

Your guide to practical products, technologies and applications

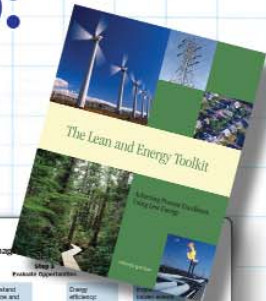
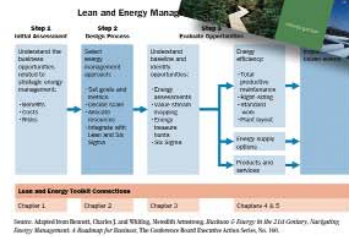
Automation NOTEBOOKTM

Fall 2009

Issue 15

Cover Story

Industry Slims Down, Peps Up: Manufacturers are discovering that producing smarter means cutting energy



New Product Focus AutomationDirect Introduces Productivity3000 Controller



Productivity3000
www.productivity3000.com

AutomationTalk

New videos added to

learn.automationdirect.com

Technology Brief

Transformers - Application,
Construction and Efficiencies

Just **CLICK!** for built-in discrete and analog I/O



Complete PLC starting at \$69 Mighty as a stand-alone unit, or expand to 142 total I/O

- Seven stand-alone DIN-rail mountable DC-powered CPU combinations including:
 - 8 DC In / 6 DC Out (sinking)
 - 8 DC In / 6 DC Out (sourcing)
 - 8 DC In / 6 Relay Out
 - 8 AC In / 6 Relay Out
 - **NEW!** 4 DC In / 4 DC Out (sinking), 2 analog in, 2 analog out (current / voltage selectable)
 - **NEW!** 4 DC In / 4 DC Out (sourcing), 2 analog in, 2 analog out (current / voltage selectable)
 - **NEW!** 4 DC In / 4 Relay Out, 2 analog in, 2 analog out (current / voltage selectable)
- Built-in communication ports (two in discrete CPUs, three in analog CPUs)
- Removable terminal blocks for easy wiring
- Eleven stackable, discrete I/O option modules
- Program AND documentation stored in CPU
- Supported by FREE, high-feature programming software

With CLICK PLCs, you get a lot of application control in a small package. The new analog CPUs feature 8 discrete and 4 analog I/O built-in, plus battery-backed memory with real-time clock. Download the free programming software and see how easy automation can be.

CHECK OUT JUST A FEW PRICES ON CLICK

Product Description	AutomationDirect CLICK Price/Part Number
PLC CPU with 8 DC inputs / 6 DC outputs (sinking), two communication ports	\$69.00 C0-00DD1-D
PLC CPU with 4 DC inputs / 4 DC outputs (sinking), 2 analog inputs / 2 analog outputs, three communication ports, real-time clock	\$129.00 C0-02DD1-D
Auxiliary power supply (0.5A), 100-240 VAC input, 24 VDC 0.5A output	\$29.00 C0-00AC
AC input module, eight 100-120 VAC points	\$40.00 C0-08NA

AutomationDirect prices are U.S. published prices as of October 2009.
Prices subject to change without notice.

www.automationdirect.com

For complete information and to download software, visit:
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Your guide to practical products, technologies and applications

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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

The fall season is in full swing. Trees are displaying the beautiful red, gold, and orange colors no artist can fully capture on canvas. Evenings are cooler and most Friday nights you hear sports fans everywhere cheering for their favorite football teams. Here in the South, we are hoping for a dry fall and an opportunity for many homes and businesses to rebuild from the recent flooding.

Speaking of climate, 2009 has been a challenging one. As a direct marketer, one of our goals this year was to bring more products to market than in the previous year. We expanded our warehouse to hold them all! Please keep the product requests coming – we are listening.

In this issue of Automation NOTEBOOK you will find information on new products such as our new programmable controller, the Productivity3000. Guest writer Brian Elliott provides an informative article about sizing transformers, and the Student Spotlight for this issue features Ryan Andrade, who used the DirectLOGIC 205 PLC as part of his biodiesel project at the University of California, Davis.

Our cover story is from Keith Schmitz on how manufacturers are discovering ways to cut energy consumption. Then read how a denim manufacturer in Georgia has used AutomationDirect products to retrofit and simplify production. There are informative technical articles, and the ever popular Breakroom. Now, turn the page and enjoy...



TJ Johns
Coordinating Editor
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New Product Focus

What's New



AutomationDirect Introduces Programmable Automation Controller



The Productivity3000 Controller is Automation Direct's newest generation of industrial controllers that combines features and capabilities of a PC-based control system with that of a typical programmable logic controller (PLC). Productivity3000 is a modular, rack-based system of up to 116,000 I/O points with local, expansion and remote I/O bases and a full lineup of discrete, analog and specialty I/O modules. The high-performance CPU has 50Mb memory, fast scan times and industry-leading seven communication ports for \$599.

The P3-550 CPU features a 4 line x 10 character LCD ideal to display system alarms and information or user-defined messages. Seven onboard communications ports support USB, Ethernet and serial devices. A USB plug-and-play connection is available for programming and online monitoring. A USB local expansion port supports up to four additional I/O bases, while a dedicated Ethernet remote I/O expansion port can connect up to 32 remote base groups; each remote group supports up to four additional local

bases, for over 116,000 maximum I/O. AutomationDirect's GS series of AC drives can also be networked to the CPU directly from this port. An additional USB port allows users to log data from the system into a removable USB drive, as well as transfer projects to and from the CPU. A second Ethernet port supports programming, monitoring, email and Modbus TCP network communications. One RS232 and one RS485 serial port can communicate via Modbus or ASCII protocols for local networking or custom device interfaces.

Two power supplies, AC- and DC-powered, are available; both provide isolated 24 VDC, 5 VDC, and 3.3 VDC to the Productivity3000 bases. I/O bases are available in 3, 5, 8, and 11-slot models; any combination of I/O modules may be installed in a base without power budget considerations. Over 35 I/O modules capture and control a wide range of field signals, including up to 64-point DC I/O, 16-point AC I/O, and analog voltage, current or temperature. The patent-pending LCD interface built into each analog module displays field signal levels as well as module and signal faults. Hot-swappable I/O support allows exchange of modules or complete remote bases without interrupting the process.

The P3-RS Remote Slave module features a 4 line x 10 character LCD display and communications ports for serial devices. Up to 32 P3-RS Remote Slaves can be connected to a single P3-550 CPU for a remote I/O network. The CPU can be programmed and monitored remotely through one of the USB ports on this module.

For wiring most I/O modules, pre-wired ZIPLinks wiring systems are available to eliminate the need for hand wiring modules to terminal blocks. Five ZIPLink module types are available: feedthrough, fuse, relay, sensor input, and pigtail cable.

The free downloadable ProductivitySuite programming software features tag name-based programming for better documentation manage-

ment and more seamless integration with HMIs. The data is stored in true database format so it can be searched, filtered and sorted; a .csv file can be imported to update the tags, or the file created every time the project is saved can be imported into other databases, such as the C-more HMI configuration file. The onboard program documentation feature stores the program, tag database and all program comments to the CPU so the information is available to any PC connected to the system. Run-time editing transfers logic edits without stopping the executing program.

The software can perform hardware auto-discovery and configuration, including local and remote bases and I/O, plus GS series AC drives. The user can also configure the system offline by dragging and dropping bases and modules. After configuration is complete, modules are electronically keyed to prevent incorrect replacement.

Powerful processes in the programming environment reduce development time; timesavers include combined ladder logic and function block programming; task management that minimizes scan time; advanced instructions that simplify complex tasks, and an exhaustive HELP file that covers both hardware and software topics.

Available DataWorx™ P3K data logging software provides an easy and inexpensive way to collect data from the Productivity3000 PAC by connecting it to enterprise database systems. Report-by-exception operation eases network traffic by sending information only when needed. It also allows the device complete control to store data to a computer database or to store it locally if the network is down. The data logging software starts at \$595 for a single controller connection.

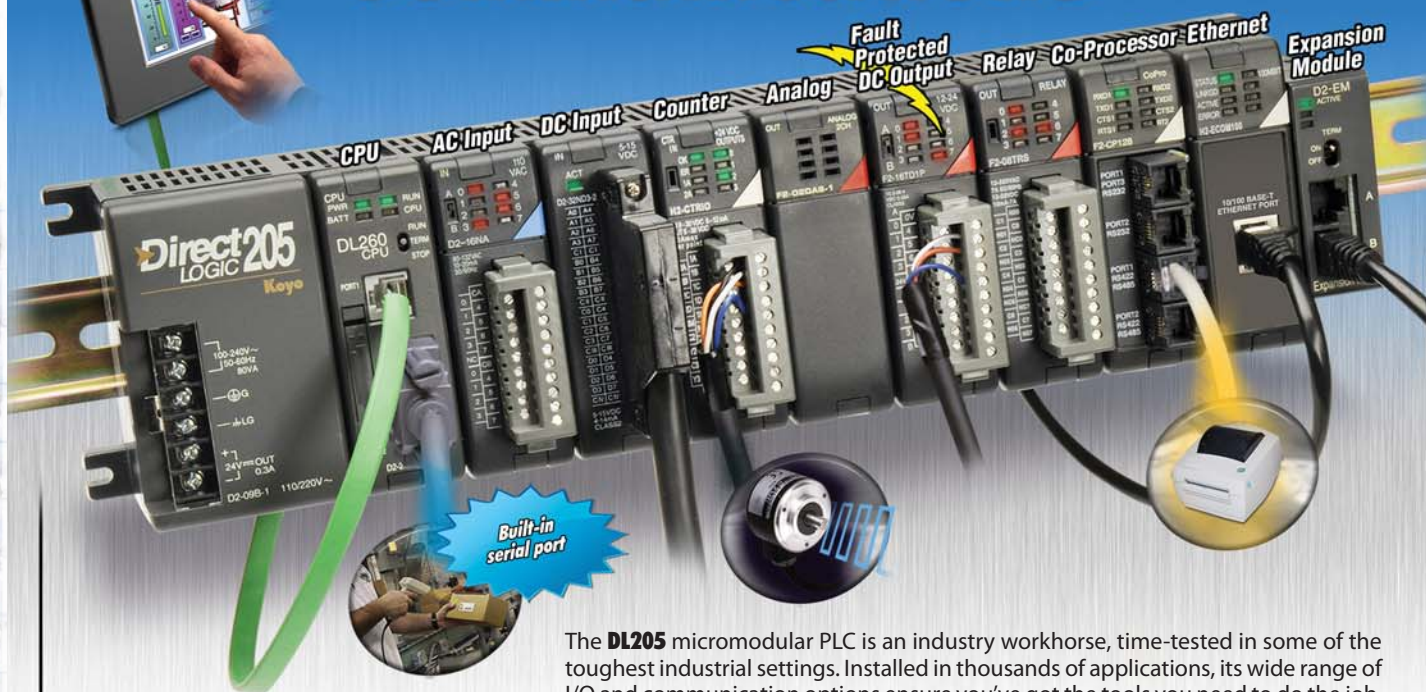
The complete line of Productivity3000 components can be seen at:

www.automationdirect.com/programmable-controllers

Do it all with our practical PLCs!

Direct LOGIC Koyo

Discrete, Analog and Communications



The **DL205** micromodular PLC is an industry workhorse, time-tested in some of the toughest industrial settings. Installed in thousands of applications, its wide range of I/O and communication options ensure you've got the tools you need to do the job. And our direct prices, 30-day money-back guarantee and FREE award-winning technical support are all standard features that make that job a little easier!



DISCRETE: Choose from **25 discrete modules** that support AC, DC and relay I/O types. All modules have removable terminal blocks for easy wiring and module replacement. Our newest DC output module performs electronic short circuit protection.



ANALOG: **19 analog modules** offer interfaces to current and voltage signals, as well as thermocouples and RTDs. Connect devices such as process transmitters, proportional valves and AC drives.



COMMUNICATIONS: The DL205 series makes **Ethernet communications** easy and inexpensive. Get fast peer-to-peer access to HMI, other PLCs and PCs on the factory floor at one of the lowest costs per node in the industry.

CHECK OUT OUR PRICES ON PLC MODULES

PLC modules

Discrete Modules

	Direct LOGIC DL205	VS.	Allen-Bradley CompactLogix
AC 16-pt. input	\$128		\$269
DC 16-pt. input	\$86		\$228
DC 16-pt. output	\$94		\$299
Isol. relay 8-pt. out	\$99		\$273

Analog Modules

4-channel input (current)	\$199		\$464
4-channel thermocouple in	\$299		\$942 (6-ch)
8-channel output (voltage)	\$269		\$1,389

Communications

Ethernet interface	\$285		\$760
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* All prices are U.S. published prices. Prices and specifications may vary by dealer and configuration. AutomationDirect prices are from October 2009 Price List. Allen-Bradley prices are based on <http://shop.rockwellautomation.com> 4/9/09.

www.automationdirect.com

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Product Snapshots

Press Releases



NITRA™ line now includes pneumatic air cylinders and position switches



The NITRA pneumatic product line now includes a series of stainless steel, round body, non-repairable cylinders.

The new cylinders feature type 304 stainless steel bodies with double rolled-in construction with high-strength aluminum alloy porting ends. Single and double acting models are available with nose, pivot and double-end mounting options. Certain cylinder models are also available with magnetic pistons for position indication. This series includes bore sizes from 7/16 inch up to 2 inches; depending on bore size, available stroke lengths range from 1/2 inch to 18 inches. NITRA pneumatic air cylinders are ideal for applications such as packaging lines, conveyors, material handling and robotics.

Optional mounting brackets, nuts and rod clevis are available. Prices for NITRA non-repairable air cylinders start at \$9.50 and are backed by a three-year limited warranty.

The NITRA line also includes the CPS series of pneumatic position switches and accessories to offer a robust interface between pneumatic actuators and electrical control systems. The

solid-state electronic switches are available in 3-wire DC PNP and NPN normally open and PNP normally closed configurations and can be purchased with an M8 wiring connector or 2-meter cable with wire leads. Five mounting bands with adapters for round body cylinders are available ranging from 5/16" to 2" sizes. Pneumatic cylinder position switches start at \$18.75 and are backed with a 3-year warranty.

The complete line of NITRA pneumatic air products can be seen by visiting:

www.automationdirect.com/pneumatic-parts.

NEC Class 2 Power Supplies added to RHINO™ line



The RHINO line of power supplies to include NEC Class 2 plastic-housed low-profile switching supplies in 5, 12 and 24 VDC adjustable output models. The new PSC series offering includes eight models with power ratings from 12W to 90W and feature universal 85 to 264 VAC input voltage, adjustable DC output, and output current limitation. The series provide tightly regulated output voltage for sensitive loads in industrial, commercial and residential environments. The PSC series is UL508 listed, UL1310 recognized for NEC Class 2 compliance, and CE marked. Prices for the RHINO PSC series supplies start at \$46.75. Learn more at:

<http://www.automationdirect.com/class2-dc-power-supplies>.

Multiport junction blocks for sensors launched



ZIPport™ multiport junction blocks provide time, cost and space savings by allowing multiple sensors to be wired to a single block with one cable connecting to the control panel.

ZIPport junction blocks are available in field wireable or five-meter cable versions, feature four and five-pin M12 connectors in four, six and eight-port models, and offer a choice of one or two I/O per port. The blocks provide 24 VDC and 120 VDC/AC operation in temperatures ranging from -20°C to +80°C (-4°F to +176°F) and also provide an IP67 degree of protection when all ports are either connected or covered with recommended protective caps.

The five-meter integrated cable series come with three 18-gauge wires for power connection and four to sixteen 22-gauge wires for I/O connections, depending on the number of ports.

The field-wireable junction blocks allow the installer the option of using his cables of choice and only the I/O necessary. All ZIPport models are available with or without power and signal LED indicators.

Prices for the ZIPport multiport junction blocks start at \$39 and include two spare port caps. Additional caps can be purchased in packs of five for \$2.50. See the full line of ZIPport multiport junction blocks at:

www.automationdirect.com/junction-blocks

Higher voltage motor contactors available



The Fuji electric contactor line now includes models with higher coil voltages. The new SC series components operate with AC coil voltage ranges of 440-480V and 500-550V at 60hz and are available in frame sizes of 43mm, 54mm and 67mm. SC series SUPERMAGNET™ Coil contactors now include 88mm, 100mm and 115mm frame models with AC coil voltage ranges of 380-450V and 460-575V at 50/60hz. Also now available with SUPERMAGNET coils are the Odyssey series contactors in 138mm and 148mm frame sizes, with AC coil voltage ranges of 380-450V and 460-575V at 50/60hz. Prices for the new Fuji contactors start at \$13.75 and are backed by a 30-day return and one-year warranty.

To see the full line of Fuji contactors, visit:

<http://www.automationdirect.com/motorcontrols>

Industrial Ethernet Switches rated for wide temperatures



The Stride™ line has been expanded to include industrial-grade unmanaged Ethernet switches and media converters with aluminum housings. Designed for wide-temperature (-40° to 85°C) applications, these true plug-and-play devices automatically determine and remember devices connected to each port and only route messages through the appropriate ports, increasing speed and bandwidth. Even under heavy I/O and data exchange, Stride switches and the Ethernet control network maintain more consistent cycle times. Prices start at \$199. Learn more at:

<http://www.automationdirect.com/ethernet>.

Analog CPUs now available for CLICK® PLC line



The CLICK PLC line now includes three analog CPU models. The new CPUs feature two analog inputs and two outputs with ranges of voltage up to 5 VDC or current up to 20 mA. The modules include two built-in RS-232 and one RS-485 communication ports, and real time clock and battery backup for internal SRAM.

Analog CPU modules are differentiated by their discrete I/O; all have four DC inputs, and a choice of four DC sinking, DC sourcing or relay outputs. All CLICK CPUs are configured with the easy-to-use programming software, available as a free download. Prices for the analog CPUs start at \$129.

See the full line of CLICK PLCs at www.automationdirect.com/click-plc

Dinnector line of terminal blocks expanded



The Dinnector line of terminal blocks and accessories now includes supplementary circuit breaker terminal blocks and sockets. The blocks are available in ¼ amp to 10 amp sizes and are sold in packs of 20. Terminal block sockets, available in 12V and 24V models with or without LED indicators, are sold in packs of 50.

Also available are disconnect terminal blocks in 12V and 24V models. Sold in packs of 50, disconnect terminal blocks start at \$74.25 per pack. Disconnect knife blades are available in packs of 50 for \$21.50.

A new series of single and double level plug-in style terminal blocks are sold in packages with 32 blocks and four pin protectors; prices start at \$31 for single-level and \$45.75 for double-level block packages. New accessories available include end covers, spacers, pin protectors and marking tags, as well as two-pole and three-pole jumpers.

Thermocouple terminal blocks have been added in 50V and 300V models. Thermocouple terminal blocks start at \$119 for a pack of 50.

To view the full line of Dinnector terminal blocks, visit:

<http://www.AutomationDirect.com/terminal-blocks>

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Product Snapshots cont.

Press Releases

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Flexible Service Cord expands wiring solutions



The line of electrical wire for industrial applications now includes flexible service cord available in sizes ranging from 18 to 10 gauge, with two, three or four-conductor configurations. SEOW type cord has a 600V rating while type SJEOOW cord has a 300V rating. Both are available in 50 and 250-foot lengths. Four-conductor, 8 AWG type W cord with a 2,000V rating is also available, in lengths from 10 to 250 feet. Ideal for indoor and outdoor applications, all flexible cord types are UL and CSA approved and RoHS compliant. Prices start at \$19. To view the entire line of flexible service cord, visit <http://www.automationdirect.com/flexible-portable-cord>

ZIPport line expands with panel interface connectors

The ZIPport™ product line has been expanded to include panel interface connectors in over 30 configurations. Designed to be mounted on the outside of electrical control panel boxes, the interface connectors act as pass-through connections, allowing the operator to interface with PLCs and other programmable devices without opening the control box.

Panel interface connectors are available with single, duplex or GFCI power outlets, as well as a no-power option. Designed for frame sizes six to



48, communications connectors available include D-sub, RJ45, RJ12, USB, Ethernet, and Data Highway; and units are available in various combinations needed for the typical control panel. A standard reset 3 Amp circuit breaker limits power output of the unit.

ZIPport panel interface connectors are NEMA and UL approved and are RoHS compliant. Prices start at \$37.

The full line of ZIPport panel interface connectors is backed by a one-year warranty. Learn more at www.automationdirect.com/panel-interface-connectors

ProSense™ motor monitoring relays now available



The ProSense line now includes phase monitoring, alternating and pump seal failure relays.

The PMRU phase monitoring relays utilize microprocessor-based design to protect against phase loss, reversal, unbalance, undervoltage and overvoltage conditions. With a variety of user-adjustable settings, PMRU relays also feature a multi-color LED to indicate normal and fault conditions.

The PMRR series provides protection against phase reversal, while the PMRRL series, with an adjustable undervoltage setting knob, protects against phase loss, reversal and undervoltage. Prices for phase monitoring relays start at \$39.

AR series alternating relays feature a three-position selector switch to alternate two loads as normal, or lock the relay to one load or the other. The ARX model is a DPDT cross-wired unit that alternates two loads as normal, or locks the relay to always operate the same load first each time. Alternating relay prices start at \$21.

Also available are PSFR series pump seal failure relays, which monitor the shaft seals of submersible pumps. Featuring a user-adjustable sensitivity knob, the relays are available in two 8-pin models - SPDT single channel or dual channel relay with two SPNO contacts. PSFR relay prices start at \$47.75.

Accompanying 8-pin 10A, 600V octal sockets are available for \$3.50.

To see the complete ProSense motor monitoring relay line, visit www.automationdirect.com

New 1200 and 3600 RPM general purpose motors



More IronHorse™ general purpose AC motors have been added to include 3-phase 1200 RPM six-pole and 3600 RPM two-pole models. Six new 56C 3600 RPM rolled steel motors are now available, ranging from 0.33 to 2 HP; 13 new T-frame cast iron motors in 3600 and 1200 RPM models are available in sizes from 1 to 10 HP. These TEFC motors have 5:1 variable torque and 2:1 constant torque ratings and are ideal in applications such as fans, conveyors, pumps and more. IronHorse general purpose motors are available for same-day shipping and are backed by a two-year warranty. IronHorse motor prices start at \$70. Check out the full line of IronHorse general purpose

motors, including the existing 1800 RPM motors (0.33 to 300 HP) at www.automationdirect.com/ironhorse-motors

LED Sensor cables now available



The latest sensor cable offering now includes quick-disconnect and patch cables with LED indicators. The new patch cables have a right-angle M12 female plug with LED indicator on one end and an axial male connector on the other. Available in six lengths ranging from 0.3m to 10m, the cables feature a polyurethane jacket for dependable use in oily and direct sunlight applications. Prices for patch cables with LED indicators start at \$10.75. Also added are quick-disconnect cables with an LED indicator to confirm signal presence. Fitted with industry standard M12 right-angle female plugs, these cables can be used with patch cables to extend distance. Available in two-meter, five-meter and 10-meter lengths, these cable prices start at \$10.75. See the full line of sensor cables at: <http://www.automationdirect.com/cables>

"Age is an issue of mind over matter. If you don't mind, it doesn't matter."
— Mark Twain

Five reasons to try AutomationDirect



1

Our prices are low, we can't help it!

Our prices are well below the list price of more traditional automation companies because, with our direct business model and focus on efficiency, AUTOMATIONDIRECT has the lowest overhead in the industry. We pass the savings on to you by offering high-quality products at low prices.

2

Our service is exceptional.

Independent surveys completed by readers of Control Design magazine placed us at the top of the list for service (*in multiple product categories*) nine years in a row in their Readers' Choice awards (2001-2009). Other surveys by magazines such as Control Engineering and Control have echoed the results.

3

We make ordering easy.

Shop online with our exhaustive product listings or use our new interactive catalog. You don't have to register to see prices or create quotes. Or fax or phone us - you'll get friendly, efficient service from the most helpful sales team in the business.

4

We ship super fast (and FREE on orders over \$300).

The majority of our products are stocked for same-day shipping, when you place your order by 6 p.m. E.T. (*with approved company credit or credit card, see Web site or catalog for details and exclusions*).

Plus, you get free shipping on orders over \$300 U.S. within the U.S., Canada and Puerto Rico, shipped via ground service or LTL (*certain heavy items are excluded, see Web site or catalog for details*).

5

We guarantee it.

We want you to be pleased with every order. That's why we offer a 30-day money-back guarantee on almost every stock product we sell, including our software (*see Terms and Conditions for certain exclusions*).

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Cover Story

The State of Manufacturing

Industry Slims Down, Peps Up: Manufacturers are discovering that producing smarter means cutting energy

By Keith Schmitz

It now seems like a thousand years ago, but before the wave of economic bad news, many managers and executives had been weighed down by out of control energy prices, and with a fear that the world was reaching peak oil production and things would get even tougher.

Now, businesses have other things on their minds. But the good news is that as companies are wringing more out of their assets, in the process they are cutting back on energy consumption. What a bargain.

Time Magazine, at the end of 2008, noticed this trend, explained in an article "America's Untapped Energy Source: Boosting Efficiency." As they point out, improving efficiency will not alone solve our ongoing energy problem, but it is "a renewable energy source that is perfectly clean, remarkably cheap, surprisingly abundant and immediately available." As happens often, this kind of energy source is a by-product of something we are doing right now – finding more ways to produce more, but in less time, and with fewer resources.

Industry is tracking their carbon footprint for good reason. In 2004, the National Association of Manufacturers related in their report "Efficiency and Innovation in U.S. Manufacturing Use" that industry can cut their energy use by 20%. This translated into \$19 billion in savings in 2004. About 30% of these savings can be achieved without capital investment, using only procedure and behavioral changes.

These changes can be brought

about with the use of tactical tools such as Lean Management, often using Six Sigma. With Lean/Six Sigma, the target is waste, which ultimately sets energy use in its sights.

One reason why Six Sigma is used to make operations more efficient is that it is a great detective tool. Robert Johnson is the Quality Assurance Manager with the Tyco Fire Suppression and Building Products plant in Lubbock, TX, where they manufacture millions of fire sprinklers annually. He is also immediate past chair of the American Society for Quality Lean Enterprise Division.

One such detective story at Tyco was the mystery of the faulty fire sprinkler seal. Setting in motion a black belt Six Sigma project, the Tyco team used root cause and failure mode analyses to look at hundreds of leakers and track down the elusive problem.

Their investigation turned up several rather simple but not readily apparent problems. The first problem was that the cardboard dunnage which carries valves through manufacturing, was leaving fibers on the valve seat area. The simple solution – Tyco switched to plastic dunnage. (Figure 1)



Figure 1

Controlling the flow of work can be another strategy that reduces both production costs and energy bills. Chad Vincent is ASQ Lean Enterprise Division for Social Responsibility Liaison, and has the opportunity to look into a number of operations. "The traditional approach in a lot of plants," he observes, "is that in driving down the inventory count at the end of the month, there can be a lot of wasted

effort. What happens is there is a big push to use up the entire inventory. While that may keep the accountants happy, there are some real energy savings that can be missed."

Vincent points out there are peaks and valleys in the action along the production line using that approach. He recommends applying line balancing with the help of Six Sigma to shave these outcroppings, even eliminating an extra shift. Machinery can be right-sized more precisely, equipment can be on only when needed and HVAC systems can be operating fewer hours.

"That," concludes Vincent, "translates into energy savings."

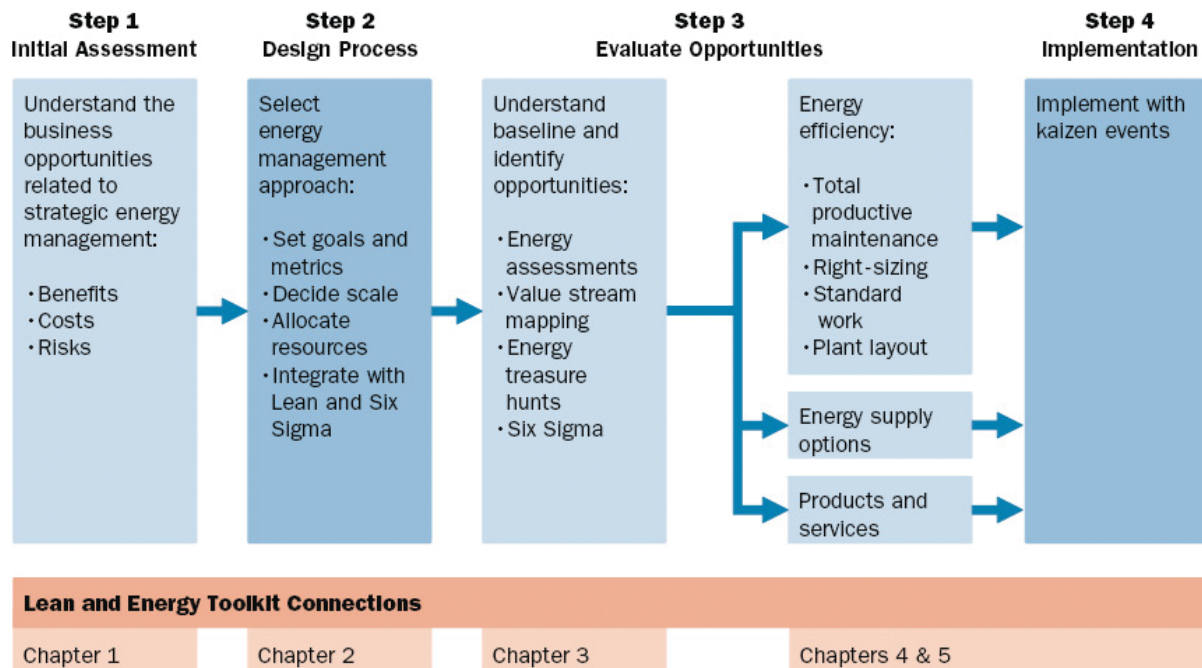
"Six Sigma has been a great help to us," says Bill Bailey, principal consultant in DuPont's Energy Engineering Group in Charlotte, NC. This internationally renowned sciences and services company has been using Six Sigma, Lean Management and other improvement tools for the past decade and credits these approaches with reducing energy use by 7% while growing production more than 40%. Bailey is tasked with leading the company's efforts to accelerate improvement in energy efficiency.

"Certainly we have had success in improving energy use through the years, but most people at DuPont would agree that we have been able to make more improvements faster and ensure we keep these changes active using these tools." Bailey goes on to explain, "In the energy realm, most defects are invisible and you really need data to verify that you are using more energy than you should be."

He credits the interaction of energy champions at the 100 largest plants with broad leveraging of improvement opportunities. "At the moment," says Bailey, "we are tracking over 600 defect-elimination projects." One of their plants discovered a defect in the design of a large combustion system. Annual energy savings were sufficient to produce a 60% internal rate of return on the total investment.

DuPont also recognized the need to silently monitor unit operations and

Lean and Energy Management Roadmap (Figure 2)



Source: Adapted from Bennett, Charles J. and Whiting, Meredith Armstrong. *Business & Energy in the 21st Century, Navigating Energy Management: A Roadmap for Business*, The Conference Board Executive Action Series, No. 160.

Figure 2

alert personnel when equipment performance had drifted from optimum, leading to the development of an Excel-based tool called the Energy SMARTBoard. This program receives live and historical data from a plant's process data historian and, based on rules and heuristics, determines when energy-saving measures are not working as well as possible.

The SMARTboard calculates the amount of excess energy required for current operation and translates that defect into an annual savings stake. Operators can understand the value of corrective action.

The SMARTBoard helps operators troubleshoot poor performance and return unit operations to optimum. "The tool," Bailey points out, "has enabled one site to maintain the savings level of a dozen Six Sigma projects, avoiding annual energy costs of over \$1MM."

Long regarded as an enforcement

agency, the U.S. Environmental Protection Agency through its National Center for Environmental Innovation (NCEI) has been working with companies to develop better ways to process and manufacture that are coincidentally cutting down on emissions and saving energy. This is certainly the case with Lean/Six Sigma.

"Lean usually helps the environment without really intending to," observes Mitch Kidwell, senior staff person with the center. "It means less material resources are used per unit, and produced energy is used more efficiently."

Often environmental costs and impacts are regarded as overhead. In working with companies, NCEI seeks to bring the production side and the environmental side of the company together to recognize that they are achieving manufacturing and energy benefits simultaneously.

"Where Six Sigma comes in is

being able to focus on the variability of a process," says Kidwell. "It's a wonderful tool for not only removing big spikes in plant energy use throughout the day, but also balancing their consumption, while also detecting the cause of production rejects."

The companies that have used Lean are eager to share, and the EPA has compiled their stories plus tips on how to implement lean/Six Sigma into their "Lean and Environment Toolkit," available for download at www.epa.gov/lean. (Figure 2)

To consolidate their growing business into one facility, JohnsonDiversey recently opened a massive 550,000 sq ft distribution center (DC) in Sturtevant, WI, to handle their growing world-wide commercial cleaning business. The building's sustainable design earned a LEED-NC Gold (Leadership in Energy and Environmental Design for new construction).

Continued, p. 12>>

Cover Story cont.

The State of Manufacturing

Continued from, p. 11

This is one of the largest industrial buildings to garner the gold. The building features a state-of-the-art ventilation system, a water system that has reduced usage by 51% and a foundation made of totally recycled material.

But JohnsonDiversey isn't stopping there. They are currently working on a LEED-EB certification for existing buildings. This is an all-encompassing process with JohnsonDiversey bringing their vendors into the effort.

In their operations, forklifts are the heaviest energy users. There are 75 Crown forklifts, and according to JohnsonDiversey's regional warehouse manager Bruce Maple, "Crown has gotten on board with our green program." (Figure 3)



Figure 3

Crown has taken the initiative to suggest improvements, developing a high frequency system to detect when the battery is fully charged to then power the charger off. In addition, the charger process has been arranged to process the batteries in stages to shut down completely during certain hours of the day. Management has also configured the forklifts travel patterns to minimize travel, time and energy.

Anthony Manos, a principal partner with the Chicago consulting firm Profero, has worked with over five dozen companies in implementing Lean Management and setting up preventative/predictive maintenance programs. He advocates a program of total productive maintenance to ensure operations are on track; this is a lean concept and a combination of planned maintenance procedures and predictive maintenance. Both enable operations to stay ahead of

developing glitches. "The problem for many companies, and I'm talking about very large companies," says Manos, "is that many are just involved with reactive maintenance and have trouble making the leap to predictive."

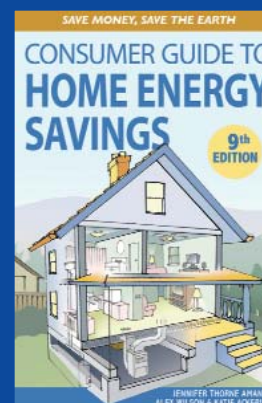
This takes some discipline. Manos discusses using Six Sigma and Kaizen events to measure the deviations in an operation to determine where the losses are in performance and analyzing them using a Pareto chart, ranking deviations to determine which ones to attack first.

Energy Savings Begin at Home

Perpetuating sustainability cannot be considered just part of the job description and left behind at work when the day is done. According to Jennifer Thorne Amann, Director of the Buildings Program with the American Council for an Energy-Efficient Economy (ACEEE), this has to be a seamless lifestyle. As she puts it, "the idea here is if you are doing energy saving-stuff at home you will be more prone to do it at work, and vice versa."

There is no place like home when it comes to energy use; and, it's a good place to start when scaling back in terms of saving the environment and saving money. The average American household releases about 150 pounds of CO₂ daily into the atmosphere, five times the global average. To calculate the emissions at your house, go to www.epa.gov/climatechange and click on the GHG Emissions Calculator. You might be surprised.

The question when it comes to home energy use is always where to start. Amann has expert tips for families and individuals on how to shrink their carbon footprint without freezing or baking in their houses. In a recent issue of National Geographic, she served as an energy coach for three families, helping



them analyze their energy consumption and finding ways to cut back.

Amann recommends that the first thing is to set priorities. Through ACEEE she has authored the Consumer Guide to Home Energy Savings, which leads homeowners through the process of sizing up their energy use and developing a strategy for how to attack it. There are links to free online software tools enabling a comparison of a household's energy usage to other people in the area with similar housing types.

"The Guide," relates Amann, "has a home energy checklist and there is information on where to get started in your priorities."

Changing energy usage can be accomplished gradually with an eye to the household budget. Cheap and easy items on the checklist that can be done today include changing furnace and air-conditioner filters and turning the water heater temperature to 120° – any higher scalds hands. Next week – caulk leaky windows. A year later, think about insulating or replacing aging, inefficient appliances.

"We found that one of the difficulties with going green," adds Amann, "is that people have a hard time figuring out how well they are doing—are their homes relatively efficient; or is there a lot of room for improvement—and where to get started."

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Product Management Corner

NEW CONTROL PLATFORM RELEASED

Productivity³⁰⁰⁰

By Jeff Payne,
Product Manager, PLC/IO and PC Control

In past articles we have discussed the definitions of a Programmable Logic Controller (PLC), Programmable Automation Controller (PAC), and PC-based control and how each plays a role in today's industrial marketplace. Today we will discuss the Productivity3000, a new control platform recently released by AutomationDirect. Some say this resembles a PLC; others say it's a type of PAC. We categorize this product simply as a new control platform called Productivity3000.



A PLC was originally designed to replace hard-wired relays and timers in the automotive industry. And, a PLC's programmability enabled changes to a control system which allowed it to be more flexible, and therefore more effective than its hardwired predecessors; this was one of the greatest advancements in the history of industrial automation.

With Personal Computer technology booming in the 1980s and 1990s,

there was a natural progression to consider using the processing power in these units to solve more complicated applications that extended well beyond the realm of digital and analog I/O manipulation. However, the PC was not designed for use in harsh industrial applications; it did not have the flexibility of a modular I/O based system.



But, the PC raised the bar from a technical standpoint. The need was not only to solve complex applications with the speed and open architecture of a PC-based application, but to source equipment capable of withstanding the environmental pounding that PLCs have been subjected to for many years. OEMs, system integrators, and end users were sampling the processing power of the PC-based control in real-time industrial applications – and they liked it. But, they needed a hardware offering to match the PC's performance in a flexible yet rugged package.

When AutomationDirect began researching the design of the Productivity3000, the goal was not necessarily to build a PAC. The goal was to build a controller which met the expectations and specifications of today's automation marketplace. We evaluated specifications of our current product lines, and specifications of other supplier's products, and determined that we could offer a better solution which could be less expensive, easier to use and more productive.

As the development project began to mature into a tangible product, we realized the majority of the application space where we would market this

product was currently occupied by PACs. The features of our new product all pointed in the direction of a PAC. However, the Productivity3000 pricing structure is similar to our traditional PLCs. The end product is a powerful control solution with built-in data logging, unprecedented communication capabilities, integrated drive technology,

and enterprise connectivity - all at a fraction of the cost when compared to similar solutions in the industry.

With Productivity3000, you get all the power needed for advanced applications. You may call it a PLC because of its modular footprint; or, you may call it a PAC because of its superior performance and capabilities. In short, Productivity3000 is a control solution which provides an economical solution to your application needs. And, if not this product, we have thousands of other products you may want to consider.

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User Solutions

Retrofits Bring Rewards

Denim Manufacturer Upgrades Controls to Add Flexibility to Process Lines

By Jonathon Payton
Mount Vernon Mills

Nestled along the Chatooga River, in Trion, Georgia, Mount Vernon Mills is one of largest and oldest textile mills in the United States. Its long history dates back to 1845. The initial 5,000 square foot two-story mill had 40 employees and produced 5-lb. bunches of yarn to sell to local merchants from wagons.

Over the next 160 plus years, the mill survived General Sherman's march through Atlanta, a fire in 1875, bankruptcy in 1912, two World Wars, the fight to become unionized, and a major flood in 1990. Through all of this, the mill has continually expanded, renovated, and modified in order to tailor its end products to change with the times. The mill has produced many different products over the years, including fabric used for military uniforms, crop sacks, sheeting, shirting and even gloves.

In 1971, the decision was made for this Trion, Georgia, plant to produce denim. This turned out to be one of the best decisions in the mill's history. By installing new equipment, the plant rode the wave of growth in the denim industry. By 1976, Mount Vernon Mills had over 1,100 looms producing denim. The company continued to grow, but nearly experienced disaster when the "Hundred Year Flood" hit Trion in 1990. The company spent the next several years modernizing its plant with state-of-the-art machines to gear up denim production.

After its latest round of renovations, the mill now operates with state-of-the-art machines in over one million square feet of manufacturing space. Denim from Mount Vernon Mills is

woven and finished for sale to many major manufacturers across the country, such as Wrangler™ and Lee™. Mount Vernon is now the third largest producer of denim in the United States. (See Figures 1 & 2)

few years have been no exception. On some of the finishing ranges and re-beamers, control systems still worked, but finding replacement parts had become more difficult, thus making it harder to give operators features and



Figures 1 & 2, Denim Finishing line at Mount Vernon Mills

Over the years, the company has endeavored to continually upgrade machines and technologies, and the past

functions they wanted. Even modest changes and modifications were difficult based on the age of the control system. Late in 2006, the mill decided to embark on upgrades for re-beamers and one of its finishing lines.

The task of replacing the control system for the finishing line, a very large multi-motor machine, seemed daunting. All the motors have to work together and are self-adjusting, with dancer position sensors which send signals back to a PLC system. The PLC system automatically adjusts motor speeds to keep everything running together.

Because of the machines' size and complexity, the mill sought bids for the work. When job bids came back with costs far exceeding budget, the decision was

made to use AutomationDirect components, and do the whole project in-house. To save time, new backplanes

were purchased to bolt onto the old cabinet back so they could be assembled and tested before installing in the machine. This task would be performed in the system designers' spare time over a period of three months. They ended up having only three weeks to build and no time for testing. Electricians were finished mounting the motors and drives before programmers had the software completed.

The old finishing line was powered by DC drives with field regulators. The new system has been upgraded to AutomationDirect's Durapulse AC Drives all networked via Ethernet to a DL-260 *Direct*LOGIC PLC System. A 15" *C-more* touchscreen operator panel was chosen to replace the main operator console. The mill purchased, installed and programmed the entire system within the three weeks allotted. All HMI and PLC programming was performed in-house, and

AutomationDirect's telephone technical support staff answered questions when problems arose. (See Figures 3 & 4)

The solution has been a great success. The mill saved nearly \$40,000 compared to the bids received, and now the control system is now largely software based. Operators have much more control of the machine, including setup parameters of dry cans and dancers, line speeds, trimming capabilities, as well as some fault indication and maintenance screens. New functions or features can also be added, as they continually refine the process to improve productivity.

On a second project, Mount Vernon retrofitted the legacy control system for a re-beamer in order to improve performance and flexibility. The re-beamer is a speed-controlled center winder which winds yarn from several section beams onto a single-loom beam prior to weaving. The winding speed requires constant adjustment to



Figure 4, The 15" *C-more* touch screen operator interface brings all the controls of the finish line to a common point on the machine and includes setup screens, maintenance screens, operations screens as well as diagnostics.

Continued, p. 18>>



Figure 3, Jonathan Payton stands in front of the new finishing line control cabinet which includes a DL260 *Direct*Logic PLC, 8 Durapulse variable frequency drives, and all the associated control equipment. The entire design including software was installed during their 3-week shutdown.

User Solutions cont.

Retrofits Bring Rewards

Continued from, p. 17

maintain a constant yarn velocity.

The original control design for the re-beamer featured manual controls (pushbuttons, pilot lights, and meters) on the operator station and a DC drive to wind the spool. With dozens of these machines throughout the facility, not only was it more difficult to obtain replacement parts for outdated equipment, but it was also difficult to make changes to the machines, operator interfaces, and control system.

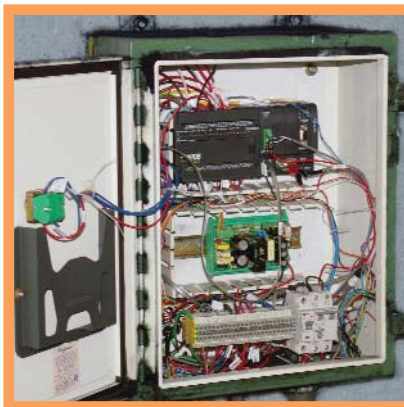
The re-beamer is now equipped with a **Direct**LOGIC DL06 PLC, a Durapulse AC variable frequency drive, a proximity sensor and a **C-more** operator interface panel. Because the out-sourced PLC program never worked correctly, it was scrapped and rewritten in-house. This allowed placing more parameters and adjustments at the operators' fingertips. Additionally, operators continually suggest improvements to the process or machine, and now system programmers are able to act on their inputs, and use the software based control system to streamline the process.

(See Figures 5 & 6)

Mount Vernon Mills continues to retrofit additional control systems as time and budgets permit. The control solutions put together with AutomationDirect equipment have provided quite a cost savings over

alternative solutions on the initial purchase. Changing the controls to software-based HMI and controls also provides the flexibility to easily make changes and improvements to the line.

Control engineers at Mount Vernon Mills agree the free technical support from AutomationDirect is the best they have ever used. They also feel the quality and service of AutomationDirect products to be comparable to more costly products purchased from previous suppliers.



Figures 5 & 6, An operator works the rebeamer during production. The move to a software based C-more has given the operator more capability to change parameters during production.

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User Solutions

Energy Needs

Natural Gas Reclaimed from Expired Wells

By Glenn Erickson
Expert Automation Design, Inc.

Natural gas can come from wells specifically drilled to reach gas trapped in pockets beneath the surface of the Earth. These wells produce huge quantities of gas which can be piped directly to distribution centers and then on to consumers. Some wells produce a lower-quality gas which has to be processed to remove unwanted components before it can be sent to the distribution center. This separation process can be expensive, and is therefore only used on mass-producing wells where the cost can be justified.

But that is not the only viable source of useable natural gas; thousands of exploratory and low-yield oil wells have been drilled over the years. Once the "cheap" oil is extracted, these wells are typically capped off, becoming a statistic on a map. Even good oil wells, once they are "used up," are often capped. However, they are not forgotten.

Many of these now-unused oil wells contain natural gas. The quantity and/or quality of the product from these wells may be too low to be commercially viable by conventional means, but one oil company recognized a need to turn these wells into valuable energy sources for America.

To extract useable natural gas from these wells, this company used a technology that has been known and applied to many processes: Adsorption. In this process, molecules "stick" to a media, forming a film of the molecules. This is not to be confused with the Absorption process in which molecules are actually drawn INTO the surface of the media. Both processes are helpful in thousands of applications, using solids

and liquids to purify products.

The company chose to use granular carbon as their adsorption media because of its natural affinity for hydrocarbons. The carbon is contained within a steel pressure vessel. A pair of these pressure vessels allows the system to alternate between the Adsorption and Desorption portions of the cycle.

One vessel is connected to the well and gas is allowed in under pressure, while at the same time the other vessel is

evacuated. The carbon in the vessel connected to the well attracts methane and other hydrocarbons, while ignoring nitrogen and other non-hydrocarbon gases. Once the media is saturated with molecules, the vessel is disconnected from the well and placed under a vacuum. During this process, the other vessel is connected to the well to take its turn at adsorbing methane.



Figure 1, The picture above is of the system on site in Oklahoma. The two large white towers are the adsorbers. The smaller tower is a dehumidifier. The old tanks in the background are the remains of the decommissioned oil facility.



Figure 2, This is a photo of the entire system. The small white house to the left is the control center. The generator on the right runs on gas from the well. The purified natural gas is stored onsite in a huge propane tank. The connection to the gas distribution pipeline is behind the white tanks. This system is designed to run autonomously once started. The only human interaction needed is for someone to check on the generator's engine oil periodically.

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User Solutions cont.

Energy Needs

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Placing the vessel under vacuum “de-sorbs” the hydrocarbon molecules from the granulated carbon, which are then pumped to a temporary storage tank. This cycle of adsorption and desorption can occur thousands of times before the granulated carbon needs to be replaced. The purified natural gas is stored onsite in a huge propane tank.

Any hydrocarbon molecules that are not adsorbed are flared off by a small pilot flame to keep them from escaping and becoming greenhouse gases.

The company built a demonstration plant to test their theory and ran it manually until they had what they considered to be a commercially viable process. It was at this point that they turned to AutomationDirect to help them find a company to automate a larger adsorption plant. From AutomationDirect’s list of system integrators, Expert Automation Design Inc (EAD) of Seminole, Florida, answered that call.



Figure 4, This is another view of the enclosure showing the 6-inch C-more touch screen. The next system will use a larger screen.

The oil company needed a repeatable sequence of operation, with parameters they could adjust as they improved the process. EAD developed a simple system using a *DirectLOGIC* DL06 PLC with various analog functions, *C-more* touch panel and Ethernet for both the touch screen and future Internet communications.

Throughout the design process, ease of use was vital; the idea was that anyone should be able to start the system, or shut it down, with little or no training.

All critical values and status are



Figure 3, This is a picture of the control enclosure just after completion. It is a simple system using an O6 PLC with various analog functions, and Ethernet for the touch screen, and for future Internet communications. The small black box in the lower left corner is a phone dialer for alarms and system status. Internet is not available in the area.

available on one screen. The STARTUP and SHUTDOWN buttons lead the operator through a series of screens to properly start up and shut down the entire system. Status messages appear below the digital displays.

In early summer 2008, EAD installed the system in a refurbished valve building at the site, and flexible conduit was run to junction boxes around the plant. The entire installation of all electrical components took two and a half days. The gas-powered generator was converted from 208 volts to 240 volts. After various challenges, from pressure regulator issues to a lightning strike which destroyed the PLC, now the plant came online. Once up and running, it operates autonomously around the clock. The only human interaction needed is for periodic



Figure 5, Here is a shot of the screen in action onsite. The interface is as simple as it looks. The idea was that anyone could start the system up, or shut it down with little or no training. All critical values and status are available on this one screen. The STARTUP and SHUTDOWN buttons lead to a series of screens that walk the operator through the proper ways to startup and shutdown the entire system. Status messages appear below the digital displays. The alarm banner is at the bottom of the screen. Once this process has been perfected, many more of these systems can be produced to help meet the energy needs of America.

routine maintenance on the pumps and generator.

EAD has worked closely with the oil company to remotely troubleshoot control issues and add upgrades. They used DNloader to download PLC program changes sent to them. They have become adept at using the *C-more* software to download supplied changes or to make small changes themselves.

For more information, visit:

www.canda-technical.com.

“Cherish all your happy moments: they make a fine cushion for old age.”

– Christopher Morley (1890 - 1957)

“In the modern world of business, it is useless to be a creative original thinker unless you can also sell what you create. Management cannot be expected to recognize a good idea unless it is presented to them by a good salesman.”

– David M. Ogilvy

Student Spotlight

The Future of Technology

The Future of Technology Science/Technology Student Spotlight

Who: Ryan Andrade
Hometown: Hollister, California
College: University of California, Davis
Major: Mechanical Engineering
Graduation Date: June, 2009



What first got you interested in your area of focus?

I am interested in design and control of electromechanical systems in the alternative energy industry. My interest originated from experiences I had as a 2nd year undergraduate engineering student in the UC Davis Hybrid Electric Vehicle (HEV) Center research group, where I helped design and build a prototype parallel Plug-In Electric Hybrid Vehicle (PHEV) and learned about energy and global climate issues. I decided to dedicate my career to working on innovative solutions to the global energy crisis.

What has been your toughest challenge in higher education?

Managing to maintain a healthy balance between all of the different aspects of my professional and personal life.

What career/job/industry do you hope to be involved in after graduation?

The alternative energy industry, as a designer and engineer, with a particular interest in new ventures and startup companies.

What do you think is the most important issue facing our country and the world today, and do you have any opinions on possible solutions?

As I mentioned, I think the biggest problem we face revolves around energy: the way we use it, the sources we generate it from, how much of it we consume, etc. Any real solution to this problem will consist of a variety of approaches, including using our energy more efficiently, producing it more cleanly, and getting it from renewable, sustainable sources. In particular, I think that electrifying our transportation system, harnessing the sun through solar thermal and solar photovoltaic cells, continuing the development of clean nuclear power, and recycling wastes into fuels like biodiesel are key pathways toward solving our energy crisis.

Describe how the idea for your application of AutomationDirect products came about.

BioFuelBox is a startup waste-to-fuel company in San Jose, CA, that converts unusable waste products from animal tallow, wastewater treatment plants, etc. into ASTM-quality biodiesel fuel. I worked as a process engineering intern with BioFuelBox during the summer of 2008, and they subsequently sponsored my undergraduate engineering senior project.

The project entailed redesigning and optimizing process controls for a high pressure reactor on BioFuelBox's pilot biodiesel plant. AutomationDirect's *Direct*LOGIC 205 PLC was chosen as the process controller for this project, and AutomationDirect generously agreed to provide a free copy of their DataWorx software for data logging and control of the process.

Describe how the application works.

The application employs the *Direct*LOGIC 205 PLC as a feedback Proportional-Integral-Derivative (PID) controller to track setpoint changes and minimize disturbances in the control of the high pressure reactor on

BioFuelBox's pilot plant known as "Vessel Scrit." A pressure transmitter on the reactor vessel measures the pressure, then relays the signal to the PLC, which compares the reactor pressure to the setpoint value and computes an appropriate action signal based on the standard PID control algorithm. The PLC then sends the signal to a control valve actuator on the back end of the reactor. Next, the control valve opens or closes accordingly to maintain the pressure at an ideal value for reaction.

AutomationDirect's *Direct*Soft5 and DataWorx software packages were used to collect data from the system, model the system, and tune control parameters. Our efforts resulted in a pilot reactor with a highly optimized pressure control system, which in turn ensured the high pressure reactor would remain in its sweet spot for reaction, thus saving BioFuelBox money. AutomationDirect's superior products and support were crucial to the success of this project.

At the beginning of this decade, there was a large drop in the number of U.S. engineering students. As we see that number begin to rise again, what advice would you give to men and women considering this area of study?

I would commend them on their decision to consider engineering as a career path and strongly urge them to get some hands on experience in the field to see if it might be something they enjoy and/or find fulfilling. Engineering is a key part of every solution to the modern problems our society faces, particularly with regard to energy and climate issues. As an engineer, one has not only the opportunity, but indeed the moral responsibility, to use their technical skills, analytical thinking, and creativity to solve the problems of society. While this is not an easy task, I would advise that it is a necessary one, and one that for me so far has proven to be extremely rewarding.

Tech Brief

ELECTRICAL WIRING



Transformers

Application, Construction and Efficiencies

Part One of a Two-Part series

By Brian S. Elliott

Although most of us have encountered transformers in our professional lives, it's surprising just how little the average designer or technician knows about them. A transformer's principal function is to "transform" alternating current from an undesirable voltage to a voltage that is appropriate for the circuit at hand. A good example of this application is the use of control transformers to reduce high line voltages to lower, and safer, control voltages. The lower control voltage can be safely utilized within the control cabinet and throughout the various components that populate the equipment.

Transformers accomplish this task by inductively coupling the primary and secondary coils. As the voltage rises and falls in the primary coil, it creates a matching magnetic field that induces a sympathetic voltage in the secondary coil. To manipulate the input and output voltages, the number of turns in each coil is adjusted to produce a "ratio" between the primary and secondary coils of the transformer. Thus, if a transformer has 100 turns on the primary and 50 turns on the secondary, then it has a 2 to 1 ratio. Therefore, when 120 VAC is applied to the primary, the secondary will produce 60 VAC. If the roles of the coils are reversed and 120 VAC is applied to the secondary, then the primary will produce 240 VAC. The currents involved go through an inverse transformation during this process, i.e., if the secondary output requires 60 VAC @ 5 Amps, then the primary must be fed 120 VAC at a minimum current of

2.5 Amps. Figure 1 illustrates the turn ratios and voltage/current transformation of a transformer.

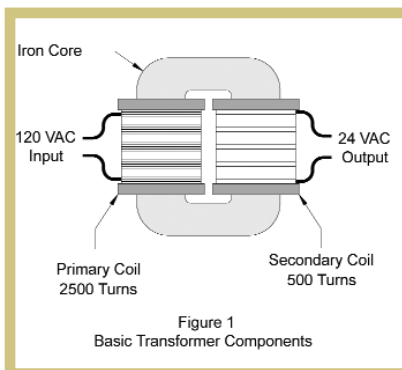


Figure 1

Principally, there are two types of transformers commonly available on the market: isolation and auto. Most transformers are isolation units, where the primary and secondary coils are electrically isolated from one another. An isolation transformer provides two distinct features that are very desirable for most applications. First is that the secondary circuit is electrically isolated from the higher, and more dangerous, input voltage. This provides a level of safety that is essential for most circuits. The second feature is that an isolation transformer will naturally filter high voltage transients and high frequency noise. In a dirty electrical environment this feature can play an important role in protecting delicate electronics. In some cases, an isolation transformer can mean the difference between having a reliable piece of equipment versus a completely non-functional piece of junk.

Figure 2 shows an exploded view of a typical "C" core isolation transformer. Note that the two coils are completely separate from one another, both physically and electrically. The only coupling between the two coils is magnetically through the core.

Figure 3 shows a typical "E" core transformer. In this case the primary and secondary coils are placed around a common post in the center of the core. This arrangement produces a more compact unit with higher efficiencies. For these reasons, "E" core designs are the preferred pattern for control and general purpose transformers.

For applications where isolation is

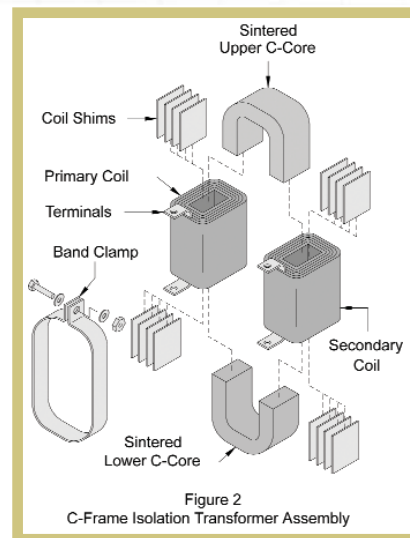


Figure 2

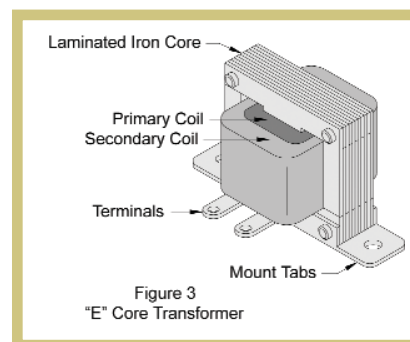


Figure 3

not desired, or not necessary, an auto-transformer may be specified. These transformers are commonly used for voltage matching. In cases where a piece of equipment may be configured for a different voltage standard than is available at the install site, a voltage matching auto-transformer provides an economical solution to the problem. A common example is a piece of equipment wired for 240 VAC being placed in a building with 208 VAC service. In this case a fairly modest auto-transformer can boost the service and the problem is quickly solved. Figure 4 shows a schematic representation of a voltage matching auto-transformer. In this case the line voltage is connected to the appropriate input terminals and the adjusted voltages are available at the various output terminals.

Although there are literally thousands of uses for transformers, the

Continued, p. 26>>

Feature Story

The Future is Now

Government Spending: Some Positive Returns

By Ken Ball

For the past nine years, the Navy has sponsored an Opportunity Forum for their Phase II SBIR (Small Business Innovative Research) contractors. The purpose is to publicize

these government funded developments thereby helping viable business products to evolve beyond Navy needs. Successes triply benefit the small business, the Navy, and the American economy, and obviously are well appreciated by the Congress.

NASA SBIR companies have been added the last two years and the Navy also includes related Office of Naval Research (ONR) projects to be shown with the exhibits. In all, about 200 booths exhibited military wares and, in a seminar format, contractors described

their products and outlined market plans.

Some 1,500 visitors attended the 8-10 June Forum at Crystal City, VA. Along with contractor and Naval project personnel, attendees were invited from major defense contractors and other large and hi-tech corporations as well as business persons such as national accounting firms, venture capitalists, and consultants.

Continued, p. 24>>



Figure 1, The Marine Corps' new Expeditionary Fighting Vehicle uses waterjets for speeds up to 25 knots in water and up to 45 mph on land.

Feature Story cont.

The Future is NOW

Continued from, p. 23

Navy Commands and Major Programs

Most Navy originated SBIR contracts are for support products for major weapons systems such as carriers, other surface ships, submarines, and aircraft. The new F-35 Joint Strike Fighter program is a primary interest to many contractors and John W. Hite, Director of Engineering for the F-35s, was a luncheon speaker. The first three F-35s have been built at Lockheed-Martin in Ft. Worth. Expectations are that more than 4,000 F-35s will be produced over the coming decade. Three versions are now planned; an Air Force Fighter; A Navy Carrier Fighter; and a Marine Corps VTOL version.

Two ship configurations built by General Dynamics and Lockheed-Martin are in sea trials competing for the planned 55-Ship Littoral Fleet. These coastal assault vessels reflect advanced concepts in flexibility and modularity. Small basic crews of about 40 officers and men will operate the ships while trained teams will be assigned to handle selected weapons and/or special equipment packages. Like cargo containers, special equipment units can be rapidly and easily installed and replaced. Besides weapons systems, special units may support unmanned aerial, surface or undersea vehicles.

The Navy Research Lab (NRL) with an overall \$2.16 billion budget administers more advanced and special purpose SBIR projects. The NRL currently has projects underway with 637 small businesses and 1,035 universities. Two "developments to watch" are an electromagnetic hypersonic gun (part of an all-electric ship) and a Free Electron Laser weapon.

Land combat equipment developments are largely under the Marine Corps. Now well along in the testing phase is the EFV, the Marines' amphibious Expeditionary Fighting Vehicle shown in *Figure 1* (previous page). The EFV uses a three-man crew to transport 17 combat loaded Marines. About two dozen SBIR projects con-

tributed to the EFV; from bilge water handling to door seals to special high strength alloys.

Brief descriptions of five SBIR products follow. Selections were based on their potentials for possible dual use in industrial and/or commercial applications along with the likely interests of Automation Notebook readers.

Rotating Machinery; Lubricants & Fluids Monitoring

Navy preventative maintenance programs for rotating machinery continue to advance. Impact Technologies, LLC (Rochester, NY) described a system designed for the forthcoming joint strike fighter engines. Wireless sensors are networked to measure temperatures, pressures, vibrations, corrosion, and fluid qualities. System features include real time alarms, long term wear and performance trending, and suggested maintenance actions. Systems can be customized for other weapons systems and equipment such as: other aircraft, surface ship turbines, diesel engines, large cranes, and compressors.

A key innovative development is the fluid quality sensor (*see Fig. 2*), a patented Impact Technologies product.

Fluid dielectric properties respond differently to various applied frequencies and thereby can provide real time fluid health data. The sensor generates a range of frequencies to measure a broadband spectra of AC electrochemical impedances, somewhat similar to optical spectroscopy (photo). Oils,



Figure 2, An Impact-Tec's SmartMon fluid quality sensor for an aerospace gearbox. SmartMons can detect fluid level, water or fuel contaminations, viscosity breakdown, additive depletion and can indicate remaining useful life.

hydraulic fluids, gear box oils, transmission fluids, and machine tool lubricants can be monitored. Contact for more information is Ryan Brewer at 585-424-1990 x 127 or e-mail ryan.brewer@impact-tek.com.

Blade-Mounted Sensors

Another rotating machinery monitoring system was described at the '08 Forum by International Electronic Machines (IEM). Along with a wireless sensor network and monitoring software, IEM has miniaturized and ruggedized wireless 2-D strain gauges with integrated temperature sensors (*see Fig. 3*) for mounting on helicopter rotor blades. Individual sensors are 3 mm square and consume about a milliWatt of power.

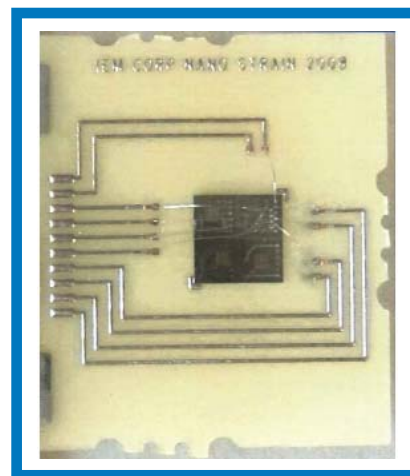


Figure 3, IEM's miniature strain gauge and temperature sensor was developed to monitor helicopter blade dynamics in flight. When packaged, the sensor measures only 3mm square.

Nearby wireless nodes (1" x 1/2" x 1/2") can handle multi-sensor channels and a special protocol enables data transfer rates about 30 times those of ZigBee networks. Data acquisition capabilities can be applied with other sensors and on all types of equipment, with either moving or stationary parts. Low power requirements encourage the use of harvested power. Contact is Ryk Spoor at 518-449-5504 x 25; e-mail rspoor@iem.net.

Mission Critical Communicating

VoxTec International provided an impressive demonstration of its Phraselator P2 hand-held machine-

based language translation units shown in *Figure 4*. Applying commonly used phrases, some 8,000 units are currently in use, many in Iraq and Afghanistan. Languages and dialects are scroll selected from the 3.5-inch touchscreen. Once selected, the user simply speaks an English phrase such as Park your car over there or Point to the location on this map. At the touch of a key, the message is spoken in the selected language while simultaneously printed in that language on the screen.



Figure 4, Phraselator automatic verbal translation unit developed by VoxTec, a company begun by a team of ex-Navy SEALs.

Over 40 languages and dialects are now supported, each utilizing 1,000 or more phrases selected as most appropriate for the application. Phrase pools are developed for specific situations such as combat intelligence, insurgency control, civilian and/or medical liaisons, responding to natural disasters, and/or specific skill areas such as pipeline installations or road construction.

No special user enunciation or speech training is needed; translation accuracies are running over 90 %. The unit draws 6 watts; four AA rechargeable batteries provide 10-12 hours of

service, and single unit prices begin at less than \$2,000. Newer versions will include two-way translations and long term foreign voice storage capability. Contact is VoxTec President John Hall at 410-626-1110 x 225; e-mail john.hall@voxtec.com.

Compact Portable Heat Pump

Underwater work and working durations of SCUBA divers in cold water are seriously compromised due to rapid chilling in waters which can be as low as 30o F at ocean depths. Under a NAVSEA contract, Rini Technologies has developed a compact and efficient heat pump which extracts heat from the sea water and circulates a 95o F sealed water working fluid for diver warming. A previously developed SCUBA wet suit and gloves have integrated heating tubes for delivering warmed water to divers' torsos and extremities.

The heat pump is in a sealed cylindrical housing 3"dia. x 10.5" long, weighing 4 lbs. The pump is battery powered with the battery unit being a slightly larger cylindrical unit weighing 5.7 pounds and providing 125 watts for 2.6 hrs of operation between recharges. The unit uses standard 134A refrigerant and the heat pump mode provides a heating coefficient of performance (COP) of nearly 3 when extracting heat from 40o F seawater. The cylinders mount alongside the breathing tank and the system's 10-pound total weight is insignificant in diving operations.

Some work has been done with the unit in the cooling mode to provide cooling for helicopter pilots flying in hot environments. CEO Dr. Dan Rini can be contacted at 407-359-7138 x 103 or by e-mail at dan@rinitech.com.

Communication in Extreme Noise Environments

Carrier catapult crews have developed hand signals to communicate in the ultra-high noise environments (upwards of 150 dB) of carrier jet launches. Such signaling requires line-of-sight vision and has serious information limits. For future launch support, Adaptive Technologies working with Aegisound combined custom designed

ear plugs and headset cuffs with digital noise-canceling circuitry and microphone to allow near-normal short range RF communications in high noise levels associated with carrier launches.

The system has been demonstrated within tracked vehicles and inside large compressor stations. Reportedly, hearing losses among military veterans cost the VA over \$1 billion per year. Contact is Aegisound's Jeff Hammel at 540-449-9856; e-mail jeff@aegisound.com.

Developments from military-driven technologies continue to infiltrate the wider industrial and commercial markets. For more information on the Navy SBIR Program, visit www.navysbir.com.

Ken Ball Bio

Ken Ball is an engineering physicist with 40 plus years in instrumentation and control systems. His career has been split between applications engineering and technical publishing. He has managed various industrial, military, and nuclear projects. Mr. Ball was the technical editor for Industry.Net and served as editorial director for Instruments and Control Systems; Programmable Controls, and InTech technical journals.

Tech Brief cont.

ELECTRICAL WIRING

Continued from, p. 22

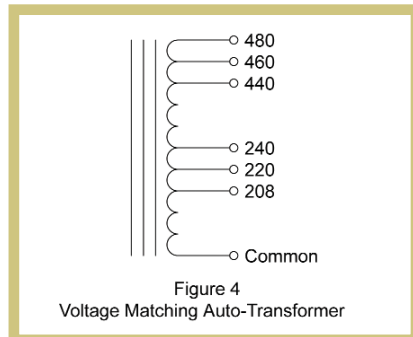


Figure 4
Voltage Matching Auto-Transformer

Figure 4

bulk of these applications fall into four basic categories. The most visual application is power distribution through the national grid. One needs only to look up at the telephone poles that have over-run our landscape and you'll most likely see a pole transformer.

The second category for transformers is power distribution for buildings.

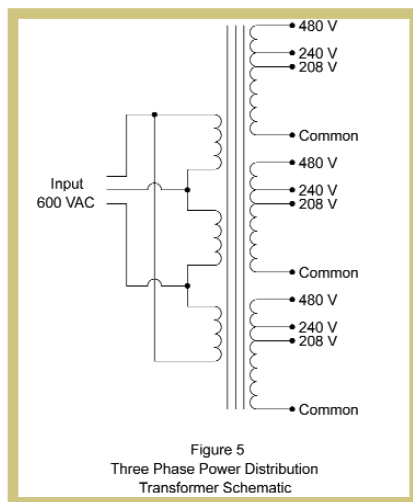


Figure 5
Three Phase Power Distribution Transformer Schematic

Figure 5

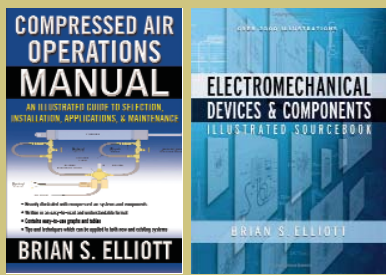
In these cases, a high standard voltage from the grid is connected to the building and routed to a central distribution transformer. The outputs of these transformers are designed to provide nearly every standard voltage that exists in the country. Figure 5 shows a schematic representation of a three-phase distribution transformer. Notice that the transformer is an isolation design, which helps protect the building from high voltage transients and noise that may be carried on the grid.

Part Two, to be continued in Issue 16, will include incorporating transformers into a machine element, control applications for transformers, plus more.

Brian S. Elliott Bio



Brian S. Elliott is the Chief of Engineering for Air Options, Inc. in Houston, Texas. He is the author of the Compressed Air Operations Manual and Electromechanical Devices & Components, both published by the McGraw Hill Book Co. He is a regular contributor to several industrial publications, including the Automation NOTEBOOK.



"A computer once beat me at chess, but it was no match for me at kick boxing."

— Emo Philips

"A word to the wise ain't necessary - it's the stupid ones that need the advice."

— Bill Cosby

"Delay is preferable to error."

— Thomas Jefferson

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Automation Talk

webinars

New videos added to

learn.automationdirect.com

By Tom Elavsky
AutomationDirect,
Technical Training Developer

In the previous issue of Automation NOTEBOOK, Shane Crider gave you an update on our progress with AutomationTalk Web seminars, or as we like to call them, 'talk shows'. Recent topics have included Ethernet, Industrial Components and our new Productivity3000 controller. If you missed the live shows, look for the recorded episodes at:

www.automationtalk.com.

If you have joined us during a live AutomationTalk Web seminar, or viewed one of the prerecorded 'talk shows', you have heard us refer to the learn.automationdirect.com Web site on many occasions. To produce high-quality informative videos, we created the LEARN Technical Training Lab. Not only is this a working test lab, but it is also a small video studio which allows us to have the product, lighting, cameras and tools needed to quickly gather and demonstrate our products. (Figure 1)



Figure 1, LEARN Technical Training Lab

The Learn site is divided into major product areas: PLCs, Operator Interface, Software, Sensors, Motor Controls, Drives/Motors and Miscellaneous. Videos are listed in posting order, with the most recent at the top. Beneath the viewing screen are links to related reference materials, AutomationTalk seminars, other Web sites and technical articles that have

appeared in Automation Notebook.

Since August, we have added several new videos to the LEARN Web site, most of which focus on PLCs. You can check them out at:

<http://learn.automationdirect.com>.

They include:

What is a PLC? Basics of PLCs, featuring the CLICK series, discusses the structure and operation of a PLC.

CLICK PLCs - An Introduction

Brief Product Overview reviews hardware features and configurations.

CLICK PLCs - A Closer Look

Detailed Product Overview covers hardware specifications and options in detail.

CLICK PLCs - Getting Started

Before you begin using your CLICK PLC

CLICK PLCs - Getting Started Part 1

Installing the Programming Software

CLICK PLCs - Getting Started Part 2

Launch the Programming Software

CLICK PLCs - Getting Started Part 3

Creating a Project

CLICK PLCs - Getting Started Part 4

Save and Compile Project

CLICK PLCs - Getting Started Part 5

Apply Power

CLICK PLCs - Getting Started Part 6

Establish PC to PLC Communications

We have also posted these videos on our YouTube channel. You can view them anytime at:

www.youtube.com/automationdirectvids.

Be sure to bookmark these sites as we continually update and expand technical content. We also invite your feedback regarding the various topics provided and additional topics you would like considered in the future. 🌐

Live Webinar Schedule

November 11, 2009

2:00 ET

**Motor Controls/
Circuit Protection**

December 9, 2009

2:00 ET

What's New Part II

January 13, 2010

2:00 ET

**PLC/PAC
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"America will never be destroyed from the outside. If we falter and lose our freedoms, it will be because we destroyed ourselves."

— Abraham Lincoln

"Attitude is a little thing that makes a big difference."

— Winston Churchill

FYI

What you need to know about Pneumatics

FYI - Pneumatic

Cylinders

By George Tsakir
Product Manager, Process and Fluid Power



Q. What pneumatic cylinders and accessories are available from AutomationDirect?

A. The NITRA A-Series non-repairable stainless steel round body cylinders includes bore sizes from 7/16" to 2" and stroke lengths from 1/2" to 18" to meet a broad range of applications. These high quality cylinders are constructed with stainless steel bodies and double rolled-in high strength aluminum end caps with full flow ports. To minimize friction, the inside of the cylinder body is polished to a mirror finish and all cylinders are pre-lubricated for optimum performance and long, reliable life. The high strength aluminum alloy piston is securely threaded, sealed and riveted to a piston rod that is ground and roller burnished 303 stainless steel (7/16" and 9/16" bores) or ground and polished high strength carbon steel (3/4" - 2" bores) with roll-formed threads for exceptional strength. Low friction wear compensating Buna N U-cup rod and piston seals, oil impregnated rod guide bushing (except 7/16" and 9/16" bores), and end caps with slots all combine for smooth break-away even at low pressures.

NITRA Pneumatic Cylinder Features

- Interchangeable with other common brands of round body cylinders
- Available bore sizes: 7/16", 9/16", 3/4", 7/8", 1-1/16", 1-1/4", 1-1/2", 2"
- Excellent selection of stroke lengths from 1/2" to 18"
- Single-acting (spring return) and double-acting models
- Nose, pivot and double-end mounting options and accessories
- Type 304 stainless steel body with high-strength aluminum alloy end caps

- Pre-lubricated for long, maintenance-free performance
- 250 psi operating pressure
- Models available with magnetic piston for position indication

Other pneumatic components available from AutomationDirect include cylinder position switches, nylon and polyurethane tubing, push-to-connect fittings, and flow control valves.

Q. What is the difference between double acting and single acting spring return cylinders?

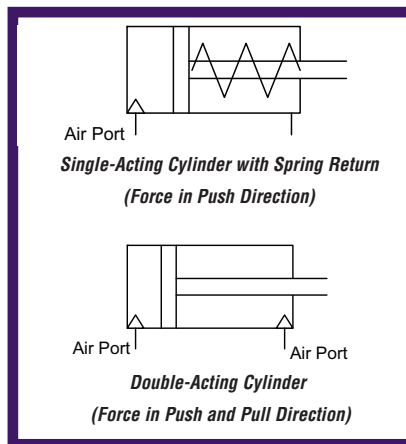


Figure 1

A. Double acting cylinders have two air connection ports. One of the ports will extend the cylinder rod and provide power in the "push" direction

pressure) to retract the cylinder rod, very little power is available in the "pull" direction. Single acting cylinders use about one-half as much air as double acting cylinders and are operated by 3-way valves. (Figure 1)

Q. What cylinder bore size should be used for my application?

A. Follow these steps to determine an appropriate cylinder bore size:

1. Evaluate the force (in pounds) needed to move the maximum load. To account for friction add another 25% as a rule of thumb.
2. Determine the minimum air pressure (in psi) that will be available at the cylinder. Keep in mind the available pressure at the cylinder will likely be less than the system pressure due to pressure drops in the air lines, fittings, valves, etc.
3. The following formula is used to calculate the required area of a cylinder piston:

$$A = F / P$$

F is force in pounds

P is pressure in psi

A is area of the cylinder piston in square inches

Using the force from Step 1 and the pressure from Step 2 calculate the minimum piston area required and select a cylinder bore size with a piston area equal to or greater than the calculated value from the table below. (Figure 2)

NITRA Cylinder Piston Area (square inches)	0.15	0.25	0.4	0.6	0.9	1.2	1.7	3.1
NITRA Cylinder Bore Size (inches)	7/16	9/16	3/4	7/8	1-1/16	1-1/4	1-1/2	2

Figure 2

and the other port will retract the rod and provide power in the "pull" direction. Double acting cylinders are controlled by 4-way directional control valves and are a better choice when it is necessary to control cylinder speed. Single acting spring return cylinders have one air connection port to extend the cylinder rod and provide power in the "push" direction. An internal spring retracts the cylinder rod in the "pull" direction. With only a spring (no air

Q. What can be done to get more power from a cylinder?

A. Based on the equation Force = Area * Pressure, simply increasing the air pressure to the cylinder within its specified limits will increase the available force. Alternatively, changing to a larger bore size cylinder will also result in greater available force.

Continued, p. 30>>

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FYI

What you need to know about Pneumatics

Continued from, p. 29



Figure 3, NITRA FVS Flow Control Valves (Speed Controllers)

Q. How can cylinder speed be controlled?

A. Double acting cylinders are the best choice when it is necessary to control cylinder actuation speed. Install adjustable meter-out flow control valves (speed controllers) on each cylinder port to control the air leaving the cylinder. Controlling the incoming air to a cylinder instead of the outgoing air can cause erratic movement during the cylinder rod's stroke. NITRA FVS series adjustable meter-out elbow flow control valves are ideal for controlling cylinder speed. (Figure 3)

Q. What are possible causes of erratic cylinder rod movement during its stroke?

A. Possible causes include:

1. Input air pressure to the cylinder is too low for the load being moved
2. Cylinder bore size is too small for the load being moved
3. Excessive side loading on the cylinder rod
4. Controlling cylinder speed with flow control valves (speed controllers) to control the incoming air to the cylinder instead of the leaving air.
5. Flow control valves are set too low
6. An absence of lubrication
7. Damaged or dented cylinder bore

Q. What is cylinder side loading?

A. Side loading occurs when the cylinder mounting and piston rod connection are misaligned or when a load is placed on the cylinder piston rod without guidance or support. Side loading creates excessive wear on the cylinder piston, piston rod, rod bearings, and seals which leads to premature cylinder failure. To minimize the adverse effects

of cylinder side loading for rigidly mounted cylinders, be sure the object being moved is in exact alignment with the piston rod. Using guide rails to keep the load being moved in alignment may be helpful. For pivot mount cylinders use a rod eye or rod clevis on the piston rod otherwise it will function like a rigid mount cylinder. Finally, don't use the full stroke especially with long cylinder rods. Using a piston stop short of full stroke will make the cylinder more rigid and extend bearing life.

Q. How can the position of the cylinder piston be sensed when it reaches its end of stroke limits?

A. NITRA CPS series pneumatic position switches offer a robust interface between pneumatic actuators and electrical control systems. Using state-of-the-art AMR magnetic sensing technology, these switches are designed for use with pneumatic cylinders that have a magnet incorporated in the cylinder piston. They can be used to provide a switched output for cylinder position indication, cycle count or to confirm operation.



Figure 4

The NITRA CPS series is available in 3-wire DC, PNP normally open, PNP normally closed, and NPN normally open electronic solid state switch configurations with either an M8 wiring connector or wire leads. Designed to provide a low profile, flush installation on cylinders with T-slot channels, these switches are also easily mounted on round body cylinders using CPSB series mounting bands. Integral LED indication provides switch status for speedy switch positioning and troubleshooting. Pre-tested for use with NITRA pneumatic cylinders with magnetic piston option, the CPS series is also suitable for use with other brands of cylinders with magnetic pistons. (Figure 4)

PROCESS MARKETPLACE

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NITRA™ Pneumatic Stainless Steel Round Body Air Cylinders

The NITRA Pneumatics A-Series non-repairable stainless steel round body cylinders includes bore sizes from 7/16" to 2" and stroke lengths from 1/2" to 18" to meet a broad range of applications. These high quality cylinders are constructed with stainless steel bodies and double rolled-in high strength aluminum end caps with full flow ports.

- Interchangeable with other common brands of round body cylinders
- Available bore sizes: 7/16", 9/16", 3/4", 7/8", 1-1/16", 1-1/4", 1-1/2", 2"
- Excellent selection of stroke lengths
- Single-acting (spring return) and double-acting models
- Nose, pivot and double-end mounting options
- Type 304 stainless steel body with high-strength aluminum alloy end caps
- Pre-lubricated for long, maintenance-free performance
- 250 psi operating pressure
- Models available with magnetic piston for position indication
- All models are available for same-day shipment
- 3-year warranty
- Made in the USA



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Business Notes



Forsyth Alliance expands Robotics reach

The 2008-2009 season for the AutomationDirect-sponsored Forsyth Alliance FIRST Robotics group saw changes and challenges, highs and lows, and major milestones in the growth and reach of the organization. The Alliance fielded an FRC Robotics team, again conducted a successful First Lego League State Qualifier, and ultimately influenced Forsyth County, Georgia's high school curriculum.

The FIRST Championship game last season took its inspiration from the celebration of the 40th year of the lunar landing by Apollo 11. Dubbed "Lunacy", this year's game involved robots driving on a very slick surface to simulate driving on ice, while towing a trailer. Each alliance of three teams tried to score balls in the opposing alliance's trailers while trying to avoid being scored on. In addition, human players tried to score for the team by throwing balls into the moving robots' trailers.

At the Peachtree Regional in March, the Forsyth Alliance went undefeated in the qualification rounds and were ranked the #1 seed at the entire tournament. Unfortunately, three breakdowns in a row in the finals took them out of contention as the Regional's winning alliance. The team brought home multiple honors - the AutoDesk Visualization Award, Delphi's "Driving Tomorrow's Technology" Award, and Outstanding Volunteer Award for Rick Folea, the team mentor. As part of a presentation the team gave to a panel of judges for the "Chairman's Award", a video offered a fun visual overview of



Figure 2, World Championships

the Forsyth Alliance and its role in not only the FIRST organization but in the community.

After the Peachtree event, the robot was shipped directly to South Carolina for the Palmetto Regional, and in transit was crushed by a container of steel sprockets; the controller and other parts had to be replaced in order to compete at the Clemson-hosted event. (Figure 1) The FIRST organization responded and helped make the quick repair possible.

At the Palmetto Regional, the Forsyth Alliance won five of nine matches, finishing as the 18th ranked seed at a very tough regional. The team was chosen for the quarter finals, but again lost at that level. The team claimed the Imagery Award at this regional.

The Forsyth Alliance participated in the World Championship in April, which hosted almost 350 teams from over 20 countries. (Figure 2)

The Forsyth Alliance performed well, winning four matches and losing three to finish in the top half of their division, despite some communication problems with the robot. Their Regional-winning animation entry was chosen as one of only five finalists from among the almost 1,700 participating teams worldwide to compete for the 2009 season's overall Visualization Design Award.

The end of this fourth season saw the graduation of many founding members of the Forsyth Alliance; virtually all are going on to college studies in engineering or a field related to their involvement in the FIRST Robotics program. Another significant byproduct of the FIRST program locally has been to spur the Board of Education to install an entire Engineering/Robotics Career Pathway in four county high schools and to create two Engineering Career Academies in Forsyth County.

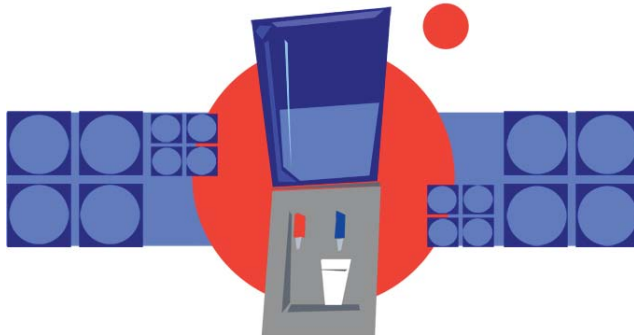
For more information, photos and video of the Forsyth Alliance, visit www.forsythalliance.com, or for information on the FIRST program, visit www.usfirst.org.



Figure 1, Crushed Otto

The Break Room

BRAINTEASERS & HUMOR



Engineering a Spider

By Ken Ball

Watch a spider build its web
Engineering and processes so inbred
What if the spider were suddenly you?

How would you know what to do?
Instinct you say must pave the way
Genes do the guiding; it's in the DNA
Watson & Crick made the revelations
Organic helices guide life configurations

Ah! How nice the biologists' advice
Spiders are spiders – not elephants or mice
But just as sciences continues to do
There's never an answer, just another clue

They just don't explain the spider's domain
The weaving machinery; the processing train
Nor how all is programmed and controlled
Maintained and expanded as the spider grows old

So let's go back and move on the tack
Man surely can emulate a low-level Arach
Assign Chem Es talented and wise
To produce silk from body fluids of flies

About extruding strands – are there special glands?
Can anyone specify maximum rate demands?
We need an entomologist, biochemist, and biologist
Also a project manager who can double as an apologist

Now we've become organized in our undertaking
We have the first committee well into the making
Process reads R&D, we see, beyond staff capability
Perhaps meet with MIT; must subcontract very carefully

Cleverly we say, "We're better off this way"
"Not caught in any web" is the cliché of the day
We'll analyze the spider's mechanics instead
Eight legs, abdomen, combined thorax and head

Four pairs of eyes and the body hair belies
They're really tactile sensors in all shapes and size
We can record web construction as guy lines are run
Then trace the patterned strands; one by one

We will map conformally; we're now on a roll
Motion guys predict "it has numerical control"
But the robotics crew, though only a few
Throws a wrench in the works – actually two

First they report that eight legs with a head
To function will be about as big as a shed
And on the prototype web – the joints never held
While those by the spider were a perfect weld

Then the silk system nerd gave us the word
(Best if he stayed away; never to be heard)
The abdomen would be as best he could see
A cylindrical unit four feet by twenty-three

Discouraging you think but we all had a drink
A toast to our progress; towards a goal so distinct
The report was a masterpiece defining the years
Needed for MEMS and Nano to dry all our tears

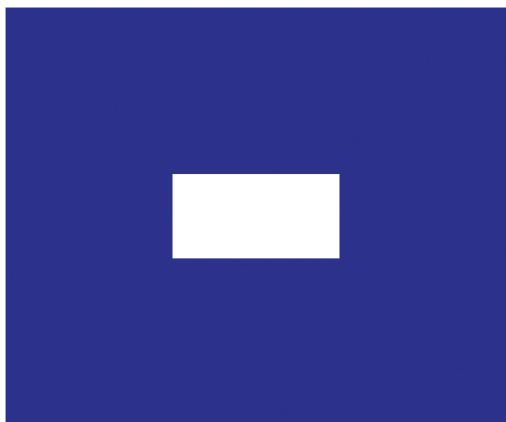
All were vindicated as our congressman related
The long term needs – more spending indicated
Weekly project meetings now open with the chant
Thanks be to the funding – our large NSF grant

So look with awe and admiration at a spider in a tree
Appreciate the technology performed so flawlessly
Energy efficient motion; never a wasted move nor a bind
Producing just-in-time; stronger strands than can mankind.

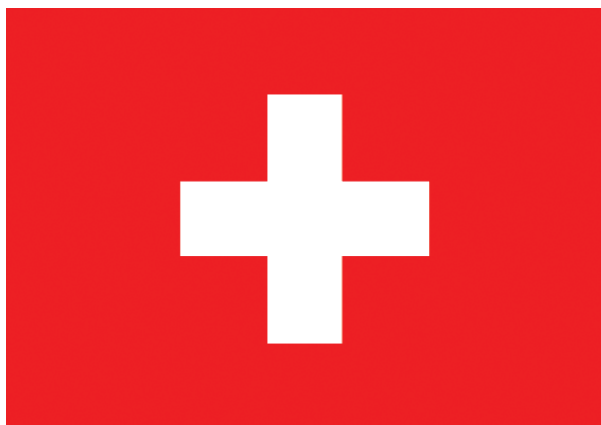
Brainteasers

Flag Cutting

1.) Can you cut this signal flag into two pieces which fit together to form a solid blue rectangle?



2.) Can you cut this Swiss flag into two pieces which fit together to form a solid red rectangle?



3.) Can you cut this American flag with fifteen stripes into only two pieces which will fit together to form a thirteen stripe flag with no wasted material?



Did you know that the American flag actually had 15 stripes for a few years? Go online for a brief history of the American flag and for the answers to all of the brainteasers.

(www.automationnotebook.com/brainteaseranswers.html)

And PLEASE don't desecrate any actual flags while solving these puzzles!

[Credit to: Sam Loyd for this month's puzzles]



"All I can do is be me, whoever that is. "

– Bob Dylan

"I'm an idealist. I don't know where I'm going, but I'm on my way. "

– Carl Sandburg

"Parrots make great pets. They have more personality than goldfish. "

– Chevy Chase

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