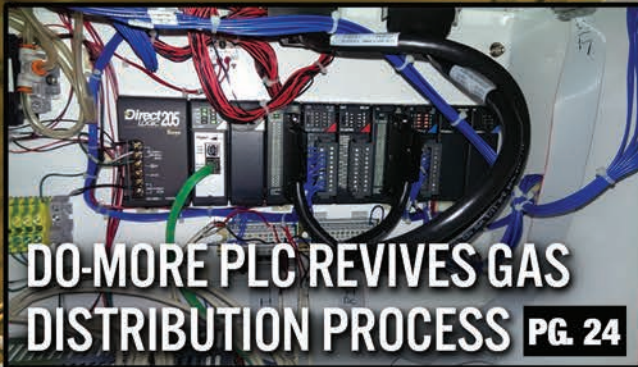


# Automation NOTEBOOK

Your guide to practical products, technologies and applications



**DO-MORE PLC REVIVES GAS  
DISTRIBUTION PROCESS** PG. 24

**CHOOSING THE RIGHT FACTORY AUTOMATION  
CONTROLLER FOR YOUR APPLICATION** PG. 18



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Spring 2018 | Issue 39

**DAN RAPOZA,  
STUDENT AT VERMONT  
TECHNICAL COLLEGE**

PG. 28



# Affordable Power Transmission

high-quality components at low prices!



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**\$549.00**  
SMR2-xx  
shaft mounted gearbox

**NEW!**



**IRONHORSE**

## Shaft Mounted Gearboxes

Designed for convenient mounting to the drive shaft of large machinery, these gearboxes provide speed reduction and increase torque output. Optional accessories include: shaft bushings, standardized shafts for use with screw conveyors, motor mounts, belt guards, screw conveyor mounting flanges and backstop (anti-reversing) assemblies.

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- Industrial grade cast-iron housings protect gearing for life
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- Dimensional drop-in for all major makes
- Torque arm included



## Helical Gearboxes

IronHorse® inline helical gearboxes provide smooth and quiet operation while delivering high power transfer. With cast-iron frames utilizing C-face mounting interfaces for C-face motors, IronHorse helical gearboxes are excellent, cost-effective alternatives to SEW Eurodrive and/or Nord brands.

- Helical gearboxes start at \$360.00



## Worm Gearboxes

IronHorse® worm gearboxes are built to withstand the toughest applications while delivering reliable speed reduction and increased torque output.

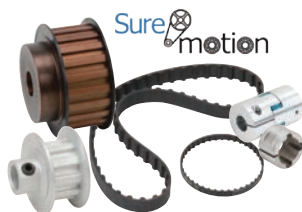
- Aluminum gearboxes start at \$88.00
- Cast Iron gearboxes start at \$147.00



## Precision Gearboxes

If it is precision you need, our SureGear® family of precision gearboxes is an excellent solution. They are available in a wide range of ratios and styles, and provide high-precision motion control at an incredible price.

- Servomotor gearboxes start at \$398.00
- Small NEMA motor gearboxes start at \$229.00



## Timing Belts, Pulleys, and Couplings

Our SureMotion® line of timing belts, pulleys, and couplings provide dependable speed and torque transfer without unwanted slippage or speed variation. **Now available in a wider range of sizes!**

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# Automation NOTEBOOK<sup>®</sup>

Your guide to practical products, technologies and applications

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

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1-800-633-0405 x1845. Thanks for  
your interest, and we look forward to  
hearing from you.

## Editor's Note

Recently, I participated in Career Day at my kids' school. I figured I'd bring in something fun and have a good time discussing automation with the kids. I quickly realized I bit off more than I could chew, but in a good way. You see, this was the first time anyone from the automation field participated and no one ever brought a hand-held, pneumatic-powered ping pong ball launcher before. One look at the launcher in action and a line quickly formed at my table as if it was an amusement ride. I struggled to answer the tons of questions coming at me while at the same time chasing balls that were off target. That one pneumatic cylinder firing ping pong balls all over the place stoked so much excitement about automation, by the end of the day almost all the kids were sure they wanted to be engineers. AutomationDirect has always believed that automation can provide a bright future for anyone. By supporting STEM at local schools, providing resources through educational outreach, working with the Boy Scouts of America and sponsoring robotics competitions, AutomationDirect is helping to show kids all over the country how exciting and rewarding automation careers can be.

This issue of NOTEBOOK is loaded with informative articles such as our Tech Thread, which provides a helpful checklist for choosing the right PLC. We also have a great Cover Story on selecting the right factory automation controller for your application. The User Solution shows how the Do-more PLC revived a failing gas delivery system, and our Student Spotlight focuses on Vermont Technical College engineering student Dan Rapoza who used his newly gained knowledge of automation to help local dairy farmers. You'll also find information on our newest products, such as the new Productivity1000 PLC, DURApulse GS4 AC drives, StrideLinx VPN routers, Power over Ethernet (PoE) switches, pneumatic rotary actuators and grippers, and lots more. As always, the Break Room is stocked with fun brainteasers so see how many puzzles you can solve and compare your answers at [www.automationnotebook.com](http://www.automationnotebook.com)

[editor@automationdirect.com](mailto:editor@automationdirect.com)

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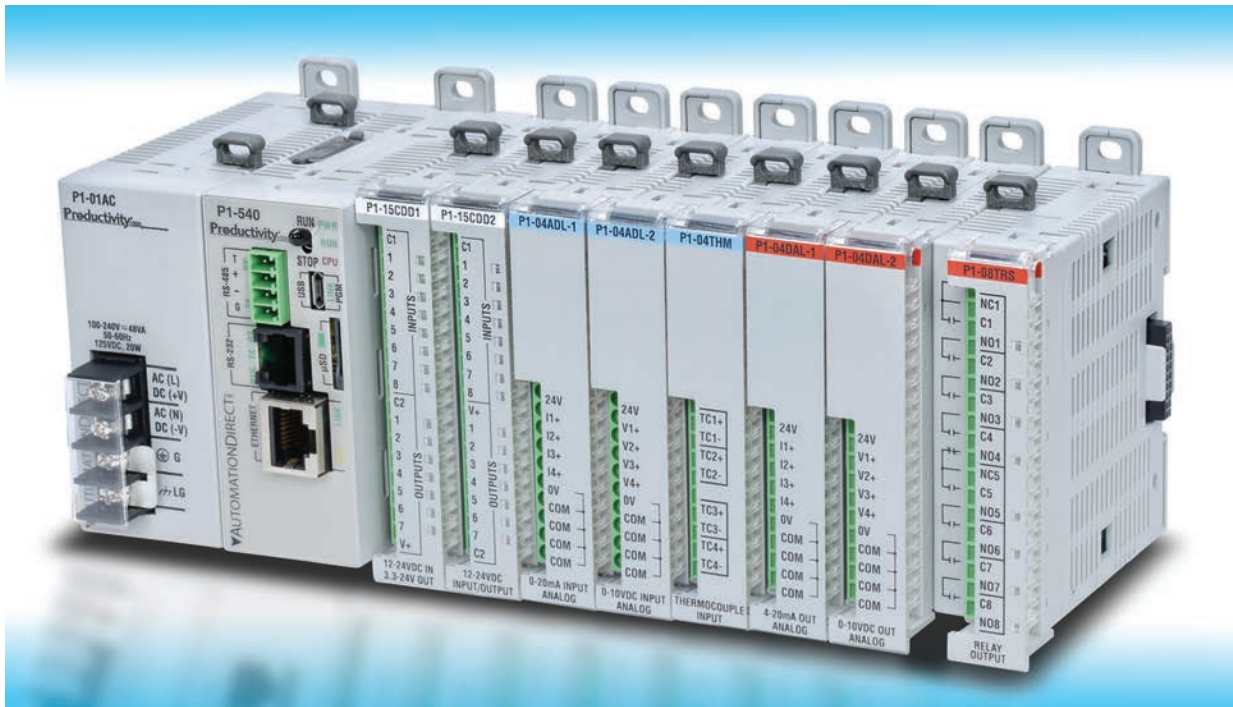
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## NEW PRODUCTIVITY1000 PROGRAMMABLE CONTROLLER



The new Productivity1000 stackable micro PLC is the super compact yet highly capable member of AutomationDirect's Productivity controller family. The P1000 is packed with many of the features of the Productivity series but housed in a smaller, slimmer design to provide space, budget and time savings.

The P1-540 CPU (\$169) has a 50Mb memory and features four onboard communications ports including micro USB, serial RS-485, serial RS-232 and Ethernet 10/100Mbps connections. Supported communications protocols include EtherNet/IP®, Modbus RTU/TCP and ASCII. The micro USB 2.0 (type B) port provides a plug-and-play connection for programming, online monitoring and firmware upgrades.

The 10/100 Mbps Ethernet port is used for programming, monitoring, and firmware upgrades as well as client/server connections (Modbus TCP, EtherNet/IP scanner and adapters). A microSD card slot accepts a standard microSD card to provide up to 32GB of data logging capacity. The CPU's built-in Web server allows users to view, download and delete data log files from any browser. One RS-232 and one RS-485 serial port can communicate via Modbus RTU or ASCII protocols for local networking or device interfaces.

The Productivity1000 requires no base or backplane and can easily be expanded with up to 8 snap-on I/O modules. The P1000 system can support up to 128 discrete I/O points or 32 analog I/O channels total. The I/O modules are easily added or removed using the single latch mechanism on the top side of each module. The P1-01AC (\$37) power supply snaps onto the CPU and provides isolated power to the P1000. Any combination of I/O modules may be installed without power budget considerations. Starting at \$33.50, the 14 I/O modules capture and control a wide range

of field signals, including up to 8-point DC I/O, 8 and 16-point relay outputs, and analog voltage, current or temperature. Each I/O module includes a QR (Quick Response) code which can be scanned from any smart phone or tablet to get the latest specifications for that module.

The free downloadable Productivity Suite programming software features tag name-based programming for better documentation management and integration with HMIs. Productivity1000 gives users the freedom to define user tags with no limits or fixed boundaries. With tag name-based programming, there are no pre-defined, fixed memory maps and no wasted, unused memory allocations.

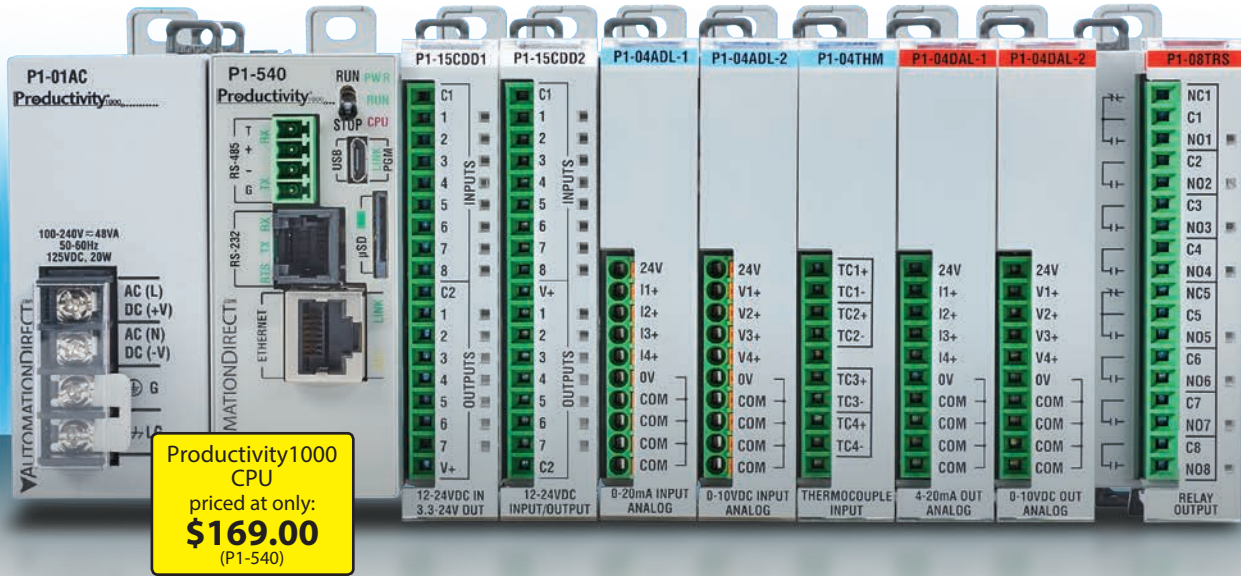
The software can perform I/O hardware auto-discovery and configuration with the option to be manually configured by the user using easy drag and drop module placement. Powerful processes in the programming environment reduce development time; time-savers include combined ladder logic and function block-style programming, task management that minimizes scan time, advanced instructions that simplify complex tasks, and an exhaustive HELP file that covers both hardware and software topics.

The complete line of Productivity1000 components can be seen at [www.automationdirect.com/P1000](http://www.automationdirect.com/P1000)



# A little Productivity makes a big difference

Introducing the newest member of the Productivity PLC family...



**Productivity1000 CPU**  
 priced at only:  
**\$169.00**  
 (P1-540)

## Productivity<sup>1000</sup>

### Affordable automation for everyone

Are you dealing with tight budget constraints? Are you tired of getting squeezed for every last PLC dollar you have? If so, then the Productivity series of PLCs has a solution for you.

With a focus on customer satisfaction, the new space-saving Productivity1000 PLC was designed to provide the features you need at a price anyone, not just the big guys, but anyone can afford. Here's just some of what Productivity1000 has to offer:

- Easy plug and play programming
- FREE advanced software with tag name memory addressing
- 50MB of user memory
- Built-in data logging
- Robust communication with Modbus, ASCII and EtherNet/IP support
- Web server and mobile access

On top of all that you also get FREE tech support for the life of the product and many other extras to help you smoothly and successfully complete your PLC project on-time and under-budget.

CPU and I/O Comparison	AutomationDirect Productivity1000	vs.	Allen-Bradley Micro850	Allen-Bradley MicroLogix 1100
CPU/PLC (with Ethernet)	<b>\$169.00</b> P1-540		<b>\$442.00</b> 2080-LC50-240VB	<b>\$704.00</b> 1763-L1688B
(40) 24VDC Inputs (Built-in I/O included)	<b>\$295.00</b> (5) P1-15CDD1 combo		<b>\$586.00</b> (1) 2085-I032 + (2) 2085-OV16	<b>\$872.00</b> (1) 1762-I032T + (1) 1762-0B32T
(32) 24VDC Outputs (Built-in I/O included)				
(4) Analog Inputs (Built-in I/O included)	<b>\$67.00</b> (1) P1-04ADL-1		<b>\$222.00</b> (1) 2085-IR4	<b>\$405.00</b> (1) 1762-IF20F2 combo
(4) Analog Outputs (Built-in I/O included)	<b>\$95.00</b> (1) P1-04DAL-1		<b>\$222.00</b> (1) 2085-OF4	
(4) Temperature Inputs (Based on thermocouple inputs)	<b>\$119.00</b> (1) P1-04THM		<b>\$343.00</b> (1) 2085-IRT4	<b>\$564.00</b> (1) 1762-IT4
Total Length DIN/rail space consumed mm (in)	<b>170mm [6.7"]</b>		<b>349mm [15.50"]</b>	<b>270mm [10.63"]</b>
Total Hardware Cost Includes required terminal blocks, end caps, terminators, etc.	<b>\$787.50</b>		<b>\$1,830.20</b>	<b>\$2,545.00</b>
Programming Software	<b>FREE</b> PS-PPMSW		<b>FREE</b> Connect4 Component WB	<b>\$5,890.00</b> 9324-RL0700XMEHC

All prices are U.S. published estimated retail prices. AutomationDirect prices as of 12/13/2017. Allen-Bradley hardware prices taken from [www.rockwell.com](http://www.rockwell.com), 10/11/2017. Allen-Bradley software price taken from [www.rockwell.com](http://www.rockwell.com), 10/11/2017.  
 \*The price for the MicroLogix 1100 software assumes the professional version, which includes RSNetWorX for EtherNet/IP configuration. No EtherNet/IP - \$2,670.

Get more than you paid for:  
[www.Productivity1000.com](http://www.Productivity1000.com)



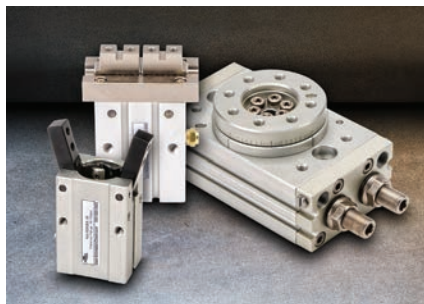
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# RECENTLY ADDED PRODUCTS

## NITRA PNEUMATIC ROTARY ACTUATORS & GRIPPERS



NITRA rotary actuators are available in four body sizes with or without shock absorbers. All are double acting and have an adjustable travel range from zero to 190 degrees. Anodized aluminum bodies include integral mounting slots for position switches and a durable ball bearing hub and integrated piston magnets are standard. The compact design of the NITRA rotary actuators is ideal for general material handling and other industrial applications such as conveying, clamping, transferring parts, positioning, and controlling valves. NITRA rotary actuators start at \$190.00 and are backed by a two-year warranty. NITRA pneumatic grippers are compressed air actuators with jaws (or fingers) to pick up, hold and release objects and are used in a broad range of general automation processes such as pick and place, material transfer, clamping and indexing. Two-jaw parallel and two-jaw angle NITRA grippers are available in seven body sizes and with side mount or end mount grips. Parallel grippers open and close parallel to the object and angle (or angular) grippers open wider than parallel jaws requiring more space. NITRA pneumatic grippers are either double-acting, single-acting normally open, or single-acting normally closed. Gripper bodies are Anodized aluminum and include integral mounting slots for position switches. NITRA grippers are priced from \$67.00 and have a two-year warranty.

Learn more by visiting:

[www.automationdirect.com/pneumatics](http://www.automationdirect.com/pneumatics)

## WENGLOR 3-COLOR SENSORS AND 12-COLOR FIBER-OPTIC SENSORS



Wenglor color sensors from AutomationDirect reliably select color objects in automated high-speed processes based on previously defined reference colors. The sensor pulsed white light is insensitive to extraneous light and makes reliable color recognition possible even at varying scanning distances. Applications include detection of color markings on print marks, labels and packages; color object sorting; verifying color values for painting operations, and spectral measurement of colors in printing processes.

The Wenglor OPT2023 color sensor is capable of evaluating up to 3 colors simultaneously. Single lens optics allows this sensor to have a small spot diameter and large working range. The 3-color OPT2023 sensor is \$295.00 and has a 2-year warranty. The Wenglor OPT2022 12-color fiber-optic amplifier (\$545.00) is a multispectral sensor with 12 switching outputs for detailed color analysis using spectral measurement in ROYGBV color space. Integrated LED technology ensures ideal adjustment of light intensity and reliable evaluation of measured values even with distance fluctuation. Sensor settings are selectable on the built-in graphical display. The OPT2022 sensor can operate in diffuse (reflective) as well as through-beam mode. Starting at \$43.00 and designed for tight spaces, four Wenglor OPT series plastic and glass fiber optic cable options are available for use with the OPT2022 amplifier.

Learn more by visiting:

[www.automationdirect.com/color-sensors](http://www.automationdirect.com/color-sensors)

## BRX ANALOG I/O EXPANSION MODULES



The versatile BRX PLC system from AutomationDirect combines powerful features in a compact, stand-alone footprint. One of the many features of the BRX platform is its ability to expand its capability to fit the application. New analog I/O expansion modules are available in high-resolution current/voltage and temperature models. Starting at \$187.00, two 8-channel analog current or voltage input modules and two 8-channel current or voltage output modules are available. Current signal ranges are 0-20 mA, 4-20 mA; voltage ranges are 0-5 VDC, 0-10 VDC, +/- 5 VDC, +/- 10 VDC. Input and output signal resolution is 16-bits (external 24 VDC required). The new 4-channel temperature module, priced at \$194.00, supports type J, E, K, R, S, T, B, N, and C thermocouples. The module can also be configured for 4-channel millivolt level analog inputs.

These analog expansion modules give the user the ability to add analog I/O as needed for process control applications. Each is clearly identified by the module's front panel color scheme and symbol. Expansion modules easily snap onto the side of any BRX Micro PLC Unit (MPU) creating a rugged PLC platform. Once the expansion module has been snapped in place, the software automatically discovers the I/O with little to no additional setup required. Do-more! Designer programming software for the BRX PLC is a free download with no key code required.

Learn more by visiting:

[www.automationdirect.com/brx-plcs](http://www.automationdirect.com/brx-plcs)



## NEXT GENERATION GS4 SERIES DURAPULSE AC DRIVES ... UP TO 300 HP



The AutomationDirect DURApulse GS4 series of AC sensorless vector drives includes many of the same standard features as current GS drives including dynamic braking, PID, and removable keypad, as well as major enhancements. GS4 drives are available up to 300hp in 460V models, up to 100hp in 230V models. All 230V models can operate in 3-phase or single-phase configurations. Starting at \$422.00, GS4 drives have a 100kA Short Circuit Current Rating (SCCR), a 50°C operating temperature rating, and STO (Safe Torque Off) is built in. Built-in I/O includes eight DC digital inputs, two DC digital outputs (up to 48V), and five analog channels (3 inputs and 2 outputs) configurable for either voltage, current or potentiometer (input). The expansion I/O slot accepts any one of three I/O option cards (DC In/Out, Relay Out, AC Input). GS4 drives support both Modbus RTU and BACnet (serial) protocols as standard. GS4 drives also accept an optional Modbus TCP or EtherNet/IP Ethernet card for fast network access at low cost. The GS4 smart keypad with embedded Quick Start menu can be remotely mounted with a simple bezel kit and a standard Ethernet patch cable. The keypad can configure and store up to 4 complete sets of drive parameters for backup and recovery operations. Beyond initial drive setup, the keypad can be used for run/stop control of the motor and as a scalable speed or frequency display. A fully functional PLC is built in to the GS4 drives, capable of up to 10k ladder logic steps for drive-related logic requirements. Drive and integral PLC programming/configuration is supported with individual free downloadable software packages. Advanced PLC features include real-time calendar/clock and

full PID control. DURApulse GS4 Series AC drive units start at \$422.00 and are backed by a two-year warranty. GS4 drives are CE, TUV, UL and cUL listed.

Learn more by visiting:

[www.automationdirect.com/durapulse-gs4-drives](http://www.automationdirect.com/durapulse-gs4-drives)

## NEW CLICK ETHERNET PLC UNITS WITH BUILT-IN ANALOG I/O



CLICK Series stackable micro brick PLCs are now available from AutomationDirect with both Ethernet communications capabilities and analog I/O built-in. 12 new units provide both discrete and analog I/O including four discrete inputs, four discrete outputs, two or four analog inputs and two analog outputs. These CLICK Ethernet/Analog PLC units are available with a variety of current and voltage (0-20mA, 4-20mA, 0-5VDC, 0-10VDC) inputs and outputs, with 24 VDC or 120 VAC discrete inputs and DC or relay outputs. The units feature one built-in 10/100 Mbps Ethernet communications port for both programming and Modbus TCP networking, plus RS-232 and RS-485 serial ports. CLICK Ethernet Analog PLC units include a calendar/real time clock and battery backup and are configured with easy-to-use programming software (a free download).

CLICK Ethernet/Analog PLC Units have a 2-year warranty and start at \$179.00.

To learn more, visit:

[www.automationdirect.com/click-plc](http://www.automationdirect.com/click-plc)

## STRIDELINX RELIABLE, SECURE REMOTE ACCESS



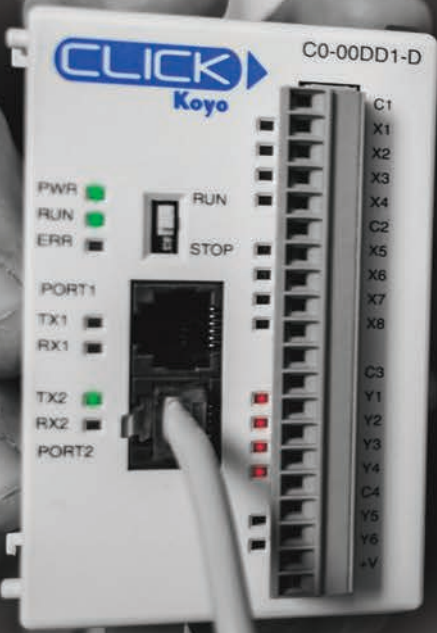
StrideLinX provides secure access over the "industrial internet" to remotely connect to, monitor and troubleshoot multiple field devices. StrideLinX easily and affordably cloud enables any Ethernet-ready device. The StrideLinX platform consists of three types of VPN routers and two antenna sets (Wifi and cellular). 5GB monthly data bandwidth is included free and subscription options include additional bandwidth (up to 50GB) and cloud data logging. The StrideLinX platform allows unlimited users, and unlimited concurrent client and mobile connections. Starting at \$450.00, router options include Gigabit wired, cellular 4G LTE and WiFi. The AT&T 4G LTE model allows access to remote locations that do not have internet access. The WiFi model allows configuration of the router as an access point or client. All models have 4 LAN ports and a WAN port for optional Gigabit wired connections. Cloud Data Logging subscriptions, starting at \$15.00/month, provide added functionality to the StrideLinX remote access platform. These are not needed for the basic function of the VPN remote access, but can be added to enhance the value of the platform. Cloud data logging allows system data to be saved within the platform for a convenient, web-based live or historical record of system performance available whenever needed. StrideLinX's Standard, Professional, and High Resolution Cloud Data Logging records data at 1,000, 5,000 and 20,000 samples per hour, respectively, with unlimited data tags, unlimited cloud storage for 7 years with active cloud logging license, unlimited number of data reports and easy-to-use data dashboards.

[www.automationdirect.com/StrideLinX](http://www.automationdirect.com/StrideLinX)

continued p. 9 >>

# PLC & HMI for less than **\$170**

*plus FREE software and tech support for life!*



**STAND-ALONE PLC  
W/ 14 DISCRETE I/O  
POINTS**  
starting at:  
**\$69.00**  
(C0-00DD1-D)



**3 INCH  
MONOCHROME  
NON-TOUCH HMI**  
starting at:  
**\$98.00**  
(EA3-S3ML-RN)



## Just CLICK for everyday applications

The CLICK PLC family offers extreme value for simple systems where time and resources are limited. The compact size, affordability and easy programming make CLICK great for small applications and beginner projects.

- **NEW!** Ethernet Analog PLC Units with 8 discrete I/O points, Ethernet and serial communication, and up to 6 analog I/O channels built in. Starting at \$179.00
- Easy expansion with snap-on I/O modules for up to an additional 128 discrete or 48 analog I/O points
- Communicate with, and power a low-cost C-more Micro HMI from the RS232 serial port for even more savings
- All CLICK PLCs use our FREE programming software with a simple but practical instruction set

[www.CLICKPLCs.com](http://www.CLICKPLCs.com)

## C-more around your plant for less

C-more Micro HMIs provide graphical system status and operator interaction for a fraction of what you'd pay elsewhere. Paired with the CLICK PLC, C-more Micro panels provide practical and complete control for any small system.

- Numerous sizes up to 10-inch with touch and non-touch screen versions available
- FREE easy-to-use programming software with simulator

[www.CmoreMicro.com](http://www.CmoreMicro.com)



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continued from p. 7

## C-MORE 10-INCH WIDESCREEN & 15-INCH BASE MODEL HMI TOUCH PANELS

### NEW ENTRY-LEVEL 3-INCH C-MORE MICRO HMI PANELS



New additions to the C-more and C-more Micro HMI lines provide more affordable HMI solutions for any budget. Now starting at only \$98, C-more Micro HMIs are perfect for small systems or cost-conscious applications and can display text, graphics, and bitmaps to effectively communicate critical data to operators. These lower priced C-more Micro EA3 series HMI panels, available in touch and non-touch versions, have a 3.1-inch STN LCD monochrome display and 12 selectable LED-driven backlight colors. The panels feature a 128 x 64-pixel display, and five user-defined function keys each with a red LED indicator. Each panel has one RJ12 serial port for programming and PLC connection (supports only AutomationDirect/Modbus PLC protocols). For applications requiring greater functionality, the C-more EA9 line now offers a 10-inch full-featured widescreen model (\$685.00) and a lower cost 15-inch base model (\$1,299.00). Both panels include Ethernet, serial, and USB ports with one or two SD memory card slots. Providing 64K colors and screen resolutions of 1024 x 600 (10-inch) and 1024 x 768 (15-inch) pixels, these panels are NEMA 4/4X and IP65 rated

(for indoor use only) and are programmed using the EA9-PGMSW programming software, priced at \$99.00.

For more information, visit:

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

## MORE HUBBELL-WIEGMANN ENCLOSURES AND ACCESSORIES



Hubbell-Wiegmann NEMA enclosures now include new models in 1, 3, 3R, 3S, 4, 4X, 6, 6P, 12 or 13 ratings. These enclosures are excellent for industrial/commercial applications and configurations including disconnect, pushbutton, padlocking, keylocking, floor-mount, freestanding, stainless steel, knockouts, and consoles/consolets. New model prices start at \$19.50 (A060604), and units are shipped directly from factory. New enclosure accessories include hose-proof fan hoods, designed to increase UL protection to 4X, easily installed over current filter fans and the Filter Fan Plus line. STEGO Ecoline LED lights (from \$43.00) require no special cables/connectors, and add a new convenient clip mount that allows the light to be moved for spot lighting, and a no-switch option for use of independent switching devices.

For more information, visit:

[www.automationdirect.com/enclosures](http://www.automationdirect.com/enclosures)

## NEW SAFETY MATS, EDGES AND RELAYS FROM ASO SAFETY SOLUTIONS

AutomationDirect has teamed with ASO GmbH who, since 1984, has been a leader in providing innovative ASO Safety Solution products such as safety edges, mats and specialized safety relays. Safety mats detect the presence of personnel on horizontal surfaces (usually the floor). ASO safety



mats provide a wide horizontal detection area for personnel and the safety function is triggered when a person steps on the mat. Tapered or straight edge styles allow configuration flexibility. ASO safety mats start at \$285.00. Safety edges can be used on any surface, usually near possible crushing or shearing points and are touch-sensitive devices that detect presence at possible danger points. The safety function is triggered when a person or object contacts the edge. They are typically installed near automatic gates and other machinery to protect individuals from bodily harm or machinery from damage. ASO safety edges start at \$36.00. The ASO Safety Solutions safety relay module (\$169.00) is a specialized relay used to wire both mats and edges for fail-safe triggering of the intended safety function. Safety mats are cULus rated and safety edges are cURus compliant. Both mats and edges are CE, RoHs, Reach compliant and carry a one-year warranty.

For more information, visit:

[www.automationdirect.com/safety-mats-edges](http://www.automationdirect.com/safety-mats-edges)

## EXTENDED SENSING RANGE AC POWERED INDUCTIVE PROXIMITY SENSORS



New V3 series AC powered inductive proximity sensors from AutomationDirect

continued p. 10 >>

continued from p. 9

are available in 8, 12, 18 and 30mm sizes. Extended sensing distances for these new sensors range from 2mm shielded and 4mm unshielded for 8mm sensors to 12mm shielded and 18mm unshielded for 30mm sensors. These sensors operate on 20-250 VAC/VDC input voltage with N.O. and N.C. output options available. The sensors are short-circuit protected and have a yellow LED status indicator that is output energized. Axial cable and 1/2 in. micro AC quick-disconnect models are available and all sensors are IP67 protection rated. The sensors are cULus approved and are CE, RoHs and Reach Compliant.

AC powered V3 series inductive proximity sensors start at \$37.00 and are backed by a lifetime warranty.

[www.automationdirect.com/proximity](http://www.automationdirect.com/proximity)

## CONTINUOUS FLEXING CONTROL CABLE



Continuous flexing control cable is now part of the AutomationDirect bulk multi-conductor wiring and cable product line. Continuous flexing cables are designed to be exposed to constant flexing during their operation and withstand millions of flex cycles. CF5 and CF6 multi-conductor control cables from igus are specifically designed, tested, and manufactured for continuous flexing, high mechanical load application requirements, and will provide a guaranteed service life between 5 million and 10 million cycles when operated within specified conditions. Starting at \$10.25 for a 20-foot coil, igus Chainflex® cables are available with 3 to 25 unshielded (CF5 series) or 4 to 12 shielded (CF6 series) conductors in 20 AWG to 14 AWG sizes. Chainflex cable is sold in 20, 50, 100, 250 and 500 ft. lengths. Chainflex individual conductors are bare copper and stranded for flexing applica-

tions. Conductor insulation is high-quality black TPE mixture for 20AWG and black PVC mixture for 18 through 14 AWG. Individual conductors are marked with white numbers for easy identification and a ground conductor with green-yellow insulation is included in each cable. Cable outer jackets are a low-adhesion pressure extruded PVC mixture that is resistant to sunlight, oil penetration, and is flame retardant. Chainflex cables have a unique tear strip underneath the outer jacket (unshielded) or underneath the inner jacket (shielded). The jacket can be opened like a zipper to the desired length by pulling on the special tear strip and the outer jacket/inner jacket removed from conductors. The tear strip saves time and effort for electricians and assemblers, and reduces the requirement for additional stripping tools.

For more information, visit:  
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## NEW SUREMOTION LINEAR SHAFTS, SHAFT SUPPORTS AND ROTARY SHAFTS



SureMotion® shafts are precision ground for exceptional straightness, accurate diameters, and a surface finish of 10RMS. Linear shafts are available in C1060 medium-carbon steel or 440C stainless steel, and are heat treated for additional hardness. Starting at \$7.75, carbon and stainless steel shafts are made in the USA and are available in 12, 24, and 36-inch lengths and 0.5", 0.75", and 1.0" diameters. Starting at \$9.50, SureMotion hard-anodized aluminum supports offer superior shaft holding strength and are available in standard-height 6061 T6 black and low-profile 6061 T6 gray aluminum designs. The removable-top design allows easy removal of the shaft while maintaining alignment with connected equip-

ment during servicing. Alloy-steel fasteners are included.

SureMotion hardened rotary shafts (from \$2.50) are available in diameters up to 3/4 inch and precut lengths up to 36 inches. SureMotion 303 stainless steel grooved rotary shafts, starting at \$3.25 and available in 3" to 12" lengths, are precision ground, hardened and grooved for retaining rings with spacings to fit typical bearings.

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[www.automationdirect.com/power-transmission](http://www.automationdirect.com/power-transmission)

## MARATHON STAINLESS STEEL AND JET PUMP MOTORS



New Marathon Powerwash SXT wash-down duty motors are designed for use in food and beverage processing and other washdown environments. The all stainless-steel totally enclosed motors are available in single and three-phase configurations. C-face with rigid base (footed) and C-face footless mounting options are available. Marathon Powerwash motor prices start at \$320.00. Jet pump motors are commonly used in commercial and industrial water treatment and processing applications to power centrifugal and hydraulic pumps. Marathon jet pump motors are available in single and three-phase configurations, and in TEFC and Open Drip Proof (ODP) designs. The ODP design allows air to circulate through the motor windings for cooling, but prevents drops of liquid from falling into the motor. The increased air flow means lower operating temperatures and increased efficiency when compared to TEFC or TENV motors. Marathon jet pump motors start at \$143.00

For more information, visit:  
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# WHICH PLC IS FOR ME?

By Bill Dehner, AutomationDirect



As with any engineering decision, it's always best to put it on paper first to see the "big picture". The same holds true when choosing the most effective PLC for your application. This choice depends on a number of factors and the following steps serve as a checklist of things to consider when determining PLC requirements. Listed are the most important areas to consider when choosing a control system and can help determine your system needs.

## Step 1. Proposed System

Determine whether your system is new or existing. Will your system be installed from scratch or are there existing products already installed? The rest of your system will need to be compatible with new components.

Why this is important: Certain controller products may not be compatible with others. Making sure your existing products are compatible with any new products you are researching will save you time and money.

## Step 2. Environmental Issues

Consider any environmental issues that will affect your application (temperature, dust, vibration, codes specific to your facility, etc.)

Why this is important: Certain environments may affect the operation of a con-

troller. For example, typical controllers have an operating temperature of 0-55 degrees Celsius (32-130 degrees F). If your application will include any extreme environmental conditions, or you have specific codes at your facility that must be met, you will need to either research products that meet those specifications or design the installation to meet requirements.

## Step 3. Discrete Devices

Determine how many discrete devices your system will have and which types (AC, DC, etc.) are needed.

Why this is important: The number and type of devices your system will include is directly linked to the amount of I/O that will be necessary for your system. You will need to choose a controller that supports your I/O count requirements and has modules that support your signal types.

## Step 4. Analog Devices

Determine how many analog devices your system will have and which types (voltage, current, temperature, etc.) are needed.

Why this is important: Same as with discrete devices, the number and type of devices your system will include is directly linked to the amount of I/O that will be necessary for your system. You will need to choose a con-

troller that supports your I/O count requirements and has modules that support your signal types.

## Step 5. Specialty Modules or Features

Determine whether your system will require any specialty features. Will your application require high-speed counting or positioning? What about data logging, a real-time clock, or other specialty feature?

Why this is important: Specialty functions are not necessarily available in a controller CPU or in standard I/O modules. Understanding the special functions your system may perform will help you determine which CPU to choose and whether or not you will need to purchase additional specialty modules.

## Step 6. CPU Requirements

Determine the type of CPU you will need. How much memory will your system require? How many devices will your system have (determines data memory)? How large is your program, and what types of instructions will your program include (determines program memory)? How fast a scan time do you need?

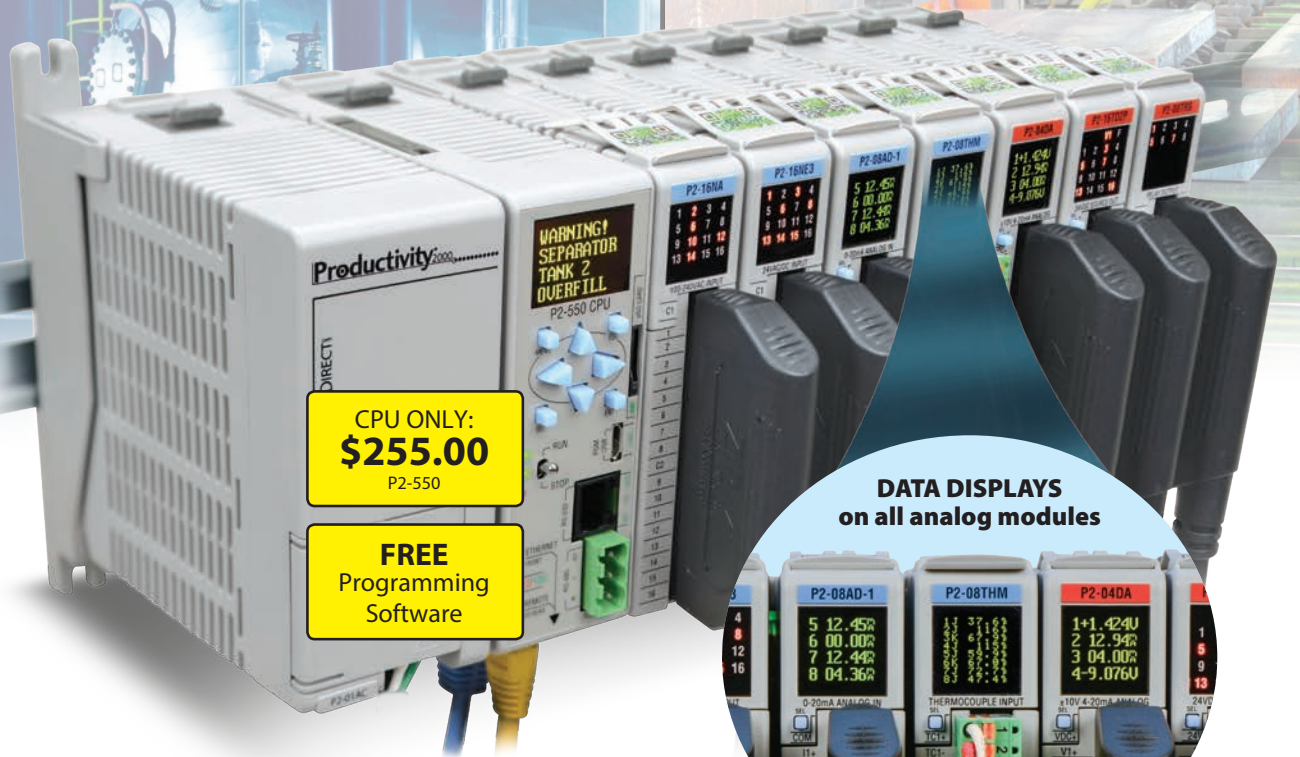
Why this is important: Data memory refers to the amount of memory needed for dynamic data manipulation and storage in the system. For example, counter and timer instructions typically use data memory to store setpoints, current values, and other internal flags. If the application requires historical data retention, such as measured device values over a long period of time, the size of the data tables required may determine the CPU model you choose.

Program memory is the amount of memory needed to store the sequence of program instructions that have been selected to perform the application. Each type of instruction requires a specific amount of program memory, typically defined in a programming manual. Applications that are basically sequential in nature can rely on the I/O device rule of

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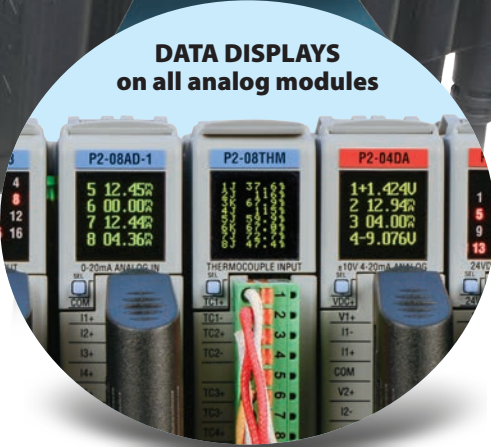


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thumb to estimate program memory (5 words of program memory for each discrete device and 25 words for each analog device); complex applications will be more difficult to judge.

If scan time is important in your application, consider the CPU processor speed as well as instruction execution speed. Some CPUs are faster at Boolean logic but slower with data handling instructions. If special functions such as PID are required, the CPU you select may make those functions easier to perform.

## Step 7. I/O Locations

Determine where your I/O will be located. Will your system require only local I/O, or both local and remote I/O locations?

Why this is important: If subsystems will be needed at long distances from the CPU, you will need a controller that supports remote I/O. You will also have to determine if the remote distances and speeds supported will be adequate for your application.

Ethernet-connected I/O hardware is becoming one of the more popular communication standards. This I/O may also be referred to as distributed I/O, and may require a particular protocol, such as Modbus.

## Step 8. Communications

Determine your communication requirements. Will your system be communicating to other networks, systems or field devices?

Why this is important: Communication ports (other than the programming port) are not always included with a controller. Knowing your system communication requirements will help you choose a CPU that supports your communication requirements, or additional communication modules if necessary.

## Step 9. Programming

Determine your programming requirements: Does your application require only traditional programming instructions, or are special instructions necessary? Do you prefer

fixed memory addressing or tag name based control? Which programming language are you accustomed to?

Why this is important: Certain controllers may not support every type of instruction. You will need to choose a model that supports all instructions that you may need for a specific application. For example, built-in PID functions are much easier to use than writing your own code to perform closed-loop process control. Typical instructions such as timers, counters, etc., are available in most controllers. Also, many variations exist when it comes to the programming language (ladder logic, structured text, etc.) and memory addressing (fixed or tag name based). Choose the programming package that you are most comfortable with and that will offer the most ease-of-use when developing, troubleshooting and maintaining.

## What's next?

Once you have your control system specifications, it's time to decide which PLC



is right for the job. PLC suppliers are abundant in today's industrial automation market. With so many choices it can often get confusing as to which PLC will work the best for your application. At AutomationDirect, we try to serve the controller needs of as many industrial automation professionals as possible. Therefore, we offer many PLC choices each intended to fulfill a particular need or purpose.



## CLICK – The beginner's best friend

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## Productivity – Break free from A-B!

The Productivity family of PLCs was designed for those who prefer the custom memory allocation that tag name based controllers provide and to provide a low-cost alternative for those familiar with Allen-Bradley controllers.

Buying the right PLC can sometimes seem like a daunting task, but compiling a list of requirements beforehand can get you headed in the right direction and make you more confident with your final decision. If you have any questions on the hardware capabilities of our many PLCs try our interactive tool at [www.go2adc.com/select-plc](http://www.go2adc.com/select-plc) or contact our tech support group at 1(800) 633-0405; they're always happy to help. ■



## Do-more! – Master your control challenge with the power of Do-more!

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## LOCAL HIGH SCHOOLS TAKE HOME GOLD AT GEORGIA ROBOTICS COMPETITION



**C**ongratulations to South Forsyth and Forsyth Central High Schools on their huge win at the Georgia Robotics Invitational Tournament and Showcase (aka “GRITS”) in October 2017.

This was the last opportunity to play last season’s STEAMWORKS game against all the top teams in Georgia. Last year’s seniors have moved on so it was up to the new teams to carry on the proud tradition of robotics excellence in Forsyth County, and they didn’t disappoint by bringing home both first and second place at the tournament.

AutomationDirect sponsors the “Forsyth Alliance”, an umbrella organization that provides funding, materials, services, supplies and mentors to over 125 robotics teams in Forsyth County, GA. The Forsyth Alliance started 12 years ago with a single team. Over the following decade the program has grown to one of the largest of its kind in the world.

And the young man that started the first Forsyth Alliance team? He is now an AutomationDirect employee. So AutomationDirect’s philanthropy has come

full circle! Many former students have come back to work in our local community and teach STEM curriculum in Forsyth County where they are raising the next generation of engineering professionals.

The Forsyth Alliance even produced the top robotics team in the world at one World competition last year. What an incredible feat!

We wish all the robotic teams the best as they ramp up for a new robotics season and can’t wait to share in their success.

## AUTOMATION-DIRECT WINS THREE CATEGORIES IN AUTOMATION WORLD’S 2017 LEADERSHIP IN AUTOMATION AWARDS

PMMI Media Group’s Automation World magazine announced the First Team category leaders in the 2017 Leadership in Automation Program on January 11, 2018. Automation World, a leading business

magazine serving automation professionals, launched this community-based program in 2010. Over the course of last year, automation professionals were invited to vote for their preferred automation vendors in unaided-recall surveys (not multiple choice).

Over two dozen categories were featured, representing the wide variety of automation technologies, products and software in use by today’s manufacturing professionals across the discrete, batch and continuous process manufacturing industries. First Team Honorees were recognized for innovation, leadership and excellence among suppliers of industrial controls. AutomationDirect was awarded First Team Honors by the Automation World community in the following three categories:

- HMI Hardware**
- PLCs/PACs**
- Sensors-Process**



The AutomationDirect C-more touch and micro panels lead a strong contingent of HMI Hardware products. These products include operator interface touch and text panels, industrial LED message displays, industrial monitors and HMI software.

The new Do-more BRX PLC and Productivity1000 stackable micro PLC are just





a few of the complete line of programmable controllers available. These controllers lead the PLCs/PACs category by providing easy control implementation and the latest in PLC technology, along with award-winning support and free PLC programming software.

In the Sensors-Process category, AutomationDirect delivers a wide range of sensors, as well as process control and measurement devices for detecting position, proximity, pressure, temperature, level, flow, current, voltage, etc. These sensors and transmitters provide data critical to automating any machine or process.

"We're pleased to recognize the First Team Honorees who offer both excellent customer service and best-in-class product innovation," commented Kurt Belisle, Publisher of Automation World. "We appreciate the end users who took the time to vote for their favorite solution providers. Congratulations to the honorees!" Leadership in Automation First Team Honorees were recognized in Automation World's January 2018 issue, available here: <http://www.automationworld.com>

AutomationDirect would like to thank all the professionals who voted for us in 2017. We also encourage you to vote us for the 2018 **Leadership in Automation** program. As the leading online store for industrial controls, we work hard to promote excellence in the automation community, and to provide solutions and support to satisfy your needs.

## BRX PLCS – TWO-TIME ENGINEERING AWARD FINALIST

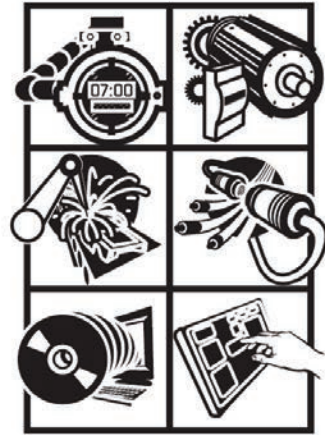


Do-more BRX PLCs hit the market in early 2017 and have garnered a lot of positive feedback since then, and received much attention

from readers of both Control Engineering and Plant Engineering magazines. BRX PLCs have already been recognized by Control Engineering's Engineer's Choice Awards and they are currently a Finalist in the Automation and Controls category for Plant Engineering's 2017 Product of the Year Awards. Plant Engineering selected the Do-more! BRX series micro PLC for its innovative hardware design, easy configuration and control capabilities. Over 25 years of PLC hardware design knowledge has gone into the BRX PLC, to the benefit of control system designers, programmers, technicians and end users. Besides the built-in discrete, high-speed and analog I/O options, the BRX platform includes onboard serial communication with an Ethernet option, and an additional user-selected, hot-swappable communications port supporting serial, Ethernet or USB communication. Easy I/O expansion is available with the numerous snap-on I/O expansion modules when extra I/O is required. The BRX PLC's software, Do-more Designer, boasts one of the most comprehensive instruction sets in the market. With an instruction library that includes data-centric instructions, enabling custom data logging/file handling operations, and integrated motion control for performing simple to advanced move profiles, BRX PLCs have what it takes to tackle the most demanding applications. On top of that, the software also provides an easy-to-use PLC simulator and embedded video help for times when a little guidance is needed.

The winners of Control Engineering's Engineer's Choice Awards were announced in February with BRX PLCs taking the Honorable Mention award. The winners for Plant Engineering will be announced on April 2, 2018, in Chicago. To read more about these annual award programs please visit [www.controleng.com/events-and-awards/engineers-choice-awards/](http://www.controleng.com/events-and-awards/engineers-choice-awards/) or <https://www.plantengineering.com/events-and-awards/product-of-the-year/>

# CONTROL ENGINEERING



## 2018 ENGINEERS' CHOICE AWARDS

FINALISTS



# CHOOSING THE RIGHT FACTORY AUTOMATION CONTROLLER FOR YOUR APPLICATION

By Jeff Payne, the Automation Controls Group Product Manager at AutomationDirect

**Picking the right hardware is critical, but make sure to include the controller programming software in the evaluation process as it will determine ease of use.**

**W**hen selecting a controller for factory automation, it's not just about whether a PLC, PAC or PC should be used. It's also about defining the requirements for the application, including control basics and scalability for the future.

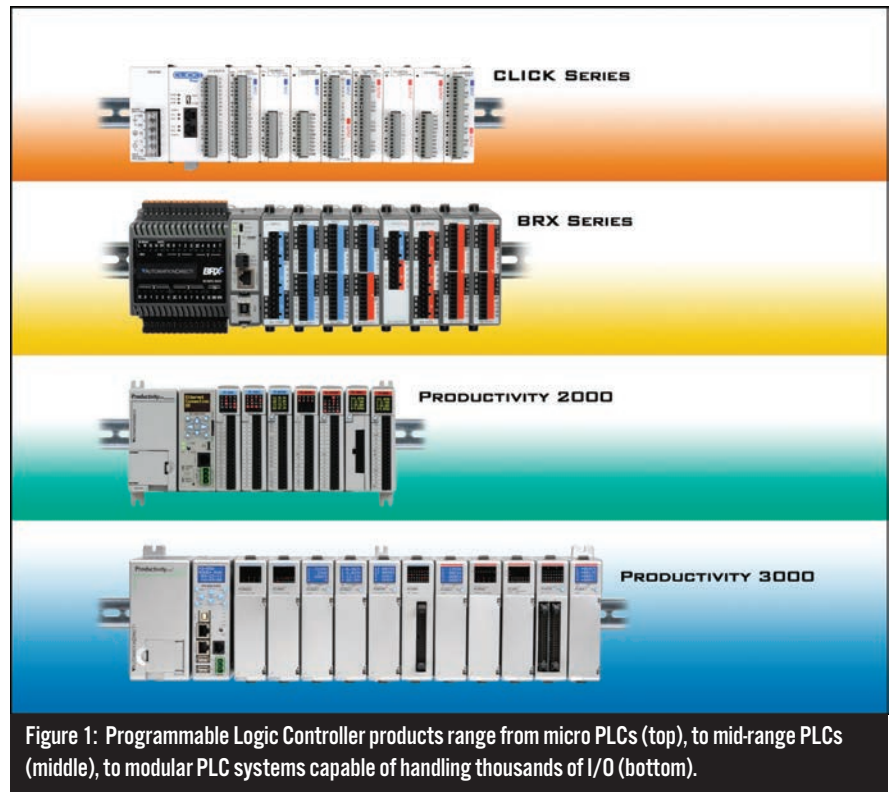
This article looks at some of the requirements to consider when choosing a controller for factory automation to ensure the hardware and software are right for the application and are future proof. The programming software platform can be just as important as picking the right hardware, so it needs to play a big part in the evaluation.

For machine or process control, typical families of controllers include programmable logic controllers (PLCs), programmable automation controllers (PACs) and industrial PCs (IPCs). There are many differences among these controller types, but their features and functionality are merging.

While the PLC was first to the game as a relay replacer, and it remains the best choice for small- to medium size-applications, its capabilities are growing as new technologies are adapted. Many lower-end models use ladder logic programming, which is sufficient for most applications. More expensive PLCs allow the use of function block and other IEC 61131 languages.

The PAC adds capabilities to the PLC including improved motion, safety and vision capabilities. PLC-based PACs are also available as a subset of this class of controllers, providing PAC power with PLC ease of use. IPCs are a good choice for the most complex applications due to their more advanced features and the ability to work with additional languages such as variants of C.

Regardless of which controller family is chosen, vendors offer a wide variety of controller form factors within each family, from small to medium to large. (Figure 1)



**Figure 1: Programmable Logic Controller products range from micro PLCs (top), to mid-range PLCs (middle), to modular PLC systems capable of handling thousands of I/O (bottom).**

Within each family of controllers, there are many configuration options, and different combinations of built-in and remote I/O. Communications options also abound, from simple serial to Ethernet. Hardware configurations may also include standalone controllers with built-in I/O, often called bricks, that often can be expanded with stackable I/O and rack-based options.

## Controller Selection Considerations

While understanding the specifications of the controllers being evaluated is critical—application requirements, plant personnel capabilities, and future connections are also important factors in the decision process. Some key controller selection considerations

are listed in Table 1 (pg. 20) and discussed below.

Some facilities are very automation savvy and able to handle a wide range of controllers and equipment, while others have limited familiarity with newer technologies. PLCs are the primary automation tool for many industries and applications because they provide accurate, reliable and modifiable control, while being easy to work with due to their widespread use and familiarity.

If plant personnel are new to PLCs, then a small and simple controller is a good choice. These types of controllers are the easiest to use, but can be easily expanded, and have many of the features of larger PLCs.

continued p. 20 >>



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## Application Drives Selection

With plant personnel capabilities understood, the next step is examining application requirements. A good starting point is to estimate the number of discrete and analog input and outputs. A list of major components, such as actuators and cylinders—along with sensors, such as position and presence—will help determine an accurate count.

In addition to discrete machine and analog process functions, some PLCs have evolved to perform complex tasks such as motion and PID control (Figure 2). This type of controller can handle complex applications such as a high-speed packaging line using registration alignment or synchronized velocity control with encoder feedback.

Key Controller Selection Considerations
• Automation experience of plant personnel
• Number and type of I/O
• Required control functions: closed-loop PID, motion, high-speed, etc.
• Communication options
• Data collection requirements
• Special function requirements

TABLE 1: Key Controller Selection Considerations



Figure 2: Some controllers are designed to handle a wide range of automated machines and process.



## Controller Programming Software Considerations

- Ease of programming
- Preferences and comfort zone
- Time and money investment
- Training resources available
- Data logging and remote access

TABLE 2: Controller Programming Software Considerations



Figure 3. PLC programming software provides access to data for both system development and monitoring.

Servo and variable speed drives used for some motion control functions usually don't require coordination, but can still be quite complex in terms of communication and other requirements. There are many controllers available that can communicate to multiple drives at one time to command position, speed or torque. RS-232, RS-485, Ethernet and other options are all valid choices to communicate to drives. Digital communication protocols such as these are the better choice as compared to discrete I/O because they simplify wiring, allow more parameters to be monitored and commanded, and are more flexible to accommodate changes.

Data collection requirements should also be considered. Fortunately, many controllers, even some of the new small PLCs, have not only communications built in, but also data logging, web server access and email capabilities. The ability to write data to micro SD cards is another feature

worth having in many cases, along with web server functionality and remote access.

Some applications require safety ratings to meet regulatory requirements. While the application may suggest use of a safety-rated PLC, considering a non-safety rated PLC along with one or more programmable safety relays can greatly reduce cost, while still providing the required functionality.

## Software Determines Ease of Use

Software programming is about half the effort on a typical automation project, but the time required to program the controller and the required level of expertise can vary widely depending on the controller programming software (Figure 3). Table 2 lists some of the leading considerations for evaluating software.

Simple, and sometimes free, software with limited programming instructions covers

most applications suitable for use with these small controllers. While some controllers may only have 20 or so types of instructions—such as contacts, coils, timers and counters—this is usually sufficient for small applications. As machine size and complexity increases, most midsize and larger PLCs provide software platforms with many instructions, but these take longer to learn than their simpler counterparts.

Controller programming software choices often have much to do with a user's preferences and comfort zone. While the hardware required is directly driven and determined by the application requirements, selection of software is often more of a subjective decision. Many programmers have a strong opinion of what software is better, but for most companies, it's best to enforce a standard controller programming platform, along with consistent methods of programming.

Users should consider training resources available when selecting programming software. The Internet and growth of multimedia has changed the way programmers learn and develop applications. Huge libraries of technical information and user manuals exist online. However, not all suppliers are created equal when it comes to training resources, so careful evaluation is a must.

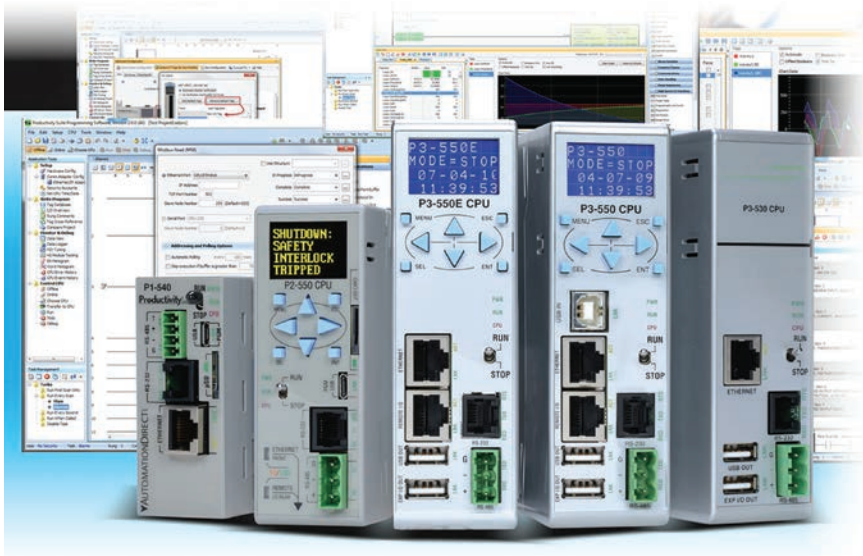
Some suppliers have extensive online documentation, and also have videos embedded directly in the software development platform. This quickly improves understanding and fluency with the programming software.

The availability and cost of tech support should also be considered. Some suppliers offer free tech support, with phones answered quickly by technical experts. Others charge for this type of service, with their free service limited to automated and usually frustrating and useless canned responses.

Once the software program is developed, it needs to be tested. The programming software should include the ability to view PID loop response and motion profiles, and to simulate other functionality in software. Built-in project simulators can be a huge timesaver allowing code to be tested without the hardware present or before being downloaded to an existing system.

There are many considerations when selecting the right factory automation controller for your application, in terms of both hardware and programming software. For all but the smallest company, it's unlikely one size controller will fit all, so it's better to instead pick the right family of controllers, one capable of handling the entire range of your company's requirements. ■

# PRODUCTIVITY SERIES: SCALABLE FROM TOP TO BOTTOM



controllers has many common features that can benefit their users. This includes but is not limited to:

- Tag name base programming
- Tremendous communications capabilities
- Integrated data logging to removable media (USB or uSD)
- EtherNet/IP & Modbus TCP protocols standard
- Large memory capacity for program and user memory
- And many more

However, a key benefit of the Productivity Series is the scalability of the control program. The Productivity Series now has three controller platforms (P3000, P2000, P1000), each with their own unique hardware features, but very similar in programming and functionality. These systems were designed so you can write a program in one controller and easily port to another. By using the Project Conversion utility within the software's hardware configuration, you can convert from any P-series hardware platform to another and retain the same program.

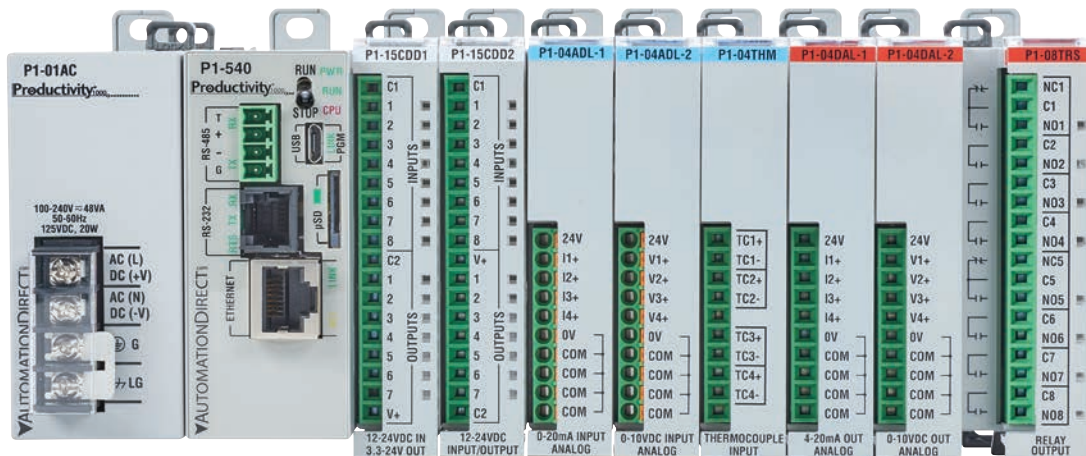
**W**ith the release of the Productivity1000, the newest and smallest of the Productivity Series controllers, we now have a scalable product offering that gives you the flexibility to design your control system program for a broad range of applications and sizes, without sacrificing functionality.

The Productivity1000 (P1000) is a compact, stackable micro Programmable Logic

Controller (PLC). While it may be small in stature, it has a big heart. How big you may ask? 50MB to be exact. That's the amount of memory included in the \$169 P1-540 CPU, the heart of the control system.

The new P1000 PLC complements an already existing and mature platform of programmable controllers that includes the Productivity3000 (P3000) and Productivity2000 (P2000). This series of

## Productivity<sup>®</sup>Series.....





## Why is scalability important to so many?

For many Original Equipment Manufacturers (OEMs), System integrators (SIs) and some end users, having a PLC family that can use a single or similar program and be ported across various platforms for different machine configurations is an incredible time saver.

Some machines may be advertised as a complete solution that includes multiple functional modules:

1. Product preparation
2. Process stage 1
3. Process stage 2
4. Process stage 3
5. Inspection phase
6. Packaging
7. Etc.

However, some customers may be integrating into an existing production environment that

already contains elements of the full solution, or perhaps they simply do not require initial prep for the product, inspection or packaging. It's possible they're only interested in the main three modules of the process.

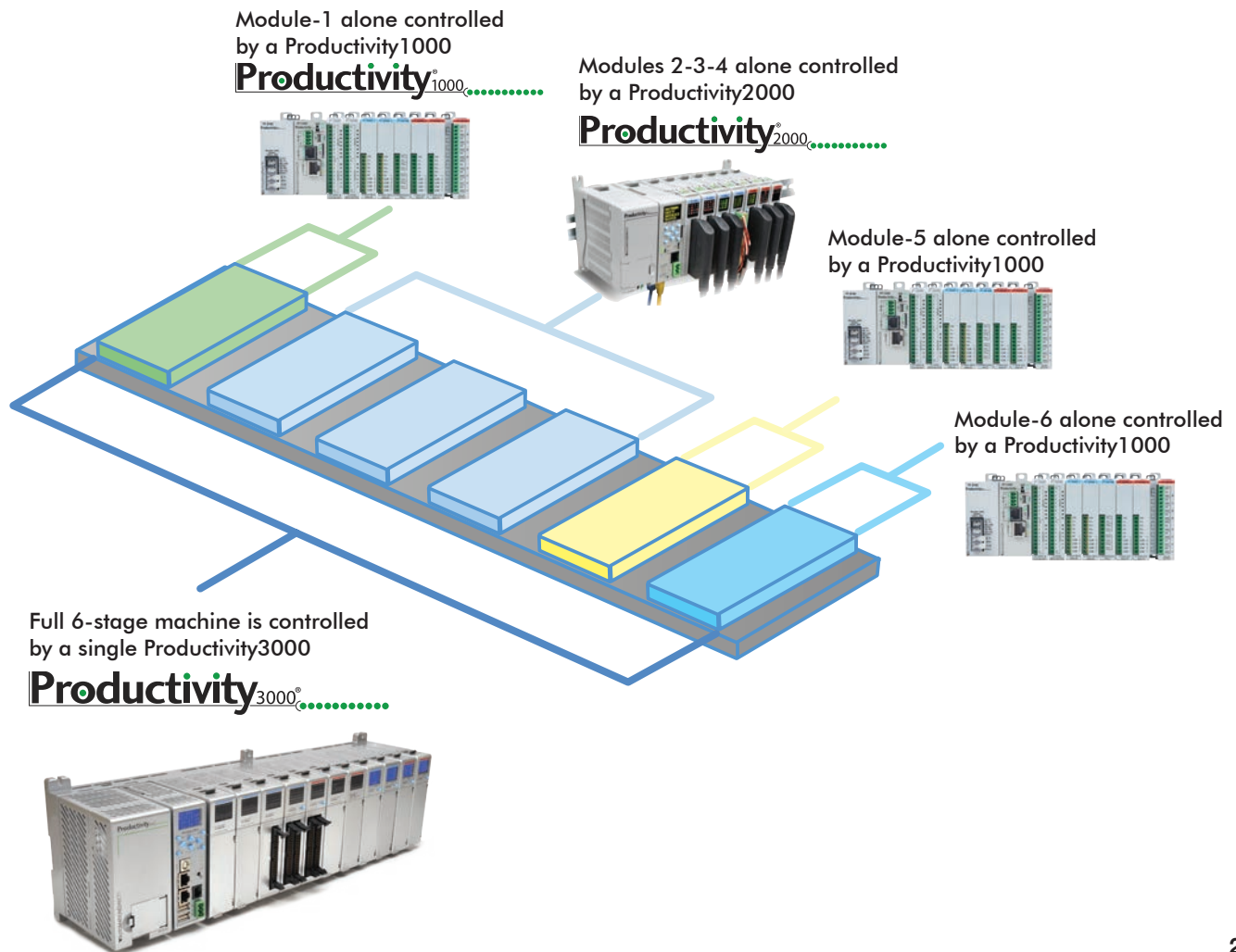
Depending on the application, this may drastically change the look, size, functionality and specifications required by the customer. In the example below, the full 6-stage process program was designed with the Productivity3000 hardware to accommodate the I/O requirements for the entire system.

So if a customer only requests the core of the system (modules 2-3-4), the P3000 is now likely overkill and would be costly to continue to use. In this case, the OEM or SI can simply substitute the P2000 hardware and convert the project. In minutes the original program can be converted and the unnecessary tasks can be moved to the Disable Task folder or deleted from the program completely.

Similarly, if a customer is looking to add just an inspection module to an already existing application, they may determine the P1000 is powerful enough to handle the processing requirements and can accommodate the minimal I/O needed for this particular stage. Same process ... Begin with the original program, convert the project and remove the unnecessary tasks.

Consider a machine that is configured around a PLC line without a scalable offering. Now the OEM or SI could be forced to select a completely different PLC line for smaller or larger variations of the same application. This is time consuming and costly for the programmer as well as the end user, who is now forced to support multiple varieties of controllers that do not use a common programming environment.

On the other hand, the scalability offered by the Productivity Series of controllers ensures the right amount of control for each particular application. ■



# DO-MORE PLC REVIVES GAS DISTRIBUTION PROCESS

KCC Software fuels the safe and reliable upgrade of a highly flammable, corrosive and toxic gas distribution system for semiconductor tools.

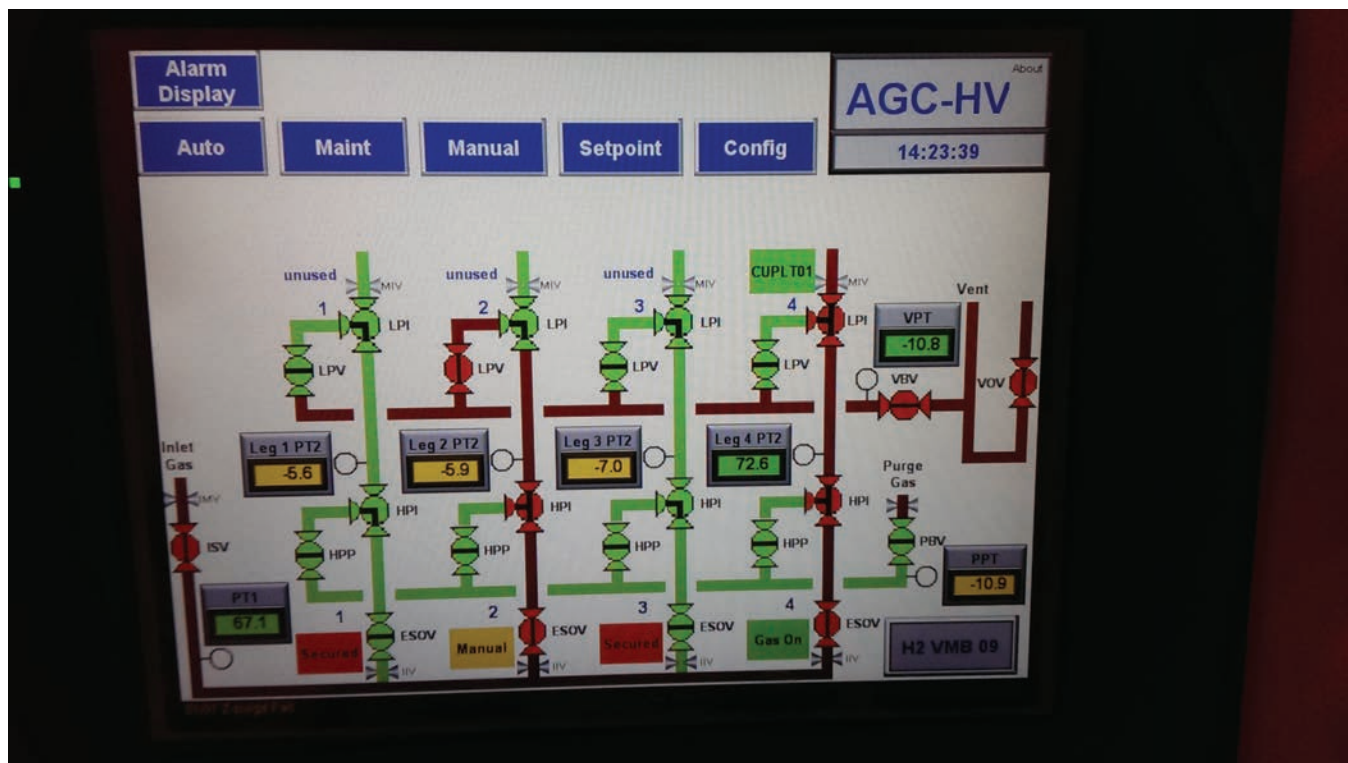


Figure 1: The graphics and usability of this AutomationDirect C-more Touch Panel were improved to show gas distribution gas from a single supply point to multiple production tools.

A semiconductor manufacturer of memory and drive head technologies, Headway Technologies in Milpitas, California is a part of the TDK group of companies, the largest independent recording head supplier in the disk drive industry. Headway designs and manufactures recording heads for high-performance hard disk drives.

Headway Technologies could no longer tolerate production interruptions, and its first step in the solution process was to contact KCC Software, an experienced system integrator with clients in over 27 states, to upgrade its automatic gas control (AGC) system.

In his May 2017 NASA Tech Briefs Automation System Manages Critical Gas Distribution Process article, Scott Martin, owner of KCC Software explains how his company upgraded Headway's aging AGC system. Martin made his passion for supporting U.S.-based manufacturers clear as he describes how he used an AutomationDirect Do-more PLC and over twenty years of experience in steel,

textile and automotive industry to upgrade a portion of Headway Technologies' manufacturing process.

A semiconductor manufacturer of memory and drive head technologies, Headway Technologies in Milpitas, California is a part of the TDK group of companies, the largest independent recording head supplier in the disk drive industry. Headway designs and manufactures recording heads for high-performance hard disk drives.

"In Headway's manufacturing processes, industrial gases are used extensively due to the cleanliness demands of their high-density semiconductor products," says Martin in the NASA Tech Briefs article. "A valve-manifold box (VMB) distributes gas from a single supply point to up to eight production tools (Figure 1)."

"As the gas is distributed through multiple legs, with one leg per process tool, the gas pressure is monitored constantly at multiple points", continues Martin in the article. "Many of these gases are highly toxic, corrosive and/or flammable," he says. "The VMB not only

monitors gas delivery, but also provides multiple purge and maintenance functions when the gas manifolds, gas delivery legs or components need to be maintained or replaced."

## Safely Purge the Process

Under normal operation, the gas delivery system is active most of the time. The AGV system insures adequate gas flow and pressure are maintained by monitoring up to five gas pressure transducers and several gas flow switches. Gas pressure is monitored continuously, and any pressure out of limit conditions must be responded to immediately. A depleted supply or possible leak are indicated by a decrease in pressure, and closure of manual valves or blockages often cause an increase in pressure.

A purge sequence is executed during maintenance of valves, regulators and transducers when the AGC system is not active. "As many of these gases are toxic, flammable or both—a very detailed purge routine is required to first insure all process gas is



removed from the lines,” points out Martin in the article. “A purge process can take hours to ensure all gasses have been evacuated.”

When starting back up after maintenance work, the gas lines must be free of contaminants, so a similar purge process must run. Once the gas lines are purged and clear of contaminants, gas can be reintroduced while the control system carefully monitors all flow and pressure transducers to ensure they are within the defined operating parameters.

These purge and monitoring routines are where the control system automation is critical. “These detailed purge routines and procedures create the greatest demand for an AGC system,” notes Martin in the NASA Tech Briefs article. “Gas delivery alone could be accomplished in a manual or semi-automatic fashion. However, to provide the greatest safety for the equipment and personnel involved in the maintenance of the equipment, the AGC and VMB, with advanced controller and automatic functions, is the route most manufacturers prefer.”

## Upgrading the Controllers

Seven VMBs are located throughout the clean rooms near production equipment at Headway Technologies’ facility. The process control equipment continually monitors several gas leg-specific and general alarm conditions including leg high pressure, excess flow, high temperatures, jacket leaks, leg

emergency gas off—along with seismic, smoke and fire detector status. Many other critical parameters are monitored including high, high/high and low delivery pressures

“Due to a series of large power spikes, many of the AutomationDirect DL205 WinPLC CPUs in the plant were damaged, although the I/O for these PLCs remained intact,” explains Martin. “As a result of CPU failures due to power spikes, and AutomationDirect’s announcement in 2015 that the CPU was no longer recommended for new installations, Headway Technologies decided to upgrade the automation controllers. Since KCC designed and developed the program for the original system, it was contacted to assist with the upgrade.”

## An Experienced Integrator

Specializing in PLC, PC and database integration, KCC Software, a system integrator in Huntsville, Alabama, has been in business for over 20 years. Typical clients include larger engineering firms with a wide variety of mechanical and electrical skills but little automation design and programming capabilities. On other projects KCC works directly with an end user, such as with Headway on this project.

KCC Software was familiar with the original AGC and VMB systems, so Headway Technologies selected them for this new integration project. AutomationDirect PLCs were also in use at the facility, and KCC has developed and installed dozens of systems

using these PLCs. As an AutomationDirect SI Direct system integrator, KCC partners with AutomationDirect in many industries that KCC serves including semiconductor, automotive, steel and textile.

“After reviewing the situation at Headway, KCC recommended the existing automation system be retrofitted with a new AutomationDirect Do-more H2 Series Programmable Logic Controller CPU,” relates Martin in the article. “Selecting this newer PLC CPU provided Headway Technologies with a system offering 10-years plus of service and support. Costs were minimized because of the low price of the new CPU, and because the new CPU was able to work with the existing I/O (Figure 2).”

The mechanical components of the VMBs were still in great shape, so there was no need to replace them, continued Martin. “But in addition to the PLC CPU, the existing 12-year-old HMI had to be replaced as well because it did not have a driver for communications with the new CPU,” he says in the article. “Replacing the existing HMI would simplify integration with the CPU, and would allow for addition of new features, along with extending service and support.”

The new PLC works with the installed, original AutomationDirect DirectLOGIC DL205 hardware. This backward compatibility made the CPU hardware upgrade simple and cost-effective since no I/O modules needed to be changed. All wiring remained intact, which shortened the time required to complete the project.



Figure 2: The new AutomationDirect Do-more PLC worked with all the existing I/O modules and wiring.

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### Electric model (shown) also includes:

- Adjustable electric soft start
- Electric shut-off valve
- Adjustable pressure switch with LED indication

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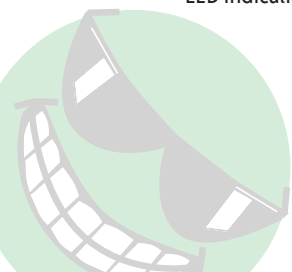
	AutomationDirect <b>NITRA</b>	Festo
<b>Size</b> (HxWxD)	5.7" x 6.5" x 4.2"	11.7" x 12.2" x 3.9"
<b>Weight</b>	3 lbs.	8 lbs.
<b>All-in-One Unit</b>	Yes	No
<b>Through-Panel Mount</b>	Yes*	No
<b>Flow</b> <sup>†</sup>	141 SCFM	159 SCFM
<b>Price</b>	<b>\$313.00</b> TAP-3000	<b>\$769.00</b> Multiple part numbers

\* Panel Mount Kit sold separately  
† Flow (SCFM) measured at 87psi with ΔP of 14.5psi

All prices are U.S. published prices. Many other part numbers are available from all vendors. AutomationDirect prices as of 12/13/2017. FESTO prices are from www.radwell.com 7/15/2017. Prices subject to change without notice.

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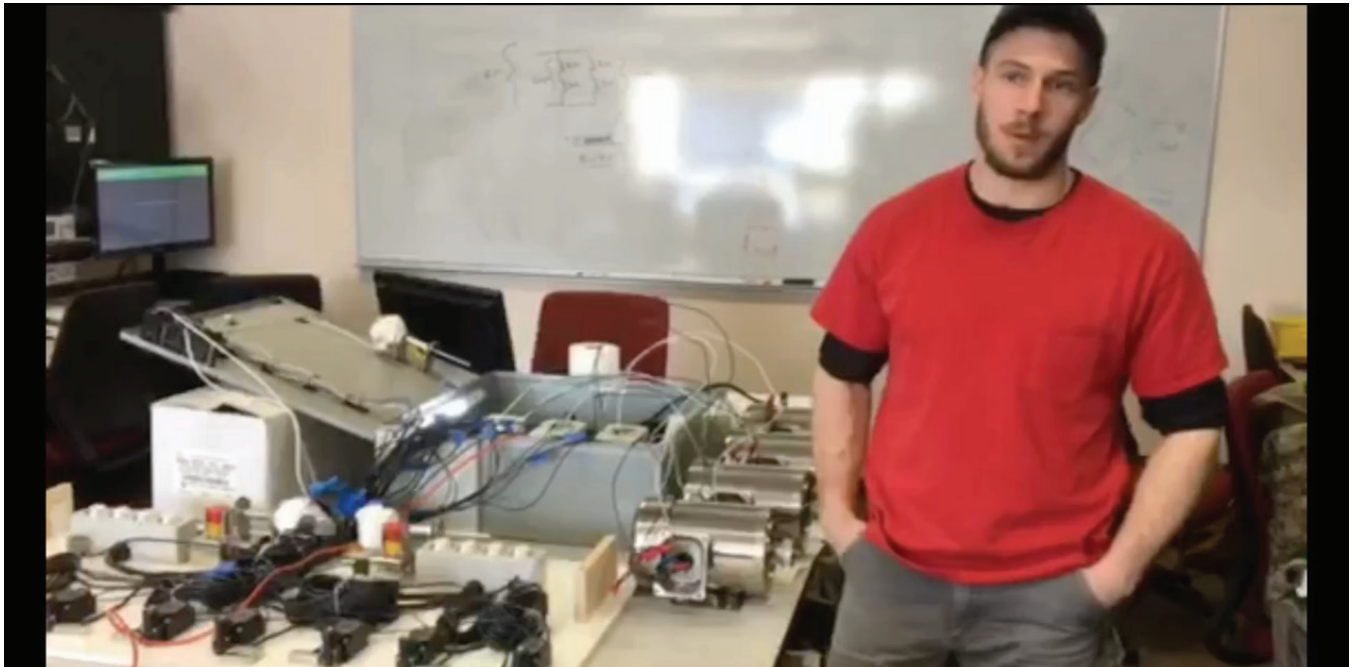
## DAN RAPOZA, STUDENT AT VERMONT TECHNICAL COLLEGE

### Droid Names, Faraway Galaxies or Automation Components?

**V**FDs, RS-485, PLCs -- to some, these terms may seem like names of droids or faraway galaxies and planets in a "Star Wars" movie. However, they really refer to earthly based components that Vermont Technical College engineering student Dan Rapoza learned about when he set out to help a dairy farmer save time and money by automating a routine process critical to milking cows.

into reality. "The website provided me with more options to consider," said Rapoza. "I now had options to achieve the linear motion needed to push and pull the curtains, a way for them to slide, and the system needed to control their movement."

"At the beginning of the project, I knew next to nothing about Variable Frequency Drives (VFDs) and AC motors working together or how they would communicate with the programmable logic controller (PLC), but I was excited to learn," explained Rapoza. "I learned about control systems and instru-



Rapoza's main project challenge was to figure out how to automate the opening and closing of four heavy vinyl curtains. These curtains serve as a barrier to keep heat in a farm's milking parlor during the winter and also to keep bacteria out, therefore ensuring compliance with the milk inspector. Before automation, the curtains were being operated manually 30 – 40 times a day, 365 days of the year, to let 80 cows enter and exit a milking parlor six at a time. In addition, Rapoza wanted to address how the curtains were suspended to reduce maintenance needs and increase energy efficiency.

"I am passionate about improving agriculture as well as the control systems," said Rapoza. "I believe that all agricultural facilities can benefit from implementing automated systems in one form or another."

For his project, Rapoza considered several different methods of building a system to move the curtains back and forth, but discarded them due to high costs or ongoing maintenance needs. He designed, fabricated, and tested a PVC pneumatic cylinder which tested well and seemed to be cost-efficient to create and maintain. He then turned to the AutomationDirect website to look for the components he needed to turn his project

into reality. "The website provided me with more options to consider," said Rapoza. "I now had options to achieve the linear motion needed to push and pull the curtains, a way for them to slide, and the system needed to control their movement."

From his research, Rapoza opted to use an AC motor and VFD to push and pull a timing belt for the linear motion needed to open and close the curtains. To create the curtain sliding system, he built a new header to move the curtain suspension cable away from the wall, installed a new cable to suspend the curtains, and designed custom pulleys to minimize friction. For the control system, he used a CLICK PLC equipped with Ethernet, RS-485, and RS-232 communication ports. The RS-485 port was used to communicate to the VFDs and SOLO temperature controllers. Finally, he used diffuse photoelectric sensors and limit switches to sense the position of the curtains, polarized photoelectric sensors to detect the location of the cows, and inductive proximity gate sensors which ultimately determine when the curtains should open or close.

Rapoza's planning, research, and hard work proved to be successful. After the project was installed, the temperature in the milking parlor increased 12.4 degrees, and the curtains open and close automatically. Ultimately, the project achieved its goals of improving energy retention, boosting operational





efficiency, and reducing maintenance costs. He recently reflected on his project “—I learned that even the smallest projects require extensive and careful planning from coming up with a functional design to fabricating and implementing the final product,” he shared. “I also learned how to manage projects and deliver my product on time.”

Rapoza’s education about strange-sounding components and how they can work together, paid off. He recently graduated from college and now works for Freeport McMoRan Copper and Gold in the Process Control and Automation group. In the future, he looks forward to continuing to automate processes in the field of agriculture.



continued from p.25

## Control of Gas Delivery

"In addition to the PLC and the HMI, the AGC automation system includes existing 32-point and 16-point discrete output modules, and an 8-point relay module. It also includes a 16-point discrete input module, a 32-point discrete input module, and two 8-channel analog input modules. All I/O modules are mounted in a 9-slot base with the CPU" explains Martin in the NASA Tech Briefs article.

KCC developed and programmed five modes of user interaction in the AGC automation system: configuration, setpoint, manual, maintenance and auto.

"Due to safety concerns, a high level of password protection and security is provided for all five modes of user interaction," points out Martin in the article. "Entry into any mode of operation requires a password. The AGC operates on three password-protected access levels: operator, maintenance and engineering. Operator access allows auto mode functions only. Maintenance access allows all modes except for configuration. Engineering access allows all modes of operation."

The AGC system can distribute a wide variety of specialty gasses, so a configuration mode is needed to select gas options and define operating ranges of the pressure and flow transducers. The options and ranges are selectable via several HMI screens. The setpoint mode provides access to additional operating parameters such as valve open times during purge and vent cycles, and the number of cycles, which are adjusted depending on the type of gas used.

"Considering the differences between ammonia and argon for example, a purge control page allows the user to define the nature of the purge and the vent controls used," explains Martin in the article. "Only a trained user with password access is able to use the manual mode to open and close valves."

Functions and management tools required to maintain the VMB cabinet are available when in maintenance mode. Purge and evacuation functions are a big part of this. Auto mode is the normal operating mode when delivering gas.

## Do-more Process Control Results

"KCC developed the new PLC and HMI software applications, and installed the new hardware and software at Headway Technologies' facility in March of 2016," relates Martin. "The new application was tested and verified in less than three days, with Headway's equipment and maintenance staff assisting in the verification of the new system. The ease of working with Headway's team quickly led to a functional and successful project."

The first three AGC systems at Headway Technologies have been completed and the customer is extremely happy. The difficult and critical purge functions were carefully duplicated and work well. The new HMI screens that KCC created added additional capabilities for improved management of the VME processes. The screens were also easier to read and more attractive than the old ones.

"Headway has scheduled the purchase of the necessary hardware to run the same applications on four more VMBs, and KCC will assist with these upgrades as required," notes Martin in the article. "Headway has also asked KCC to quote similar upgrades to non-VMB systems running at their facility. Headway is already discussing an IT upgrade to their facility to make good use of the AutomationDirect C-more HMI's capability to send emails at critical points in the process. This would allow the maintenance staff to respond in a timely manner while still being able to perform other work during lengthy purge processes."

The process improvements were completed with minimal downtime and at a reasonable cost, and the upgrades were a great success for both KCC and Headway. ■



## BRAINTEASERS

By Chip McDaniel



### 1.) Conveyor Race

Three boxes of automation equipment are traveling in the same direction on parallel conveyors in the Automation-Direct warehouse. At a certain moment, a box full of motors is a certain distance behind a box of gears, which is twice that distance behind a box of timing belts. The conveyors are all moving at uniform rates of speed, such that the motors pass the gears in seven minutes, and go on to pass the timing belts five minutes later. How long after that, would the gears pass the timing belts?



### 2.) Fuse Ruse

An automation supplier (who shall remain nameless) sells fuses in strange quantities. Boxes of fuses are available containing 16, 17, 23, 24, 39, and 40 fuses respectively, but they will not sell them any other way – nor will they break a box. A customer wished to order exactly 100 fuses. Were they able to fill the order exactly? If not, how close were they able to get? They do have ample quantities of all box sizes.



### 3.) Paint Match

It was noted that the robot in the factory can assemble 65 widgets in one eight hour shift. Alternately it can paint assembled widgets at a rate of 104 widgets per shift. The foreman asked how many widgets could be assembled AND painted in a single shift by the one robot? ■

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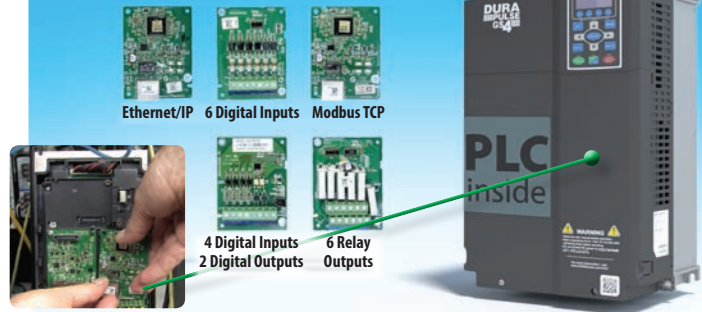


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