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Automation NOTEBOOK®

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Issue 19

Cover Story

Is it Time to Upgrade Your Control System?
Are your machine or robot control systems good enough,
or should you make a change?



New Product Focus

**ProSense line expands with
Thermocouples, RTDs, and
Extension Wire**

User Solutions

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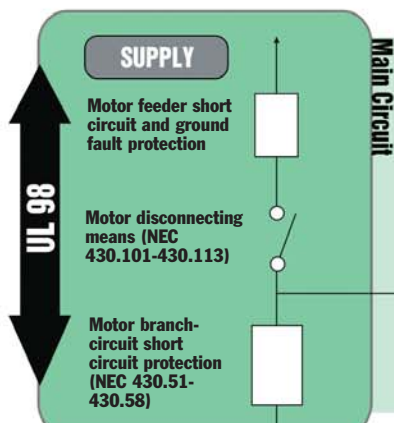
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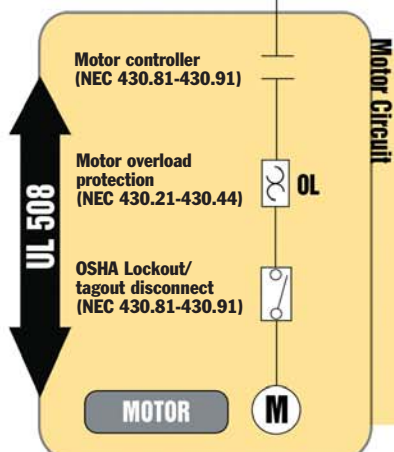
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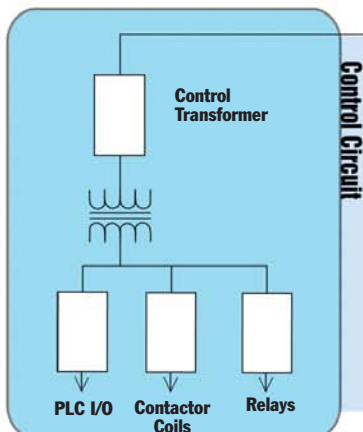
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Automation NOTEBOOK

Your guide to practical products, technologies and applications

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

Editor's Note

So, we've almost made it to the end of winter 2011. What a winter it has been, too. When "Snowpocalypse" hit the south in mid-January, much of Georgia was shut down for a few days. Snow accumulations in excess of six inches in most places and ice over an inch thick on some of the highways made things quite treacherous. (You know it's bad when UPS and FedEx can't make their deliveries.)

The southern states are not accustomed to rough weather conditions like we experienced. But, we forged onward. With much appreciation for the hard work of our logistics team, and help from UPS and FedEx, we shipped a tremendous backlog of orders when services resumed.

With the worst snow storm to hit the south in 18 years behind us, now we look forward to the sunshine and warm, beautiful months ahead.

We have a great issue of Automation NOTEBOOK ready for you. This issue is filled with information about our latest products and line extensions. Brian Elliott concludes his two-part series on Electrical Arcs; our Student Spotlight focuses on Larry May, a student at Southern Polytechnic State University who has developed a volleyball setting and serving machine. Our cover story, from contributing writer Jack Smith, addresses the topic of whether to upgrade control systems or not.

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



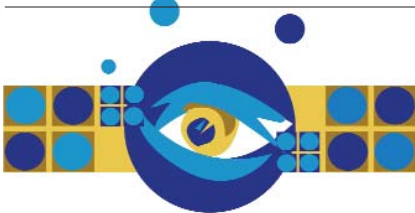
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New Product Focus

What's New



ProSense line expands with Thermocouples, RTDs, and Extension Wire

The ProSense line of process measurement devices now includes type J and type K thermocouples, more varieties of RTD sensors, and extension wire.

Thermocouple probes with connection heads feature cast aluminum NEMA 4 screw covers with captive gasket and stainless steel chain. The 1/4" diameter probes are available with temperature sensing ranges of 32 to 1,330°F (Type J) or 32 to 1,700°F (Type K). Welded-style probes, in 6", 12" and 18" lengths, are bendable to adapt to installation requirements; spring-loaded probes are available in 4", 6" or 12" lengths. Prices start at \$42.00.

Thermocouple welded and spring-loaded probes with 1/2" x 1/2" hex nipples allow easy replacement of existing probes and easy connection to wiring junction boxes. Available in 6", 12" or 18" lengths, the 1/4" diameter welded style is bendable to adapt to installation requirements, while the spring-loaded style provides positive tip contact in thermowells. Prices start at \$33.75.

Available thermocouple probes with pre-attached plugs feature 1/8" or 1/4" diameter sheaths in 6" 12" or 18" lengths; thermocouple probes with lead wire transition come with a six-foot heavy-duty lead wire. Temperature sensing ranges are 32 to 970°F or 32 to 1330°F (Type J) and 32 to 1700°F (Type K). Prices start at \$17.25.

Type J or K thermocouple

adjustable immersion sensors, ideal for plastics processing applications, feature a 32 to 900°F temperature range and 4, 6, or 10-foot lead wires; the spring and armor adjustable styles allow for variable immersion depths. Adjustable immersion sensors start at \$16.00.

Bolt-on ring sensors are ideal for nozzles, extruder barrels, die heads, molds and other surface-mount sensing applications. Thermocouple bolt-on ring sensors with a 32 to 900°F temperature sensing range start at \$15.25; RTD bolt-on ring sensors with a -58 to 572°F temperature sensing range are available for \$54.00.

RTD probes feature 1/4" diameter stainless steel sheaths with 100 ohm platinum three-wire elements. With a temperature sensing range of -58 to 572°F, the probes are available in 6", 12" or 18" lengths. Models available include welded and spring-loaded probes with cast aluminum NEMA 4 connection head and captive gasket, 3/4" NPT conduit opening and stainless steel cover chain; probes with 1/2" x 1/2" hex nipples are available in welded and spring-loaded styles, allowing for easy replacement of existing probes and connection to wiring junction boxes. Also available are probes with pre-attached three-pin plugs for quick and easy wiring connection, as well as probes with lead wire transition or M12 connections. RTD probes start at \$29.00. RTD thermowells start at \$23.50.



ProSense RTD sanitary Clean-in-place probes are designed to meet the stringent requirements of H T S T pasteurization systems. These 4-inch probes are available in the standard 1/4" diameter or with a 3/16" diameter reduced tip for greater durability in high-viscosity applications. The stainless steel probes have a -58 to 400°F temperature sensing range. Clean-in-place probes start at \$89.00.

Two-conductor thermocouple extension wire for types J and K, in standard ASTM/ANSI colors, are available in convenient 50-foot and 100-foot lengths starting at \$15.00. Also available is RTD extension wire which offers superior performance compared to "off-the-shelf" cable. Starting at \$21.00, the three-conductor wire is available in 50-foot and 100-foot lengths.

Accessories for thermocouples and RTDs include: thermowells, compression mounting fittings, bayonet adapters and thermocouple and RTD connectors. See the full ProSense line at: www.automationdirect.com/temperature-sensors

"Behind every great man is a woman rolling her eyes."

— Jim Carrey

Get your sensors now, not later

It's time to try AutomationDirect



Over 120 thermocouple and RTD sensors are pre-built stock items - order today, they ship today!*

NEW! Thermocouples starting at \$15²⁵

Get the most popular thermocouple probe configurations at practical direct prices.

- Probes with connection head
 - Spring-loaded probes with connection head
 - Probes with hex nipple
 - Spring-loaded probes with hex nipple
 - Probes with attached plug
 - Probes with lead wire transition
 - Adjustable immersion thermocouple sensors
 - Bolt-on ring thermocouple sensors
-
- Probes have type J or K thermocouple elements to meet many temperature sensing applications
 - Made in the USA
 - RoHS

Thermowells starting at \$23⁵⁰

- Thermowells for RTD probes with M12 cable connector
- **NEW!** Thermowells for spring-loaded thermocouple and RTD probes

NEW! RTD sensors starting at \$29⁰⁰

These 100 ohm platinum RTDs are available as 3-wire elements (*except where noted*) with Class A accuracy.

- Probes with connection head
- Spring-loaded probes with connection head
- Probes with hex nipple
- Spring-loaded probes with hex nipple
- Probes with attached plug
- Probes with lead wire transition
- Bolt-on ring RTD sensors
- Probes with M12 cable connector (3- and 4-wire elements)
- Sanitary Clean-in-Place (CIP) probes

NEW! Extension Wire 50 ft. and 100 ft. lengths

- Thermocouple extension wire for Types J and K with standard ASTM/ANSI color coding
- RTD extension wire specially constructed to offer superior performance compared to "off-the-shelf" cable

Accessories

- Compression mounting fittings for temperature probes
- Bayonet mounting adapter for temperature sensors
- Thermocouple and RTD connectors

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Product Snapshots

Press Releases



Sensors for food and beverage industry



A new line of food and beverage sensor products includes AC and DC proximity and photoelectric sensors and quick-disconnect sensor cables. Compliant with the IP69K standard, the sensors withstand washdown conditions up to 212°F and are constructed of FDA certified materials.

The PFM 12mm and PFK 18mm proximity series are sensors with shielded or unshielded stainless steel housings and M12 quick-disconnect plug with gold-plated pins. Providing complete overload protection, each series has 10 models available. The PFM series has a standard sensing distance of up to four millimeters and extended distance of up to eight millimeters. The PFK series has a standard sensing distance of up to eight millimeters and extended distance of up to 12mm. Models are available in a choice of 10-30 VDC PNP or NPN transistor outputs and normally-open or complementary output configurations. PFM and PFK series sensor prices start at \$35.

The PFT 30mm series of proximity sensors are available in four models with sensing ranges up to 22mm. Models are available with

shielded or unshielded housings and normally-open outputs. PFT series prices start at \$45.

The VFK 18mm and VFT 30mm series proximity sensors are available with shielded or unshielded stainless steel housings and half-inch micro AC quick-disconnect plugs with gold-plated pins. With complete overload protection, each series provides normally-open 20 to 140 VAC outputs. VFK series prices start at \$55 and VFT series prices start at \$59.

Magnetic proximity sensors are available in 12 mm and 18 mm diameters. The shielded 10-30 VDC sensors have a sensing range of up to 70mm and a normally-open output. Prices for magnetic proximity sensors start at \$44.

Two series of 18mm food and beverage photoelectric sensors have also been added. The FF series photoelectric sensors are available in 30 models and four styles: diffuse, polarized reflective, through-beam, and retro-reflective (for transparent objects). Sensing distances range from 100mm to 20 meters. The FFRS series diffuse photoelectric sensors with background suppression are available with adjustable maximum reading distances – 30 to 130mm and 60 to 100mm for shiny objects. Sensors are equipped with LED status indicators; yellow indicates output while green indicates teaching function. FF series prices start at \$65; FFRS sensors start at \$79.

IP69K-rated cables are also available. Industry standard axial and right-angle M12 or half-inch micro connectors with open leads are available in five and 10-meter lengths. M12 screw-lock patch cables are also available in axial and right-angle models and 0.3m to five-meter cable lengths. Prices for cables start at \$12.50.

See the full line of food and beverage sensor products at: www.automationdirect.com/food-beverage-sensors

Standard CPUs added to CLICK PLC line



The CLICK family of micro brick PLCs now includes standard CPU units. The new units feature eight discrete inputs and six discrete outputs, available in four combinations of built-in I/O types. In addition to two RS-232 RJ12 communication ports, the standard CPU units are equipped with one RS-485 communication port and feature real-time clock and battery back-up for the internal SRAM. Sold separately, the battery allows data to be stored for up to five years.

CLICK Standard CPU units start at \$99. CLICK's user-friendly programming software is downloadable for free at www.automationdirect.com, providing the tools, layout, and interactivity needed for quick and intuitive program development. In addition, an online help file provides information to help users get acquainted with the software quickly.

To learn more about the new Standard CLICK CPU units, visit www.automationdirect.com/click-plc or call 800-633-0405.

C-more Micro 4-inch TFT Touch Panel

The C-more Micro-Graphic family of operator interfaces now offers a 4-inch TFT color touch screen HMI panel. The panel features a 320 x 240 dot display; 32,768 colors provide clear and colorful graphics for vibrant and



intuitive screens. The free programming software offers the choice of using built-in objects or importing custom graphics. The user can create and save custom objects and graphics to software libraries for fast and easy access from multiple projects. The 4-inch touch panel is equipped with a standard Type B USB programming port, a serial communications port which supports the most popular PLC drivers, and five durable function keys with LED indicators. The unit offers 3.2 kB memory, LED backlight, multistate bitmap support and Windows font support. C-more Micro's 320 x 240 screen allows either portrait or landscape installation when space is a concern. Backed by a two-year warranty, the panel is priced at \$329. Learn more at www.automationdirect.com/C-more-micro

NITRA line expands tubing and hose offering



New tubing and hose options have been added to the NITRA line of pneumatic components, including

bonded straight and coiled styles.

Available in 50-foot lengths, NITRA bonded polyurethane tubing is made by a continuous bonding process, resulting in a strong, organized, color-coded package with flexibility and kink resistance. The shore A 98 hardness rating provides tight outside diameter tolerance, making it ideal for use with NITRA push-to-connect fittings. Available in 5/32 to 1/2-inch and 4mm to 12mm sizes, bonded straight tubing starts at \$13.

NITRA polyurethane coiled tubing has also been added. Coiled tubing is available in single, double, and triple bonded configurations with double and triple coils in contrasting colors. Available in three working lengths, and in sizes ranging from 5/32-inch to 3/8-inch and 4mm to 10mm, prices start at \$4.50.

The addition of pneumatic air hoses includes reinforced polyurethane straight, as well as coiled and reinforced coiled styles. Available in quarter-inch and 3/8-inch sizes, the hoses are fitted with one rigid and one swivel fitting, based on hose inside diameter.

Reinforced polyurethane hose comes in 25 and 50 foot packages. With a shore A 85 hardness rating, the hose is strong, flexible and kink resistant. Prices start at \$11.50 for a 25-foot package.

NITRA coiled and reinforced coiled hoses are available in eight, 12 and 16-foot working lengths. Coiled hose has a shore A 98 hardness rating while the reinforced coiled hose has a shore A 85 hardness rating. Prices start at \$12.50 for coiled hose and \$23 for reinforced coiled hose.

See the full line of NITRA pneumatic tubing and hoses at www.automationdirect.com/pneumatic-tubing-hoses

New safety light curtains and limit switches

Machine safety devices for use in industrial applications are now available. Two series of safety light curtains (active optoelectronic protective devices) are designed for human protection and product/machine safety where risks



cannot be eliminated by machine design and the process might require frequent and open access during operation.

The YBB-14 series has a 14mm sensing resolution for finger-size protection and an operating distance of up to 3.5 meters; protective heights range from 142 mm to 1,045 mm. The YBB-30 light curtains series has a 30 mm sensing resolution for hand protection and an operating distance of up to 12 meters; protective heights range from 279 mm to 1,827 mm.

All safety light curtains have Type 4 and Cat 4 PL e safety ratings and are IP65 rated. Light curtain sender prices start at \$250.00 and receiver prices start at \$275.00. Mounting brackets are included with each unit and additional mounting accessories and protective columns are available.

AutomationDirect has also added a line of machine guarding safety switches to detect unsafe conditions and isolate power. Normally-closed contacts are used for a positive break and redundant normally-closed contact and normally-open feedback outputs are available. The safety switches cannot be easily defeated and all units have CE, UL and CSA approvals. Four bases are available: 30mm plastic, 50mm zinc alloy, 40mm aluminum and 60mm aluminum. Four types of interlocks are available for common safety applications including tongue (key), shaft hinge, lever hinge interlocks and pull cord actuators with reset for emergency stop or without reset for simple stop. Safety interlock switches start at \$15.00 and safety limit switches start at \$12.75.

See the full line of safety products at: www.automationdirect.com/safety

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Cover Story

Trends in Automation

Is it Time to Upgrade Your Control System?

Are your machine or robot control systems good enough, or should you make a change?

By Jack Smith

The machines and robots you build work well. You've kept up with periodic improvements. Most of your support calls are predictable. Why rock the boat?

As a machine or robot builder OEM, you understand the favorable economics of selling machines or robots for which your company has recovered its initial investment, particularly in the control system. Your margins are good, but are they as good as they could be with a control system upgrade?

Maturity Indicators

Most of the factors affecting decisions to upgrade can be categorized as performance related. However, other decision criteria include communication requirements, reliability, and safety.

Does the machine still do what it was designed to do as efficiently as it could to satisfy customers' production requirements? "An automation system upgrade should increase Overall Equipment Effectiveness (OEE), often an important benefit for our customers," says Mel Bahr, executive vice president at MGS Machine (www.mgsmachine.com), Maple Grove, Minnesota, in Control Design's October 2010 cover story, "Time to Make a Change."

MGS Machine builds top and horizontal-load cartoning machines as well as product feeding equipment (Figure 1). "Automation upgrades often make it easier to change products, crucial to our contract packaging clients, and increases in speed are also often realized," adds Bahr in the cover story.

"Other reasons why we upgrade our automation systems periodically are

improved HMIs and help screens, ability to control robots from a common machine control platform, improved servo performance and control, better data collection and tracking, automated data transfer to items like printers, and the need for vision systems and vision inspection," concludes Bahr in the same Control Design story.

There are many reasons to upgrade automation systems says Joe Sebastian, senior systems engineer at Optimization (www.optimization.com), a system integrator servicing robot and machine builders along with other customers. "Safety, efficiency, increased availability of spare parts, easier or less maintenance required, improved connectivity to other systems, higher production capacities, less operator involvement and quicker setup or changeover times have all initiated automation upgrades," he says in the cover story. His company has added very basic automation to machines and doubled their production speeds.

"Changeover times are also a huge consideration, as new machines can automate a great deal of the product changeover process, or even do it on the fly with it being initiated directly from an MES system," Sebastian notes in the story. "Usually it is some combination of all of these factors that add up to an

automation upgrade with an acceptable ROI."

Is 'Old Reliable' Still Reliable?

"If it ain't broken, don't fix it," is a variation of an old maintenance and repair adage. Many machine control components continue to work well even as they approach obsolescence. Evaluating what to keep and what to replace often boils down to reliability, maintainability, and how the components in question affect machine performance.

Dan Jensen, senior automation engineer at Nelson Sales Corp (www.nelsonsales.com) in Muskego, Wisconsin, says in the same Control Design cover story, "The real question is, does the machine work well overall. In the case of older hydraulic systems, their on/off nature and abrupt directional or velocity changes often wear out parts and mean headaches for maintenance personnel."

According to Jensen, replacing the old directional valve with a new hydraulic proportional servo valve/motion controller combination can prolong the life of a machine due to reduced mechanical stress. Also, using better closed-loop controls can often enhance the reliability of some of the older hydraulic and mechanical components which are still functional



Figure 1. This work cell from MGS Machine feeds and opens auto-lock bottom, flat-blank, or glue-bottom cartons. The top is closed after a robot loads products into the carton. (Image courtesy of MGS Machine)

for the application. "The machine builder can often cut costs by keeping the hydraulics and mechanicals, and replacing just the controls," Jensen explains in the cover story.

Jensen did exactly that with a welding system he upgraded for a customer (Figure 2). His company used the existing hydraulic system, but it required a positioner that could stand up to weld spatter. "We added a linear magnetostrictive displacement transducer for positioning a slide that held the assembly being welded, a PLC, an operator screen, and a motion controller," Jensen explains in the story.

A control system should probably be upgraded if it's based on old relay logic, but what if solid-state control hardware is discontinued? The Internet makes supporting just about any legacy hardware or equipment possible, but is it desirable to rely on third-party support?

Obtaining support isn't necessarily the primary reason for control system upgrades, as Jensen suggests. "Does the machine work well now, and will it stay working?" he asks in the Control Design story.

Do you remember floppy disk drives? "Does the computer software work with newer laptops, or do you have to keep an old laptop with special software on the shelf just in case?" Jensen asks in the story.

The machines may work and the designs may still be viable, but at what cost? If older components have high failure rates, maintaining or supporting a legacy control system can become costly. "Failure of obsolete components is generally unpredictable and almost always occurs at the least convenient time," says Phil Gilkes in the Control Design cover story. Gilkes is director of product support at Intelligrated (www.intelligrated.com), a builder of material handling equipment in St. Louis, Missouri. "The downtime can result in significant costs to the end user."

Additionally, controller ease-of-use can make selling machines a bit easier.

"Traditionally, robot manufacturers used their own proprietary controller, which was complicated to program and had to be interfaced with other system components," observes Gilkes in the cover story. "Now, complete robotic systems can be controlled by a single, powerful PLC. Customers are far more comfortable with PLC controls and tend to prefer systems and vendors that use them."

Sometimes, there may be psychology at work in the use of the expression "new and improved." But sometimes a new and improved control systems platform will better handle all the new tasks, requirements, and regulations that continue to surface in today's manufacturing environments.

Playing it Safe

Safety continues to be a valid consideration when deciding if a control system upgrade is in order. In the Control Design cover story, Roger Rosinski, plant manager at All American Poly (www.allampoly.com) in Piscataway, New Jersey, says "Safety standards have become more stringent over the years, and older machines generally can be made much safer with an investment in controls."

The European Machine Safety Directive (EN ISO 13849-1 or EN IEC 62061) is one of the new safety standards global machine and robot builders must satisfy. However, safety upgrades may not present value to an OEM for machines that already meet the standards required in their markets.

Jensen advocates simplicity. "A safety-networked architecture has to be large and duplicated to be cost-effective," he notes in the cover story. As an example, he states, "Safety in a robot cell may be easier to do with discrete components such as a door interlock and a couple of E-stops."

A systems integrator suggests an integrated approach. "An integrated automation and safety system is the accepted norm for most industries," says Sebastian in the Control Design cover story. "If the existing system is proven

safe, however, then safety is a hard sell by itself. Many old machines don't have safety mechanisms built in, so safety controls can't be added without major mechanical changes."

Gilkes advises in the story, "The most compelling safety-related reason to upgrade is based on an assessment of the system itself to determine whether it meets with current standards, which can change as new legislation is developed."

Safety relays and hard-wired safety interlocks may be employed in older safety systems to stop the equipment. However, if an emergency stop occurs, the control system could end up in an unknown state when these relays and interlocks cut power to critical components.

Unless compliance with standards is an issue, safety by itself is typically not a sufficient reason to upgrade a control system, according to system integrators and OEMs.

A Failure to Communicate?

A major advantage to upgrading your machine control platform is the ability to offer modern communications functionality such as Ethernet, fieldbuses, wireless, and Web access.

Michael Gurney, CEO at systems integrator Concept Systems (www.conceptsystemsinc.com) in Albany, Oregon, says in the Control Design cover story that communications is easier with newer control systems. "With the evolution of communication standards, there's no reason that manufacturer to manufacturer communications can't be done easily. If you're considering a hardware manufacturer that's difficult to interface to other automation components, you might want to reconsider using that supplier."

The ever-increasing need for manufacturing and equipment data is another significant factor to consider. For example, modern communications can allow machine-to-machine, HMI/SCADA, Internet, and enterprise software connectivity. "In any

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Cover Story cont.

Trends in Automation

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automated environment, sharing data in real time is the key to efficient operation,” says Duane Grob in the story. Grob is the vice president of engineering at Optimization. “Without a means of sharing and communicating information with other subsystems, all actions are basically reactionary.”

adds in the cover story. “Another related item is smart I/O communications for gathering more detailed device status. Some device information is simply inaccessible unless smart I/O platforms are incorporated into the overall system design. The data gathered from these devices can enable better decisions about maintenance, OEE, and system

and platforms are available today with a plethora of communication protocol choices such as Ethernet and various fieldbuses. The demand for MES and ERP integration is growing among end users. Some OEMs are offering remote service and VPN functionality, which greatly reduce the demand on their support staff and lower their customers’ maintenance costs. If a control platform can’t keep up with data demands, it may be time for an upgrade.

Other Considerations

Rick de Jong, general manager, AEMK Systems

(www.aemksystems.com), a robot manufacturer in Waterloo, Ontario, Canada comments in the cover story: “The most significant changes in machine and robot building are controls and flexibility. Flexibility means a machine or robot should be designed with product changes in mind. This means less fixed tooling, and a control platform that can be modified with minimal cost and time. Avoid the automation graveyard by ensuring that automated systems can not only be upgraded and modified, but also that the technology can be recycled into new applications.”

Sometimes, the decision comes down to money. “The overall cost of ownership needs to be considered,” advises Gurney in the story. “This includes maintenance costs, downtime costs, and the cost of not having something faster, more accurate, and/or more functional. These costs need to be considered over an acceptable ROI period.”

Where do systems integrators and machine builders stand on the question of whether to choose a single supplier, or work with multiple equipment and software vendors?

In the cover story, de Jong says, “It’s wise to focus on a single vendor that integrates various products to one common platform. This reduces integration time and cost, provides faster service and support, reduces the training time, and

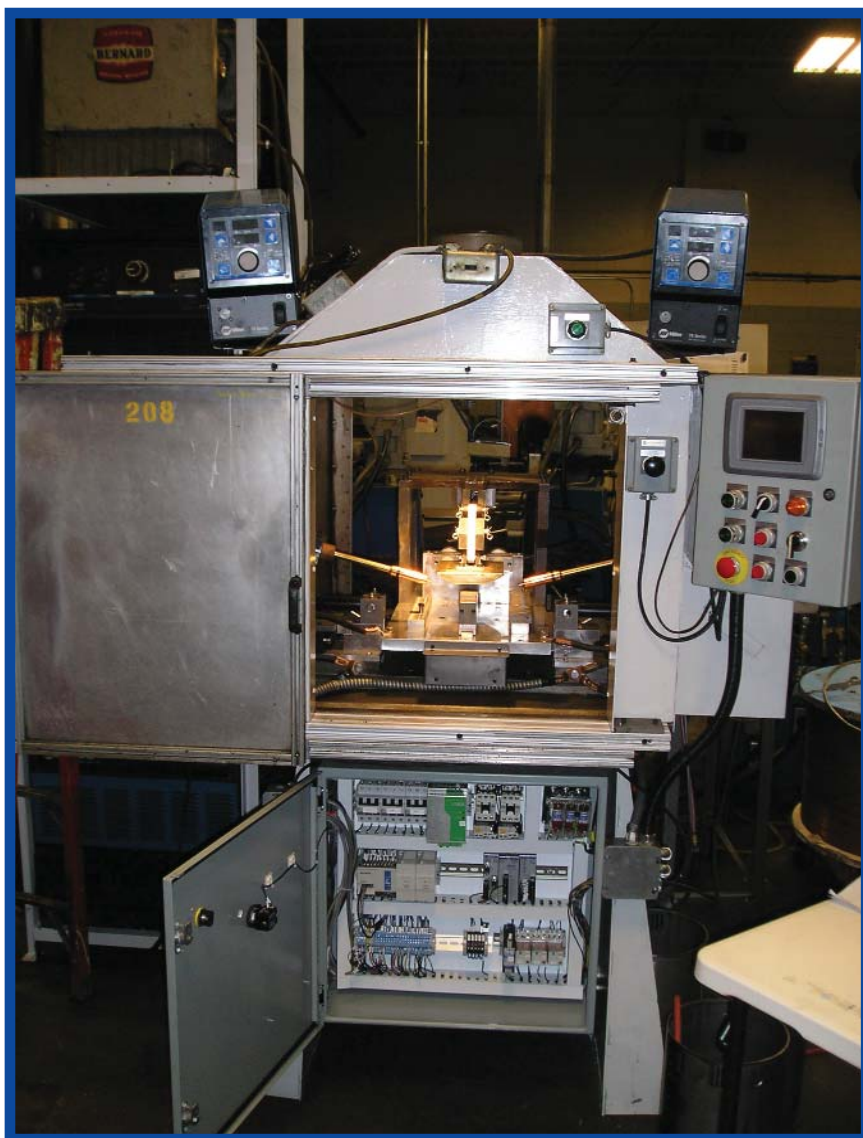


Figure 2. Operators can now enter recipes on the touch screen of this welding machine due to automation system upgrades.

(Image courtesy of Delta Computer Systems)

Better data means better information and better decisions. “Many older systems don’t integrate well with an overall automated environment,” Grob

performance—as well as inform plant personnel on repairs needed to continue operations.”

Many control system components

eliminates the complexities of multiple vendor interfaces.”

Gurney also advocates vendor standardization. “We encourage companies to standardize on a single vendor for similar functions,” he advises in the Control Design story. “For example, companies should standardize on a PLC manufacturer, an HMI manufacturer, and a drive manufacturer. This minimizes spare parts and training requirements.”

Jensen offers a different perspective. “Using single-vendor systems usually means sacrificing capability for the sake of a name. Just because a manufacturer makes PLCs doesn't mean their control architecture for servo control is worthwhile. Nowadays, everything worth using comes with an Ethernet interface and will communicate via various protocols, so being limited to one manufacturer isn't necessary,” he said in the Control Design cover story.

Procurement comes with significant inherent overhead. Buying from multiple vendors can increase costs that are not always easy to quantify. Using a single vendor can help reduce these costs. “From a purchasing perspective, the customer only has to deal with one vendor and thus can generally negotiate better discounts,” adds Gilkes in the story.

On the other hand, not upgrading is one way to avoid the single-source/multiple vendor debate. “If a machine is old but otherwise performing well, it may be best to leave it unchanged, providing it continues to meet production and product life cycle requirements,” de Jong sums up in the cover story.

Reasons for Control System Upgrades

1. Increased machine speed
2. Increased safety
3. Increased reliability
4. Need for better, faster communications
5. Better visualization of machine operation
6. Increased production capacity
7. Quicker changeover times
8. Increased machine marketability

Table 1

Reasons for Single-sourcing

1. Minimizes spare parts requirements
2. Minimizes training requirements
3. Various products can be integrated into one platform
4. Simplifies communications networks
5. Integration of safety systems
6. Component compatibility

Table 2

Reasons to use Multiple Vendors

1. OEMs can offer the best-of-breed for each component
2. Lowers up-front costs
3. Most products now work together reliably
4. OEM can avoid being locked into using just one vendor

Table 3

System Integrator Corner

Automation provides cost savings

PCA provides complete turnkey, cost effective control system solutions for a variety of industries

By John Keller,
Pacific Coast Automation, Inc.



Pacific Coast Automation, Inc., located in Modesto, California, was founded in 2008 based upon the need for a competent, dependable and reasonably priced control system engineering firm, and not just a "controls tech" company which bases its existence on service calls. Since its meager beginning, PCA has seen an almost 500% growth from 2009 to 2010, making it a powerhouse in the controls industry. Major clients include General Mills, E&J Gallo, The Wine Group, California Dairies, Safeway, Cargill, CertainTeed, and the list goes on.

While PCA primarily specializes in solutions for the Food and Beverage industry, we cover a wide variety of areas, including steel manufacturing, plastic products fabrication, agricultural products, chemical packaging, water/wastewater treatment and several others.

PCA offers its customers complete turnkey solutions, setting them apart from other integration firms. They provide services from conception to completion, which include upfront process consulting, design engineering, CAD drafting, PLC/HMI programming, construction supervision, startup support, operator/maintenance training, and follow up services.

In addition to our integration services, PCA, a UL 508A listed panel fabrication facility, designs and builds

custom control panels at our location. PCA also has electrical and mechanical contracting partnerships to provide complete solutions from concept to installation and beyond. PCA is a member of CSIA (Control System Integrators Association), a global, not-for-profit, professional association for control system integration companies.

Some of the application capabilities include bottling/packaging line control systems, wine and beer production, dairy processing, CIP (clean-in-place) systems, nut hulling operations, plant utilities, industrial wireless technologies and other food/beverage processes. One major part of PCA's offerings includes the design and implementation of OEE (Overall Equipment Effectiveness) systems. In contrast to canned solutions, PCA performs consulting and evaluation services for customers to determine which vendor's solution is the best fit for their particular needs. Although it can be confusing and overwhelming for someone new to OEE, PCA removes the guesswork by utilizing years of experience and vast knowledge so customers can immediately benefit from the valuable data that such systems can provide.



During these difficult economic times, many companies look for ways to streamline operations and become more efficient. PCA assists customers by evaluating and suggesting cost-saving projects which may not be immediately apparent.

Starting with a complimentary plant "walk through" by a well-trained PCA engineer, suggestions are given which can lead to cost savings through the implementation of automated systems and/or modifications of existing systems.

For example, PCA recently

completed a cost savings project initially discovered by one of their engineers during a plant walk-through at CertainTeed in Lodi, CA, a PVC pipe manufacturer. The customer had a plant-wide filtered water system that was running more pumps than necessary, due to the way the piping was configured. PCA worked with CertainTeed to develop a new piping arrangement and control strategy to reduce the number of pumps that had to be running at any given time. By using DURApulse GS3 drive units in conjunction with a new PLC and C-More HMI, PCA developed an automatic control system which cycles the supply pumps based upon plant demand. As a result, CertainTeed will achieve a cost savings of over \$50K a year and a return on investment of less than two years.

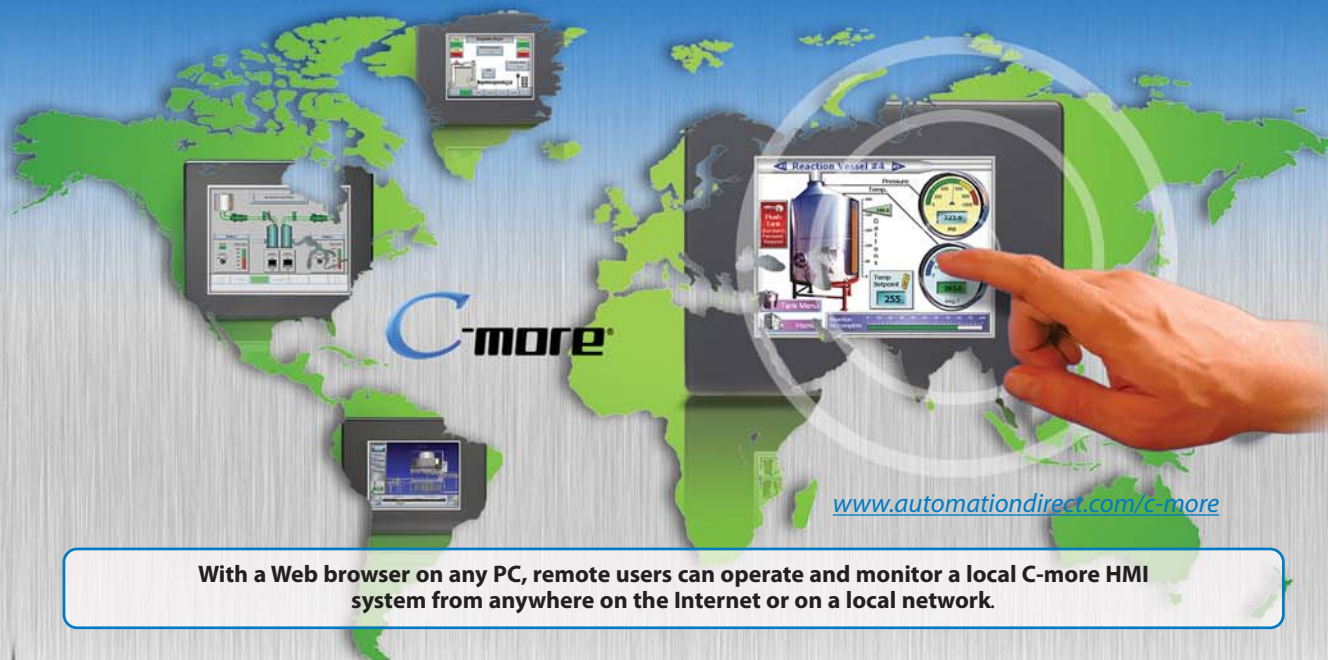


PCA delivers meaningful and economical solutions to its customers while providing the utmost in customer service. PCA's service area primarily covers the Northern California valley region, however, they service clients in several remote locations and have the ability to support processes via Internet and/or cellular networks. For more information on how PCA can benefit your particular operation, call (877) 655-8251 to set up a free consultation. You can also obtain more information and fill out an RFQ form by going to our Web site at:

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Product Snapshots

Press Releases

Continued from, p. 7



Class T fuses available

Two series of Class T fuses have been added to the line of circuit protection products. The TJN series 300 VAC and TJS series 600 VAC fuses are extremely fast-acting fuses in a compact, space-saving size, making them ideal for use as the main fuse protection for panel boards, load centers, meter stacks, and AC drives. Available in one to 600 Amp sizes, the fuses are current limiting and are designed with no intentional time delay to open quickly on overload. Class T fuse prices start at \$6.50 for a single fuse, or \$65 for a 10-pack. Screw and box lug-type fuses blocks for Class T fuses have also been added, starting at \$8.50. To see the full line of Class T fuses and fuse blocks, visit

www.automationdirect.com/fuses

Compact Pneumatic Air Cylinders



The NITRA™ pneumatic product line now includes a series of compact stainless steel, round body cylinders. The new C-series cylinders feature type 304 stainless steel bodies with anodized aluminum alloy heads. The type 303 stainless piston rod is equipped with Buna “N” o-ring rod seals and sintered bronze rod bushings. The double-acting cylinders are available in 9/16-inch to three-inch bore sizes and stroke lengths from 0.25 inch to four inches. Optional clevis brackets and rod eyes are also available. Backed with a two-year warranty, C-series compact cylinders start at \$33.

See the full line of NITRA compact pneumatic air cylinders at:
www.automationdirect.com/pneumatic-cylinders-compact

Stellar full-featured soft starters

The Stellar line of soft starters now includes the SR44 series of solid-state soft starters to control three-phase AC induction motors. The fully digital SR44 soft starters use thyristors in all three motor phases to provide controlled reduced voltage motor control for smooth acceleration/deceleration and reduced mechanical shock and starting stress.

The SR44 series features 115 or 230 VAC selectable control voltage, as well as easily and separately adjustable motor start and stop times. The Automatic Application Setup feature fully configures



the starter for specific applications with one entry. The advanced energy-saving Optimizing Mode improves motor efficiency and power while delivering the demanded torque at low rpm.

These fully programmable units are equipped with six-button keypads with two-line, 32-character displays; programmable I/O for remote control applications include a single digital input and two relay outputs. An optional Modbus communication card and remote keypad are also available.

Suitable for a variety of motor loads, Stellar SR44 soft starters can be used for motor reversing, with external contactors, and can be connected “in-delta”, allowing for use of a smaller soft starter.

Stellar SR44 soft starters are UL listed, CE, REACH, and RoHS approved. Size 1 starters, with 9A to 146A current ratings, start at \$769; Size 2 starters, with 174A to 370A current ratings, start at \$2,030.

To learn more about the full line of Stellar Soft Starters, visit:

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*All prices are U.S. published prices. AutomationDirect prices from October 2010 Price List. Hoffman prices are taken from www.hoffmanonline.com Price List 4/5/10. Prices may vary by dealer. Many other part numbers are available from all vendors.

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User Solutions

Improving ingredient measuring

Advanced Automation, LLC takes baking to the next level

Advanced Automation, LLC, in Riverdale, New Jersey, is an automation systems manufacturing company specializing in creating solutions for companies in need of more efficient automated processes.

One such need is in the baking industry. Food associations, such as the British Retail Consortium (BRC), Safe Quality Food (SQF) and the American Institute of Baking (AIB), are setting stricter regulations on tracking ingredients from their origin, to the warehouse, to the manufacturer, and ultimately to the retailer. With these increasing regulations and food safety requirements, many bakeries find it difficult to efficiently produce quality baked goods that are still affordable to consumers.



In late 2008, Advanced Automation developed the Batch Process Analysis system (BPA©) geared specifically toward the baking industry to substantially improve the production process. BPA assists users in following common regulatory requirements and food safety practices, as well as automatically aid in analysis of inventory and product expenditures.

BPA is a minor-ingredient batching system with a very small footprint; taking no more room inside a bakery than work benches regularly used today. The modular system is designed to not only save space but also be time and cost-efficient.

The expandable system is equipped with stainless steel ingredient hoppers which are mainly controlled by two DirectLOGIC D2-260 PLCs and an industrial PC. User-friendly SCADA software tracks and records the activities of daily production runs, allowing bakeries to adhere to the very strict standards set forth by the food associations. This SCADA technology also enables users to trace individual recipe batches back to unique lot numbers.

By integrating major ingredients, such as flour, oil, and water, along with the minor ingredients, bakeries can easily repeat the desired outcome every time. The software also allows users to easily set production schedules as well as create new recipes with a few simple keystrokes.



Due to the precision of BPA, many bakeries using this system have been pleased with increased productivity and efficiency. They are assured that information being conveyed to the end user is accurate at all times. The SCADA software populates all production activity which can then be easily sorted to answer various queries, allowing information to be traced from the manufacturer to the retailer.

Recently, Advanced Automation demonstrated BPA at the International Baking Industry Exposition in Las Vegas. Companies of all sizes showed great interest in how BPA allows for batching and mixing of minor ingredients. Until now, it has been cost-prohibitive to replace manpower with automation; therefore, many facilities still perform much of the micro batching by hand. With BPA, human

hands are virtually no longer required to complete recipes.

Companies were further impressed that the entirely automated micro batching system, integrated with major ingredients, has the ability to track all ingredients and activities from the individual ingredients' lot numbers to the end user.



Marcelo Tise, president of Advanced Automation, stated, "We at Advanced Automation believe in the philosophy of 'Eating with a small spoon.' We are able to offer this to our customers because AutomationDirect offers good products at fair prices along with superior technical support, which we pass on to our customers."



To learn more about Advanced Automation, LLC, visit: www.advancedautomation1.com or call 973-831-2059.

Student Spotlight

Automated volleyball server



Larry May

By Chip McDaniel
AutomationDirect

Larry May, a student at Southern Polytechnic State University (SPSU), contacted AutomationDirect in April, 2010, and outlined his goal of building a volleyball setting and serving machine for his senior design project. Larry is active as a recreational volleyball player and is the father and coach of a competitive high school player. Larry is also a long time AutomationDirect customer, and has worked in the Automation field for many years.

He led a team including three other students – Kelly Gray, Ryan Howell, and Trenton Phillips – to design and build a full scale working prototype of the “Ace Within Reach” volleyball setting and serving machine. The team goals were to improve on the existing “state of the art” volleyball serving machines. Several manufacturers offer similar machines today, but Larry and his teammates saw room for improvement in several areas. All the existing machines require the operator to feed the balls manually, one at a time, into the machine, forcing the operator (usually the coach) to be at the opposite end of the court from the player being coached. Larry and his team wanted to build a machine with a hopper to store and feed the balls into the launcher automatically, and to have a remote control interface so that the coach can stay near the player for maximum instructional advantage. They also envisioned a set of lights on the machine

to simulate a ‘virtual toss’, giving the human players an intuitive warning that the launch of a (potentially 80 mph) volleyball was imminent. Other criteria included the ability to fit through a standard door, to roll on casters, and to hold up to 20 balls in the hopper awaiting launch.

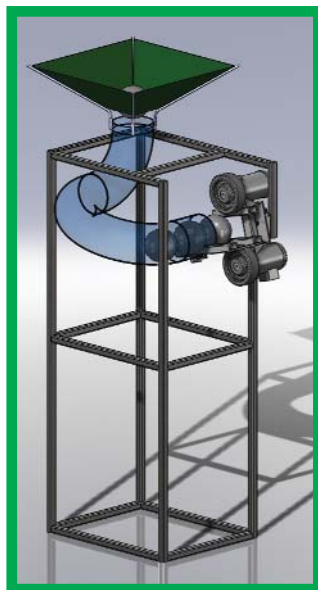


Figure 1, CAD model of Final Design



Figure 2, Photo of prototype

The basic electrical design includes a CLICK PLC controlling two GS drives (VFDs) via Modbus. The GS drives power two small Ironhorse 3-phase motors. The ‘remote control’

consists of a C-more Micro HMI mounted in a handheld enclosure, and tethered to the machine via a long serial cable. The CLICK PLC also controls a series of lights on the front of the machine used to simulate the tossing of the ball into the air (prior to a serve) by a human server.

(Figures 1 & 2)

The mechanical set-up uses two wheel/tire assemblies driven by the Ironhorse motors – one above and one below the volleyball. While the two motors work in concert to determine the overall velocity of the launch, the machine can also impart varying degrees of top-spin to the ball by running the upper motor somewhat faster than the lower motor. Top spin and speed are the primary variables used by volleyball players to vary their serves, and the machine allows a coach to vary both speed and top-spin from the remote control. The mechanical setup also allows for manual adjustments to various angles of the ‘launch head’ delivery mechanism to allow a wide variety of ‘serve’ and ‘set’ simulations.

Research

The team conducted a study of forces that apply to a volleyball in flight using Computational Fluid Dynamics (CFD). The purpose of this study was to predict the path the ball would follow as it flew through the air. CFD calculations were performed using the SolidWorks 2009 CAD software with Flow Simulation package. The coefficient of drag (C_d) and the coefficient of lift (C_l) are the two dimensionless parameters that need to be determined to find the trajectory of the ball in flight. The following formulae show how the coefficients are determined: (Figure 3)

$$C_d = \frac{2 \times F_d}{\rho \times V^2 \times \pi \times r^2}$$

$$C_l = \frac{2 \times F_l}{\rho \times V^2 \times \pi \times r^2}$$

Continued, p. 19 >>

Tech Brief

Power Principles



Electrical Arcs (Part 2, Sources, Suppression & Safety Considerations)

By Brian S. Elliott

In Part One of this article we discussed the equipment and procedures used to manage the damaging effects of arcs in electrical equipment. In Part Two, we will discuss some of the basic methods, tools, components and circuits that should be used to operate safely around circuits with high arc potential. Part One can be found on our web site at:

<http://automationnotebook.com/technology-brief.html>

Surge Suppressors

To a very large extent, arc suppression is accomplished by controlling high voltage transients. If a sudden voltage spike initiates a spark within a circuit with access to sufficient energies, an extremely damaging arc may result.

Recently, the application of commercially available surge suppressors has become the accepted method for controlling these transients. In most cases, a large capacity surge suppressor is applied at the primary power connection while lesser units are applied throughout the equipment or distribution system as necessary.

In addition to limiting the initiation of arcs, surge suppressors are nearly mandatory for any equipment that uses microprocessor-based components such as PLCs, digital displays and smart products.

Until recently, the performance of surge suppressors has varied among manufacturers and even from component to component. This held true even though they all carry the same ratings and were, presumably, tested using the same procedures.

This anomaly has been due principally to UL's 1449 standard which specifies testing procedures for these devices. Previous versions of this standard left more than a few "loopholes" in testing procedures, which allowed manufacturers a little too much latitude in certifying their products.

Over the past two years, UL 1449 has been repeatedly updated to better quantify the testing and make the procedures less ambiguous. The current version provides concise testing and procedural guidelines, leaving very little to interpretation. This should ultimately have the effect of producing a more uniform industry standard.

Crowbar Circuits

Electrically speaking, a "crowbar" is a circuit specifically designed to automatically discharge potentially hazardous voltages from a piece of equipment when it is turned off, if the power is disconnected or if it experiences a fault.

A great deal of electrical equipment uses internal components that have storage potential. Even after the power is disconnected, many electrical components retain lethal electrical energies. The best example of these components is capacitors. Large capacitors retain a great deal of energy for long periods of time - days, weeks and, in some instances, even months. If an unaware technician comes in contact with these components, he may sustain serious injuries or even be killed.

The basic crowbar is a fairly simple circuit and, in the interest of safety, should be kept that way. Figure 1 shows a typical crowbar circuit.

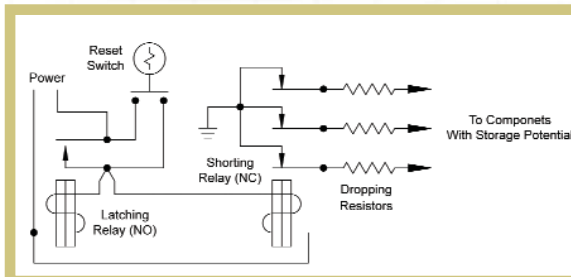


Figure 1, Crowbar Circuit Schematic

It consists of a holding relay that controls one or more shorting relays; in this case, a single, normally closed, three-pole unit. The shorting relays are configured to discharge any stored energies within the main circuit. In some cases the stored energies may be high enough to require some sort of dump load, as shown in the illustration. These dump loads are typically in the form of a high wattage resistor. Crowbar circuits are commonly designed to automatically reset, but they may also carry a manual reset key. (In this case, the circuit shown contains a manual reset.) Intended to add another level of safety to the equipment, the manual reset assures that the equipment cannot be reenergized without a specific action from a technician.

The Grounding Hook

For a variety of reasons, most extremely high voltage equipment can't realistically utilize crowbar circuits. In these cases the technician must be sure that all components with storage potential are manually discharged and remain in that state during the service work. This is the realm of the grounding hook, as shown in Figure 2.

These units consist of a copper bar bent with a long-leg hook. The shaft is insulated and the opposite end has two handles with a high voltage hand guard. A plastic-coated piece of aircraft cable is connected to a copper plate and bar. The opposite end of the cable is connected to a bolt-on ground clamp. The bolt-on clamp assures that the ground connection can't be casually or accidentally disconnected.

Continued, p. 22>>

Student Spotlight cont.

Automated volleyball server

Continued from, p. 17 >>

Where

F_d = drag force (N)

F_l = lift force (N)

ρ = density of air @ $25^\circ = 1.184 \text{ kg/m}^3$

V = velocity (m/s)

r = volleyball radius (0.105 m)

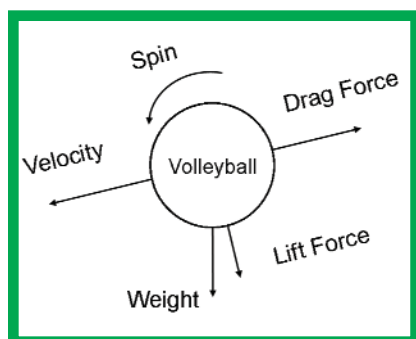


Figure 4

Many CFD studies were performed to calculate the drag force (F_d) and lift force (F_l) acting on the volleyball at various combinations of velocity, spin, and surface roughness. The CFD 'solver' was used to determine the forces acting on the ball. These forces were then plugged into Equations 1 and 2 and the coefficients of drag (C_d) and lift (C_l) were calculated. This figure shows a free body diagram of forces acting on the volleyball: (Figure 4)

The drag force acts directly

opposite to the direction of the velocity vector and the lift force, due to spin, acts perpendicular to it. Some assumptions were made in order to allow for somewhat faster calculations and a simpler CAD model. The surface variations due to the seams were ignored, and the leather surface of the volleyball cover was modeled with a surface roughness of $6\mu\text{m}$ and $20\mu\text{m}$. (Figure 5)

The first flow diagram shows a stagnation point at the front of the ball where the air velocity is very low. On the backside of the ball (dark blue area), some of the air actually moves in the direction of the ball's motion. The red areas, both above and below the ball, show that the airflow reaches a maximum velocity just above and just below the ball. This is due to the ball having the largest frontal area at that section perpendicular to the air flow. (Figure 6)

The second flow diagram shows the flow around a spinning volleyball. When the ball has top spin, it resists the air flowing over the top and speeds up the flow under the ball. The red area under the ball is noticeably larger than the red area over the ball. Pressure and velocity are inversely related, so the higher velocity below the ball creates an area of low pressure underneath it. This is the inverse of the familiar airplane

wing dynamic which creates the low pressure area on the top of the wing. This means that the spinning ball will encounter a downward 'lift' force, which will make it drop faster than a ball that is not spinning. This will come as no surprise to a volleyball player who has ever faced a powerful, overhand (top spin) serve.

The team also modeled several pressure contours, shear graphs, and flow trajectories. The value for the coefficient of drag (C_d) for all the calculations averaged 0.242. The average value for the coefficient of lift (C_l) for all calculations was 0.466.

Finite Element Analysis

The team performed a Finite Element Analysis (FEA) on a critical shoulder bolt that holds (and helps to position) the 140 pound launching head assembly. Due to the complex detail of the actual bolt used, a simpler version was created for FEA testing. The static stresses on the bolt were determined to be 65 MPa with a displacement of 0.3 millimeters. The material of the bolt is medium carbon steel with a yield strength of 350 MPa. Since the maximum stress on the bolt is far below the yield strength, this off-the-shelf bolt was deemed acceptable for the application.

(Figure 7)

Cost Analysis

The costs for the electrical and mechanical components of the machine totaled less than \$3000 for the completion of the prototype, right in line with the prices charged for several commercially available serving machines which do not include the multi-ball hopper or remote control capabilities. Of course the team spent many hours designing and building the prototype, but they believe that with certain refinements their design

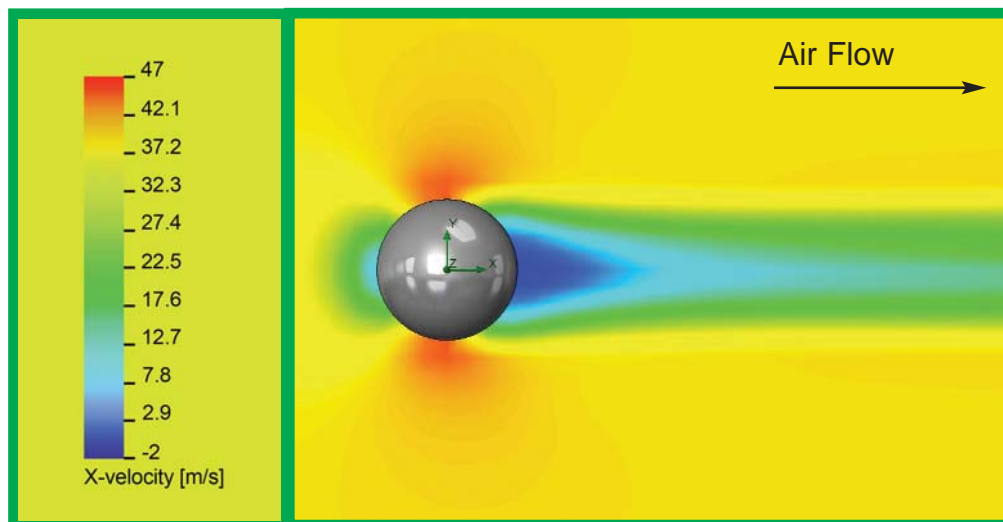


Figure 5, 80 mph Velocity with no spin and 6um Roughness

Continued, p. 20>>

Student Spotlight cont.

Automated volleyball server

Continued from, p. 19

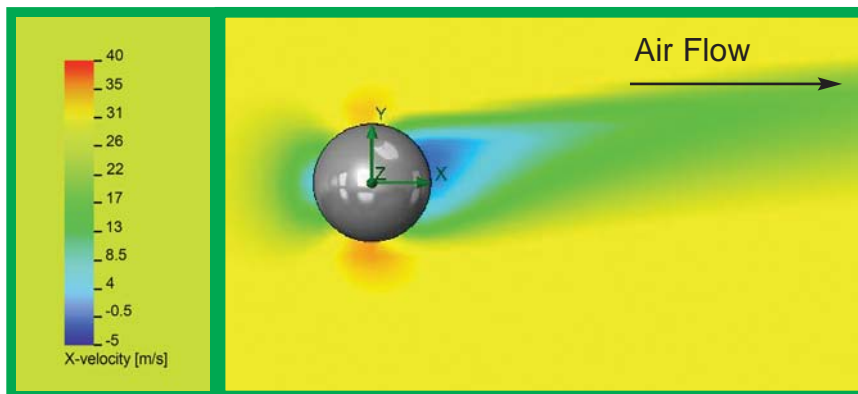


Figure 6, 60 mph Velocity with 75rad/s Top Spin and 20um Roughness

could be manufactured at a reasonably comparable cost - and sold at a competitive price - to the currently available machines on the market.

Testing

During the initial testing phase, the volleyballs were not launching with as much velocity as the team had anticipated. They determined that the volleyballs were slipping against the wheels in the launching head. The upper wheel was lowered to add more compression to the volleyball, thus increasing the velocity at which the volleyballs were being launched. While this helped, the machine was still not launching balls at realistic competition serving speeds. The team then wrapped the tire surfaces with a much stickier rubber layer to add extra friction, providing the desired launch speeds.

Conclusions

The team was pleased with the performance of the 'Ace Within Reach' Volleyball Serving and Setting Machine. The machine was tested by many by-standers during the testing phase and at the team's final presentation. The repeatability of the machine allowed testers to improve their game by concentrating on a particular placement, speed, and spin of serve. The immediate feedback was very positive. The team has a few ideas for improvements, and they even have a local volleyball club who has eagerly volunteered to spend several weeks testing the machine and to provide detailed

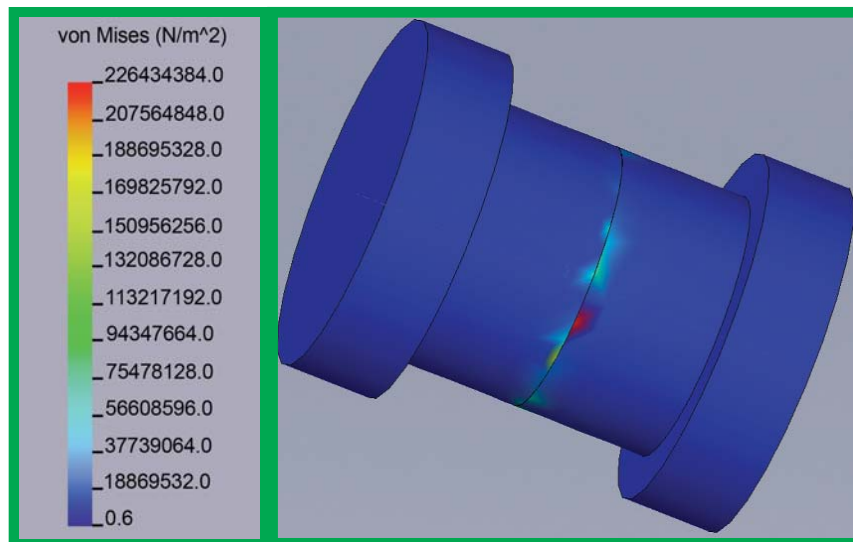


Figure 7, FEA Diagram of Simulated Shoulder Bolt

feedback. After they receive feedback from the volleyball club, the Ace Within Reach Team wishes to explore the possibilities of patenting and marketing the automatic volleyball serving and setting machine.

As for Larry, this senior design project was the last step required for graduation, and a key step towards his new Engineer position with Hansgrohe. Established in 1901, Hansgrohe designs, manufactures and sells luxury shower, bath and kitchen products. This internationally recognized company is based in Germany and has a U.S. manufacturing headquarters located in Atlanta, Georgia.

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Tech Brief cont.

Power Principles

Continued from, p. 18

Even though a grounding hook is a shorting device, it typically carries a maximum voltage rating. As with any high voltage equipment, never exceed the maximum voltage rating of the unit; doing so may cause serious injury or death. In use, grounding hooks are often permanently mounted in the area where they are to be used. After the equipment is disconnected from the power source, the sticks are hooked onto the appropriate terminals to assure that the circuit is completely discharged and remains in that state.

Live Testing

Despite how much technicians try to avoid it, sometimes it is simply necessary to troubleshoot an energized circuit and/or conduct live testing. In these situations, crowbar circuits and grounding hooks do nothing to protect the technician.

During live testing, arc hazards are at their peak; personnel should exercise great care in these environments. To a large extent, arc suppression during live testing is done by identifying high potential areas and avoiding anything that will deteriorate the stand-off effectiveness of the equipment. If the

technician inadvertently inserts a conductive tool between two high potential terminals, it may initiate an arc that can produce serious injury or even death.

Poor grounding exacerbates this condition and only serves to heighten arc hazards. In a situation where an arc forms within a properly grounded cabinet, the hazard is safely contained and does little more than startle the technician. However, if the cabinet isn't grounded, an inadvertent arc may form through the person standing in front of the box, which can instantly kill them instantly.

Dirt build-up can significantly reduce the stand-off voltage of any electrical component. As stand-off voltage is reduced, arc hazards increase. It is very important to keep high voltage equipment clean. If a piece of equipment is particularly dirty, it should be cleaned or replaced before any live work is conducted. Properly cleaning a piece of hazardous electrical equipment can mean the difference between an uneventful afternoon and one you'll remember for the rest of your life.

High Voltage Meters and Probes

Troubleshooting high voltage equipment is typically done with specially designed high voltage meters or ordinary multimeters equipped with specialized high voltage probes, as shown in figure 3. This particular probe is rated at 25 KV and has a 100 to 1 attenuation factor. The meter is set to the 250 volt range and the probe is connected to the input terminals. The technician simply multiplies any reading by 100 to determine the circuit voltage. (Figure 3)

Following a few basic safety procedures makes using these probes very safe. On the other hand, ignoring these procedures can cause serious bodily harm and even death. Remember, when working around this type of circuitry, there is no middle ground.

When using any high voltage instrumentation, always read and understand the manufacturer's recom-

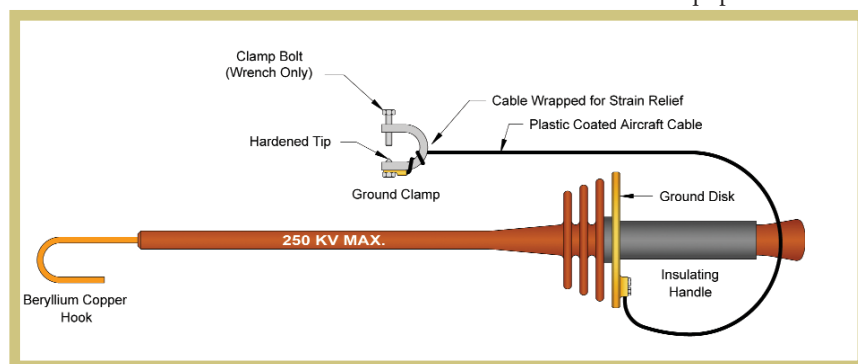


Figure 2, Grounding Hook or "Jesus Stick"

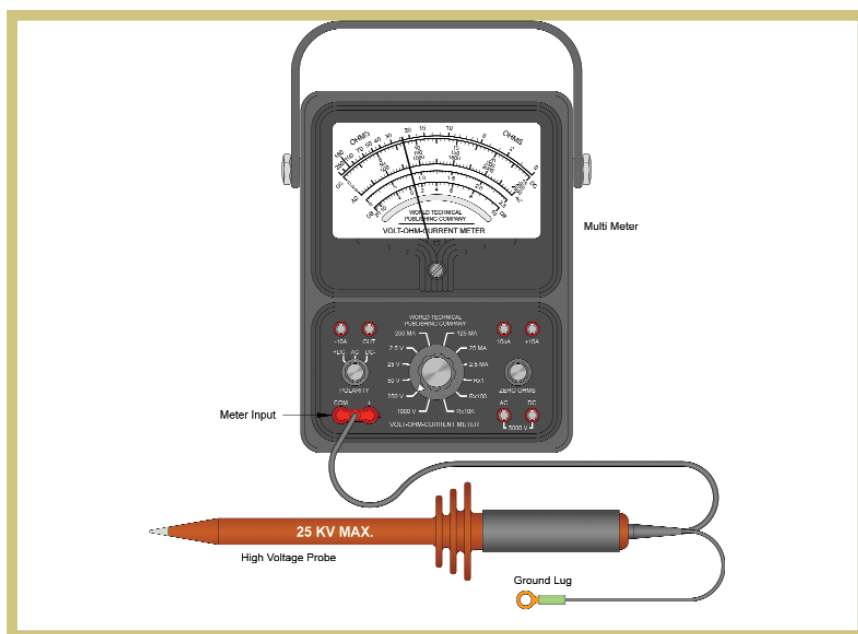


Figure 3, Multimeter W/ High Voltage Probe

User Solutions


Wastewater Pumping Station

mendations concerning the specific equipment.

When using high voltage probes, always connect the grounding lug to a suitable earth ground. This connection serves an important safety function as it adds a second level of protection for the technician.

Similarly, never use a high voltage probe at voltages higher than its maximum rating. During operation, one hand should be in your pocket and the other should be used to grip the handle. Never touch the probe in front of the hand guard, even when the probe is not in use. Obviously, touching the forward part of the probe during use greatly increases the technician's chance of electrocution. Touching the forward part when not in use will deposit oils and dirt from the skin. Over time, contaminants like these can build up and affect the stand-off voltage of the probe.

Have your high voltage probes re-qualified by the factory on a regular basis. Never use a high voltage probe of unknown origin. If the history of the probe is not clear, it should either be sent back to the manufacturer for re-qualification or destroyed. Inspect your high voltage probe before each use.

In any high voltage case, work being conducted on this type of circuit should always be carried out by personnel who have been properly trained for the specific equipment and safety issues that apply to the environment. Additionally, a spotter technician, trained in CPR, should always be present when personnel are working with potentially hazardous electrical equipment. With the right equipment, proper training and judicious application of safety procedures, a technician can safely work with and around equipment that would otherwise be considered lethal. 

PLCs give Wastewater Pumping Stations a Lift

Flexible, economical PLCs provide automatic failover, backup pump control, and remote lift station monitoring.

By Jeremy Poarch, P.E.,
Moccasin Bend Wastewater Treatment Plant

The Moccasin Bend Wastewater Treatment Plant (WWTP) is part of the Interceptor Sewer System, which has served Chattanooga, Tennessee, and its surrounding metropolitan areas since it was built in 1952. The WWTP includes pumping stations as well as liquid and solids handling.

Our treatment plant receives an average flow of around 50 million gallons per day (gpd), and has a peak treatment capacity of 220 million gpd. We also operate the associated sewage collection system and remote sewage lift stations.

For the most part, gravity conveys area wastewater from its origins to our treatment facility, but deep-pipe areas require lift stations or pumping stations to lift the wastewater to shallower pipes.

We remotely monitor every sewer pumping station and lift station to ensure normal operation. If something fails, we receive an alarm at our central control room at the treatment plant. Other remotely monitored information includes pump status (running or stopped), number of pump starts and stops, and daily pump running hours.

We recently installed new controls at one pump station site. The new control system monitors and controls wet-well levels, and provides status and alarms over a Modbus connection. The new system uses two *DirectLOGIC* DL-06 PLCs and an *OptiMate* HMI sold by AutomationDirect.

We designed an automatic failover system for this pump station site. One of the PLCs serves as the master; the other serves as the client, or as a redundant controller in case of a failure of the master unit.

We also recently redesigned the Remote Telemetry Units (RTUs) that operate and monitor our remote sewage lift stations. For the new RTUs, we also use DL-06 PLCs from AutomationDirect.

Upgrading the Pump Station Control Unit

The pump station site that we upgraded with the automatic failover system consists of two constant-speed pumps started across-the-line. The pump station control unit monitors and controls the level of water in the storage or wet well. The controller starts and stops the pumps according to a user-defined level. It also provides high and low level alarms, indicates whether the pump controls are in "Hand" mode or "Auto" mode, and indicates if an overload relay has tripped.

The pump station control unit is programmed to alternate which pump starts first to distribute pump motor run time evenly. It's also programmed to start the second pump if the first pump can't provide enough effluent flow to keep the wet well within an acceptable range.

The operator enters level control parameters via the HMI connected to the master PLC. A Modbus connection sends these parameters to the client (or slave) PLC. If the master unit fails, pump control is transferred to the client PLC through a series of relays.

Pump station operation continues without interruption, but the operator now needs to move the HMI cable from the master to the client to provide operator interface to the client PLC. Attaching the HMI to the client PLC provides a means for the operator to change operating parameters until the issue with the master unit is resolved.

Continued, p. 27>>

FYI

ABCs of Safety Components

Safety Light Curtains

By Lenny Filipkowski,
AutomationDirect
Product Manager,
Industrial Components



Figure 1

Safety light curtains are an advanced method of safeguarding personnel around hazardous machines through the use of photoelectric technology and a concept known as Control Reliability.

Safety light curtains are a great alternative to other traditional guarding methods such as mechanical barriers, sliding gates and pull-back restraints; they reduce operator fatigue and offer flexibility and freedom to the operator as well. (Figure 1)

How do they work?

Safety light curtains consist of a transmitter and a receiver. A photoelectric transmitter projects an array of synchronized, parallel infrared light beams to a receiving unit. When an object breaks the beams of light, the logic circuit in the light curtain sends a signal to the control system of the machine and stops the hazardous movement of the machine.

(Figure 2)

The transmitter contains light emitting diodes (LEDs) which emit pulses of invisible infrared light when energized by the light curtains timing and logic circuitry. These light pulses are sequenced; one LED is

energized after another and they are modulated or pulsed at a specific frequency. The receiving units are designed to detect only the specific pulses and frequency from the matched transmitter unit.

In order to meet the OSHA and ANSI requirements for control reliability, the safety light curtains are continuously doing self checks; if the self checks detect any fault, the light curtain immediately sends a stop signal to the machines control system. The light curtain then becomes locked in a safe

condition until the faulty component is replaced and an appropriate reset is done.

Safety light curtains also have a set of two relays in order to provide a redundant circuit. If one relay fails, the second will still provide the stop signal. There are two basic types of outputs for light curtains: relays with force-guided contacts, and electronically cross-monitored and self checking solid-state devices known as OSSD (Output Single Switching Device).

In what applications are they used?

Light curtain applications are typically categorized by the type of guarding required. Light curtains are used in guarding machines such as mechanical and hydraulic power presses, molding presses, stamping, forming and automated assembly machinery. Safety devices are typically selected to protect the operator's finger or hand from the pinch point of the machine.

If there is a perimeter or boundary defined by a machine, robot or other equipment, then a perimeter guard style light curtain may be selected.

The main difference between a light curtain designed to protect a finger

versus a hand, and one designed to protect a perimeter, is the spacing of the actual beams. A unit designed to protect a finger utilizes 14mm spacing between each beam while one for hand protection is designed with 30mm between the beams. Perimeter style light curtains can have beam spacing from 300mm to 500mm.

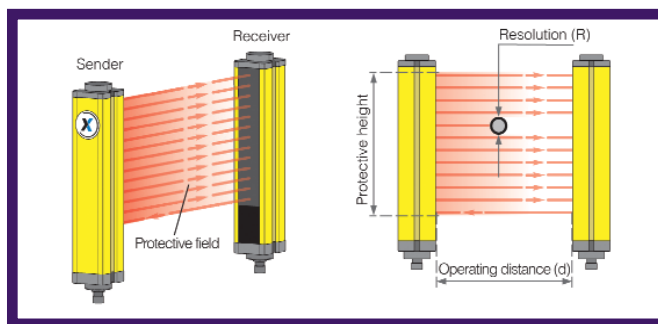


Figure 2, Operating Principle

How do I select the proper light curtain system for a given application?

Several points must be addressed to make the proper selection; some of these factors include:

- The size of the object or body part being detected or protected will determine what resolution of beam spacing is required; 14mm for finger or 30mm for hand. (Figure 3)
- Determining the height and length of the area and the protected field to be guarded will determine the required maximum protective height of the light curtain system.
- The time required for the machine or process to stop after an interruption of the light curtain system will determine the required response time needed from the light curtain system.
- The maximum distance or range needed to separate the emitter and the receiver in the application must be considered.
- What type of load will the light curtain safety outputs control? Are they sufficient for the control

Continued, p. 26>>

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Safety light curtains in finger (14mm) or hand (30mm) protection resolutions

- Protective height:
14mm resolution - 142 to 1045mm
30mm resolution - 279 to 1827mm
- Operating distance:
14mm resolution - up to 3.5 mches
30mm resolution - up to 12 mches
- Double PNP outputs
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	\$275.00 YBB-30R4-0250-G012 (receiver)
Safety limit switch, pull-reset action, plunger actuator, 30mm plastic body, 1/2 NPT	\$12.75 AP2R11X11
Safety switch, cable pull interlock, no reset, 40mm plastic body	\$20.50 SBM2K97X11

AutomationDirect prices are U.S. published prices as of January 2011. Prices subject to change without notice.

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FYI

ABCs of safety components

Continued from, p. 24

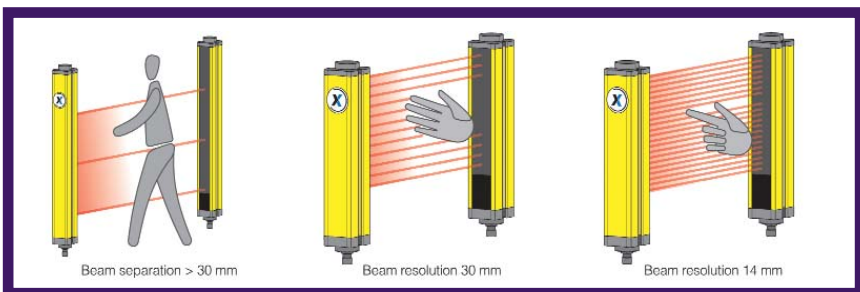


Figure 3, Resolution of the access control barrier or light curtain

circuitry? This will determine the current capability required of the safety signals. Do you need semiconductor style outputs or heavy duty relay outputs for direct control of a motor starter?

- What safety level or safety control category does the application's risk assessment indicate is required? Can a basic type 2 rated light curtain unit suffice or do you need the more robust type 4 units for the most protection and reliability for the application? All are points for consideration when determining the proper light curtain system.

What other functional features can safety light curtains perform?

Safety light curtains can be used in a variety of different modes which can range from providing a stop signal to a machine's safety control circuit to more sophisticated functions such as muting, fixed blanking, floating blanking and presence sensing device initiation. These functions can be part of the logic circuitry in the light curtain units themselves, or certain functions such as the muting and presence sensing device initiation can be handled by an external safety control relay module.

What is muting?

Muting is the provisional and automatic overriding of the light curtain safety output function during normal, uninterrupted machine cycle operation. This function allows the light grid to be interrupted by some part of the machine or material being processed without stopping the operation or process.

An example of this would be a palletizing system within which the palletized product must be allowed to pass through the opening protected by the light curtain, while the entry of a person must stop the machine in a safe manner.

Muting is typically accomplished by using an external safety control relay module and additional sensing devices such as safety limit switches or photoelectric sensors in conjunction with an external signaling light to show when the muting function is activated.

What is fixed blanking and floating blanking?

Fixed blanking is when a fixed set of adjacent light beams are set to be permanently inactive to allow product or part of the process to enter the sensing area without deactivating the light curtain safety outputs.

Floating blanking is when a set number of adjacent beams are allowed to ignore the presence of an object within their portion of the protected field. Unlike the fixed blanking method where there is a specific set of inactive beams, floating blanking allows the set number of adjacent beams to "float" within the protective field. This allows the object to be ignored to move within the protected field without deactivating the light curtain safety outputs.

These functions are typically designed into the logic in the safety light curtain units themselves and require some sort of programming or dip switch settings.

When the application allows for the use of safety light curtains, the

functions and benefits allow the protected machine to run more safely and more productively than many other protection devices. The most important, consideration when choosing a brand of light curtains is to make certain they meet all requirements of the relevant safety standards such as EN/ISO 13849-1:2008 (former EN 954-1), and EN/IEC 61496-1:2004/-2:2006 type requirements. Also, it is important to verify these have been tested and certified by an independent, recognized third party such as TUV in order to make sure they are compliant to the relevant standards for safety light curtains.

"A bank is a place that will lend you money if you can prove that you don't need it."

– Bob Hope

User Solutions cont.

Wastewater Pumping Station

Continued from, p. 23

We designed the automatic failover to operate in case of PLC failure, which would normally result in an after-hours call to an electrical technician. The failover function allows the station to function normally until repairs can be made during regular work hours.

An output on the master PLC is held energized by an "always-on" bit in the PLC. If the master PLC stops operating, the output de-energizes a series of relays. The appropriate relay contacts direct the outputs of each PLC to the appropriate control relay to provide failover operation.

The two main control PLCs share operational parameters, basically level settings. The master PLC also retrieves power quality data from a power quality analysis meter through a Modbus connection. The PLC then sends all appropriate data to a data logging unit, also connected via Modbus. Establishing the Modbus communications between the non-PLC devices was the most challenging part of this project.

In this particular pump station, a series of dry contacts provide alarms and pump status indications to an RTU. One pair of contacts is used for each function. The RTU, in turn, sends this status and alarm information to the treatment plant central control room via a licensed radio system.

Upgrading the RTUs

We've considered replacing our RTU systems for several years. We chose the AutomationDirect PLCs as the heart of our new RTUs because we could obtain what we needed quickly and for a lower cost than from other suppliers. Because we could have hardware in our hands in a matter of days after the order, we were able to develop these systems quickly. Also, the PLCs we chose provided us with additional pump control options.

The new RTUs operate and monitor our remote sewage lift stations through a cellular connection. At the central control room, an OPC server

connection provides information to a PC-based HMI. The connection between the control room and each RTU is via a cellular network.

When we installed the first of the new RTUs, we found it extremely convenient that those of us authorized to work with the PLC logic could access the unit remotely. The operator in charge of monitoring the stations has called me many times in the evening or on weekends asking me to take a look at the site.

I can connect to the PLC from my home, and see how the site is performing. I can assess the conditions and advise whether the situation is "normal" or needs attention from maintenance or operations. I can even determine whether an issue had arisen here at the plant with the PC, based on what I could see from the PLC.



Control Cabinet

There is a communication issue with the RTUs that we're working to resolve. The software driver residing on the PC can handle some delay between the data-request message and the response to that message. However, the communication delays we're experiencing over the cellular-based Internet connection have forced us to look for alternate connection methods.

Our local power distributor is implementing a fiber-optic-based Internet service, which we feel holds the key to resolving this issue. We are currently evaluating sites to find good candidates for a pilot project using this higher speed connection.

We've installed 16 RTUs so far, and many of these units have been retrofitted into enclosures that used to contain older radio-based

RTU equipment.

System Upgrades Worth the Effort

The new pump station control unit has proved to be more reliable than the original control system. We don't have specific records of how many times the operations staff was dispatched to the site in the past, or how many times electrical maintenance was needed after hours. However, I have noticed that the frequency of issues at the site has decreased dramatically.

We attribute the drop in after-hours calls to the increased reliability of the new control unit and redundant PLC. Although we've thoroughly tested it, we haven't yet had a situation that required the use of the automatic failover function. If it saves us only once, it was worth the effort.

Purchase price was one of the main considerations for the RTU system PLCs. The hardware is modular, so we don't have to buy more than we need. We've installed 16 systems so far, and we calculate that our choice in PLCs is saving us around \$200 per site. When you consider that we have more than 80 remote sites, the savings can add up quickly.

"Time is what we want most, but what we use worst."

— William Penn

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Business Notes



AutomationDirect launches 3D CAD catalog on TraceParts Web site

AutomationDirect now has 3D CAD models available through TraceParts, an online provider of 2D drawings and 3D models. Customers can find the 3D models by going to www.tracepartsonline.net and selecting the "AutomationDirect" listing. There are also direct links to the models from the item level pages on the AutomationDirect Web store. We will continue to maintain our libraries of 2D CAD drawings on our store site as well for the foreseeable future.

The TraceParts Online CAD portal is freely available to millions of CAD users worldwide, offering a convenient way to download 3D models in the most popular file formats. This initial launch includes 128 part numbers covering CLICK and Productivity3000 PLCs, C-More micro operator panels, PSP24 power supplies, and GH Series motor contactors and overloads.

We will continue to add 3D models on a monthly basis as new files are completed. Visit: www.tracepartsonline.net to view the complete list of models, and begin downloading at will!

AutomationDirect achieves 10th straight year of #1 service



For the 10th year in a row, AutomationDirect has been voted tops in service by readers of Control Design magazine. Their Readers Choice Awards survey polls machine builders and system integrators to rate their experiences with automation vendors. In 50-odd hardware and software categories, survey participants name the companies that provide them the best technology value for the products with which they have experience. Once they choose the best providers, participants rate service and support they receive from them. In 2010, AutomationDirect received the highest service rating of any vendor for the following product categories: PLCs, PLC programming software and Operator Interface Terminals. We also received the highest service score across all vendors. Our dedicated Technical Support team continues to put our customers first, and it shows – thank you all for your vote of confidence!

Atlanta Business Chronicle ranks AutomationDirect as one of the "Best Places to Work" in Atlanta

AutomationDirect was named one of Atlanta's Best Places to Work in 2010 by the Atlanta Business Chronicle.

Employees voted the company to the number two position in the medium-size company category by completing a 37-question online survey. The survey focused on specific categories relating to a company's workplace culture. Things considered included: team effectiveness, trust in senior leaders, feeling valued, manager effectiveness, compensation and benefits. Companies were then ranked and finalists chosen in each size category based on their overall composite score. Winners were chosen based strictly on the results of the survey. According to Anne Reich of the Atlanta Business Chronicle, winners are, in essence, chosen by the employees themselves. In 2010, approximately 500 companies were nominated.

Expressing gratitude, company captain Tim Hohmann says, "This award is the best compliment to our company and management team that I could ask for. We feel if teamers love what they do, they'll naturally take care of customers with dedication and enthusiasm. And that does prove true based on the many customer surveys we do."

"By all means marry; if you get a good wife, you'll be happy; if you get a bad one, you'll become a philosopher."

– Socrates

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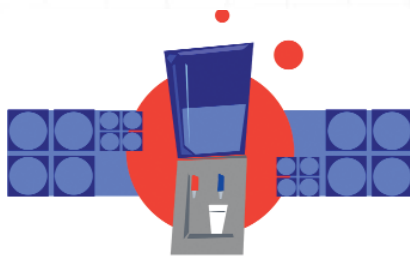
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The Break Room

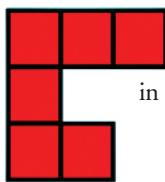
BrainTeasers



BrainTeasers

Example:

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Note: This simple example does have multiple solutions.

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Our thanks to Erich Freidman for this issue's puzzles. Packing Puzzles © Erich Friedman 2009

Check out more of Erich's Puzzles here:

<http://www2.stetson.edu/~efriedma/puzzle.html>

Solution:



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2. Pack 5 copies of



in a 7x7 box

3. Pack 6 copies of



in a 6x7 box

4. Pack 6 copies of



in a 6x8 box

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6. Pack 6 copies of



in a 7x8 box

7. Pack 7 copies of



in a 7x8 box

8. Pack 7 copies of



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