Automation NOTEBOOK

Cover Story
The Evolution of Wireless Communication

New Product Focus
New DataLynx™ Software offers remote data collection and file reporting

Technology Brief
Safeguarding your Computer

Feature Story
Demystifying Network Communications
Save 25% on Quality Drive & Motor Combos

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The new DURAPULSE series drive is built on simplicity and flexibility, incorporating feedback from our customers with extensive research and testing in our own drives lab. DURAPULSE offers simple Volts per Hertz control, PID functionality and dynamic braking as well as sensorless vector control and autotuning, and is available with optional encoder feedback for speed control. Little programming is required, with default values that were carefully selected for the U.S. industrial market for “out-of-the-box” operation. DURAPULSE drives are specifically designed to operate within U.S. voltage levels. And now save 25% when you team up one of our already low-cost DURAPULSE drives with a Marathon Electric motor. We have a drive to match every motor we carry, and our AC drive and motor combos start at $374. For information on DURAPULSE drives and Marathon motors, get our free catalog, or visit the AC Drives / Motors section of our Web site at www.automationdirect.com.

Editor’s Note

It’s a new year and we’re busy preparing for this year’s show at the Automation Pavilion at National Manufacturing Week, March 7-10th at McCormick Place in Chicago. This will be our second year there, and we’ll have interactive product demonstrations and displays, free popcorn and more. Stop by our booth (number 4311) to learn more about our products or just to relax and enjoy a cup of coffee and a snack. We look forward to seeing you there.

Another project happening at our headquarters concerns office space. We are outgrowing our current facility and are expanding into an adjacent building, so our team will be relocating there shortly. In order to make the transition more appealing, we’ve been given free reign to decorate certain areas of our new habitat. This should be lots of fun considering all the artistic talent on our team. I’m sure we’ll have some interesting stories to tell in our next issue.

We wish for you a happy and healthy new year.

Keri Schieber
Managing Editor
editor@automationnotebook.com

Contributors

Publisher Tina Crowe
Managing Editor Keri Schieber
Senior Editor Jennifer Gerborg
Design Manager Justin Stegall
Contributing Writers Tom Elavsky Paul Ruland Bob Ogelsby Robert Thornton Tim Cutler Tim Lawrence Steve Cleary

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New Product Focus

DataLynx™ Software offers remote data collection and file reporting

by Jennifer Gerborg

Senior Editor

AutomationDirect has recently added DataLynx™ Remote Data Collection Software to their line of industrial automation products. This new software package uses modern technology to provide an inexpensive and simple solution for collecting, viewing and storing data from industrial devices, regardless of location.

DataLynx is the ideal solution for collecting data from remotely located I/O devices, or for relaying data from multiple stations back to one location. It empowers those in charge of plant operations by bringing important information from distant or hard-to-reach locations right to their fingertips.

"DataLynx uses dial-up modems so it’s perfect for collecting data from several locations that are miles away," says Joey Kulakowski, software engineer for BizWareDirect, the AutomationDirect technology provider responsible for the development of DataLynx. "When you have pipes running long distances, Ethernet connections become expensive and complicated. But phone lines are everywhere—they are cheaper and more functional for hard-to-reach locations."

With DataLynx, remote data from any MODBUS serial-enabled device can be viewed and stored in an easy-to-read format, with no PLC programming or SCADA system required. The software is capable of collecting an unlimited amount of data from an unlimited number of remotely located devices, saving data into comma-delimited or tab-delimited text files. For added convenience, DataLynx runs on its own, even when a user is not logged into the PC.

DataLynx also offers file reporting. Reporting allows the user to view and archive the text files that are stored on the PC’s hard drive. Files can be opened or viewed in Notepad, Excel, or another program of choice. DataLynx allows the instant retrieval of important industrial data, even when physical access to the server and industrial devices is not available.

"With this product, there is finally an inexpensive, easy-to-use application for remote data acquisition," says Bill Glower, product manager for BizWareDirect. "This product is advanced enough to satisfy users’ needs, yet simple enough that anyone can use it and any facility can afford it."

DataLynx is compatible with any industrial device that supports serial MODBUS connections. Four packages are available to support up to one, five, ten or an unlimited number of devices. DataLynx software packages are priced from $395 to $1,495.

For more information about DataLynx, visit AutomationDirect (www.automationdirect.com) or BizWareDirect (www.bizwaredirect.com).

**Features include:**
- Easy-to-use configuration software
- Built-in Symbol Factory™ with over 2,000 symbols
- FDA compliant, low profile, dimmable
- VGA resolution (480 x 640 pixels) on 8”, 10” and 15” units
- 128 colors on objects and screens
- 320 touch cells on menus

"Misquotations are the only quotations that are never misquoted."
- Hesketh Pearson

Other touch panel options available, with serial drivers or various network interfaces:

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- Data Highway Plus
- DeviceNet
- DeviceNet
- PROFIBUS
- MODBUS Plus

Serial drivers include:
- Allen-Bradley
- Modicon
- GE Fanuc
- Mitsubishi
- Omron
- Siemens

AutomationDirect PCs

If you are looking for a practical touch panel, our EZTouch line is here to help. Loaded with features, functionality, and communication options, it’s the perfect fit for the most popular PLCs in the industry. We ship all in stock orders the same day, and we back up these panels with a 30-day satisfaction guarantee. Best of all, EZTouch products are supported by AutomationDirect's service, which has been voted #1 in the industry three years in a row by Control Design magazine readers. Call for your free catalog, or go online and learn all about our EZTouch panels.

Visit: www.automationdirect.com/eztouch

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- 320 touch cells on menus

*Email or visit site for specific serial driver details  **Network models have a 7-day lead time.

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1.800.633.0405 www.automationdirect.com
Screwless terminal blocks added to connection systems line

--- AutomationDirect now offers screwless terminal blocks, including feed-through, double-level, one-to-two connection, two-to-two connection, and knife blade disconnect models, along with a line of accessories.

Screwless clamp technology offers many benefits not found in traditional terminal blocks. Without screws, connections can typically be made in half the time. Wires can be run on top of the terminal blocks, making it easier for installers to fully insert wires into the spring clamps. Screwless terminals also offer vibration-proof connections and are maintenance-free, since screw clamps apply constant tension to the wires.

Feed-through terminal blocks connect two wires together and are available in sizes suitable for up to 8 AWG. They are sold in packages of 50 in blue or gray. Double-level terminal blocks allow fast circuit disconnection without rewiring by using a pivoting, insulated “knife blade”. They are available in gray in packages of 25.

Ground terminal blocks are used to mechanically and electrically connect wires to a DIN rail by means of a conducting clamp foot, allowing the DIN rail to function as a ground bus. Ground blocks are molded in green and yellow to meet international standards. They are available in packages of 10.

A line of accessories, including DIN rail, end brackets and covers, angled support brackets, jumper bars and marking accessories rounds out the offering. Prices for the screwless terminals start at $0.48 per piece (sold in quantity).

One connection-to-two connection and two connection-to-two connection terminal blocks allow multiple wires to be tied together by way of multiple spring clamps. They are available in packages of 25, LED and diode styles are also available, in packages of 10.

Knife blade disconnect terminal blocks allow fast circuit disconnection without rewiring by using a pivoting, insulated “knife blade”. They are available in gray in packages of 25.

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--- AutomationDirect now offers 100 Mb Ethernet I/O base controller module and Ethernet communication module for the DirectLOGIC line of PLCs. Both modules are priced at $299.

--- The H2-EB100 Ethernet Base Controller module provides a low-cost, high-performance Ethernet link between DL205 I/O and a PC-based control system or WinPLC/DL205/ DL405 CPUs using AutomationDirect’s Ethernet Remote M eter module for remote I/O. The module can also be used to connect DL205 I/O to a MODBUS TCP/IP client (master). The module is compatible with TCP/IP, IPX and MODBUS TCP/IP protocols for flexible PC communications. EBC modules support a virtually unlimited number of I/O points, deterministic I/O updates on dedicated networks, and fast I/O updates (4ms per base). An on-board serial port is available for connection to operator panels, ASCII In/Out, etc.

--- PC-based control software is available that is ready to use with the H2-EB100 module. These packages are equipped with compatible I/O device drivers, program development tools, and run-time environments.

--- The H2-EB100 supports the industry standard MODBUS TCP/IP Client/Server protocol in addition to standard IP and IPX protocols.

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n 1901, Guglielmo Marconi used Morse code to communicate the letter “s.” This transmission was an analog equivalent of a “digital” signal. By 1914, the Marconi Company was engaged in experimental voice transmissions that laid the groundwork for broadcast radio. With the advent of short wave radio, costs came down and reliability went up, ensuring commercial viability. At first, wireless transmission was unregulated, but as broadcasting began to develop, it became obvious to lawmakers that some type of regulation was needed to provide for orderly use of the airwaves. To fill this need, the Federal Communications Commission was formed on June 19, 1934, when President Franklin Roosevelt signed the Communications Act of 1934.

The earliest form of wireless communication on the factory floor was the use of walkie-talkies, where manufacturing engineers communicated with their use of walkie-talkies, where manufacturing engineers communicated with manufacturing engineers communicated with maintenance engineers to troubleshoot production or machine problems. It was a crude wireless network, but a wireless network nonetheless. Problems with these networks began to surface as other companies in the area started using the same walkie-talkies. Manuscripts were being garbled when radios keyayed at the same time from multiple locations collided with each other, resulting in misinterpreted messages and forced re-transmission of information.

The first wireless data communication devices had its share of multipath fading and interference or jamming. Multipath fading occurs when multiple copies of the same signal arrived at the receiver with slight differences in timing or phase. These differences in timing and phase occur when the radio frequency (RF) signal reflects or bounces off objects, thus taking a longer path than the signal that goes directly from the transmitter to the receiver. When the signals arrive out of phase and slightly later in time, they tend to reduce the signal strength of the direct path signal, causing “fading.”

Interference occurs when another device, such as a microwave oven, generates RF frequency noise at the same frequency as the radio.

The FCC helped alleviate another problem faced by wireless communications - the licensing of radios, and the limited availability of frequency licenses. To ensure that as many people as possible had a reasonable chance to obtain a license, the FCC limited the amount of bandwidth and transmission power for each license. To facilitate deployment of these local licenses, frequency coordinators were designated to assign licensed frequencies to individual facilities. While this limited the number of radios a facility could have and the narrower bandwidth resulted in lower data rates.

In addition to making radio signals hard to detect and intercept, spread spectrum offered another advantage for factory applications. By operating over relatively large chunks of spectrum, it was less likely that an interfering signal would block the entire band and that multipath fading would affect the entire band equally. In the case of frequency hopping radios, if the radios are hopping fast enough over a large enough number of channels, other radios could be used in the same area since the radios would only interfere with each other when they were using the same channel at the same time. This might reduce data throughput but would allow communication. Thus the FCC set a minimum number of channels covering a minimum amount of spectrum and a minimum amount of time in which each channel must be used at least once.

For direct sequence radios, if the signal is spread over a wide enough range, the signal intensity will be low enough that its signal will not interfere with other radios. Thus the FCC set a minimum amount of spreading to be legal. For both methods of spreading, the FCC set power limits as a further guarantee that multiple users could operate in the same band. Thus spread spectrum held promise for factory floor wireless data applications.

Because of their lower data rates, frequency hopping radios operate over a much wider range than direct sequence radios. The ability to co-locate more radio networks using frequency hopping technology provides more reliability. And without the need for computing-intensive protocols, frequency hopping radios can be easily connected to devices with limited intelligence. Many frequency hopping radios have been designed to work with several industrial communication buses, such as M-DOBUS.

Factory Floor Communications

In 1985, the FCC recognized the potential benefit of spread spectrum technology and the need to use radio transmission for commercial in-building communications systems. The FCC allocated three separate bands for low-powered systems that did not require licensing. The Industrial, Scientific, and Medical (ISM) band was broken down into 900 MHz, 2.4 GHz and 5.8 GHz. High bandwidth was provided in these bands and non-ISM operators were required to employ spread spectrum technology.

As you might imagine, use of the ISM band turned into a free-for-all as a large number of proprietary systems were developed with no interoperability. Radios were being designed to maximize performance in specific applications. The 900 MHz radios were the first technology on the market. The 900 MHz band, by virtue of its lower frequency, had better propagation characteristics than 2.4 GHz and 5.8 GHz— a fancy way for saying it goes farther. However, the 900 MHz band is not as wide as the 2.4 GHz or 5.8 GHz bands. As a result, you cannot get as many channels or of a high data rate at 900 MHz. A second limitation is that paging systems operate at a frequency close to the 900 MHz band. Paging transmitters cannot interfere. A third limitation is that the 900 MHz band is limited to 1 watt. Thus the potential for interference from paging systems is clearly present— even from systems not close by. Also, 900 MHz is not an unlicensed frequency in most of the world, so 900 MHz products can only be sold in North America, parts of South America and Australia. The emergence of 900 MHz cordless phones that operate in the same frequency band has also caused concern due to the large number of these phones in use.

Meanwhile, 100 Mbps Ethernet became the standard in office environments. Thus wireless Ethernet devices needed to provide similar speed connections to the network. Given the FCC rules for the ISM bands, it was difficult to achieve this level of performance in the 900 MHz band. Fortunately, RF technology has progressed sufficiently so that radios operating in the 2.4 GHz band could be produced at a reasonable cost. The advantage of the 2.4 GHz band was that it was wide enough to allow radio systems to be built with 1M bps + data rates. In addition, 2.4 GHz is an unlicensed frequency in most of the world. Some disadvantages of 2.4 GHz are that it has slightly worse propagation characteristics than 900 MHz. Also, microwave ovens operate in the 2.4 GHz band. Nevertheless, a large number of radio manufacturers produced 2.4 GHz radios. The 802.11 Standard

When 1-Mbps and 2-Mbps wireless connections failed to gain wide acceptance due to the lack of a standard, the IEEE created 802.11, a standard for wireless LAN products. (Note: The initial standard had no letter after it.) The 802.11 standard was established as an “after the fact” standard encompassing existing products. As a result, it was decided to start over and develop a true standard to which new products could be built rather than trying to fit a standard to existing products. So work began on the 802.11b standard.

The 802.11b standard has turned out to be an excellent standard for short range, wireless LANs. However, 802.11b products were tried in many applications where their success was very limited. The factory floor was one of those less than successful applications.

To understand the shortcomings of 802.11b for factory applications, it is helpful to understand the benefits of...
wireless on the factory floor. First and foremost is removal of the need for wires. In most instances, the biggest cost of an industrial control system is the cost of running the wire. Often, to run wires or conduit, production lines must be stopped, resulting in lost production. Another benefit of wireless is the flexibility it provides. If lines are changed or moved, no wires have to be moved.

To provide these benefits, a wireless solution must be able to cover the distances commonly found in a factory—typically hundreds of feet. When 802.11b radios were deployed in factories with the expectation that they could cover the range while providing the maximum data throughput, they failed miserably. The solution was to deploy many access points around the factory, typically in the ceiling. But access points need to be wired to the network, so one of the main benefits of wireless was lost. And when many access points are needed, 802.11b has only three non-overlapping channels. Thus only three access points could be deployed in a factory without fear of interference.

In the meantime, applications specifically designed for use on the factory floor were by and large proprietary solutions. While frequency hopping radios could not boast the high potential data rates promised by 802.11b radios, it turned out that the high data rates were not needed. What were needed were radios that could stand up to the high RF noise environment, be deployed easily, and work reliably. Radios employing the FHSS technology meet this need today.

802.11b has some areas where it performs well on the factory floor. The most common is in stock room inventory applications. The ranges are not as long as those on the factory floor and they are further removed from equipment such as lighting systems, welding machines and motor starters that may cause interference. With the proliferation of notebook computers and even handheld devices that have PC card slots, 802.11b radios can be used as a short range connection to production machinery for diagnostic or configuration purposes. Like the narrowband licensed radios that found their niche in outdoor SCADA applications, 802.11b radios have exhibited their usefulness on the factory floor.

What’s Next?

Already there are two new radio technologies being discussed as the next great thing—ZigBee and Ultra Wide Band (UWB). ZigBee is designed to be a low power, low data rate mesh radio technology. A mesh network is one in which there are multiple paths between points. ZigBee holds promise for industrial sensing applications where a large number of sensors need to be read at a fairly slow rate. Data throughput will range up to 250Kbps and latencies will vary by network size, but will typically be on the order of 100 milliseconds. ZigBee products are expected to hit the market in volume in the second half of 2003.

UWB is a technology that uses a very wide chunk of spectrum but at a low RF power to obtain theoretically extremely high data rates. Reports have circulated recently reporting data rates in the hundreds of Megabits per second. The tradeoff will be a very short transmission range. The UWB products currently being tested are focused on location-finding devices such as wall stud finders. It remains to be seen where UWB will find its niche in industrial applications.

Conclusion

While it has taken some time and caused frustration, robust and reliable wireless products are now available for factory floor applications. There is not one size that fits all applications, but by having a clear understanding of the application and with the help of a well-trained provider, the benefits of wireless communications can now be realized on the factory floor.
Let's talk PLCS

Although the North American market for automation and controls has seen nowhere near the growth it did 15-20 years ago, programmable logic controllers (PLCs) are still the preferred controller choice for industrial applications. What has changed for PLCs are the expectations and desired functionality of their specifiers and users. In this edition of PLC Speaking, we will discuss some of the results from over 300 readers who participated in our online PLC survey. We thank all of you who participated, and congratulations to the five winners of the BOSE Wave® Radios.

While reviewing the survey responses, we found our readers to be savvy users of PLCs, with expertise in all areas of programming, communications, PID, and motion control. All respondents but three were involved in specifying, recommending, or buying PLCs. Respondents were also from a diverse set of industries, with over 30% opting to write in the specific industry served, rather than pick from the standard list.

PLCs are largely used for machinery and process control applications, with over 50% of the respondents selecting one of these application categories. Within the machinery and process control category, General Machinery, General Motion Control, and Assembly were the top three applications for PLCs. The overwhelming popularity of these mostly discrete applications for PLCs was not surprising, but use of a PLC for motion control has continued to show more popularity recently than in years past. Motion control interfaces directly from PLCs are becoming more prevalent and often offer a much more cost-effective solution than choosing a purpose-built motion controller and combining it with a separate PLC for a complete control system.

Also noteworthy was the significant number of respondents who wrote in several non-industrial applications, such as building automation and HVAC, commercial refrigeration controls, fire safety systems, and security systems. Recent technology advancements and price reductions in PLCs, especially in the area of communications and lower cost nano and micro class PLCs, have made them appealing for these types of applications. When a 14 I/O DirectLOGIC DL05 PLC starts at $59 and a 36 I/O DirectLOGIC DL06 PLC starts at $199, both with two built-in serial communication ports, the products rival the value of any purpose-built controller, even in medium to high volume OEM applications.

Process, Batch, SCADA and RTU systems also have proven to be an increasingly popular application for PLCs. This supports the notion that customers realize a traditional DCS system is often not necessary for many of these process-based systems. Additionally, many process and batching systems are no longer being built on-site, but are rather designed as skid mount sub-systems that fit into standard shipping containers, which can then be assembled on-site as part of the complete control system. Modern PLCs, with their smaller physical footprint compared to most DCS hardware, but with extensive process features such as built-in PID and Ethernet communications, can easily be installed in smaller enclosures and mounted to almost any size equipment.

All process and discrete PLC applications showed a significant increase in communication connectivity and data acquisition requirements. 15 to 20 years ago, there was very little automation of the data acquisition portion of a control system, let alone performing it solely through the PLC. Today, with the overwhelming pressure to increase production and reduce downtime and waste, and doing so with a reduced workforce, data acquisition is often at the forefront of any control system buying decision. With this increased need for data acquisition and connectivity, newer PLCs must offer more "PC-like" functions, such as expansion for multiple serial ports, Ethernet ports, larger amounts of data logging memory, and instructions for manipulating data through high-level array and math instructions. The need for PC capabilities in a PLC has resulted in next generation PLCs being designed as "ruggedized" embedded PCs that can be installed in standard chassis-based PLC I/O systems. The DirectLOGIC DL205 WinPLC, with a built-in Ethernet port, addressable serial port, 100 M Hz CPU, and a 512K ROM, and a Windows CE operating system for easy connectivity to other M isocraft based systems, possesses most of the PC control capabilities within a PLC package.

There is no indication that PLCs will stop evolving; rather, they will solve more control and information system needs for both industrial and non-industrial automation. However, the desire for a single big black box that does everything may be replaced by the need for several "not-so-silent" black boxes that can do many things and can be easily connected together.
**Business Notes**

**Going on in the Automation Industry**

**2005 Manufacturing Sector Outlook**

According to its press release in November, the M
data on the Manufacturing Activity 

- The surge in oil and other commodity prices and rising 
- Business capital investment will be an important contributor to 
- Business activity should continue to grow faster 
- The Surge in Oil and Other Commodity Prices and Rising 
- A larger percentage gains will come from a rebound in the 

**AutomationDirect wins Reader's Choice service awards for fourth year**

- Control D design magazine, an Industrial OEM (Machine 
- The Sprayheads, supports, and 

**Real live training**

- Although there is increasing emphasis on Web-based 
- The sprayheads, supports, and 

**User Solutions**

**Controlling Nature's Way of Cooling**

by Jennifer Gerborg, Senior Editor

When conventional air 

**Phase Motion Control appoints Michigan Industrial Controls as its authorized service center**

- Phase Motion Control of Genova, Italy has recently appointed Michigan Industrial Controls, Inc. as its authorized 
- The system cools the exterior surface of 

- The ProfiBUS Trade Organization, in cooperation with the ProfiBUS Interface 

- The company also received the second highest score in the 

**Phase Motion Control of Genova, Italy has recently appointed Michigan Industrial Controls, Inc. as its authorized service center.**

- Michigan Industrial will provide start up assistance, repair and replacement for Phase 

- The Sprinkool system can have a unique programmatically specified for the 

- With systems cooling industrial, commercial and educational facilities, from 8,000 square feet to in excess of 17 

- With systems cooling industrial, commercial and educational facilities, from 8,000 square feet to in excess of 17 

- AutomationDirect received the highest service scores of any 

- AutomationDirect has received a number of awards which recognize the 

- AutomationDirect received the highest service scores of any 


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www.automanutenotebook.com
DL205 PLCs include one of the widest varieties of discrete, counter, and analog control options in any class of PLC:

- Low-cost single-channel high-speed counting or single-axis pulse output for only $79, or multi-channel counting or multi-axis open-loop motion control starting at $289.
- Over 40 varieties of discrete, analog, and temperature modules to choose from at the industry's best prices.

The DL205 family offers extensive serial and Ethernet device communications beyond what is commonly offered in much larger and more expensive PLCs:

- Connect most US RTU Master/Slave devices (inverter drives, displays or other controllers) directly to the PLC CPU port with no additional hardware or cost required.
- Connect bar code readers, labelers, weigh scales, or other ASCII devices to the D2-260 CPU Port 2, or choose a CoProcessor and develop custom data handling of any serial protocol.
- Add wireless serial/Ethernet radios or a serial dial-up modem for practical remote device communications or for remote programming.

Check out our prices on everything from I/O modules to CPU's and you'll see that our everyday list prices are the lowest in the industry. For instance, you can buy two of our DL205 systems for the price of one Allen-Bradley's SLC 500 modular systems of similar configuration. Will that help your budget?

The DL205 WinPLC CPU offers the best connectivity to other Microsoft-based software, including extensive on-board data, math, and array handling capabilities not commonly found in conventional PLC CPUs. The WinPLC (starting at only $759), programmed with the easy-to-use Think&Do flowchart software, can accomplish much larger and more complex control applications that would typically require an expensive dedicated industrial PC.

DL205 PLCs include several hardware and software options for easy connectivity to business systems:

- Ethernet communication modules for only $299 each can be connected to any Ethernet network in your facility's LAN or remote WAN for fast access to critical data.
- A full set of practical software tools for local data collection, remote modem data polling, or OPC connectivity allow the DL205 to provide necessary production data to keep your systems running at peak efficiency.
Demystifying Network Communications

by Bob Oglesby, hostEngineering

F or many, the world of communications is mystifying, shrouded in complexity and unknowns with equal parts science and magic, and 100% scary. We would like to define some common terms and show you how they fit together so you’ll find that networking is no more complicated than ordering a hamburger at a drive-through.

Let’s take a journey through the world of networking and see if we can demystify some of the networking products offered in today’s industry. We’ll start with some networking concepts and end with some products that use them. And to make this journey as painless as possible, we’ll start simple… and keep it simple.

The Network

In the broadest sense, a network is any two things bound together. In our case, a network is two or more nodes (master or slave) that communicate. At its simplest, a network could be two people talking on a street corner. At the most complex, a network could be the entire Internet. The only real difference between the two is size and topology.

A Typical Ethernet System

In networking, topology refers to the shape of the network or the way the nodes are interconnected. When referring to topology you’ll hear terms like “daisy-chain,” “trunk and taps,” or “star.” In most cases the topology is defined by the networking hardware and system requirements. There are advantages and disadvantages to each topology. Some networks, Ethernet for example, can be configured in different topologies, whereas others may be limited to one.

Two forms of networking are Master/Slave and Peer-to-Peer (P2P). In Master/Slave, only the master can initiate communication. Think of a drill sergeant barking orders at a private. The private won’t speak until spoken to, and if he’s smart, he’ll only ask questions if he’s asked. In P2P, anyone can talk to anyone else. Picture a group of friends sitting around a table where there is generally more than one conversation going on at a time, and a person may be involved in more than one conversation. So, if a few folks talking make up a network, and it really is as simple as ordering a hamburger, then what is an Ethernet or a network and why should you care?

The Magic of Ethernet

Ethernet. The very name suggests magic. Data from the Ethernet, no doubt delivered by fairies, or maybe tiny nros, no, not really. Ethernet is hardware network that was originally invented by Xerox Corporation. With Ethernet, each node has a unique hardware address called a Media Access Control address, or MAC for short. Ethernet was designed to be inherently P2P, but it can easily support Master/Slave as well.

The earliest version of Ethernet used a trunk and tap topology, where nodes were connected to a rigid cable backbone through vacuum taps. It was called 10base5 or Thicknet. The designation 10base5 literally meant 10 megalinks per second, over baseband, up to 500 meters. The original Thicknet was also referred to as Chasaeplin or Thinnet, owing to the thinner, cheaper cable.

The most common standards currently in use are 10baseT and 100baseT. As before, the 10 and 100 refer to the speed, and 100 megabits per second, respectively. The T designation refers to a twisted pair wire. Unlike the previous standards that used a trunk and tap or daisy chain, the T variants use a star topology, with each node connected to a center hub or switch, much like the telephone in your house is connected to a switch at the phone company. In fact, the earliest 10baseT cables were a thinner coax cable that was daisy chained (connected from point-to-point). The newer 10base2 was also referred to as Cheapernet or Thinnet, owing to the thinner, cheaper cable.

TCP/IP Protocols and Services

TCP/IP by itself just tells us how our devices will interact. It defines the way data is passed. The two that are used most often are TCP and UD/P. TCP stands for Transmission Control Protocol and is a streaming protocol, meaning it is like a garden hose. You connect to the one device you want data from, and each byte put into one of the hose eventually falls out the other. UD/P stands for User Datagram Protocol and is packet protocol, meaning the connection is like a mailbox.

I have two Ethernet devices that support TCP/IP, surely I can talk now? Sorry, same answer. Even if we have two people who have functional voices, a desire to talk, and they both speak English, there really is more to a conversation. Let’s look at ordering a hamburger at a drive-through. Every restaurant has a slightly different procedure, but in general, there is a protocol that you follow when you order. Being at the right place and speaking the right language isn’t enough. You must know what to ask for, how to ask for it, and have the money to pay for it. Is protocol important? Yep. Try going to a bank and asking for some hawtixies in a bag to go.

TCP/IP is a language you can speak or read on a web page, we are doing TCP/IP equivalent of going to the post office or library. Those TCP/IP devices are to other TCP/IP devices as the post office or library is to other post offices or libraries. TCP/IP has its own, which of course, is an oxymoron. Occasionally, a particular protocol gains enough acceptance to be considered a de facto industry standard. The simplicity of serial MODBUS resulted in wide acceptance, and the TCP/IP based version, MODBUS/TCP, has also become a de facto standard.

There are many different TCP/IP protocols that you can choose from. There are some protocols that are very good at talking yet? Again, the answer is a definite maybe. Having two IP devices like two people that speak languages using the same character set, perhaps Spanish and English. Obviously we need more. Within IP there are several major sub-protocols that define the way data is passed. The two that are used most often are TCP and UD/P. TCP stands for Transmission Control Protocol and is a streaming protocol, meaning the connection is like a garden hose. You connect to the one device you want data from, and each byte put into one of the hose eventually falls out the other. UD/P stands for User Datagram Protocol and is packet protocol, meaning the connection is like a mailbox.

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Safeguarding Your Computer

by Tim Lawrence, the IT Guy, AutomationDirect

In this day and age it seems most of us spend more time cleaning the little spies and pests off our computers than truly using them for productive work or play. One thing you can count on in technology is that you won’t really miss it until it’s gone, and if you’re not careful your data could be gone... forever. Imagine losing all your hard work or your digital family pictures because you forgot to, or didn’t know how to, backup and protect your data. There are many contributing factors to how or why we lose data and there are many ways to safeguard your computer and gain some sanity in our often too crazy lives.

First things first; every computer should have a good virus protection program. There are many to choose from, but the most well-known are McAfee and Norton AntiVirus. The best part about choosing well-known or reputable software vendors is that they are dedicated to keeping up to date with the new viruses that continually appear. Once you install the virus protection program, make sure to keep your virus definition files up-to-date. This is done by going into the virus program and scheduling the program to download updates automatically. These updated files will keep your computer informed about new viruses. This is very effective, but make sure you schedule the updates for a time you usually have the computer up and running. You could also choose to update manually.

Next, make sure you scan your computer. This is usually done in the virus scanner program under the virus scan console. The virus program can actively protect you against known viruses, but what about the ones that might already be on your machine? I try to scan my computer once a month. And while we are talking about viruses, always be sure you know the person from whom you are opening email attachments; too many viruses are propagated via email by unsuspecting individuals. One outstanding virus fact: at its peak infection rate, 1 in 12 emails on the internet were infected with the MyDoom virus. So a good virus protection program is a wise investment.

Now let’s talk about Adware and Spyware. Adware usually results from downloading shareware or freeware programs or by clicking that common popup box that says “your computer may be slow” click here to speed it up,” or something to that effect. Adware is pretty harmless but excessively annoying, and it has been known to slow computer speed to a crawl. If you actually read the EULA (end user license agreement) the next time you load a free program instead of just clicking “next,” you will be amazed at what it tells you. It basically says you are giving the licensor the right to load anything on your computer. So you load a really cool program, and then switch to Google to search for something, and 20 popup boxes begin streaming on your screen. Spyware is installed similarly to Adware, but is more malicious in its nature. Spyware can be used to log keystrokes, remotely access your computer, or just cause grief and headaches. Much like virus programs, there are several SpywareAdware programs out there at a cost. Spybot Search and Destroy 1.3 (http://www.safer-networking.org) is a good free program for combating Spyware and Freeware. Lavasoft’s Ad-Aware (http://www.lavasoftusa.com) is also a good free program to use.

One observation about free programs is that while one may find pests and remove them, you can install another free program and it will find pests the previous program couldn’t. The key to addressing that problem is to use a purchased program. Purchased programs seem to find more problems and clean more effectively. A program called PestPatrol® (http://www.pestpatrol.com) is a very good program that costs around $39.95 for the home user. The key to remember with any important documents, pictures, files, etc. in “My Documents”. This way I have one central easy backup area for my data. I back my data up once a month—just in case my computer crashes, and chances are it will crash one day. We live in a digital age where most saved data is digital, however, if my computer crashed and all saved files were lost I would lose personal photos equivalent to losing all my pictures in a fire or flood. We have the advantage of being able to avoid loss by backing up our data to CDs or DVDs. Storage of these backup files, which takes hardly any space at all, should be in a fire-safe or a safety deposit box. So, use the backup utility that comes with Windows®; it’s fairly intuitive and it will save you lots of pain in the future.

Lastly, one very nice feature of Windows® XP and Windows® Me is the System Restore feature. This feature will write a restore point when new software or changes to your system occur. This gives you the ability to roll back to a previous point when your computer was working.

I hope this information assists you in taking control of your computer. Nothing is more annoying and stressful than a zombie computer that doesn’t want to execute when you want and need it to perform. So, go forth and take control of your computer, and happy computing.

R-D. Laing
Tech Thread

Serial Ports for DirectLOGIC

A User's Guide to Configuring Serial Ports for DirectLOGIC PLCs: A Two Part Series

by Robert Thornton, Product Engineer, AutomationDirect

Part 1

The capabilities of Port 2 of the DL06, DL250-1 and DL260 CPUs are often overlooked when designing a process control network. Like Port 1, Port 2 can be used for programming the CPU or connecting other RS-232 devices, such as an operator interface panel, to the PLC. Unlike Port 1, Port 2 supports different types of network interfaces and protocols and has more flexible communications. While Port 1 is limited to 9600 baud, odd parity, and RS-232 serial communications, Port 2 supports RS-232C, RS422/485 4-wire, and RS-485 2-wire (DL06 and DL260 only) networks. It supports a variety of protocols, including DirectLOGIC, MODBUS RTU, Non-Sequence (ASCII/IN/OUT) and Remote I/O on the DL205 CPUs. The baud rate can be set from 300-38400, and there are no timing issues that may arise with a 2-wire multi-drop network.

With this flexibility, common uses for Port 2 include PLC to PC communications, operator interfaces, bar code readers/Printers, load-cells, serial radio and telephone modems and DirectLOGIC Remote I/O. In order to fully understand the capabilities of Port 2, let's take a look at the advantages of the different network interfaces and protocols.

Network Interfaces:

In the following, each of the three networking options available on Port 2 will be discussed. Additional information can be found on the Technical Support page at www.automationdirect.com.

RS-232C

RS-232C is a simple way to connect two devices that are less than 45 feet apart, such as connecting a host computer or an operator interface to a DirectLOGIC CPU.

RS-232C Configuration

RS-232C is capable of operating at data rates up to 38.4 Kbps. The data rate may need to be reduced depending on the type and length of cable. RS-232C is a simple ended interface, meaning that a single electrical signal is compared to a common signal (ground) to determine the binary logic states. As a result, RS-232C is fairly susceptible to electrical noise.

RS-422/485 4-wire

RS-422/485 4-wire is a differential interface which means that logic levels are defined by the difference in voltage between a pair of wires, like TXD+ and TXD-. Instead of a single signal wire to ground, the advantage of a differential interface is that it is typically more immune to noise or voltage spikes that may occur on the communication lines. It also has greater drive capabilities that allow for longer cable lengths. RS-422/485 is rated for a maximum cable length of 4000 feet, and with the DirectLOGIC PLCs, a maximum data rate of 38.4 Kbps. Again, the data rate is highly dependent upon the cable type and length. AutomationDirect recommends using a Belden 9729 or equivalent cable.

The advantage of a 4-wire network is that it uses a separate pair of wires for transmit and receive signals. As a result, timing issues associated with 2-wire networks are eliminated.

RS-485 2-wire

RS-485 2-wire is available on the DL06 and DL260 CPUs (MODBUS RTU only). Like RS-422/485 4-wire, RS485 2-wire is a differential interface and is rated for a maximum cable length of 4000 feet and data rate of 38.4 Kbps. Since it is a 2-wire network, the transmit and receive signals are exchanged on the same pair of wires. As a result, protocol timing can be difficult with some devices.

To determine which type of serial network to use, consider these factors: How many devices will be on the network? What is the maximum distance? What are the requirements of the other devices on the network? Are you comfortable with handling timing issues that may arise with a 2-wire multi-drop network?

Protocols:

All of the protocols available have a maximum data rate of 38.4 Kbps. These protocols support half duplex communications with DirectLOGIC PLCs.

K-Sequence

K-Sequence protocol can be used with RS-232C or RS-422 networks. K-Sequence is typically used to communicate to a DirectLOGIC PLC from a host computer running DirectSoft. It may also be used to communicate between an operator interface acting as the master to a PLC network. When using K-Sequence with DirectLOGIC PLCs, the PLCs cannot be the master.

The advantage that K-Sequence has is that it is capable of performing write operations on individual bits such as I/O points or control relays.

DirectNET

Like K-Sequence, DirectNET protocol can be used with RS-232C or RS-485 networks. DirectNET is an open protocol. You can learn the specifics of DirectNET in the user manual, DA-NET-M, which can be found at www.automationdirect.com.

DirectNET is an easy-to-use protocol when used with the DirectLOGIC family of products. It is suitable for those applications requiring data to be shared between PLCS or between PLCs and a host computer. A network utilizing the DirectNET protocol requires one master station that issues commands to transfer data between the master and slave. Examples of master stations are operator interfaces, host computers or even another PLC.

The advantage of DirectNET is that a DirectLOGIC PLC can be the master station. DirectNET is available on a number of DirectLOGIC PLCs where other protocols may not be available. One disadvantage is that data manipulation cannot occur at the bit level. Also, DirectNET is not an industry-standard protocol.

MODBUS RTU

When using DirectLOGIC PLCs, MODBUS RTU protocol can be used with RS-232C, RS422/485 4-wire or RS-485 2-wire networks.

There are numerous advantages to using MODBUS RTU. First, it is well known and widely used in all industries. Because of its simple way of transferring data, it is up to three times faster than DirectNET. It also utilizes CRC error checking, making it more robust than DirectNET, which uses LRC error checking.

Remote I/O

Remote I/O is not just a protocol, but also a network specification. Remote I/O is used to communicate with remote I/O racks up to 1000 meters away. Using Remote I/O allows the placement of sensors and other field devices a long distance from the CPU. The built-in Remote I/O master station has the capabilities of a RS-232C interface, which means that logic levels are defined between a pair of wires, like TXD+ and TXD-. Instead of a single signal wire to ground, the advantage of a differential interface is that it is typically more immune to noise or voltage spikes that may occur on the communication lines. It also has greater drive capabilities that allow for longer cable lengths. RS-422 networks DirectNET is an open protocol. You can learn the specifics of DirectNET in the user manual, DA-NET-M, which can be found at www.automationdirect.com.

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Non-Sequence

Non-Sequence (a non-structured protocol) allows the CPU to use Port 2 to either read or write ASCII strings using the ASCII (DL06 and DL260 only) and PRINT instructions. It can be used with RS-232C, RS-422 or RS-485 networks. Note: there is no provision for multi-stations with the Non-Sequence protocol.

Part 2

In Part 2 of this series, we'll be looking at how to set up Port 2 using the DirectSoft PLC programming software.

“*The quieter you become, the more you can hear.” — Ram Dass

www.automationdirect.com
A Condensed Guide to Automation Control System Specification, Design and Installation

Part 1: System Identification and Safety

by Tom Elavsky, AutomationDirect

If you have not been directly involved in the world of factory automation, data acquisition, process instrumentation or electrical controls in general, then the above words and acronyms may be somewhat overwhelming. But these words, and many others, are part of the language that’s used in the industry. (For “A Guide to Common Automation Terms” refer to http://support.automationdirect.com/docs/glossary.html)

The following is a series, with continuation in future issues of Automation Notebook, to act as a general guide to the specification, design and installation of automated control systems. The information and references are presented in a logical order that will take you from the skills required to recognize an operation or process suited for automation, to tips on setting up a program, to maintaining the control system. Whether you are an expert or a novice at electrical controls in general, or electrical controls in general, then the above words and acronyms may be somewhat overwhelming. But these words, and many others, are part of the language that’s used in the industry. (For “A Guide to Common Automation Terms” refer to http://support.automationdirect.com/docs/glossary.html)

There are many reasons why the electrical devices that you will use in the design of your automated control system should be listed, approved or registered with a testing laboratory. One reason is to ensure that the device meets standards that will prevent failure that could lead to catastrophic results. Another reason might be for insurance or compliance purposes. One of the most specified and premier safety testing laboratories is Underwriters Laboratories (UL). The most applicable area of interest for control systems is UL’s Standard for Safety 508A. If your control system panel requires being built to UL508A, then you will need to contract directly with a UL508A panel builder. Additional information can be found at: http://www.ul.com/controlequipment/devices.html

Compliance to UL508A for AutomationDirect products can be found on our Web site at: http://support.automationdirect.com/compliance.html

The following are other safety points to consider in the design of your automated control system:

- Emergency Stop - The control system must provide a quick manual method of disconnecting all system power to the machinery, equipment or process. The disconnect device or switch must be clearly labeled “Emergency Stop.” After an emergency shutdown or any other type of power interruption, there may be requirements that must be met before the control system or PLC control program can be restarted.

The first and most important item to consider before attempting an automated control system, or even a simple on/off control for a pump, is safety, both for personnel who may be working with or near the automated equipment, as well as to prevent damage to the equipment.

To minimize the risk of potential safety problems, you should follow all applicable local, state and national codes that regulate the installation and operation of your control system, along with the equipment or process it is designed to control. These codes vary by area and usually change over time. It will be your responsibility to determine which codes should be followed and to verify that the equipment, installation, and operation is in compliance with the latest revision of these codes.

Most likely your control system will be dealing with electrical energy, so your first goal will be to eliminate the risk of fire and electrical shock to personnel. The top organizations that provide applicable standards and codes are listed below, but even before you get to this area of safety, it would be wise to educate yourself as much as possible about electricity and electrical equipment in general. A good understanding of basic electricity, including DC and AC theory and practice, Ohm’s Law, etc. will go a long way in helping you understand the various codes and standards. There are many good publications and articles on the subject of basic electricity and some local technical colleges offer courses covering subjects dealing with basic electricity. Some even offer courses in Programmable Logic Controllers (PLCs), which can be very useful when dealing with automated control systems. Also, many Web sites offer free tutorials covering basic electricity and PLCs. It would be beneficial to have some understanding of electronic devices, such as the operation of a transistor and other solid state devices, as well as understanding of the use and operation of electrical test and measurement instruments, such as voltmeters, current loop meters, clamp-on amp meters, etc.

At a minimum, you should follow all applicable sections of the National Fire Protection Association (NFPA) fire code, and the codes of the National Electrical Manufacturer’s Association (NEMA). There may also be local regulatory or government offices that can help determine which codes and standards are necessary for the safe installation and operation of electrical control equipment and systems.

Please keep in mind that if the automated control system you are developing needs to be accepted in the international market, the National Electrical Code (NEC), as a publication of NFPA, is being harmonized with the International Electrotechnical Commission (IEC) (Web site: www.iec.ch/) and the European Hazardous Location Ratings. For more information, check the Instrument Society of America’s (ISA) Web site at: www.isa.org. Additional resources on the subject can be found at: www.annex5.com.

Another area of safety that needs to be considered for automated control systems is lockout/tagout procedures as specified by Occupational Safety and Health Administration (OSHA). “Lockout/tagout” refers to specific practices and procedures to safeguard operators and maintenance personnel from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities. In order to have your control system make use of a lockout/tagout procedure, the design should include the ability to shut off, neutralize, or isolate any energy source, such as the main electrical feed, but also any pneumatic, hydraulic or mechanical energy storage device. The means to do this should be considered in the initial design of the automated control system. Additional information can be found on OSHA’s Web site at: http://www.osha.gov/SLTC/controlhazardousenergy/

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Technical Review
Control System Design Continued

For example, there may be specific register values in the PLC memory that must be established (or maintained from the state prior to the shutdown) before operations can resume. There may also be mechanical positions of equipment that have to be moved or jogged to the proper position.

- Avoiding Electric Shock or Overt CE Outputs - Do not rely on the automation control system alone to provide a safe operating environment. You should use external electromechanical devices, such as relays or limit switches, that are independent of any digital or electronic controlling device, such as a solid state relay or a PLC output module, to provide protection for any part of the system that may cause personal injury or damage. These devices should be installed in a manner that prevents any machine operations from occurring unexpectedly. For example, if the machine has a jammed part, the controlling system or PLC program can turn off the motor rotating a saw blade. However, since the operator must open a guard to remove the part, you should also include a bypass switch that disconnects all system power any time the guard is opened.

- Orderly Equipment Shutdown - Whether using a control system designed around relays and timers or a PLC, an orderly system shutdown sequence should be included in your design. If a failure is detected, then any mechanical motion, valve position, etc., needs to be returned to its fail-safe position and the equipment/process stopped. These types of problems are usually things such as jammed parts, broken cutting tools, bin full, etc., that do not pose a risk of personal injury or equipment damage. If a detected problem would result in risk of personal injury or equipment damage, then use other means to deal with it, such as applying a brake to rotating equipment to stop it before personnel can come in contact with it.

- Grounding - To prevent electrical shock, incorporate good grounding practices in the design, construction and installation of your system. Use protective devices for faulted conductors to prevent fire, and also realize that good grounding practices can reduce electromagnetic and radiated noise interference to sensitive electronic devices. A good practice is to use an earth ground rather than a metal conduit to return current to the source. This practice also reduces the impedance of the ground circuit, preventing transient overcurrents. This is especially important when communicating over long distances. Nintendo Corp.

- Control Power Distribution - Develop a power distribution scheme in the control system circuitry, according to code, that ensures all circuits are protected with fusing, circuit breakers or other interrupting devices that have been specifically selected for the job. It is also important that you have an understanding of basic hydraulics, pneumatics, mechanical operating mechanisms, electronics, control systems, etc., and a solid knowledge of the operation or process that you are going to automate.

- Finger Safe and Dead Fronts - Another safety area to consider is the use of devices that have finger-safe terminal connections, which are surrounded by insulated guarding. The use of protective guards over live circuits should also be considered, even on control panels that have limited access, so it is safer for maintenance/electricians and authorized personnel to troubleshoot or make adjustments to electrical control devices. Dead fronts should be used on control system enclosures where the operator needs to make adjustments to devices, such as selector switches, thumbwheels, potentiometers, etc., and the controls need to be inside the enclosure so as to protect them from outside weather conditions. The dead front is normally an interior door that is mounted in front of the main control panel. The outside enclosure door may still require key entry by the operator, but the dead front interior door with adjustable devices is interlocked so that it requires a switch to open it, disconnecting power to the electrical devices mounted on the main control panel.

Closed-loop Control - It is your responsibility in any type of closed-loop control system to ensure that if the feedback signal is lost, the system shuts down so as not to cause injury to personnel or damage to the equipment.

Identifying Process for Automation:

The first step in configuring an automation control system is to identify what can be automated. You need to have a good understanding of basic electricity and safety.

- You should understand how to control motion and movement, regulator the flow of fluids, dispense granular materials, orient parts, sense product position, detect an operation is complete, etc. As a simple example, let’s say we have a conveyor that moves our product from point A to point B. The conveyor is powered by a 3-phase AC motor, which is turned off and on by a manually controlled motor starter and includes, for fire protection, both short circuit and overload protection. The system requires an operator standing at the motor starter to watch as the product reaches the entrance, and to turn the conveyor on to move the product. The operator must also turn the conveyor off once the product has reached the discharge end.

To automate the conveyor, we will need to replace the manually controlled motor starter with an electrically controlled motor starter, including short circuit and overload protection. We will need to size the motor starter to work with the existing conveyor motor. (Refer to our Web site at http://www.automationdirect.com/static/specs/fujimcselection.pdf for information on specifying and sizing motor starters.)

We will also need to identify where to locate sensors such as position sensors, proximity sensors, etc., that will indicate when an operation is completed. This is required so our control system knows when to proceed to the next step in our operation. As an example, we usually need a limit switch to detect when a cylinder is fully extended, as in the case when the cylinder is used to push our product onto a conveyor. The cylinder “fully extended” signal is used to energize the solenoid valve that provided the air pressure to the pneumatic cylinder. We also need a limit switch to indicate when the cylinder has fully retracted, and provide a signal to the start/stop control of the conveyor that the product push cylinder is out of the way for the next product. Another application for a sensor is to indicate when the product has reached the end of the conveyor. The sensor can be a limit switch with a roller arm that comes in contact with the product or a photoelectric sensor that can detect the product by using an infrared beam of light. The photoelectric approach may be the better choice because the position of the product on the conveyor belt may vary, and you need to check the following site: http://www.automationdirect.com/static/specs/position.pdf for information on selecting photoelectric sensors.

We would continue with this analysis, looking at each piece of equipment or component in our system, and select a device that could control or sense it. Some examples include an electrical solenoid valve to control water used to wash residue from a product, or a pneumatic valve to control air pressure to a cylinder operating a gate that diverts product on a conveyor, or energizing a switch control relay to signal a product that is in position on a scale.

In some instances we may need to vary the speed, rate or position of our controlling device, such as varying the speed of a conveyor, changing the amount a valve opens to control a flow rate, or remotely changing the setpoint level for a tank. This could be accomplished by using an analog output signal. An analog output signal is a varying signal that corresponds to the real value we have determined and calibrated into the device. For example, a 0 to 10 VDC signal could represent a conveyor speed of 0 to 500 feet per minute. An analog signal to the speed controlling device for the conveyor motor of 5 VDC would result in a conveyor speed of 250 feet per minute.

Identifying devices to control motion, flow, events, etc., and sensing condition is basically identifying the I/O (inputs and outputs) of our control system. Once these devices are identified, they can be used as the field devices in a PLC-based system, or they can be “hard-wired” for simpler applications.

You will also want to determine if your automated control system will benefit from the use of an operator interface, also referred to as a Human Machine Interface (HMI). If your process requires making changes to setpoint values, process time, flow rates, etc., then the use of an HMI is the best way to proceed. In these situations, you will most likely need a PLC that can easily communicate with the HMI device.

If your application requires keeping data records for reference, traceability, history, trending, meeting regulations, etc., then you should look at using a control system that would fall into the category of a “Supervisory Control And Data Acquisition” (SCADA) system. Most of these control systems would be comprised of PLC-type I/O that interface to a PC with appropriate software.

Watch for Part 2 on System Specification in our next issue.

References:

For information on “PLC Logic and Principles” by Doug Bell of InterConnecting Automation, PLC training books, and training through technical schools and organizations visit: http://support.automationdirect.com/docs/training.pdf

For Web sites with free tutorials that cover basic electricity principles, visit any of the following: http://www.theengineeringlibrary.com/elect/btheory/etbmenu.html or http://www.kilowattclassroom.com/index.htm or http://www.mrpdc.com or http://www.plcs.net/

You may also want to visit the AutomationDirect Customer Forums at: forum@1automationdirect.com/cgi-bin/OurLounge.cgi

For information on the National Electrical Manufacturers’ Association (NEMA) you can find their Web site at: http://www.nema.org. NEMA is also being harmonized with the International Electrotechnical Commission (IEC) (Web site: www.iec.ch/) and other European standards. Additional information can be found at Global Engineering Documents’s Web site at: www.global.ih.edu. Global Engineering Documents is also the source for obtaining NEMA, IEC and CE documents.

Further information for the National Fire Protection Association (NFA) can be found at their Web site at: http://www.nfpa.org/. Some of the more useful publications are the National Electrical Code (NEC), publication NFPA 70 and also, as a good reference refer to the Electrical Standard for Industrial Machinery, publication NFPA 79.
FYI

Optical sensors

New Spherical Optics Technology for Sensing in Small Areas

By the Managing Director of AutomationDirect’s sensor supplier

The challenge

Diffuse sensors enjoy great popularity with users. With diffuse sensors, pulsed light from an emitting diode falls on an object of any shape or color and is reflected in a diffuse manner to a light-receiver, which is located in the same device (fig. 1). If the intensity of the received light is sufficient, the output is switched. Operating distances depend on target size, color and surface structure.

Diffuse sensors work using optical lenses. It should be noted that two optical systems are required in the same device, one for the emitter and one for the receiver.

No appreciable problems arise when scaling down the optics of the emitter and receiver to put into a small housing. However, there are fundamental limitations. The lenses themselves can be reduced in size almost indefinitely, but the dimensions of the transmitter and receiver components cannot. Light emitting diodes (LEDs), which are available in very small housing sizes, are generally used as the transmitter. These housings are still much too large for really small reflex sensors. It would appear the only remaining solution would be to change to unhoused chips; however, their use would add considerable cost. Only now can the basic challenge be recognized. An optical system is shown to scale in fig. 3.

In this figure, the LED chip is extremely large in relation to the lens diameter. Inevitably, the result is very poor beam quality. Both the quantity of output-coupled light and the total beam angle on the transmitter and receiver sides leave much to be desired. Smaller LED chips could be the solution, but these unfortunately do not exist. An additional disadvantage is that the roughly cubic LED chips emit their light more or less uniformly in all directions. There is no better on the receiver side.

One elegant and effective solution for light coupling and shaping has been developed in the form of cylindrical miniature devices in which the lenses have been replaced by concave mirrors. The result is impressive, with an operating distance of 50 mm. However, the total beam angle of ± 22° is quite large, in fact too large for many applications.

For light-based detection applications on a miniature scale optical fibers are very well suited. Yet all optical fiber solutions suffer from the disadvantage of a large total beam angle, so that the problem is still not resolved. The total beam angle of optical fibers is essentially determined by the numerical aperture of the optical fiber material, and therefore cannot be influenced.

From a technical point of view, the obvious solution when narrow total beam angles are required is to choose lasers. However, laser devices cannot easily be inserted into small housings. In addition, there are economic considerations that currently limit more widespread use of laser devices.

New technology - Spherical optics

In view of many unresolved detection problems in the miniature field, there is a solution. Amazing results can be achieved with spherical optics.

With this technology, a sapphire sphere is cut in two in order to separate the transmitter and receiver parts. Between the two halves of the sphere, there is an opaque layer to prevent an optical short-circuit. The transmitter and receiver semiconductor chips are mounted as closely as possible to the surface of the sphere. As seen in fig. 4, the chips (LED and photodiode) are somewhat off the optical axis.

This is normally a disadvantage in optics, but not in this case, since the transmission beam and the detection zone of the receiver “squint” somewhat or cross at a certain distance from the device. As a result, the detection zone is approximately cylindrical.

The optical system is vacuum potted together with the electronics module in transparent resin. The wide beam of conventional diffuse sensors is generally troublesome. However, a problem appears when devices with very small diameters (M5 or less), short operating distances and/or narrow total beam angle are called for. (See fig. 2)

Technical Analysis

Conventional diffuse sensors work using optical lenses. It should be noted that two optical systems are required in the same device, one for the emitter and...
Observations on Turning 50

by Steve Cleary
AutomationDirect

I turned 50 this year, which is not a bad thing. I am in good health and have a very good life, so I feel very fortunate. Yet, I’ve definitely noticed some changes.

I was recently at the supermarket, and among my purchases was a bottle of wine. Displayed prominently was a sign reading, “We check ID on ALL alcohol purchased!” I have news for you – they never check my ID anymore. Oh, I know this isn’t a big deal. I’ve never had a problem buying alcohol, but I can’t help but wonder why they continue to post it.

It’s not 300 MPH!

Earlier this year I was filling out an application for a passport. In the space for hair and eye color, I instinctively entered “Brown” for both, as I had been doing since I applied for my driver’s license when I was 16. Later that day, I glanced in a mirror and saw a lot of gray hair. I reluctantly changed my hair color entry to “Brown/Gray”. The next morning while I was shaving and getting ready to go to the post office, I took a good look at all the gray I was seeing in the mirror. I crossed out the “Brown”, and just left “Gray” on my form. My passport will be valid for 10 years, and it’s doubtful that my hair will magically start turning brown again.

I might add that the dutiful, somewhat bored-looking civil servant who processed my application smiled broadly and laughed when she saw how I had entered my hair color on the form, which brings up another observation: Over the years I’ve learned that it really helps to have a sense of humor!

Brainteasers

1. “Next Day Air”
   An AutomationDirect purchasing agent flies from our Cumming, GA facility to visit one of our vendors on the most economical flight she can find (two stops, one plane change). The average speed of the outbound trip (including the stops) is 120 mph. For the return trip, a jet is chartered to deliver all of the urgently needed products to our warehouse as fast as possible. It averages 480 mph on the return trip. What is the average speed for the entire trip?

2. Fill-in-the-blanks
   Use each of the numbers 1 - 9 to fill-in the blanks and complete a valid pair of equations:
   __ __ __ __ = __ __ __ __
   __ __ __ __ = __ __ __ __
   __ __ __ __ = __ __ __ __
   __ __ __ __ = __ __ __ __

3. “Think outside the blocks”
   Fred wants to use a pair of wooden cubes (cubes) to display the day-of-the-month on a simple desk calendar. How can he number two blocks (one number per side) so that he can display all the dates of any month: 01 - 31?

Bonus puzzle: Ignoring the many solutions made possible by re-arranging a given set of numbers on a block, how many ways can he assign the numbers to the two blocks?

D-dazle bonus: What is the total number of ways to number the blocks including the re-arrangement possibilities?
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- Low “let through voltage"
- High surge current capability
- Five-year product warranty

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or www.automationdirect.com/powerandaccessories

Molded Case Circuit Breakers ( mccB)
AutomationDirect’s new offering of Cutler-Hammer MCCBs includes the 100A G-Frame, 225A T-Frame, 400A K-Frame and 600A L-Frame. Standard and flex shaft handles offer mounting flexibility. Accessories include auxiliary contacts, shunt trips, and undervoltage release modules.

Features:
- UL489 listing
- 15 to 600 A ratings
- Patented contact conductor design with high-speed “blow-open” action
- Line and load lug kits included
- Mounting hardware included
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- Three position toggle handle (on/off/tripped) with visual indicators
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- UL1077
- UL1077
- UL1077

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Cutler-Hammer WMS Supplementary Protectors are used to provide overcurrent protection where branch protection is already provided or not required. They are designed to be applied in conjunction with a branch protector ( if required) and can be a replacement for similarly applied fuses.

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or www.automationdirect.com/powerandaccessories

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