40 percent have been achieved simply by adding pressure regulators.

OEMs can also improve their systems by regulating air pressure. Typically, standard machines and robots are designed to accommodate users with the highest pressure requirements. By adding pressure regulators, OEMs can more accurately size components while still ensuring that all requirements are met.

### Turn It Off

Shutting down a machine when it's not working seems obvious. However, many installations have no automatic way to stop airflow to idle machines. Reduced staffing often means that manufacturers can no longer send maintenance workers to manually turn off air to specific machines.

While some elements of the system, such as air bearings, can require pressure even after the machine is turned off, the amount of pressure is usually much lower than that needed during operations. In these instances an automatic air reduction control package will lower the air pressure to the necessary levels when the machine isn't working, more than paying for itself in short order.

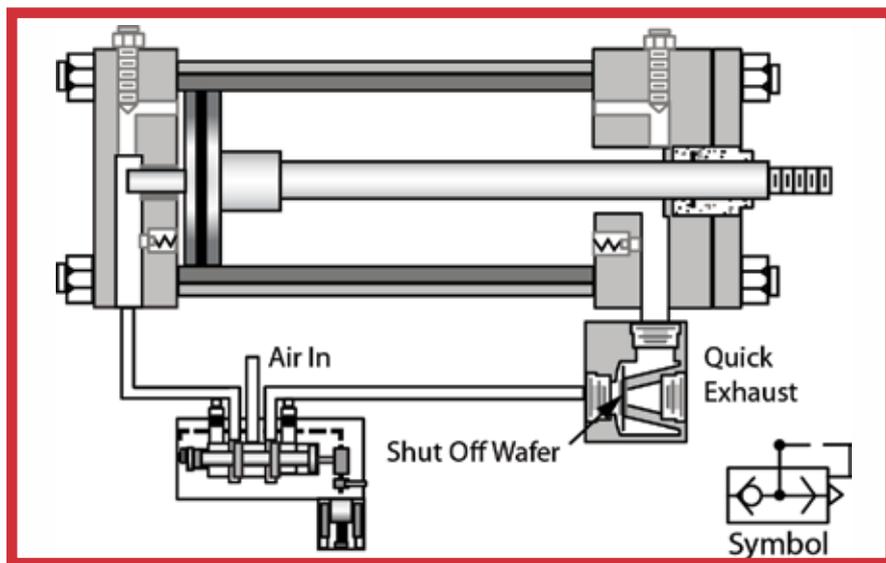
### Don't Overlook the Return Stroke

Another way to reduce wasted energy is by supplying the correct pressure to the return stroke. Most applications only move the load in one direction through pushing or using vacuum to move the load. However, many machines use the same amount of pressure on the return stroke as they do on the working stroke.

Processes with shorter strokes can use a spring return actuator on a single-acting cylinder. The control valve in a spring return actuator ports the pressure (using the compressed air) for the working part of the stroke, and then exhausts that air. During the return stroke the spring, or sometimes merely the weight of the mechanism, brings the cylinder back to the starting position.

For example, a material handling system with a conveyor pushes a box to a side conveyor. The cylinder is only working in one direction. The working stroke of the process needs 100 psi to move the item. On the other hand, the return stroke only requires 10 psi, yet the same pressure is used for the return stroke. If a spring return actuator is implemented, the volume of air pressure for the return stroke is eliminated. The job is performed correctly, and a lot of energy is saved over the thousands of cycles that the action is performed.

Another application in which a spring return actuator on a single-acting



**Figure 2: Quick exhaust valves increase the operating speed of pneumatic cylinders.**

cylinder can reduce energy demand is with a pressing action. In this type of application, two items are being pushed together, such as a bearing into a housing or a plug into a hole. The job demands a significant amount of force to press the item, but only a small amount to retract, making it a good candidate for energy savings by optimizing return stroke energy consumption.

An important and often overlooked benefit of regulating air pressure to only the required level is lessening wear and tear on the pneumatic and related components. By not over-pressurizing the extract stroke, vibrations and shock to the machine are reduced.

Moreover, by adding a quick exhaust valve, cycle times can be reduced because cylinder speed is affected by exhaust rate on the return stroke of the machine (Figure 2).

### Minimize Leaks

Leaks are very common and expensive in pneumatics systems, but many leaks can be prevented or fixed. Statistics from the U.S. Department of Energy show the average manufacturing plant experiences compressed air leakage in the range of 30 to 35 percent (Figure 3).

There are many points between the compressor and the load where leaks can be fixed, with valves and seals two main

areas for improvement. Deteriorated seals and certain valve designs, such as lapped-spool valves with metal seals, have inherent internal leakage that is constant as long as air is supplied to the valve. Switching to valves with soft seals can significantly lower this leakage.

However, it's important to note that lapped spool and metal sleeve valve air consumption doesn't vary during operation. On the other hand, during an open crossover when the valve shifts, a soft seal produces hundreds of times more leakage than the lapped spool-and-sleeve valve. Therefore, total air leakage can be optimized by selecting the right type of valve for the application.

It's equally important to consider environmental conditions such as temperature, moisture content, and type of or lack of lubrication, as these will all affect the leakage rate of a seal. In some instances, hardy and relatively expensive



**Figure 3: The average plant loses as much as 35 percent of compressed air due to leakage.**

seals like Viton, Teflon or polyurethane may be the best option.

Pneumatic systems aren't quite as simple as they might first appear. The engineering concept of actuating valves and moving loads with air is quite straightforward, but optimizing pneumatic system designs and maintenance involves many variables.

Perhaps the complexity of operating conditions and component selection plays a large factor in the general inefficiency of these systems, but it's important to remember that efficiencies in pneumatic systems can be greatly improved by implementing the concepts covered in this article.

OEMs play a big part because much of the energy inefficiency of pneumatic systems can be remedied at the design level. OEM customers also have a crucial part to play as they are responsible for the overall design and maintenance of the plant's pneumatic systems.

Perhaps in the past it was acceptable to build systems that worked well but wasted large amounts of energy. However, in today's world end users are more aware of how energy consumption affects their bottom line. They will not be as complacent, so OEMs must consider their customers' TCO, and not just upfront costs.

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“What the world really needs is more love and less paper work.”

– Pearl Bailey

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“If you want to kill any idea in the world, get a committee working on it.”

– Charles Kettering

# Tech Brief

DATAWORX & DO-MORE



## DataWorx with Do-more PLC support

By David Bark,  
AutomationDirect

AutomationDirect has partnered with BizWareDirect for several years, supplying DataWorx data collection and monitoring software for compatible **Direct**LOGIC programmable logic controllers (PLCs), Productivity3000 and WinPLC controllers. Previously, it had been necessary to purchase an OPC/DDE server and write code, or buy an HMI package, to collect data from AutomationDirect controllers. BizWareDirect's data collection software makes it simple and cost-effective to collect valuable data; their engineering services assist manufacturers and utilities to automate, monitor, and collect data from their processes through the most productive and cost-effective means possible.

DataWorx now has direct support for Do-more, easily connecting your Ethernet-enabled Do-more PLCs to standalone PCs or network servers for simple data logging. This means that any PC or server on the network can collect PLC data without the need for special PC programming or a 3rd party HMI, SCADA, or DAQ software application. DataWorx is easy to set up and use, and is affordably priced.

Some applications where DataWorx can be implemented include:

- Logging valuable production data to networked PCs or file servers for Statistical Process Control decision making.
- Archiving test data in a secure server file location with built-in date/time stamping features to satisfy quality assurance or audit trailing procedures.

- Data acquisition applications, as source content for historical trending for use by higher level business system applications.
- Transferring, updating and retrieving data into/from a network database.

Configuring a system to log data requires two logical steps. First, install the DataWorx software on a PC or file server on the same Ethernet network where the PLCs reside. Next, enable the controller logic to write data to your choice of delimited text files or CSV files to networked PCs or a file server.

The following are instructions on how to configure DataWorx for use with the Do-more PLC.

**Note: You will need DataWorx version 2.2 build 99 or higher and H2-DM1E for this exercise.**

In Do-more Designer we will first create a UDP device that will be used in the PACKETOUT instruction.

**Note: Ensure you have assigned an IP address to the Do-More CPU either in NetEdit or under System Information in Do-More Designer.**

1. Click on PLC from the Menu bar > then click on System Configuration. (Image 1)



Image 1

2. Now select Device Configuration > then select New Device.
3. In the Device name field enter '@dataworx', and in the UDP port field enter '30583' > then hit ok > then hit ok once again to close out the configuration window. (Image 2)

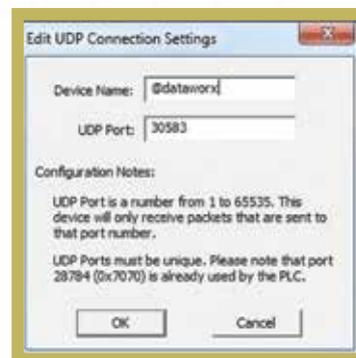


Image 2

4. Select 'Yes' in the pop up window. (Image 3)

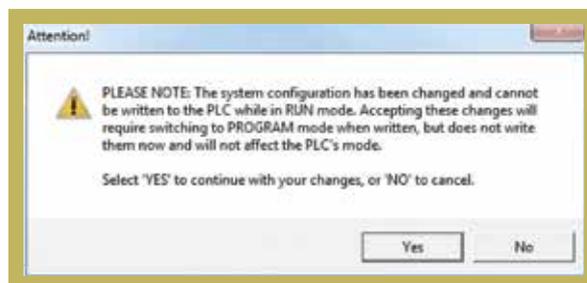


Image 3

5. Next, on a empty rung enter a 'PACKETOUT' Instruction and fill in the fields with the below information:

- a. **Device:** Select the newly created '@dataworx device'.
  - b. **IP Address:** Select Fixed and enter the IP address of the PC running DataWorx.
  - c. **To UDP Port Number:** Enter '30583' (port number DataWorx is listening to)
  - d. **Data Start:** Select Numeric Data Block and enter: (These will match our DataWorx setup in a later step)
    - i. Buffer Start = V0
    - ii. Number of Bytes to Output = 8 (This will match our DataWorx setup in a later step)
  - e. On Success: Leave as default or select an unused C bit.
  - f. On Error: Leave as default or select an unused C bit.
6. Select the green checkmark to accept your selections.



Image 4

7. Now for the input leg to the PACKETOUT instruction enter a Normally Open contact (F2) and assign an input or boolean bit.
8. Accept and Download this to the Do-More CPU. (Image 4)

These next steps set up the DataWorx configuration:

9. Open DataWorx PLC Monitor (Image 5)

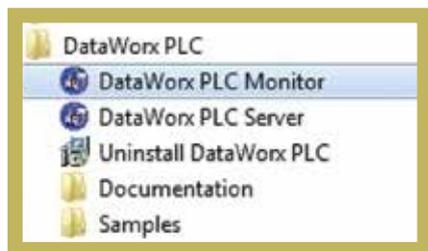


Image 5

10. Now click on Options > Configure Server > then Add.
11. Use DataWorx to setup the PLC Configuration:

- a. IP Address: enter IP address of your Do-More CPU
- b. Data Directory: Select a directory in which you would like the .csv file stored.
- c. PLC Configuration: Enter 'V0'
- d. Do-More PLC: Check this box

12. Select Add and enter four (Integer) 2 byte words starting with V0. (Image 6)

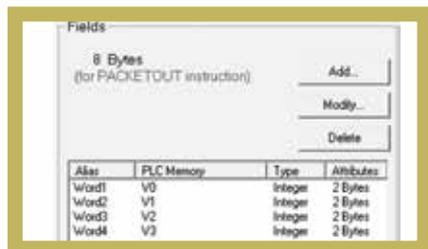


Image 6

13. Select Ok to finish the configuration. (Image 7)



Image 7

14. Now trigger the input rung to the PACKETOUT instruction in the Do-More PLC.

15. You should get the below update in the DataWorx window: (Image 8)

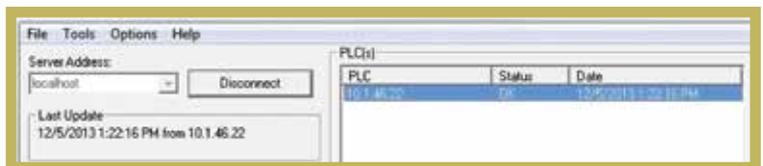


Image 8

16. Now open the EXCEL .csv file in the Data Directory we set up in step 11.b and verify the data was written.

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“You only live once, but if you do it right, once is enough.”

– Mae West

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“The man who does not read has no advantage over the man who cannot read.”

– Mark Twain

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# Student Spotlight

CO2 POWERED CARS

## What a Drag! CO2 powered drag strip teaches students the science of speed

By Chip McDaniel,  
AutomationDirect

John Harpell's 9th grade class at Moira Secondary School in Belleville, Ontario, Canada has built and automated a model racecar track for CO2 powered "dragsters" using various components from AutomationDirect. A CO2 powered dragster is a small lightweight vehicle fitted with a CO2 cartridge; think "pine-wood-derby on steroids". The CO2 cartridge is punctured on the starting line, and the vehicle is propelled (rapidly!) down the track by the release of the compressed carbon dioxide gas. Individual students craft these model cars in various shapes and then compete in side-by-side drag races on the flat, level track that the class has constructed. Speeds can reach 65 MPH, with elapsed times around one second or less.

### The Track

Before the students could race any dragsters, they had to build the track. The class brainstormed a number of ideas



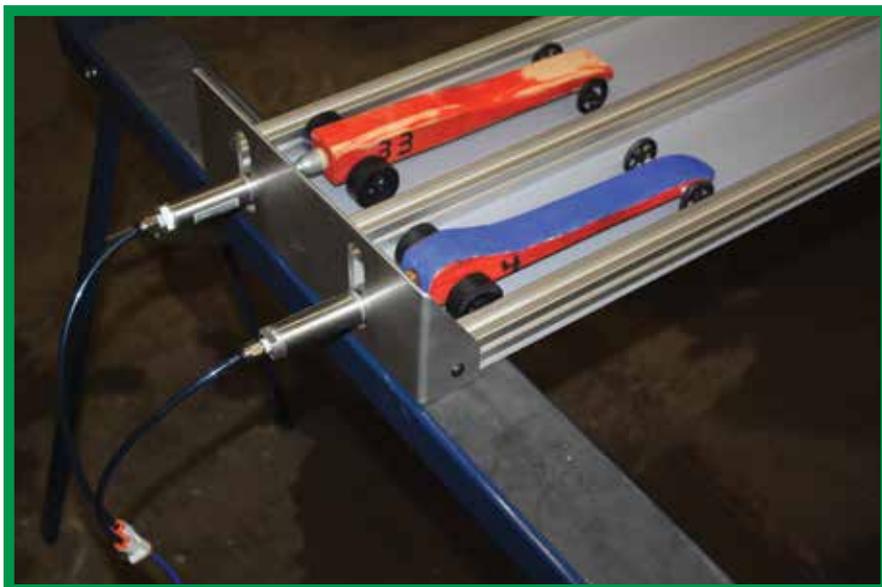
Photoelectric sensors at finish line

after completing some basic research and studying what was realistic and affordable. They reported that the AutomationDirect Web site was very useful when researching electronic components such as photoelectric eyes (NPN vs. PNP), momentary contacts, 24V relays, and digital timers.

They constructed the two lane track from 6mm plastic sheet and 1.25" x 1.25" aluminum channel. The students had the opportunity to lay out, measure and drill mounting holes, and then to bolt the entire

track together in 8-foot sections for a total of 48 feet of track.

The control and timing system consists of a Start button which actuates a pneumatic valve causing two 7/8" cylinders to plunge forward, puncturing the CO2 cylinders extending from the rear of the cars. The Start button also triggers two KOYO Digital Timers (KT-V4S-C-D); one for each lane, which increment in thousandths of a second until a car breaks the beam of the photoelectric eye at the end of its respective lane. When the beam is broken, it opens the contact on a 24V relay which, in turn, signals the timer to stop counting, leaving each car's "Elapsed Time" displayed on the timer for that lane. The use of a photo eye with 1kHz switching frequency coupled with the precision Koyo timer yields an accuracy of 1/1000 of a second for each lane.



Starting line with two 7/8" cylinders to plunge forward and punch the CO2 cylinders extending from the rear of the Dragsters



Enclosure with Koyo Digital Timers for Elapsed time



Students preparing for a race

### The Cars

John stresses the importance of the design process to his students before they begin to build the actual CO2 dragsters: “The design process helps the students understand the relationship between friction, drag and weight. The students conduct their own research and analyze the information to select the best design for their own vehicle. Each student is required to create sketches and drawings showing the development of their dragster’s final form. The design of this vehicle is not a linear process, it is expected that many revisions to the design will occur. Thus, each student’s dragster will have a different form that is based on their design.”

The CO2 powered cars must be built to certain specifications for the success of a particular design and to ensure safety on the track. The designs must avoid any interference with the propulsion system. Wheel placement, launch system specifications, and guidance system

details are all critical to prevent failure or damage during testing. During the construction phase the students learn to use many hand tools, as well as shop machinery and safety equipment, and to identify and prevent any associated safety hazards.

The students quickly realize that certain construction techniques are critical to their car’s success. Axle holes are drilled

on a drill press to ensure perpendicularity. The students sand and paint their car bodies with high-gloss paint to reduce surface drag. Axles and wheels are fitted carefully. And finally they are ready to test their designs!

### Race Day

Students are expected to set up and organize “race day” with very little assistance from the teacher. The cars are weighed in and assigned to categories according to weight. Race results are recorded by students who officiate the heats. The competition format is “single elimination”, with the winner of each heat moving on to race again. The winning cars from each category compete in a final bracket to determine the overall winner.

More information about CO2 racing (including various kits of parts available for sale) can be found here:

<http://www.science-of-speed.com>



Students wiring the enclosure with Koyo Digital Timers

Although the Moira School runs their event independently, the Technology Student Association (TSA) organizes a series of CO2 racing events each year:

<http://www.tsaweb.org/High-School-Competitions>



Entire team showing off their Dragster designs

# User Solutions

## Retrofitted SCADA System

### An Affordable Retrofit Prevents Expensive Replacements A rapidly growing water/wastewater utility is able to retain its existing SCADA

By Wesley Benefield,  
President, RTUdirect

The Harvest-Monrovia Water & Sewer Authority (HMWSA) was established in August 1965 to operate and maintain a water system to provide domestic water in the Harvest-Monrovia area of Madison County, located near Huntsville, Alabama. In the early years, the utility serviced only 700 customers. As a result of growth in the area, the HMWSA now serves a population of 42,000 inhabitants through 15,000 water meters.

In less than 50 years, the system has gone from only two wells providing 1.15 million gallons of water per day to today's demands of 12 million gallons of water per day. To provide for this increase the HMWSA has grown to include two state-of-the-art water treatment plants manned by 41 employees. Although the staff has grown exponentially from the original two-person workforce, it's still a relatively small number of personnel to cover the main plants and the numerous remote sites. (See Figure 1)

In July 2011, the two million gallon a day membrane package water treatment plant and the 10 million gallon a day water treatment plant were awarded the Best Operated Plant Award by the Alabama Water Pollution Control Association. That same year, the Alabama Water Pollution Control Association also recognized the HMWSA's three wastewater treatment plants for excellence in operation. In addition, the Authority was awarded the Best Operated Distribution System in the 5,001-15,000 water meter category in the State of Alabama by the Association.

#### Expanding the System

In 2002, the Authority's board of directors decided it was time for the HMWSA to start providing sewer services to additional locations in the Harvest-Monrovia service area. As a result, the Authority built two new wastewater treatment plants to handle the expansion. This greatly increased the capacity of the wastewater treatment operations, which had previously consisted of two small treatment plants.

The four wastewater plants have a total capacity of 850,000 gallons per day. The Authority also administers sand filter-style treatment plants in 20 subdivisions. Overall, the water/wastewater system is currently comprised of 44 remote sites, with plenty of bandwidth to add more sites for this rapidly growing area.

The lift stations and sand filters are spread out over a large area and must be monitored closely to avoid system disruptions or spills, but the HMWSA only has a small maintenance crew of two to three people.

This state of affairs created a need for a Supervisory Control and Data Acquisition



Figure 1: The SCADA system for the HMWSA wastewater facility with the Ethernet tower behind the building

(SCADA) system that could economically supervise the lift stations and other remote sites, so maintenance staff could be notified of an issue before a problem escalated.

To improve the monitoring and control of remote sites in its wastewater system, the Authority purchased and implemented a SCADA system from a major automation supplier. Unfortunately, the SCADA system wouldn't function as required with the existing remote terminal units (RTUs), despite the fact that the RTUs had been previously purchased from the SCADA system supplier. After a few years and a lot of expense, the HMWSA was only able to get three sites online, and the data supplied to the SCADA system from the RTUs wasn't meeting the needs of the utility. The Authority didn't want to replace its new SCADA system, and it needed to find another solution to improve operations, all while minimizing costs.

At this point, our company, RTUdirect ([www.rtudirect.com](http://www.rtudirect.com)), was approached by HMWSA. RTUdirect provides automation products, services and systems to a wide range of clients in the water/wastewater and other industries. We studied the existing system, and then suggested a retrofit that would build upon the existing SCADA and network systems.

### Existing System Issues

The existing SCADA system uses canopy-style Ethernet radios to create a wide area network. This type of communications system is often used to provide wireless Ethernet connectivity and Internet service to communities in difficult-to-access and rural areas. We initially discovered that although the RTUs came from the SCADA manufacturer, they couldn't communicate with the SCADA system in the manner required by the utility.

The problem was that the RTUs were communicating with the central SCADA system via a polling-based with exception reporting format. Polling-based systems don't require a lot of bandwidth, but they also can't provide the real-time data needed for a SCADA system to provide accurate and timely data.

With these polling-based RTUs, the central SCADA system polls each remote site once every 30 minutes. If an alarm or

event occurs at a remote site, such as a pump coming on, the RTU will update the central SCADA system with an exception report, but this procedure lacks the immediacy of real-time data reporting required by the utility.

Due to these and other limitations, after two years the SCADA system had only eight RTUs connected with essentially no real-time monitoring or alarming capability.

### Finding a Low Cost Solution

Our company demonstrated a solution to the utility via a pilot project. For the project, we created an RTU using an AutomationDirect ([www.automationdirect.com](http://www.automationdirect.com)) DirectLOGIC DL-06 PLC and associated I/O with an ECOM Ethernet module. The Ethernet module was then connected to the existing wireless Ethernet network, providing a high-speed and reliable wireless Ethernet SCADA/RTU communication system.

This solution provided a low cost method for acquiring data from a remote site, transmitting and receiving data from the central SCADA system, and controlling components and equipment at the remote site—all in near real-time as required by the utility.

After the successful pilot project demonstration, the decision was made by the HMWSA to replace the existing RTUs with the new RTUs. In addition to replacing the RTUs, the HMWSA also had a variety of existing control panels from different manufacturers that needed to be integrated into the SCADA system from various remote sites. A decision

was made to use the same DL-06 PLC/ECOM solution.

Although the DL-06 has a small footprint, in some instances we couldn't fit it into existing spaces in panels already installed at the remote sites. In these instances, we installed the PLC in a small fiberglass cabinet next to an existing panel, and wired the new PLC to existing controllers and components. The data could then be delivered in a uniform format to the SCADA system.

During the retrofit, the Authority received approval to add new remote sites, which were each supplied with the new-design RTU, which maintained consistency with the RTU retrofits (See Figure 2).



**Figure 2:** The new RTU design combined a PLC and associated I/O with an Ethernet communication module to provide high-speed and reliable two-way wireless networking between the central SCADA system and each remote site.

Continued, p. 24 >>

# User Solutions Cont.

## Retrofitted SCADA System

Continued from, p. 23

In order to cover the entire water/wastewater system, we improved the canopy Ethernet system by installing a few towers with radios at key locations to complement radios already mounted on water tanks. We then reconfigured communication paths to improve network performance, and to make it easier to add new sites.

The HMWSA now has 44 sites online, with the capacity to add many more. The speed of the wireless canopy Ethernet network enables a real-time display of conditions in the system including motor amp readings, water pressure, dissolved oxygen levels and other variables (Table 1). In addition, the SCADA system can be used to issue commands to the remote sites, controlling equipment as required to deal with issues and optimize operations.



Figure 3: The SCADA system now provides easy-to-understand, detailed information in real time that shows operating conditions at each remote site.

Retrofitted SCADA System Provides:	
1.	Real-time float and pump status
2.	Daily run time and start/stop info for all pumps
3.	Previous run time and start/stop info for all pumps
4.	Real-time process status of items such as amps, dissolved oxygen and level
5.	Historical trending
6.	Alarm status at a glance for the entire system
7.	Real-time communication and power status

Table 1: Retrofitted SCADA System Provides Benefits

### Using Real-time Data to Improve Operations

After the retrofits and upgrades, a previously mismatched system became standardized and capable of providing important real-time data for monitoring and control such as number of starts, run time and other important operating information (Figure 3).

The current SCADA system is an invaluable asset for system managers

to diagnose and adjust processes to achieve peak performance. The essential information needed for system maintenance and repair is now displayed in real-time. If there's a high level at a lift station, the SCADA system immediately receives this information, allowing operators to take action to correct the problem before a spill occurs.

Moreover, the SCADA system not only alerts the Authority of existing and

imminent issues, it also allows qualified staff to spot problems before they occur and perform proactive maintenance. The system's trending and analysis capabilities make it easy for operators to see where improvements in efficiencies can be made, and to improve overall operations. In-depth analysis of data and operating condition has also helped the Authority make better budget decisions for new equipment purchases, obviating the need to purchase and warehouse certain items of new equipment.

### Keeping Costs Low

In addition to the PLCs, associated I/O and Ethernet modules, we supplied a variety of other AutomationDirect components for various Authority projects such as relays, terminal blocks, selector switches, indicator lights, amp sensors, transducers, and more. We chose AutomationDirect products because we knew we'd get quality, affordable solutions that were well suited for this project.

When all of the projects were completed, we had used the DL-06 PLC as a retrofit RTU, a new RTU, and as an

addition to existing relay-based control panels for remote monitoring and control. In each case, the PLC provided a uniform I/O and register structure common to all the remote sites, greatly simplifying SCADA system expansion.

Because the HMWSA had already spent a considerable sum on its SCADA system, funds were limited to make the required upgrades and improvements. By making extensive use of AutomationDirect components and by taking other actions to provide a low cost solution, we were able to stay within the Authority's limited budget, while still meeting their stringent performance and safety requirements.

By upgrading the canopy Ethernet system to provide the communications backbone of the system, and by replacing polled-based RTUs with new RTUs with improved communications capabilities, the HMWSA is now able to monitor even analog values in real time, all without having to spend a fortune replacing the existing SCADA and communications infrastructure.

Furthermore, the retrofit and the new automation systems significantly improved the system by providing a real-time clock, high-speed and reliable Ethernet connectivity, and trending information that can be used to plan for improvements. Most importantly, the retrofitted and new automation systems help the HMWSA provide better service to its customers.



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### PLCs and PACs Simplify Data Acquisition

Many PLCs and PACs are full-featured systems that can provide both control and data acquisition for existing I/O. Moreover, additional I/O can be added to acquire data from areas that do not require control, only monitoring. Data logging can be triggered by an event within the process or scheduled to occur at regular intervals.



Data transfers from the controller to other systems are typically done by an Ethernet port, which comes standard with most new PLCs and PACs. Popular protocols are also supported, eliminating the need to write complex drivers for the transfer of data from the controller to external systems.

Modern PLCs and PACs perform basic data acquisition as part and parcel of real-time control tasks. This double duty approach ensures the lowest overall cost, smallest footprint and simplest data acquisition systems.

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"I have not failed. I've just found 10,000 ways that won't work."

– Thomas Edison

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"It is never too late to be what you might have been."

– George Eliot

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"One good thing about music, when it hits you, you feel no pain."

– Bob Marley

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# FYI

## DIRECTLOGIC DO-MORE VS. TERMINATOR I/O DO-MORE PLC

### Do-more H2 or Do-more T1H PLC: How to choose

By Rick Folea, AutomationDirect

Which is better? A *DirectLOGIC* style Do-more or the new Terminator I/O style Do-more PLC?



The incredible power of the Do-more processor is now available in the popular Terminator I/O form factor. Functionally, both units have identical Do-more engines, so how do you know which one is better for your application? The answer is ... It depends ...

#### Under the hood

From a programming viewpoint, the two CPUs are, for all practical purposes, identical. Both have the same flexible memory management, same ease of use, same built-in free simulator, the same easy-to-use instructions, the same programming environment, and the same strong data typing. They both have the same built-in serial port and Ethernet port options and they both use the same Do-more Designer software.



Both processors have the same configuration dip switches ...

DIP Switch Settings		
Switch Number	Switch Position	Function
0	ON	Load the last copy of the operating system.
1	ON	Do not load an Operating System, stay in the Booter.
2	ON	Disable the hardware watchdog timer - the hardware watchdog is always enabled, but this switch allows the user to override the ability of the Force Watchdog Error (WATCHDOG) and Debug Mode to generate a Watchdog condition.
3	ON	Disable ability to update the firmware and/or gate array.
4	ON	Reserved
5	ON	Reserved
6	ON	Reserved
7	ON	Reset the TCP/IP Network Settings to factory default values - Must be used with DIP #1
All 8	ON	Clears everything from the controller (see details in the following pages)

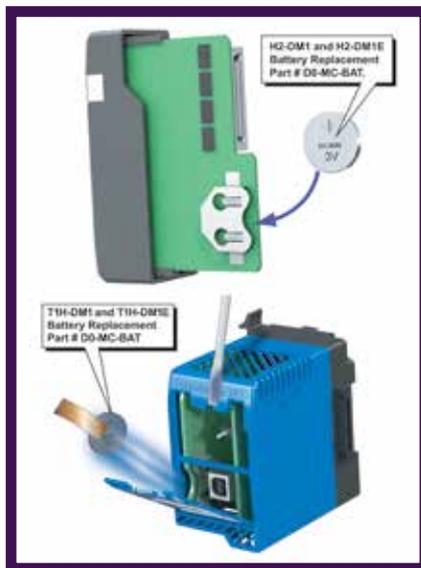
bit location \$BatteryLow (ST149) will be ON.

They are so similar, that you can even develop your ladder code on one and then deploy it on the other (Image 5).

#### How to Choose

If they are so similar, how do you choose between them? For most applications, either will do just fine. There are a few applications where one provides a definite benefit over the other, though.

and even use the same backup battery:



over the other, though.

In general, if you are doing everyday PLC control applications, you'll find the *DirectLOGIC* platform will be the most straightforward and may cost a little less too. With the *DirectLOGIC* platform, additional serial ports and Ethernet ports can easily be added - the Terminator version does not offer those types of modules (Image 6).



Image 6: The *DirectLOGIC* system supports modules you can plug in to add serial ports and Ethernet ports - Terminator does not.

And on both controllers, if the backup battery needs to be replaced, the PWR LED will be YELLOW instead of its normal GREEN color and the system

The Terminator style may be a good choice if you have a lot of analog I/O.

Terminator I/O has a much higher analog I/O density than the *DirectLOGIC* platform, which can make Terminator more cost-effective with that type of I/O mix.

A huge advantage of the Terminator I/O form factor is that all three connections for power, ground and signal are on the module;

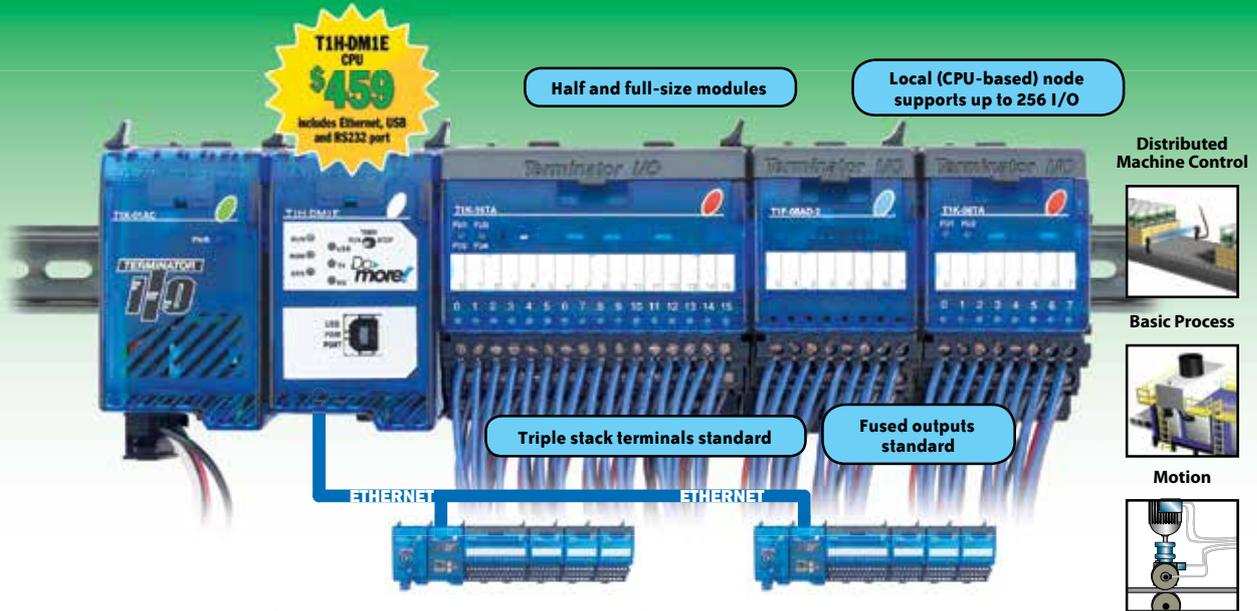


Image 5: The *DirectLOGIC* and Terminator I/O CPUs are so similar, you can actually swap software programs back and forth between them for identical I/O configurations.

Continued, p. 28>>

# Need control everywhere?

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## Do-more® in small spaces

For control applications that are space-constrained or need distributed I/O, why not consider the new Do-more T1H series PLC? We took our popular Terminator field I/O system and added the Do-more T1H CPUs as a new brain - an incredibly powerful controller in a compact, flexible form factor.

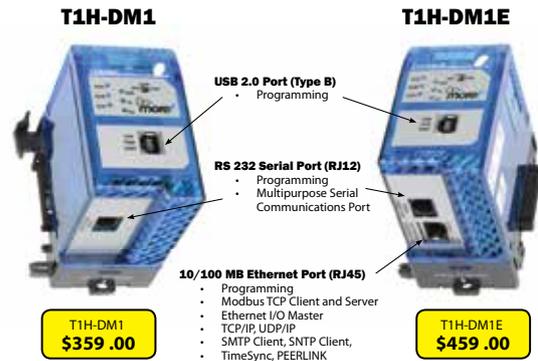
*The Terminator distributed I/O system combines the features of terminal blocks and I/O modules into one convenient package.*

- Reduces panel space by as much as 30% over conventional PLC system with terminal blocks
- Distribute I/O nodes close to field devices for faster and more efficient wiring and troubleshooting
- I/O modules fit into individual I/O terminal bases for quick replacement without disturbing field wiring
- Easy troubleshooting at the device termination, with status and blown fuse indicators

*The new T1H series CPUs give the Terminator field I/O system all the super powers of the Do-more PLC family, including expansive program memory and I/O capacity, fast processing and an intuitive instruction set.*

- Onboard communication ports include USB, serial, plus Ethernet (on T1H-DM1E)
- Up to 256 I/O in local node (with CPU), and thousands more with optional Ethernet I/O
- Coupon for 30 days free online video training included with every CPU

Create your programs and documentation with the **FREE Do-more Designer software**. Download it online - with the built-in simulator, you can try out your logic right away.



T1H-DM1  
**\$359 .00**

T1H-DM1E  
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# FYI

## DIRECTLOGIC DO-MORE VS. TERMINATOR I/O DO-MORE PLC

### Continued from, p. 26

you do not need the extra footprint to wire to external ZIPLink wiring modules or individual terminal blocks (Image 7).

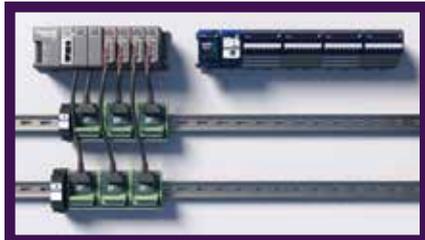


Image 7: You don't need external terminal blocks with Terminator – all the connections for power, signal and ground are right there on the PLC.

Another footprint savings you get with the Terminator I/O is when it comes time to add another power supply because you ran out of current to drive all the sensors. With the *DirectLOGIC* platform, you would have to add another external power supply and another row of DINnector terminal blocks and extra wiring to get power to all of the sensors.

With the modular design of the Terminator I/O, you simply drop another power supply in line at the end of the existing modules and continue adding I/O modules as needed (Image 8).



Image 8: The Terminator I/O system is designed to allow you to easily add power supplies and additional I/O modules to the system as you need, without disturbing the I/O already in place.

Since the Terminator platform is “stackable” – no I/O racks, just add a module at a time – it can be more flexible when needing to expand the system.

The Terminator has another unique advantage: you get to choose the type of terminal connection you prefer – screw terminal or spring clamp. This is really a personal preference, but for those who like spring clamps for quick, easy and reliable wiring connections, this is a big deal (Image 9).



Image 9: With Terminator I/O version of Do-more you can select how you want to attach wires – screw terminal or spring clamp.

### Bottom Line

Either Do-more PLC will likely do the job; most important is determining what types of I/O and communications you need and ensuring that your preferred platform supports those.

### DirectLOGIC Do-more and Terminator I/O Do-more PLC (Communication port protocols supported are identical for both series)

Protocols	CPU Modules		
	XXX-DM1 /XXX-DM1E	XXX-DM1E	XXX-DM1E
	USB Port	RS-232 Serial Port	Ethernet Port
<i>Do-more Designer Programming</i>	Yes	Yes	Yes
<i>Modbus/RTU Client (Master)</i>		Yes	
<i>Modbus/RTU Server (Slave)</i>		Yes	
<i>Modbus/TCP Client (Master)</i>			Yes
<i>Modbus/TCP Server (Slave)</i>			Yes
<i>DirectLOGIC RX/WX Client (Master)</i>			Yes
<i>DirectLOGIC RX/WX Server (Slave)</i>			Yes
<i>K-Sequence Server (Slave)</i>		Yes	
<i>DirectNET Server (Slave)</i>			
<i>HEI Ethernet I/O Master</i>			Yes
<i>SMTP (EMail) Client w/Authentication</i>			Yes
<i>Simple Network Time Protocol (SNTP) Client</i>			Yes
<i>Do-more/PEERLINK</i>			Yes
<i>Do-more Time Synchronization Protocol (Client, Server, Alternate Client)</i>			Yes
<i>Do-more Logger/UDP</i>			Yes
<i>Serial ad-hoc ASCII/Binary Programmatic Control</i>		Yes	
<i>UDP ad-hoc Programmatic Control</i>			Yes
<i>TCP Client Programmatic Control</i>			Yes
<i>TCP Server Programmatic Control</i>			Yes

Blank = Not Supported

# Business Notes

*Goings on in the Industry*

By Joan Welty

## AutomationDirect supplies automated trophies for state robotics competition

AutomationDirect has supported competitive robotics at the local, regional and national levels for many years. This past year, in addition to sponsoring the annual Georgia Robotics Invitational Tournament and Showcase (GRITS) competition, AutomationDirect also provided the very unique trophies awarded to the winners.

GRITS is a one-day event, produced by GeorgiaFIRST Robotics, the arm of US FIRST that promotes FIRST Robotics Competitions (FRC) in Georgia. This year's event, "Ultimate Ascent", took place at the World Congress Center in Atlanta, Georgia on Oct 5th, 2013.



This year's trophy design grows to almost twice its starting height with the flip of a toggle-style hand lever pneumatic valve. The cylinders, regulators, valves and fittings used to animate the trophies are all part of the NITRA® line of pneumatics offered by AutomationDirect; two dial pressure gauges are from the ProSense® family of process control and measurement devices. Each trophy is fitted with an on-board air tank, allowing the trophy to operate 10-15 times before being refilled with air. The trophies are topped with the same Frisbee game element used by the robotics teams in the competition. Trophies were awarded to the competition winners (an alliance of three robotics teams), as well as team awards for Spirit and Outreach. But, perhaps the most sought after trophy was awarded to the

team that embodied the unique FIRST concept of Coopertition®.

According to the FIRST Web site, "Coopertition is displaying unqualified kindness and respect in the face of fierce competition. Coopertition is founded on the concept and a philosophy that teams can and should help and cooperate with each other even as they compete."

To see the trophies in action, visit: <http://bit.ly/grits-trophy>.

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All of the most current articles are displayed right on the homepage to keep you up-to-date. If you're a system integrator, there is a place where you can gain easy access to articles from your peers. Plus, everyone will want to visit the new White

Paper Gallery. We already have three very helpful resources that we hope will help you learn or get refreshed on the basics of different control technologies. They include "Top 10 Tips for Specifying VFDs", "Understanding Encoders", and "PLCs and PACs Simplify Data Acquisition".

The new [Library.AutomationDirect.com](http://library.automationdirect.com) also integrates with all of our social media profiles, so if you haven't already, make sure you follow us on whatever social media site you use. (Facebook, Twitter, Google+, LinkedIn, YouTube)

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"People often say that motivation doesn't last. Well, neither does bathing. That's why we recommend it daily."

– Zig Ziglar

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"You can't use up creativity. The more you use, the more you have."

– Maya Angelou

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# The Break Room

## Brain teasers



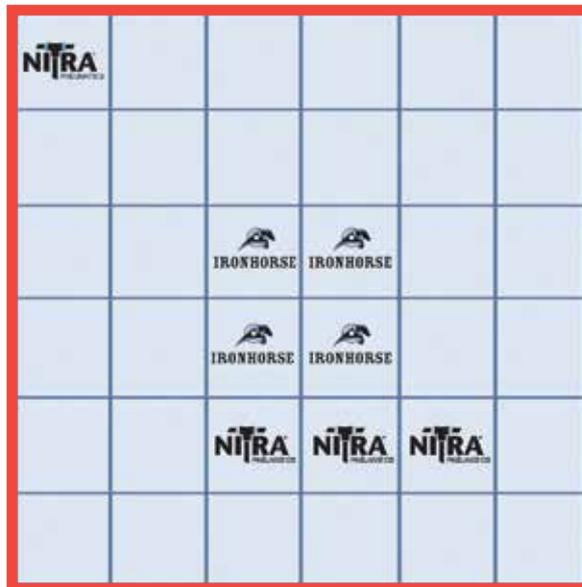
### Brain teasers

By Chip McDaniel,  
AutomationDirect

#### 1.) Cavity Fighter

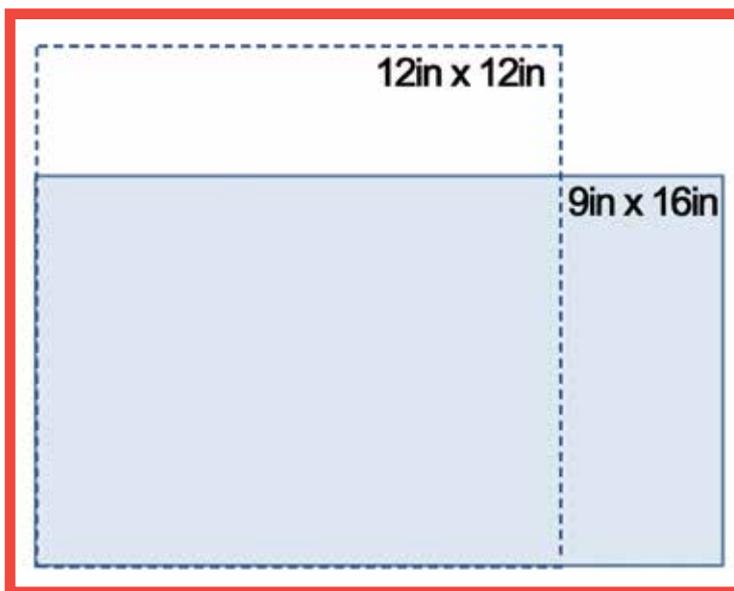
The miserly owner of the candy factory purchased 1000 gallons of molasses to fill his main storage tank. But because he was a cheapskate and didn't spend any money on maintenance, the ancient valve at the bottom of the tank began leaking in the middle of the night. The following morning the factory workers arrived to find a huge mess with molasses all over the floor. The owner instructed the foreman to top off the tank with water, and to turn on the mixing apparatus in the tank to combine the water with the remaining molasses. The following night, the exact same amount of the new molasses/water mixture leaked onto the floor. Again the owner instructed the foreman to top off the tank with water and mix the solution. The factory's chemist then ran a test and determined that the tank now held a mixture of 50% water and 50% molasses. *How much of the contents leaked from the tank each night?*

#### 2.) Cellular Degeneration



The eccentric director of operations at the puzzle factory has fenced-off four identically shaped 'work cells' that completely fill the factory floor. The edges of the work cells fall on the grid pattern shown, and each work cell contains one pneumatically powered machine that uses NITRA® components and one electrically powered machine that uses IronHorse® Motors. *Can you determine the shape of the work cells?*

#### 3.) Enclosing Time



The inept purchasing agent at the puzzle factory bought the wrong subpanel for the control enclosure for their new automation project – and worse, he didn't buy from AutomationDirect! The enclosure accepts a 12" x 12" subpanel, but he bought a 9" x 16" subpanel. When the project manager heard the news, he was dismayed, because he realized that the time it would take to exchange the subpanel with 'that other vendor' would delay his project by at least a week. But the technician working on project announced that he knew a way to cut the

subpanel into just two pieces and weld them back together to fit in the enclosure. *How did he cut the subpanel?*



# It's easy to be a PRO at DATA EXCHANGE



Productivity3000 programmable controller



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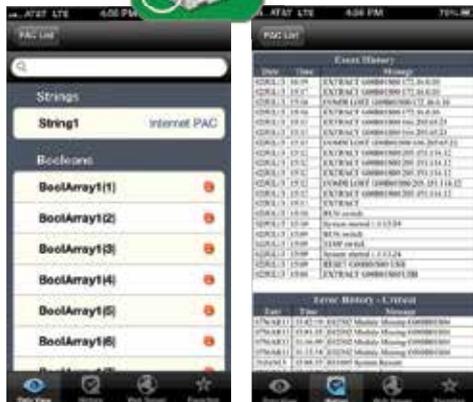
## Easy DAQ or SCADA with flexible I/O and practical software

Use the technology built into the Productivity3000 programmable controller to make your job easier. If you need data collection or monitoring from the factory floor, lab, or field - get your data the way you need it.

One program instruction in the controller connects and passes data to all the common database formats - Microsoft Access, ODBC, and SQL Server. The controller can retrieve, add, delete and update data records in the remote database. Low-cost server software (*DataWorx P3K for PC sold separately, starting at \$595*) makes the data readily available to your upstream application.

For even simpler data logging, the CPU can write data to a removable mass storage device (USB) on an event or time basis. And for basic mobile monitoring, there's the new PACData app.

Choose one approach, or all - it's that flexible.



Monitor data by type

View Event and Error Histories

Check out the new "PACData" app (*free download on Apple App Store*) that gives you the capability to remotely monitor specified program tags in the Productivity3000 from your phone or tablet (*iOS only at this time*). You also gain access to error and event history as well as login capabilities to the CPU's built-in Web server where you can view any of your data log files. On any screen, zoom into specific values and save a screen capture if needed.

Research, price, buy at:  
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- Modbus RTU messages through the RS232 or RS485 port
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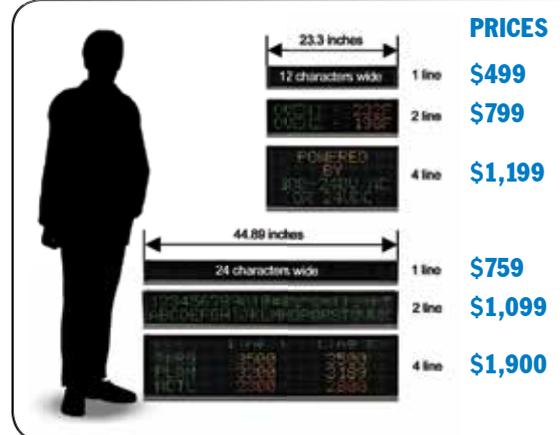
The Viewmarq line offers:

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- Chain and wall/ceiling mount brackets included



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### Six models to choose from:



Use the FREE Viewmarq configuration software (*online download*) to configure the display; create, preview and send messages from a PC; or create ASCII strings that can be transferred to PLC instructions to control the Viewmarq.

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