

Automation NOTEBOOK®

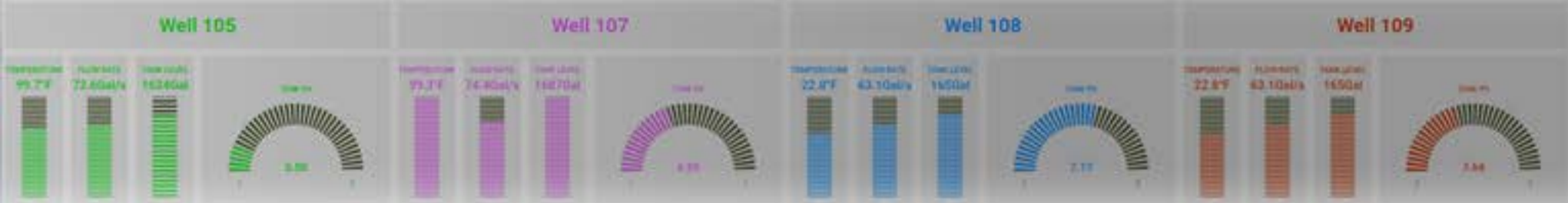
Your guide to practical products, technologies and applications

PLCs Power Industrial Data Integration

PLCs have recently gained capabilities formerly possible only with PCs, expanding their role to support seamless data integration with the enterprise.



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Automation NOTEBOOK[®]

Your guide to practical products, technologies and applications

Publisher

Tina Gable

Managing Editor

Joan Welty

Editor

Bill Dehner

Design Manager

Erika Kinney

Contributing Authors

Bill Dehner, Damon Purvis, Chip McDaniel,
Zachary Werlund, Westport Yachts

Contacts

Automationdirect.com Inc.
3505 Hutchinson Road
Cumming, GA 30040

Phone.....1-800-633-0405
or 1-770-889-2858

Fax.....1-770-889-7876

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www.automationdirect.com

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- New CLICK PLUS PLC Series
- Datalogic Safety Laser Scanners
- NITRA Pneumatic Automation Link (PAL)
- PS-AMC Motion Controller and P1-RX Remote I/O Module
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Who doesn't love going to the beach? I know I do, at least for the first few days. Then the sand begins its advance and outflanks my defenses. Children are its ally, and before you can say, "Don't shake that!", it's everywhere. But besides the sandy blitzkrieg, the beach does offer a lot



of fun. One activity that everyone seems to enjoy, at least where I'm from, is heading to the beach late at night with flashlights and nets to catch sand crabs. You may know them as ghost crabs, but they are impressively quick and built for their environment. For one, they blend in perfectly with the sand. As mentioned, they are super quick and I've read they can reach speeds up to 10mph! For food, they can survive on almost anything including clams, decaying material, and, if needed, other crabs. Their eyes can swivel 360° to detect predators or a meal. To escape predators, they hide in deep burrows they've dug in the sand or make lightning-fast escapes into the water. But for all their preparedness, it's obvious they never expected a child, at night, with a net and a flashlight. This just goes to show that even the best laid plans and preparation can go awry and have to be modified in an instant. As your supplier, we understand that unexpected things can happen, and that's why we offer hassle-free returns and 30-day money back guarantees on most products. Our webstore is open 24/7/365 so you can order any last-minute items you need, and our 2-day shipping will get it to you fast.

This issue of NOTEBOOK is loaded with informative articles such as our Tech Brief, which looks at some important PLC fundamentals. We also have a great Cover Story on how recent advancements have expanded the role of PLCs in

enterprise data collection and analysis. The User Solutions show how ProductivityOpen was used to increase heat exchanger efficiency and how ABS-certified Productivity PLCs are helping modernize the luxury yacht industry. Our PLC Speaking section discusses a common coding technique used to program package tracking applications. For information about exciting events happening in and around AutomationDirect, take a look at the Business Notes. In this issue, you'll also find information on our newest products, such as the new CLICK PLUS PLCs, IronHorse ACN Series NEMA 4X AC drives, the NITRA Pneumatic Automation Link (PAL) system, Saginaw enclosures, Datalogic safety laser scanners, and more. As always, the Break Room is stocked with fun and challenging brainteasers, so give them a try and see how many puzzles you can solve.



IronHorse ACN series NEMA 4X AC Drives

AutomationDirect has added new NEMA 4X AC drives to their IronHorse brand of drives. These new high-performance VFDs support four control modes including V/Hz, slip compensation, sensorless vector, and torque control, and come in a variety of voltage and horsepower ratings for an extremely affordable price.



New CLICK PLUS PLC Series

The new CLICK PLUS PLC series is the next generation of simple control. Building on the practical and popular CLICK PLC series, CLICK PLUS PLCs provide the same low-learning-curve control but with advanced options like Wi-Fi communication and data logging.



Datalogic Safety Laser Scanners

AutomationDirect has added Datalogic safety laser scanners to its lineup of safety products. Safety laser scanners offer an ingenious, cost-effective way to protect an entire area. This can be a static application such as a robot cell or the area surrounding a moving device such as an AGV. They are ideal for providing safe access to potentially dangerous locations or areas.



NITRA Pneumatic Automation Link (PAL)

The NITRA Pneumatic Automation Link (PAL) series of components from AutomationDirect is a versatile field I/O system that can include electrical I/O or pneumatic valves, or a combination of both.





PS-AMC Motion Controller and P1-RX Remote I/O Module

AutomationDirect has added PS-AMC motion controllers designed to work seamlessly with select Productivity PLCs to provide accurate, coordinated, plug-and-play motion control. These controllers are capable of up to 4 coordinated axes of motion per controller (PS-AMC4) with differential encoder feedback for each axis and a maximum switching frequency of 1MHz. Up to 24 general-purpose high-speed inputs and 12 general-purpose high-speed outputs are also included.



Saginaw Enclosures

Saginaw has been serving the electrical industry since 1963, specializing in manufacturing top-quality carbon steel, galvanized steel, and stainless steel electrical enclosures built to accurate dimensions. AutomationDirect is proud to add Saginaw's standard stock of enclosures, including freestanding, floor-mount, wall-mount, disconnect, modular, operator console, pushbutton, junction box, and wire trough enclosures, to our already extensive line of quality enclosures.



StrideLinX VPN Routers and Free Cloud Service

AutomationDirect's StrideLinX Cloud has been upgraded to provide machine builders, system integrators, and end users with an end-to-end cloud solution offering improved collaboration, advanced user management, easier navigation, and custom user-defined dashboards to make remote access and monitoring even easier.



PLCs Power Industrial Data Integration

PLCs have recently gained capabilities formerly possible only with PCs, expanding their role to support seamless data integration with the enterprise.

By Damon Purvis, AutomationDirect

Not too many years ago, the roles of industrial automation devices and systems were a little more straightforward. Most field devices and sensors were relatively ‘dumb’ and were connected directly to controllers, which may have interacted with operator displays, and in rare cases some data may have flowed up to higher level enterprise systems. Today’s smart sensors, clever controllers, and more capable communications have improved upon this scenario, and end users are looking for the best ways to enable the enterprise host systems to access valuable field-level data.

The operations technology (OT) domain of sensors, programmable logic controllers (PLCs), and human-machine interfaces (HMIs) is converging with the information technology (IT) world of PC servers and cloud connectivity. In practical terms, all these technologies are more intelligent than ever, with a lot of overlapping functionality, so users have more options than ever for building or upgrading an industrial automation system to deliver integrated data. Applications where OT data is accessed with IT methods are often referred to as internet of things (IoT) implementations.

In particular, some of today’s newest PLCs are speeding end users on their journey to seamlessly extract data from their manufacturing systems and transport it to enterprise systems so business users can make information-based decisions on how to optimize operations. This article discusses why trusted OT-centric PLC platforms are making this possible due to IT-friendly additions.

YESTERDAY’S CHALLENGES

Gathering field data, let alone connecting to some higher-level host system, historically has involved several types of challenges. Hardwired sensors were easiest to connect to a PLC, but reliably publishing the PLC information up to on-site or cloud-based systems required careful curation of the data structures, along with configuration of networking and communication protocols. PLCs didn’t support all the industrial protocols required to talk with more intelligent field devices, and they certainly had limitations for connecting with any host systems. Navigating the architectural hierarchy from the control level, through operations, up to the enterprise systems and the cloud was a thorny problem (Figure 1).

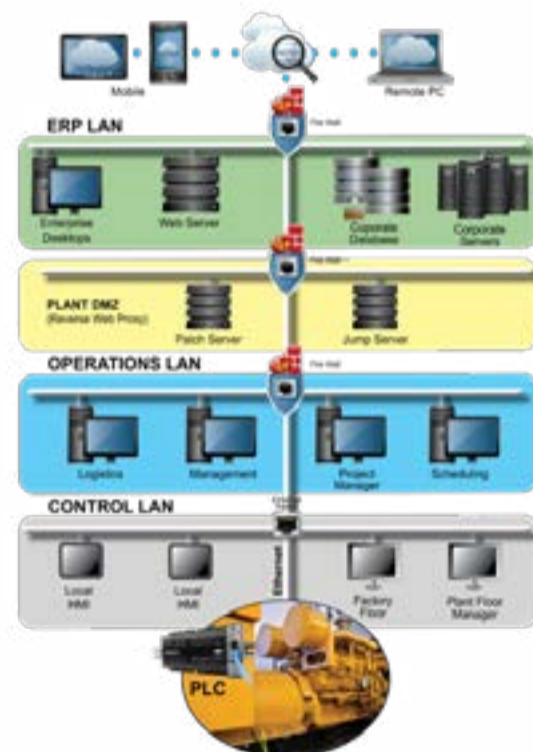


Figure 1: Sending valuable plant floor data up to higher level operations, enterprise, and remote cloud systems has traditionally entailed troublesome configuration for many layers of hardware, software, and networking.

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Basically, users needed to generate custom configurations of code to select, arrange, and manage data, and they had to take additional steps to handle extended information like scaling, engineering units, and tag descriptions. A lot of parts and effort might be involved: PLCs, gateways, PCs, software packages, network configuration, and custom code.

Even when data connectivity could be patched together, it was often at the expense of security. Traditionally, PLCs have not included strong—or any—cybersecurity provisions, especially for internet-connected systems.

Solved by Today's Tech

Fortunately, some of today's most modern PLCs include all the elements needed to overcome these challenges, eliminating complexity from the task of getting data from the shop floor and up to the cloud and enterprise.

PLCs are already an established and reliable platform for edge automation tasks. Instead of creating a new category of device only tasked with data communication duties, some vendors realized that next-generation OT-based PLCs could be enhanced with the necessary IT-associated tech to provide a complete data integration solution (Figure 2)



Figure 2: Next-generation PLCs, like the AutomationDirect BRX Series, are built from the ground up with OT and IT communication protocols, and the necessary security features, for enabling seamless data integration. With the free programming software, users can configure the BRX (with or without classic I/O) to also act as a data gateway

For best results, all data integration elements need to reside natively in the PLC product, providing an off-the-shelf experience for users. End users, especially in the IT field, are also looking for open source-based solutions because they are already familiar with this approach, as opposed to the specialized environments common to OT products.

Some of the most popular serial and Ethernet protocols for OT purposes include ASCII, Modbus RTU, K-Seq, Modbus TCP, and EtherNet/IP. From an IT standpoint, protocols like SNMP DNS, MQTT, SMTP, SSL, and web service are essential. A PLC bundling these capabilities together becomes a bridge from OT to IT, creating many ways to connect new and legacy factory floor equipment to today's enterprise systems.

Multiple Options

Following are several popular data integration approaches possible with modern PLCs. Users can select one or more options to best meet their needs.

Store Data in the PLC and Forward via FTP

Today's PLCs have enough memory to log data locally over a period of hours, days, or weeks—and then forward it to a network- or cloud-connected computer using FTP. This form of storing and forwarding data can be especially effective for bulk transactions which do not need to be near-real-time, however it will require the user to carefully configure both the PLC for aggregating the data and the host system for parsing the data.

Web Server

Sometimes it is only necessary for a PLC to expose limited data for read-only, near real-time remote viewing by users. In this case, some PLCs include built-in web servers, empowering users to develop HTML5 displays of data and information viewable using browsers. No other additional software or licensing is required. A downside to this basic approach is the need for clients to be connected on the same network—or via a firewall and routing—with the proper access privileges.

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MQTT over TLS

The MQTT protocol has emerged as the common standard for PLC-to-cloud communications, for several reasons. While it offers two-way communications, the PLC in the field initiates conversations as outbound messages to a centralized broker—which can be on premises or more commonly in the cloud—avoiding firewall and IT management issues. Although MQTT can be implemented without security, best practice is to perform communications using the standard transport layer security (TLS) networking protocol, and to use other security features provided within MQTT.

MQTT communications are processed quickly but are resilient enough to withstand the kinds of network outages which can be common for industrial and edge-located installations. Users can access the broker data with enterprise and/or mobile clients, or they can implement cloud computing services like Microsoft Azure and IBM Watson IoT to connect with PLC-sourced MQTT data directly.

REST API

The previous three methods require users to manage and configure the source data at the PLC. However, if a PLC offers a representation state transfer (REST) application programming interface (API), then external clients can initiate communications and access data residing in PLC memory with a standard request (Figure 3).

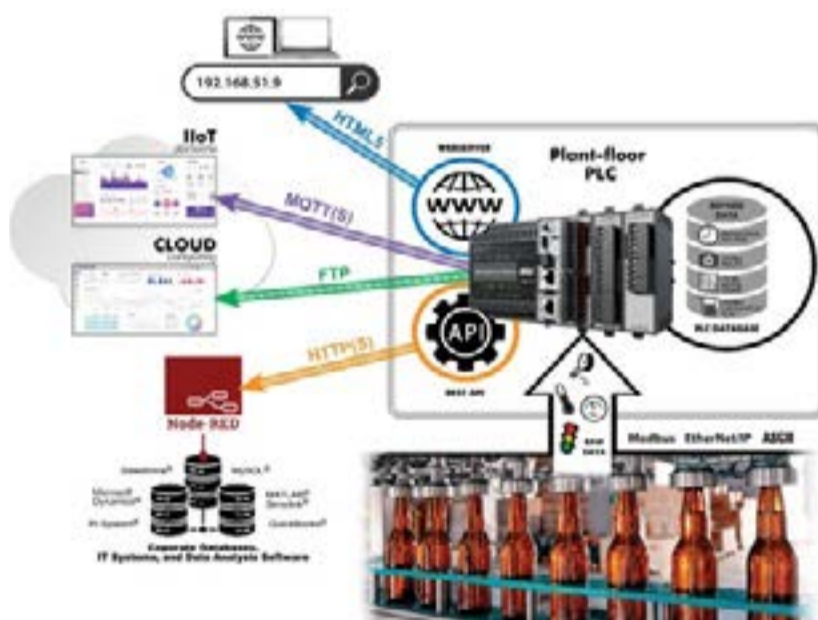


Figure 3: AutomationDirect BRX Series PLCs include multiple data connectivity options. A REST API enables external clients, such as Node-RED operating on a computing service, to initiate requests to access data residing in PLC memory, so long as proper security credentials are presented.

This powerful ability makes it easier for users to change polled data tags in the future, as no modifications are needed in the PLC. The client sends a request to the PLC, and the PLC gathers the necessary data from its memory and replies with the data assembled into an easy to read and parse JavaScript Object Notation (JSON) format. Messaging occurs via HTTP requests from clients, using traditional and typically open IT ports, like port 80. However, as with the web server option, external clients must be on the same network or permitted through any firewalls.

Security Must Be Built-In

One natural consequence of improved PLC data connectivity options is greater exposure of the PLC to bad actors who could access potentially valuable information. Therefore, new PLCs must include built-in security features, extending far beyond what was offered in previous generations. Users should look for:

- PLCs which by default (right out of the box) are not open to requests from the outside world
- The ability to store username and password credentials on-board (managed by OT personnel using programming software)
- Support for IP whitelisting to control which external clients are allowed to communicate with the PLC
- Secure communications over TLS when possible

With the right tools and security, users are afforded a world of options for creating safe PLC-based data connectivity.

Applications

Typical IoT clients are remote monitoring applications needing to receive certain items of data. Sometimes developers will configure programming tools like Node-RED or NiFi, which are IT-centric methods for preprocessing, formatting, transforming, and configuring data for consumption by other applications.

Designers can build new systems using a modern PLC able to support these types of connections, or they can implement such a PLC on top of an existing system to add IoT capability. Data becomes easily available using one or more of the methods described in this article, so developers can focus their efforts on the host applications.

For example, solutions provider Quantum

continued >>

Automation has developed a cloud-based IoT application which can access many operational sites, such as pump houses, using MQTT. Before PLCs were available to support MQTT and other methods, it was necessary for developers to add in dedicated communication gateways (Figure 4)

PLCs as the Future of OT Data Connectivity

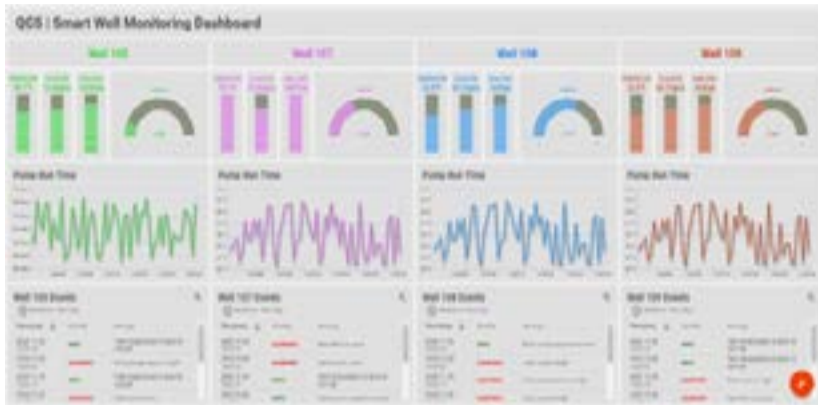


Figure 4: Modern PLCs include the necessary protocols and security users need in support of accessing industrially-sourced data and integrating it with higher level computing systems.

Whereas yesterday's industrial automation products were often very specialized and somewhat limited in terms of data handling, the processing power incorporated in today's OT digital devices imbues them with greater capabilities. These new capabilities are addressing end user needs for obtaining timely field data to support IoT and analytical initiatives at the enterprise level.

OT-based PLC technology is already well-proven in the field. The addition of IT-friendly protocols and security features to PLCs makes them ideal as edge devices for accessing raw field data using industrial protocols, processing it into information, and securely publishing or transmitting it to any industrial IoT client or external computing platform.

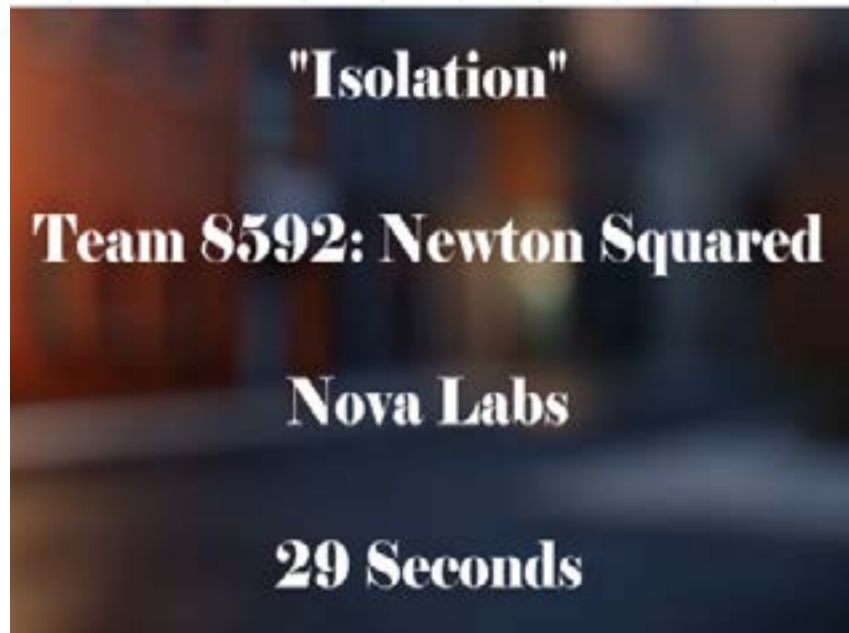
About the Author



Damon Purvis is the PLC Product Manager at AutomationDirect.com. He has over 22 years of industrial automation experience. Previous roles have included designing and deploying automated solutions in a variety of industries, and managing product development of manufacturing data management and business intelligence applications.



Business Notes



FIRST Robotics Competition 2021 Digital Animation Award Winner

The Digital Animation Award from FIRST is offered to help encourage students to cultivate skills in design and creation of animation including, but not limited to, storytelling, creativity, use of computer software, and an understanding of different techniques and forms of animation. This award is open to all FIRST Robotics Competition teams.

Business Notes



Industry End Users Choose AutomationDirect's ProductivityOpen Arduino-Compatible Controller as the Plant Engineering 2020 Product of the Year Grand Award Recipient

AutomationDirect's ProductivityOpen controller was announced as the Plant Engineering 2020 Grand Award recipient. This is the highest award a product can receive from Plant Engineering, and it is based on receiving the most votes from plant engineers, managers, and maintenance professionals.

User Solutions



Open Controller Speeds Time to Market

As a worldwide original equipment manufacturer (OEM) of evaporative condensers, Güntner is tasked with designing and delivering systems for a wide range of industries, users, and locations. Reliable long-term performance of these large-scale heat exchangers is crucial to increase uptime.

User Solutions



Automation Helps Crews Run a Tight Ship

Westport Yachts, based in the state of Washington, is the leading yacht builder in North America and among the largest in the world. They currently construct luxury models ranging from 112 to 172 feet long and have launched hundreds of luxury yachts since their founding in 1964.

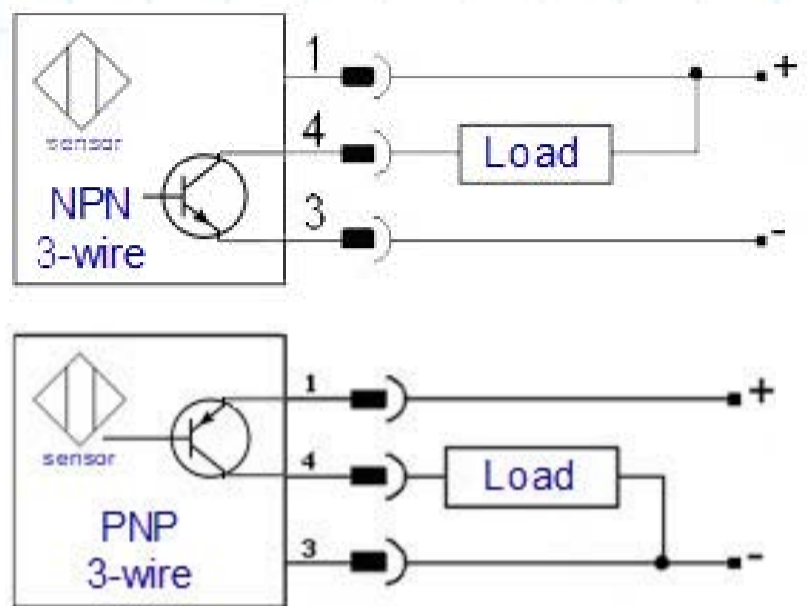
Tech Thread



The PLC Scan

With PLC control, it's important to understand the sequence of operations for the CPU. Some may think when an output is set to ON in the ladder code, that this output change is immediately reflected in the output card. Or that when an input is activated, the CPU instantly sees it. While it may seem that way to the naked eye, that is not actually the case.

Tech Thread



Sinking and Sourcing Circuits

Two of the most important fundamentals to understand when it comes to sensors is sinking and sourcing circuits. To properly wire your control device, you need to first know whether the sensor you are using is switching the positive or negative connection.

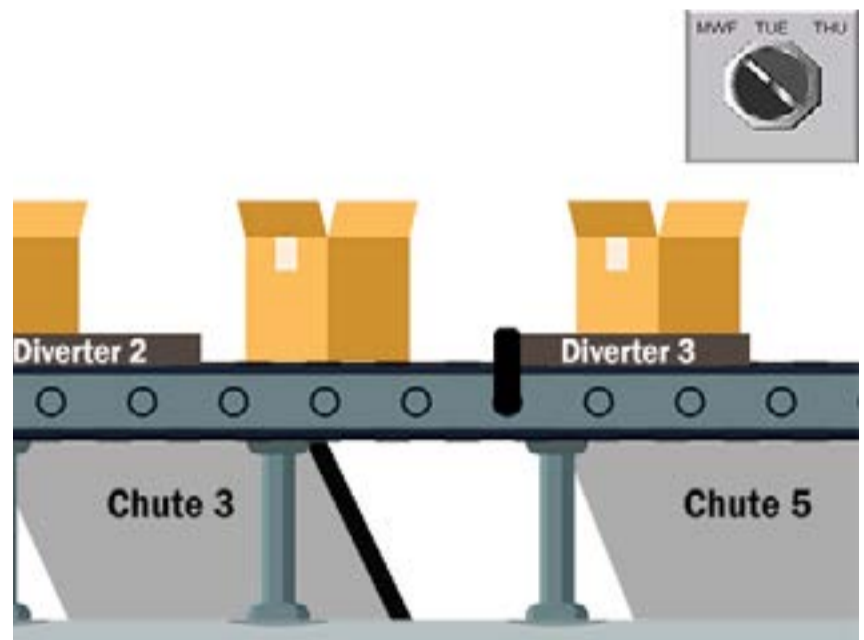
Tech Thread



Logic Circuits

For a better understanding of PLCs, let's take a closer look at one of the fundamentals of automated control – logic circuits. Electrical components can be hardwired in a way to allow certain decisions to be made electrically. They can provide physical "If, then" statements that systems can use in their decision making.

PLC Speaking



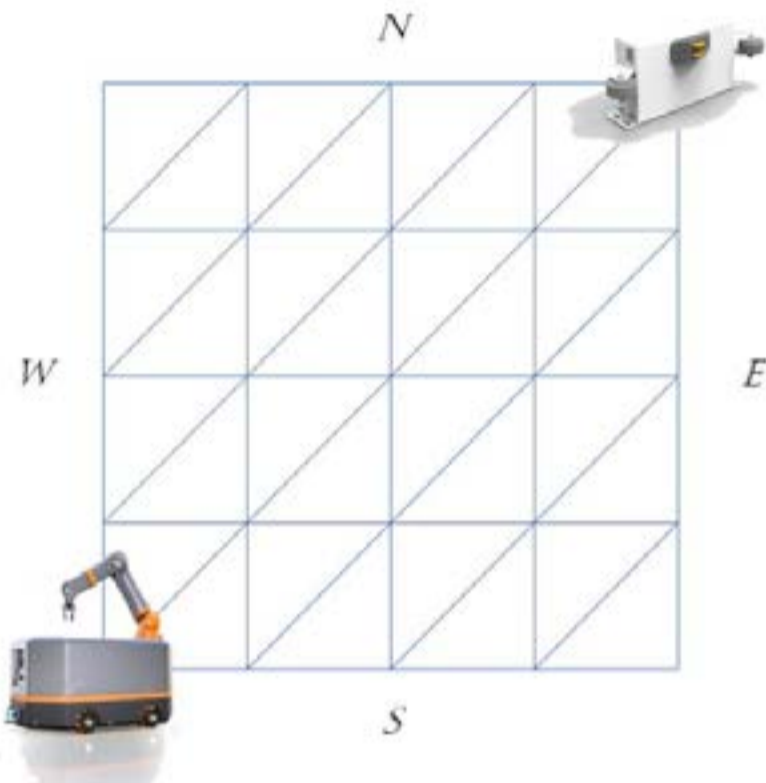
PLC Package Handling

PLCs play a major role when it comes to material or package handling operations. Conveyors, motors, drives, object detection sensors and of course controllers are used quite often when it comes to delivering your suitcase to the right airplane or getting the laptop you ordered to the right delivery truck. But how would you go about coding the PLC for a package handling application?

Brain Teasers

By Chip McDaniel, AutomationDirect

1.) Zig or Zag



The factory manager wants to know how many routes there are for the AGV (Automated Guided Vehicle) in the lower left corner to get to the charging station in the upper right (see the diagram below). The AGV must always travel along the lines shown such that it gets closer to the charging station with each move; that is, it must always travel either North, East, or Northeast along the lines.

2.) Dividing Fluid

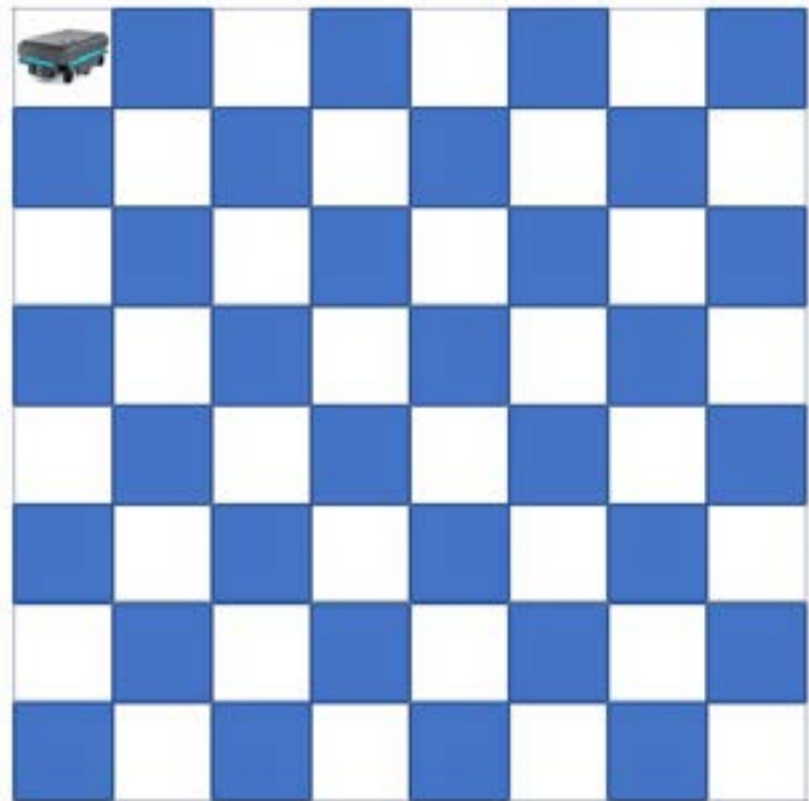
The factory manager purchased a barrel containing 24 liters of cutting fluid for the factory's three CNC machines. She desires that the fluid be divided evenly between the three machines – but the only buckets available hold 5, 11, and 13 liters respectively. How do the machine operators divvy up the cutting fluid? What is the minimum number of pouring operations possible to arrive at three containers with exactly 8 liters in each?



Solutions on next page

3.) Diagon Allie

The factory floor contains 64 work cells alternately painted blue and white as shown. Starting in the upper left work cell, Allie (the AGV) needs to visit all the white work cells, without fully entering ANY of the blue cells (she will always move diagonally). And she must not cross any of the intersections more than once. It can be done with 17 straight segments. Can you find Allie's path?

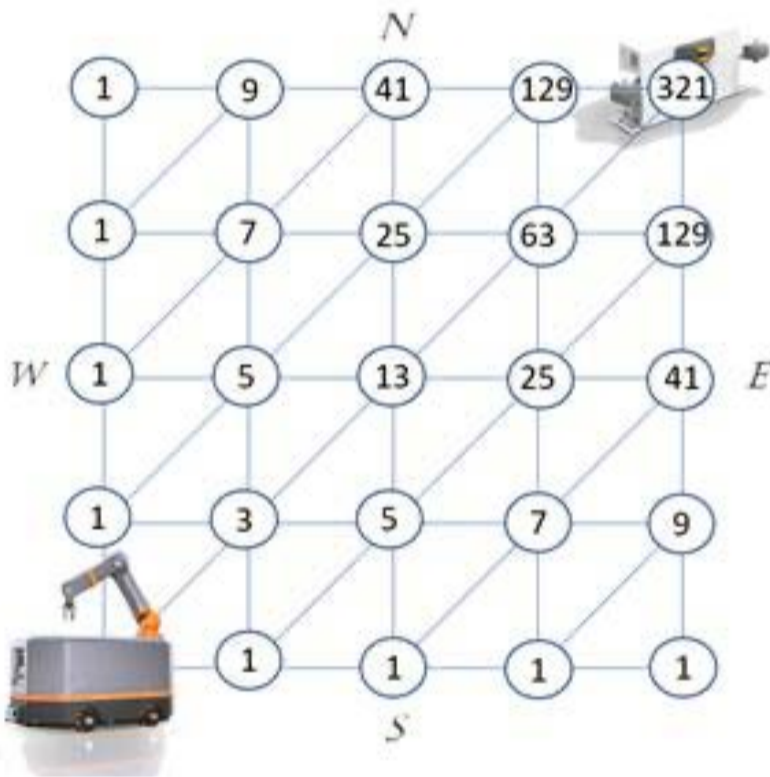


Brain Teaser Answers

By Chip McDaniel, AutomationDirect

1.) Zig or Zag

Starting in the lower left corner consider how many ways there are to get to each vertex, and label that vertex with the number of possibilities. Work your way up and to the right, adding the number of possibilities from the connecting vertices as you move through the entire matrix. As shown below, the final number of possibilities to reach the upper right corner (at the charging station) is 321 routes.



2.) Dividing Fluid

Start with 24 liters in the original container – use it to fill the 11 and the 5 liter buckets, leaving exactly 8 liters in the original. Empty the full 11 liter bucket into the 13 liter bucket. From the full 5 liter bucket, finish filling the 13 (which takes 2 liters, and pour the remaining 3 liters into the 11 liter bucket. Then fill the 5 liter from the 13 liter bucket – leaving exactly 8 liters in the 13 liter bucket, then pour the full 5

liter bucket into the 11 liter (contains 3 liters prior to this pour) to make 8 liters in the 11 liter bucket. The quantities in the containers after each pour are shown below.

Container Size:	24	13	11	5
Start	24	0	0	0
1st pour	8	0	11	5
2nd pour	8	11	0	5
3rd pour	8	13	3	0
4th pour	8	8	3	5
5th pour	8	8	8	0

3.) Diagon Allie

A path with 17 legs is shown below. There are several variations, and mirror image solutions. Can you do it with fewer segments? Drop us a line at marketing@automationdirect.com. Please include "Brainteaser August 2021" in the title, and your complete mailing address. We would love to see your solution!

