Your guide to practical products, technologies and applications

Automation NOTEBOOK™

Autumn 2004 Issue 2

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Automation NOTEBOOK™

Your guide to practical products, technologies and applications

Contributors

Publisher Tina Crowe

Managing Editor Keri Schieber

Senior Editor Jennifer Gerborg

Design Manager Justin Stegall

Contributing Writers

Frances Richards
Paul Ruland
Wayne Labs
Richard Palmer
Tom Matyas
Gary Multer
Lynn Mitchell
Andy Feimser

CONTACTS

Automationdirect.com Inc.
3505 Hutchinson Road
Cumming, GA 30040

Phone 1-800-633-0405
or 1-770-889-2858
Fax 1-770-889-7876

Monday - Friday
9 a.m. to 6:00 p.m. EST

www.automationdirect.com

Editor's Note

We were so pleased with the responses we received from our readers that we just had to do it again. You have been telling us how much you enjoyed the technical articles in the magazine, so we've tried to bring you information that's helpful and relevant.

As we started pulling together material for this publication, we noticed a trend: many of the articles were focused on power. I'm sure we all remember the power grid outage last year in the Northeast. We asked guest writer Frances Richards to report on the industry's progress since the blackout and where the strategy for power resources is headed in the future. We also have a power-related article on high efficiency AC motors and drives and another that covers commonly asked questions about control transformers.

And we hope you will browse the automationnotebook.com Web site. We will be updating the site frequently to discuss company, industry and product news, and we'll be inviting you to join in the conversation soon.

We hope you will enjoy this issue as much as we enjoyed putting it together for you.

Keri Schieber
Managing Editor
editor@automationnotebook.com

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New *Sure*Step™ stepping system features high performance and torque, with simple and accurate control

by Jennifer Gerborg
Senior Editor

AutomationDirect has launched the *Sure*Step family of products, a new open-loop stepping system that provides simple and accurate control of position and speed and offers a great solution for applications requiring lower power and low cost.

The *Sure*Step family includes four standard motors and a "one-size-fits-all" step motor drive. With holding torques from 83 oz-inch to 434 oz-inch in NEMA size 17, 23 or 34 frames, the motors handle a wide range of automation applications, including woodworking, assembly and test machines. The motors also feature 2.8 A per phase while their square frame style produces high torque and allows the motors to achieve the best torque-to-volume ratio. All four motors are connectorized for easy hookup.

A 20-foot extension cable with locking connector is a standard option to interface the *Sure*Step motors to the 2-phase microstepping drive. The cable can easily be cut to length if needed. The drive operates all of the four standard motors and features standard +5 VDC optically isolated logic inputs for interfacing with DirectLOGIC PLCs.

The *Sure*Step microstepping drive incorporates a 9-position DIP switch to set up the drive parameters; no software or add-on resistors are required for configuration. The DIP switches are used for built-in self test, step angle selection, current level selection and optional idle current reduction.

Step pulses and direction signals from the DirectLOGIC PLCs or other indexers and motion controllers are "translated" by the microstepping motor drive into precise movements of the stepping motor shaft. The 2-phase bipolar motors have 200 full steps per revolution or 1.8 degrees per full step. Older type stepping motor drives, which operate stepping motors in full step mode, can result in stalling or lost motion due to the potential for problems with low-speed mechanical vibration. To minimize these types of problems, the *Sure*Step microstepping drive uses advanced microstepping technology with selectable step sizes of 400 steps per revolution (divide by 2), 1,000 steps per revolution (divide by 5), 2,000 steps per revolution (divide by 10) and 10,000 steps per revolution (divide by 50).

A standard 32 VDC, 4-amp power supply completes the *Sure*Step line. The power supply operates at least two *Sure*Step stepping systems of any size with an auxiliary +5 VDC regulated supply to facilitate DirectLOGIC PLCs and stepping motor drive interfaces.

Prices for the new *Sure*Step motors range from $19 to $99. The *Sure*Step microstepping drive is priced at $149 and the power supply is $99.

Sure step™

For more information on the new *Sure*Step line of products, visit www.automationdirect.com.

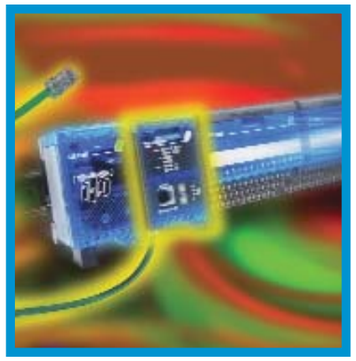
"One machine can do the work of fifty ordinary men. No machine can do the work of one extraordinary man."

- Elbert Hubbard (1856-1915)

Product Snapshots

Press Releases

New module provides high-performance, low-cost Ethernet link



Cumming, GA --- August 15, 2004

---The new T1H-EBC100 module provides a high-performance Ethernet link between Terminator I/O and any connected client hardware or software system for applications in PC Control, PLC Remote I/O, or data acquisition. Terminator I/O is a distributed Field I/O system that combines the I/O points with their terminal blocks into a modular package to save cost and panel space.

The T1H-EBC100 module supports TCP/IP, UDP/IP, DHCP, and IPX at 10/100 Mbps. It also supports MODBUS TCP/IP protocol, the most widely used open protocol in industrial manufacturing.

The module can be configured using an Internet browser to access the module's HTML configuration page, or with NetEdit, a free Windows Software configuration utility.

The module supports the full lineup of Terminator I/O discrete, analog, and motion control modules. It is priced at $249.

Non-metal models added to growing enclosure line

Cumming, GA --- July 15, 2004

---Several non-metallic enclosure models have been added to AutomationDirect's line of enclosures. Premier series enclosures are available in opaque, hinged cover models with pull latches or screw covers, as well as clear hinged models with screw covers or link lock latches. Prices start at $32.00.

Junction box enclosure models are also available. Slimline series junction boxes carry a NEMA 4X rating and are priced starting at $16.00.

New pushbutton enclosures for 22 or 30 mm size pushbuttons feature lift-

off covers with up to seven pushbutton cutouts. The 30 mm multi-hole units are also available with 4, 6, 9, 12, 16, 20 or 25 cutouts. Prices start at $18.00.

JIC series enclosures are available in opaque lift-off cover models with four screws; opaque, hinged covers with two screws; opaque hinged covers with quick release latches; hinged covers with link-lock latches and windows; and hinged covers with quick-release latches and windows. Prices start at $24.00.

New 3R or 4X control series units are also available with prices starting at $189.00.

Carbon steel, fiberglass, stainless steel and aluminum subpanels, as well as a line of accessories, round out the new non-metal enclosure offering.

Marathon Motors line extended

Cumming, GA --- August 15, 2004

---The Blue Max® 2000 series of Marathon motors is now available with a shaft-mounted encoder. The encoder is a Dynapar model HS35 and requires a 5-26 VDC power source. It has a line count of 1024 pulses per revolution (PPR) and a differential line driver output. A 10-pin connector is supplied

with the TEFC models and a junction box is provided with the TEBC models.

Also new are lower horsepower versions of Marathon Blue Chip XRI® motors. The Blue Chip XRI motor line previously included 40-100 HP models and is now available in 15, 20, 25 and 30 HP versions. New lower HP Blue Chip XRI models start at $839.

2-pole models added to supplementary protectors line

Cumming, GA --- August 15, 2004

---2-pole versions of the Cutler-Hammer WMS line of supplementary protectors are now offered, in addition to existing 3-pole and 1-pole models. The 2-pole protectors are available in models ranging from 6- 60 amps and are priced at $14.

WMS Series protectors are UL1077 recognized for applications where branch circuit protection is not required or is already provided. The

thermal magnetic devices protect against short circuit and overload conditions.

50 and 75 VA control transformers added to offering

Cumming, GA --- August 15, 2004

---Two new models have been added to the existing CPT line of control transformers. The 50 and 75 VA models offer primary and secondary fuse boxes and

230/460 to 115 V. The control transformers are UL, CSA and CE listed and are priced at $36 (50 VA model) and $41 (75 VA model).

"I find that a great part of information I have was acquired by looking up something and finding something else on the way."

- Franklin P. Adams (1881-1960)

New Product Request

AutomationDirect is actively adding new products so it can become your one-stop shop for industrial automation components. We welcome your input; we recently introduced wire duct and non-metal enclosures largely in response to customer requests.

If you have suggestions, please feel free to jot down the info requested below and fax to 770-844-4212. (If you need to review our current product offering, the best way to do it is to visit www.automationdirect.com and click on the Site Map link at the bottom of the home page.)

Product Request

Name_____

Company_____

Type of Business: End user OEM Integrator Other

Product Suggestions:

_____

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Cover Story

Modernizing America's Electric System

After the Blackout

by Frances Richards,
Freelance Writer

Where were you on August 14, 2003? If you live somewhere other than the Northeast or Midwest, the date of North America's largest blackout may not be familiar to you. I was working on my home computer, while my spouse was engrossed in vacuuming our cars. When everything came to a flickering halt, I immediately blamed him for overloading our touchy circuit breakers. It soon dawned on us that something drastic had occurred. From our car radio, we heard reports of power outages in major cities across the U.S. and Canada. Confusion set in, not to mention a bit of panic. Could terrorists have coordinated this massive blackout? Fortunately, not this time.

In the weeks and months that followed, causes were determined and many recommendations set forth. Where are we one year later and what opportunity does this represent for our country's technical elite, including engineers and systems integrators? Good news on both fronts. Many plans and visions are in place and - better yet - opportunity abounds for those who get to know the grid.

Grid 101

America's electric system (aka "the grid") has been hailed as "the supreme engineering achievement of the 20th century" by The National Academy of Sciences. According to the U.S. Department of Energy (DOE) and its new Office of Electric Transmission and Distribution (OETD), each day more than 10,000 power plants deliver electricity over 157,000 miles of high-voltage electric transmission lines to 131 million customers. The U.S. spends $247 billion on electricity each year and the grid's total asset value is estimated at $800 billion.

According to industry experts, including OETD, the grid is "reaching the limit of its ability to meet the nation's electricity needs." While the country is moving quickly into the digital

information age - increasing its need for reliable electricity - the electro-mechanical grid is aging. The existing infrastructure of wires, transformers, substations and switchyards has been in place for 25 years or more. According to OETD, a number of factors are impacting grid performance, including aging equipment, transmission bottlenecks, deregulation, and regulatory change. These factors have combined to discourage private sector investment in grid upgrade, especially regarding new transmission and distribution technologies.

Why is it so difficult to reliably operate the grid? First, electricity flows at nearly the speed of light and is not able to be stored in large quantities, economically speaking. It must be produced the moment it is used. Second, without expensive control devices, AC current flow can't be regulated like a liquid or gas. So, it flows freely on all available paths according to the laws of physics. These two factors make reliability a complex challenge.

In order to ensure reliability, NERC (North American Electric Reliability Council) and its 10 regional reliability councils focus on standards that address seven main areas: balance power generation and demand continuously; balance reactive power supply and demand to maintain scheduled voltages; monitor flows over transmission lines and other facilities to ensure that thermal limits are not exceeded; keep the system in a stable condition; operate the system so that it remains in a reliable condition even if a contingency occurs; plan, design, and maintain the system to operate reliably; and prepare for emergencies.

August 14 Revisited

What happened on August 14, 2003, to cause the widespread power outage? To find answers, President George W. Bush and then-Prime Minister Jean Chrétien established a joint U.S.–Canada Power System Outage Task Force. An interim report was published in November 2003, with a final report issued April 5, 2004. The task force investigated the outage to determine its causes and developed 46 recommendations to minimize the possibility of future outages.

According to the report, the blackout could have been prevented. The outage affected approximately 50 million people and 70,000 megawatts (MW) of electric load in Ohio, Michigan, Pennsylvania, New Jersey, New York, Connecticut, Vermont, Massachusetts, and the Canadian provinces of Ontario and Québec. It started a few minutes after 4 p.m. Eastern Daylight Time and lasted four days in some areas, with a total cost estimated between $4 billion and $10 billion. Key parties included FirstEnergy Corp. (FE), American Electric Power (AEP), and their respective reliability coordinators, Midwest Independent System Operator (MISO), and PJM Interconnection (PJM). Causes of the blackout are grouped into four main areas within the report.

Group 1 is summed up as "inadequate system planning." This refers to the failure of FE and the East Central Area Reliability Coordination Agreement (ECAR) to assess and understand the shortcomings of FE's system, especially its voltage instability and the vulnerability of the Cleveland/Akron area. The report concludes, "FE did not operate its system with appropriate voltage criteria." Group 2 is summed up as "inadequate situational awareness." FE didn't recognize or understand the deteriorating condition of its system. Group 3 involved "inadequate tree trimming." Group 4 centered around "inadequate RC (reliability coordinator) diagnostic support." This refers to the failure of the interconnected grid's reliability organizations to provide "effective real-time diagnostic support."

Specific causes of the cascading blackout fall into one of these four groups. To enjoy the full report, grab a cup of coffee and visit www.electricity.doe.gov. Click on "Blackout" at the top of the page.

Grid Progress, Fast Forward One Year

Many of the immediate concerns addressed in the final report have been corrected, a large number of them by FirstEnergy. Mark Durbin, spokesman for FE, says, "We've looked at four main areas, including voltage criteria and reactive resources, operational preparedness and action plans, emergency preparedness, and operator training. In addition, we've worked closely with technical teams from NERC to ensure we comply with their readiness audits." Durbin also notes that FE has established procedures and processes to operate more conservatively, installed new computer systems in its Ohio and Pennsylvania control centers, enhanced monitoring capabilities, enhanced operator training, and increased its vegetation management. "We've foot-patrolled all 11,000 miles of our high-voltage transmission lines and have cleared any potential problem trees. Easement rights are also being enforced to assure adequate clearances."

20 Hours before blackout, 8/14/03 - satellite image courtesy of NOAA/DMSP

7 Hours after blackout, 8/15/03 - satellite image courtesy of NOAA/DMSP

Beyond these immediate issues, NERC is working closely with FERC (Federal Energy Regulatory Commission) on two broad audit areas across the country, according to David Meyer, senior advisor for the Office of Electric Transmission and Distribution (OETD). "NERC and FERC are focusing on compliance audits, which deal with alleged violations, and readiness audits that are forward looking. Between February and June of this year, these two agencies audited 20 of the largest energy-related entities east of the Rockies," says Meyer. An estimated 50 readiness audits will be completed by the end of 2004.

Meyer also notes that the DOE is working closely with its Canadian counterparts to establish an Electric Reliability Organization (ERO), which hopes to give well-defined direction and oversight to the entire North American transmission network. According to Meyer and other industry and government spokespersons, the most important issue is to make reliability standards mandatory and enforceable, with penalties for noncompliance. The U.S. Congress must enact these reliability provisions to make them stick with industry, something many folks both in and out of government have wanted for years.

"We need legislation," says Meyer, "but we have other things in place to work with until legislation gets approved. NERC is in the process of restating its reliability standards in a more specific form, making them easier to follow and enforce. Final approval of these new standards is expected in 2005." Other standards are also in development, according to Meyer. These include national guidelines for vegetation management as well as real-time operating tools that will allow for wide area visualization and give earlier warnings about arising problems.

Grid of the Future

Moving from an aging electro-mechanical grid to a fully automated, electronically controlled system that supplies affordable, clean and efficient energy sounds like a dream. Yet, little by little, with advances in technology and the right people to install it, the grid will slowly morph into its future self. OETD's vision of the new system, called Grid 2030, "envisions a fully automated power delivery network that monitors and controls every customer and node, ensuring two-way flow of information and electricity between the power plant and the appliance, and all points in between. The grid will use distributed intelligence, broadband communications and automated control systems to enable real-time market transactions and seamless interfaces among people, buildings, industrial plants, generation facilities, and the electric network."

EPRI (Electric Power Research Institute) shares a similar vision. Its "21st Century Transformation" aims to stabilize electricity markets, provide for the public good, protect the environment, educate and empower consumers, and unleash technical innovation. EPRI sees a "trilemma" of economics, politics, and technology that needs to be synchronized

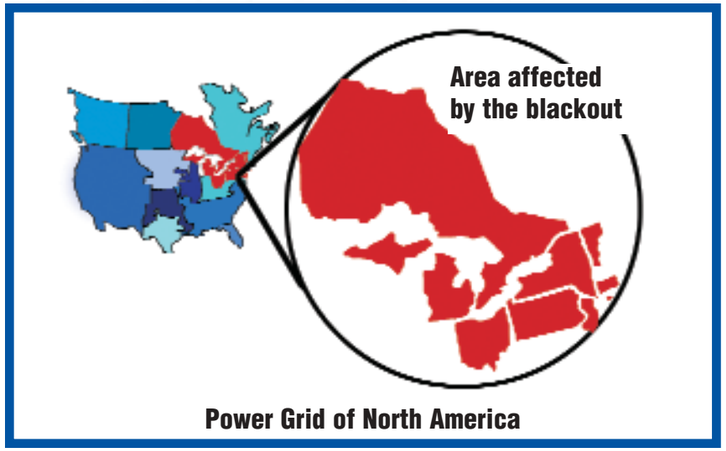
Cover Story

Modernizing America's Electric System continued

in order for progress to go forward. No one can solve the trilemma alone, according to EPRI, and no simple solution exists.

Further, a joint statement issued July 20 by EPRI and the National Council for Advanced Manufacturing, reports, "Currently, the electricity sector is laboring under an inconsistent and conflicting set of federal and state rules and a highly uncertain regulatory framework. Due to this regulatory ambiguity, most utility companies have limited their investments until the market structure is more clearly understood. Magnifying this lack of investment is the fact that the pressures of cost containment have essentially stifled and deferred needed infrastructure investment for at least two decades." The statement encourages both the Bush and Kerry presidential campaigns to include modernizing the electricity infrastructure as a top priority.

The technology portion of grid transformation depends on developing innovations that "enable digital control of the power delivery network, integrated electricity and communications for the user, transformation of the meter into a two-way energy/information portal, integration of distributed energy resources into the network, and a robust advanced power generation portfolio, including coal refining," according to EPRI. How much will it cost? A rough estimate calls for $100 billion in public and private investment over the next 10 years. Benefits are expected to outweigh costs by a 10-1 ratio, says EPRI.



Engineers, Systems Integrators Weigh In

Engineers and systems integrators working in the field have their own views on what's happening with regard to modernizing the grid. Steve Drouilhet, president and founder of Sustainable Automation LLC, Boulder, CO., designs and manufactures controllers for individual power system components and supervisory controllers for complete distributed power systems, particularly those incorporating wind energy. The company also provides custom control solutions for a variety of industrial manufacturing and process control applications.

Drouilhet says that distributed generation, such as customer-owned wind turbines and natural gas fueled engine generator sets, is already cost-effective in many cases. In addition, distributed generation could make the power grid more robust. "The problem is that many utility companies see distributed generation as a threat, so they require costly interconnection studies and impose exorbitant standby charges, which are unfortunately often approved by public utility regulatory commissions. The result is far fewer distributed power systems than there could be," he says. Drouilhet adds that the situation varies from state to state, utility to utility.

"Progress is being made in renewable energy, and if the inhibiting factors were removed, results would appear even faster," he adds. Small victories are indeed taking place. As reported in the August 6 issue of Wind Energy Weekly, The Massachusetts Department of Telecommunications and Energy issued an order approving a settlement with NSTAR Electric that exempts renewable energy facilities from standby charges.

Andy Feimster, a systems integrator at North Fork Electric, Crumpler, NC., also works in the power and utility industry. He acknowledges the difficulty of working with today's grid. "The complexity of the system is such that no single human being can truly understand it. It's grown almost organically," he says. The effects of deregulation have served to further confuse the situation. Feimster notes, "There are opportunities for integrators to provide systems and services to electric utilities, but it can be very complicated. Utilities are brokering power all over the place, and systems are being interconnected in ways they never have been, ways they were never designed for."

Feimster believes the evolving grid may offer some opportunities for engineers and systems integrators. He notes that the line between industrial grade equipment and utility grade equipment is beginning to blur. In many cases, he says, the industrial grade has become advanced and reliable enough to be specified into power and utility work. "If these products are suitable for use in chemical plants that have life and death consequences for malfunctions, then surely they are reliable enough for utility applications," he adds. *(see application story on page 20 that details North Fork Electric's hydrolectric plant upgrade for Lockhart Power.)*

Industrial grade components such as Windows-based computers, PLCs, and DCS equipment are serviceable by a wide group of experts and consultants, good news for those hoping to work in the utility market as well as for the utilities who are looking for more reliable and cost effective solutions. Feimster feels that the grid will have to make further moves in the direction of fully automated controls as well. "These systems must become fully automated and remotely monitored. Humans have the capacity to do only so many things at once, not to mention the fact that problems can occur within fractions of a second and originate from hundreds of miles away," he says.

Opportunity Abounds

Modernizing the grid is going to require huge investments of time, money and technical talent. Engineers and systems integrators will no doubt play an important role in modernization. David Meyer of OETD says, "Technical experts need to do everything they can to find out what's going on in their geographic region. Regional transmission planning is a critical part of the solution. Regionally, where do we need new capacity? What are the relevant technologies? Getting information from the appropriate RTO (regional transmission organization) is a good first step," advises Meyer.

Clark Gellings, vice president of power delivery and markets for EPRI, also sees a need for talented engineers. "The number of power engineering graduates continues to decline, as have the number of new engineers being hired and groomed by utilities. Recent events have not yet changed this. In the meantime, corporate cost reductions have often forced the oldest and most knowledgeable engineers out of utilities. We see a real problem looming. Second, regarding the skilled workers or trades, they're definitely graying and departing with knowledge that cannot be replaced. The current focus here is on knowledge capture, using various means to record undocumented worker knowledge," says Gellings. All of this bodes well for technical experts. Utilities that have slashed their engineering departments need knowledgeable consultants - such as engineers and systems integrators - to fill the gap.

Another area of opportunity is the need to diversify the grid's energy supply. FERC, in support of new rules for integrating wind energy into the grid, says, "Encouraging the development of intermittent generation will increase diversity in the resource base, thereby improving system reliability as a whole." The Union of Concerned Scientists supports this view as well. "A renewable electricity standard requiring utilities to increase their use of renewable electricity from a mere 2 percent today to at least 10 percent by 2020 was one of the few positive provisions in the energy bill recently passed by the Senate," says the group.

The bottom line? The North American power grid cannot be offshored, as many jobs and factories have been. If engineers and systems integrators do their homework - get familiar with regional planning, emerging technologies, and renewable electricity resources - they may find themselves dancing the Electric Slide all the way to the bank.

Names to Know

DOE - U.S. Department of Energy

www.doe.gov

The DOE's "Energy Strategic Goal" is to protect our national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy.

OETD - Office of Electric Transmission and Distribution

www.electricity.doe.gov

OETD is a new DOE program office formed to help ensure a robust and reliable U.S. transmission grid for the 21st century. Its mission is to lead a national effort to help modernize and expand America's electric delivery system.

FERC - Federal Energy Regulatory Commission

www.ferc.gov

FERC regulates and oversees energy industries in the economic and environmental interest of the American public.

NERC - North American Electric Reliability Council

www.nerc.com

NERC's mission is to ensure that the bulk electric system in North America is reliable, adequate and secure. Its members include 10 regional reliability councils.

EEI - Edison Electric Institute

www.eei.org

EEI is the premier trade association for U.S. shareholder-owned electric companies.

EIA - U.S. Energy Information Administration

www.eia.doe.gov

EIA is the government's energy statistical agency. View its report, "The Changing Structure of the Electric Power Industry 2000: An Update".

EPRI - Electric Power Research Institute

www.epri.com

EPRI is a nonprofit research consortium for the benefit of utility members, their customers and society.

About Frances Richards

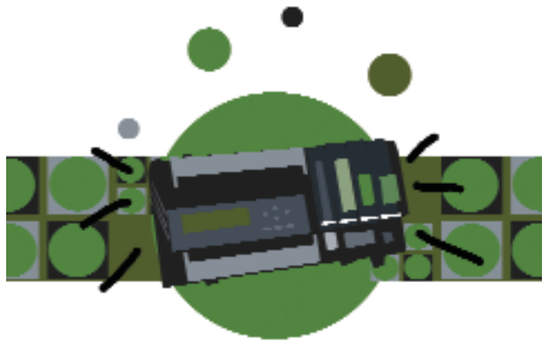
Frances Richards is a freelance writer based in Chagrin Falls, Ohio. A former editor of several design engineering magazines, Richards now writes about energy efficiency and a variety of technical topics from the comfort of her own home.

"Man's mind, once stretched by a new idea, never regains its original dimensions."

- Oliver Wendell Holmes (1809- 1894)

PLC Speaking

Let's talk PLCs



PLC Technology and Application Tips

by Paul Ruland,
AutomationDirect Product Manager
PLC, I/O and PC-Controls Group

Over the past ten years, AutomationDirect, formerly PLCDirect, has provided PLC (Programmable Logic Controller) products in many shapes, sizes, and I/O counts, and with a wide variety of features. Since PLCs were the products on which this company was founded, it is only natural to devote a column on the subject of PLCs in the new Automation Notebook. So, welcome to the first installment of "PLC Speaking", where we will share AutomationDirect's insight into PLC technology and pass along helpful application tips from our customers.

PLCs have traditionally suffered from the stereotypical complex of "bigger must be better". However, in the last five to seven years, smaller PLCs in the nano and micro classes have been introduced that have significantly improved capabilities previously found only in larger PLCs. The need to specify a large PLC just for additional features or performance, and not the increased I/O count, is now no longer necessary. Even the smallest I/O count nano PLCs are capable of Ethernet communication, motion control, on-board PID with autotune, remote connectivity and more.

This recent increase in PLC capabilities, found in much smaller packages, has allowed the application of PLCs to go well beyond simple on/off sequential control. Modern PLCs have the ability to perform functions of process control, motion control, data acquisition, RTU (remote telemetry unit) and even some integrated HMI (human machine interface) functions, all in one programmable controller. Previously, each of these functions often required its own purpose-built controller and software, plus a separate PLC for the discrete control and interlocking. For example, the DL06 micro-brick PLC can be a great alternative for a process application that would normally combine a PLC with one or multiple single loop controllers or temperature controllers. By installing either temperature or analog I/O cards into any of the four available DL06 option card slots, and taking advantage of the snap-in LCD display and PID loops built into the CPU, this application can be accomplished with just the PLC and its connected devices. Add an Ethernet module and the PLC can also double as a data acquisition node providing connectivity to any larger plant LAN or WAN information system. Connect a dial-up modem to the secondary serial port and this PLC can be the controller for an RTU as part of a large SCADA system. And, if your application requires motion control, use the integrated high speed I/O to connect a simple stepper system, or install a high-speed counter/pulse output module connected to a servo drive to accomplish a variety of open-loop motion control applications.

Many of these capabilities can be found in new PLCs from most of the PLC vendors around the world. PLC users benefit greatly from increased performance and scalable control capabilities; there are fewer controllers and control programs to maintain, and programs can be reused for multiple applications. This allows quicker installation and easier service of PLC systems, resulting in significant savings in the initial capital expense of hardware and software, and savings in engineering time for system integrators, OEMs, and the end users they serve.

In the next installment of PLC Speaking we will explore the changes in traditional and non-traditional PLC applications that these new lower cost and feature rich PLCs are accomplishing. For this topic, AutomationDirect has a customer survey on PLCs we'd like you to participate in (see www.automationnotebook.com/plc_survey). Questions will be centered around the most popular PLC applications of today, and the fastest growing newer PLC applications being brought to market. If your company uses PLCs, or is planning to use PLCs, complete this online survey and be entered in a drawing to win one of five BOSE Wave® radios.

I hope you enjoyed this first talk on PLCs and look forward to your survey answers so we may "Speak PLCs" with you again.

Metcalfe's theory states that the power of a network increases by the square of the number of nodes connected to it. For example, where X is the number of nodes, the power of the network is X squared.

Metcalfe observed that new technologies are valuable only when large numbers of people use them.

-Robert Metcalfe (inventor of Ethernet and founder of 3Com Corp.)

Business Notes

Goings On in the Automation Industry

AutomationDirect switches Web seminar hosting service

To improve service both internally and to seminar attendees, AutomationDirect is switching their Web seminar hosting service from Webex to Raindance, effective September 1st. For past seminar attendees who may have bookmarked the seminar landing page in their Internet browser, the new address is http://automationdirect.raindance.com. A link to the current live seminar schedule and registration, as well as a list of pre-recorded seminars available for download, is always available on the home page of www.automationdirect.com.

Durapulse.com Web site focuses on AC drives

With the Internet becoming an increasingly valuable tool for engineers to do research, automation suppliers are taking advantage of new technologies to present product information in more informative and interactive ways. A case in point is AutomationDirect's new Web site focused on AC drives, www.durapulse.com. The site specifically highlights the recently launched DURApulse line of sensorless vector drives. A high-bandwidth version of the Web site makes use of audio/video and visually-oriented demonstrations to provide a more interactive way to learn about the product's features, applications and configuration. A low-bandwidth version is available for dial-up connections, which rely more heavily on traditional text screens and audio. While the site makes it easy to gain a general overview of the DURApulse drives, it also provides links to details such as technical specifications and the complete product manual. It is anticipated that as more technical information is added, the site will eventually become a technology center on the topic of AC drives.

(In any video production, there are always bloopers before you get it just right. Visit www.durapulse.com's "Now What" page and see if you can find the smiley "blooper" icon to view some of these moments!)

RFID will affect many manufacturers and packagers

Radio frequency identification (RFID) has become one of the most visible issues in manufacturing and packaging in recent months. At its simplest, RFID is a generic term for technologies that use radio waves to automatically identify products to which a special tag has been affixed. To identify or access information about the product, an RFID reader typically communicates with the tag, which holds digital information in a microchip. While RFID technology has been available for years, it has been too expensive and too limited to be practical for most commercial applications. As both the capability and cost of the tags has improved, RFID is being viewed as the solution to some of the problems associated with bar code identification systems.

In mid-2003, Wal-Mart announced plans to begin using RFID marking at the pallet and case level for product receipt at Wal-Mart distribution centers by January 2005. The Department of Defense followed shortly with the announcement of their own RFID policy for received materials, to be applied to the lowest possible piece/part/case/pallet packaging, also by January 2005. As the suppliers to these two mammoth customers begin to implement the technology, it will naturally proliferate to other customers and manufacturers. Regardless of the cost and technology hurdles remaining, these initiatives have greatly increased the likelihood that RFID use is inevitable in a wide range of industries, including food, beverage and particularly pharmaceuticals.

To gain a basic understanding of RFID technology and applications, visit www.rfidjournal.com or www.aimglobal.org/technologies/rfid. Many trade magazines have also covered the technology, suppliers and applications in recent months, including *Control Engineering*, *Modern Materials Handling* and *Automation World*.

User Solutions

Application Stories

Ever wonder how AutomationDirect customers are applying their products?

---Check out some of the application stories we've collected and you'll see that AutomationDirect products are used in a wide variety of applications across many different industries. ---

D2-250 PLC PID loops control pumps in residential water system

by Peter Carman,
Wyoming Controls

We used PID loops in the D2-250 CPU to control three pumps and maintain pressure in a residential water system. The flow demand varies from zero to 250 gallons per minute. The pumps all have variable speed drives with the speed reference and run commands coming from the 250 CPU. At low flow, one pump runs alone, as needed, to maintain the pressure. As the flow increases, the other pumps are brought on, either in tandem with the first, or at a constant flow rate. The flow from each pump has an upper limit; if the total flow demand exceeds the combined upper limits, the pressure will fall. The result is that each pump can operate in an optimum range on its pump curve, and a widely varying flow can be delivered and the pressure is maintained very closely. The operator interface is a color touch screen that displays the pump status, flow rates, and system pressure. All the setpoints for pump on/off and associated time delays are easily accessible to the system operator.

D2-250 CPU maintains water pressure for city water system

by John Neiswanger,
Industrial Electronics

We created a water pressure controller for a local city water system. We used a pressure transducer to feed a water pressure signal into the DL205 PLC system analog card. The output from an analog card is used to vary the speed of a 75 HP well pump, controlled by a variable frequency drive, to keep the city water system at a more constant pressure. Setpoints are entered with a touch panel and the pressure is displayed as well. The system controls the startup sequence, releasing the well flow to a drain and slowly cutting into the system to prevent a pressure spike on startup. It also controls the shutdown to prevent a pressure dip. System pressure is maintained with a PID loop in the D2-250 processor.

DL06 PLC and EZTouch panel help move cement at bulk handling facility

by Jeff Bailey,
Ozinga Bros. Inc.

We recently installed a bulk cement handling facility. The facility offloads cement from river barges and pneumatically conveys the powder into a massive storage dome and truck loading facility. The concrete dome, which can hold 30 barge loads of cement powder, was erected using an inflatable air form system. A MODBUS network of four DL06 PLCs, controlled by an EZTouch Operator Interface, outloads the cement from the dome. A 4-20 ma PID loop implemented in one of the DL06 processors controls the speed of two hydraulically driven sweep augers. An analog radar sensor monitors the cement level in the truck-loading silo. All three primary functions are graphically animated and displayed on the EZTouch panel. The "supervisory master" DL06 controls the pneumatic conveying system and acts as the communications hub for the slave processors. Each processor runs local functions independent of the master. One feature that is particularly useful is the alarm history on the EZTouch panel. Future planned expansions of this facility will be simply and easily added to our system network.

Aluminum anodizing system controlled with help from D2-260 PLC system and EZText panel

by C R Williams,
Robo Systems

Our system controls aluminum anodizing. The operator uses an EZText panel to enter the size of the job and the desired thickness of anodizing. The D2-260 translates this into the necessary current, voltage, and time profile required to produce the desired result, and controls a 300kW SCR switched power supply that delivers the anodizing current to the workpiece. Since the optimum waveform has both short term (~1sec) and long term (~5min) components, and needs precise control over two orders of magnitude (10A to 1000A), the floating point math capabilities of the D2-260 are used quite heavily. The environment is extremely noisy electrically (because of the 300kW SCR phase angle switching), so the design of the grounding and shielding, as well as software filtering, were very important to the success of the project.

In addition to the standard PLC on/off inputs and outputs, analog inputs and analog outputs are used as part of the monitoring and control process.

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AC sensorless vector technology, up to 100 hp

AC motors up to 100 hp

Our most powerful AC drive

The new *DURAPULSE* series builds on the simplicity and flexibility of our GS1 and GS2 series drives, and adds sensorless vector control and autotuning, as well as optional encoder feedback for tighter speed control. *DURAPULSE* configuration settings offer fast and easy "out of the box" operation with carefully selected default values for the most common applications. And our **two-year warranty (*three years if you purchase and install an input line reactor*) is the best in the industry!**

DURAPULSE features:

- Specifically designed to operate within U.S. voltage levels
- Internal dynamic braking circuit for models under 20 hp
- Automatic torque and slip compensation
- Programmable jog speed
- Three analog inputs and one analog output
- Eleven digital inputs
- Four programmable outputs (three digital and one relay)
- Built-in RS-485 MODBUS communications
- Optional Ethernet communications
- Optional configuration software
- UL/CE listed

Built-in keypad is easy to use

The digital keypad includes a two line x 16 character LCD display, five status LED indicators, and nine function keys. The keypad is designed with defaults for the North American customer and allows you to configure the drive, set the speed, start and stop the drive, and monitor critical parameters for your application. The internal memory stores up to four complete programs that can be transferred to any *DURAPULSE* drive.

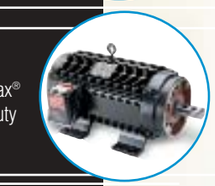
For more information please visit: www.durapulse.com

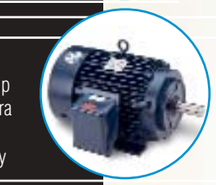
Drive/Motor Combos

Horse Power (hp)	230 VAC DuraPulse Drive	microMAX™ 1-10 hp 1800 RPM	Pkg Price US$	Black Max® 1-30 hp** 1800 RPM	Pkg Price US$	Blue Chip XRI® 40-100 hp 1800 RPM	Pkg Price US$	Blue Max® 2000* 40-100 hp 1800 RPM	Pkg Price US$
1	GS3-21P0	Y364	$374	Y535/Y536	$389/$396				
2	GS3-22P0	Y368	$509	Y551	$546				
3	GS3-23P0	Y999	$606	Y541	$659				
5	GS3-25P0	Y372	$711	Y543	$771				
7.5	GS3-27P5	Y994	$921	Y545	$1,049				
10	GS3-2010	Y996	$1,191	Y547	$1,273				
15	GS3-2015			Y549	$1,551	E205	$1,379		
20	GS3-2020			Y552	$1,941	E206	$1,559		
25	GS3-2025			Y553	$2,399	E207	$2,054		
30	GS3-2030			Y393	$2,706	E208	$2,354		
40	GS3-2040					E209	$3,239	Y571	$3,689
50	GS3-2050					E210	$3,996	Y572	$4,574
	Drives	Motors		Motors		Motors		Motors	
Horse Power (hp)	460 VAC DuraPulse Drive	microMAX™ 1-10 hp 1800 RPM	Pkg Price US$	Black Max® 1-30 hp** 1800 RPM	Pkg Price US$	Blue Chip XRI® 40-100 hp 1780 RPM	Pkg Price US$	Blue Max® 2000* 40-100 hp 1800 RPM	Pkg Price US$
1	GS3-41P0	Y364	$449	Y535/Y536	$464/$471				
2	GS3-42P0	Y368	$569	Y551	$606				
3	GS3-43P0	Y999	$644	Y541	$696				
5	GS3-45P0	Y372	$741	Y543	$801				
7.5	GS3-47P5	Y994	$959	Y545	$1,087				
10	GS3-4010	Y996	$1,229	Y547	$1,311				
15	GS3-4015			Y549	$1,626	E205	$1,454		
20	GS3-4020			Y552	$1,941	E206	$1,754		
25	GS3-4025			Y553	$2,474	E207	$2,129		
30	GS3-4030			Y393	$2,781	E208	$2,429		
40	GS3-4040					E209	$3,089	Y571	$3,539
50	GS3-4050					E210	$3,771	Y572	$4,349
60	GS3-4060					E211	$4,799	Y573	$5,294
75	GS3-4075					E212	$5,744	Y574	$5,984
100	GS3-4100					E213	$6,764	Y575	$7,439

* Also available in TEBC. ** Also available in 6-pole 1200 RPM models (up to 10 hp) and with encoder feedback options. Visit our website for availability and prices.


microMax™ AC inverter duty


Black Max® vector duty


Blue Chip XRI® ultra high efficiency


Blue Max® 2000 vector duty

DURAPulse AC Inverters

Hp	230 VAC Part Number	230 VAC Price (US$)	460 VAC Part Number	460 VAC Price (US$)
1.0	GS3-21P0	$289	GS3-41P0	$389
2.0	GS3-22P0	$339	GS3-42P0	$419
3.0	GS3-23P0	$399	GS3-43P0	$449
5.0	GS3-25P0	$459	GS3-45P0	$499
7.5	GS3-27P5	$649	GS3-47P5	$700
10	GS3-2010	$799	GS3-4010	$849
15	GS3-2015	$999	GS3-4015	$1,099
20	GS3-2020	$1,299	GS3-4020	$1,299
25	GS3-2025	$1,499	GS3-4025	$1,599
30	GS3-2030	$1,699	GS3-4030	$1,799
40	GS3-2040	$2,499	GS3-4040	$2,299
50	GS3-2050	$3,099	GS3-4050	$2,799
60			GS3-4060	$3,199
75			GS3-4075	$3,599
100			GS3-4100	$3,999

With our 25% discount you can get our drive and motor for less than one of their drives.

100 hp drive GS3-4100	+	100 hp motor Y575	=	Total if purchased individually	-25% combo discount	=	Our drive & motor 100 hp combo price!	<	Allen-Bradley 100 hp drive 1336F-B100-AA-EN
$3,999		$5,919		$9,918			$7,439		$11,179

AutomationDirect VS. Competition

HP/Volt Class	DURAPULSE Drive & Marathon Motor	Allen Bradley 1336 PLUS II Drive & Reliance VS Master Motor	Baldor Model 15H Drive & Baldor Motor
5 hp/230 VAC	$771 GS3-25P0 & Y543 Black Max	$2,857 1336F-AQF50-AA-EN & P18G1189	$2,415 ID15H205-E & IDNM3665T
10 hp/230 VAC	$1,273 GS3-2010 & Y547 Black Max	$4,863 1336F-A010-AA-EN & P25G1152	$3,878 ID15H210-E & IDNM2238T
50 hp/460 VAC	$4,349 GS3-4050 & Y572 Blue Max 2000	$14,757 A1336F-B050-AA-EN & P40G3208	$14,291 ID15H450-E0 & IDM4115T
100 hp/460 VAC	$7,439 GS3-4100 & Y575 Blue Max 2000	$20,859 A1336F-B100-AA-EN & P40G3207	$25,337 ID15H4100-E0 & IDM4400T-4

All prices are U.S. list prices. AUTOMATIONDIRECT prices are from June 2004. Allen Bradley drives prices are shop.rockwellautomation.com on 5/24/2004. Reliance motor prices are from Reliance 2004 Industrial Motors & Drives Catalog. Baldor motor and drives prices are from www.baldor.com on 5/7/2004. Prices and specifications may vary by dealer and configuration. All product names, trademarks, and registered trademarks are the property of their respective manufacturers. Prices subject to change without notice. AutomationDirect disclaims any proprietary interest in the marks and names of others.

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- GS3-FB feedback card
- Ethernet interface
- Replacement keypads
- Four and eight-port communication boards

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Feature Story

Motors/Drives Technology

Strides in Motor Technology

by Tom Matyas,
AutomationDirect Product Manager

When AutomationDirect was looking to provide customers with a high-performance, cost effective drive/motor package to complement their growing line of AC variable speed drives, they turned to Marathon Electric – a well-recognized, well-respected name in the industry. Marathon manufactures a full line of general purpose, inverter-duty, vector-duty and NEMA premium efficiency motors to meet the needs of a wide range of customers, and specializes in severe duty and explosion-proof motors for chemical washdown applications and hazardous applications.

Marathon's manufacturing and logistics operations are ISO9001:2000 certified, which contributes to the superior quality of all their products. Marathon Electric received the highest overall customer satisfaction index values for their product category in a customer satisfaction survey conducted by Control Engineering magazine in 2004.

To help address customer questions about inverter-duty motors and motor/drive applications, we talked to Tom Matyas, AutomationDirect's Drives, Motors, and Motion Product Manager, about Marathon's history of product development and recent advances in motor and drive technology.

When did Marathon Electric start to develop "inverter duty" motors?

About twenty-five years ago, customers started to approach Marathon Electric with applications that required motor speed to be altered with variable speed devices known as "drives" or "inverters". Since many of the original drive manufacturers were located in the upper Midwest and Marathon is headquartered in Wisconsin, the company became a logical and convenient location to help develop those manufacturers' products. Marathon accommodated these manufacturers by providing outstanding test facilities for them to test their products with Marathon motors. The rewards were twofold: drive manufacturers saw how their products functioned with Marathon motors and Marathon engineers learned how those drives affected their motors. This led to several generations of drive-compatible motors that are now named Blue Max®, Black Max®, Blue Chip XRI®, and microMAX™. With the advent of the IGBT drive, several new parameters were introduced to the motor. Changes in firing speed and carrier frequencies highlighted the need for further motor developments, and vector duty applications made even more refinements necessary. Through all these changes, Marathon has continued to improve the capability of its products. In fact, Plant Engineering magazine named Marathon's microMAX "Product of the Year" in 2001.

Why do motors operate more efficiently when connected to a Variable Frequency Drive (VFD)?

To some degree, a motor operates more efficiently, and certainly with greater dependability, when teamed with a VFD. This is particularly true at lower operating frequencies, where iron losses are lower. Any time a particle is magnetically charged in one polarity (i.e. "north"), and then must reverse its polarity (i.e. "south"), energy is expended. Think of this phenomenon as "magnetic friction". At lower frequencies, this polarity reversal occurs less frequently, thus "magnetic friction" is reduced. The lower losses allow the motor to run cooler. Unfortunately, the laws of physics operate in the same manner at higher frequencies; therefore, motors typically run a little warmer above 60 Hz.

With regards to efficiency, the real issue is not component (or even the motor/drive system) efficiency. It is really more a matter of improving the efficiency of the process that is powered by the drive/motor system. An example is a fan or pump application, where at lower frequencies, the HVAR system's airflow or the pump's fluid flow may be more appropriately matched to the requirements of the user. Reducing motor (and thus fan and pump) speed, versus using dampers or valves, utilizes power more efficiently, thus improving system efficiency. Machinery or conveyors become more efficient as they operate at optimal speeds.

Also, motors operated by VFDs are not adversely affected by "inrush" current, as are their line-started counterparts. This high current, typically six to seven times full load, causes more stress on the endturns of the motor than the program-controlled ramp-up of a VFD, which upon startup, acts much like a soft-starting device. As a result of lower mechanical insulation stresses (if you installed plexiglass in the motor's endbell, you would actually see physical movement of the endturns in a motor that was line started) the insulation life of the motor is lengthened when operated with a VFD.

What is the history behind the Blue Chip XRI product?

The Blue Chip XRI motor line was originally developed to meet the efficiency and performance demands of the chemical process industry. Companies like Dow Chemical were among the first customers to recognize the important role of energy in the production of their products and demanded that motor manufacturers improve the efficiency and life of their offering. Through extensive cooperative engineering research and development, Marathon Electric has developed a line of premium efficiency motors that meet or exceed the rigorous requirements of all major processing manufacturers. These industries include petrochemical, mining, pulp and paper, pumping, and automotive.

The Blue Chip XRI Ultra High Efficiency motor incorporates an all cast iron frame and end bells that provide the necessary strength and corrosion resistance for the most demanding industrial applications. They also feature 100% copper windings that offer lower resistance and lower temperature-rise for higher overall efficiency. Low-loss electrical grade steel laminations and longer stack lengths in the rotor and stator reduce electrical losses and improve heat transfer by lowering flux density and increasing cooling capacity. The Blue Chip XRI family boasts one of the highest overall efficiency levels in the motor industry and is inverter rated at 20:1 constant torque. XRI motors meet NEMA Premium efficiency levels, have a 1.25 service factor through 40 HP (1.15 above), and provide the eXtra Return on Investment (XRI) expected of a high-efficiency motor.

Are these features incorporated in the Blue Max product line?

In addition to the features of the Blue Chip motors, the Blue Max motor line was engineered with several premium components that stand out from the competition. They include the MAXGUARD Class H insulation system, a patented low-stress winding design, normally closed thermostats (one per phase) and encoder provisions included on the opposite drive end. The Blue Max line offers constant torque operation from 0 to base speed (RPM) on vector drives and constant HP operation up to twice base speed (143-256 frame size). These motors are optimized for operation with IGBT inverters.

Why was the microMAX motor developed?

Originally, Marathon Electric wanted to develop a low cost replacement for Permanent Magnet DC (PMDC) motors. Combined with low cost digital micro drives, the microMAX provides exceptional performance throughout its rated speed range. This revolutionary design features up to a 1000:1 constant torque and 2:1 constant horsepower range, rivaling much more expensive variable speed motors. Other design features include linear torque characteristics, superior starting torque (up to 400%), excellent torque to inertia, and smooth low speed performance. To ensure long life, Marathon utilizes their exclusive CR2000 corona-resistant magnet wire. microMAX motors meet all applicable UL, CSA, and NEMA standards, including NEMA MG1-1998, Part 31.

In addition to initial acquisition cost savings, maintenance (cost of ownership) costs are virtually zero. With no brushes or commutators to maintain, the user can expect significant savings over the lifetime of the motor. As an example, the five-year cost of ownership of a ½ HP microMAX motor versus PMDC shows no brush replacements (as compared to 15 brushes @ $30), equaling $450 in savings; no commutator maintenance (as compared to 5 commutators @ $100), equaling $500 in savings; and energy savings (@ $0.8/KW) of $161. While the total physical savings is approximately $1,100, the improved productivity is even more valuable.

Why has Marathon Electric developed an association with AutomationDirect?

Marathon Electric believes that AutomationDirect offers a unique approach and access to the marketplace through its Internet site, and complete product support to assure customer satisfaction and reliable product quality and service. AutomationDirect has taken the time to extensively test and evaluate the Marathon Electric product offering to assure the reliability and compatibility of the Blue Chip XRI, Blue Max, Black Max, and microMAX products. AutomationDirect's DURApulse and GS2 lines of AC drives have been tested at Marathon's state-of-the-art lab facility, also to ensure interoperability and to validate performance requirements. The entire line of Marathon motors offered by AutomationDirect carries a 3-year warranty, complies with UL requirements and NEMA standards, and carries the CE mark.

These factors, combined with the unique features of AutomationDirect's DURApulse drive line, make AutomationDirect the ideal source for serious drive application customers. Marathon Electric also realizes that AutomationDirect can reach those customers who understand the requirements of their application and can independently choose the most appropriate motor/drive package for their needs.

For complete technical specifications and pricing for the Marathon motors and DURApulse AC drives offered by AutomationDirect, visit www.automationdirect.com/drives.

Application Spotlight

Hydroelectric Power

Cost-effective I/O simplifies hydroelectric plant controls upgrade

by Lynn Mitchell,
Operations Superintendent
Lockhart Power Company

by Andy Feimser,
President
North Fork Electic

Lockhart Power Company owns and operates a hydroelectric plant located on the Broad River in upstate South Carolina, and services over 6,000 direct customers and 6,000 indirect customers over its 90-mile transmission network. The plant includes an 8-gate dam feeding a canal that channels the water flow to the powerhouse, which contains five turbine generators with a combined power capacity of over 17 MW. The dam and turbine control system receives data from power, flow, and level sensing devices to perform monitoring and control of the dam, generators, and associated equipment.

The previous control system, installed in 1987, was a proprietary microprocessor-based system that had become obsolete. Lockhart required a control system that would provide open networking capabilities, and result in a lower total cost of ownership. The new system needed to coexist with an upgraded design of the existing hardwired generator controls, and perform distributed, independent control at the dam and each of the five turbine stations. Each I/O control node would replace the old equipment in the existing control cabinets and be networked to the central control room.

Systems integrator and vendor selection

Lockhart Power contracted North Fork Electric, a provider of hydroelectric products and systems integration services in Crumpler, NC, to lend their expertise to the renovation. North Fork Electric proposed a 3-tier solution. Level 1 included new hardwired controls for manual operation of the system. Level 2 included PLC-based control of the dam and generators in an automatic mode. Level 3 provided PC-based redundant control and monitoring from a central location, and also supplied connectivity to the plantwide Ethernet network.

System components

The system consists of seven DL205 micro-modular PLCs using D2-250 CPUs with built-in PID functionality. Each of the five systems for generator control includes analog I/O and an Ethernet communications module. The remaining two PLCs are configured in a master/slave arrangement and

control the dam gates, located upriver from the powerhouse, via radio modems.

To reduce maintenance costs, North Fork Electric selected DL205 I/O components to maximize commonality among all systems. The identical analog output modules used on the generators, configured for ±10 VDC, can be configured for the 0-5 VDC dam gate control signals by simply moving the module's range selection jumpers. AC/DC relay modules are also used for both generator and dam control. Two operator interfaces and a Windows NT-based PC running the LookoutDirect SCADA/HMI software package complete the system.

System operation

In the automatic mode, the PLC can start, stop, and operate the generator via two PID loops that control startup and synchronization of the turbine. Changing the generator gate position varies the flow of water to the turbine, and thus the generator's speed/frequency. To bring a generator online, it must first be synchronized with the line frequency of the power utility. The first PID loop slowly increases the generator speed until it reaches 90% of the setpoint, at which point the logic switches to frequency control. Once online, the generator's power output is varied by changing gate position.

To complete Level 2 control, North Fork Electric then installed the dam control system. This system controls the eight canal gates located at the dam, which regulate the flow of water downstream to the turbines. The operator enters the required gate-position setpoints using a color touch panel connected to the dam control's master PLC in the control room. Data is transmitted to the slave PLC, located at the dam, via 900 MHz radio modems. The slave PLC monitors individual gate positions using proximity switches that count teeth on the drives' gears, and moves the gates up or down until they reach the desired positions.

North Fork Electric engineers then implemented the third and final tier of control and monitoring. The LookoutDirect SCADA system communicates to all the PLCs over an Ethernet network, performs supervisory control, and collects data that is easily passed to the plant's information system.

The installation was completed in four weeks to provide Lockhart Power with a powerful, yet simple, redundant control system that uses their familiar hardwired design as the manual control mode.

Technology Brief

Control System Security Measures

How secure is your control system?

by Wayne Labs,
Guest Writer

-Maroochydore, Australia, April 2000-

Fired by the contractor who installed the control system at the local water treatment plant, engineer Vitek Boden was then rejected for a job by city council. Laid off and ticked off, Boden sought his foul revenge. Using a stolen laptop and two-way radio, he connected wirelessly to the plant's control system and issued a few lines of code. Over the course of several weeks, he presided over the release of hundreds of thousands of gallons of raw sewage into nearby waterways.

-Davis, Ohio, January 2003-The Davis-Besse nuclear power plant's process computer and Safety Parameter Display System shut down for several hours. The culprit? The Slammer worm, inadvertently released by a contractor who established an unprotected computer connection to the corporate network, through which the worm reached the plant network and SQL server. Upon investigation, Davis-Besse discovered that plant engineers weren't even aware of the Microsoft patch released six months earlier. Fortunately, the plant was off-line so neither of the affected systems caused safety failures.

What is the common thread connecting these two examples? Failure to act-not after the incidents occurred-but ahead of time to prevent them from happening in the first place. In the first situation, Boden's ability to log onto the system should have ceased the moment his position was terminated. In the latter case, Windows security patches were not installed when they were issued. Even though the plant SQL Server may not have been attached continuously to the enterprise system, operating system (OS) updates and patches should have been applied in case of a breach.

Whether you have a small industrial I/O system that forms the guts of a packaging machine, a data acquisition and control system for a pilot plant, a PC/PLC-based control system, or a distributed control system, you can't afford to take chances with security. Hackers bent on outright destruction may surprise you with their knowledge of PLC/DCS programs and networks. And just because you may have a proprietary PLC or DCS, or run a UNIX or Linux box, you're not guaranteed security unless you take some initial steps. As a first line of defense you need to know where the attacks are coming from.

The disgruntled employee

Clarence is the "model" employee. Loyal, courteous, an astute problem solver, patient, efficient, and innovative. But lay him off due to downsizing or outsourcing and he could be a threat to security. What if the IT department kills his email box almost instantaneously with his layoff but no one thinks to remove his FTP logon, kill his TELNET logon to the data acquisition system, shut down his VPN connection, and kill his remote dial-in? What about the wireless connection? Has it been secured? You don't need to provide hot spots for disgruntled employees. Let Starbucks® do that.

Once you've removed Clarence from all possible logon and database lists, make sure his "ghost" doesn't return via a backup/restore operation. Check that his logon has also been removed from any archives. And keep in mind that 70% of industrial cyber incidents originate from within the company.

The unrelenting hacker

"It's been a quiet week in Lake Wobegon." Maybe, but on the Internet, quiet weeks without hackers and the viruses they create are a faded memory. Whether or not your plant LAN ties into the enterprise LAN, it's a good idea to have virus protection on all computers, unless, of course, you have an embedded system that isn't exposed to the network. In one recent week alone, there were three or four McAfee® virus definition updates to combat various versions of MyDoom and Bagle worms.

While not all viruses or worms will destroy your data, they can steal sensitive information that you probably don't want them to have. Assuming they do no damage to your computer and steal no data, worms can still decrease your network bandwidth to almost zilch, and that's what shut down the Davis-Besse plant for about six hours. Once infected by email, a computer with a worm spreads its nasty germs to other computers on your network in peer-to-peer fashion, and to other computers around the world via email. Your computers become zombies, and when commanded by a hacker, join an army of computers directing denial of service attacks against a planned destination, for example, Microsoft®.

Not a virus but almost as bad

If a plant floor, Internet-connected Pentium all of a sudden behaves like a 25 MHz 386, it may have an infection; or if this computer is also used to surf the Web, and allows downloadable installs, extreme slowness might be due to adware, spyware, or other unwanted Trojans. Some Web sites that add toolbars to your browsers can install as many as three or four programs or services that track your every move on the Web and relay the information to marketing firms. While these are technically not viruses, they can have the same effect on your machine – they bog it down to a crawl. Sometimes these programs will give you a warning about what they'll install, but it's usually buried in a couple thousand words of boilerplate. Sometimes, if you're lucky, they'll show up in "Add-Remove Programs," where you can get rid of them.

How to avoid problems

Avoid connecting your HMI or control computer to the network and don't connect a phone line for remote access. If either is necessary, and your plant LAN and enterprise LAN are tied together, talk it over with IT, and make sure you at least have routers/firewalls in between to control traffic, so only specific hosts get to talk to the plant floor system. Plant networks can be put on separate subnetworks, which provides some isolation. Use routers to close unnecessary ports, and firewalls to exclude hosts and domains.

Use only the "Professional" versions of Windows® 2000 and XP. If you still have Windows NT floating around, don't expect Microsoft to support it much longer. Although it's annoying to put up with frequent Windows updates (especially for servers because there's never a good time to restart a server after installing the update), if you haven't updated lately, you're inviting problems. It's probably a good idea to check with your HMI or DAQ software supplier before you apply updates, just in case there are any issues. Updates also mean "Service Packs," which are up to Version 4 on Windows 2000, and Version 2 (soon to be released) on Windows XP.

If an HMI must be connected to the Internet, virus protection is mandatory, and you might also want to consider the use of Spybot Search & Destroy®, Ad-aware® or similar tools to search for and eliminate any commercial spyware/adware that may exist on the computer. Checking the task list and running a sniffer program (like ActivePorts®) is a good way to see what's going on behind the scenes, and what might be affecting your performance. Take a snapshot of the task list [ALT-Print Scrn], paste it into a Word document, and print it. Check your task list regularly to see if any "new" unauthorized tasks or programs are running, which might be viruses, spyware, adware, etc.

A good way to prevent spyware and adware from getting installed is to make sure user accounts don't have any installation privileges. Don't give operators any more privileges than necessary to get their job done. If you must use Internet Explorer, keep its security settings very high. It's probably not a good idea to mix email with HMI, but if you must have email, why not try a more loosely-connected client such as Pegasus® or Eudora® instead of Outlook® or Outlook Express?

Be careful about assuming that embedded systems are safe. In August of 2003, several Diebold ATM machines running Windows XP Embedded were shut down because of a Windows XP Embedded RPC DCOM vulnerability, which was attacked by Nachi, a descendent of the Blaster worm. Ways to prevent infection include keeping up with Microsoft patches, installing only the modules needed for an application, closing all unneeded ports, and shutting down any services not needed, especially RPC. Also, a properly positioned and configured firewall can help. If you're designing an embedded system from scratch, one way to eliminate the worms that run on Microsoft-based systems is not to use a Windows operating system. Instead, why not look into QNX®, Wind River®, or a flavor of a real-time Linux® OS?

Conclusion

In the "old days" computers got viruses from users exchanging infected floppy disks. The time it took to spread was very slow compared to today's Internet-connected computers where viruses travel around the world many times over in less than an hour. Now you can get a computer virus simply by staying connected to the Internet. Your best remedy is to stay up to date with software patches and virus definition updates, and to shut off all Windows services you don't need. The same applies if you're running Linux/UNIX. For more information, see the sidebar, "Security helps and info." And by the way, think twice before laying off Clarence.

Security Helps and Info

All about spyware:
http://www.spywareinfo.com

Forums on security:
http://www.wilderssecurity.com/index.php

ISA Security page: www.isa.org; click on "Technical Information and Communities," then click on "Security"

Microsoft Security: www.microsoft.com/security

SecurityFocus (A Web site dedicated to security):
http://www.securityfocus.com/

U. S. DOE: 21 Steps to Improve Cyber Security of SCADA Networks:
http://www.ea.doe.gov/pdfs/21stepsbooklet.pdf

U. S. Government. Accounting Office-Critical Infrastructure Protection: Challenges and Effort to Secure Control Systems:
http://www.gao.gov/new.items/d04354.pdf

Windows Task List programs:
http://www.answersthatwork.com/Tasklist_pages/tasklist.htm

What Microsoft is doing for security:

-Windows XP Service Pack 2 will ship with fire wall turned on as default.

-Future versions of Windows and microprocessors will feature a hardware-enforced "no execute" to minimize the possibility of running a worm or virus residing in data-only memory.

-Windows components are being recompiled with the newest compiler technology to help mitigate against buffer overruns.

-Windows Servers will be shipped with Internet Information Services (IIS) shut off as default.

-Software will become available to scan computers connected to a network for viruses, patch updates, and illegal open ports before they will be given full access to network services.

-Windows Rights Management Services will control email destinations, protect sensitive files, and safeguard Web portal content.

-Outlook Web access will pre-authenticate all users.

-ISA Server 2004 firewall protection will make email safer to outside employees.

About Wayne Labs

Wayne Labs served as senior technical editor for 18 years with Control Solutions International magazine (formerly Instrumentation & Control Systems) where he covered sensors, control system hardware and software, wireless and networking, embedded systems, HMI, and enterprise systems. His monthly column, "Software Upload/Download," discussed software issues including open source, security, applications, and networks. Before becoming an editor, Labs worked as a field engineer in wireless systems with GE.

Tech Thread

Indirect Addressing

Using Indirect Addressing in a PLC to Scale a Non-linear Analog Input Signal

by Richard Palmer,
AutomationDirect

Indirect addressing, or pointer addressing as it is called with Koyo PLCs, is an addressing mode found in many processors' instruction sets that specifies a register that contains the effective address. Accessing the operand requires two memory accesses – one to fetch the effective address and another to read or write the actual operand. Indirect addressing has many uses, the most common of which is lookup tables. You could perform numerous compare statements for the same function, but lookup tables can cut your programming time and number of rungs considerably.

For instance, finding the number of gallons in a horizontal tank is a fairly long and complex math process that can take up a lot of scan time. It certainly isn't a linear equation as seen in Figure 1. The dashed red line indicates a linear line and the blue line shows the actual gallons in the tank. The equation for this curve is:

g = (L*((r^2*(ACOS((r-h)/r)))-(SQRT(2*(r*h)-h^2)(r-h))))/231

Where g=gallons, L=tank length in inches, r=tank radius in inches, and h=liquid height in inches. It's pretty easy to see that this would be difficult to implement in ladder logic.

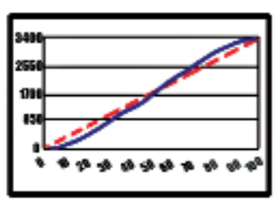


Figure 1

Horizontal Tank Level

So how do we accomplish this without performing the entire difficult math equation? The answer is to pre-calculate several "points" across the scale and then do a linear calculation equation between those points.

Obviously, this method will induce a certain amount of error since you are taking a curve and slicing it into divisions and then performing a linear calculation on the individual divisions. The more divisions, the less error, but the more CPU memory consumed.

Creating the lookup table can be performed in several different ways. One way would be to take the manufacturer's table and cut it into equal divisions. Next, find the values at these divisions and place the engineering units at those divisions into the table. Then, divide the raw units by the same number of divisions and use this to perform the lookup.

Another method is by calculation estimation. For example, you might take the equation and place it into a spreadsheet and derive the engineering units by calculation. Still another option is by manual calibration, although this method is sometimes nearly impossible to accomplish.

In the following example, we will be using the manufacturer's table method, with a non-linear analog value, such as an orifice flow meter. In order to scale the non-linear signal, we need to divide the raw analog signal into sections. If we divide the raw analog value (4095) by 10, we have 11 sections, 10 of 409 units and 1 remainder of 5. We also need to divide the manufacturer's table into engineering units by dividing into 11 sections. For this example, our engineering units will be 0, 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, and 1024 (See Figure 2). This is where the numbers for the lookup table come from.

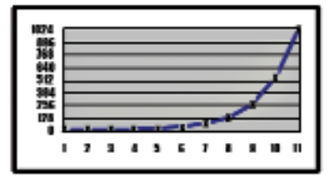
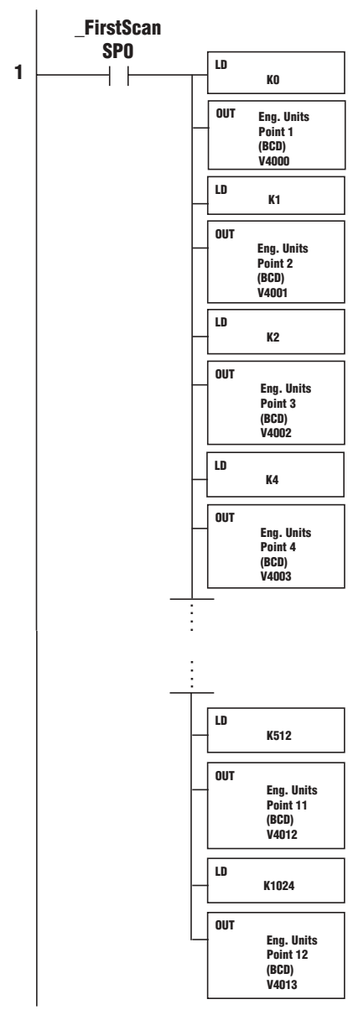


Figure 2

Orifice Flow Meter

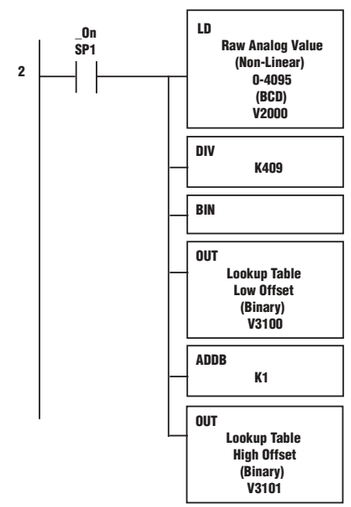
In our ladder program, the first step is to load the lookup table values into V-memory (variable memory). Anytime you have variables that will not change often (if ever), load them during the first scan cycle as shown in Ladder Example 1. This will save frustration if something should ever happen to the V-memory, such as forgetting to install a battery for backup.

Ladder Example 1
Load the non-linear table on the first scan



To find the lookup table offsets (which are the high and low values that fall below and above the actual measured raw values), we take the raw analog input signal and divide it by the unit number 409. This gives us the lookup table low offset value. We will add one to this number to obtain the high offset value. These values will be used to index the lookup table. (See Ladder example 2.)

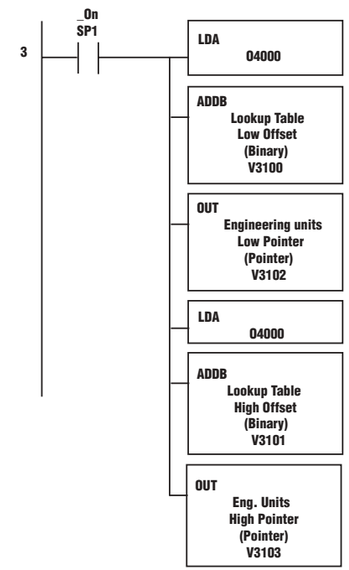
Ladder Example 2
Divide the raw analog value by the 409 (max analog counts divided by 10). The result will be the low and high offset.



All pointer addressing in *Direct*Logic PLCs is done as a hexadecimal equivalent of an octal V-memory address. In other words, take the octal address (for example V2000), drop the 'V' from the front of it and change to octal (O2000), and convert to hexadecimal (octal 2000 = hex 400.) If just thinking about this makes you dizzy, you can use the Windows calculator in scientific mode to perform the conversion. Also, there is a document on the Technical Support section of the AutomationDirect.com Web site that can help you with the data types as well. It can be found at: http://support.automationdirect.com/docs/an-misc-013.pdf.

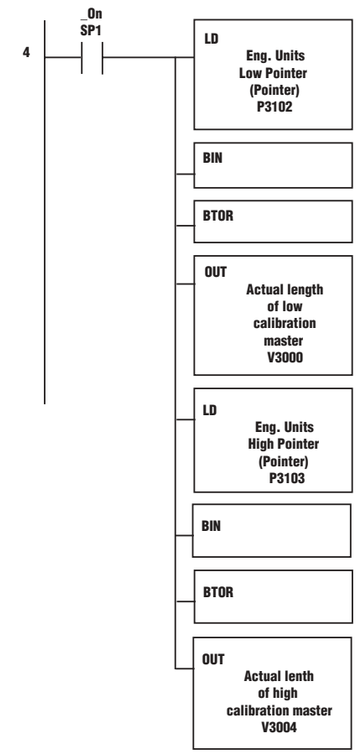
We will take the starting V-memory address of our table (V4000) and convert it to hexadecimal (800). Next, add the offsets, which were created above, to get the actual address pointers that we will use later. (See Ladder Example 3.)

Ladder Example 3
Add the index created in Ladder Example 2 to the lookup table start address (V4000) to find the actual address of the engineering unit values, high and low.



Now that we have the addresses of the engineering units that we need, we will load those values into memory locations for calibration. In Ladder Example 4, the LD "P3102" will peek into V-Memory location V3102 and see what address is stored there as a hexadecimal number. It will internally convert that to an octal number and use it as the address to get the accumulator data. For example, if V3102 is equal to hexadecimal 802, it will convert this to octal 4002, then it will look into V4002 to find the number (V4002=2) that will be placed into the accumulator.

Ladder Example 4
Convert the low and high scale values to a "real number" format

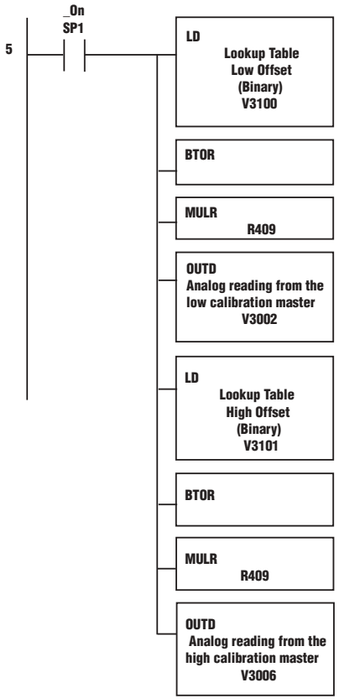


Now we need to know the "low" and "high" raw unit values for the range we are calibrating. Ladder Example 5 shows how to calculate the raw unit values based on the table offsets that were calculated in Ladder Example 2.

Continued on next page

Tech Thread
Indirect Addressing Continued

Ladder Example 5
Convert the calculated low and high scale values for the raw units into a "real number" format



We are now ready to perform the analog calibration. This is covered in the FYI article on pages 28 and 29, Implementing a PLC Calibration Routine to Ensure Accurate Instrument Readings.

For other example ladder logic programs, please visit www.automationdirect.com's tech support home page and click on example programs. Follow the instructions on the page to view zipped files. (Note: DirectSoft software is required to view the sample programs. If you do not currently have DirectSoft, you can download a free demo version at http://support.automationdirect.com/demos.html)

Technical Review
Selecting Transformers

Common Questions about Control Transformers

by Keri Schieber, Managing Editor

What is a control transformer?

A control transformer is an isolation transformer designed to provide a high degree of secondary voltage stability (regulation) during a brief period of overload condition (also known as 'inrush current'). Control transformers are also known as machine tool transformers, industrial control transformers, or control power transformers.

How do I select a control transformer?

Selecting a control transformer requires that you have a first hand knowledge of the specific application for the transformer, and that you understand some basic terms used in the selection process. By using the following information, you will be able to select the correct control transformer for your application.

To select the proper transformer, you must first determine three characteristics of the load circuit. They are total steady-state (sealed VA), total inrush VA, and inrush load power factor.

Total steady-state "sealed" VA is the total amount of VA that the transformer must supply to the load circuit for an extended length of time. Calculate by adding the total steady-state VA of all devices in your control circuit. (The operating VA data for the devices should be available from the manufacturers.)

The inrush VA is the amount of VA that the transformer must supply for all components in the control circuit that are energized together. Consideration for the start-up sequence may be required. (Inrush VA data should be obtained from the device manufacturers.)

The inrush load power factor is difficult to determine without detailed vector analysis of all the control components. In the absence of such information, we recommend that a 40% power factor be utilized.

Once the three circuit variables have been determined, follow these six steps to select the proper transformer:

1. Determine your primary (supply) and secondary (output) voltage requirements, as well as the required frequency (i.e. 60 HZ).
2. Calculate the total sealed VA of your circuit.
3. Calculate the inrush VA by adding the inrush VA of all components being energized together.
4. Calculate the total inrush VA using one of two methods:

$$\text{Total Inrush VA} = \sqrt{(\text{VA sealed})^2 + (\text{VA inrush})^2}$$

or

$$\text{Total Inrush VA} = \text{VA sealed} + \text{VA inrush}$$

5. If the nominal supply voltage does not fluctuate more than 5%, then reference the 90% secondary column in the manufacturer's Regulation Data Table for the correct VA rating. If the supply voltage varies up to 10%, the 95% secondary voltage column should be used to size the transformer.
6. Using the manufacturer's regulation data table, select the appropriate VA rated transformer:
   a. With a continuous VA rating that is equal to or greater than the value in Step 3.
   b. With a maximum inrush VA equal to or greater than the value obtained in Step 5.

Frequently asked questions

Q. When you calculate the VA requirements of a transformer, do you use the primary or secondary voltage?

A. The secondary voltage is used in calculating the VA.

Q. Can the control transformer be used in reverse?

A. Yes, a control transformer can be used in reverse. However, keep in mind the output voltage will be less than its rating, due to the compensation factor of the windings.

Q. Can a control transformer regulate the output voltage?

A. No, a control transformer will not regulate voltage. Output voltage is a function of the coil's turn ratio times the input voltage.

Q. Can you explain the "VA" or "Volt Ampere Output" rating?

A. The VA or volt ampere output rating designates the output which a transformer can deliver for a specified time at its rated secondary voltage and rated frequency, without exceeding it's specified temperature rise.

For additional information on control transformers, visit the Technical Support Applications and FAQ section of the AutomationDirect web site. Be sure to read the application note on control transformers: "Fuse sizing for primary and secondary windings."

FYI

Calibrating PLC Analog Signals

Implementing a PLC Calibration Routine to Ensure Accurate Instrument Readings

by Gary Multer,
MulteX Automation

Why calibrate?

Many applications call for a means to take accurate analog measurements. Force, pressure, electrical current, lengths, positions and other analog values that are measured must be done so with a degree of accuracy. Factory and lab personnel use calibration procedures to ensure that equipment is reading accurately. If the readings are not as accurate as required, a calibration procedure should allow for the implementation of a correction factor. Personnel operating the equipment can perform their jobs more readily if the measurement system can easily be checked for accuracy and calibrated. Ideally, the process would be transparent to operators who do not need to understand the details of the operating system and only need to see and understand the measurement results reported by the equipment.

An engineer designing a measurement system will generally examine the voltage or current to be provided by the measuring transducer and the "counts" that should result after the analog input card converts the electrical signal to a number. The conversion factors can be set up to convert counts to real world units such as pressure or force. These theoretical or ideal factory published numbers are suitable for specifying equipment, but when the system is set up and running, the actual readings and numbers will differ from the theoretical. Wires will add resistances that cannot be calculated in advance and temperature changes will cause variations that must be accounted for. No analog system will run exactly per "book values" and thus a calibration routine must correct for the differences.

Calibration Method

The calibration method described here can be applied to any analog measurement such as pressure, amperage, weight, length or force. Let's consider an example where the length of an object is being measured. We will assume that a device has been built that converts the length of the object to numerical readings via the analog input. The type of instrumentation used may be a laser measuring device, an LVDT, or any device that provides an analog signal that will vary with the length of the object being measured. We will assume the following:

1. The object being measured ranges from 2 to 9 inches in length and the analog device is capable of measuring over this range.

2. The analog device provides a voltage signal to the analog input card. The voltage is converted to a number or "counts" by the analog card. The "count" resides in real time in a register in the PLC and the ladder logic can perform math functions using this number. For example, let's assume that an object is being measured 2 inches in length and the count is 100, and when an object 9 inches in length is measured the count is 3900.

The nice thing about the method described here is there is no need to be concerned with the amount of voltage provided by the transducer or received by the analog input card. By utilizing the counts and then converting the counts directly to length, the voltage becomes irrelevant as long as any change in counts is linear with any corresponding change in length. This provides the advantage of not needing to be concerned with calibration or setup of the transducer and its amplifier. Too often, time is spent setting the "zero" and "span" of amplifiers and signal conditioners where a person might determine: "This object measures 2.3 inches, therefore my voltage should be 1.2 volts". Then they proceed to set the zero and span to achieve an exact voltage for the corresponding length. By using the calibration method described here, this process is no longer necessary and the exact voltage at any given length is of no concern. Time is saved because the calibration of the amplifier's voltage is now rolled into the software calibration of the entire system. Additionally, if someone comes along later and adjusts the zero or span, the calibration procedure described below can be run and the PLC program will compensate for the changes.

Calibration Procedure

Calibration routines are often set up to simply add in a correction factor; but this "one point" method leaves room for error over a range of readings. A car speedometer that is permanently stuck at 60 mph will appear accurate if checked when the vehicle is moving at 60 mph. A better calibration method uses two points; a "low point" and a "high point" and then calculates a line that goes through both points. We will use a 2-point calibration, which requires two calibration units of specific lengths. We will call these units "calibration masters". In our example, they can be any length within the readable linear range. Let's assume that one is 4.2 inches long and the other is 6.8 inches long.

Four values will be captured during the calibration procedure:

a. The actual length of the "low" calibration master (4.2 inches)

b. The analog reading (counts) when the low master is measured

c. The length of the "high" calibration master (6.8 inches)

d. The analog reading (counts) when the high master is measured

From this point forward the four values, a through d, will be used to set up the math required to covert counts to inches. We will call the resulting value "e".

The change in length for any corresponding change in counts is calculated as follows:

(c-a)/(d-b) = e

The person performing the calibration enters the lengths of the high and low calibration masters (values a and c) via the operator interface and these values are stored in PLC registers. The corresponding analog counts for the high and low calibration masters (values b and d) are captured during the calibration routine and are also stored in PLC registers. We will use the following data registers:

a = "low" calibration master = Register V3000 / V3001

b = low master analog reading = Register V3002 / V3003

c = "high" calibration master = Register V3004 / V3005

d = high master analog reading = Register V3006 / V3007

The following ladder logic will calculate "e" and store this value in V3010/V3011. Data register V3014 is used to store temporary math results while the accumulator is in use performing other math. See Figure 1

Length Conversion

After the calibration routine has been run and the values a through e are stored in the PLC, the formula for converting counts to length is:

((counts - b) x e) + a

The following ladder logic will calculate the length from the counts and store the resulting length in V3012/V3013. The analog reading from the device being measured is stored in register V2000. See Figure 2

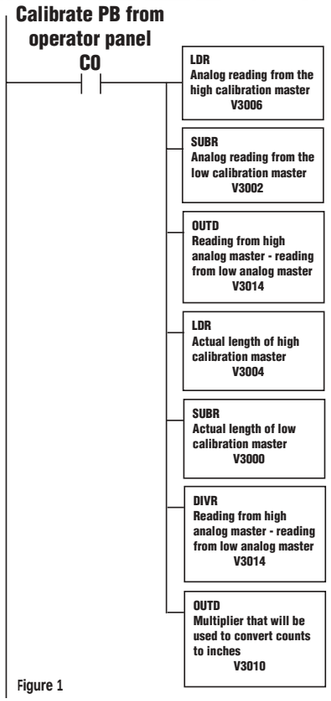


Figure 1

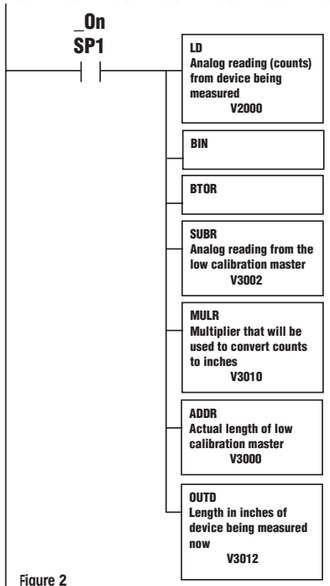


Figure 2

Some of the advantages of this calibration procedure are:

Because the user chooses the calibration points, calibration masters can be at any length. Calibration masters no longer need to be made to a specified predetermined length.

If a specific range is the most critical, the calibration can be done at that specific range. In the example above, if the most critical readings are between 3.5 and 4.2 inches of length, the calibration masters can be approximately 3.5 and 4.2 inches. In this way, calculating the straight line over the critical range minimizes any non-linearity in the system and provides the most accurate readings in the critical range.

By displaying the actual calculated length and the analog counts on the operator interface, anyone who desires can follow along with the PLC and observe the math in action. This makes the system's internal workings clear to anyone using the equipment.

About Gary Multer

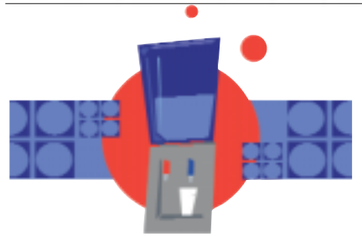
Gary Multer is with MulteX Automation in Boston and has over 20 years experience designing and building custom assembly machines and test equipment for manufacturing operations and laboratories. Gary specializes in istallation and troubleshooting of equipment. He can be reached at gmulter@multex.org; (617) 262-4143.

"Nobody got anywhere in the world by simply being content."

- Louis L'Amour (1908-1988)

The Break Room

Humorous stories, Cartoons and Brainteasers



Does your dog bark?

by Chip McDaniel, AutomationDirect

While commissioning a systems integration job in Holland several years ago, a co-worker and I left the plant to get some lunch. A road-side concession stand a few blocks away had been recommended, so we walked. As we rounded the last corner, we noticed a dog chained to a tree beside the concession stand, and - more importantly - he noticed us. The dog began barking immediately, and kept barking as we walked up the street, and while we were standing in line to be served. When it became our turn, we struggled to communicate with the proprietor – he spoke only a bit of English – and our Dutch was abysmal. As we gestured at the menu and pointed at the food, the man finally got fed up with the incessant barking. He leaned out across the counter and shouted a long string of angry Dutch at the dog. The dog immediately ceased barking and sat down. We obtained our food, and started to walk back to the factory. The dog never made another sound. As we walked past, my co-worker commented to me, "You know… that dog understands more Dutch than we do!" I laughed all the way back to the plant. I suppose he was barking in Dutch, as well!

Brainteasers

1. O T T F F _

What's the next letter in sequence? (They are all letters.)

Submitted by a reader:

2. Two old friends meet after a long separation. They swap stories, talk about jobs, families, etc.

The first man says "I have three children now."

Second man asks, "Really? What are their ages?"

First: "I'll give you clues and you try to figure them out. First, the product of their ages is 36."

Second: "That's not enough to solve it."

First: "The sum of their ages is the same as the address where we used to play chess."

Second: " Okay. That's still not enough to solve it."

First: "The oldest looks a lot like her mother."

Second: " Okay, I know their ages."

What are they?

3. Replace each letter with a unique integer from 0 – 9, so that the addition problem "adds-up".

```
FIFTY
+STATES
AMERICA
```

"Okay your father managed to get a mouse. Now how do we use it?"

Mouse Trap

My mother wanted to look up something on the Internet. Having never touched a computer let alone the Internet, I showed her how to use the mouse and the significance of the hyper-link. She said, "I want to see what this page says," so I told her to put the mouse pointer over the icon and click the left mouse button. She successfully navigated the cursor to the icon, picked up the mouse to eye level, looked at the button she wanted to click, clicked it, and asked, "Did I do it right?"

"The major difference between a thing that might go wrong and a thing that cannot possibly go wrong is that when a thing that cannot possibly go wrong goes wrong it usually turns out to be impossible to get at or repair."

- Douglas Adams (1952-2001)

Answers: 1.) S (as in Six) 2.) The twins are two years old, the eldest daughter is nine. 3.) 65682 + 981849 = 1047531

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

Did you see him?

This issue of Automation Notebook contains a hidden "smiley" guy. He is a familiar icon associated with our advertising tables and charts, but if you're not sure what he looks like, we have a sample above. If you're one of the first to respond with his location, you will be included in the drawing from our "big box of free stuff". This is not the same free stuff that you can request anytime, but new, more exciting freebies that we have available.

He could be anywhere!

If you locate Smiley and wish to be entered in the drawing, please send an email to: editor@automationnotebook.com with Smiley's location. We will collect all responses and award multiple prizes. All entries received thru October 12, 2004 will be eligible.

Disclaimer: Advertising pages containing charts and/or tables featuring Smiley are not eligible locations. Keep looking!

Program EZTouch operator panels in minutes!

Configuration software only **$140**

EZTOUCH

One of the most feature-packed panels is also extremely easy to use!

1 Setup

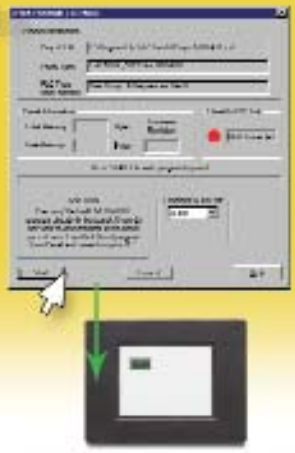
Create a project by selecting PLC type and panel type

2 Configure

From the objects menu, select an object, fill in the dialog boxes, then place and size the object on the screen

3 Write to Panel

Connect the cable to the panel and download your configuration



EZTouch configuration software for EZTouch panels comes with a large assortment of high-speed vector-based objects and also features built-in Symbol Factory™ with over 2,000 symbols.

- Pushbuttons and indicators
- Radio buttons and step switches
- Numeric entry and numeric display
- Recipes and thumbwheels
- Analog and digital clocks

- PID faceplates and line graphs
- Meters and bar graphs
- Multi-state indicators and alarm history
- Multiple text functions
- Dynamic and multi-state bitmaps
- Bitmap buttons
- . . . and more

Available in 6", 8", 10" and 15" models
EZTouch panels start at $425

AUTOMATIONDIRECT'S EZTouch operator panels and configuration software were designed with "ease-of-use" as the number one priority. When you combine that with great prices (panels starting at $425), the advantage you gain is an interface solution that's both practical and profitable for OEMs and end users alike.

EZTouch Editor Features

- 32-bit Windows-type application
- Compatible with WIN95/98/2000/NT4.0/XP/XP Pro
- Objects with "EZ" fill-in-the-blank configuration
- Symbols Factory with over 2000 objects
- 128 colors for objects and screens
- Scale objects using "click-n-drag" with a mouse
- Preview objects while configuring
- Copy and paste screens to other projects
- Configure up to nine languages
- Password protection at screen and object level
- Online programming
- Fast and "EZ" download to panel
- Configuration software only $140

Get your FREE EZTouch demo software today by going to http://support.automationdirect.com/demos.html

Order direct by phone, fax, or online

Designed and built by

AVG

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AVG manufactures EZTouch panels and EZText panels sold exclusively through *AutomationDirect* and *AutomationDirect* resellers. Check out www.avg.net for other AVG products such as resolvers, PLSs, marquees, custom display products and electronic manufacturing services.

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