Your guide to practical products, technologies and applications

Automation NOTEBOOK™

Summer 2008 Issue 11

New Product Focus

Pressure Sensors

Technology Brief

Sunlight Efficiency Detector

Feature Story

Let the Sun Shine In: GA Tech Competes in the Solar Decathlon

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Editor's Note

Louis Armstrong sang, "I see trees of green, red roses too. I see them bloom for me and you, and I think to myself, 'What a wonderful world.'" And what a wonderful, but curious, world it is.

As technology evolves, we find more ways to improve things, such as how to operate an automobile on less fuel, or how to produce more light using less electricity.

Many refer to this as "going green," but those are just a few examples of how people are finding better ways to use the earth's resources. Here at AutomationDirect, we are recycling aluminum cans, cardboard, plastic bottles, and paper. Perhaps a bit of this is making all of us evaluate ways to become more responsible with our resources.

With all that, we decided that "green" should be the focus of the summer issue of Automation NOTEBOOK. We have articles to inspire readers about ways to improve current applications and develop new ones which limit negative effects to our atmosphere and the planet.

In this issue, you will read an article about an outstanding group of college students who competed in the 2007 Solar Decathlon held in Washington, D.C. We also have an article from guest writer Keith Schmitz about the innovative ways Boston Children's Museum is working to save the planet while educating our youth.

We invite you to consider your own applications and evaluate areas where energy could be renewed, saved, or reduced. Now, turn the page and enjoy…

TJ Johns
Senior Editor
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New Product Focus

what's new

AutomationDirect offers pressure sensors

prSense™

AutomationDirect has added ProSense™ pressure switches and transmitters to its growing offering of sensor products. ProSense pressure sensors are designed to monitor system pressure in hydraulic and pneumatic applications, while the vacuum sensors provide an accurate readout of increases and decreases in vacuum systems.

ProSense sensors are smaller and easier to install than traditional mechanical pressure switches. With no moving parts, such as pistons or springs that can stick or break, ProSense pressure and vacuum sensors are a worry-free, solid-state solution to mechanical switches. ProSense offers pressure sensing solutions using capacitive sensing technology and strain gauge technology.

The compact PTD Series pressure and vacuum transmitters, in robust stainless steel housings, detect system pressure and convert it into an analog output signal for reliable pressure indication. Designed for quick installation and easy setup, pressure transmitter output options include 4 to 20 mA or 0 to 10 Volts, and are available in sensing ranges up to 1,000 psi. Vacuum-style transmitters offer 20 to 4mA or 10 to 0 Volt outputs. The sensors' ceramic sensing element provides high burst/overpressure protection, and the flexible film circuitry results in excellent shock and vibration resistance. All transmitters are $125.

The PSD series electronic pressure switches feature an extremely durable housing, with a 316 stainless steel process connection and gas-tight measuring cell to reliably detect gas and liquid pressure. The switch withstands aggressive media and detects pressure ranges up to 5800 psi (400 bar). Mechanical adjustment dials rotate quickly to establish the setpoint and reset point. The sensor is adjustable without system pressure and supply voltage and does not require calibration. The sensor's high accuracy and long-term stability (over 50 million switching cycles) ensure the setpoint does not drift. Vibration and shock-resistant, PSD series electronic pressure switches are equipped with LEDs which indicate switching and operating status. The switches provide a dual switching DC output through a micro connector. All switch models are priced at $89.

All ProSense pressure sensors are cULus and CE approved, and utilize quick-disconnect cables, sold separately.

AutomationDirect sells over 6,500 feature-packed products through its online automation superstore and 2,016-page catalog. The company offers its customers high-quality automation products at prices typically below the industry average, same-day shipping on in-stock items, the best documentation in the industry, outstanding sales and technical support, and a 30-day money-back guarantee on nearly every product. For a free catalog, access the Web site at www.automationdirect.com or call 800-633-0405.

"The dream begins with a teacher who believes in you, who tugs and pushes and leads you to the next plateau, sometimes poking you with a sharp stick called truth."
– Dan Rather

Product Snapshots

Press Releases

AutomationDirect launches high-current models of current sensors

AutomationDirect has expanded the acuAMP™ line of current sensors to include high-current models. ACT and ACTR series acuAMP current transducers combine a current transformer and signal conditioner into a single package. The new acuAMP single phase AC current transducers feature a fixed core and jumper selectable inputs from 375 amps all the way up to 2,000 amps, with 4-20 mA outputs. The new transducers are also available in true RMS versions; new models start at $108.

AcuAMP current operated switches combine a current transformer, signal conditioner plus a limit alarm into a single package. The current switch outputs are isolated solid state switches and are now available in Normally Open and Normally Closed universal configurations. All acuAMP sensors are panel-mountable; convenient DIN rail adaptor accessories are also available.

DC-to-DC Converters added to RHINO Power Supply Line

RHINO™ PSP DC-to-DC converters are available with wide input ranges (9.5 to 18 VDC and 18 to 75 VDC). All four available models can be

operated from popular DC supply voltage systems. Tightly regulated output voltage provides a reliable power source for applications exposed to critical industrial environments. Output ratings include 5A @ 5VDC, 2A @ 12VDC, and 1A @ 24VDC. RHINO DC-to-DC converters can also be used to isolate a specific load from the 24 volt bus voltage, and offer easy installation with snap-on DIN-rail mounting and detachable screw terminal blocks. Converters are also wall mountable with included wall-mount bracket. With prices starting at $70.25, the DC-to-DC converters are backed by a 3-year warranty.

High-Contrast C-more Micro-Graphic Panels

The C-more™ Micro-Graphic panel line now includes high-contrast panels and supports additional PLC protocols. Starting at $139, the new 3.1-inch micro-graphic models, in touch and non-touch versions, feature white and red LED backlights and support 5 selectable screen colors. In addition to the existing DirectLOGIC PLC, Modbus RTU and Allen-Bradley DF1 protocols, new communication drivers support Allen-Bradley DH485, Siemens PPI, and GE SNPX for Micro 90 and VersaMax Micro. Updated software is available for free download from http://C-MoreMicro.AutomationDirect.com.

AutomationDirect adds 18 gauge electrical wire

AutomationDirect offers three types of electrical wiring, now in sizes up to 18 gauge, for industrial applications. Type MTW conductors are primarily used in control cabinets, in machine tool applications and appliance wiring applications. Type TFFN (stranded) conductors are primarily used as fixture wire as specified by the National Electrical Code (NEC). Type THHN building wire is intended for general purpose applications. It is appropriate for new construction or rewiring for 600 volt applications.

"When one burns one's bridges, what a very nice fire it makes."
– Dylan Thomas

Cover Story

Going Green

Museum Practices What It Teaches:

Going Green Drives Home the Lesson at Boston Children's Museum

by Keith Schmitz,
Guest Writer

Many historians reckon that the Boston Tea Party took place on the banks of the city's Fort Point Channel. Though the site may be somewhat in question, the educational impact of another present day revolution taking place at Boston Children's Museum is indeed very firm.

A century-old wool warehouse along the Channel is now a world of wonder for children and their parents. The recently opened 23,000-square-foot addition to Boston Children's Museum is a must-see for the city's residents and visitors, offering many hands-on exhibits. Exhibits include bubble-making machinery, a three-story climbing maze, the Construction Zone featuring kid-sized equipment, Kid Power that promotes healthy lifestyles, and Boats Afloat, where children can float wooden objects down a 28-foot-long model of the Fort Point Channel.

The Museum is also a must-see for architects. At last month's (May) American Institute of Architects conference, Boston Children's Museum was one of the highlights of a tour that included the Big Dig and the new Institute of Contemporary Art that was conducted for the members and their families.

The Museum is very much tied into the environment of the Fort Point Channel. The Museum moved to this location in 1979 with the intent of developing programs and exhibits consistent with the new waterfront home environment. A wide range of exhibits helps visitors explore waterfront habitats and learn about their creatures, while programs educate kids and their families about the importance of enjoying – and protecting – the environment.

Lessons of energy conservation and sustainability are taught throughout the Boston Children's Museum, and by the building itself.
Photo courtesy of: *Boston Children's Musuem*

The Museum has made a strong effort to spread the lessons of that environment throughout the Boston public school system. During the summer the museum has brought local teachers to the waterfront location and taught them how to involve students in doing fieldwork activities. The vision of the Museum staff is to bring every Boston school child to this site to discover the ecosystem in which the Museum functions. It anticipates educating 500,000 students, teacher, parents and other visitors annually.

Over 5,000 children and parents helped install plants for the museum's green roof.
Photo courtesy of: *Boston Children's Musuem*

According to Boston Children's Museum's Chief Operating Officer Neil Gordon, "We have made environmental stewardship a core part of our educational vision."

These efforts on the part of Boston Children's Museum's management and board have been certified by a national organization that is playing a prominent role in this country's green building movement. The Museum project is one of a growing number of buildings registered with the US Green Building Council's LEED® certification program and earned the LEED Gold certification. More and more projects are in the hunt to achieve the certification.

According to an article in USA Today, developers and builders aren't joining the green revolution purely out of a sense that it's the right thing to do. They simply can't afford to be left behind. By the end of 2006, at least 6% of the nation's non-residential construction, a $15-billion chunk of the industry, was expected to be green, says Greg Kats, a green-building consultant in Washington, D.C. In 2000 it was less than 1%.

The process of striving for LEED certification coordinates the efforts of the participating firms and Boston Children's Museum's management to reach a level of ecological harmony and minimize the building's impact on the channel area. The roster of project participants included Cambridge Seven Architects, Inc. and R. G. Vanderweil Engineers, LLP, with the construction led by Shawmut Design and Construction, and mechanicals installed by TG Gallagher.

The LEED certification has a scoring system based on a set of required prerequisites and a variety of credits in six major categories. Credits can be earned based on factors such as site selection, water use, energy use optimization, selection of building materials, employee comfort and an evaluation of innovation in the design process. In LEED v2.2 for new construction and major renovations for commercial buildings, there are 69 possible points and buildings. To achieve the gold rating, Boston Children's Museum scored between 39 and 51 points.

Literally the whole museum building itself is an exhibit, teaching children the lessons of sustainability from top to bottom.

Up on the roof

Topping off Boston Children's Museum is an extensive green roof of plantings and organic materials. Working with the Museum's staff, "Green Team" interns and guest scientists, more than 5,000 children and parents participated in preparing and installing the plants that form the visible green roof over the Museum's entrance. A highly visible demonstration of Boston Children's Museum's green agenda, the green roof sedum and flowering plants will cover a 6,400-square-foot surface.

The museum's hangar style doors allow light and air into the building.
Photo courtesy of: *Boston Children's Musuem*

Over 5,000 children and parents helped install plants for the museum's green roof.

Along with irrigating the plants, the harvested water will comprise the cooling tower make-up water. Vanderweil installed a 20,000-gallon reclaimed water system in the building. As the water passes through the building, it is recycled as gray water for toilets, reducing potable water demand by 77%. Their goal is to reduce storm water discharge from Boston Children's Museum's site by 88%, and reduce phosphorus discharge from storm water runoff by 40%.

Gordon notes, "The water quality on the Fort Point Channel is rated among the worst in Massachusetts's bodies of water for organic and pathogenic pollutants."

Even with the significant private/public investments being made in improving the channel's water quality, Boston Children's Museum feels it is important to do its part in this effort. "Storm water if left unchecked," notes Gordon, "will jeopardize the future of the channel."

In the galleries

The HVAC system at Boston Children's Museum is set up to responsively provide the right level of heating/cooling based on visitor traffic throughout the facility. The system monitors the crowds using Kele CO2 sensors on the return air in each zone throughout the building. This information is fed to the Johnson Controls Metasys® building management system that controls and coordinates the building's HVAC.

Recalling our high school science, humans give off CO2 as we exhale. When the sensors detect a CO2 level of 750 parts per million (ppm), the Metasys system commands the dampers on the variable air volume (VAV) make-up air boxes to open to bring fresh air into the zone.

The VAV's help make Boston Children's Museum's air conditioning systems more efficient by regulating the heating/cooling load targeted toward any specific zone in the building. When a VAV box constricts a valve to let less air through, it decreases the amount of energy consumed by fans that direct the air around the building.

"The beneficial part about this system is that our HVAC in the building does not run on a set program," according to Gordon, "[rather it] is based on real-time building usage."

This system runs in conjunction with the 36 high efficiency heat pumps working together with a condenser water system incorporated into the existing water tower. The cooling tower's two 40 HP fans are controlled by variable frequency drives, which control the speed of the fan motors based on a cooling load.

The 45 heat pumps positioned throughout the building to cool individual zones each have control valves for regulating the condenser loop. If some of the heat pumps do not call for heating/cooling, those valves close. The differential pressure goes up, which signals the drives to slow the pumps to save energy.

The savings on the rooftop systems are achieved through dampering down the VAV boxes when CO2 falls below 750 ppm, and adjusting the drives on the rooftop units so they are not running continually at 100% speed. Together with daylight lighting controls, the HVAC system is projected to deliver an 18% energy performance improvement.

Throughout the building

From structural supports to flooring and railings, the Museum incorporated up to 25% recycled materials and up to 20% locally harvested or manufactured materials. In addition, materials used in the project are certified low-emitting materials to ensure the Museum maintains a high level of air quality for its visitors.

At ground level

The Museum has two large 21'4" wide by 20'7" high Wilson hangar style vertical bi-folding doors that match the addition's overall exterior design so that when closed, the doors blend into the other solid walls.

The doors are part of the Museum's

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Cover Story cont.

Going Green

Continued from, p. 9

goal to connect viewers and programs to the waterfront while completely blending into the overall look of the new façade. They also support the Museum's green mission by enhancing day-lighting and view capabilities for the new spaces.

Lessons of energy conservation and sustainability are taught throughout the Boston Children's Museum, and by the building itself.

As an integral part of the high window wall, the full height glazing on the doors reduces energy requirements by reducing the need for artificial lighting in the lobby. Along with using daylight for illumination, the doors are glazed with one-inch thick high-performance double-pane glass, trapping the heat of the sun to reduce winter heating and summer cooling costs.

The door is propelled by two 1HP motors rather than one 2 HP motor to provide longer shaft life for these large doors that are made heavier by the glass. The door operation is controlled by an AC drive and 3-button controller. The variable speed AC drive provides a visitor-friendly, smooth, soft start and stop at half door speed, minimizing wear on the motor and components, while significantly decreasing the opening and closing time of the door.

Investing in the Future

While Boston Children's Museum is presented to the community as a learning experience, building the addition to the Museum was a learning experience for management as well. In the process, the Museum was able to deliver on their green mission, as evidenced by the LEED Gold certification, while fitting the project within budget constraints against the board's adoption of a 15-year payback as the basis for analyzing cost/benefit.

But the real investment that will pay off is in the young people of Boston. As Gordon states, "the commitment to a green building is really a commitment to creating the next generation of environmental stewards."

Cover Story Side note

LEED® Standard Leads the Way to More Ecological, User-Friendly Buildings

In the drive to go green, buildings loom large in the potential part they can play in making major reductions in energy and resources. Construction contributes 9% to this country's annual GNP, and one organization is working with contractors and building owners to build facilities that are friendlier to the environment and to future generations.

Leading the charge in the area of construction, the U.S. Green Building Council (USGBC) is a non-profit organization committed to expanding sustainable building practices. USGBC is composed of more than 13,500 organizations from across the building industry working to advance structures that are environmentally responsible, profitable, and healthy places to live and work. Comprising the council are building owners and end-users, real estate developers, facility managers, architects, designers, engineers, general contractors, subcontractors, product and building system manufacturers, government agencies, and nonprofits.

They have developed the LEED® (Leadership in Energy and Environmental Design) Green Building Rating System to be a voluntary, consensus-based national rating system for developing high-performance, sustainable buildings. LEED addresses all building types and emphasizes state-of-the-art strategies for sustainable site development, water savings, energy efficiency, materials and resources selection, and indoor environmental quality. It is a third-party certification program and the nationally accepted benchmark for the design, construction and operation of high performance green buildings.

The LEED certification gives building owners and operators the tools they need for an immediate and measurable impact on their buildings' performance. The LEED process promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality. Based on this quantifiable criteria, a building can attain a silver, gold or platinum certification.

The LEED system has helped spur the growth in green products and services. In 2005 that market was at $7 billion. By 2010 it is expected to reach $60 billion.

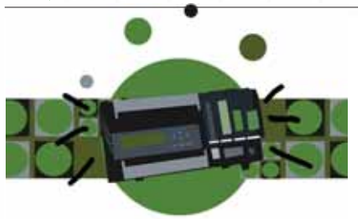
Currently about 200 buildings have been LEED certified. In Las Vegas, construction is underway for one of the largest projects to date seeking LEED certification. MGM is building the $5 billion, 18-million-square-foot City Center on 60 acres of land just west of the Las Vegas Strip. This massive complex will open in 2009, earning its rating by eliminating 48,000 tons of green house gases per year, diverting over 80% of construction waste through re-use and recycling, and having improved indoor air quality by using low-VOC and non-toxic materials.

Keith Schmitz is a business-to-business and technology writer based in Milwaukee, WI. He has written on a range of topics including electronics, HVAC applications, use of lean/SixSigma/TRIZ techniques, and hydraulics.

Industries he has been involved with include supply chain and material handling, manufacturing, mining, construction and medical.

PLC Speaking

control Platforms



What about PC Control?

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

Control fads have come and control fads have gone, but through it all Programmable Logic Controllers (PLCs) have withstood the test of time. However, there are times when the basic ladder logic programmed PLC is not the best answer to your control solution. Enter PC-based control …

PC-based control (application control from a personal computer) entered the automation control market some 15 years ago and was quickly tagged as the PLC replacement - obviously this did not happen. However, we have seen this type of control settle in with a comfortable following.

For many, ladder logic programming may seem archaic or simply just not as familiar as another style of programming. Ladder logic was designed to resemble an electrical schematic because the PLC was originally intended to be a simple relay replacement and those programming the PLC were more familiar with writing, reading or troubleshooting from an electrical schematic.

However, as control systems have advanced with available technologies, the PLC has become much more than a relay replacement. With that being said, today's control platform programmers have a much wider background and may prefer to take advantage of the PC influence in today's world. It is not uncommon to find a high school graduate versed in one or more computer-based programming and assembly languages.

With this influence pouring into our market more and more each year, it is understandable why today's younger programmers would prefer a programming option other than ladder logic. In this case, PC-based control is a very suitable solution. Many saw the benefits of the advanced PC technologies - more memory, faster processing, communications capabilities and flexibility. However, there was always concern for the reliability of a PC as the control engine in an automation environment, and rightly so. Aside from a few specifically designed and very expensive exceptions, the generic PC was not designed to withstand the typical industrial environment.

It appears that PC-based control has found a 'niche' in the market and serves many applications very well. Not all applications subject the controller to a rugged environment, and may, in fact can, be designed to provide the clean and cool (but not cold) atmosphere needed to provide long reliable life for a personal computer.

So what application characteristics qualify as suitable for PC-based control? Let's take a look at a few areas where this excels:

- The need for an Human Machine Interface (HMI) as well as control
- Advanced data manipulation (even string arrays) and advanced math functions
- Data exchange with business applications (from spread sheets to ERP systems)
- One or more third-party PC cards, such as those for motion control or vision systems
- Communication with serial or networked field devices
- Storage or access to large amounts of data
- Large number of PID loops (64 or more)
- Open architecture for C/C++ or VisualBasic
- Online productivity tools to analyze and improve the per formance of your process

These are a few application needs that help define the PC-based control market, but what are some of the real advantages? In a popular package such as Think & Do from Phoenix Contact, they include:

- With Think & Do, your control environment, HMI and motion control all share the same database so your original development time is drastically reduced.
- The math functionality is the same as found in high-level programming languages so it easily calculates complex algorithms and data management.
- The PC architecture allows Think & Do to seamlessly support a variety of specialized motion control, vision systems and field bus network interface PC cards.
- This same architecture also allows for simplistic interoperability with serial devices like barcode readers and interface to Enterprise Resource Planning (ERP) and Structured Query Language (SQL) databases.

A wise man once said, "To each, his own." This is, perhaps, why PLCs are still as popular as ever and why PC-based control is satisfying the needs of many as well.

Tech Thread

Machine Upgrades

Teaching an Old Dog Some New Tricks

Modernizing the speed controls of Hardinge Turret lathes using AutomationDirect GS2 Variable Frequency Drives

By Brian S. Elliott
V.P. of Engineering and Manufacturing
Air Options, Inc.

Just about every machinist in the U.S. has encountered a Hardinge turret lathe during the course of their career. These little machines, commonly referred to as "second operation lathes", are astoundingly productive pieces of equipment which still have great value in almost any machine shop. This holds true even in the face of the CNC tidal wave that seems to be overwhelming the machine industry. Used Hardinge turret lathes are inexpensive, readily available and use commonly available tooling. Once set up, a minimally trained operator can man the machine and generate production that will rival most CNC machines. These attributes allow these little lathes to produce substantial quantities of high precision parts at a very low cost per unit.

If the Hardinge turret lathe has a significant flaw, it would be the spindle speed control system. The spindle motor is generally a two-speed, 3-phase motor with 1750 and 825 RPM ranges. The motor speed and direction are easily changed during operation via a pair of levers mounted on the front of the spindle, which actuate large drum switches mounted in the control cabinet.

The drive system comes in two different varieties, a fixed belt drive and a vary-drive. The fixed belt system uses a step pulley arrangement to change spindle speeds, which provides the operator with only two easily changeable speeds during operation. The vary-drive utilizes a pair of variable sheaves, which are controlled with a set of buttons adjacent to a speed indicator mounted on the top of the spindle. The vary-drive retains the two-speed motor and is a significant improvement over the fixed system. However, the vary-drive is slow to change and has a tendency to disrupt the flow of production. In addition, the two-speed motor selection will only allow the operator to halve the spindle speed at any given setting. If, as an example, the part being turned requires high speed operations, such as turning and/or drilling, a medium speed operation, such as reaming, and a low speed operation, such as threading, then the factory drive system begins to hinder production. Most machinists who have used these machines would agree that the speed control system is adequate, but a more flexible system would be a great improvement.

After we purchased the Hardinge turret lathe shown in figure 1, it became obvious that something had to be done to improve the speed controls. I had had very good experiences with AutomationDirect GS2 variable frequency drives on several other pieces of equipment in our shop, so I decided to design a system for the turret lathe that would utilize one of these units. I configured a system that would retain the factory lever controls but expand on their basic function. Coupled with a variable frequency drive, this arrangement provides the operator quick access to a wide range of

Figure 1, Hardinge Turret Lathe

speed variations.

The original controls consisted of a fairly traditional motor controller with two heater blocks, a control transformer and a collection of lesser components, including a front-mounted panel switch rated at two horsepower. The forward and reverse functions are controlled with a pair of drum switches mounted on the back plane of the control cabinet. Even though they are overkill for logic switching, I retained the original drum switches because they are very high quality units and provided excellent tactile feedback to the operator.

Figure 2 shows the schematic I designed for this particular project. If you take a minute to study the schematic, it becomes clear just how simple a wiring system can be when using a GS2 variable frequency drive. M1 is the spindle motor, M2 is the coolant pump, S1 is the original panel toggle switch, S3 is the speed control drum switch and S2 is the

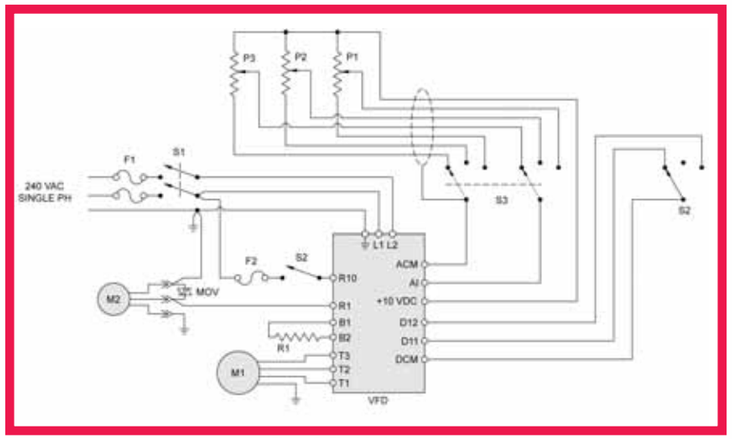


Figure 2, Electrical Schematic

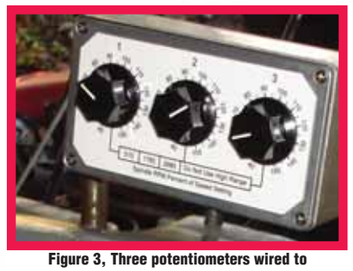


Figure 3, Three potentiometers wired to a shielded cable

forward/off/reverse drum switch. I specified fuses for the main line and the coolant pump. The MOV is a metal oxide veristor intended to suppress inductive kick back when the coolant motor is turned off. R1 is a 200 ohm, 100 watt braking resistor intended to provide electrical braking action. This feature of the GS2 drive allowed me to completely remove the old mechanical brake that was originally supplied from the factory. P1 through P3 are 5K ohm potentiometers that provide quick adjustment to each of the three speeds selected by the lever on the front of the spindle. Since the potentiometers are mounted on the top of the spindle, a shielded cable is specified per the drive manual's recommendation.

The second step I took was to configure the small cabinet shown in

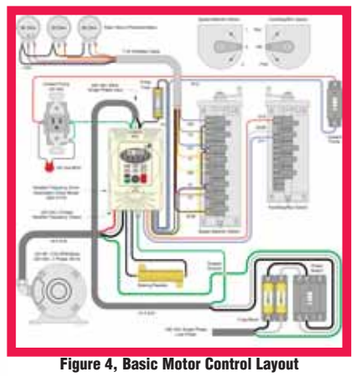


Figure 4, Basic Motor Control Layout

figure 3, which carries the three potentiometers wired to a shielded cable.

I also designed a simple pin bracket so it could be mounted into one of the existing equipment holes on the back of the spindle head. The label shown was made by printing the graphics on an ink jet printer and then laminating the page. The label was cut out and two-face carpet tape was used to bond it to the face of the cabinet. If you're careful, this little trick can produce a clean, professional panel at almost no cost.

Next, I designed the control system to fit with the existing machine configuration. I typically make a general layout, as shown in figure 4, which guides the technician in the placement of the major components and routing of cables.

Figure 5 shows the control cabinet after completion, with the GS2


Figure 5, Completed Control Cabinet

mounted at the upper left of the panel and the braking resistors placed just below. The original toggle switch (lower right) is now used as the primary power and connects to the double fuse block shown. A single-pole toggle switch was installed in the hole left by the original push button actuator (upper right). This switch overrides the coolant pump which plugs into the 120 VAC receptacle (lower left).

The GS2 drives are designed to suit nearly any motor application that one may encounter. As such, a little study was required to pick the parameters applicable to our specific project. However, once I familiarized myself with the unit, I found setting the parameters was a rather simple, step-by-step, process that you get accustomed to very quickly.

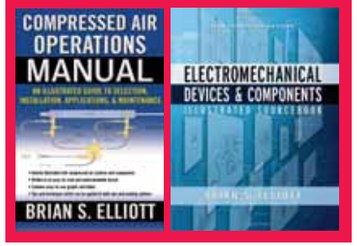
After double checking all of the completed wiring, I turned on the power to the GS2 drive and set up the basic parameters of the selected motor. Next, I programmed the source of frequency control to accept input from the potentiometers and set the acceleration and deceleration time to one second. There was a slight amount of over-spin (continued rotation) after the spindle was turned off, so I adjusted the DC injection current level, DC injection during stopping and the start-point for DC injection. This had the effect of stopping the spindle dead whenever the switch was turned off.

Overall material costs for the project were only $461.97. In anybody's book, this is a small cost to bear, considering that this project reduced manufacturing time for two of our parts by 60% and three others by approximately 35%. This translated to the total material cost of the project being paid off in just one production run!

In conclusion, the modifications dramatically improved the functionality of our Hardinge turret lathe. With minimal costs, a productive machine was made even more productive. Overall, I would highly recommend this modification to any Hardinge turret lathe that is in regular service; it is well worth the effort.

Brian Elliott Bio

Brian Elliott is currently V.P. of Engineering and Manufacturing at Air Options, Inc. During the course of his long career, he has worked in various industrial, technical and scientific fields ranging from automated manufacturing to high energy physics. He has authored two books, "The Compressed Air Operations Manual" (ISBN 0-07-147526-5) and "Electromechanical Devices and Components" (ISBN-10 0-07-147752-7), both are published by the McGraw-Hill Book Company. Both books are available through book retailers worldwide.



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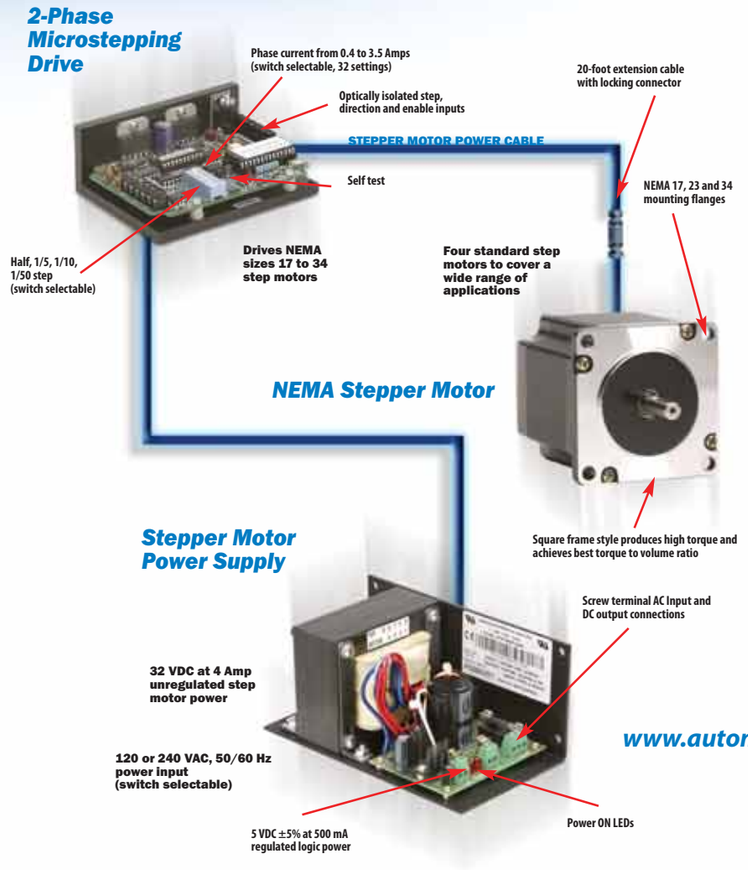

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Feature Story

Solar Technology

Let the Sun Shine In:

GA Tech competes in the Solar Decathlon

By TJ Johns
AutomationDirect
Senior Editor

We hear every day about the importance of conserving energy and the increasing need to use renewable natural resources. To help educate people on ways to "go green," various organizations sponsor events which display and explain unique ways one can conserve energy while maintaining an otherwise normal life. One such event is the Solar Decathlon.

Sponsored by the U.S. Department of Energy, the 2007 Solar Decathlon was held on the National Mall in Washington, D.C., in mid-October. This competition featured twenty teams from around the world and emphasized the creation of attractive, energy-efficient and completely solar-powered homes. One of the homes was designed and constructed by faculty and students of GA Tech's College of Architecture, and the College of Engineering and Sciences.

"Solar Village" on the National Mall in Washington, D.C.
(Credit: Kaye Evans-Lutterodt/Solar Decathlon)

Georgia Tech's solar-powered house placed 6th after the week-long competition during which the house was judged in a series of 10 competitions: architecture, engineering, market viability, communications, comfort "zone", appliances, hot water, lighting, energy balance, and "getting around" (maneuverability).

Of course, such a big project requires teamwork. Joe Jamgochian, a recent architecture graduate and co-leader of the construction project, relished the opportunity to work in close collaboration with university professors, engineering students, and specialists in the construction industry. He was particularly proud of the team's work ethic. "There's been a real commitment by a core group of students and faculty to take individual responsibility for our project as a whole," he says. "They think of the potential issues ahead [of time] and address them."

The 700-square-foot house, named "Icarus" from Greek mythology, was first constructed on the GA Tech campus. Once completed, it had to be dismantled and transported to Washington, D.C., where it was erected with the other entries in a "solar village" set on the National Mall.

The road to the Solar Decathlon was a long one. During the summer of 2006, faculty in the College of Architecture joined forces with faculty in the College of Engineering and Sciences to lead a five-week Interdisciplinary Design Workshop to set the basic design parameters for the house. At the conclusion, the schematic design package including architectural design of the house, preliminary energy and economic analysis, and material and product research was submitted to the U.S. Department of Energy's National Renewable Energy Laboratory (NREL).

Through generous investments of many local sponsors, fundraising efforts began to yield material deliveries

Continued, p. 20 >>

Feature Story cont.

Solar Technology

Continued from, p. 18

beginning in October. “Team sponsorship meant everything,” said Project Manager Chris Jarrett. “It enabled Georgia Tech’s team to get the job done, to be creative and competitive; it enabled them to pursue state-of-the art sustainable design and technology integration.”

Team Icarus focused the fall of 2006 on testing the house’s design through a variety of real and simulated operations. This required extensive quantities of drawings and construction of large-scale models, including 1:1 mock-ups of sections of the wall and roof of the house. Students coordinated the design of the chassis, as well as worked out logistics associated with the construction and transportation of the house.

In spring 2007, the team attended an NREL-sponsored Solar Decathlon meeting in Washington, DC. The remainder of the spring term was devoted to completing construction documents, and finishing extensive shop drawings associated with the various custom parts of the house; while maintaining the highest levels of safety, major emphasis was placed on organization of the construction process.

For Team Icarus, the summer of 2007 was consumed with construction of the house, with the goal to finish the house on time and under budget. For a high-performance building of this nature, that’s a tall order. Actual project costs for each team typically exceeded $600,000. Cutting, gluing, bolting, shaping materials and carefully assembling the various parts of the house, the team continued construction into the fall semester. As the finishing touches were applied, engineering students spent long hours testing and monitoring various control systems throughout the house.

Once completed, the team turned its focus on successful transportation of the house to the National Mall in Washington, D.C. There students had to assemble the house within a few days before opening to the public and the start of the 10-event competition.

Icarus is designed to harness and celebrate the power of sunlight. Through various media, the students are bringing in the sun by experimenting with light to see how it can transform and open up

GA Tech’s “Icarus” ready for the competition
(Credit: Kaye Evans-Lutterodt/Solar Decathlon)

living space. "We've placed a great emphasis on light and bringing light into the house in unique ways," says Jason Mabry, a recent architecture graduate and co-leader of the construction project. "Visitors will be able to see how the house works within itself. They'll see all the technologies we're putting into the house to make it more livable and efficient." And what a house the team has designed.

The starting point was radically rethinking a basic roof design. To avoid complete opacity, the use of an innovative material was proposed where the sun's rays meet the building’s upper most skin, By incorporating ethylene tetrafluoraethylene (ETFE), an inventive roof assembly was engineered to control and channel greater amounts of light within the interior of the building. Built of a series of insulated plastic films, the roof skin is primarily an assembly of semi-transparent layers held together by wood and steel mullions. The 14’x48’ house is segmented structurally into nine bays with ETFE integrated into this organizing geometry. Conceived as nine pillows, the roof is a landscape of light transmission.

Icarus’ main energy collector is the solar array. Designed to perch over the roof, a matrix of 27 solar panels, individually supported using custom made wing-like figures, is comprised of both a photovoltaic (PV) panel and a shading device to insure 100% shading of the roof. Mounted on an adjustable rack, the wing-like figure can be rotated to the optimal solar angle, while the shading device can be calibrated to maximize or minimize solar heat gain.

The ETFE roof panel material is a light-weight, double translucent film which allows diffused light to pass through while maintaining its opacity and thermal efficiency.

Each panel is inflated like a pillow and filled with aerogel insulation. The lightest substance known, aerogel is a solid-state material, derived from gel, in which the liquid component of the gel has been replaced with gas. The result is an extremely low density solid with several remarkable properties, most notably its effectiveness as an insulator.

This roof design provides 6.5 KW of electricity to power the energy systems and appliances of the house. A portion of the south wall contains 12 PV panels to provide an additional 2.0 KW of electricity to help power the house and an electrical vehicle.

Rainscreens, used on the roof and on the south wall, are ventilated cavities which utilize wind pressure to dissipate the energy of driven rainwater. As a result, rainscreens prevent the premature decay of building materials in homes due to moisture intrusion.

Just below the roofline, a row of small windows wraps the perimeter of the house providing additional daylight and panoramic views of the sky from inside the house.

As part of the outdoor landscape, easily installed evacuated tubes convert the sun’s energy for heating water. Each evacuated tube consists of two glass tubes separated by a vacuum. The vacuum helps retain heat from the sun. The insulation properties show that while the inside tube may be 150°C / 304°F the outer tube remains cold to touch. As a result, evacuated tube water heaters can perform well even in cold weather. A set of 20 glass tubes provide all the domestic hot water needed for the house.

The solid walls of the house are composed of factory-made structurally-insulated panels (SIPs) composed of energy-efficient expanded polystyrene insulation. SIPs on the west and north walls are finished with “light gauge” metal panel siding.

The Georgia Tech house's translucent walls give off an inviting glow as night falls on the Solar Village on Oct. 15 at the 2007 Solar Decathlon on the National Mall in Washington, D.C.
(Credit: Kaye Evans-Lutterodt/Solar Decathlon)

A split heat pump provides individual control of air-conditioningfor different spaces in the house without ductwork. The outdoor unit is connected to the inside fan coil units by small refrigerant lines cycling refrigerant to heat or cool the air inside the house. Its slow cooling mode also allows users to control humidity in the house.

An energy recovery ventilator (ERV) conditions incoming air using the temperature and humidity of the outgoing exhaust air from the house. An energy wheel rotates within the ERV unit and transfers the energy of the exhaust air to the incoming air. This easy-to-install, off-the-shelf technology reduces air-conditioning energy consumption by recovering what would otherwise be wasted.

Icarus is controlled by software which continuously assesses solar power available against energy demands of the house. The software not only predicts energy balance over the next week, but also warns the user about expected operation of the house when solar power is limited.

The interior of the house demonstrates the integration of LED and fluorescent light technology for ambient lighting in residential applications. Extremely energy efficient, LEDs last up to 25 times longer than traditional incandescent light bulbs. LED flood strips are integrated into the design of the walls in the bedroom, producing a luminous effect that can be dimmed to suit one’s lighting demands. Fluorescent lighting is also more efficient than incandescent light. The living areas of the house use fluorescent lighting modulated by zoned light circuits.

Solar technology is also showcased in this house at night. Small solar lights, self-sufficient with their own battery, line the outdoor deck. These small lights charge with solar energy during the day and provide outdoor deck lighting at night.

In the area of water conservation, Icarus' water management system collects rainwater from the roof, the sinks, and air conditioning, and channels it to a storage tank in the garden for gray water use in the house's energy systems and for the indigenous plants around the deck.

Team Icarus designed their solar house to operate efficiently and economically over the long term. The open plan is filled with abundant natural light; durable, low-maintenance, easy-to-clean surfaces enable the home-owner to perform everyday living tasks with a minimum of effort and a maximum of safety.

Sustaining life with light, the house is accessible to the most rapidly growing population - mid-life, empty-nesters who desire an adaptive living environment. The interiors of the house have been designed to facilitate movement and address issues of physical impairment.

“We tried to create a house that could grow with people,” said Amanda Cook, an architecture graduate student. “It is a very accessible house with an open floor plan, (low) countertop height in the kitchen, low appliances, and three exit doors and ramps.” The bathroom features a roll-in shower to accommodate wheelchairs. Additional features include adjustable shelving, accessibility under work areas, navigation lighting at night, and a high level of evenly-distributed natural daylight. Houses designed for accessibility help people continue living independently in their homes longer.

After the week-long decathlon competition, the house was dismantled and returned to the GA Tech campus in Atlanta, where it is now open for public viewing. Those interested in touring Icarus can visit www.coa.gatech.edu for open hours and directions.

Source material contributed by Georgia Tech College of Architecture

2007 Solar Decathlon photos by Kaye Evans-Lutterodt/Solar Decathlon

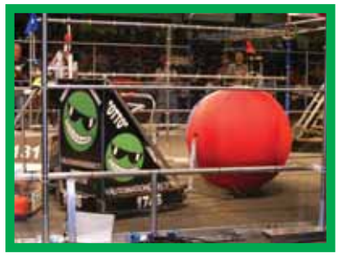
Business Notes

FIRST Robotics

Another great season for AutomationDirect sponsored FIRST Robotics team

By Joan Welty
AutomationDirect, Director of Marketing

For the Forsyth Alliance, the FIRST (For Inspiration and Recognition of Science and Technology) Robotics team sponsored by AutomationDirect, the 2007-2008 season was another successful adventure. In its third year, the team, comprised of students from Forsyth County, GA high schools, continued to expand its mentorship of local FIRST Lego League (FLL) teams, starting or supporting programs in all but three county elementary and middle schools. The team conducted the largest FLL qualifier in Georgia last December, which sent nine teams to the State Tournament.



Otto competing in "Overdrive"

The FIRST team honed its own design and build skills in the fall by competing in the BEST Robotics' South National Championship Tournament in October, finishing 18th and the top-ranked team from Georgia, and winning the 2nd place Founders (design) Award. The team also volunteered at the Forsyth County and State Technology Fairs.

The FIRST Championship season kicked off in January, revealing the season's game, "Overdrive". In this game, robots had to be designed to race around a track knocking down 40-inch inflated Trackballs and moving them around the track, passing them either over or under a 6'6" overpass. Each match lasts 2 minutes and 15 seconds, allowing the two alliances of three teams each to score points in both "autonomous" and driver-controlled modes.

At the Peachtree Regional in March, the Forsyth Alliance won six of its seven qualifying matches, finishing 5th out of 45 teams. They moved on to the quarter finals, where their alliance was bested by the ultimate Peachtree Champions. At the Palmetto Regional two weeks later, the Forsyth Alliance won eight of 10 matches, finishing as the 4th ranked seed at a very tough regional. The team was chosen for the quarter finals, but again lost at that level. The team claimed two Regional honors at Palmetto, the Imagery Award and the AutoDesk Visualization Award. They also received peer-presented Safety and Classy Chassis Awards.

The Forsyth Alliance participated in the World Championship in April. The competition, held in Atlanta, Georgia, hosted 340 teams from over 20 countries. The team finished 13th in its division of 85 teams, their best result ever at the Championships, and were the highest-ranked team from Georgia. Disappointingly, they were not chosen by any of the top eight teams to participate on their alliances in the finals, possibly due to some robot control issues they experienced during Friday afternoon's qualifying matches. However, their high-ranked finish positioned them as the backup robot in their division in the event of a finalist team's failure during the succeeding elimination matches.

AutomationDirect feels that sponsorship of the FIRST program is very relevant to developing the next generation of engineers and automation professionals. They reap more immediate benefits also, by hiring summer interns from the rising junior and senior high school students on the Robotics team. The interns have made significant contributions to a variety of business functions, including new product testing, Web development and video production.

First Lego League Regional Qualifier in December 2007

Tech Brief
green challenge

Sunlight Efficiency Detector (SLED) Chosen as Finalist in Freescale Semiconductor Contest

By Chip McDaniel
AutomationDirect

Announced in October 2007, Freescale's first FTF Design Challenge encouraged embedded systems designers worldwide to "go green". A team of engineers from FACTS Engineering, including Tom Moulton and Eric Wilhelmson, took up the challenge with their design for a SunLight Efficiency Detector or SLED. FACTS is a federation partner of AutomationDirect, and the supplier of numerous AutomationDirect PLC modules and other automation components. Freescale Semiconductor designs and manufactures embedded semiconductors for the automotive, consumer, industrial, networking and wireless markets.

In February, Freescale announced the ten finalists and the SLED made the cut. Finalists were selected from a field of 65 participants. These embedded systems developers and engineering students represent Argentina, Brazil, Canada, Colombia, Mexico, and United States. Each submission was judged on creativity, design efficiency, technical complexity, number of Freescale devices used, and overall application innovation to improve the environment.

Each of the ten finalists received a $1,000 (USD) award, a professional CodeWarrior® development platform and a video camera to capture their design building experience. Freescale has invited these finalists to develop prototypes of their designs to be submitted to an expert panel for final judging at FTF Americas, June 16-19.

Good SLEDing in bright sunlight

The SLED is a microprocessor-based circuit (embedded system) used to monitor the performance of an individual photovoltaic (PV) module in a solar array (Figure 1). The prototypes that FACTS has built contain just a few chips, the heart of which is the Freescale Flexis QE128 microprocessor, with onboard Flash memory, RAM, and Analog to Digital conversion capability. This system-on-a-chip is perfectly suited to the sunlight efficiency monitoring task and only requires minimal support electronics for power and communications. The isolation circuit (power supply) actually draws what little power is needed by the SLED circuitry from the solar panel itself. The FACTS design patent covers various communications techniques for the SLED. These include wireless networking and a signal-over-power scheme that can communicate across the DC power wiring of the PV panels themselves, requiring no additional network wiring. The prototype SLEDs use a simple RS485 multi-drop connection to feed the information downhill (that's 'downstream' -*editor*).

The SLED will verify the operation of solar PV modules by comparing an instantaneous reading to an onboard database of historical information about each specific PV module. A network of SLEDs, one on each PV module, will allow for continuous performance monitoring of an entire solar array.

When a SLED is installed on a PV module, the system will be programmed with information including the module

Figure 1, Solar Array

location and data about the specific PV model, such as manufacturer, part number, lot number and power specifications from the product's datasheet. The early data collected for each module will be used to form a baseline for that module. Performance data on similar modules in an array can also be compared. Over longer periods of time historical data can be collected, not only locally, but also from other locations and correlated by model number and published as an update to the manufacturer's specifications. This in turn could also help the manufacturers set realistic expectations and keep quality levels high.

This data will also help protect the user's investment in PV modules by providing evidence that modules are performing within the manufacturer's promised specifications during the initial warranty period. Manufacturers also specify limits on output degradation over time; for example, a 5% reduction in the first 10 years and no more than a total of 10% across 20 years. At the present time it would be hard to measure a degradation of 5% in the entire system, much less a specific panel, especially without precise historical data for comparison, or to back up a warranty claim.

SLEDs can save time and money

While some present day PV systems have devices that monitor the operation of solar array sub-systems at the inverter level, they typically do not monitor the individual panels (the smallest field-replaceable unit in the system). This approach is lacking when it comes to determining which of the roof panels has a problem and it ignores individual panel inefficiencies, such as dirt buildup, poor connections or module degradation over time.

Identifying a specific problem module is worth the effort especially when the user wants to have all PV modules operating at maximum efficiency. Finding a failure among the tightly packed rows of modules on a roof can also be a daunting task. The technician with this job may find himself perched on the roof for some time moving and testing modules for the correct operation. The technician may end up causing more harm than good while searching for a problem module, because the system needs to be taken apart during the search. The SLED network can identify a specific problem module in a working system so the technician will be able to go directly to the panel that needs attention.

How many SLEDs do you have on your roof?

According to the US Department of Energy, the demand for PV modules has grown dramatically since 2003 at rates of 60% to 75% per year (Figure 2). There were over 200MW of PV Modules delivered in 2006. Assuming 200W per module, that means there were 1 million modules shipped in 2006. If this 50% growth rate continues, by the year 2010 we will be consuming 1GW of PV modules or 5 million modules per year. These numbers could be much higher once all the planned PV foundries come online since the modules will then be in greater supply, possibly causing price reductions. There should also be greater demand for solar energy in the future as prices for other forms of energy continue to rise.

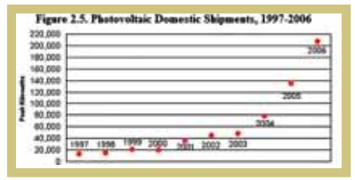


Figure 2,
Photovoltaic Domestic Shipments, 1997-2006[1]

Exhibition SLEDing

FACTS Engineering is building prototypes and a small exhibit to show off their concept at the contest finals in June. The exhibit will include several working photovoltaic panels with SLEDs which will network to a PLC for monitoring. The PLC will connect to a C-more operator interface for graphical display of the data, illustration of the system functions, and for data logging. Figure 3 shows the prototype setup as it is being assembled.

Figure 3, Assembling the prototype

In addition to the Freescale contest, FACTS plans to present a paper at the annual ASME conference in Jacksonville in August, and also at the Solar Power Conference and Expo in San Diego in October. Who knows, maybe one day we'll all have SLEDs on our rooftops, and not just at Christmas!

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(727) 375-8888 x114

Additional Information:
Freescale Technology Forum
http://freescale.com/ftf
Freescale Announces Finalists in its First Green FTF Design Challenge
http://media.freescale.com/phoenix.zhtml?c=19520&p=irol-newsArticle&ID=1111427&highlight

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2. Moulton, Thomas A.; Wilhelmson, Eric; "Sun Light Efficiency Detector (SLED)." Proceedings of the 2nd International Conference on Energy Sustainability ES2008 (2008)

"There's an old saying about those who forget history. I don't remember it, but it's good."
– Stephen Colbert,
The Colbert Report,
March 10, 2008

"I can't give you a sure-fire formula for success, but I can give you a formula for failure: try to please everybody all the time."
– Herbert Bayard Swope
(1882 - 1958)

User Solutions
from Sustainable Automation

Sustainable Automation, Inc. Improves Efficiency of Lock Pin Laminating Machine

By Steve Drouilhet
Sustainable Automation

InstaKey Security System, a lock management company in Denver, Colorado, supplies lock cylinders that can be re-keyed up to twelve times using only a step-change key. The step-change key is a specially designed device which removes a single metal wafer from a glued stack inside the chamber of a lock cylinder. Because of the growing demand for their patented security system, InstaKey saw a need to replace their existing lock pin laminating machine, because it had become unreliable and difficult to repair.

InstaKey engineers completed the mechanical design for a new lock pin laminating machine and requested that Sustainable Automation, Inc., a provider of custom industrial automation solutions, create a low-cost control system for it. The control system would require gluing the wafers in stacks of two to six to create lock pins, thus maximizing machine throughput. The machine would also need to shut off automatically when the requested number of stacks were completed, and would detect and annunciate faults. The customer requested an operator interface to enable the user to enter the size of the stacks and the number of stacks to be made.

Sustainable Automation used an AutomationDirect DL06 PLC, a cost-effective controller for an application requiring only discrete I/O. The DL06 is programmed using DirectSOFT, a versatile language that allows the code to be easily changed as the machine evolves. A programmable C-more® micro touchscreen operator interface mounted on the door of the control cabinet provides easy data entry, screen navigation, and alarm annunciation.

Sustainable Automation optimized the performance of the lock pin laminating machine by analyzing process flow and organizing tasks into groups that could execute in parallel. All actuator response delays are user-definable via the touchscreen, allowing the operator to tune the controls according to the actuator performance. A NEMA 4/12 cabinet protects the electrical components from the plant environment.

Sustainable Automation delivered the completed control cabinet ahead of schedule. InstaKey installed and commissioned the new control system themselves without any outside support. Les McMillin, VP of Engineering, commented to the engineers at Sustainable Automation, "I am pleased with the professional job you did," describing the layout and wiring of the control panel as "a work of art."

Sustainable Automation has broad experience designing and implementing custom PLC and PC based control systems for machine and process control in a variety of industries. Manufacturers with industrial automation needs may contact them at sales@SustainableAutomation.com or 303-996-0647.

"I've missed more than 9000 shots in my career. I've lost almost 300 games. 26 times, I've been trusted to take the game winning shot and missed. I've failed over and over and over again in my life. And that is why I succeed."
– Michael Jordan

FYI
Question and Answer

ProSense Q&A

By Lenny Filipkowski
AutomationDirect
Product Manager, Industrial Components

When selecting a pressure sensor, what factors should I consider?

There are three primary considerations when selecting a pressure sensor; pressure values the system will have, temperature of the process material and the compatibility of the sensor with the process fluid.

System pressure values – the normal working pressure should be below the maximum range of the sensor. The overload pressure, which is the pressure at which the measurement cell is damaged, and the bursting pressure or the pressure at which the measurement cell is destroyed should be high enough to provide an adequate margin of safety in any event of overpressure.

Temperature – the normal temperature of the process fluid should fall in range of the compensated temperature range (TEMPCO) for transmitters and in the temperature drift range for switches. The minimum and maximum process fluid temperatures should always stay with in the stated limits.

Process fluid compatibility – since many types of fluids can be corrosive, it is very important to identify and refer to compatibility charts to assure that the process fluid will not harm the sensor, and that the sensor material will not have any affect on the process fluid.

What technical specification features are most important when selecting a pressure sensor?

There are many types of pressure sensors in the market today with a varied list of technical specifications. Some of the more important specs a user should examine would be repeatability and accuracy. Also important are burst pressure, overload pressure, life cycles, material compatibility and ease of use.

Repeatability, or the precision by which repeat measurements of the same pressure sample give the same output value of a sensor, may be one of the most important specifications that a user may want to review. The better the repeatability a sensor has, the more consistently a process will be monitored.

Accuracy, or the closeness of an output of set value to the actual value, is typically considered to be the most important specification. Accuracy of a sensor ensures confidence that the process will be controlled appropriately, and is a good indication of the quality and precision of the sensor and its internal components. A good sensor is one that can utilize its accuracy with a repeatable output value.

What is the difference between Gauge pressure (psig), Absolute pressure (psia) and Differential pressure (psid)?

The pressure of a system is defined as the force exerted by the system on a unit area of its boundaries such as pounds per square inch (psi).

Gauge pressure (psig) is the comparison of system pressure to atmospheric pressure. This is the most common type of pressure that is measured. A sensor measuring gauge pressure would read zero if the measuring cell (element) is exposed to the atmosphere (room pressure) regardless of elevation or other barometric influences.

Absolute pressure (psia) is the comparison of system pressure to an absolute vacuum. As an example, a sensor measuring absolute pressure would read approximately 14.696 psi if the measuring cell (element) is exposed to the atmosphere (room pressure) at sea level.

Differential pressure (psid) is the comparison of one system pressure to another, so the sensor would have two measurement cells that could be connected to two different pressure systems. This is most common in filter type monitoring systems.

Should I select a pressure switch or pressure transmitter for my pressure measurement?

When deciding on whether to use a pressure transmitter or a pressure switch for your system, the main consideration should be the way the output will be processed. If you have a system that just needs to know that a setpoint has been reached, a switch would be well suited for this type of application. If your system is going to monitor the pressure over the complete range of the system pressure and be tied to a monitoring system such as a PLC or other type of controller or recorder, a pressure transmitter is required.

What are the benefits of using an electronic style pressure switch compared to a mechanical style design?

There are many differences in construction between an electronic pressure switch versus a mechanical pressure switch.

A typical mechanical pressure switch consists of either bellows, diaphragms, pistons and springs or some combination of these elements. Since these elements will wear, the actual life span is a typical 1 million switching cycles. A mechanical switch theoretically has a large working range, but each application requires the user to balance switch life against setpoint accuracy. If the monitored system pressure is close to the maximum range of the pressure switch, the user will gain accuracy, but the life expectancy of the switch shortens. If the system pressure is on the low side of the range of the switch, then the accuracy is poor, but the user could expect higher life cycles from the switch. Therefore, the mechanical switch really needs to be operated in a small range in the middle to gain good accuracy and maximum life expectancy.

An electronic pressure switch basically has no moving parts to wear out or break; it utilizes strain gauge technology that measures the strain induced on the sensing element due to changing pressure. This strain is proportional to the applied pressure. Since there are no true moving parts to wear or break, the life cycle of an electronic pressure switch can be 50 million or more switching cycles. Also, the accuracy and repeatability stay consistent and accurate through the entire allowable pressure range.

What is the difference between a pressure transmitter and pressure transducer?

A pressure transducer is basically a device that converts an applied pressure into an electrical signal. This is typically a millivolt output signal which will vary as the pressure varies. A typical pressure transducer output signal is generated by the primary sensing element such as thick film, ceramic, thin film or semiconductor strain gauge. The transducer also typically contains a circuit to trim the zero and span offsets and compensate for errors over the operating temperature range.

A pressure transmitter is basically a pressure transducer with electronics added to transmit an amplified output signal. This enables signal transmission over large distances and reduces electromagnetic interference. Typically, a pressure transmitter will supply a 4–20 mA signal. Since a pressure transducer that has an amplified voltage output, such as 0-5 VDC or 0-10 VDC, can transmit over large distances, they can be classified as pressure transmitters as well.

"A boy can learn a lot from a dog: obedience, loyalty, and the importance of turning around three times before lying down."
– Robert Benchley

Tech Review

NEMA Enclosure Ratings Explained

NEMA 1 Enclosure

NEMA 3R Enclosure

NEMA 4 Enclosure

NEMA 4X Enclosure

NEMA 12 Enclosure

NEMA 4 & 12 Enclosure

What Do The NEMA Ratings Mean?

NEMA 1

NEMA 1 enclosures are typically used for protecting controls and terminations from objects and personnel. This style of enclosure, while offering a latching door, does not have a gasketed sealing surface. NEMA 1 enclosures are used in applications where sealing out dust, oil, and water is not required. Motor start/stop stations are often housed in NEMA 1 enclosures.

NEMA 3R

NEMA 3R enclosures are typically used in outdoor applications for wiring and junction boxes. This style of enclosure provides protection against falling rain, sleet, snow, and external ice formation. Indoors they protect against dripping water. This style of enclosure does not have a gasketed sealing surface. Some models have hasps for padlocking.

NEMA 3S

NEMA 3S enclosures are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain, sleet, and to provide for operation of external mechanisms when ice laden.

NEMA 4

NEMA 4 enclosures are used in many applications where an occasional washdown occurs or where machine tool cutter coolant is used. They also serve in applications where a pressurized stream of water will be used. NEMA 4 enclosures are gasketed and the door is clamped for maximum sealing. They have continuous hinges, mounting feet, and padlock hasps. NEMA 4 enclosures are available in sizes from small wall mounts to two-door floor mount models.

NEMA 4X

NEMA 4X enclosures are made of stainless steel or plastic. NEMA 4X enclosures are used in harsher environments than standard NEMA 4 units. Applications where corrosive materials and caustic cleaners are used necessitate the use of a NEMA 4X enclosure. Applications include food, such as meat/poultry processing facilities, where total washdown with disinfectants occur repeatedly and petro-chemical facilities, including offshore petroleum sites. NEMA 4X is used when protection from the worst environments is required. NEMA 4X enclosures are available in sizes from small wall mounts to two-door floor mount models. Wiegmann NEMA 4X enclosures are made of 304 stainless steel.

NEMA 6P

NEMA 6P enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against the entry of water during prolonged submersion at a limited depth.

NEMA 12

NEMA 12 enclosures are designed to prevent the ingress of dust, water, and oil. NEMA 12 enclosures are most often used for indoor applications of automation control and electronic drives systems. Some examples are packaging, material handling, non-corrosive process control, and manufacturing applications. Gasketed doors seal the enclosure's contents from airborne contaminants and non-pressurized water and oil. NEMA 12 enclosures are available in sizes from small wall mounts to two-door floor mount models.

NEMA 4 & 12

Wiegmann's "412" enclosures combine the attributes of NEMA 4 and NEMA 12 in an attractive, clean line enclosure. This enclosure features reversible doors for left or right opening, concealed hinges, and rear mounting holes for a more attractive installation. Optional mounting feet are available for conventional wall mounting. Wiegmann's 412 enclosures are available in wall mount models up to 60" x 36".

NEMA 13

NEMA 13 enclosures are intended for indoor use primarily to provide a degree of protection against dust, spraying of water, oil, and non-corrosive coolant.

The Break Room

Memory and Crossword

Memory Aids...

By Tom Elavsky
AutomationDirect

We all have used an acronym, mnemonic, rhyme, word association, or other technique to help us remember information, lists, events, etc. I know they work because most of them are still stuck in my head. See how many of the following you may remember.

Resistor Color Code

Color bands are used to represent numeric values in ohms on certain types of resistors. The numbers 0 through 9 are represented by the colors black, brown, red, orange, yellow, green, blue, violet, gray, and white respectively. The first and second band are typically the resistor's first two significant digits, the third band is the number of zeros following the first two digits, and the forth band is the resistor's tolerance. There are many variations to this type of resistor coding, but to recall the basic color order, you can memorize the saying 'Better Be Right Or Your Great Big Venture Goes West'. A little investigation will most likely discover many other sayings for memorizing the resistor color code, some not as elegant as the one we have shared.

Visible Color Spectrum

To remember the main colors that we may see in a rainbow, or viewing the result of light that has traveled through a prism, think of Roy G. Biv. The colors with the longest to shortest wave length are Red, Orange, Yellow, Green, Blue, Indigo and Violet. You may have noticed that other than Indigo, the color spectrum order matches part of the Resistor Color Code.

ELI the ICE man

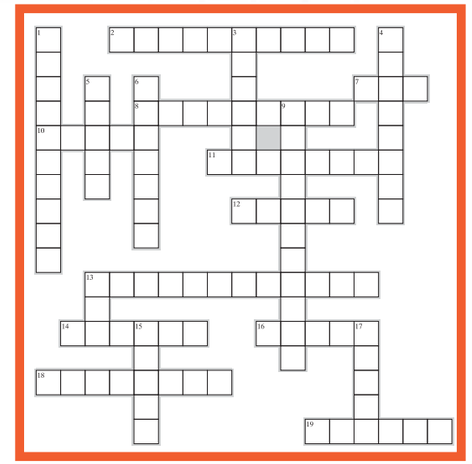
In an AC circuit involving inductance or capacitance, the voltage and current in the circuit will be out of phase with each other. An inductive circuit will cause a phase shift in one direction and a capacitive circuit will cause the opposite. To remember which is which, think of ELI the ICE man, where E = Voltage, I = Current, L = Inductor, and C = Capacitor, therefore: ELI (Inductive Circuit) – Voltage leads Current ICE (Capacitive Circuit) – Current leads Voltage

Algebraic Expressions

Solving algebraic expressions can be somewhat confusing unless we understand the order of operations that have been defined. Take the following equation: 7 + 6 / 2 - 2 * 3 = In which order do we solve the various elements? Can we take 7, add it to 6, then divide the result by 2, or maybe divide 6 by 2 and take the result away from 7? Luckily the order has been defined for us. We solve algebraic expressions by doing the computations in Parentheses first, if they are present, followed by Exponents, then either Multiplication or Division (order does not matter), and finally either Addition or Subtraction (again order does not matter). An easy way to remember this order is to memorize the saying 'Please Excuse My Dear Aunt Sally'.

PI

If you forget PI = 3.14159, you can get a quick approximation on a simple calculator by solving 22/7, or for more accuracy while just a bit harder to remember, solve 355/113.



Crossword Puzzle

Recycled Verbiage
The clues (and answers) for this crossword puzzle have all been 'recycled' from this issue of Automation NOTEBOOK, enjoy!

ACROSS
2.) ERV = Energy Recovery _____
7.) Boolean Operator
8.) Name of the FIRST game for 2008
10.) Type of race and a common electrical device
11.) New sensor (and switch) brand
12.) ____& Do
13.) Type of module used in a solar array
14.) Mythological name for GT house
16.) Direct_____
18.) Maker of Turret Lathes
19.) Microproccesor used for sledding

DOWN
1.) FACTS is a _____ partner of AutomationDirect
3.) _____Logic
4.) Location of the 2008 Solar Power Conference & Expo
5.) Excuse her for her math skills
6.) Colorful character
9.) For _____ and Recognition of Science and Technology
13.) Common factory floor device
15.) DC-to-DC converter brand
17.) Operator Interface

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