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Automation NOTEBOOK®

Summer 2010 Issue 17

Cover Story

Bale Hay While the Sun Shines:

A Revolution in Commercial Hay Production

New Product Focus

1/3 to 2 HP DC Motors now available

Feature Story

How to Improve Process Control by Automating Data Flow

Technology Brief

Why is my TVSS an SPD?

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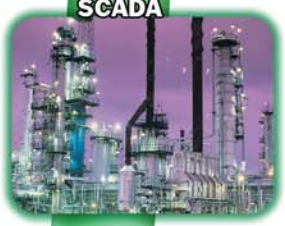

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Editor's Note

Summer is in full swing, which means vacation time for many. In the South, most of us like to head even farther down toward a beach. This year, it's not that simple.

At the time of this publication, our country is still dealing with the worst environmental disaster in our history. With the present oil leak in the Gulf of Mexico, many beaches have been polluted with tar balls and oil washing onto the shores. The full impact of this devastation remains to be seen.

For more than 60 days and counting, hundreds of people have been working to not only stop the leak but also clean up the wildlife, vegetation and landscape. Personally, I am amazed by, and grateful to, all the workers and volunteers pulling together to accomplish such a huge task. So, to all the scientists, engineers, natural resources workers, and everyone else involved in this massive project, I say, "Thank you." Often during adverse times new technologies are discovered and ideas are born.

This issue of Automation NOTEBOOK provides you with information about our latest products and line extensions, such as wiring devices and DC power supplies. Joe Kimbrell (our motors, drives and motion control product manager) answers questions about DC motors, and we have a user solution describing how an IBM research facility improved efficiency and safety using products from AutomationDirect. Our feature story discusses the use of data collection software to improve processes in a manufacturing facility through streamlined communication.

You'll find informative technical articles, and we provide some mental relaxation in the Breakroom. Be sure to let us know what you think about Automation NOTEBOOK. We look forward to your comments.

TJ Johns
Coordinating Editor
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Table of Contents

New Product Focus

what's new

1/3 to 2 HP DC Motors now available

The IronHorse® family of motors now includes DC motors. The permanent magnet DC 56C-frame motor line features totally enclosed non-vented (TENV) and totally enclosed fan-cooled (TEFC) models. The motors are constructed of a rolled steel frame with cast aluminum end bell, and are available in sizes ranging from .33 to 2HP. IronHorse DC motors are ideal for applications such as conveyors, turntables, and whenever adjustable speed, constant torque, dynamic braking and reversing capabilities are needed.

IronHorse DC motors, with a base 1800 RPM, are designed for use on unfiltered SCR (Thyristor) type 115 or 230V rectified AC inputs, when used with an appropriate SCR drive. They may also be used with PWM (pulse width modulated) type DC adjustable speed drives.

Other features include linear speed/torque characteristics over the entire speed range, high starting torques for heavy load applications, reversible rotation, and dynamic braking capability for faster stops. Large brushes provide for longer brush life. All IronHorse DC motors are shipped with a set of brushes in the motor, with an extra set of brushes included in the box.

IronHorse DC motors can be mounted to the Stable™ motor slide bases for accurate and easy motor positioning. Available in sizes from NEMA 56C- NEMA 449T, these motor bases start at $8.

IronHorse permanent magnet DC motors start at $119, are available for same-day shipping, and are backed by a two-year warranty. View the complete line of IronHorse permanent magnet DC motors at: **www.automationdirect.com/dc-motors.**

"Reason itself is fallible, and this fallibility must find a place in our logic."

– Nicola Abbagnano (1901 - 1990)

"There are only two people who can tell you the truth about yourself - an enemy who has lost his temper and a friend who loves you dearly. "

– Antisthenes (444 BC - 371 BC)

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Product Snapshots

Press Releases

Free Think & Do® programming software for WinPLC

In keeping with the philosophy of offering the best value in the automaton industry, AutomationDirect recently cut the price of its Think & Do programming software for their WinPLC processor from $695 to free. Before this price cut, the lowest cost option for programming the WinPLC processor with Think & Do was the purchase of a Think & Do WinPLC-only programming package for $695. Now, customers can download the Think & Do v8.04 Keyless Development Demo package for PC-based control for free. The free Demo is offered as a download only, but it includes the same development software that customers receive when they purchase the full Think & Do development package for $1,895.

Like most industrial automation controller programming software, Think & Do consists of a development package that runs on a PC, and one or more runtime keys that reside on real-time industrial controller application targets.

The free Think & Do Demo package has no limits when it comes to development, only in terms of runtime targets. But, these limits don't affect the WinPLC as it comes pre-loaded with Windows CE and Think & Do runtime software. This means that customers can download the Think & Do v8.04 Keyless Development Demo package for free, create software applications with Think & Do, and download these applications to an unlimited number of WinPLC targets.

For real-time industrial controller targets not pre-loaded with Think & Do runtime software, the Development Demo package has certain runtime limits. Runtime use is restricted to unlimited sessions up to 30 minutes each for 30 days. These sessions allow ample time for testing and proof of concept, but aren't intended for use in actual real-time industrial control applications. The Demo package also doesn't include the software CD, the Quick Start Guide and the USB Runtime hardware key supplied with the $1,895 Think & Do v8.04 Development package.

The Think & Do v8.04 Keyless Development Demo package features Flow Chart programming, an integrated HMI creator, advanced data manipulation and data exchange with business applications such as from an ERP systems and spreadsheets. Also included are an SQL database interface, and an OPC client and server. The software comes with a CD-ROM, a USB hardware runtime key and a QuickStart guide. System requirements are the Windows 2000, XP or Vista operating system running on a Pentium IV processor with at least 256MB RAM and 750MB hard disk space. The development system must also include a CD-ROM drive, an Ethernet adapter, a 64MB or higher video adapter and minimum 800x600 monitor resolution.

The WinPLC with Think & Do Runtime is a 100 MHz WinPLC processor module pre-loaded with Windows CE and Think & Do runtime software. The WinPLC plugs into the CPU slot of any DL205 base. It includes 8 Mbyte flash ROM, 8 Mbyte RAM, a built-in Ethernet port and a serial port. Technical information, pricing and delivery for the complete line of Think and Do and WinPLC products can be found at **www.automationdirect.com/software**

Low-cost DC power supplies added to RHINO line

The RHINO™ line of power supplies now includes panel and DIN rail mountable power supplies designed for applications requiring a basic DC voltage power supply. The low-cost supplies offer high performance and reliability when additional features of higher cost full-featured supplies are not needed.

The panel-mountable RHINO PSS series features rugged aluminum housings allowing for three different mounting orientations. The series is available with universal single-phase input and output voltages of 12 and 24 VDC from 35 to 100 Watts. The high-quality power supplies equipped with overload, overvoltage, and thermal protection are UL recognized, CE marked, RoHS compliant and backed with a two-year warranty. Prices for the PSS series start at $19.75.

The DIN rail mountable RHINO PSB series is available with universal single and three-phase input and output voltages of 12 and 24 VDC from 15 to 480 Watts. Constructed of rugged plastic and aluminum housings, the power supplies easily install with integral 35mm DIN rail mounting adapters.

These high-quality power supplies equipped with overload, overvoltage, and thermal protection are backed with a three-year warranty and are UL listed, CSA certified, CE marked and RoHS compliant. Prices for the PSB series start at $21.50.

The full line of RHINO power supplies can be seen at:
www.automationdirect.com/dcpowersupplies

Straight blade and locking wiring devices and accessories

AutomationDirect has added a new line of Bryant wiring devices to its product offering. Industrial grade locking and straight blade plugs, connectors and receptacles are available in 15, 20, and 30 amp models.

Locking plugs and connectors constructed with impact and chemical-resistant nylon housings feature an internal Triple Gripper® cord clamp which automatically centers and secures the cord. Double wall construction provides extra durability; the configuration-specific plug face surrounds plug blades to prevent infiltration of contaminants. Each terminal cover is imprinted with amperage, voltage and NEMA configuration on the face for easy identification and extended "teardrop" wiring pockets and backed-out captive terminal screws simplify wiring. Locking plugs start at $6.25.

Locking receptacles are designed with back and side wiring terminals that accept 14 to 8 gauge solid or stranded conductor wires. Molded of rugged reinforced thermoplastic polyester, the base minimizes heat buildup and resists breakage. Heavy-duty nickel-plated mounting straps are grounded for safe installations. NEMA rating and configurations are molded into the toughened nylon face for easy identification. Receptacle prices start at $4.75.

Straight blade devices are available in 15, 20 and 30 amp sizes. A universal cord grip design accepts .300-inch to .655-inch (7.6mm to 16.6mm) wire sizes. Prices for straight blade plugs and connectors start at $6.25.

Available high-visibility lockouts provide additional protection. The OSHA lockout/tagout regulation compliant devices protect against unexpected start-up of equipment during maintenance and repair work. To accommodate a full range of plug designs and ratings, the lockouts are available in three sizes. Lockout prices start at $12.25.

A variety of accessories includes stainless steel receptacle plates, starting at $1.50, angle adapters for 20 and 30 amp plugs and connectors for $14.25, and weather boots starting at $9.25.

Learn more about the UL approved and CSA certified Bryant wiring devices at:
www.automationdirect.com/wiring-devices

Cat5e Ethernet patch cables available

Cat5e STP Ethernet patch cables are now available in eight colors and three foot to 50 foot lengths. The straight-through and crossover patch cables support up to 1000 Mbps, and are designed to reduce the effects of electromagnetic interference by incorporating a single metal foil shield which wraps around the entire set of four twisted pairs. The robust RJ45 connectors are also shielded against electrical interference. Our 350 MHz cables exceed all Cat5e TIA/EIA standards, and drastically reduce both impedance

and structural return loss (SRL) when compared to standard 100 MHz cables. With prices starting at $5.00, these cables help create solid, reliable Ethernet networks with any application. See more at:
http://www.automationdirect.com/communications

Cover Story

Trends in Automation

Bale Hay While the Sun Shines: A Revolution in Commercial Hay Production

By Dave Staheli
President, Staheli West

A steam generating plant on wheels? That's right. The DewPoint 6110 hooks up between a large farm tractor and hay balers that make large rectangular bales from 1,500 to 2,000 lb each *(Fig. 1)*. Its purpose is to add moisture to dry hay to prevent mechanical damage to the crop during the baling process. This revolutionary concept, which has been successfully used and refined over the past 14 years, will change the way hay is made.

Figure 1, Baled Hay

Growing high quality hay for the commercial market is one of the most important steps in the process of bringing meat, milk, cheese and other dairy products to the table. Huge machinery investments are made by hay growers and custom hay harvesters to ensure a successful harvest.

First, the hay is cut and laid into swaths or windrows for drying. After one to three days of drying the hay is raked, with two or more swaths or windrows being merged together into larger windrows for further drying in preparation for baling. On the fourth or fifth day the hay is fully cured and ready to bale.

However, one big problem exists at this point. When the hay is dry, it needs to be baled quickly to maintain the quality of the hay, and it needs to get off the field before the next rainstorm hits. Then why not just start baling?

Can't Make Hay without Water

To make good bales and prevent crop damage a little moisture must be introduced back into the dried windrows of hay so the leaves and stems of the crop remain intact as the hay is processed through the baler. Natural dew has been the primary source of this baling moisture. But, since the invention of the hay baler, hay growers have struggled to anticipate atmospheric conditions conducive to proper dew formation for baling hay.

If the dew is too light or if there is no dew, hay is damaged and a lot of the leaves are lost on the ground. If the dew is too heavy, the hay can't be baled because it will spoil and there is a high risk of hay stack fires. The window of acceptable baling time typically ranges from zero to four hours a day, all depending on the whims of Mother Nature.

So how do farmers deal with making hay under such adverse conditions? Until now, they have been forced to purchase large quantities of equipment to cover lots of acreage quickly when conditions are favorable.

Commercial hay operations ordinarily have one tractor and a large rectangular baler for every 40-60 acres they want to bale each day. On a medium-sized hay farming operation of 2,000 acres, it's common to see at least four of these machine combinations running to bale 150-200 acres a day. It's an impressive sight, but at $250,000 each, it's also very expensive. In a whole season each of these expensive machines might operate for fewer than 100 hours each, and that's a very inefficient and costly way to run a farm.

Simulating Dew

The DewPoint 6110 is a steam dew simulation machine which, when coupled with one tractor and one baler, can replace up to four conventional tractor/baler combinations. The patented DewPoint technology enables commercial hay growers to bale hay anytime the crop is sufficiently dry without needing to wait for natural dew. Baling moisture levels can be accurately controlled in a wide variety of ambient conditions for 12-24 hours a day.

Here's how it works:

1. Steam is produced by the DewPoint machine, a mobile steam generating plant, using a low pressure boiler supported by water tanks, a feed water system, fuel tanks, a generator and a PLC-based control system.
2. Steam is injected into the hay as it is lifted from the windrow by the baler pickup and as it passes through the feed chamber of the baler. Treatment of the hay is accomplished by injecting steam through a series of distribution manifolds mounted in the baler.

Figure 2, Operator Panel on Dew Machine

3. Bale temperature is monitored continuously and adjustments to the steam injection rate are made by the machine operator *(Fig.2)* as needed to maintain optimum bale moisture conditions at all times.

The 2,000 acre hay operation can reduce its capital outlay to around $400,000 for hay baling equipment instead of $1,000,000. Labor expenses and machinery maintenance are also dramatically reduced, and the quality of the hay produced will be higher and much more consistent. Commercial hay farming operations with two or more large square balers are a natural fit for the DewPoint 6110.

Over the past 14 years, our commercial hay operation in arid western Utah has grown to nearly 2,000 acres. We use a John Deere 8410 tractor coupled to a DewPoint 6110 machine with one Massey Ferguson/Hesston 2170 3x4 large square baler. We can easily bale 200-250 acres each day in eight to ten hours with this setup. Several times we have baled 500 acres in a 24-hour period ahead of an expected rain with the wind howling and no natural dew, and every bale has had ideal baling moisture.

The dew simulation machine allows you to schedule your harvests by the calendar, with the exception of rain. As long as the hay is dry enough, you can bale any time of the day or night.

Automation Makes it Possible

Automation has allowed us to make the machine very user friendly. All control functions are via an AutomationDirect (**www.automationdirect.com**) ***Direct***LOGIC DL06 PLC mounted in a control panel that's installed at the front of the machine (***Fig. 3***). We use an AutomationDirect **C-*more*** touch screen panel in the tractor cab to give the operator full control of the machine settings and functions from start-up to field operation to shut-down. There is a main overview screen, and the operator can drill down and see more detail via 20 other screens.

Figure 3, Control PLC

The PLC system automates the background processes, so the operator only has to start up the machine and manage the moisture content of the hay. Everything else is automatic, although operating conditions can be monitored as desired. Minor programming updates are made from time to time to streamline function and performance, and these updates are provided free of charge to our customers.

The PLC controls and monitors the machine via 30 discrete and 20 analog inputs and outputs. All I/O is local to the PLC and installed in expansion slots. The PLC is connected to the touch screen via Ethernet.

Conditions monitored by the PLC include boiler operating parameters, bale temperature and crop flow. Future plans call for the addition of bale moisture monitoring, allowing us to automatically close the moisture control loop.

The PLC uses the monitored inputs along with operator data entered via the touch screen to control steam application rate valves, the water systems and boiler functions.

When we first decided to automate, we had to decide which control system platform was the best fit. We selected AutomationDirect for a number of reasons.

First, the cost of their hardware and software is lower than competitors. Second, the technical support during the design phase and continuing on into initial deployment has been outstanding. The fact that the machine functioned almost without a hitch right out of the box attests to the professional assistance we received. Third, AutomationDirect offers a wide variety of components from a single source which easily integrate together. Integrating components from different vendors can be a major challenge, one that we wished to avoid.

Quantum Automation, in Anaheim, California, (**www.quantumautomation.com**) is our AutomationDirect Value Added Reseller. Since my first contact with Cynthia Snyder, our Quantum Automation rep, she and others at both Quantum and AutomationDirect have been extremely helpful in assessing our control system and providing professional assistance. We even got

Continued, p. 10>>

Cover Story cont.

Trends in Automation

Continued from, p. 9

Cynthia up here to Cedar City last fall and taught her how to drive a big green tractor and bale hay with the DewPoint System. Due to its ease of use, she picked up on it right away!

Remote Diagnostics

We've also integrated a Moxa (**www.moxa.com**) OnCell Cellular IP modem remote monitoring system which allows us to connect to the machine's control system via the Internet from any computer with an Internet connection. This feature allows us to provide direct technical assistance if the need arises, and also to provide alarm event notification.

Using the remote monitoring system - we can check machine functions, performance, and baled hay properties. We can also perform diagnostics, or even remotely operate the DewPoint 6110 machine from our office computer to assist operators.

We currently have diagnostic capabilities to check the many sensors on the machine for proper function. Some of these critical diagnostic functions are automated using comparative data from more than one sensor.

We are expanding the diagnostic capabilities this season, primarily through PLC program updates.

In large farming operations, remote monitoring can also allow a farm manager to watch and even control multiple DewPoint hay baling operations on his farm from a central computer. No additional software is needed, just an Internet connection into the control system via the remote cellular modem.

Another benefit of using cellular technology is that the modem has the ability to alarm if conditions arise which warrant alerting appropriate personnel. The PLC can send an output to one of two relays on the modem which will cause a text message to be sent to pre-defined phone numbers. Once a message is received, one can remotely log into that baler via any Internet browser and check the C-*more* screens to see what alarm conditions are occurring and to make appropriate corrections.

Seeing is Believing

Based on our experiences, most people really can't appreciate the effectiveness of the DewPoint without actually seeing it work. Most are skeptical and are very surprised when they see high quality hay baled in the middle of the afternoon.

The main issue slowing adoption of the dew simulation process over the past 14 years has been confidentiality restrictions. There were several hay symposium presentations given and articles published in trade magazines in 1997 and 1998. However, once a technology license was granted in 1998, publicity was stopped to allow research and development activities to continue under some cover.

Now with our system ready to enter the market, we welcome the opportunity to present it again, this time in a far more advanced and robust package ready for the rigors of commercial hay production. Quantum Automation and AutomationDirect have been great partners in our efforts and we look forward to working with them for many years to come.

We welcome anyone who wants to come and see the DewPoint 6110 in action, operate it or examine the hay produced by the process. For more information, call us at 435-590-2537. You can also visit our Web site for photos, videos, demonstration schedules and other information at **www.StaheliWest.com**.

"All the art of living lies in a fine mingling of letting go and holding on."

– Henry Ellis

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* All prices are U.S. published prices. Prices and specifications may vary by dealer and configuration. AutomationDirect prices are from March 2010 Price List. Allen-Bradley prices are based on http://shop.rockwellautomation.com 10/30/09.

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System Integrator Corner

Modernizing Machines

AAA Absolute Automation And Electrical Services, Inc. implements energy savings through machine control

By Bob Swarner,
AAA Absolute Automation And Electrical Services, Inc.

AAA Absolute Automation And Electrical Services, Inc. is an independent control systems and industrial electrical company based in Covington, Georgia. They provide solutions to both end user and OEM clients in many industries including material handling, chemical processing, food and beverage, metals processing, plastics, recycling and general manufacturing. Services offered range from complete turnkey automation systems to scheduled and emergency service calls relating to electrical wiring, programmable controllers, AC drives, pneumatics, and other control system components.

AAA specializes in PLC and PAC based control systems and provides engineering and design services, controller programming, custom control panel fabrication, system installation, start-up assistance, and documentation for almost any sized project.

Their experience has been gained through numerous projects ranging from simple troubleshooting to complete design and installation of complex plant control systems.

One area that sets AAA apart from their competitors is the level of documentation they deliver with each control system. Documentation packages are designed to quickly give clients information they need to fully understand, operate and troubleshoot the system. Many systems are supplied with remote access capability, allowing AAA to assist with troubleshooting issues from anywhere in the world via the Web.

Figure 1, Steel Processing Machine Control Panel

Recently, a chemical producer approached AAA seeking energy saving suggestions in their manufacturing process. The client stored finished products in forty agitated tanks. Since manual push buttons and across-the-line motor starters controlled the agitators, they ran continuously at full speed, even though most of the products did not require it.

To capitalize on this energy saving opportunity, AAA replaced the existing motor starters with a series of DURApulse drives connected to a ***Direct***LOGIC D2-260 PLC based control system. Now plant operators, using a C-*more* operator interface screen, easily set each agitator to run the minimum speed and period of time required to maintain a quality product. Agitators can also be set to automatically cycle on and off, based on easily configurable time schedules. The resulting energy savings yielded a very short payback time for this project.

AAA also utilizes the industry's latest products to upgrade control systems on existing manufacturing machinery. During a recent system upgrade, a forty-year-old pushbutton and relay control system on a steel processing machine was replaced with a modern system consisting of a ***Direct***LOGIC D2-260 PLC, C-*more* operator interface screen, and Fuji motor starters. ZIPLink pre-wired cables were used to decrease panel fabrication time and reduce costs.

Because the old control system utilized a two-speed reversing motor starter to control the machine's main motor, constant speed changes caused a great deal of mechanical wear to the machine. When the old system was upgraded, the starter was replaced with a DURApulse drive. ***(Fig. 1)*** This upgrade allowed the machine to accelerate smoothly between speeds, thus greatly reducing mechanical wear. The machine now runs at its most efficient speed during every phase of the production cycle.

AutomationDirect products are also used extensively in control panels built for original equipment manufacturers. Recently AAA chose a ***Direct***LOGIC DL06 PLC, C-*more* Micro operator interface screen, and a *Sure*Servo motion system to accurately cut foam to correct lengths during a laminating operation. The torque control mode of the SureServo drive allows the machine to keep the proper tension in the foam sheets during the cutting process.

AAA Absolute Automation and Electrical Services, Inc. is proud to use AutomationDirect products in their control systems, allowing them to provide great control solutions at reasonable prices. For more information please visit: **www.aaaelectricalservices.com**

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NEMA 12 wall mount 20 x 16 x 08"	$214.00 N12201608		$450.50 A-201608LP
NEMA 12 DISCONNECT wall mount (24" x 25-3/8" x 8")	$372.00 SDN12242508		$698.40 A24SA2608LP
NEMA 4 wall mount 20 x 20 x 06"	$277.00 N4202006		$584.50 A-20H20ALP
NEMA 4X wall mount 20 x 20 x 06"	$660.00 SSN4202006		$1,412.00 A-20H200GSSLP

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User Solutions

Volatile Material Handling for IBM

By Scott Martin
KCC Software

When IBM needed a control and delivery system for Silane gas at the T. J. Watson Research Facility in Yorktown Heights, NY, they turned to KCC Software of Huntsville, AL.

Silane gas is essential in an ultra-pure method of applying silicon in the manufacturing of semiconductors and solar panels. The SiH4 compound, however, is extremely volatile and will combust if exposed to atmosphere. Thus, the storage and delivery of this gas to their many labs has to be handled very carefully.

In addition to storage and on-demand delivery of the gas to dozens of production tools in multiple labs, the system also manages many automated purge routines to safely remove the dangerous gas from several points throughout the distribution network. Many of these purge routines require synchronized processing by multiple PLCs. Thus, networking and PLC-to-PLC communication were central aspects of this system.

The system that KCC Software developed is a network of six PLCs, touch panels, and a supervisory PC. The main PLC is a *Direct*LOGIC DL205 series with a D2-260 CPU. This PLC contains three Ethernet connections, multiple analog and thermocouple inputs cards, discrete input cards and discrete output cards distributed through the main and remote bases. *(Fig. 2)*

Each lab in the research center has a DL06 PLC. Each DL06 has an additional discrete I/O card and two analog input cards. All PLCs are networked through 100 Mbit Ethernet connections using ECOM100 cards. *(Fig. 1)*

Each PLC has a C-*more* touch panel displaying interactive graphics with password-protected configuration and control of the system. Additional 15-inch *C-more* touch panels are located at critical points throughout the facility, allowing personnel to view the status of all PLCs, the central distribution system, each lab control system, and the status of each tool receiving gas from the system *(Fig. 3)*. The touch panels also include an electronic version of the operations manual allowing quick references to the system documentation.

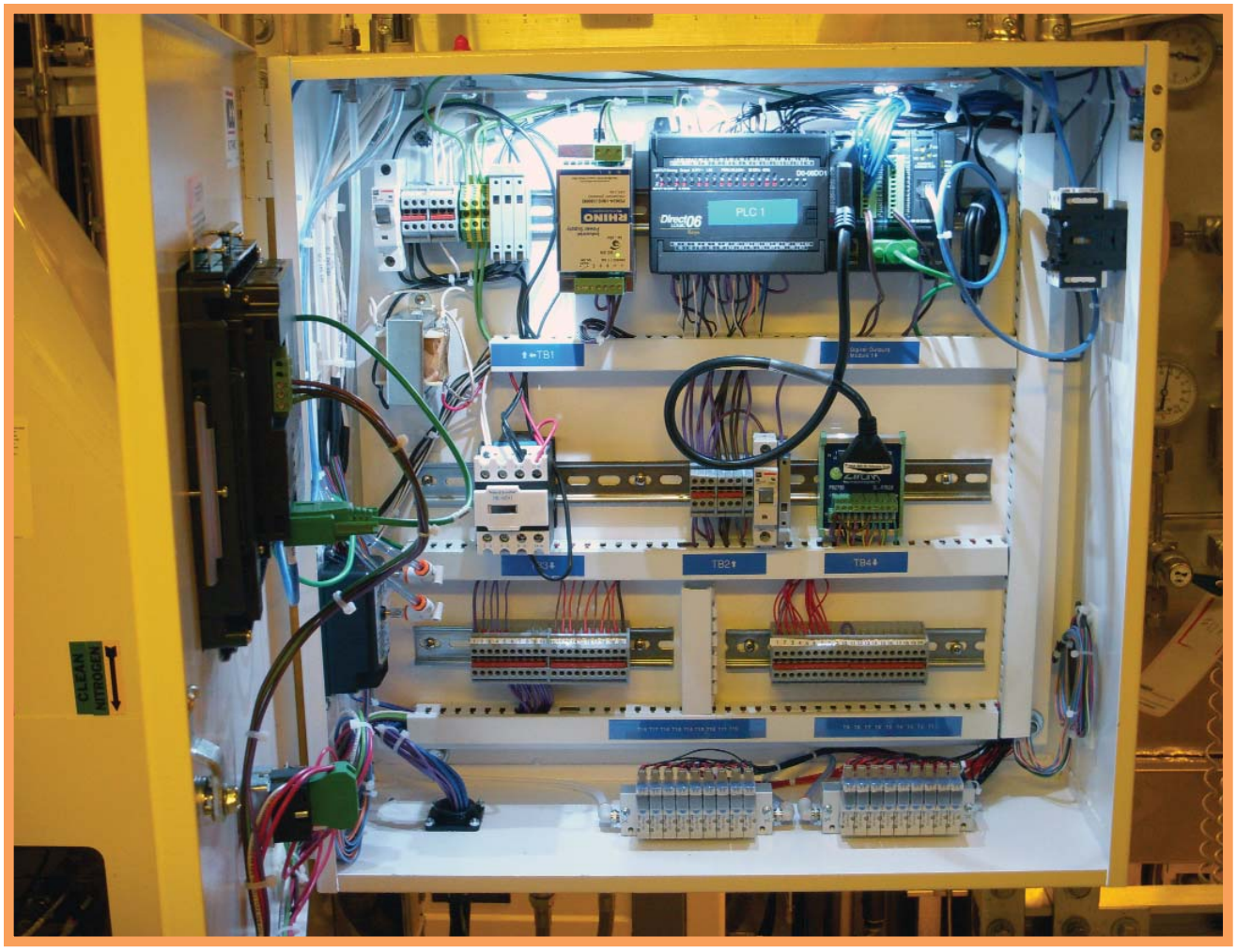


Figure 1, Typical Lab Control PLC

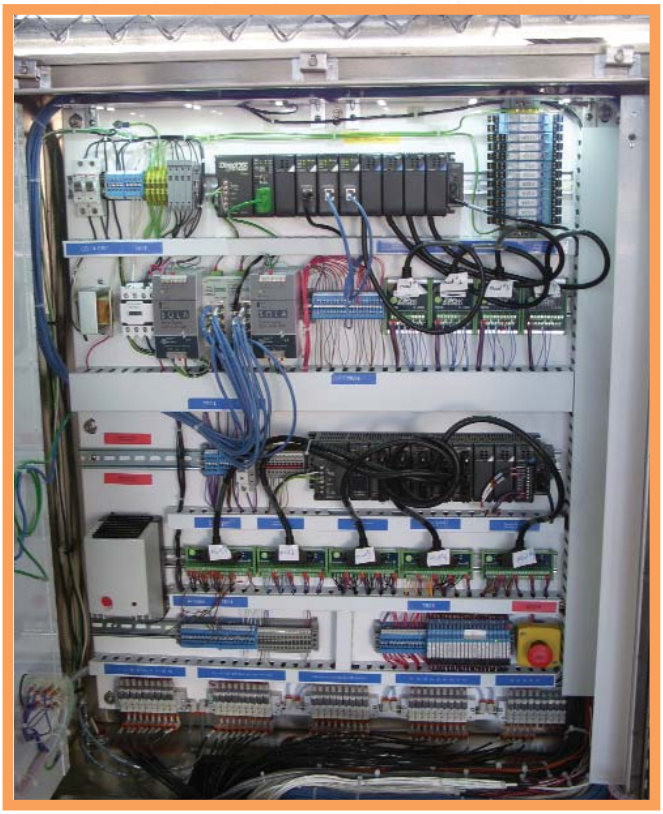


Figure 2, Master Control PLC

"KCC Software was chosen to develop a new PLC-based gas delivery control system for our facility. Scott Martin and his colleagues were given the task of developing software and hardware to implement our needs on a very tight time schedule. This was done while allowing us to continue to operate the older delivery system in tandem until time of change over. Scott worked hand-in-hand with us to fully understand our current system and to implement improvements with the new system along the way. KCC Software's commitment to detail is unparalleled and was one of the main reasons for a trouble-free and on-time project," says Ray Sicina of IBM Research.

One important feature provided by the touch panels is that all pressure transducers and thermocouples are trended with alarm setpoints included in the trend graphs. If a problem occurs, IBM can review the key system operating parameters looking for abnormal behavior.

For safety purposes, critical signals were wired from one PLC to another in a fail-safe form of handshaking. Since hundreds of tags are shared between the central controller and each lab controller, extensive use of Network Read and Write commands was implemented. This allows for continuous "behind the scenes" communications without adding code to the lab DL06 PLCs, and without the need to manage or synchronize polling. This network communication capability designed into the AutomationDirect PLC family was a vital aspect to the success of this distributed system.

The system includes a supervisory PC which contains a central database for all process parameters and alarms for every component in the system. This supervisory application was developed using Think & Do PC-based software, with a Modbus interface to each PLC. The PC application includes interactive color graphic screens showing the active state of the entire distribution system with current valve states, active gas flow, and all pressure transducer readings.

In addition to the ***Direct***LOGIC PLCs, expansion cards, **C-*more*** touch panels, and Think & Do software, KCC Software also selected Rhino power supplies, STRIDE Ethernet switches, cables, pushbuttons, lamps, circuit breakers, wire, terminal blocks, DIN rail, and many other components from AutomationDirect. The exceptional customer support and fast response to orders have always been appreciated by KCC Software; in this project, it also surprised and impressed IBM. AutomationDirect's products and support created a foundation upon which KCC Software was able to build an exceptional system that will keep IBM safe and productive for decades to come.

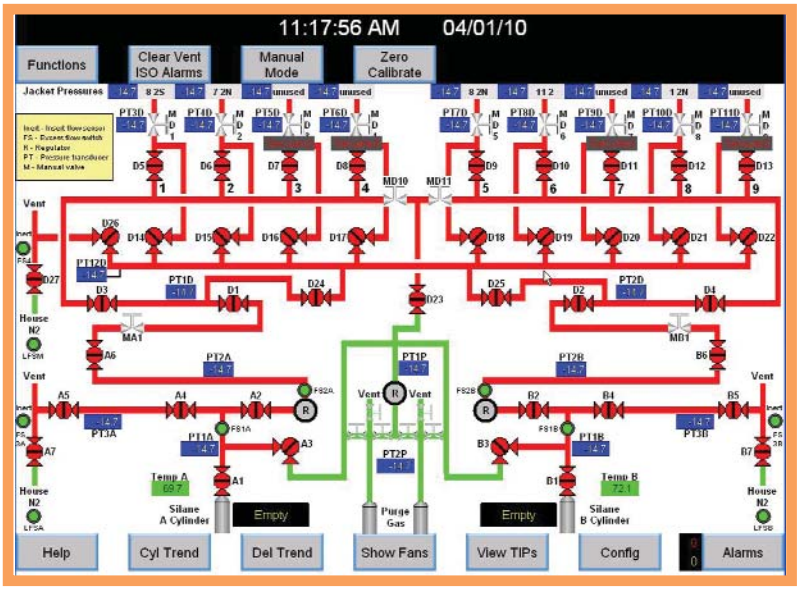


Figure 3, Operator Screen on C-*more*

Product Management Corner

control options

Why the WinPLC?

By Jeff Payne,
AutomationDirect
Product Manager,
PLC, I/O and PC Control

When a "do-it-yourself user" makes the decision to automate, integrate or just simplify applications and machinery, the world is his/her oyster. In today's world of industrial automation controllers there are many options. Depending on your specific needs, you could select a very extravagant or very basic automated system. The automation application could range from simple relays and timers to coordinate a sequence, to larger distributed controls and SCADA (Supervisory Control and Data Acquisition) systems for your complex control, calculation and reporting applications.

Regardless of design complexity, you must determine how to program your control system. Depending on your background and areas of expertise, this can vary greatly. The majority of controllers today offer a variation of ladder logic control at a minimum. Ladder Logic is a programming language born with the origination of the PLC (Programmable Logic Controller). The first PLCs were basic "relay replacers" in industrial controls, so Ladder Logic emulated an electrical schematic with power rails and rungs. Instructions consist of conditional contacts that, when enabled in a specific sequence, will energize an output coil or trigger an event.

Based on data from the Programmable Logic Controllers and Programmable Automation Controllers (PLC, PAC) Product Research study conducted by Control Engineering (September 2008), virtually all respondents used ladder diagrams to program PLCs / PACs, which is almost double the usage of any other programming language. However, if your background expertise is not electronics, and is more focused on other programming languages, ladder logic can be foreign and confusing. This is where a hybrid PC-PLC solution, such as WinPLC, can benefit you.

The WinPLC is a Windows CE based CPU (Central Processing Unit) for the ***Direct***LOGIC 205 series PLC (DL205) from AutomationDirect. A key feature of the DL205 series is that it allows you to manipulate your application's I/O (inputs and outputs) in a compact form factor; it offers multiple options for system control, such as deterministic control and connectivity to other control devices and business systems. The WinPLC (H2-WPLC3-EN) is one CPU option for this series; it comes pre-loaded with Think & Do PC-based control runtime software, and uses its flowchart programming environment. ***(Fig. 1)***

Figure 1, WinPLC Module

In keeping with its philosophy of offering the best value in the automaton industry, AutomationDirect has recently cut the price of its Think & Do programming software for the WinPLC processor from $695 to FREE. Prior to this change, the lowest cost option for programming the WinPLC processor with Think & Do was to purchase the programming package for $695. Now, customers can download the Think & Do v8.04 keyless development demo package for free, which includes the same development software that customers receive when purchasing the full Think & Do development package for $1,895.

Like most PC-based control programming software packages, Think & Do consists of a development package that runs on a PC, and one or more runtime keys that reside on real-time industrial controller application targets. The free Think & Do demo package has no limits when it comes to development – only for runtime targets, and these limits don't affect the WinPLC since it comes pre-loaded with Windows CE and Think & Do runtime software. Customers can download the Think & Do v8.04 Keyless Development Demo package for free, create software applications with Think & Do, and download these applications to an unlimited number of WinPLC targets. ***(Fig. 2)***

Figure 2, Flowchart Programming

This begs the question, "Why should I choose the WinPLC?" The answer is very simple, but depends upon personal preference. Do you prefer a more traditional style controller with a ladder logic programming method? If so, the WinPLC is probably not for you. However, if you are looking for a processor with built-in Ethernet and serial ports that handles advanced data manipulation, string arrays and complex math functions in an easy-to-follow Flowchart programming environment, then the WinPLC may be what you need to simplify your application needs.

With Flowchart programming, if you can visualize your process and write a simple process flowchart, your programming is complete. When you are looking for PC-based control characteristics, but prefer the rugged form factor of a PLC, the WinPLC is the control solution for you.

Student Spotlight

The Future of Technology

Beverly Hills High School

Science/Technology

Student Spotlight:

Alexander Kern

Alexander Kern is a member of the Beverley Hills High School MorTorq Robotics team. He contacted AutomationDirect in February of this year with questions about interfacing a *C*-more touch panel to his high school's robot. In a few short weeks, Alex and his team built a robot from scratch, interfacing the *C*-more panel to operate the robot during competition, including several screens dedicated to various diagnostic functions required by the team.

In early March, Team 1515 traveled to a FIRST Robotics regional event in Portland Oregon, where the team won the Motorola Quality Award in part due to the innovative use of the touch screen interface. They went on to win the regional as part of a three-team alliance, and qualified for the World Championship event in Atlanta.

Less than a month later, the team attended the Los Angeles regional event, and won the Regional Chairman's Award, the most prestigious award given in each region.

We sat down with Alex at the World Championships (April 15-17) and asked him a few questions:

Q: How did you become interested in robotics?

A: When I was around 11 years old, I attended a technology-based summer camp known as PlanetBravo. I took the robotics course and it got me really interested in the whole concept, especially the programming aspect. After experimenting with VeX for a couple of years, I was invited to join my high school's robotics team when I was in eighth grade.

Q: What was your first robotics project?

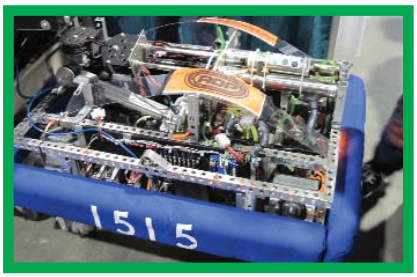
A: For my first project, I built a little robot which pushed and kicked ping pong balls into miniature soccer goals. It could also track a black line on the ground using sensors underneath the robot.

Q: What is your favorite subject in high school?

A: Undoubtedly, my favorite subjects in school are Computer Science and Math. Being a programmer, I've always found computers to be intriguing and really enjoy both courses. Next year, I will be taking a combined Computer Science and Math Analysis class, which unlike most kids my age, I'm looking forward to.

Q: What are your plans after high school?

A: I plan on becoming an Internet entrepreneur, creating the next huge Web site like Facebook or Google. Networking and systems architecture has always been my specialty, and I hope to pursue it in my career.



Q: How does the C-more touch panel interface with the MorTorq Robot?

A: The touch panel controls all functions of the robot, including manual overrides for each of the robot's Mecanum wheels and the pneumatic kicker. The touch panel first communicates via Modbus over TCP/IP into a

DL06 PLC. The PLC's digital outputs then control another set of relays which take the 24 volts supplied by the PLC and step it down to 5 volts. These relays then feed into a small USB Cypress Board, connected via USB to the laptop. The laptop communicates wirelessly with the robot's onboard controller. We also have two-way feedback, which has a reverse signal flow.

Q: How similar was the final solution to the original plan?

A: The final solution of using a PLC and relays to communicate with the robot was absolutely nothing like what I had originally designed. We attempted to use an Arduino Mega instead of a PLC, in order to save space and battery, but the Arduino could not handle the fast poll times needed to control the robot during the game. We then chose to use a DL06 PLC from AutomationDirect. Once we started it up, however, the 24VDC from the PLC fried the USB Board instantly, forcing us to install relays to reduce the voltage.

Q: Why did you change this approach, and what did you learn?

A: While playing around with the Arduino and the touch panel, I became very familiar with the industry standard Modbus protocol, because I had to develop a software library which could both send and receive it. When

Continued, p. 23>>

Tech Brief

Surge protection by any other name

Why is my TVSS an SPD?

By Jerry Reaves,
AutomationDirect
Product Manager,
Power Distribution

In the last few years, the electrical industry has seen significant changes in safety standards. One area of major change is with surge protection. In the past, you would use a surge arrestor or transient voltage surge suppressor (TVSS) to solve transient overvoltage or surge issues. Today, we don't even use the words surge arrestors or TVSS; we simply call them Surge Protection Devices (SPD).

The UL 1449 standard has progressed through several revisions and has become the standard governing all surge protection devices, including surge arrestors. One change to UL 1449 is intermediate fault current testing which has been added to test at 10A, 100A, 500A, and 1000A. In this test, the sample must either disconnect safely at the rated current or maintain the current level for seven hours without charring, flaming, or igniting a piece of cheesecloth lying on the test sample.

TVSSs and surge arrestors specifications are now combined into one single standard called Surge Protection Devices; this means that surge arrestors are required to pass the same testing as TVSSs. Previous versions of UL 1449 indentified two types of SPDs: permanently connected and cord connected. Now SPDs are identified as Type 1, 2, 3, 4 or 5. This change allows UL 1449 to align with IEEE standard C62.41.2 – 2002.

Nominal discharge current testing has been adopted from the IEC standards to test endurance and capability of the SPD. There are no grandfather clauses so all SPDs must be compliant and tested or retested to meet the 3rd edition as of September 2009. The 2008 National Electrical Code (NEC) Article 280/285 has also been updated to coincide with the latest UL 1449 3rd edition standard.

An explanation as to why all these changes have taken place begins with a review of the basic building blocks of an SPD. In the 1950s, selenium cells and gas discharge tubes were used. Selenium cells are very toxic, and in the 1980s were replaced by the Metal Oxide Varistor (MOV). Gas Discharge Tubes (GDT) have low capacitance, and are commonly used on high frequency lines. You can still find them in use from time to time.

Today the most common devices used are Metal Oxide Varistors (MOV) and Silicon Avalanche Diodes (SAD). The SAD is typically used in data/telecom applications and works very well, but it has limited fault current capabilities. The MOV is much more robust and is by far the most common technology in use today for transient overvoltage and surge protection. The MOV is made primarily of zinc oxide and is designed with a predetermined voltage threshold. The maximum voltage and current capacity of the MOV is determined by its physical diameter and thickness. When a nominal voltage is applied and is below the voltage threshold, the MOV has very high impedance and is not seen by the circuit. When the nominal voltage goes above the voltage threshold, the MOVs impedance will decrease and can go to almost zero ohms if needed, acting as a shunt to divert the excess voltage through the MOV. Typically, when an MOV is used in a surge protection application the MOV is connected across the main power lines and ground, which puts it in parallel to the load it is protecting. While the MOV is conducting the excess voltage it produces heat (P=I2R): the lower the resistance of the MOV, the higher the current level will be, and the more heat produced.

Ideally, when a transient voltage event occurs, the MOV clamps the voltage at the voltage threshold level and the load will only see that clamped level. When the spike has passed and the voltage level drops below the threshold level, the MOV returns to the high impedance state and stops conducting. This works well as long as the voltage level stays below the threshold long enough to allow the MOV to dissipate the heat and cool down. If the nominal voltage level rises and stays above the threshold for an extended period of time, or multiple voltage transients occur with little or no time between transients, the MOV may not have enough time to cool down. Depending on the severity of this condition, the MOV can overheat and burn up, catch on fire, or even explode. When an MOV burns, a mixture of toxic gases and soot is released into the environment around the MOV. The conductive soot can cause premature failures of exposed components..

Initially, you would expect the upstream circuit protection to open the circuit if this happens, but this is not always the case.

For example, let's say the voltage is just slightly above the threshold point of the MOV. The MOV will start conducting but it will not produce enough current to open the circuit protection device. The MOV will continue to conduct, until it fails, which can cause a potentially harmful and unsafe condition.

Changes in testing procedures are challenging manufacturers to build better products that eliminate these conditions. The most common method of solving these problems is to add a thermal switching device to the MOV; so, if the MOV starts to overheat, the switch will open, removing the MOV from the circuit before it destroys itself or anything around it.

In a typical automation project, the sensitive devices that may benefit the most from SPDs include PLCs, operator interfaces, and communication devices.

Continued, p. 22>>

Feature Story

Industrial Data Management

How to Improve Process Control by Automating Data Flow

By Bill Glover
President, BizWareDirect

One key to improving your process is properly managing information—specifically controlling, monitoring and maintaining information flows into and out of your process control system. Whether you are responsible for a manufacturing facility, a utility plant or a bio-dome—you need to control and know what's going on in your process.

Managing your information will help you make smart decisions to ensure that your operations run smoothly and efficiently. And, by properly managing your information, you'll make your life easier and your organization more profitable.

Let's define what we mean by your process. Your process consists of the machines, control systems and people used to transform raw materials into finished products. No matter what type of process you have, people make up a critical component, and the only way they can make good decisions is with good information.

Operating your process without the proper information is akin to a game of chance. Games of chance are fun and have their place, but more certainty is needed on the plant floor. So to reduce risk and add certainty to your process, your operators, maintenance people, supervisors and managers need good information.

Process information can be divided into two categories. The first category is information that flows into your process, and second is information that flows out of your process. Let's first look at why and how information flows into your process.

Quality Data In, Quality Products Out

The information that flows into a process tells an operator or supervisor what the process is supposed to do, how it's supposed to do it, and how much or how long it has to do it. Whether a plant is making a part, processing water or producing electricity—someone has to produce defined desired production data and communicate this data to plant personnel in order to run the process.

For example, a car part manufacturing plant might have work orders that tell production personnel what parts to produce and in what quantities. A water treatment plant could have set point values for various process parameters such as flow rates, pump speeds and tank levels. Process improvements can be realized by making this information correct, available and tightly controlled.

Recipes are an important part of manufacturing, and plants without data automation communicate recipe information to operators either verbally or on paper. Operators use this recipe information to adjust control system settings and parameters. Over time, each operator typically learns through experience and makes manual adjustments in an attempt to correct and improve operations.

These adjustments aren't the same from one operator to the next, and they often don't accomplish intended results. Data automation can reduce variability when using recipes, resulting in improved operations.

Manufacturing schedules are another area where data automation can improve processes. In many plants, schedules are created and maintained on a spreadsheet running on a PC, or maybe just on a whiteboard in an office or a control room.

In the first case, schedules are printed out and given to plant operators, a process fraught with potential sources of error. In the second case, the situation is even worse as operators need to manually copy data from the white board and take this data to the plant floor.

Automating recipe data transfer into the process control system removes the vagaries of operators' manual adjustments and allows for systematic process improvements. AutomationDirect hardware and software provide two ways to automate data transfers into the process.

Automating Data Transfers to the Process

The first way to automate the transfer of recipe, scheduling and other data into the process control system is via PC-based data management software products, such as DataWorx PLC Pro or P3K. Plant personnel can create, store and modify recipe and other data using DataWorx directly from PLC logic. Alternately, DataWorx can read recipe and other data directly from a database, managed by a separate system, or DataNet Enterprise running on a different computing system. In either case, this data can be transferred to the process controller, typically a PLC.

Managing recipe, scheduling and other data on a PC-based system located in a secure control room makes it easy to create and modify information, while also maintaining necessary levels of security. Values can't be changed without authorization, and changes can only be made at the PC. Any changes can be examined for effectiveness, and recipes and schedules can thereby be systematically modified and improved.

The second way to automate the transfer of recipe, scheduling and other data into the process control system is to use a C-*more* panel as the process control system HMI. The C-*more* panel's recipe functionality allows plant

Continued, p. 20>>

Feature Story cont.

Industrial Data Management

Continued from, p. 19

personnel to enter recipe and scheduling data at the HMI screen. This data can then be downloaded to the PLC.

This approach moves data management from the control room to the plant floor C-*more* panel. But, with the DataWorx control room centric approach, proper authorization is still needed to make changes typically controlled through password protection.

Communicating via DataNet Enterprise or DataNet Lite to a C-*more* panel and connecting the panel to a remote computing system allows recipes, scheduling and other parameters to be downloaded from a corporate database. This allows the C-*more* panel recipe, scheduling and other data to be modified at a management level, providing tighter control.

Measure It, Improve It

A first tenet of management is that it's necessary to measure performance before it can be improved. This is true not only for personnel management, but also for process control in a manufacturing facility.

There are many ways to control the information flowing from the process controller, typically a PLC, to the rest of the company. But the main goal is always the same—to provide accurate and timely information to the people who need it.

Transferring process data from the PLC to computing platforms such as PCs is typically referred to as data collection. Data collection is the process of preparing and collecting data for a variety of uses including, but not limited to, record keeping, reporting and creation of decision management tools.

Primarily, data is collected to provide information that will be used to make specific process improvements. The goal of data collection isn't to collect as much information as possible, but to instead collect useful and meaningful information on which to base sound business decisions.

Data collection can be separated into two areas: real time and historical. Real time data collection provides a snap shot of the process, which can range from a single alarm to a comprehensive graphical representation of multiple values. These process snapshots are typically displayed on HMIs such as a C-*more* panel, or a PC running supervisory control and data acquisition (SCADA) software.

Historical data collection is more complex and requires upfront analysis. In order to provide true process improvement, collected process data needs to be stored in a database. But before selecting a database and designing a data collection system, a process improvement plan needs to be developed.

This plan is defined by setting goals, and by determining key quality characteristics which need to be measured and controlled to meet these goals. Data to be collected is then identified, and a plan for analyzing these data and setting a course of corrective action is developed.

In order to set goals, the following questions need to be answered. Is there anything wrong with the process? Is there room for process improvement? What key quality characteristics of the process can be measured?

What kinds of metrics such as energy usage, percent downtime and raw material yields will we need to help us understand what's going on with the process? What raw process output data is needed to perform these metric calculations? Are the process controller and instrumentation in place to measure these parameters—or will we need to install electric meters, part counters or other components?

Other questions to be answered include where to find the data, and where to put the data after it's collected. It's also necessary to know who will need to look at the data, where they will be, and in what format the data should be displayed to them.

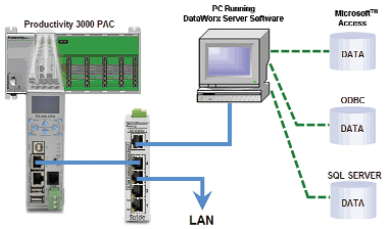
After answering these questions, baseline data will have to be collected before any changes are made to the process. An hypothesis can then be formed of what changes can be made to the process to make it better, focusing on key measurable quality characteristics.

Changes can then be made to the process based on the initial hypothesis, and data can be collected again. Following this procedure, and experimenting with different changes, will result in continuous process improvements – the goal of every manufacturing operation.

Collect Data More Easily

Rather than using large SCADA systems for data collection and reporting, many plants are implementing the use of HMI such as C-*more* panels or a PC running SCADA software as visualization tools. The primary function of these HMIs is to view and control the process, but a need still exists to provide a summary of real time and historical information to management.

This information can be provided via data collection, which allows summary lists of key information from machines or equipment in the process to be created and distributed. DataNet Lite and Enterprise provide an easy-to-use low-cost solution, both which can display real time data from PLCs, drives and other real-time controllers on Web-based screens that can be viewed by multiple people.



This real-time data can be displayed in a row and column format, typical of the way in which many management personnel like to see and review process data; values collected directly from the process.

It can also consist of real-time data combined with values such as standards and thresholds for each machine or production order. Another option is to set alarm and event values that can be emailed to key personnel.

To transfer data from a PLC to a

database, software such as DataWorx Pro or P3K, or DataNet Enterprise or Lite, can be used. The basic difference is that DataWorx pushes the data from the PLC to the database through ladder logic via report by exception. By contrast, DataNet polls the PLC for data, providing more information but causing more network traffic.

For example, a machine builder providing a turnkey solution to a customer might want to provide basic information, such as part counts that their customer could view and analyze with their own software. This can be accomplished with DataWorx PLC Standard, a software program that allows PLC ladder logic to write data in text file format to a PC running the DataWorx package.

DataWorx can then manage these text files, for example, by sending them to another PC via FTP or by archiving them. For remote systems accessible over a phone line, DataLynx allows users to dial each location on a periodic basis and store defined data into a text file.

If ladder logic wasn't used to program the PLC, then DataNet is probably the best tool. Once data has been collected with DataNet, it can be put into a spreadsheet, graph or chart for visual comparison against baseline data. Using this process, it often becomes clear which changes have made improvements to the process and which ones haven't.

Another good way to analyze process data is through reports and graphs created using DataNet Enterprise's reporting and graphing tool. These reports and graphs can be run on demand, or they can be set up to run automatically, and then emailed to key personnel.

Information management is of great value from the plant floor to upper management and all points in between. Using the right tools, data can be distributed to and collected from most any control system automatically and remotely. Data can then be distributed and accessed when and where it's needed most to improve the process.

About BizWareDirect

BizWareDirect is a software-development firm that specializes in industrial data collection, data management and reporting. Since 2003 we have offered software products that are affordable and easy-to-use. Every product in our software lineup is designed to make industrial data more useful and more accessible to employees and management throughout all areas and levels of the company.

Benefits of Automated Data Exchange

Data Transfer to the Process:

1. Eliminates manual errors
2. Provides recipe and scheduling records
3. Allows management control
4. Enables systematic process improvement

Data Transfer from the Process:

1. Provides data to management in usable formats
2. Provides event and alarm information to remote users
3. Enables data analysis
4. Enables systematic process improvement

"The good news about computers is that they do what you tell them to do. The bad news is that they do what you tell them to do."

– Ted Nelson

"It is the mark of an educated mind to be able to entertain a thought without accepting it."

– Aristotle

"I worked in a pet store and people would ask how big I would get."

– Rodney Dangerfield

Tech Brief cont.

Surge Protection by any other name

Continued from, p. 18

Other devices, such as transformers and power supplies, are not particularly vulnerable to transient voltage events. System designers should pay particular attention when designing systems that will operate in environments where inductive loads such as motors and contactors are turned on and off as part of normal operation or where variable frequency drives (VFDs) are being used, as this type of equipment is known to induce voltage spikes and other transients.

If you are already using Surge Protection Devices for your automation projects, make sure that you specify devices which meet or exceed the new standards. If you are retrofitting older equipment, make sure that you retire any selenium cells that may still be in use. Given the cost effective nature and multiple benefits offered by these newer SPDs, it would not be unreasonable to use SPDs in many applications to safeguard sensitive components and improve electrical safety.

"The good news about computers is that they do what you tell them to do. The bad news is that they do what you tell them to do."

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"I worked in a pet store and people would ask how big I would get."

– Rodney Dangerfield

Student Spotlight cont.

The Future of Technology

Continued from, p. 17

implementing the relays, we ran into some difficulty with the difference between sourcing and sinking, but we'll make sure that we never make that mistake again!

Q: You mentioned that your robot uses Mecanum wheels – as do many of the FIRST robots – can you briefly explain how they work?

A: A Mecanum wheel is a conventional wheel with a series of rollers attached to its circumference. Each roller has an axis of rotation that is 45° to the plane of the wheel and in a plane parallel to the axis of rotation of the wheel. As well as moving forward and backward like conventional wheels, they allow sideways movement by spinning the wheels of the front and rear axles in opposite directions. Vehicles with Mecanum wheels can move forward, backward, sideways, diagonally, turn about their axis, and perform various combinations of these movements at the same time.

Q: The MorTorq Robot has independent motors driving each of the four Mecanum wheels. What happens if one of these drive systems gets damaged during the competition?

A: Because of the nature of Mecanum wheels, the result of losing a driven wheel is a serious steering problem. If we lost a wheel, the robot would be nearly impossible to control due to the complex nature of the steering algorithm. One of the features we were able to implement with the touch screen was the ability to adapt for lost power at any wheel. With a simple touch of the screen, the algorithm is changed so that the three remaining wheels compensate by reducing or increasing their speed. The driver of the robot never notices a difference, aside from a slightly slower robot.

Q: Do you have plans to improve or reuse the application?

A: We do! In the future, we plan to use the exact same operator interface for the robots, each year adding to or improving its existing features. One of the benefits of using a touch panel over standard physical switches and buttons is that you're able to completely change the interface without modifying any hardware. Aside from the actual software changing, we plan on outfitting the case with Lexan and lights to add an extra "wow" factor. Other modifications we are considering include alternative joysticks, another touch panel, and a smaller, more compact carrying case.

Check out more about Team 1515 at their website: **http://bhrobotics.com/**

Learn more about FIRST Robotics at: **http://www.usfirst.org/**

"A lot of people are afraid of heights. Not me, I'm afraid of widths."

– Stephen Wright

"Information's pretty thin stuff unless mixed with experience. "

– Clarence Day

FYI
DC Motors

DC Motors Explained

By Joe Kimbrell,
AutomationDirect
Product Manager,
Drives, Motors, and Motion

IRONHORSE

How many types of DC motors are there?

There are several types of DC motors, including shunt, series, compound wound or stabilized shunt, permanent magnet, and brushless DC. The main differences between these types of motors revolve around how the electromagnetic fields are generated. The IronHorse DC motors are Permanent Magnet motors: the magnetic field in the stator is supplied by permanent magnets positioned just inside the frame of the motor. The magnetic field in the rotor is produced by the applied voltage.

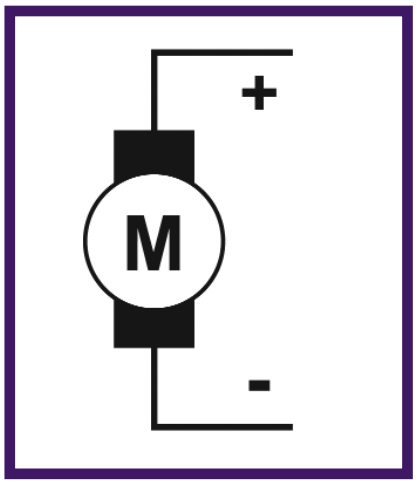

Figure 1, Permanent Magnet Motor

Permanent Magnet motors are simple to operate: there are only two wires to hook up. ***(Fig. 1)***

What are the key differences between AC and DC motors?

As with the different types of DC motors, the main difference between AC and DC motors centers around how the magnetic fields are generated. The rotor of a typical AC induction motor has no electrical connection. The rotor is influenced by the field generated by the stator, which is fed an AC voltage. A typical DC motor has a rotor with electrical connections through a brush and commutator arrangement. The brush/commutator acts as a switch which applies voltage to the different segments of the rotor. The field can also have either an electrical connection or can be composed of permanent magnets.

Why choose AC over DC?

A. AC motors and control have taken over many applications formerly driven by DC motors. One of the main reasons many people prefer AC to DC is that AC motors require less maintenance. While most motors require minimal maintenance, DC motors require an extra step of monitoring and replacing the internal brushes. While this step may be simple to perform on small motors, care must be taken on higher horsepower DC motors to correctly install motor brushes. On smaller (2HP or less) Permanent Magnet motors, the brush change-out can be accomplished in a matter of minutes.

Why choose DC over AC?

There are several reasons to choose DC motors over AC motors. High performance (especially at low speeds), high power density, simplicity of control, and a large installed base help determine applications for DC motors. DC motors develop full-load torque at low speeds ***(Fig. 2)***. This, combined with low inertias, result in excellent performance from DC motors. AC motors and controls have closed the performance gap, but general purpose DC motors still outperform general purpose AC motors. To obtain comparable low-speed performance from an AC motor, much more expensive AC drives and motors must be used (see DURApulse drives and BlackMax motors).

DC motors generally have much higher power density than AC motors. This allows a customer to use a physically smaller DC motor than the equivalent-HP AC motor. The control system for a DC motor is much simpler and less expensive than an equivalent AC drive.

An AC drive must rectify incoming AC power into a DC bus and then create its own AC voltage to send out to the motor. A DC drive rectifies the incoming AC waveform and passes that rectified power out to the DC motor.

While AC motors and controls have made large in-roads, DC motors have been around for 100 years and have been used extensively in almost all industrial applications. There is a large installed base of DC motors in the automation industry. Usually, replacing an existing DC motor with a new DC motor is much quicker, easier and economical than redesigning a control system to incorporate an AC motor and drive.

How do you power DC motors?

DC motors can be fed from a variety of DC power sources, even batteries. Typically, though, industrial DC motors are driven from DC drives. The quality of output power from different types of DC drives varies dramatically. This quality can be measured by how much ripple current is

Continued, p. 26>>

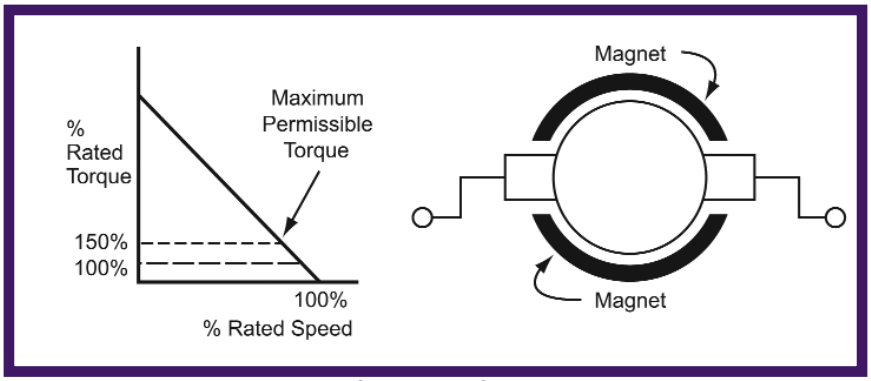

Figure 2, DC Motor Torque Characteristics

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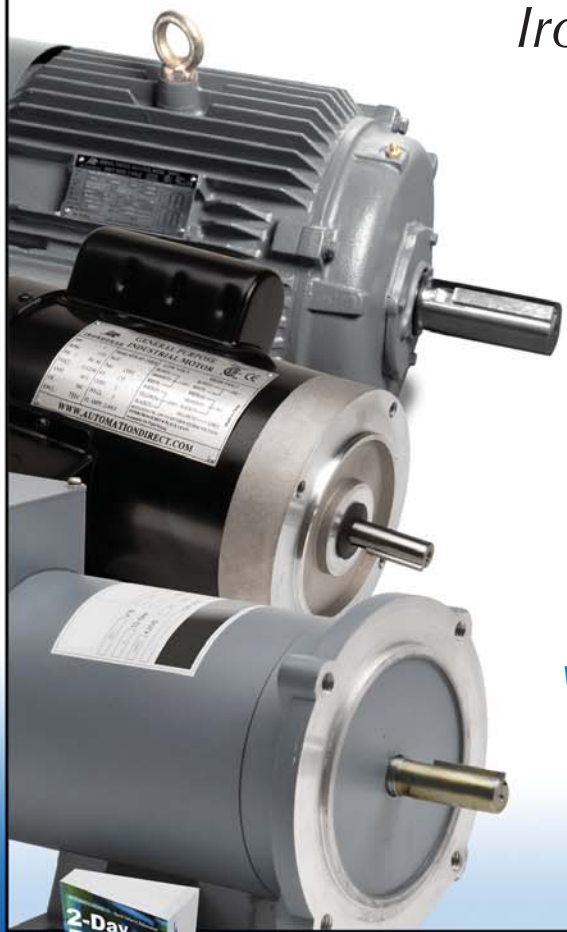

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Continued from, p. 24

Form Factor Table	
Form factor	***DC voltage source***
1.0	Battery (pure DC)
1.05	Pulse width modulation (PWM)
1.35	Full wave rectification (single phase)*
1.9	Half wave rectification (single phase)**

*Single phase full wave rectification is the most common form of DC drive in .33 to 2 hp range.
** Not Recommended

Figure 3, Form Factor Table

produced by the drive. The ripple current is designated by a drive's Form Factor, which is the relationship of the ripple current to the main DC current. High ripple current results in increased motor heating and possibly premature brush failure.

A battery is considered the ideal current source, which has a current Form Factor of 1.0. With a battery, there is a constant voltage (and current) to power the motor. A Pulse Width Modulated (PWM) DC drive emulates pure DC so well, that it generally produces a Form Factor of 1.05 (only 5% ripple) ***(Fig. 3)***.

One of the more common drives for small horsepower DC motors is the Single-Phase Full-Wave Rectified DC Drive. This drive takes an AC voltage and passes the positive half of the wave and rectifies the negative part of the wave to produce a waveform with a Form Factor of 1.4 (40% current ripple). These drives are commonly referred to as SCR (Silicon Controlled Rectifier) drives. IronHorse DC motors are "SCR-rated", meaning their full load torque and power are produced when using an SCR drive.

Another type of drive has a much worse Form Factor: Single-Phase Half-Wave Rectified DC drives. These drives only pass the positive half of the AC sine wave. These drives have a form factor of 1.9 and are not recommended for use with many DC motors (including IronHorse).

What is the maintenance for a DC motor?

DC motor maintenance follows basic AC motor maintenance standards (keep the motor and fan clean, grease the bearings if non-sealed, etc). DC motors have one extra step: brush maintenance. The general rule of thumb is to replace the brushes once they reach 1/3 of their original length. For IronHorse Permanent Magnet DC motors, we recommend replacing the brushes every 2,500 hours of use. This will ensure that the brushes are always within spec. We ship an extra set of brushes with each IronHorse DC motor and also offer additional brush sets on our Web site.

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Business Notes

From robots …

Forsyth County, Georgia's robotics program completed its fifth season with growth reaching hundreds more students. The Forsyth Alliance, an umbrella organization formed to administer funds donated by AutomationDirect, managed the county's FIRST (For Inspiration and Recognition of Science and Technology) involvement, which includes over 35 Lego League teams in elementary schools, as well as the advanced high-school level FRC team. Six Forsyth Lego League teams advanced to the Georgia State Championship, where the final top five out of 48 teams included three of those teams - the Brick Busters were 2nd Place Champions, Team Super Awesome were 3rd Place Champions, and Crash Test Smarties received 3rd place in robot performance.

This past season, the Alliance expanded its support to include the BEST and VEX competitions as well. The VEX program in particular has become very popular since entry fees and kit of parts costs are significantly less than the FRC program ***(Fig.1)***. County VEX teams won seven regional tournaments, and nine Forsyth teams (out of 22 teams sent from the Georgia/Florida region) qualified to attend the World Championships in Dallas in late April, one of whom had won the Georgia state competition (West Forsyth High). Three of North Forsyth High's teams garnered a "Cooperate" award at the World Championship finals, celebrating extraordinary teamwork.

One interesting note for this year is that Forsyth Alliance board chairman Rick Folea has the lead on writing the requirements for a planned Robotics Merit Badge for the Boy Scouts of America. An enthusiastic Forsyth Board of Education member said, when learning of the news, "How can I start working on my badge?!"

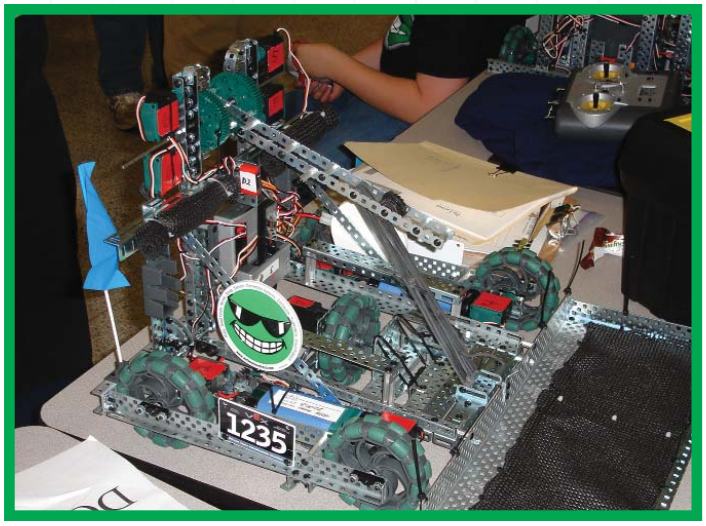

Figure 1, 2010 Season VEX Robot

… to rockets!

AutomationDirect has gotten into the air as well, with sponsorship of rocketry teams at local high schools. The Team America Rocketry Challenge (TARC) is the world's largest rocket contest, sponsored by the Aerospace Industries Association (AIA) and the National Association of Rocketry (NAR). According to the TARC Web site, "Approximately 7,000 students from across the nation compete in TARC each year. Teams design, build and fly a model rocket that reaches a specific altitude and duration determined by a set of rules developed each year. The top 100 teams, based on local qualification flights, are invited to Washington, DC, in May for the national finals. Prizes include $60,000 in cash and scholarships split between the top 10 finishers. NASA invites top teams to participate in their Student Launch Initiative, an advanced rocketry program."

For the 2008-2009 season, the South Forsyth High group, sponsored in part by AutomationDirect, was the lone Georgia representative at the National Championship in May 2009. The South Forsyth kids attained the best score in the history of TARC (Team America Rocketry Challenge) and sat in first place in the nation after the first round. Unfortunately, the second launch didn't go as well, so it knocked them down to 11th place in the final standings.

For the 2009-2010 season, the contest guidelines required students to build a rocket that would:

- reach 825 feet in altitude
- have a hang time of 40-45 seconds
- bring a raw egg up and back safely
- use streamers as a recovery device (no parachutes)

The contest started in November with 669 teams vying for the top prize nationwide. This year AutomationDirect assisted the fledgeling Lambert High Rocketry Team, who successfully qualified for the National Finals with an 830-foot flight that lasted 42.23 seconds. At the May 15th-16th Finals in Manassas, Virginia, the top 100 qualifying teams got a single launch, and the top 20 earned their way into the final "flyoff" for the championship. The Lambert team placed 14th going into that final round, a great achievement for a first-year program. Due to a slight technical difficulty (torn streamer) in the final round, they finished in 16th place overall, and were the top finisher among Georgia schools.

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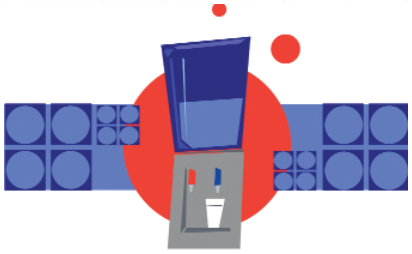
The Break Room

Brainteasers & Humor



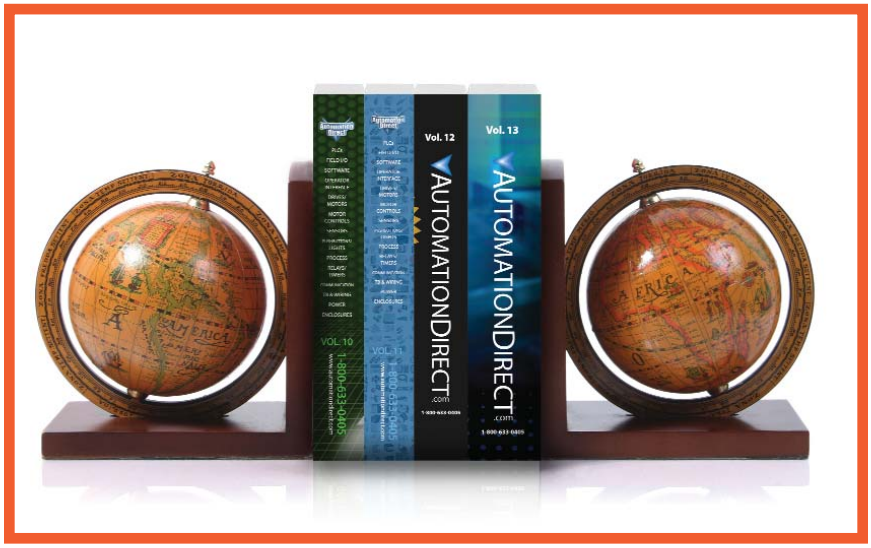
BrainTeasers

Top cat? Top dog?

1.) *The combined weight of the factory's resident dog and cat is 27 lbs. The dog's weight is an odd number, yet the cat's is even. If his weight is twice that of hers, what do each of them weigh?*

Bookworm

2.) The AutomationDirect Catalog has gotten thicker each time we've printed it. Volume 10 was approximately 1.5" thick (including the cover) and the volumes have increased in size an average of 1/4" each issue. *If the volumes were arranged on the shelf as shown below, and a bookworm started at the first page of volume 10 and ate his way straight to the last page of volume 13, how far would he have traveled?* You can assume that the thickness of the covers is 1/16" for all the catalogs.



Three Color Techs

3.) Three technicians: Mr. Black, Mr. Blue, and Mr. Red were wiring a control panel, and each was using only a single color of wire: one black, one blue, and one red.

"Have you noticed that none of us is using the color of wire that corresponds to our own name?" asked the man using the red wire.

"You're absolutely right!" replied Mr. Blue

What color of wire was each man using?

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– John Greenleaf Whittier

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– Bill Vaughan

"A joke is a very serious thing. "

– Winston Churchill

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2 hp, 180V	$335.00 MTPM-002-1M18	$2,242.00 CDP3585	$1,217.00 4Z380 (not 56C)	$2,301.00 G644 (1.5 hp, not 56C)

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