Cover Story:

Museum Practices What It Teaches:
Going Green Drives Home the Lesson
at Boston Children’s Museum

New Product Focus
Pressure Sensors

Technology Brief
Sunlight Efficiency Detector

Feature Story
Let the Sun Shine In:
GA Tech Competes in the Solar Decathlon
Motor Slide Bases
NEMA 56 to NEMA 449T
starting at:
56C Frame Rolled Steel (MTR)
Single-phase, 115/230 Volt
T Frame Cast Iron (MTC)
Industrial Duty three-phase, TEFC enclosure, EPACT rated

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Motor Slide Bases
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MTR-005-3BD18
MTR-P33-1AB18
MTR-P50-1AB18
MTR-P75-1AB18
MTR-1P5-1AB18
MTR-200-3BD181
MTR-250-3BD181
MTR-300-3BD181

Part Number
MTR-001-3BD18
MTR-005-3BD18
MTR-P33-1AB18
MTR-P50-1AB18
MTR-P75-1AB18
MTR-1P5-1AB18
MTR-250-3BD181
MTR-200-3BD181
MTR-300-3BD181

Price
$108.00
$86.00
$112.00
$112.00
$112.00
$112.00
$765.00
$1,08.00
$1,488.00

Weight
8.8 lbs (4.0 kg)
3.0 lbs (1.4 kg)
7.7 lbs (3.5 kg)
11.8 lbs (5.3 kg)
13.6 lbs (6.1 kg)
15.2 lbs (6.9 kg)
208 lbs (94 kg)
250 lbs (113 kg)
286 lbs (130 kg)

Dimensions
1.5 x 10.1 x 10.1 in (3.8 x 25.7 x 25.7 cm)
1.5 x 6.1 x 6.1 in (3.8 x 15.5 x 15.5 cm)
1.5 x 6.1 x 6.1 in (3.8 x 15.5 x 15.5 cm)
1.5 x 6.1 x 6.1 in (3.8 x 15.5 x 15.5 cm)
1.5 x 6.1 x 6.1 in (3.8 x 15.5 x 15.5 cm)
1.5 x 6.1 x 6.1 in (3.8 x 15.5 x 15.5 cm)
1.5 x 6.1 x 6.1 in (3.8 x 15.5 x 15.5 cm)
1.5 x 6.1 x 6.1 in (3.8 x 15.5 x 15.5 cm)
1.5 x 6.1 x 6.1 in (3.8 x 15.5 x 15.5 cm)

Automation Notebook   Summer 2008 Issue Eleven
www.automationnotebook.com

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 AutomationNOTE BOOK. 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…
New Product Focus

AutomationDirect offers pressure sensors

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.

The compact PTD Series pressure and vacuum transmitters provide an analog output for reliable process 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 4 mA 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 5,800 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 service, and the lowest prices. For a free catalog, please visit: www.automationdirect.com or call 800-633-0405.

The compact PTD Series pressure and vacuum transmitters provide an analog output for reliable process indication. The transmitters offer quick installation and easy setup.

For complete specifications and ordering, please visit: www.automationdirect.com/pressure-sensors

AutomationDirect can HELP!

Are you under Pressure?

Pressure Transmitters

PTD25 Series

Features

• Pressure models available in 100, 500 and 1000 psi ranges, with 4-20 mA or 0-10V output options
• Vacuum models measure up to 29 inch Hg, with 20-4 mA or 10-0V output options
• Ceramic sensing element provides high burst/overpressure protection
• Analog output via micro DC connector
• Flexible film circuit results in compact size, with excellent shock and vibration resistance
• Robust stainless steel housing

All Models

Features

• Available in 145, 1450 and 5800 psi ranges
• Simple setup using rotating adjustment dials
• Compact, extremely durable housing with 316 stainless steel process connection
• No moving parts in sensing technology ensure long-term stability without setpoint drift
• No calibration required
• LEDs indicate switching and operating status
• Dual switching output, DC
• Convenient signal connection via micro DC connector
• Vibration and shock-resistant

For complete specifications and ordering, please visit: www.automationdirect.com/pressure-sensors

All prices are U.S. published prices, as of April 2008.
AutomationDirect launches
high-current models of
current sensors

AutomationDirect has expanded the
cuAMP™ line of current sensors to
include high-current models. ACT and
ACTR series cuAMP current transducers combine a current
transformer and signal conditioner into a
single package. The new cuAMP 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.

CuAMP current operated switches
combine a current transformer, signal
conditioner plus a limit alarm into a
transducers combine a current
transformer and signal conditioner into a
transducers are also available in Normally Open
outputs are isolated solid state switches
single package. The current switch
conditioner plus a limit alarm into a
transformers 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™ M i-cro-Graphic panel line now includes high-contrast panels and supports additional PLC
protocols. Starting at $139, the new 3.1-
inch micro-graphics models, in touch
and non-touch versions, feature white
and red LED backlights and support 5
selectable screen colors. In addition to
the existing DirectLogix PLC, Mdbus RTU and Allen-Bradley DF1 protocols, new communication drivers support Allen-Bradley DH 485, Siemens
PPI, and GE SNPX for M icro 90 and
VersaMax Mi cro. Updated software is
available for free download from

AutomationDirect offers three
types of electrical wiring, now in sizes up
to 18 gauge, for industrial 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.

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RHINO™ PSP DC-to-DC con-
trollers 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 @ 35 VDC, 2A @
12VDC, and 1A @ 24VDC. RHINO
to-DC converters can also be used to
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detachable screw terminal blocks.
Converters are also wall mountable with
included wall-mount bracket. With prices starting at $70.25, the DCTo-DC converters are backed by a 3-year warranty.

AutomationDirect adds 18
gauge electrical wire

AutomationDirect offers over 1,600 enclosures from
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N412006SSLP  $54.12  $64.12
SSN4202006  $201.75  $239.25

Product Snapshots

Press Releases

AutomationDirect launches high-current models of current sensors

AutomationDirect has expanded the cuAMP™ line of current sensors to include high-current models. ACT and ACTR series cuAMP current transducers combine a current transformer and signal conditioner into a single package. The new cuAMP 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.

CuAMP 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 cuAMP sensors are panel-mountable; convenient DIN rail...
Guest Writer
Lesson at Boston Children's Museum
Going Green Drives Home the Museum Practices

M any 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 renovated 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 apparatus, 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 channel.

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

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 they live.

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

The Museum is also a must-see for architects. At last months (April) 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 features 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.

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.

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 environment and the ecosystem. The roof of the Museum includes a sedum green roof that reduces energy consumption and provides insulation. The roof is also a habitat for wildlife and adds visual appeal to the building. The Museum is an extensive green roof of 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 site by 88%, and reduce phosphorus discharge from storm water runoff by 40%.

According to Boston Children's Museum's Chief Operating Officer Neil Gordon, "The water quality on the Fort Point Channel is rated among the worst in Massachusetts bodies of water for organic and phosphatic 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.

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 buildings' HVAC systems.

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 space. 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 contracts 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 45 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 are cooled individually via control individual zones. Each zone has 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 high-wall 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

Continued, p. 10 >>
Cover Story cont.

Spring 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 M’s green mission by enhancing daylighting 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 and view capabilities for the new spaces.

Investing in the Future

While Boston Children’s Museum is a learning experience, building the addition to the M was a learning experience for management as well. In the process, the M 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 Gordan states, “the commitment to a green building is really a commitment to creating the next generation of environmental stewards.”

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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 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–programmed may seem archaic or simply just not as familiar as another style of programming. Ladder logic was designed to resemble an electrical schematic, whereas the PLC was original–ly 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, communication 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 rightly so. 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.

There 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 T-hink & 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.

You can afford to improve the productivity of even your simplest process with easy-to-use micro PLCs and operator interfaces. Depend on these time-tested controllers for applications ranging from simple monitoring to more advanced batch, manufacturing or motion control. All DirectLOGIC PLCs are programmed with intuitive Windows-based software, available FREE (100-word program limit), or for $395 for unlimited program sizes. C-more micro configuration software is FREE when downloaded from our Web site. Or if you want to step up to C-more touch panels, it’s just $129 for configuration software. All PLC and HMI programming cables sold separately. And all our products are backed by our FREE award-winning technical support!
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
VP 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 careers. 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 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, 5-phase motor, 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 speeds, which provides the operator with only two easily changeable speeds during operation. The vary-drive utilizes a pair of variable shaves, 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 have 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 inadequate, 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 speed variations.

The original controls consisted of a fairly traditional motor controller with two heater blocks, a control transformer and a collection of leder 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 and M3 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 3, which carries the three potentiometers wired to a shielded cable. I also designed a simple pin bracket so it could be mounted onto 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 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 panel-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. 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. This was a slight and minor over-boost (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 savings. I must also consider that this project reduced manufacturing time for two of our parts by 90%, and the total labor costs on each had been approximately 35%. This translated to the total labor 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.

SureServo drives accept a wide range of command sources:

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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 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.

He was particularly proud of the team’s commitment by a core group of professors, engineering students, and specialists in the construction industry. He was especially proud of the team’s work ethic. “There’s been a real responsibility for our project as a whole,” he says. “They think of the potential issues ahead of time and address them.”

Creating a 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 Jangchian, 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 Solar Decathlon is a competition and event which display and explain unique ways one can conserve energy while maintaining an otherwise normal life.

One such event is the Solar Decathlon. 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.

Let the Sun Shine In:

GA Tech competes in the Solar Decathlon

Senior Editor

By TJ Johns

Solar Decathlon

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Solar Technology

W

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.

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In the sun by experimenting with light to enhance the energy and heating potential of the house, engineering students spent $600,000 on cutting, gluing, bolting, and building the house to the National Mall in Washington, D.C., before opening to the public and the start of the 10-event competition.

Team Icarus focused the fall of 2006 on testing the house's design through a variety of real and simulated operations. 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, D.C. 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 came in well under budget, and the house was completed on time. 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 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.

This is a difficult operation to deploy and celebrate the power of sunlight. Through various media, the students are bringing in this high technology with light to see how it can transform and open up living space. "We've placed a great emphasis on light and bringing light into the house in unique ways," said Jason Mackey, a recent architecture graduate and co-leader of the construction project. "Visitors will be able to see how the house works 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 inoperable opacity, the use of an innovative material was proposed where the sun's rays meet the building's uppermost skin. By incorporating ethylene tetrafluoroethylene (ETFE), an inventive engineering roof assembly was constructed to control channel 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 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.

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Another great season for AutomationDirect sponsored FIRST Robotics team

For the FIRST 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.

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 Imagiary 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’s team failure during the succeeding elimination matches.

The Forsyth Alliance has conducted the largest FLL qualifier in Georgia last December, which sent nine teams to the State Tournament. The team honored 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.

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By Joan Welty
AutomationDirect, Director of Marketing

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Contest Semiconductor Freescale Chosen as Finalist in Tech Brief

Freescale Semiconductor, a leading supplier of embedded technology for consumer, industrial, networking and semiconductors for the automotive, designs and manufactures embedded components. Freescale has built contain just a few chips, the heart of which is the Freescale Flexis Q128 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 downtown (that's "downstream"—editor).

The SLED will verify the operation of solar PV systems by comparing an instantaneous reading to an onboard database of historical information about each specific PV module. A network of SLEDs can be installed on each PV module, with all PV modules connected to a network to 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 location and data about the specific PV model, such as manufacturer, part number, lot number and power specifications from the product's database. The data is collected for each module which 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 manufacturer 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 individual panels (the smallest field-replaceable unit in the system). This is where the SLED comes in. The SLED will keep track of how many watt-hours of electricity each PV module produces, track the degradation of the module, and monitor the overall system performance. The SLED can also help identify any degradation in the system (or part of the system) that is occurring. This is key because the system needs to be taken apart during the search. The SLED network can identify a specific problem module in a working system to the technician who will be able to go directly to the panel that needs attention.

In addition to the Freescale contest, FACTS plans to present a paper at the annual AEM 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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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, the normal working pressure 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 (TEMP/PCD) for transmitters and in the temperature drift range for switches. The minimum and maximum process fluid temperatures should always stay within 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.

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 use 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 monitoring system?

When deciding on whether to use a pressure transmitter or a pressure switch, 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 a pressure switch?

A pressure transmitter 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 transmitter 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 transmitter 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.
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 turning door, does not have a gasketed sealing surface. NEMA 1 enclosures are used in applications where sealing against dust, 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 3R**
NEMA 3R enclosures are typically used in outdoor applications for wiring and junction boxes. This style of enclosure provides protection against falling rain, snow, and external ice formation. Indoors they protect against dripping water. This style of enclosure does not have a gasketed sealing surface.

**NEMA 4**
NEMA 4 enclosures are available in sizes from small wall mounts to two-door floor mount models. 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 opening, concealed hinges, and rear mounting holes for a more attractive installation. Optional

**NEMA 4X**
NEMA 4X enclosures are made of stainless steel or plastic. NEMA 4X enclosures are used in harsher environments than standard NEMA 4 until Applications where corrosive materials and caustic cleaners are used necessitate the use of NEMA 4X enclosures. Applications include food, such as meat/poultry processing facilities, where total washdown with disinfectants occurs 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.

**NEMA 6P**
NEMA 6P 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 12**
NEMA 12 enclosures are designed to prevent the ingress of dust, water, and oil. NEMA 12 enclosures are used in most applications of automation control and electronic drives systems. Some examples are packaging, material handling, non-corrosive electronic drives systems, such as motor start stations. NEMA 12 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.

**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 bands are typically the resistor’s first two significant digits, the third band is the number of zeros following the first two digits, and the fourth band is the resistor’s tolerance. There are many variations to this type of resistor coding, but to recall the basic color code, some not as elegant as the one we all have used an acronym, mnemonics, rhyme, word association, or other techniques to help us remember information.

**Reactor Color Code**
Color bands are used to represent numeric values in plasmids on certain types of inductors. The numbers 0 through 9 are represented by the colors brown, 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.

**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 =\text{In which order do we solve the various elements? Can we add 7, add it to 6, then divide the result by 2, or maybe divide by 2 and take the result away from 7? Luckily the order has been defined for us. We solve algebraic expressions by doing the calculations 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’. If you forget Pi = 1.314159, 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.
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