

MachineDesign®

# LEADERS

In Machine Design



# ALTECH CORP.

## ABOUT ALTECH

Altech Corporation is an established United States supplier of components and devices used in industrial control, instrumentation, medical and automation applications. Altech provides a very broad line of products that meet UL and international standards and are RoHS and REACH compliant. Altech's commitment to continuous quality management has been recognized since 1999 when they were awarded ISO 9001 certification.

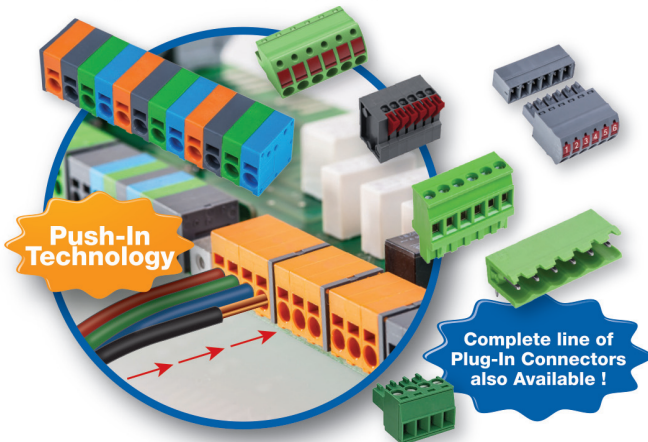
Altech provides a multitude of services for customers. This starts with its employees, where product managers provide technical support and partner with customers in design assistance, ensuring the best solution for the application. Next, an efficient customer service department ensures that customers are informed with complete order information. Depending on the product, the versatile assembly department provides manufacturing, value-added, or customization services to expedite delivery. Altech's marketing department has been highly recognized for its catalogs, advertising, and website designs, while the sales department motivates the sales organizations throughout North America, ensuring product information is current and complete.

## SERVING AUTOMATION AND CONTROL INDUSTRIES SINCE 1984

Altech's products meet UL and international standards, and all are RoHS- and REACH-compliant. Altech's commitment to quality and continuous quality management had been recognized since May 27, 1999 when it was awarded the prestigious honor of ISO 9001 certification. Since then, Altech has successfully gone through the recertification process and complies with ISO 9001:2015.

## WIDE VARIETY OF AUTOMATION & CONTROL SOLUTIONS

The Altech product line includes miniature circuit breakers, busbars, DC-UPS devices, digital panel meters, DIN rail terminal blocks, printed circuit board terminal blocks, contactors, industrial relays, motor disconnect switches, pin and sleeve devices, receptacles, foot switches, relay modules, safety relays, slimline relays, solid state relays, push buttons, and pilot lights.



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35 Royal Rd.  
 Flemington, NJ 08822



## LARGEST Selection of DIN Enclosures

Also available are metal detection systems, ferrules, marking and engraving systems, fuses, power distribution blocks, corrugated tubes, liquid tight strain reliefs, programmable relays, digital multi-timer, test and measurement devices, LED panel lights, mechanical thermostats, panel filters, tower lights, and wire ducts.

## OUR POLICY

Altech Corp.'s Company Policy remains to provide adequately stocked quality products at competitive prices. Superior customer service and delivery are maintained through a quality management system and continuous process improvement and by performing these services with honesty and integrity. All Altech employees are regularly trained in quality management systems, and as a team are committed to achieving these goals.

# Altech®

Your Source for Automation & Control Components



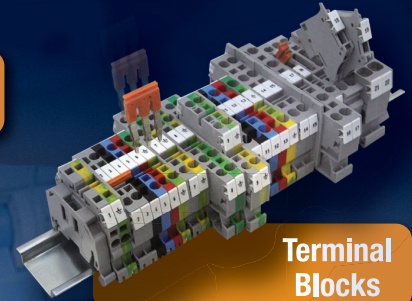
# Altech® HI-QUALITY Control Components



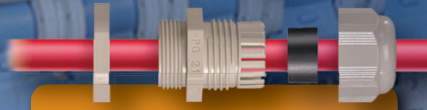
UL Circuit Breakers



UL Disconnect Switches



Terminal Blocks



Liquid Tight Strain Reliefs



Industrial Enclosures



All-In-One DC-UPS Backup



## We stock a Wide Selection of components!

### Our lines include:

- Busbars & Power Distribution
- Circuit Protection
- Contactors & Overload Relays
- DC-UPS • Digital Panel Meters
- Digital Timers • DIN Enclosures
- Eurostrips • European Fuses
- Ferrules
- Foot Switches
- Fuse Holders
- Ground Fault Protection
- Industrial Enclosures
- Interface Modules
- Limit Switches
- Liquid Tight Strain Reliefs
- Marking & Engraving System
- Motor Disconnect Switches
- Pin & Sleeve Devices
- Power Supplies
- Push Buttons & Pilot Lights
- Rope Pull Switches
- Safety & Slimline Relays
- Safety Switches
- Solid State Relays
- Sensors
- Sensor & Actuator Cables and Connectors
- Programmable Relays
- Terminal Blocks
- Test & Measurement
- Tower Lights
- Wire Ducts

## Altech Corp.®

Your Source for Automation & Control Components

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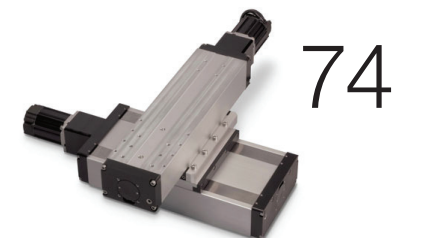
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### CONTROL MOTION AND VIBRATION WITH ACE

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ACE components can be used in a variety of applications and industries such as aerospace, aviation, machine building, marine, medical, oil & gas, packaging and robotics. From up in the air to under the sea, ACE products:

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- Reduce vibration and noise
- Protect against wear and tear
- Reduce downtime
- Increase throughput
- Increase safety

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### CUSTOM PRODUCT DESIGN & DEVELOPMENT

We offer a wide range of options to solve your motion and vibration challenges. Each product undergoes rigorous lab testing to ensure products are capable of meeting the most demanding conditions. Products are regularly evaluated for endurance, cycle life and material strength.

ACE specializes in custom engineering services, including working together with product engineers to prototype and develop patented components exclusive to your needs.

Details of Flap	
Length	500 mm
Width	300 mm
Height	40 mm
Handle Distance	500 mm
Mass	30 kg
Opening angle	80 °
Number of gas springs	2
Hinge Position	Bottom



A STABILUS COMPANY

### ENGINEERING TOOLS & RESOURCES

ACE has simple solutions to make your job easy, including a host of online resources and one-on-one assistance. Connect with ACE's application engineers who will work with you to calculate and select the right product for your needs. Or take advantage of our online tools:

- Size, Configure and Order Online
- CAD library
- YouTube
- Blog featuring case studies
- VibroChecker iPhone app



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Industrial gas springs  
Vibration isolation



Standard products  
available to buy online



Online Tools

- Calculations & product selection
- Chat function for application assistance



Resources

- ACE CAD database
- ACETips video tutorials
- Technical blog & case studies



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# aPriori

## DIGITAL MANUFACTURING INTELLIGENCE AT YOUR FINGERTIPS: *Accelerate, Automate, and Integrate with aPriori*



connect the product development production silos, individuals can work faster and more efficiently across departments.

And by using manufacturing intelligence downstream, companies establish consistent manufacturing results across the product development process. The ability to combine precise digital twin product specifications with “if/then” sourcing and manufacturing simulation capabilities illustrates the power and flexibility of DT.

### Significantly Reduce Time to Market/Time to Revenue with aPriori

What’s the key to your company’s success? There’s growing evidence that the ability to operate digitally will make or break your organization.

Did you know that more than 50% of Fortune 500 companies have been acquired, merged, or declared bankruptcy since 2000? Business innovator and author Tom Siebel believes that digital transformation (DT) is the causal factor. And the 2021 Deloitte Digital Transformation Executive Survey finds that companies with a higher digital maturity are about twice as likely to report significantly greater net profit margins and annual revenue growth than their competitors.

### Accelerate Development with Insights and Automation

In manufacturing, DT is propelling many new products to market 20-40% faster by connecting operations. And product simulation advances and manufacturing intelligence are also

helping to increase pre-launch maturity, reduce late-stage design changes, and minimize post-launch product issues.

Using the power of DT, aPriori’s simulation solution automatically analyzes digital twin CAD models for manufacturability and cost when they are checked into your PLM system. When aPriori detects a potential design issue, engineers can view the identified part along with aPriori’s cost and design guidance. Then, engineers can simulate design updates and make changes directly in the PLM system. This is just one example of aPriori automation providing users with focused recommendations quickly and efficiently.

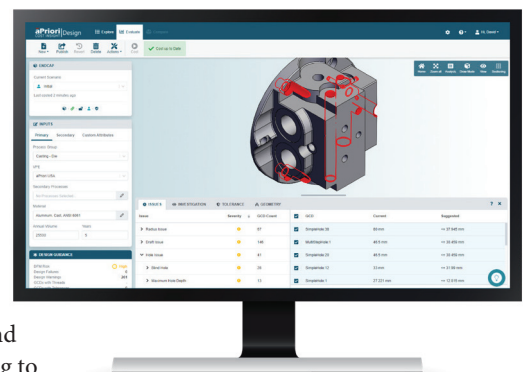
### Gain Digital Manufacturing Intelligence

Manufacturing intelligence strengthens the digital thread by guiding design decisions from the early design phase to manufacturing, sourcing, and ongoing production. By helping to

### aPriori Design & Manufacturing Solutions

aPriori’s digital manufacturing solution provides real-time intelligence to make product design, sourcing, and manufacturing decisions quickly and with greater accuracy. Our manufacturing intelligence plays a key role in accelerating business operations by tying product design and manufacturing operations together.

With aPriori, you gain actionable insights for teams throughout the product development lifecycle to meet evolving market demands quickly to fast-track growth.



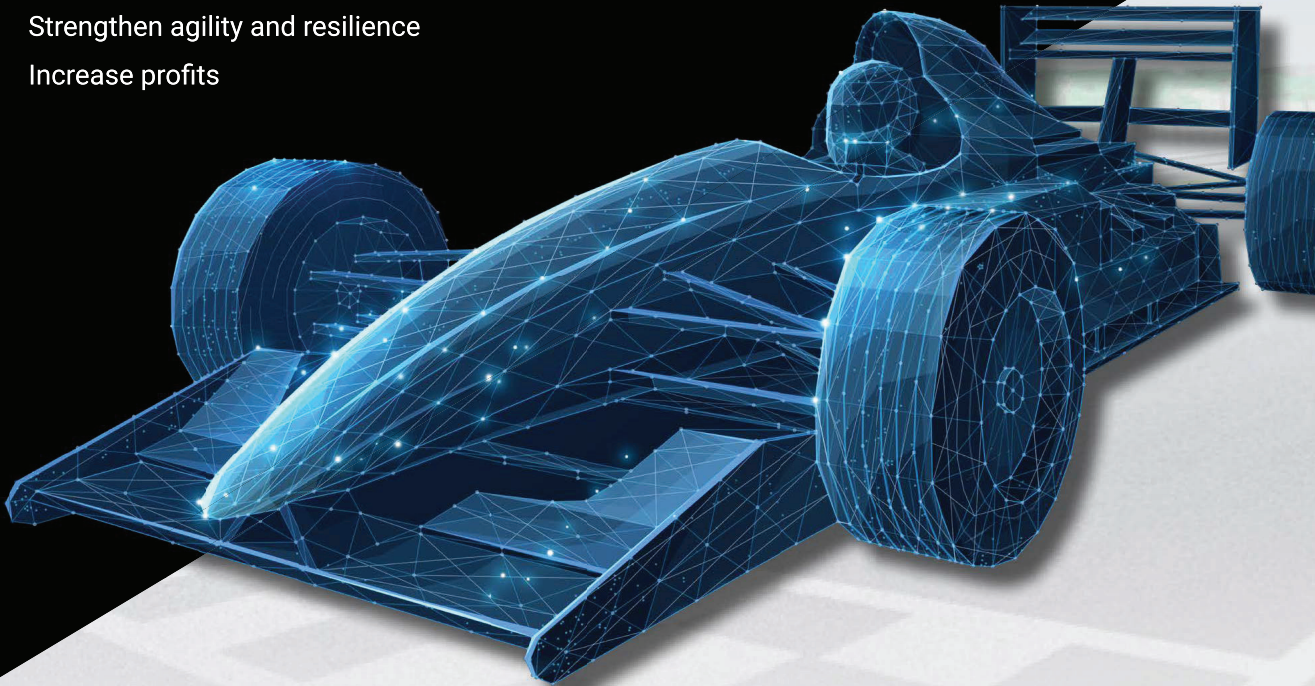


# Fast-Track Growth with Digital Manufacturing Intelligence

aPriori's digital manufacturing solution provides real-time intelligence to make product design, sourcing, and manufacturing decisions quickly and with greater accuracy. Innovative companies use our digital manufacturing intelligence solution to accelerate time to market, cut costs, and increase agility and resilience.

## APRIORI ADVANTAGES

- Align engineering, manufacturing, production, and leadership teams
- Streamline operations through automation and integration
- Accelerate time to market and time to revenue
- Strengthen agility and resilience
- Increase profits



By simulating the design and manufacturing process, companies gain early insights into the impact that product design decisions will have on manufacturing. And, users gain the flexibility to address supply chain roadblocks and other business challenges quickly and with confidence.

**aPriori**

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### AUTOMATION24 – YOUR ONLINE SUPPLIER FOR AUTOMATION TECHNOLOGY

**A**utomation24 is the premier online supplier for industrial automation components offering a well-rounded selection of products and solutions from sensor to control cabinet. We have been developing a comprehensive range of items from brand name manufacturers and offer them to our valued customers at the best prices. Order conveniently and quickly online and benefit from our cost-effective first-class products.

Throughout 2021 a variety of new items were added to the continuously growing product portfolio:

**Process instrumentation** from Endress+Hauser to reliably measure and monitor pressure, temperature, level, and more

**Safety technology** from Schmersal to ensure the safest work environment for your applications and personnel

**Precision transmitters, controllers, and data loggers** from NOVUS to accurately measure, control and record

And more!

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and above and beyond customer service. ”

“ Easy ordering and super  
fast shipping. Will order  
from them again. ”



## FAQ

# UNDERSTANDING THE BENEFITS OF DIN ENCLOSURES

*DIN enclosures are widely used in Europe and are growing in use in a broad variety of OEM systems across the world. These enclosures can be customized and fabricated to customer needs and specifications in OEM quantities.*

### **What is DIN mounting and why should I consider using it?**

DIN is a metal rail standard widely used for mounting industrial control equipment inside of controls panels. They are broadly used in Europe for both industrial and home automation applications and should be considered whenever you are engineering a system for the global market.

### **Are DIN enclosures available in enough versions that I can use them in multiple applications?**

Since DIN applications are limitless and work for all manner of electromechanical devices including relays, sensing and monitoring devices, timers, transducers, printed circuit boards, housing electrical and electronic systems, and much more, you can find a wide range of products.

### **Can I incorporate a DIN enclosure without the high cost of specialized equipment?**

Absolutely. Because DIN enclosures are widely used in Europe, they are readily available in a wide range of sizes and designs, choices of cover styles, terminal-to-board connection options, and 35mm DIN rail or panel mount configurations. For this reason, DIN enclosures are typically very economical, easy to assemble and install, and provide integral, ready-to-wire terminals in an attractive package. Because they are used globally, the level of quality meets or exceeds national and international standards for performance and safety.

### **What types of materials are the enclosures made from?**

Depending on the series enclosure you need for your application, housing shell materials are generally glass-filled polyamide or glass-filled polycarbonate. Terminal materials include tinned bronze, brass, or steel with chromated steel screws, and spring terminals of stainless steel.

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## What if I have a custom application?



*Shown are two customization application examples.*

## Do DIN enclosures come with extended environmental protections such as temperature and moisture?

## Can I incorporate DIN components into my IoT system?

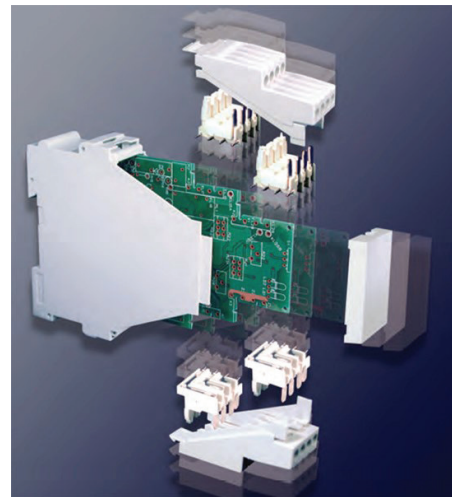
## I have a printed circuit board that I would like to convert to DIN rail. How do I incorporate a DIN enclosure into my design for holding the PCB and to make connections between the board and the outside of the enclosure?

Customization is fairly easy (see Exploded View). When working with the right supplier, they can cut special holes and cutouts for operating, setting, or indicating components that you wish to install, as well as include ventilation slots or special machined entrance points. Terminals can be marked for quick identification and efficiency in wiring as well. Even instructions and custom markings can be imprinted on the enclosures. Some enclosure manufacturers, such as Altech Corp. offer enclosures that can be molded in custom colors and custom configurations when ordered in OEM quantities. Further, some enclosure series offer a modular design that allows the user to incorporate different connection systems such as plug-in terminal blocks with screw or spring terminals (push-in). Series that include different switch cabinet enclosures, distribution enclosures, and a mounting rail bus system—for multifunction, compact, modular, or custom solutions are available.

DIN enclosures are generally meant for use in panels so water protection is not necessary. The enclosures' terminals are usually IP 20 rated to be touch proof and meet VBG4 as well as other European accident prevention requirements. Temperature ratings, depending on the enclosure series chosen can be up to 257 degrees F (125 degrees C) and meet UL94V-O standards.

Since DIN enclosures and components are used around the world, they are perfect for IoT applications that need to have a standard look, feel, and interconnection. Equipment monitoring, building management and safety, home utilities, and other IoT applications can greatly benefit from using DIN enclosures for a clean, attractive, and consistent appearance.

DIN enclosures are made to incorporate specific sizes of printed circuit boards so that they are held securely in place. The PCB must be the correct size to mount properly in the enclosure. They are usually slid into PCB guides so your board may need to be modified to the correct size to fit properly. When choosing a DIN enclosure for an existing PCB you should look for a series that has a similar or larger PCB size as well as paying attention to the board layout and terminal configuration. Integrated terminals in the enclosure allow for different types of PCB connections like machine solderable pins, card edge connections and wire jumper or hand solder connections. These terminals are then terminated outside the enclosure with screw or spring clamp terminals for convenient wiring when the product is installed.



*Seen in this exploded view, DIN enclosures incorporate a number of components, most of which can be customized to suit a wide variety of application needs.*

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# BECKHOFF AUTOMATION

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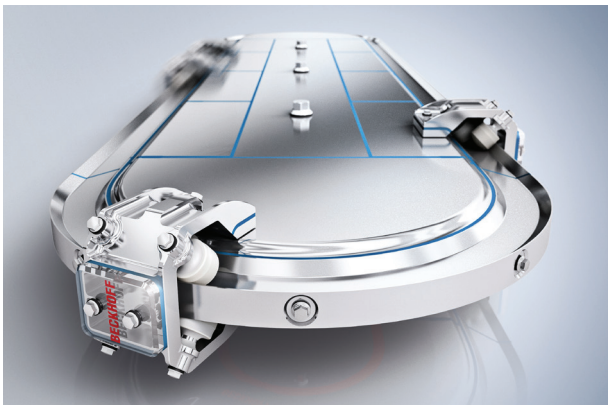
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## ADAPTIVE MANUFACTURING TECHNOLOGY FROM BECKHOFF OFFERS UNRIVALED FLEXIBILITY AND THROUGHPUT

**B**eckhoff Automation is a global provider of open automation systems based on advanced PC Control technology. The “New Automation Technology” philosophy at Beckhoff represents universal and open automation solutions used in a wide spectrum of high-tech applications around the world. These applications range from control of machines and robots, to Internet of Things (IoT) systems, to category-defining mechatronics solutions and much more. The world headquarters of Beckhoff Automation is in Verl, Germany while the U.S. headquarters office is in Savage, Minn. (Minneapolis area).

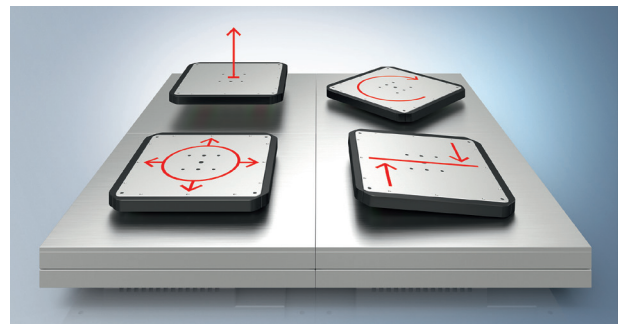


The EtherCAT-enabled eXtended Transport System (XTS) offers paradigm-shifting capabilities for motion control and mechatronics by combining the advantages of proven rotary and linear motion principles into a new modular platform. With its compact and flexible design, the advanced mechatronic system can reduce machine footprint up to 50%. The XTS revolutionizes drive technology and promotes innovative, globally competitive machine concepts. XTS contains all functions necessary to support efficient integration for motion control applications in many industries. With attached mechanical guide rails, XTS motor modules feature directly integrated power electronics, EtherCAT communication and position measurement. An unlimited number of wireless XTS movers can be controlled with high dynamics at up to 4 m/s on extremely customizable paths.

Beckhoff expanded the XTS portfolio recently with new hardware and software enhancements. XTS Hygienic, a stainless steel, IP69K version, is ideal for wash-down production environments in packaging, pharma, food and beverage. In addition, new Track Management functionality allows individual movers to transfer between multiple XTS

systems, enabling further customization, quality inspection, automatic defect ejection and more. These features, along with the system’s high speeds, dynamics, small footprint, instant recipe changeovers and real-time integration with robotics, further revolutionize possibilities in machine design.

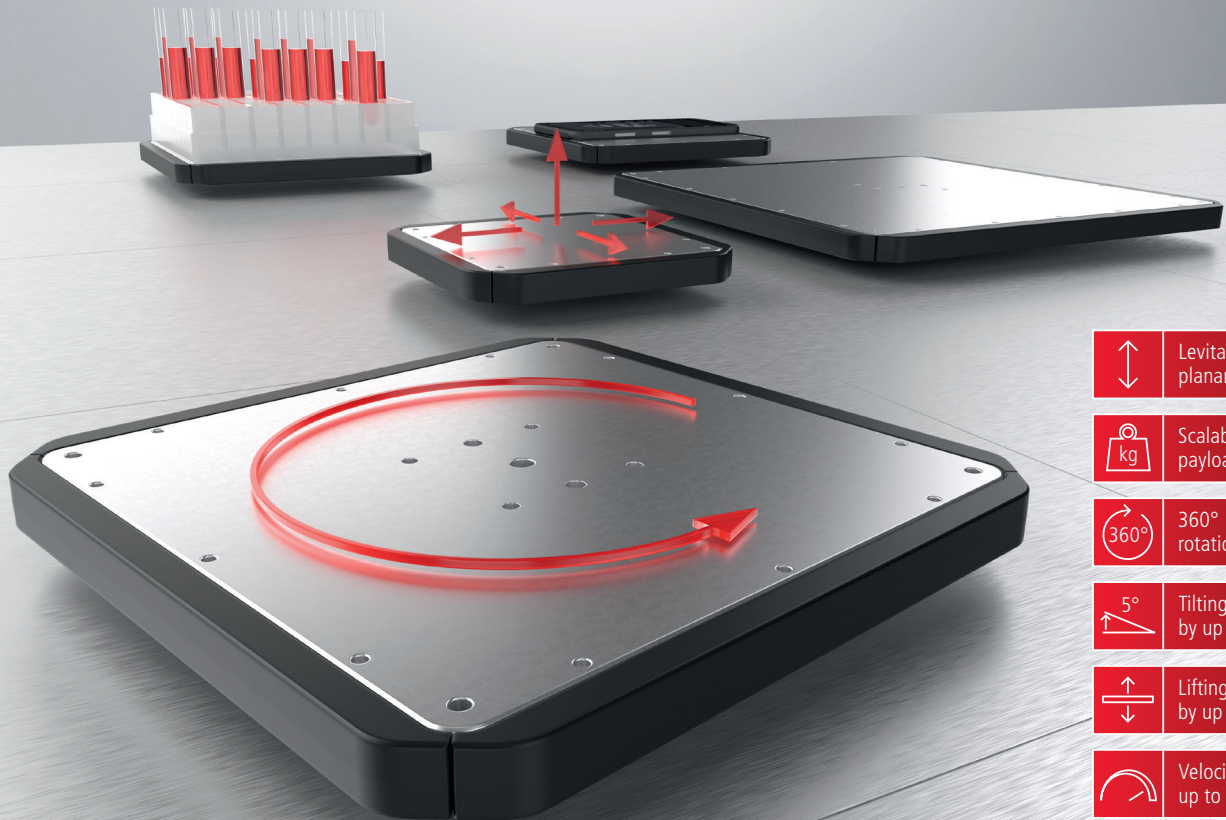
Another breakthrough in mechatronics technology, the XPlanar flying motion solution delivers adaptive manufacturing technology in part, product and package handling. The system uses planar motor tiles as a base to levitate passive movers that can fly at speeds of 2 m/s and up to 1g acceleration. Path planning and collision avoidance software produce extremely efficient and maintenance-free motion control for complex assembly, packaging, inspection and material handling applications. Anti-sloshing functionality in TwinCAT 3 software optimizes XPlanar’s transport capabilities in applications involving liquids, such as filling of beverages, cosmetics and other goods. XPlanar offers wear-free movement and the ability to cover planar motor tiles with stainless steel, glass or other hygienic surfaces.






# BECKHOFF

# XPlanar®: Take flight with flying motion technology!

Flying 2D product transport with up to 6 degrees of freedom



	Levitating planar movers
	Scalable payload
	360° rotation
	Tilting by up to 5°
	Lifting by up to 5 mm
	Velocities up to 2 m/s

XPlanar enables new dimensions of freedom in product and material handling: Levitating planar movers fly over flexibly arranged planar tiles accommodating nearly any track layout and path planning.

- Individual 2D transport at up to 2 m/s
- Processing with up to 6 degrees of freedom
- Transport and processing in one system
- Wear-free, hygienic and easy to clean
- Free arrangement of planar tiles enabling totally customized machine and process layouts
- Multi-mover control enables parallel and individual product handling
- Fully integrated into the powerful and standardized PC-based Beckhoff control system (TwinCAT, PLC IEC 61131, Motion, Measurement, Machine Learning, Vision, Communication, HMI)
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# Innovative Coatings

## Increase Design Possibilities for Medical Devices

Reduced friction and device performance are key considerations.

**F**ric tion and wear can impact a medical device's performance in the operating or treatment room...especially if the device does not function precisely, predictably and efficiently to complete a procedure. Also, during manufacturing and assembly, tight-fitting parts can make device production difficult and slow. So, it is important to think about lubricating coatings in the early stages of design to mitigate these factors. Determining the best parts lubricant for the device can help improve both production throughput as well as the completed device's performance.

### Medical Grade Coatings

There are many medical-grade lubricants on the market today to help address device friction and wear, including silicone oils and greases. Dry lubricants are also a popular choice. These dry coatings reduce the combination of friction and sticking, or "stiction," on parts that slide, shear, twist, rock or pivot. Moving mechanisms like these are most often found in disposable medical devices such as catheters, cutting tools, staplers, hypo tubes and other surface to surface assemblies.

Dry lubricating parts typically reduces actuation forces by 25-30%. This allows

the parts to move more freely and improves their performance. Without the use of a dry lubricating coating, many of today's complex medical devices would not be a viable option.

As well as using lubricating medical device parts, dry lubricants can also be used on the manufacturing and assembly equipment itself. To run more smoothly, a clean, long-lasting dry lubricant is applied to production paraphernalia such as chains and pulleys, chutes and slides, door tracks and conveyors, and other metal extrusions. Dry lubricant can also serve as a release agent for molded parts.



Surgeon hands at work: Friction and wear can impact a medical device's performance in the operating or treatment room. (Photos courtesy of MicroCare Medical)



Coatings and lubricants in-use: Dry lubricants reduce the stiction on parts that slide, shear, twist, rock or pivot.

### What is a PTFE-Based Lubricant?

Many dry lubricants use polytetrafluoroethylene (PTFE) that is suspended in a high-purity nonflammable carrier fluid for dilution and dispersion. Dry PTFE lubricant works particularly well on high-speed, high-volume mechanical assembly production fixtures to speed the assembly of plastic and metal components. It also helps the parts tolerate exposure to water, oils, chemicals, abrasion and high temperatures.

A thin layer of this non-stick solution is applied to the parts. The lubricant's carrier fluid then quickly evaporates, leaving a smooth, even dry coating on the treated part. The carrier fluid that delivers the lubricant should have low viscosity to wet and conform to the treated part's surface geometry. This helps provide a highly consistent surface coating without leaving unwanted residue, staining, drips or runs that could disguise any Unique

Device Identification (UDI) markings on the device.

### Applying Dry Lubricants

The typical application techniques for applying dry lubricants inside a carrier fluid dispersion include dipping, spraying or wiping.

**Dipping.** This is commonly used in high-volume production since it adds a consistent coating to nearly any surface shape or size, including small, complex parts such as wire coils. Conveniently, entire finished devices can also be dipped into the carrier fluid dispersion. Normally a single immersion is enough, but the coating level can be adapted by adjusting the concentration of PTFE particles in the fluid, the rate of withdrawal and number of applications.

**Wiping.** Wiping or brushing is mostly used in medium- to small-batch production. Because this method covers longer,

ongoing surfaces, it is ideal for components like rods, tubing or sheeting. However, it can also be used if only a small, select area of a larger part requires coating. Once brushed on, the carrier fluid dries rapidly, leaving a consistent, even and thin coat of dry lubricant behind.

**Spraying.** Spray application is done using a hand-held spray gun or automatic spray heads. Spraying is typically used to apply a number of thin coats, allowing the surface to dry between applications. Applying several coats over time is a better technique than one single thick coating, as the thicker coating takes longer to dry and can cause uneven coverage and poor adhesion.

Following application, the durability of the PTFE-based dry lubricant coating can be improved through heat curing or melt coating. This fuses the lubricant to the part, giving it a harder, more-permanent surface. Heating or melt coating also



turns the dry lubricant completely clear, leaving an invisible coating. It's always a good idea to consult your coatings provider to get a recommendation on which process is best for the particular application.

### Choosing a Dry Lubricant

When choosing a dry lubricant, there are some important features to look for.

**ISO 10993 certified.** Dry lubricants can typically be applied in-house within the production and assembly process, saving both time and money. In addition, using a dry lubricant that is ISO 10993 certified as a medical-grade lubricant makes it easier to add to production validation processes.

**Non-migrating.** Many lubricants like grease and oil can be expensive, messy and difficult to apply. They also often migrate to other surfaces or to product packaging. This makes facility cleanliness more challenging and process validations more complex. On the other hand, dry lubricants are clean, easy to apply and don't

migrate after application. This makes for a cleaner production or cleanroom facility and eases validation.

**Nonpyrogenic.** A non-aqueous carrier fluid helps prevent bacterial growth and other biologic contamination to the parts or devices.

**Compatible.** PTFE-based dry lubricants have excellent materials compatibility. They are safe to use on metal, glass, plastic and ceramic parts, so they are ideal for medical devices made with mixed material components. Dry lubricants are also typically compatible with commercially used EtO (Ethylene Oxide) and radiation sterilization processes.

### Don't Forget Your Coat

Medical device engineers and manufacturers must consider the lubricant coating process carefully when designing and producing medical devices. A dry lubricant contributes not only to the efficient production of the parts but also to the functionality, quality and consistency of the finished product.

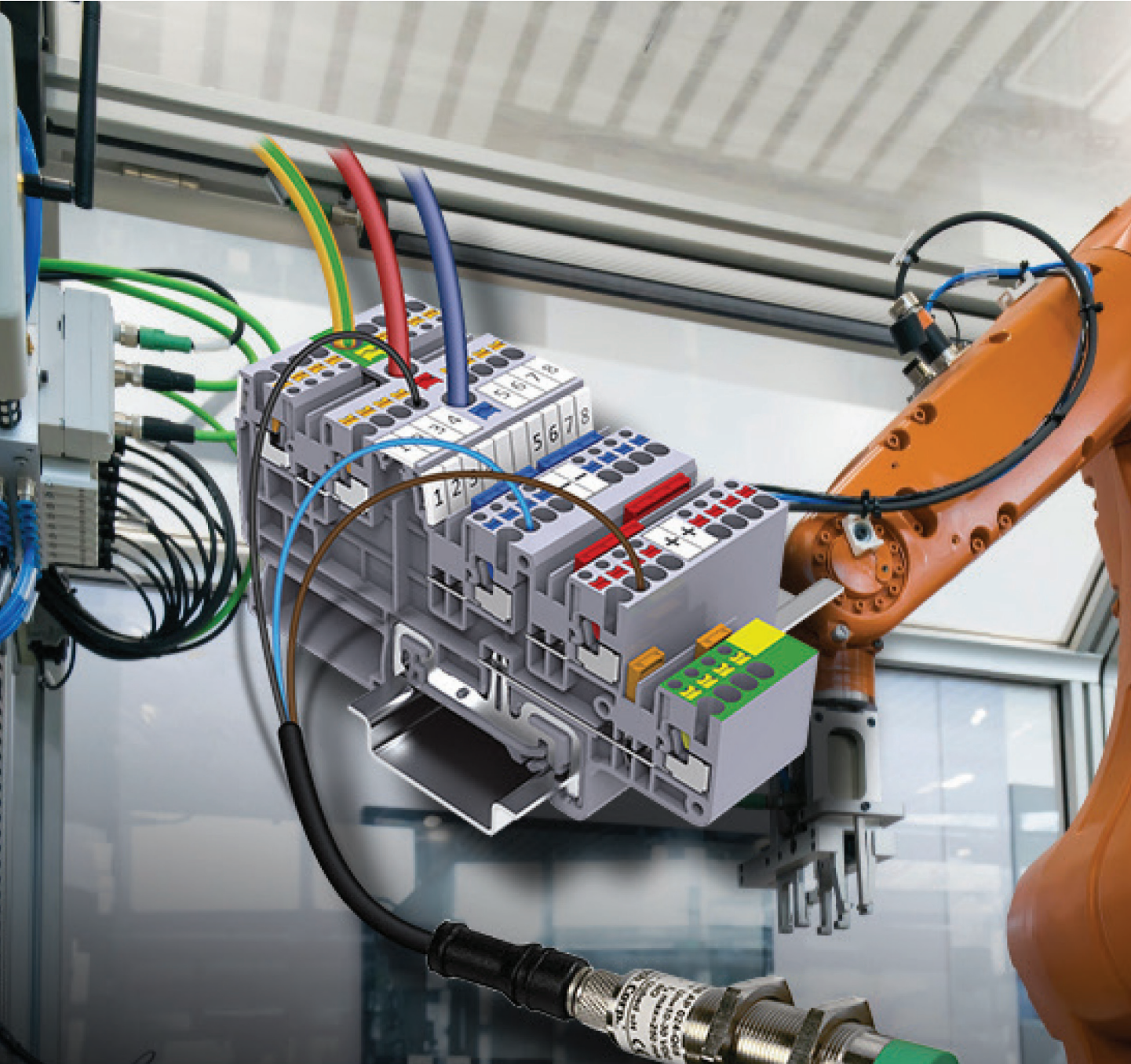
Moving away from traditional silicone oils and greases and switching to a PTFE-based dry lubricant can be beneficial. It not only works well to increase the overall performance by reducing stiction, but also addresses the long list of requirements when manufacturing medical devices. From validation conditions and bioburden risk to safety concerns, materials compatibility, and reliability and consistency.

Some medical devices would never reach their potential without the properties offered by dry lubricant coating technologies. So, selecting a lubricant coating early in the planning stage of a medical device design is critical to its success. ■

JAY TOURIGNY is senior vice president at MicroCare Medical, which offers medical device cleaning and lubricating solutions. He has been in the industry more than 30 years and has a BS from The Massachusetts College of Liberal Arts. Tourigny holds numerous U.S. patents for cleaning-related products that are used in medical and precision cleaning applications.



Dry lubricating parts typically reduces actuation forces by 25-30%.



# CYLINDRICAL SENSORS, CABLES, AND CONNECTORS



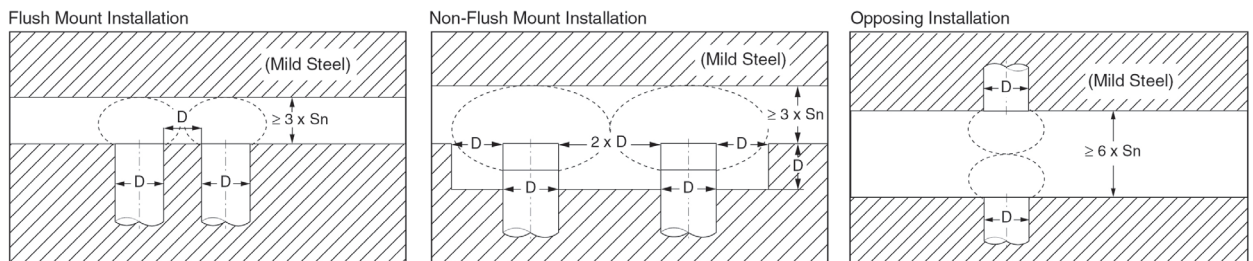
*Industrial automation is changing daily in its operational requirements. This most often affects companies on all levels and must be addressed component to component from the bottom up. Sensors, cables, and connectors are a critical factor and must offer flexibility and robustness to the user.*



In today's growing automation market, where smart factories are connected using the Industrial Internet of Things (IIoT) and Industry 4.0 technologies, a number of key factors come into play. Ease of installation, replacement, and repair are viewed as valuable additions to every system being manufactured. When it comes to the plant floor, these aspects will save time, resources, and money.

Cylindrical sensors, such as inductive proximity sensors used in a wide range of applications and under a variety of environments, offer specifications suitable for automation on multiple levels. Proximity sensors from Altech are available in two mounting configurations.

Flush mounted cylindrical sensors (also called embedded or shielded sensors), have electromagnetic fields that are concentrated directly in front of the sensing heads, which allows them to be mounted directly onto metal mounting brackets or embedded directly into metal without causing a false output. Where systems are continually getting more compact and smaller, this mounting option can become a requirement. Although there are restrictions.



Flush mounted sensors must have a minimum of one diameter of distance between adjacent sensors. There must be no non-target metal surfaces within three times the sensing distance across from the sensing head, and six times the sensing distance if sensors are mounted directly opposite one another. These conditions are typically easy to include since most designs use the least number of sensors they can to save on material costs.

Non-flush mounted sensors (non-embedded or non-shielded) have electromagnetic fields that exhibit a wide sensing angle and have no metal surrounding the sensing head. This means that care must be taken to assure that no *non-target* metal comes within a near proximity to the sensing head. Slightly different from flush mounted sensor requirements, adjacent non-flush mounted sensors should be separated by at least two times the diameter. Non-target metal should be separated from the sensor head at least three times the sensing distance. Two directly opposite sensors should be at least six times the sensing distance apart.

### Sizes and Features

Altech's cylindrical sensors come in diameters ranging from 8mm (0.32 in.) to 30mm (1.18 in.) and offer sensing distances up to 15mm (0.59 in.). The solid state operation of an inductive proximity sensor generates an output signal whenever a metal object is either inside or entering into its sensing area—from any direction. Physical contact is not required or desired. These devices work best with ferrous metals, but also work well with non-ferrous metals such as aluminum, brass, and copper but at a reduced sensing distance. Know the correction factor for each metal. For example if your target material is mild steel, use a correction factor of 1.0 x Sn as illustrated in the chart below. Note that

flat targets are preferable and that targets larger than the sensing face may increase the sensing distance.

### Rated Operating Distance Correction Factors for Standard Target Materials

Target Material	Correction Factor
Mild Steel	1.0 x Sensing Distance
Nickel Chromium	0.9 x Sensing Distance
Stainless Steel	0.85 x Sensing Distance
Brass	0.5 x Sensing Distance
Aluminum	0.45 x Sensing Distance
Copper	0.40 x Sensing Distance

The majority of models feature a combination of nickel-plated brass and stainless steel. Although non-flush mounted sensors offer a larger sensing distance than their flush mounted counterparts, all the inductive sensors meet IP67 protection levels. IP67 is the most common standard for connectivity products and provides 100 percent protection against solid objects such as dust, dirt, and sand, and will work for a minimum of 30 minutes while under 15cm to 1m of water.

Additional features include both AC and DC output connections that can be configured as Normally Open (NO) or Normally Closed (NC) with complementary NO/NC DC outputs available on some models. Altech sensors are available in a wide selection of M8/M12 Quick Disconnect styles or with fixed cables attached. Quick Disconnect models are designed to be user-friendly and to simplify and speed initial installation as well as replacement and repair.





### Component Materials

As mentioned, both flush mounted and non-flush mounted sensors are made from a combination of nickel-plated brass and stainless steel. Additionally, tip material is Polybutylene Terephthalate (PBTB) for long life. PBTB is a crystalline, high molecular weight thermoplastic engineered polymer that provides an excellent balance of properties and processing characteristics, which allows short mold cycles. The material also has low water absorption, has very good dimensional stability, exhibits high heat resistance, and is chemical resistant. All these factors add to a highly operational and robust sensor for a wide variety of environments.

### Cables and Connectors

It is essential to consider cables and connectors when integrating sensors into your automation system. The greatest number of sensors will be used to interconnect sensors and actuators used in collecting and monitoring production data from all levels of machine equipment as well as for executing pertinent commands. What is known as A-code cable assemblies, these components are designed for a wide variety of applications such as robotics,

production machinery, packaging systems, and other equipment where high temperatures and harsh environments are common—for robust and reliable operation.

D-coded cable and connector interfaces were designed for interface Industrial Ethernet, Ethernet/IP, EtherCAT, and PROFINET protocols used in more and more high-level industrial controls that must interact with real-time data feeds. These connectors and cables are also used in a wide variety of industrial applications.







A more recent addition to the connector and cable market are X-coded connectors, which are meant to handle Ethernet speeds of up to 10 GB. These components are used when high-speed, extremely accurate data is needed. These speeds are great for camera operated equipment such as vision systems that must transfer large amounts of data quickly. Other applications include virtual reality as well as security.

Both M8 and M12 cables are used depending only on your application and its environment. When designing your system, be sure to look for

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## M8/M12 – THE CODINGS

A-coding:	Actuator-sensor plug connections for DeviceNet, IO link and Profibus	
B-coding:	Fieldbus connections for Profibus and Interbus	
D-coding:	Industrial Ethernet, Profinet, Ethernet/IP and EtherCat	
S-coding:	Motor, Frequency-convertors, motor operated switches, PSUs for Power, 620 V, 12 A	
T-coding:	Fieldbus comp, passive distribution boxes, motors, PSUs for Power, 63 V, 12 A	
X-coding:	Cat6A, high-speed 10Gbit rugged industrial Ethernet applications IEC 61076-2-109	

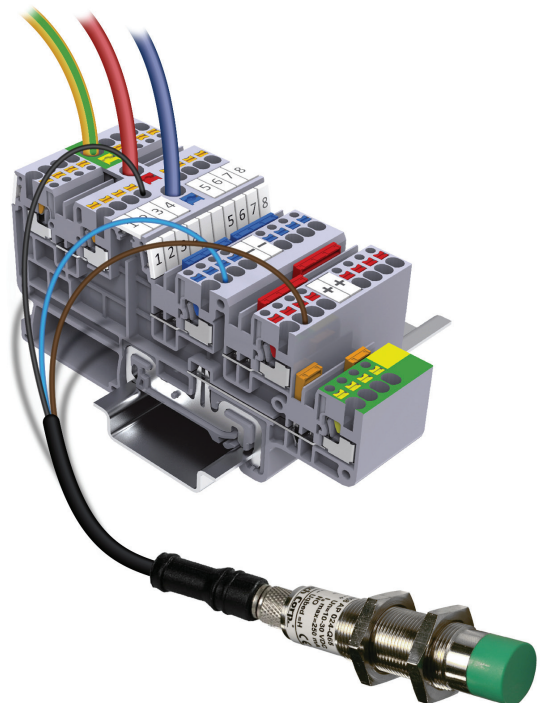
a company that offers a wide variety of viable solutions and the in-house expertise to answer your pertinent application questions. When it comes to product selection, note that Altech offers full lines of M8 and M12 molded male and female cable assemblies, field wired connectors, as well as panel feed-through connectors. When buying sensors as those mentioned above, the cylindrical sensors are provided with 2m PVC fixed cables. Two-meter and 5m PUR cables can be purchased as an option.

For a quick rundown of features, let's begin with the company's M8 and M12 molded male and female cable assemblies. These PVC and PUR cables are available in 1, 2, 3, and 10m standard cable lengths with custom lengths available. The connector comes in straight- and right-angle versions with 3, 4, 5, 8, and 12 pole interconnections. Field wired M8 and M12 connectors are available in male and female versions with screw and solder connections and 3, 4, 5, and 8 poles. Female and male versions of the M8 and M12 panel feed-through connectors are available as front or rear mounted and offer various

cable lengths. M8 connectors are either 3 or 4 pole, which the M12 connectors are available in 4, 5, 8, and 12 pole versions.

### Conclusion

Flexibility is always important in today's industrial automation world. Environmental needs can vary greatly. Ease of installation, long life, and ease of maintenance are critical factors in saving costs in the short and long run. The need for the proper sensors, connectors, and cables can vary greatly from application to application. When considering components for your industrial needs, be sure to select a company that not only has a wide variety of components but also offers the years of experience necessary to help you make the right choice for your specific needs.





# Software Eases Additive Manufacturing Transition

Barriers to adoption can be removed by combining design and material properties.

Software certainly is no stranger to traditional manufacturers. For decades, it has played an increasingly undeniable role in streamlining operations while empowering manufacturers of all sizes to meet high-volume production demands with maximum quality and efficiency, from uploading part or product designs to providing full production planning and manufacturing straight on to product delivery. Simply put, software must be tailored to support the unique and different process flows that dictate how products are designed, made and delivered using additive manufacturing.



Additive manufacturing creates the opportunity to design geometries that would be impossible to manufacture in traditional ways. *Shapeways*

While these vital software applications are the lifeblood of traditional manufacturing organizations, they haven't been designed to support the speed and agility associated with end-to-end additive manufacturing processes. As a result, proponents of additive manufacturing, commonly called 3D printing, have been forced to cobble together disparate solutions to handle discrete processes and workflows. According to the "State of 3D Printing" survey commissioned by Shapeways in July of 2021, 72% of those polled use six or more tools or applications to manage the processes needed to make a typical product using 3D printing.

The three tools used most frequently are shared data repositories such as SharePoint or Google Docs, Excel or standalone documents and machine scheduling tools. Only 29% of the respondents reported the use of applications with integrated and cohesive workflow management, while 88% agree better software would accelerate their adoption of 3D printing.

## Lack of Software Has Slowed 3D Printing's Trajectory

So, why has software been slow to support additive manufacturing? After all, 3D printing technology has been around for more than 30 years, and it continues to make major inroads proving its worth in high-mix/low-volume manufacturing applications. Additive manufacturing is ideally suited for producing parts or products with complex geometries while dramatically reducing the number of separate components needed to produce a highly complicated part or product.

The spotlight on additive manufacturing intensified during the pandemic when 3D printing technologies were used to produce record numbers of life-saving personal protective equipment (PPE) in fighting the spread of COVID-19. In most cases, traditional manufacturing was outmatched by the speed and agility of 3D printing to address evolving requirements and rigorous timelines. There simply wasn't sufficient time to take the traditional manufacturing route to market, which also helped dispel long-held misconceptions about additive manufacturing.

Manufacturers previously had relegated 3D printing to a handful of roles, such as handling rapid product design iterations and producing functional prototypes or one-off product orders. A variety of reasons are credited for the holdup in overall acceptance, including unfamiliarity with new processes, misconceptions about quality and volume issues, and trepidation about transitioning traditional manufacturing routines to new ways. Regardless, one thing is for sure: Software is poised to remove the barriers while easing widespread transition of additive manufacturing.

## Supporting End-to-End Digital Processes

To fulfill the potential of additive manufacturing, a new class of software must be capable of managing end-to-end digital processes and workflow—from uploading part or product designs to providing full production planning and manufacturing straight on to product delivery. This software must be tailored to support the unique

and different process flows that dictate how products are designed, made and delivered using additive manufacturing.

Survey respondents identified the top five software features that would most benefit additive manufacturing adoption:

- Real-time tracking and traceability
- One interface to manage internal workflows and external supply chain
- The ability to attain data needed for industry-specific certifications
- Vendor-agnostic hardware or materials
- A single view into the end-to-end manufacturing process

Where additive manufacturing software promises to be most transformative is when embraced by small CNC shops or design firms and mid-sized manufacturers. Embracing additive manufacturing empowers these organizations to not only design products with complex geometries, but manufacture them as well. That would be highly challenging or outright impossible utilizing traditional manufacturing methodologies. These organizations typically don't have massive incumbent infrastructure, the luxury of giant capex budgets or far-reaching expertise—they might not even have MES software to drive portions of their operation.

For them, software lowers entry barriers and then levels the playing field, giving them immediate design-to-deliver capabilities needed to compete with larger and more entrenched organizations. Software democratizes additive manufacturing by giving more organizations much-needed access to the tools and processes needed to succeed.

Digital manufacturing software also can reduce CAPEX and OPEX concerns by enabling shared and distributed access to world-class manufacturing machines and services. In particular, small to mid-sized manufacturers quickly can reap the benefits of this new business model, which could be categorized as print-as-a-service. The result lets a solo designer of individualized jewelry share the same footing with a man-



The variety of both designs and material properties have been expanded through the use of 3D printing. *Shapeways*

ufacturer that produces millions of parts, pieces or products. Instead of having to find a partner—or not playing in the game at all—software can create unprecedented opportunities to engage and participate in a fast-growing market segment.

### Cue the Network Effect

As more manufacturers embrace additive manufacturing software, the democratizing process gets stronger and better. It becomes a constant, continuous cycle of improvement and innovation. As the number of makers, sellers and buyers in the network increases, the so-called “network effect” amplifies value for all its members. This rings true especially in ensuring supply chain readiness, as members across the network can tap into each other's areas of expertise as well as ubiquitous access to vendor-agnostic technologies, along with world-class materials and finishes.

Software designed for additive manufacturing also can reduce obstacles for achieving desired part tolerances and consistency, which typically have been the biggest concerns facing newcomers to this arena. File analysis and optimization with instant auto-correction functionality, as well as complete traceability with pre- and post-production capabilities, ensure delivery of top-quality, finished products anywhere in the world.

### Exceptional Customer Experience

Ultimately, delivering a consistent and exceptional customer experience is the holy grail for every manufacturer. The fulfillment aspect is a big part of that customer experience. These days the impact and importance of the supply chain is on everyone's mind, and additive manufacturing software can prove its worth here. By embracing a digitized manufacturing process, items can be produced closer to end-customers, therefore reducing potential logistics bottlenecks and shipping delays. This reality alone should be enough to get even the most diehard skeptics to consider additive manufacturing.

The journey to additive manufacturing starts like any other—with taking that first step. Embracing the latest additive manufacturing software jumpstarts those initial forays while providing a path forward as the pace of adoption accelerates. The bottom line is while every manufacturer wants to stand out, they also want to take advantage of every capability their peers have, and these days that includes additive manufacturing. ■

YAN LIANG is senior vice president of products for Shapeways. A graduate of the University of Michigan, she came to Shapeways after serving in product engineering at SAP and Symantec.





## FasTest: Connection Experts in Leak Testing

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### PAVING THE WAY TO INDUSTRY 4.0

FasTest is first and foremost an innovation company. For the past three years, FasTest has been innovating to help lead the Industry 4.0 movement in the leak testing space by incorporating ICON™ technologies into its connectors. Last year, FasTest integrated ICON™ into their industry-leading FN Series quick connectors, typically used in manual and semi-automated leak testing processes.

ICON™ technology provides operators with visual verification that a successful connection has been made and that they are safe to begin the filling or leak testing process. In doing so, ICON™ technology essentially removes the connection point as an area of concern for the leak test. In being able to verify a successful connection before starting a leak test, operators are able to attribute any failed tests to the manufactured product being tested. This eliminates a significant amount of rework and scrap waste associated with false failures in the leak testing process.

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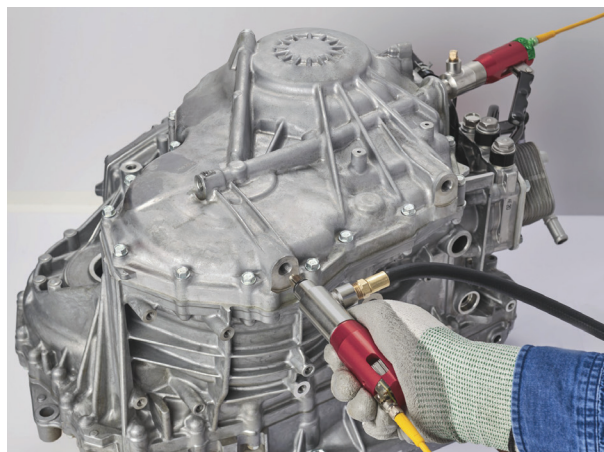
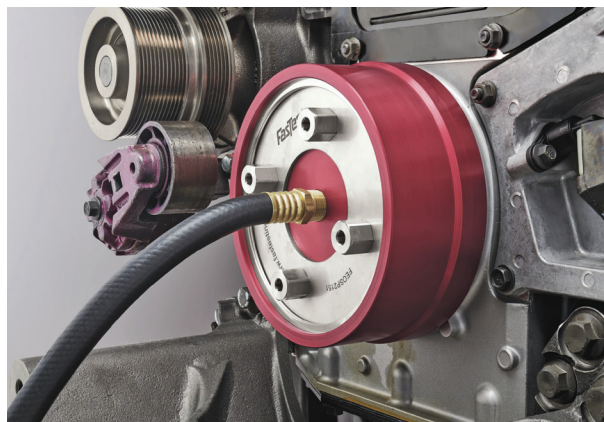
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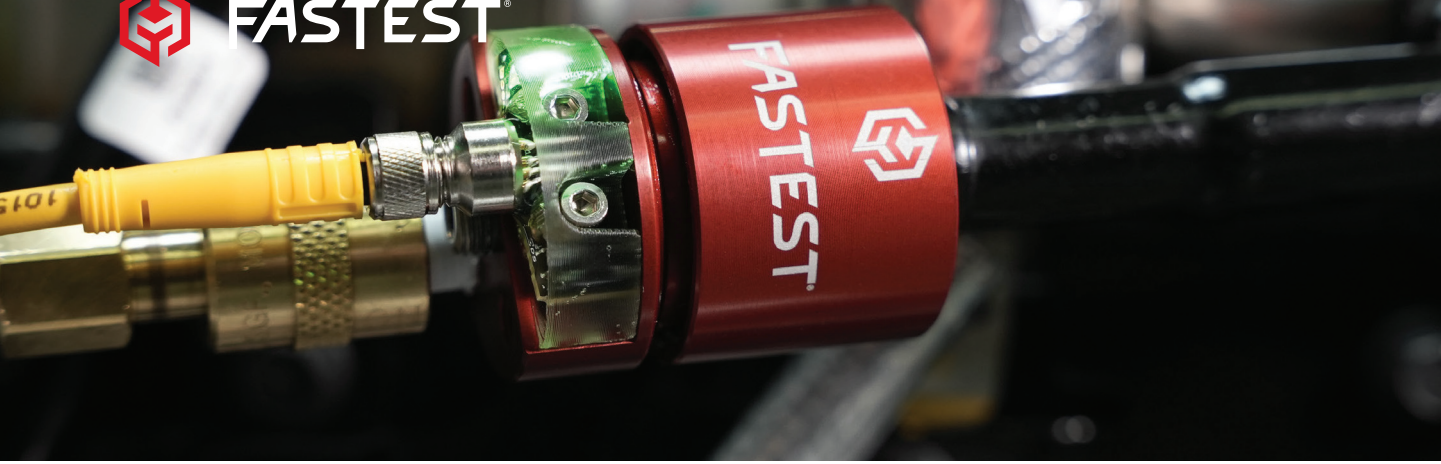
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Many manufacturers have also begun using FasTest's ICON™ quick connectors as data acquisition points to help drive process improvements. "There has been a major shift towards Industry 4.0 practices in leak testing; manufacturers are beginning to gather data to drive improvements to the manufacturing process," said Dustin Sirny, FasTest Director of Advanced Technologies. "Leak testing is a critical process that verifies that the manufactured product meets the required quality standards, so being able to collect data on that process is incredibly valuable. Our ICON™ technology drives lower warranty costs, eliminates waste in the testing process, and instantly alerts operators to test setup issues, allowing them to quickly make the necessary changes."

For more information on FasTest's quick connectors and ICON™ technology please visit:

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# Intelligent Tools for Better Results

ICON™ technology integrates with Industry 4.0 systems to prevent common problems in leak testing while improving safety of function tests and filling applications.



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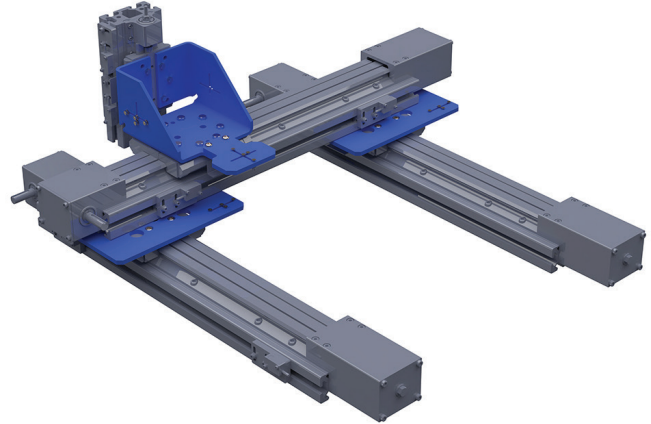
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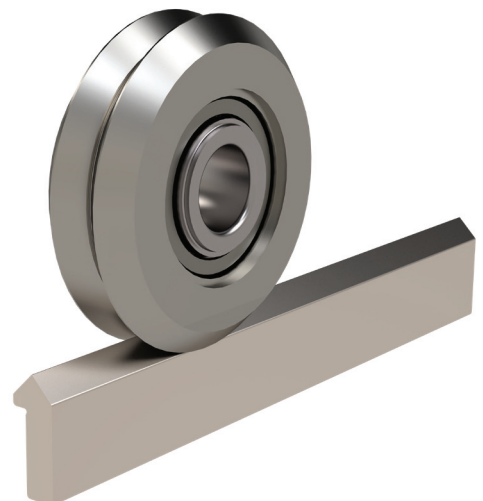
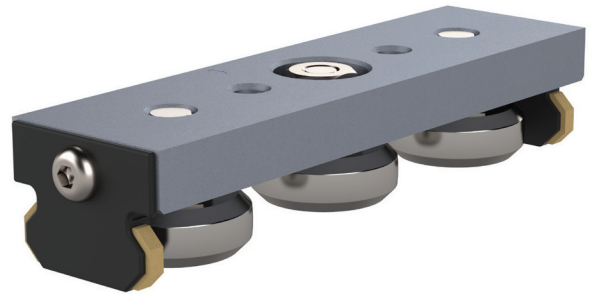


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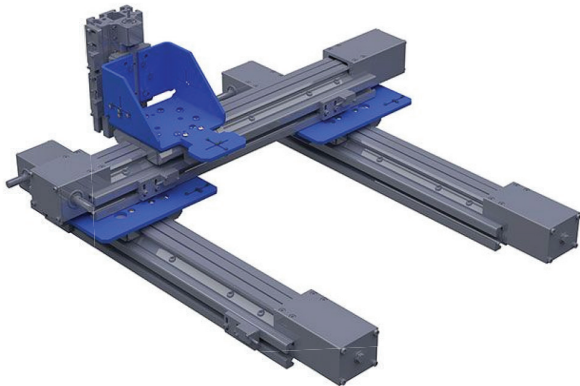
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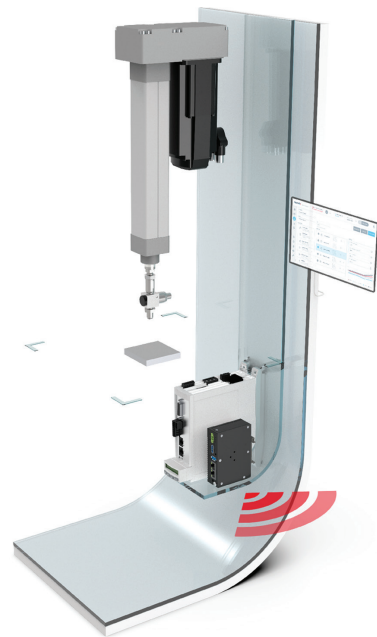
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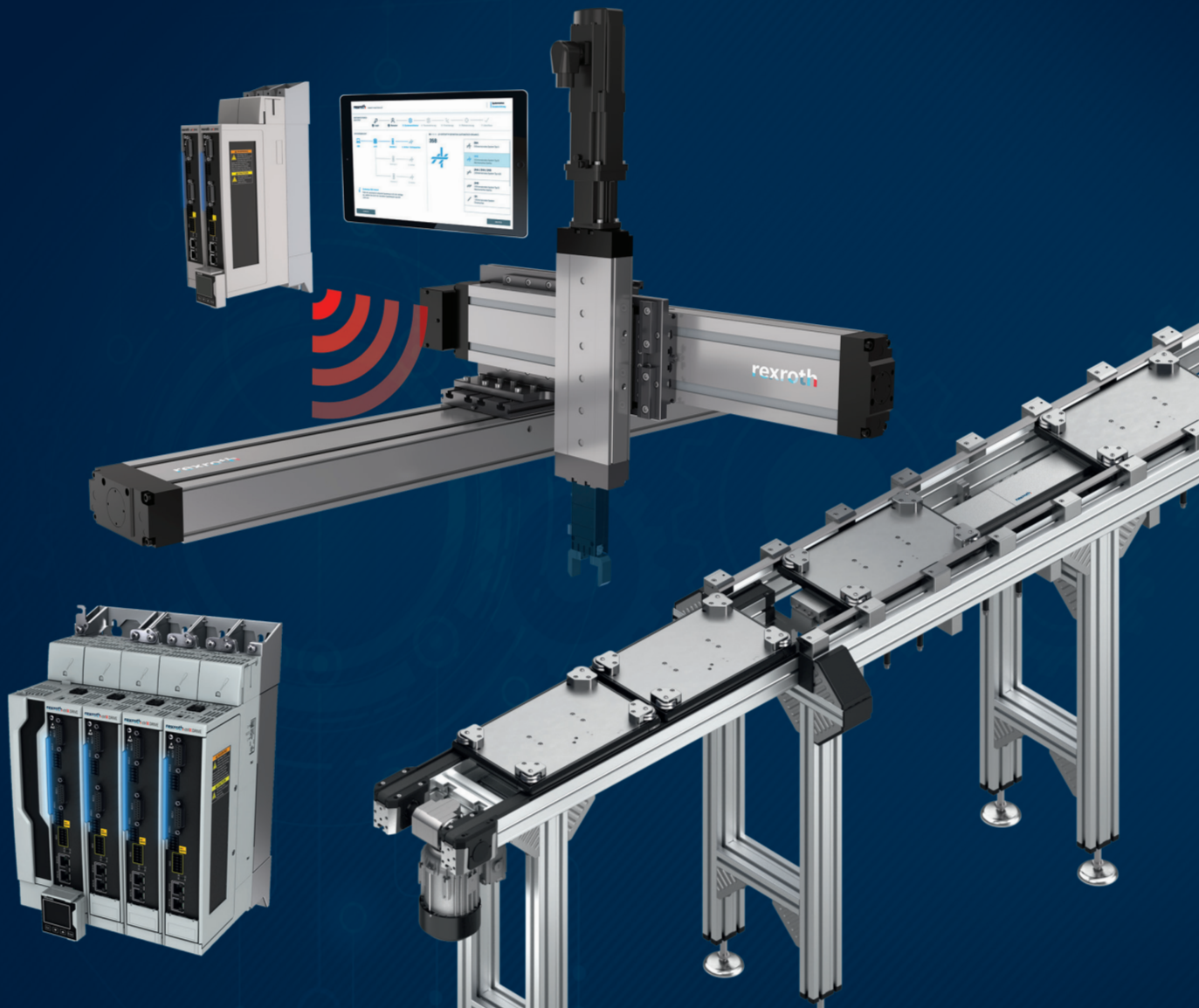
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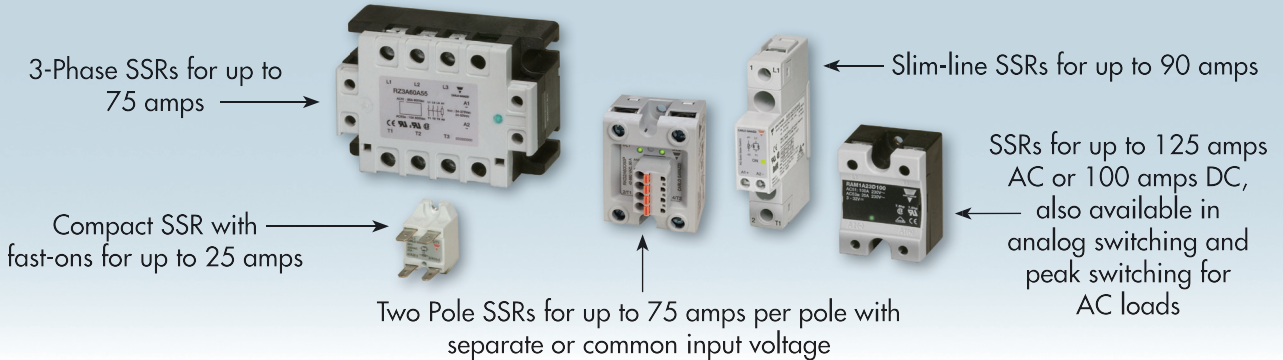
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# 5 Ways Non-Tech Companies Use AI to Adjust to a Post-Pandemic World

How AI is helping employees adapt to the new realities of a COVID-19 world.

**A**rtificial intelligence and machine learning (AI/ML) aren't just for high-tech companies anymore. Industries like manufacturing, life sciences and retail are adopting AI/ML-based tools to help solve business challenges following the COVID-19 pandemic. Consider the chemical plant operating at reduced

headcount due to social distancing or the medical manufacturer that must adapt to supply chain issues caused by an in-flux economy.

We've merely scratched the surface of the practical applications of these intelligent technologies in broader industries. Below are five concrete functions of AI and ML being used right now to help

businesses and their employees regain momentum and stability on the other end of the crisis.

## 1. Reimagining Legacy Workflows

One of the most common applications of any intelligent tool is the reallocation of repetitive or mundane tasks from humans to machines. Removing predict-



Kalypso



able or tedious tasks within an existing workflow enables organizations to give employees valuable time back to focus on more complex, high-value tasks. The introduction of automated customer service representatives in retail is an example of how AI and ML are used to reimagine legacy workflows.

Traditionally, customer service representatives would be the first point of contact for consumers; however, with AI/ML-based tools, human agents are now more often the last contact point because intelligent systems can resolve the majority of inbound customer tickets on their behalf. Restructuring the legacy workflow allows a business to restructure its human resources in a way that is adaptable to a post-pandemic environment, often reassigning employees to other essential tasks and more effectively upscaling or downscaling its operations.

## 2. Keeping Momentum with Fewer Staff

Images of fully autonomous factory floors with robots zooming back and forth aren't fictional anymore; this is how many manufacturing operations look today, especially for forward-thinking businesses that implemented automation ahead of the pandemic. Most factories at the moment are a combination of intelligent tools and specialized (yet sparse) human operators, who do more behind-the-scenes tasks. The industrial robot is often referred to as the "perfect pandemic worker"—one that will only continue to prove its value over time.

## 3. Course Correcting Supply and Logistics

Perhaps one of the greatest opportunities for AI and ML to enhance operations is in supply chain and logistics. The global supply chain is becoming more complex, coupled with an increasing demand for customized products and fiercer competition in a digital marketplace. For this reason, it's important for companies to operate leaner while meeting the needs of their customers.

### AT A GLANCE:

- Restructuring the legacy workflow allows a business to restructure its human resources in a way that is adaptable to a post-pandemic environment.
- Amongst the greatest opportunities for AI and ML is its ability to enhance operations in supply chain and logistics.
- Machines aren't taking away humans' jobs. Automation enables the next generation of workers to focus on learning and perfecting new approaches or techniques.

Logistics managers are incorporating AI and ML to help replenish depleted inventory by increasing speed in areas such as product development and research, as well as informing supply chain operators on contextual information that can improve inventory management and capacity planning. Furthermore, AI and ML are being used to correct transportation disruptions.

For example, a supplier sending goods from one side of the world to another can create logistics contingency plans informed by cognitive-based tools. These tools can determine if they should re-route or use alternate modes of transportation (such as by land, sea or air) to reduce the impact of current logistics fluctuations.

## 4. Maintaining Complex Equipment

For years, AI and ML have helped industries from oil and gas to medical device manufacturing reduce asset downtime and foresee equipment failures. However, as equipment becomes more complex, AI/ML-powered systems can continue to keep pace, sometimes better than the capabilities of their human operators. To confront this, plant managers are leveraging AI/ML to proactively address maintenance issues as well as gather data from past incidents to better mitigate equipment issues.

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**A**s the U.S. struggles with labor shortages and knowledge gaps left by retiring Baby Boomers, machines are helping to close the gap. Machines aren't putting humans out of work—machines are taking jobs humans won't.

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## 5. Closing the Knowledge Gap

A longstanding (yet false) narrative surrounding AI and ML is that they'll put humans out of work. Today, that presumption is being put to rest. As the U.S. struggles with labor shortages and knowledge gaps left by retiring Baby Boomers, machines are helping to close the gap. In other words, machines aren't putting humans out of work—machines are taking jobs humans won't. This enables younger generations to allocate existing tasks or functions to machines, so they can focus on learning and perfecting new approaches or techniques.

The COVID-19 pandemic motivated organizations to consider how intelligent tools can bring agility and precision to the operations of non-tech companies. Helping to improve factors such as speed to market, functional autonomy, supply and logistics, complex maintenance and even closing the knowledge gap, AI and ML are valuable tools that can be leveraged in a multitude of situations by a wide range of industries.

When applied in the right business context, these tools can fundamentally change the way companies discover, create, make and sell new products, which is ever-critical in times such as these. ■

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JORDAN REYNOLDS is the global director of data science at Kalypso, where his team applies AI and data science-driven approaches to help manufacturers develop and realize digital transformation goals.

# What Do Running Shoes, Memory Foam and Masonry Have in Common?

A material used in trainers and memory foam has inspired the design of a 3D-printed masonry product.

**O**n the surface, running shoes, memory foam and masonry don't have much in common. But there is a new material connection.

Auxetic materials are used in running shoes and memory foam. Researchers are now investigating the design properties of auxetics in the construction of novel applications, such as masonry.

Using off-the-shelf bioplastic to 3D print geometric shapes that mimic the behavior of auxetic materials, a Queensland University of Technology researcher has developed a material that can potentially protect buildings from collision damage and other high-impact forces, equivalent to a car travelling at 37.28 mph.

Under a tensile force applied in longitudinal direction, auxetics expand in the perpendicular transverse direction. In other words, instead of flattening when stretched, or distending when compressed, auxetics expand or contract in all directions, making them useful in specific applications.

This property makes auxetic materials highly energy-absorbent and load-resistant, said Dr. Tatheer Zahra, a researcher from the QUT Centre for Materials Science and QUT School of Civil and Environmental Engineering. The paper is published in *Smart Materials and Structures*.

Since existing commercial auxetic material is expensive and not locally available, the researcher designed geometric shapes that achieved the same behavior. She said 3D printing auxetic geometries could potentially replace steel- and fiber-reinforced polymer mesh reinforcements in composites, and could also be used as a

flexible and widely applicable protective wall render.

Zahra estimated that the energy absorption would be equivalent to a 20 mm thick reinforced composite protective render over a full-scale building wall, which could potentially withstand the impact force of a car travelling at 37.28 mph (60 km/hr).

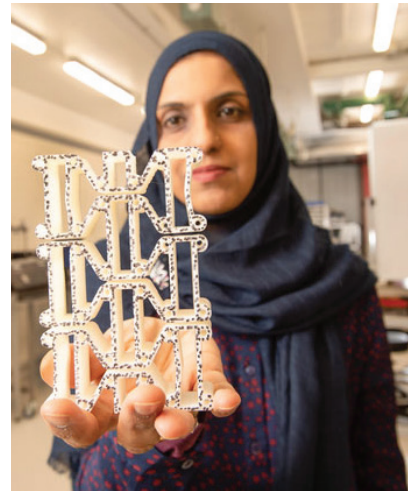
"At scale, composites embedded with these geometries could theoretically resist high-impact or shock energy caused by gas explosions, earthquakes and wind forces and car collisions," said Zahra.

She noted that protection for masonry walls was especially important because it was an essential part of most commercial and residential buildings.

"In Australia, there's an estimated 2,000 vehicular crashes each year," said Zahra. "Direct building damage cost at 2.5% would put the damage bill at about \$38.65 million per year for housing. Since vehicles also crash into apartments, office buildings, restaurants and convenience stores, this cost of building damage would probably be higher. Loss of life would be the highest cost."

Aside from safety, masonry has other material advantages. Compared to wood or steel, it is a cheap material that is resilient to noise, heat and has better fire protection properties.

On the downside, its mortar joints weaken the overall structural strength. But this can be remedied with auxetic properties. "If auxetic geometries were embedded into the mortar to make protective composites, they would also be protected from microorganisms and temperatures over 60°C, and should last the design life of the structure," Zahra said.



Dr. Tatheer Zahra was inspired by a material used in running shoes and memory foam pillows to design a 3D-printed product that could help protect buildings from collision damage and other high-impact forces. QUT

The design has been proven at lab scale. The next step is to test the designs on full-scale masonry and concrete structures at the QUT Banyo Pilot Plant.

Zahra contends the designs would be good prospects for commercialization through additive manufacturing because the production process is flexible and materials are readily available. "3D printing would also allow us to change the material, size or design of geometric shapes to suit different structures and load requirements," she said.

She maintains that bioplastics offer a more sustainable, low-carbon emission alternative to fiber-reinforced plastic or other non-biodegradable polymers.

In addition, Zahra estimated bioplastics were also more cost-effective than using available auxetic fabrics, which could cost up to \$400 per square meter and were not biodegradable. ■

EDITOR'S NOTE: A video of an auxetic geometry stress test can be viewed at <https://www.eurekaalert.org/multimedia/804117>.

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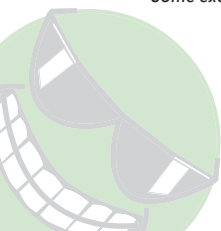
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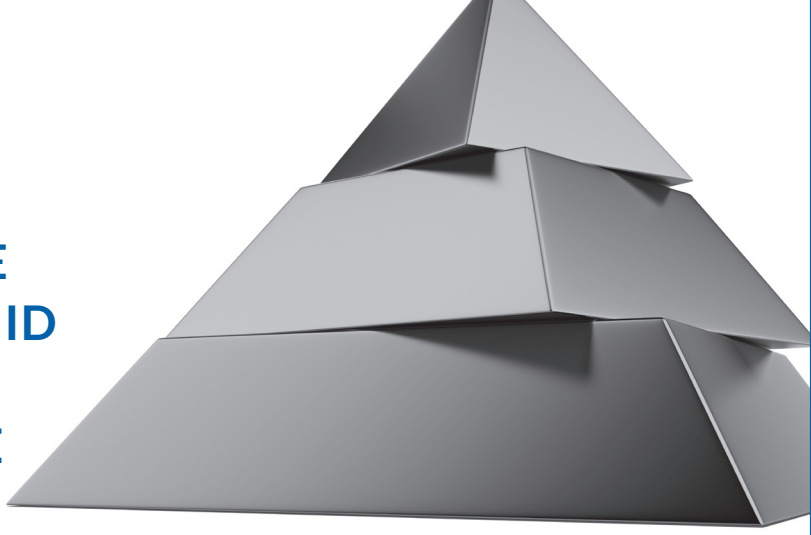
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## UNDERSTANDING THE AUTOMATION PYRAMID FOR IT LEVELS AND M12 CONNECTOR USE

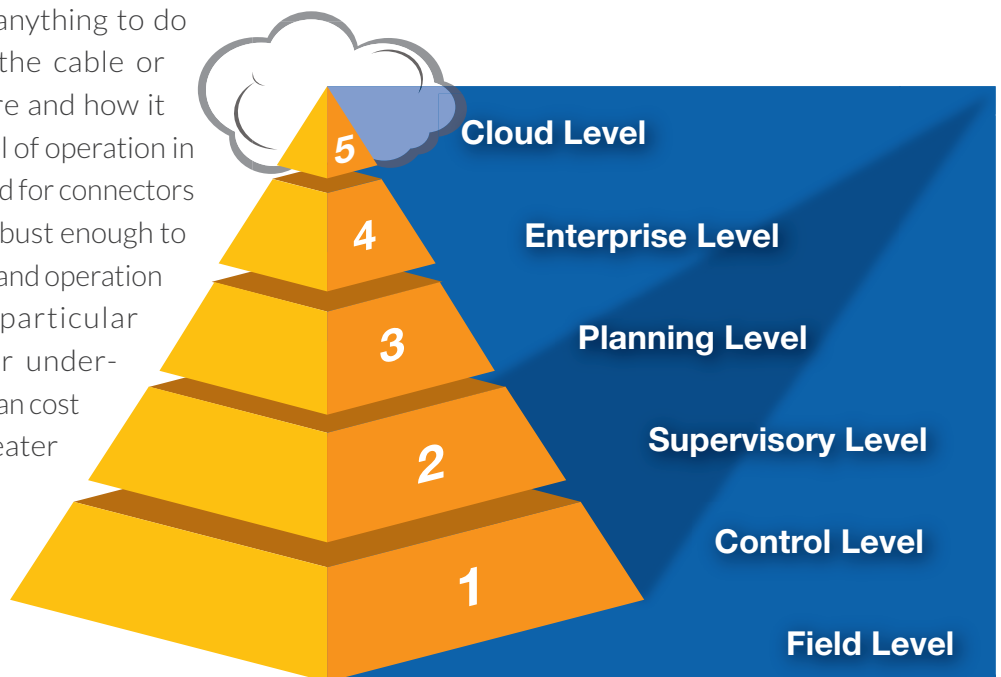


*Every level of automation has a particular set of requirements that help users select the product that has been certified to work for the specific needs they are trying to cover. This is particularly true when selecting connectors and cables.*

Cables and connectors are critical components in every application, from single application to factory floor wiring. You'll want assurance that your connector and cable selection enable the proper use of sensors and controls at each level of operation so that you can leverage the full capabilities of every device in your system.

But first, understand that the automation level does not have anything to do with the quality of the cable or connector, only where and how it will be used. Each level of operation in the automation pyramid for connectors and cables must be robust enough to handle the placement and operation required for that particular job without over- or under-compensation, which can cost more plus lead to greater maintenance needs.

**Level 0** is the field level. This level is the most often required due to the wide number of placements it is used in. The field level indicates that it is used with transducers, sensors, and actuators—such as temperature, flow, and pressure sensors and valve and motion actuators—to collect production data so that operations can be monitored, and action commands can be executed.



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**Level 1**, the control level, is used to carry the infrastructure used in controlling and steering the devices, such as sensors and transducers, as designated in Level 0. The control level is where you will find interconnections with industrial control protocols such as Ethernet and Fieldbus, which translate data to actionable tasks using I/O modules.

**Level 2** is the supervisory level, which pertains to the monitoring and supervision needed to acquire informational data with a process management system. This also means that data is collated properly, and that information gathered from processor nodes are used to provide operator control screens as well.

**Level 3**, the planning level, is also referred to as the production control level. This is where operations are used to monitor the entire manufacturing process so that planning can be completed through the computer management system.

**Level 4**, the enterprise level, pertains to the operational management level or production scheduling level of a facility. This includes a number of other interfaces, such as those for general production planning and order management through a company's enterprise resource planning system.

**Level 5** is considered the cloud level and represents the highest level of the automation pyramid, where systems are integrated with the cloud as a hub for digital transformation of the factory.

Connectors and cables are a highly important part of any application or facility and must be able to withstand the specific characteristics of the job at hand, whether that be a harsh factory floor environment or a big-data interconnection for managing your business. Using the proper component means you'll avoid unnecessary maintenance and potential downtime.

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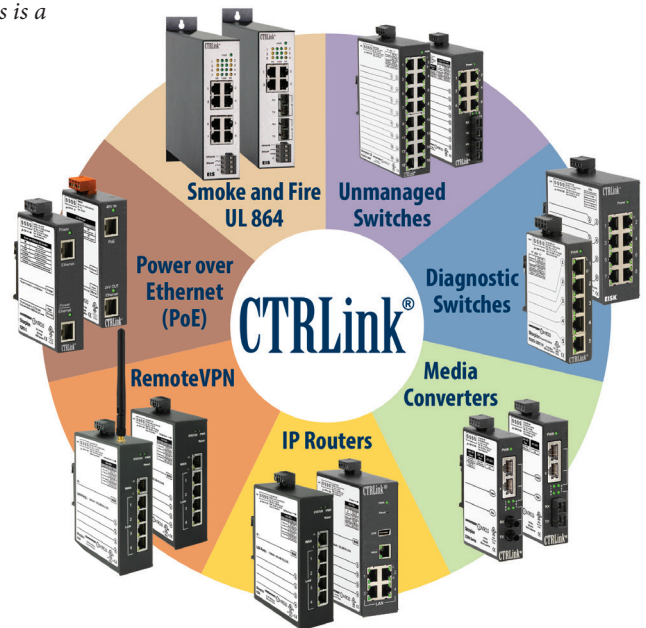
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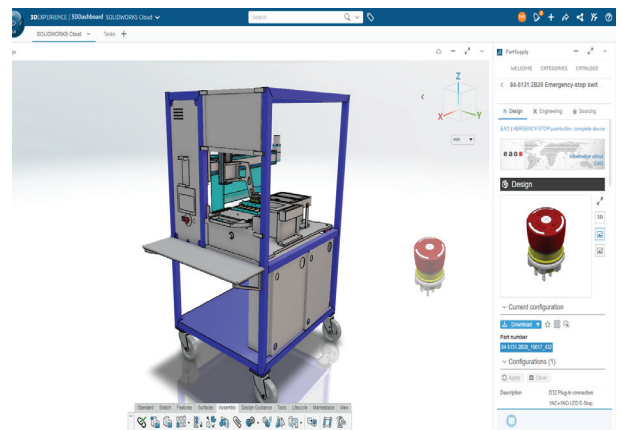
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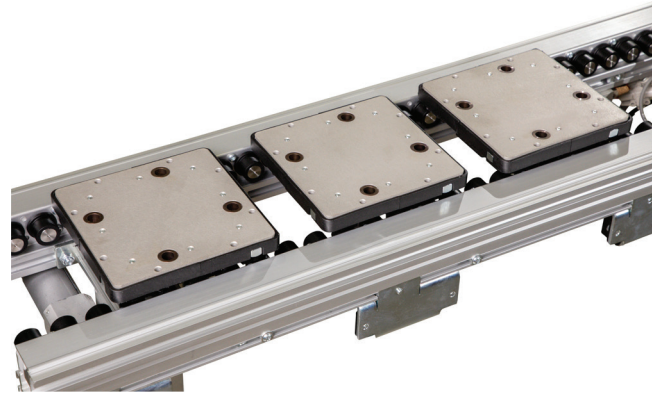
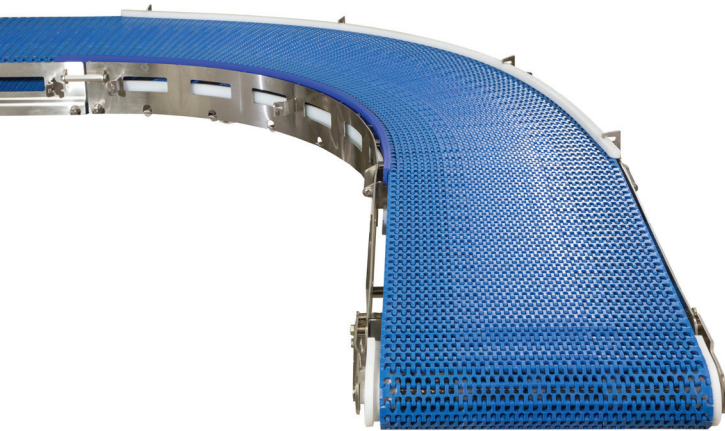
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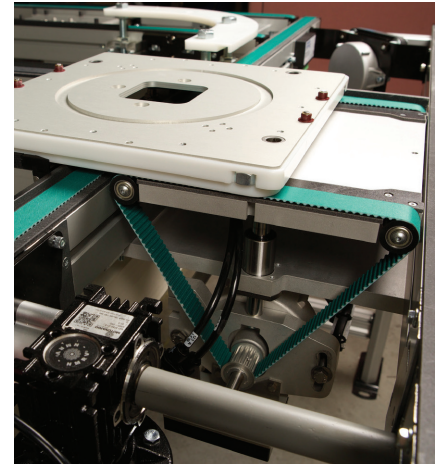
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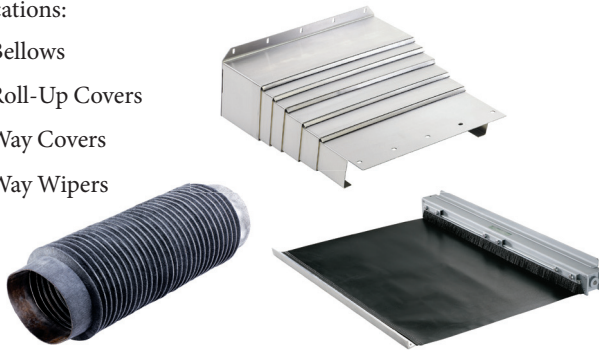
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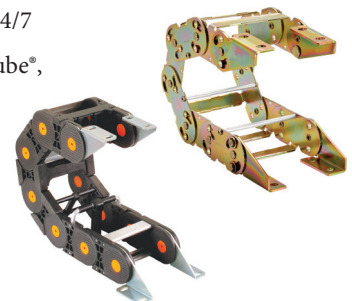
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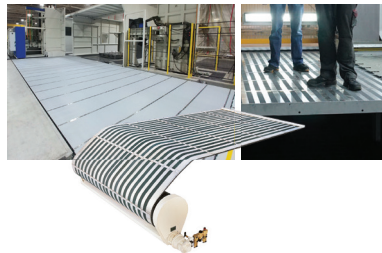
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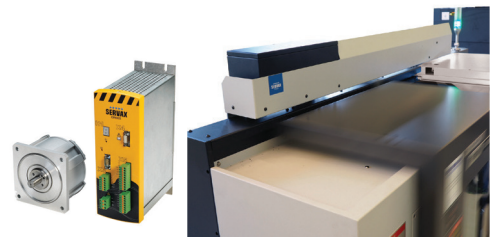
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# FROM DESIGN CONCEPT TO FINISHED PRODUCT



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Guest Commentary

SCOTT SUTTON | Owner, Henry Hansel Engineering

# Factory Automation is on a Roll

A retro-look travel trailer is customized using aircraft fabrication principles and automated electronics.



Partnering with Zenith Aircraft, and extensive use of AutomationDirect PLC and electrical components, were key factors helping with the design and build of a custom retro-themed travel trailer with fully modern features. (Photos by Scott Sutton)

Like many people around the world, our family has enjoyed camping at many destinations. But unlike most people, we had a strong desire to enhance this experience by creating our own travel trailer with classic post-World War II styling, yet with all the modern amenities. In part, realizing this vision would involve using my industrial automation skills to integrate and automate the all-electric systems.

As a self-employed consultant with more than 15 years designing, building and automating state-of-the-art manufacturing equipment, I knew I had the right combination of mechanical and electrical skills to pull this all together. The story of how we fulfilled a family dream of building and traveling with our own camper started over a decade ago. Along the way we had to overcome several setbacks, but finally were able to hit the road and travel around the country.

### Winding Road

My wife and I love all things vintage, especially from the 1950s. As we entered our mid-40s with two young children, we began the design phase. Unfortunately, we suffered three severe health setbacks in a row between the two of us.

Over a span of seven years, my wife had a major heart attack, I received a cancer diagnosis with a poor prognosis, and I also sustained a knee injury requiring reconstructive surgery and many weeks away from work. It seemed like every time we were both healthy enough to work on the trailer design, another illness beset us, or due to finances the project would be impossible. Through these times our faith sustained us, and my hope that I could build this trailer for my wife remained.

One day inspiration struck me, and I reached out to Zenith Aircraft Company to see if they wanted to partner

with us on the project. The reasoning was that Zenith sells aircraft kits, and perhaps they would consider offering a travel trailer kit if it used many of the same aircraft construction principles. The owner and president of Zenith, Sebastien Heintz, was intrigued and we collaborated on a plan.

### Upgraded Vintage

After investigation, it turned out it would not be a far leap to add a camper into Zenith's production line. I would create a CAD design, and Zenith would supply the materials and manufacture the parts. The fabrication style would use riveted aluminum like an airplane, and the overall exterior look and interior appointments would follow a retro style. My wife and I would build the camper, and Zenith could show off the prototype at air shows to gauge customer interest.



The interior follows 1950s styling but uses modern all-electrical appliances and AutomationDirect components to control lighting, heating/cooling and automatic load management.



With the project under way, I began to consider details related to my personal skills for electrical and automation design. The automotive community uses the term “restomod” to describe a classic car that is restored with modern underpinnings, like a performance suspension and a fuel-injected engine. The trailer would be similar because it would look vintage but instead of propane, it would have fully modern and all-electric systems, including:

- Inverter-driven mini-split heat pump (acts as a heater and air conditioner)
- Induction cooktop
- Electric water heater
- Electric refrigerator
- Microwave
- LED lighting

Even after sourcing all the highest-efficiency versions of this equipment, having all of them running at once would be a considerable load and could exceed the 30- or 50-amp service commonly available in campgrounds. The original camper concept did not consider a control system, but I knew from 15 years of experience with AutomationDirect’s PLCs and associated products that I could create a reliable way of monitoring and controlling all the loads.

Modern backup generator systems installed at some sites use a scheme called “load shedding” to turn off less-essential loads in favor of keeping critical loads online. Some of these systems can turn loads back on as sufficient power becomes available. The camper PLC-based load management system would need to do the same.

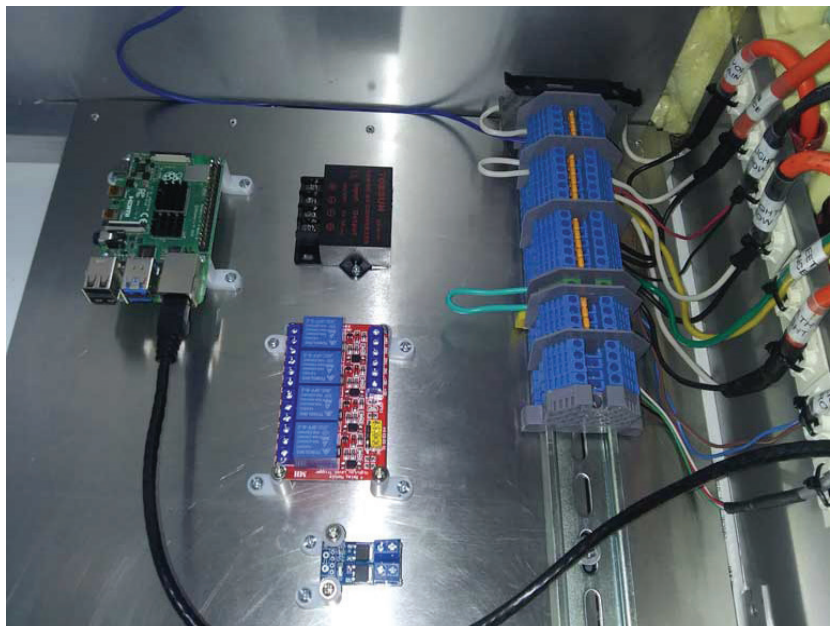
It would do this by monitoring the current used by every single load, and then comparing the available and requested power thresholds to automatically turn certain loads on or off. Using solid-state relays, the heavy power users like the water heater could be interrupted for a more immediate but momentary needs like the microwave, and then turned back on afterwards.

High-speed pulse-width modulation outputs, controllable for frequency and duty cycle, could be used for other schemes. The most basic example is using them to control the brightness of various LED lighting. A more advanced application was using them to modulate the

speed of two heat pump condenser fans, based on ambient temperature and heat pump compressor load, to keep the head pressure (estimated from compressor amps) optimized, and to increase overall heat pump efficiency while reducing noise.



**An AutomationDirect BRX PLC orchestrates all camper monitoring and control functionality, and it interfaces with the electrical systems using sensors and solid-state relays.**



**AutomationDirect wiring products and other components, like terminal blocks and DIN rail, made it easy to fabricate the electrical systems.**



## Modern Underpinnings

Regardless of how vintage the exterior and surface of the trailer looks, the underlying systems are remarkably modern. An AutomationDirect BRX PLC is the brains of the system, offering all the I/O capabilities we need, along with plenty of high-speed computing capability and Ethernet communications.

The camper also uses a 10-in. touchscreen so users can see the system status, adjust the lighting, execute other operational commands and change set-points. For this application we chose a consumer-grade Raspberry Pi running Python code and communicating with the PLC using Modbus TCP from among the many AutomationDirect industrial HMI displays and controllers. This controller enabled us to perform other PC-like functions, such as web browsing and multimedia display, in addition to the HMI functionality.

With the camper complete, my wife and I have made dozens of trips and we even displayed the camper with Zenith Aircraft at AirVenture, the largest airshow in the United States. The camper has been tested in various weather condi-

## Zenith Aircraft is actively exploring market interest in an all-aluminum kit camper trailer. Several model variations are under design and consideration.

tions from cold to extreme heat, and we use every feature and amenity without concern. The BRX PLC and control system we acquired from AutomationDirect performed flawlessly, and we have never tripped a breaker, either on board or from “shore power.”

During development, the camper’s control system logged data for trending and reporting and using this built-in feature of the BRX PLC was critical for setting power balance parameters. Once everything was dialed-in, we disabled the data logging function. In the future as

more features are added like solar power, mobile control capabilities and a security system, the data logging utility of the PLC will be used once again to optimize all the systems.

## Heading Down the Highway

Zenith Aircraft is actively exploring market interest in an all-aluminum kit camper trailer. Several model variations are under design and consideration. As for us, we plan to hit the road and tour the United States over the next few years. Just as many construction industry folks have enjoyed applying their skills to building or adding-on to their homes, I have the satisfaction of using industrial automation means, methods and my experience to create a home-away-from-home for our family with modern capabilities.

In some ways, the travel trailer is an advanced “rolling factory,” and we followed the same design, development and testing steps necessary for any type of automation project. Our story is not one of tragedy or bad luck, but it is instead a story showing the importance of faith during trying times and holding on to hopes and dreams.

We learned so much during those years about what’s really important in life, and neither of us would change anything about what happened to us. Instead, we are thankful for the friends and organizations that helped us turn our dream into reality. ■

SCOTT SUTTON has been a self-employed consultant for over 15 years at his company Henry Hansel, designing, building and automating state-of-the-art manufacturing equipment. His experience and capabilities include mechanical design using SolidWorks 3D, creation of the supporting electrical and drive systems, and automation using PC, PLC and/or embedded approaches. He routinely programs in Python for data acquisition, production reporting and more, and he holds a U.S. patent for an automatic respirator usage tracker.



A touchscreen, operated by a Raspberry Pi, interacts with the AutomationDirect BRX PLC to provide HMI functionality for system status information and control options.

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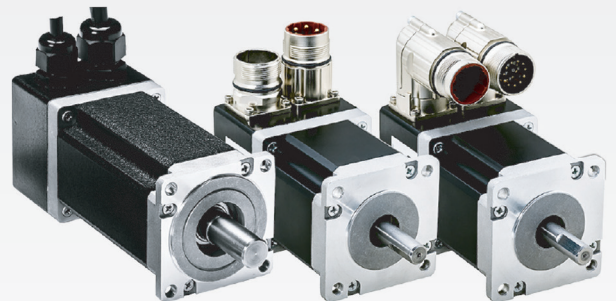
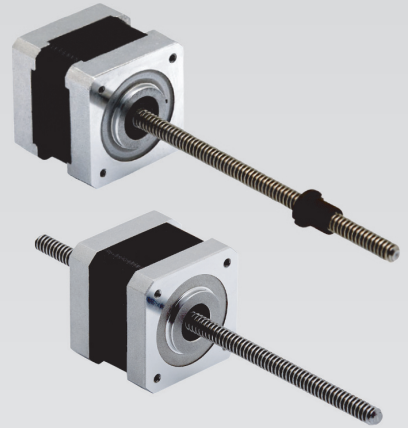
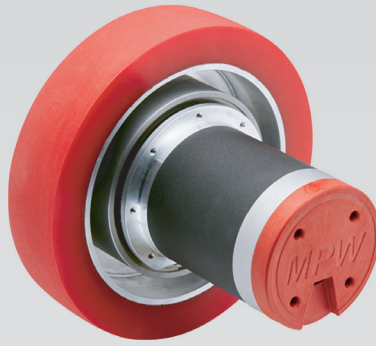
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# ULTIMATE BATTERY CARE



Advanced battery care products are an essential part of today's complex systems, allowing for greater operational capabilities in a trustworthy device that fits into multiple applications.



Battery care should be approached as an overall philosophy to benefit completely from your battery systems. The idea is to be able to implement rapid and automatic charging, provide battery charge optimization during a specific time, facilitate flat battery recovery, and deliver real-time diagnostics during installation as well as operation. Taking this philosophy forward, we're talking about optimizing battery life, but also being sensitive to providing ease of installation and reduced maintenance requirements.

Power solutions today are asked to fulfill the requirements of multiple applications whether separately or all in the same device. These functions include the power supply unit, battery charger, and battery management, and can include battery backup as well. Most importantly, available power must be automatically distributed to the load as first priority, with charging the battery second among the load and the battery. Power devices must be able to manage all the loads intended while also providing consistent and ongoing monitoring of the entire system.

## Rapid Automatic Charging

Providing high reliability for your battery system is important. This extends throughout the system, which means that your system must operate using easily accessible power with suggested standard input voltages such as 115 VAC, 230 VAC, or 277 VAC. This allows these units to operate in any country in the world without worrying about setting the correct input voltage. This DC UPS battery system capable to output multiple voltages for a wide variety of specific applications using 12 VDC with up to a 35 Amp load, 24 VDC with up to a 20 Amp load or 48 VDC with up to a 20 Amp load.

Altech's CB series is a microcontroller equipped product line that incorporates advanced automated multi-stage charging to expand battery life while also providing important features such as diagnostics and system monitoring functions for the easy handling and control of outputs. The CB series of smart battery chargers provide advanced multi-stage battery charging capabilities that are completely automatic and based on a series of algorithms suited to meet the most advanced requirements of battery manufacturers. Through the use of the microprocessor-controlled charging algorithms, the system can detect a battery's condition so it is able to choose the appropriate charging mode.

Battery systems such as the CB series of smart battery chargers are suited to operate with all battery types where jumper selection sets provide predefined curves for open lead acid, sealed lead acid, Gel, NiCd, and Li-Ion batteries. These particular units are compact, install quickly and easily, and offer a rugged enclosure with IP20 protection in a DIN rail configuration. For maximum protection and safety, these devices provide protection against deep battery discharge and reverse polarity connections as well as high insulation between primary and secondary circuits. They also provide detection of batteries with the wrong nominal voltage and provide battery disconnect protection.

Conformity to standard safety regulations is an essential part of every design. For battery systems, these may include such standards as IEC/EN 60335-2-29 Battery chargers; EN60950 / UL60950; Electrical safety EN54-4 Fire Detection and fire alarm systems; EMC Directive; and DIN 41773 (charging cycle standard).

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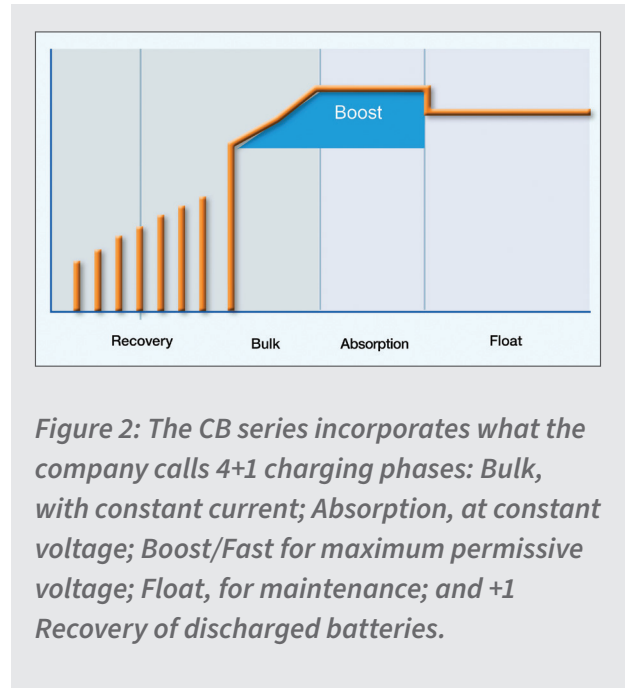
**Altech Corp.®**

## Battery Testing and Monitoring

The CB product line is equipped with an auto-diagnostic system that operates in real time to provide wide reaching fault monitoring capabilities. Units are able to detect accidental disconnection of the battery cables and perform an immediate response that switches off the output power to prevent damage. Similarly, if the battery is not connected, the output power is not engaged, and an alarm is set. During a Float charge, the quality of the battery connection (resistance) is monitored every 60 seconds to assure the cable has been properly installed. The system also tests internal impedance in case of an open circuit, checks to see if the battery is connected with inverted polarity, and checks the battery voltage connections to prevent the connection of the wrong battery type. An end of charge check is used so that when the battery is fully charged, the device automatically switches to the Float charging mode.

Diagnosis of the battery and device is presented through the illumination of an LED via a Blink Code. Indications include 1 Blink every two seconds for Float state, 1 Blink per second for Absorption state, 2 Blinks per second for Boost state, and 5 Blinks per second for Recovery state. Full diagnostics not only function during operation but throughout the installation process as well, alerting personnel of potential challenges that must be addressed.

Battery care permeates all aspects of your system. For example, managing your system assures that load outputs are never affected by battery conditions and that your system provides continuous control over time, which provides high efficiency operation. The rapid recovery of almost discharged batteries is guaranteed by the automatic multi-stage charging system and real-



*Figure 2: The CB series incorporates what the company calls 4+1 charging phases: Bulk, with constant current; Absorption, at constant voltage; Boost/Fast for maximum permissive voltage; Float, for maintenance; and +1 Recovery of discharged batteries.*

time diagnostics, adding value and reliability to the system hosting the CB device (see Figure 2).

The CB series produces event logging that includes the number of battery charging cycles that have elapsed, including how many have been completed and how many have been aborted, as well as charging times and the total number of standby/backup transitions that have occurred. System flexibility further allows the operation to be customized, including the entire charging curve of the battery, battery type setting, control of various time-out algorithms of charge, setting boost voltage, absorption, and many other features. A CANbus J1939 communications connection allows for the monitoring of over 50 parameters concerning the battery charger, the state of charge, and possible faults in the system. It is also possible to monitor, configure, record events, and receive alarms from the optionally set up CB and connected batteries.

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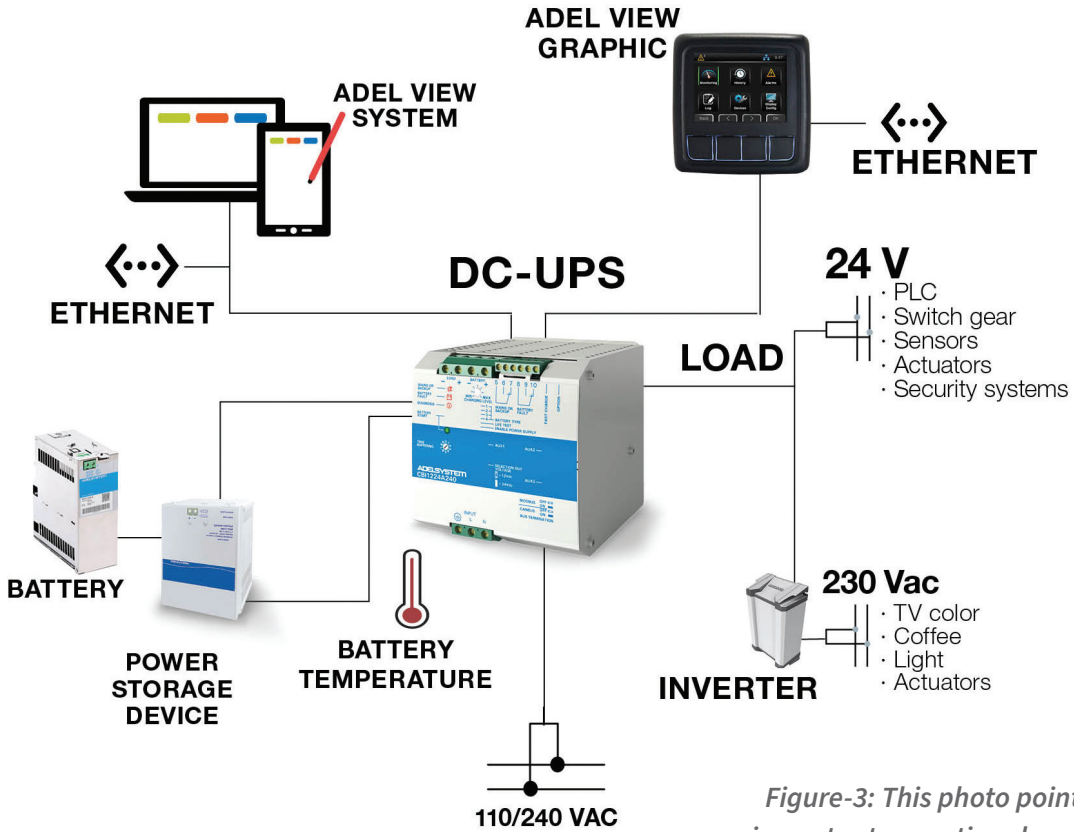


Figure-3: This photo points out the important operational controls and indicators of a CBI charger.

## Applications

Many people think of chargers being used for standard emergency backup for such applications as lighting, greenhouse control, portable equipment, remote measurement and control system, and other applications that already run off battery power. The CB series of automated automatic charging systems has extended use in industrial applications for water pumping, fire protection systems, and other key safety devices. These chargers are also used for security systems from everything from automatic revolving doors to access control and from alarms to emergency backup systems. As a product that is available for a broad spectrum of uses, systems are also installed in the telecommunications industry for telecom towers as well as base station transceivers, and

for the automotive service industry for all types of repair centers for cars, trucks, and motorcycles.

## Conclusion

Complete power solutions contain everything from your power supply unit, battery charger, battery care module and/or backup battery module. Users must keep their equipment online and operating at all times, which means that automatically distributing power among loads and the battery is important. This provides a stabilized system that provides proper operations regardless of power fluctuations or outages. Stabilizing your systems for proper operation whatever your power fluctuations or outages can provide you with significant cost savings over time.

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**What we do:** Harmonic Drive, LLC engineers and manufactures precision servo actuators, gearheads and gear component sets. We work closely with companies of all sizes to understand their application requirements and provide a standard or, in most cases, a custom-engineered solution to enable the success of their design project.

Our dedicated, full-service engineering department truly partners with our customers. We love challenges, and work to provide realistic, timely solutions. Experienced application engineers with expertise in motion control are available to assist you with your concept and detailed designs. Our design service is provided free of charge in most cases. We love what we do and are eager to share our knowledge and passion with our customers.

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## New Product: Actuator with Integrated Servo Drive



### TYPICAL APPLICATIONS:

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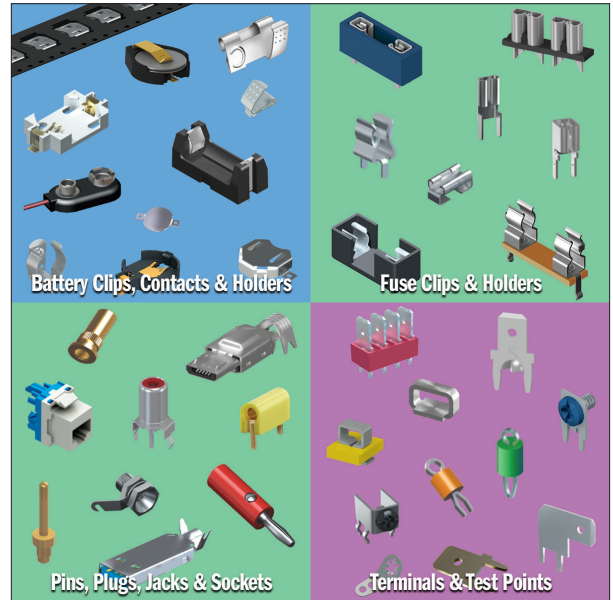
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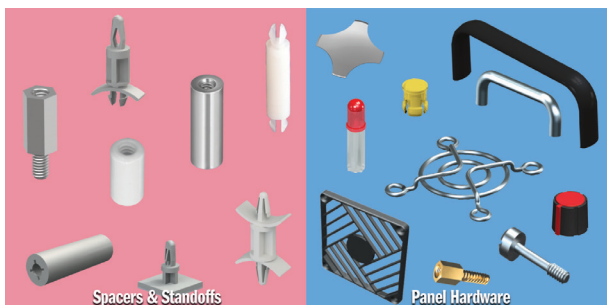
Our **Product Design Guide M70** features products that are engineered specifically for use by OEM Designers and Engineers who create and develop state-of-the-art electronic products, instruments, and systems.



## PRODUCT OVERVIEW

- **Battery Clips, Contacts and Holders**
- **Fuse Clips & Holders**
- **PCB Terminals and Test Points**
- **Spacers and Standoffs**
- **Panel & Computer Hardware**
- **Pins, Plugs Jacks and Sockets**
- **PC Board Hardware**
- **Multi-Purpose Hardware**
- **Terminal Boards and Strips**
- **LED Lens Caps and Holders**

While our catalog products meet most standard requirements, modifications as well as custom fabrications can be manufactured to meet customer-specific needs.



Keystone's design and engineering experts are fully integrated with our in-house precision tool and die shop. Utilizing the latest CAD/CAM and 3D modeling software, Keystone's Custom Manufacturing Division provides close tolerance Stamping, Machining, and Assembly services as part of their quality control and responsive customer service.

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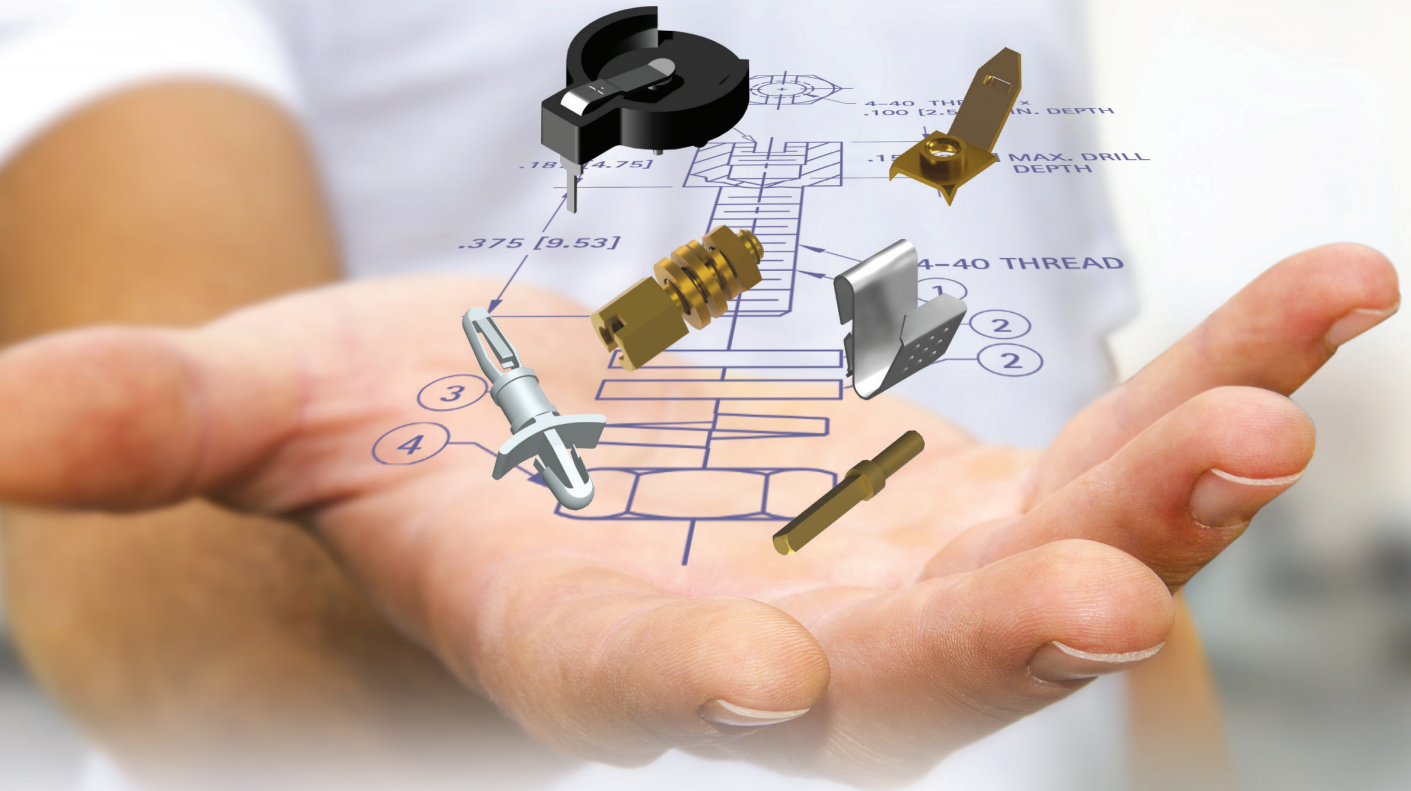
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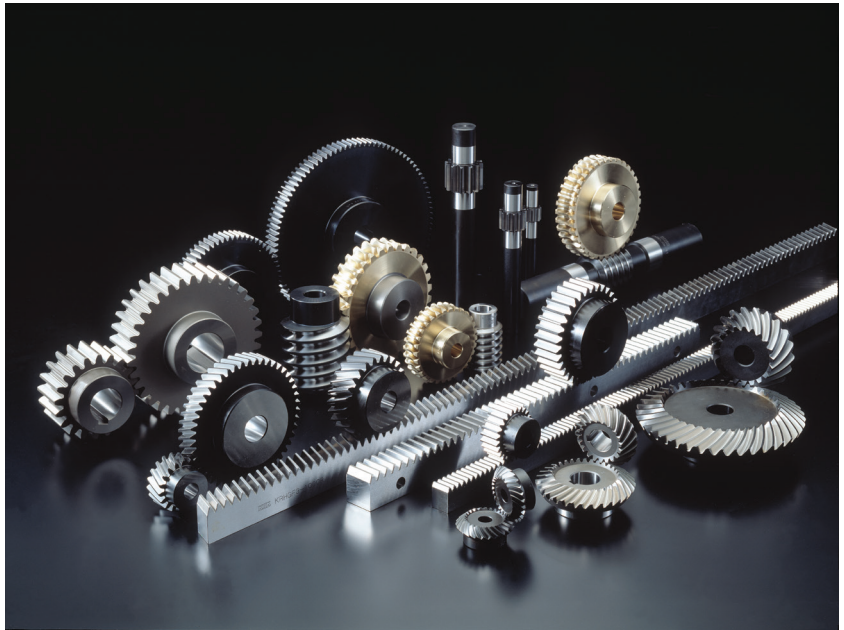
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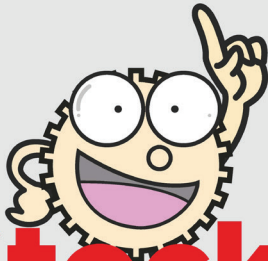


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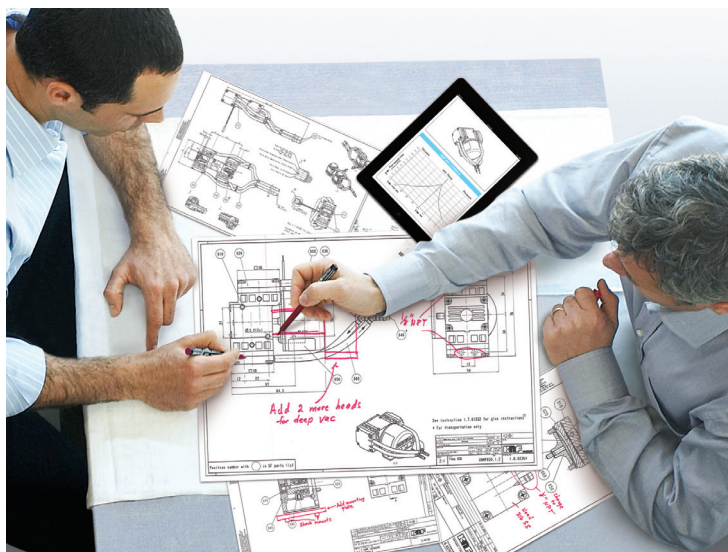


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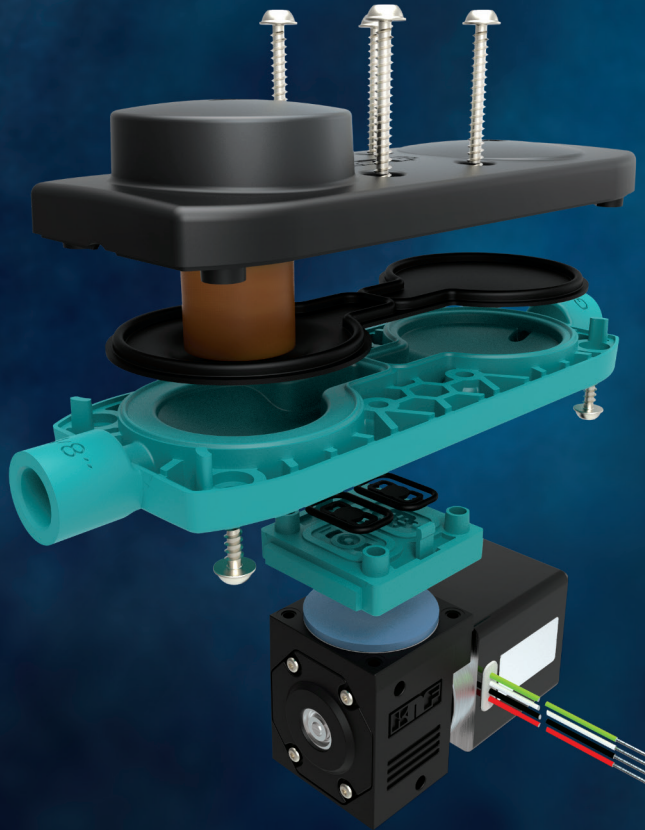
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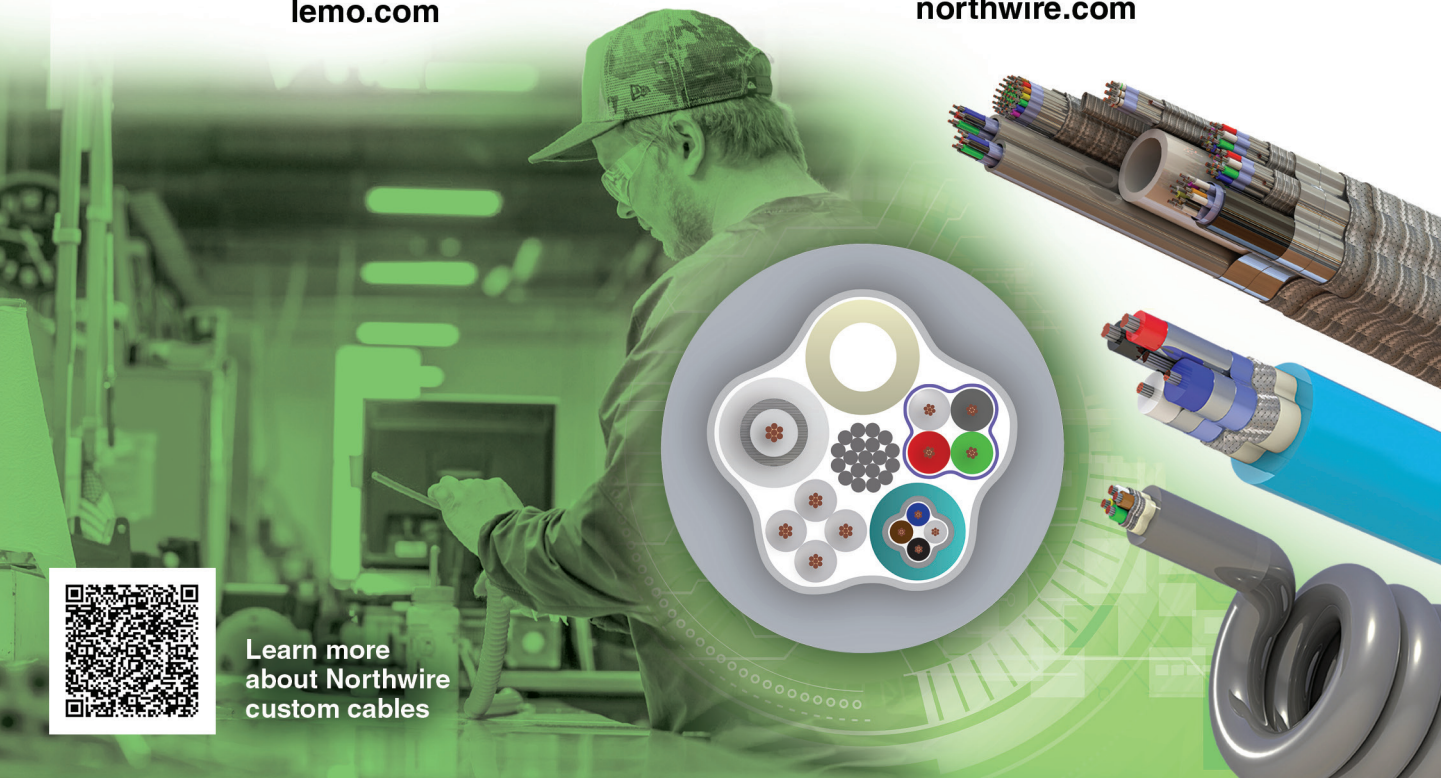


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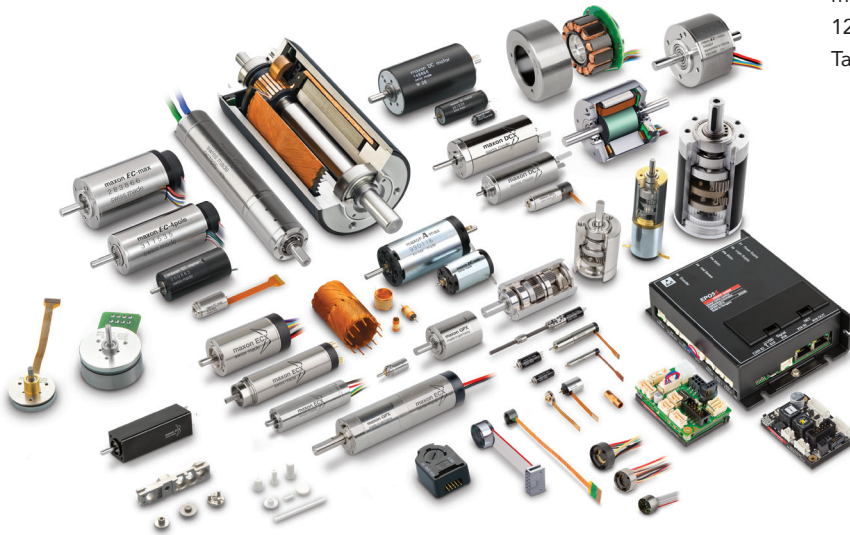
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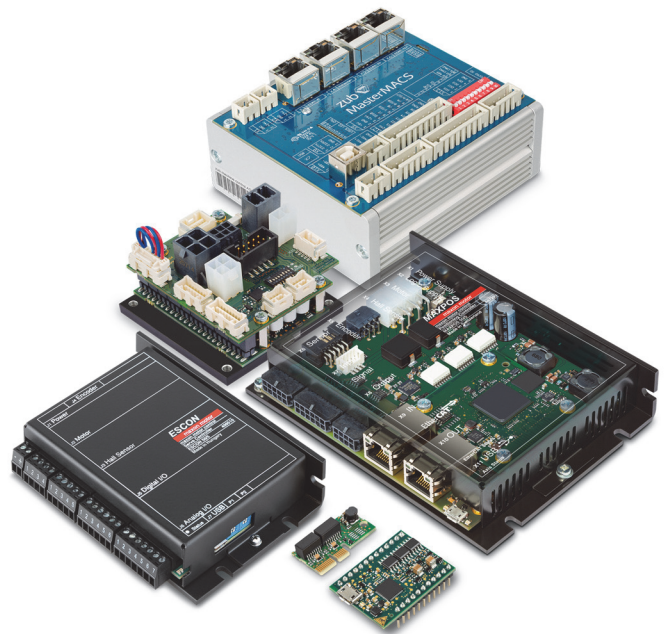
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# Automation Streamlines the Window-Making Process

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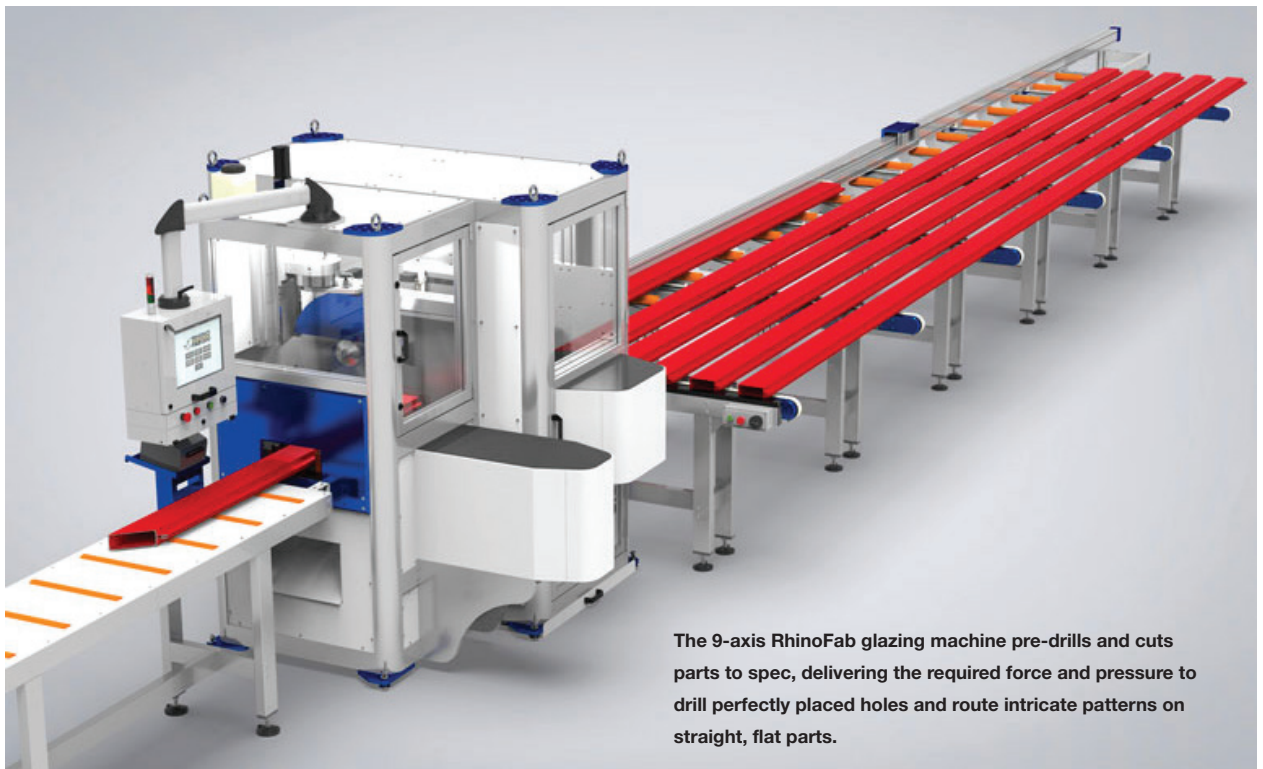
A large part of the business at the DeMichele Group (DMG) in Chandler, Ariz. revolves around designing and building industrial fabrication hardware and software for the glazing or window-making industry. Engineers there were recently tasked with automating the extrusion and assembly of linear components into windows for storefronts and curtain walls, as well as window accessories. The equipment also had to be compact to move and work at construction sites to speed installation.

Glazing contractors must work quickly, accurately and safely at building sites to properly manufacture components, assemble them and then install window frame facings, curtain walls and storefronts in multi-story commercial buildings. But if holes drilled in extruded metal parts are misplaced or not correctly cut to size, there can be problems. And if there are similar problems

with too many parts, construction slows and projects go over budget. All it takes are misplaced quarter-inch holes.

One part of the process called for a CNC machine that could automatically pre-drill holes and cut-to-length the window components, which are usually made of extruded aluminum. These had to be done precisely and the CNC machinery had to be stable. Otherwise, holes could be inaccurately positioned, or parts cut too long or too short, which ruins the fit and finish of the final assembly.

The aluminum framing also cannot deflect or bend, a common problem when machining with high-CNC speed drills and routers. As the material moves through the machine, the cutting axis may bite, bend or become unstable. If the actuator holding the drill, for example, doesn't properly hold it tightly or withstand the force of the press, it will misplace or incorrectly



The 9-axis RhinoFab glazing machine pre-drills and cuts parts to spec, delivering the required force and pressure to drill perfectly placed holes and route intricate patterns on straight, flat parts.



cut the hole(s). The pace of production then slows until the inaccuracies are scrapped and re-machined.

“The DMG engineering team started developing a new CNC machine with some readily available actuators on the market,” recalls Brian Hefner, DMG president. “But they weren’t rigid enough to properly hold the needed tolerances, plus they let particulates get inside of them where they caused problems. So, we started R&D to investigate ways to resolve these issues. We also teamed up with Tolomatic, a company with expertise in electric actuators, and developed a custom actuator with the rigidity and protective sealing the application needed.”

The challenge was to create a multi-axis CNC system that can push, pull and position the drill accurately. “It’s easy enough to apply force and pressure for a single-axis system,” says Igor Glikin, Tolomatic engineer. “But when pushing a force on a multi-axis system, it can make the system unstable if not designed properly.”

There were two problems to solve: providing enough bearing capacity to take the payload; and protecting the actuator against metal shavings and other particles from getting in.

“We created our linear actuator body out of a material with high rigidity and significant moments of inertia in mind and used FEA to calculate how much bending force would be created and if it would cause too much deflection,” says Glikin. “The goal was to make the deflection as small as possible under the required moment or force while getting the actuators to fit inside a small envelope and hitting the cost target.”

“A new Twin profile Rail Stage (TRS) rodless screw-driven actuator solved those two issues,” explains Andy Zaske, Tolomatic vice president. “The rigid aluminum single-body actuator prevents deflection and ensures a perfect cut every time. And the actuator’s flat carriage and sealed band components were critical in preventing metallic shavings created by the drilling and cutting process from getting inside the unit.”

“Tolomatic also has a long history of designing top-notch band sealing actuators that dates back to our pneumatic rodless cylinder roots,” said Zaske. “Band sealing technology let us create a much more robust seal which ensures a long, uninterrupted life.”

The final actuators could carry loads up to 1,249 lb (6.0 kN) and the TRS multi-axis (XY) systems mount carrier-to-carrier with no additional mounting plates.

The final CNC machine, the 9-axis RhinoFab, moves three XYZ systems with three actuators each. There are nine different axis points on each RhinoFab: three on the top, bottom and front. Each XYZ system can accommodate up to three different tool sets to fabricate the storefront and curtainwall window materials. The RhinoFab CNC can create machine extrusions from the top and bottom at the same time. There can also be another actuator for a cut-off saw for making 90-deg. up- or down-cuts to get the component to the required length. Then the part moves out of the fab center and is readied for installation.

During the machining process, the DMG software determines the precise position and number of holes or patterns required



**The aluminum single-body actuator prevents parts from bending and the flat carriage design and seals prevent metal shavings from getting inside the unit.**



**For two-axis motion, actuators can be mounted carrier-to-carrier without additional mounting plates.**

on a given length of aluminum facing. The part is automatically moved into position and the three-axis linear actuator CNC machine drills and routes the top, bottom and front.

“The TRS actuator design started out as a custom product for a specific application,” says Zaske. “Tolomatic has a history of innovating with customers and then using that new concept to launch products that balance engineering designs and customer needs.”

The actuators can be used for any application requiring one, two or three axis configurations, such as machining centers, laser positioning, collaborative robot movement, pick-and-place and material handling.

According to DMG President Brian Hefner, the new machine provides a lot of opportunities for smaller firms. “The machine’s faster throughput gives smaller companies an economical, automated process, which lets them get the most out of their manual labor while letting them bid on larger jobs. What used to be a complex and expensive process is now much more widely available.”

The 9-axis machine has been so successful that DMG has continued to expand its offering of machining centers to include 11- and 13-axis systems, as well as introduce another line of even more rigid and robust TRS actuators for their largest and most rugged systems. ■

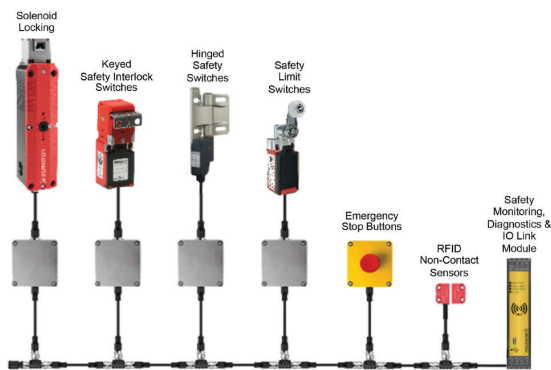
# NEW PLUGGABLE SAFETY SYSTEM SIMPLIFIES INSTALLATION, IMPROVES DIAGNOSTICS AND SAFETY



Instead of direct signaling voltage, this new system features pluggable connections using OSSD outputs to improve diagnostic communication, predictive maintenance, and safety.

## Traditional Safety Circuits

Basic safety systems are typically hardwired as normally closed safety switches and sensors using two redundant circuits, which are monitored by a safety relay. Although this method has been used for many years, there are inherent conditions which could possibly allow a fault in a safety component to be masked, creating an unsafe condition in which a door or gate could be opened while the machine is in a dangerous state.



**Figure 1:** Be sure to incorporate a variety of key safety features into your application.

## Eliminating Fault Masking

Fault masking is a condition that can occur when several safety switches are wired in series. What happens is a single contact or wire short occurs in one component and produces a fault mode in the safety relay. If a different door or gate is opened and closed afterward, the combination of events creates an unintended resetting of the safety relay that overrides the detection of the original fault. The control system interprets that sequence as an indication that the fault has been corrected, which means the machine can be restarted even though the original fault condition still exists. Therefore, the faulty door or panel can be opened while the machine is still running, putting the machine and personnel in critical danger. ISO has addressed this situation with ISO/TR 24119: Safety of Machinery—

Evaluation of fault masking serial connection of interlocking devices associated with guards with potential free contacts.

## Altech's Smart Safety Solution

Altech has introduced their SMART Safety System to eliminate fault masking. The system features safety switches and sensors with redundant OSSD (Output Signal Switching Device) safety outputs. By operating with two pulsed 24VDC signals, the non-tripped state can carry a 24V signal while the tripped state drops to 0VDC. The OSSD outputs self-check in this way: In the non-tripped state, the outputs periodically pulse low. The protective device checks the output to be sure it does go low when commanded to do so. If not, the output has either failed or shorted to 24V somewhere. So, during an idle signal, the 24V signal is periodically pulsed to 0V. An active signal is issued when both lines present 0V—a single line presenting 0V for a duration longer than the test pulse indicates an event. Sensors are run in a cascading order, so that the first sensor checks its state and, if closed, sends a signal to the second sensor, which repeats this action and moves to the third sensor, and so on, all the way down the line for up to 32 daisy chained sensors.

## Switch and Sensor Types Offered

Switches and sensors available with this include non-contact RFID safety switches, self-contained emergency stop buttons, and a transition box that allows dry contact devices to be integrated into the OSSD system (See Figure 1).

## Non-Contact RFID Sensors

Advanced non-contact safety switches, such as the SRF sensor from Altech, incorporate RFID technology to help solve several of the problems associated with other options. Compact in size, these solid-state sensors based on RFID technology generate a signal that determines if the sender and receiver are within range of each other—up to 13mm. RFID is a radio frequency device





*Figure 2: Non-contact sensors provide superior operation under a wide variety of environmental conditions.*

that incorporates a scanning antenna for transmit and receive functions, a signal decoder to interpret collected data, and a transponder (or RFID tag) to relay specific information about the sensor itself.

The scanning antenna delivers the RF signal that communicates with the transponder and provides the RFID tag with enough energy to communicate—for passive operation where the tags do not have batteries. Using the antenna as a power source allows the device to operate for long periods of time for relatively maintenance-free operation. When an RFID tag passes through the field of the antenna, it detects the activation signal from the antenna, which then wakes up the RFID chip, so that it can transmit any information gathered on its microchip to be picked up by the scanning antenna.

In general, RFID tags can be read in a wide variety of situations where barcodes or other optically read technologies are not feasible. Read times are fast,

typically less than 100ms, and are ideal for use with large control systems. A large number of tags can be read simultaneously, making them efficient for plant wide operations. Active RFID tags have their own power source, so that the reader can be farther away and still acquire the signal.

These are typically used to replace keyed switches which require precise alignment to operate properly. Misalignment by only a few millimeters can happen when a door sags or a panel shifts on its hinges. Plus, small shifts such as these can cause damage to the switch or the key. As mentioned above, as long as the RFID elements are within 13mm, the device operates effectively. The SRF sensors also provide a warning whenever the actuator is beginning to travel out of range. Precision adjustment is not an issue (10mm assured sensing ON; 25mm OFF), which is ideal for robots, packaging equipment, and pick-and-place machines that are subject to excessive vibration—a major problem

for keyed or reed switches. In fact, since RFID sensors are solid-state components, they can be used in a wide variety of harsh environments where shock and vibration are a common factor that would damage other mechanical switches (see Figure 2). Another benefit of the non-contact nature of this technology is that with its mechanical-free operation, there is no wear and tear on the components. Non-contact RFID sensors can provide service life up to 20 years.

## Emergency Stop Buttons

Altech also offers an emergency stop button in a connection box enclosure used for direct plug-in integration into the OSSD safety chain (see Figure 3). These feature a twist to release button and an optical status display via LED as well as the transmission of the device status using the DCD diagnostic to the machine control system. Emergency stops provide simple integration into the sensor chain using M12 connections, which allows diagnostic information to be available for every emergency stop device available. The devices also monitor machine compliance via regular test cycles.



**Figure 3:** Emergency stop button with OSSD outputs.

## Transition Box

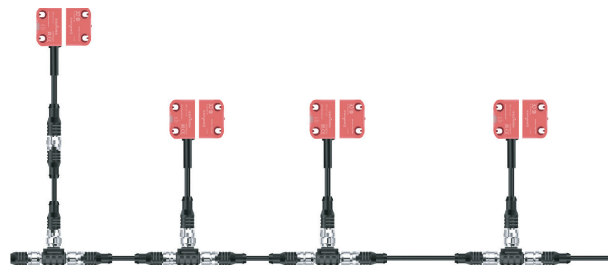
SEU connection boxes provide for the connection of existing dry contact electromechanical safety switches and sensors, such as interlocks or other emergency stop devices, all of which can be integrated into the OSSD safety chain (see Figure 4). Status data can also be transmitted to the connection box via DCD diagnostics.



**Figure 4:** SEU transition box.

## Easy Plug-in Installation and Maintenance

We're talking about simple and quick installation where both the sensor and the actuator are mounted with two screws each and require a minimum amount of alignment. Since they don't have to be perfectly aligned, users have a much wider tolerance for mounting positioning.



**Figure 5:** The SRF safety RFID sensors are daisy chained using the M12 pluggable system.



**Figure 6:** Safety diagnostics operate independently of the safety outputs.

The SRF safety RFID sensors are connected using an M12 pluggable system that includes “T” connectors for plug-and-play series installation (see Figure 5). Ease of connection also eliminates wiring errors that can crop up in manually wired systems. Individual sensors are connected to the sensor chain “main line” using the “T” connector, while the sensor chain “main line” incorporates a four-conductor unshielded cable for additional cost savings. The series line is ended using a standard terminal cap.

Since the sensors are installed in series, there is no need for large wiring bundles when multiple hoods, doors, gates, and panels need to be monitored. Up to 32 switches can be serially connected. The sensors provide safety levels of PLe, Cat. 4 (according to EN ISO 13849-1) and SIL CL3 (according to DIN EN 62061). The transmitter,

receiver, connectors, and wiring are also IP69 rated for adherence to wash-down requirements.

## Industry 4.0 Diagnostic Capability

The concept and drive toward Industry 4.0 includes the idea to include as much data collection capability as possible and making this data available centrally and flexibly to aid in an intelligent production situation. As automation and IT merge, equipment can integrate on a broader level—through warnings prior to a safety problem. This is why Altech’s DCD and I/O Link are so important as companies move into the future.

The systems must provide diagnostics to pinpoint where the problem or potential problem may occur, then communicate that information to the proper sources. Altech’s DCD, as mentioned above, provides



that diagnostics by offering over 20 different types of information that can be monitored through the internal bus system.

Once available, this data can be accessed by the machine's control system via IO Link technology and then be delivered through a standard USB port, PLC, or Android smartphone or tablet (using NFC—Near Field Communication—technology). The diagnostics system operates independently of the safety outputs (see Figure 6). Available data can include actuator detection, operating voltage warnings, status of internal or external feedback loop, actuator code received, and device temperature. The SMART Safety System is able to permanently assign a name and descriptive text to each device, safety chain, and machine, making it easier for the user to identify the corresponding device.

Error messages stored in the diagnostics module, using a time stamp, can be retrieved via all interfaces if needed. Thanks to the NFC function, this important diagnostic information can be read even when there is no voltage on the diagnostic module. This feature allows efficient troubleshooting and accelerates restart of defective machines. Moreover, a fault memory stores system-relevant data to simplify troubleshooting. All this detailed diagnostic data provides a complete status image of each sensor, even when designed into a multiple-sensor series arrangement to support smart production.

## Conclusion

Keeping employees and equipment safe is critical to maintaining continual throughput. Downtime is expensive. This is why installing the proper safety components in your machine will assure that downtime is minimal, and people are safe. Altech solutions provide a wide range of components and systems to allow manufacturers—whether Industrial 4.0 enabled or not—to save time and costs on installation, maintenance, and repair operations. Each component is designed to comply with an appropriate standard while simultaneously providing the necessary safety features needed for your applications.

# ADAPTABLE LOW PROFILE, COMPACT DIN POWER SUPPLIES



Managing the power requirements on a DIN rail system is becoming more challenging with new standards and increased compactness of control systems, particularly when mounted on smaller robotic systems and cobots.

A DIN rail system is one of the most efficient methods used to easily mount a variety of industrial control components inside an equipment rack. More often industrial controls are placed as close to the machine they are controlling as possible, further reducing the need for extra stretches of cables and wires. Although this is great for saving money on installation, it can cause real estate problems as everything become increasingly compact. Designed to be versatile and rugged—even for harsh environments—DIN rail systems are used in a wide variety of industries including utilities, building automation, machine tools, and medical equipment.

Besides standard circuit breakers, relays, and terminal blocks, DIN rail systems often incorporate important high-end components such as programmable logic controllers, motor and motion system controllers, and any number of additional special purpose devices meant to connect and interface with the growing IIoT networks in factories, buildings, and utilities around the world. For machine control, DIN rails often require power supplies that are able to integrate with an array of other devices and equipment.

## Power Supplies

Standard DIN rail power supplies are typically over 5-inches high, 2- to 4-inches wide, and around 5-inches, or more, deep. These components can take up a lot of space on the rail. As DIN rail systems become tightly packed with devices offering special control features for greater industrial control capabilities, a large number of companies have been forced to solicit custom solutions for their power requirements.

A new series of ultra slim metal case DIN rail power supplies have been designed and manufactured by Altech that takes up less than half the space that a current power supply would normally occupy on a DIN rail. In comparison to standard 120 Watt DIN rail supplies that take up about 2 ½-inches of DIN

rail space, Altech's PSC-120 series would need only 1¼-inches of space on the DIN rail. These ultra-compact power supplies make it easy to include additional functionality in the same space as well as for use in shallow cabinets—without increasing costs. These ultra-compact high efficiency units also support 1+1 or N+1 redundancy and built in current sharing functions. These supplies also allow space for additional features to be added to a system on the same DIN rail.

## Universal Input and Output

The Altech DIN rail power supplies are offered with a universal input feature that sets them apart from other products on the market. Regardless of power supply output, each product in the PSD and PSC series has an input requirement of 85-264 VAC/127-360 VDC. Output specifications vary for each unit in the series; for example, the PSC series power supplies provide outputs from 12 VDC to 48 VDC and up to 480 Watts. The PSD series power supplies cover wattages from 15 Watts up to 100 Watts and standard voltages include 5, 12, 15, 24 and 48VDC.

These new PSD and PSC DIN rail power supplies are particularly geared toward applications where the use of narrow cabinets is a necessary requirement due to real estate restrictions. This is particularly the case with the increased number of robots and cobots that are being produced today. The more portable an industrial machine becomes, the more important it is to have the controls—and power supply—available in a compact unit.

## Up-to-Date Certification

Certification is a key requirement in industrial systems design and manufacturing for worldwide distribution. This includes new safety standards based on IEC 62368-1, which are superseding existing standards. While trying to keep things simple for product vendors, regulators in the U.S. and EU had agreed on the date the new standards would supplant the outgoing

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60950-1 and 60065 standards. Vendors were provided this unified target to focus their regulation compliance efforts in two of the most important worldwide markets. On December 20, 2020, the old standards were withdrawn, and any product covered by the scope of EN 62368-1 (the IEC standard as written into law by EU legislators) had to be tested in accordance with the new standard.

Following the EU's announcement, the UL organization in the U.S. confirmed it would move its own Effective Date for UL 62368-1 (the US version of IEC 62368-1) to supersede UL 60950-1 and UL 60065 as well. Therefore, everything changed at the end of 2020. And as the rule-makers have harmonized across the waters, OEMs must now have their new testing procedures and documentation in place.

## Changing to an HBSE-Based Standard

IEC's technical committee had adjusted their standards-making philosophy to aim toward a less prescriptive and more future-proof document that helped create safer products for end users. With equipment increasingly operating in and around humans, we have officially entered the era of Hazard-Based Safety Engineering (HBSE) (see Figure 1). HBSE shifts the emphasis away from demonstrating that prescribed specifications have been met and requires product manufacturers to demonstrate that known hazards have been considered and the product has been designed to be safe to use in the expected context—such as cobots operating alongside a human in a production setting.



**Figure 1:** The HBSE three-block model shown is used to analyze energy classes, transfer mechanisms, and safeguards.

HBSE principles work to protect equipment users by identifying any potentially hazardous energy sources and the mechanisms by which the energy could transfer to a user, while proposing suitable means of preventing those transfers from happening. The scope includes normal operation and fault conditions. Safeguards are put in place to protect against pain or injury caused directly by electrical energy (electric shock) or thermal burn injury, and/or to prevent electrically caused fires that could result in pain, injury, death, or property damage. Importantly, HBSE also measures the effectiveness of the safeguards.

It is important for product designers to recognize that the new standards apply not only to the end product, but also to major components and subsystems used inside the product, such as the power supplies. For this reason, Altech has made sure that all their power supplies for their PSD and PSC series meet the latest standards. New 62368-1 hazard-based safety standards have been fully adopted in the U.S., Canada, EU, and other countries/regions. The older standards have been withdrawn. OEMs must test their new (and existing) products in accordance with the new standard.

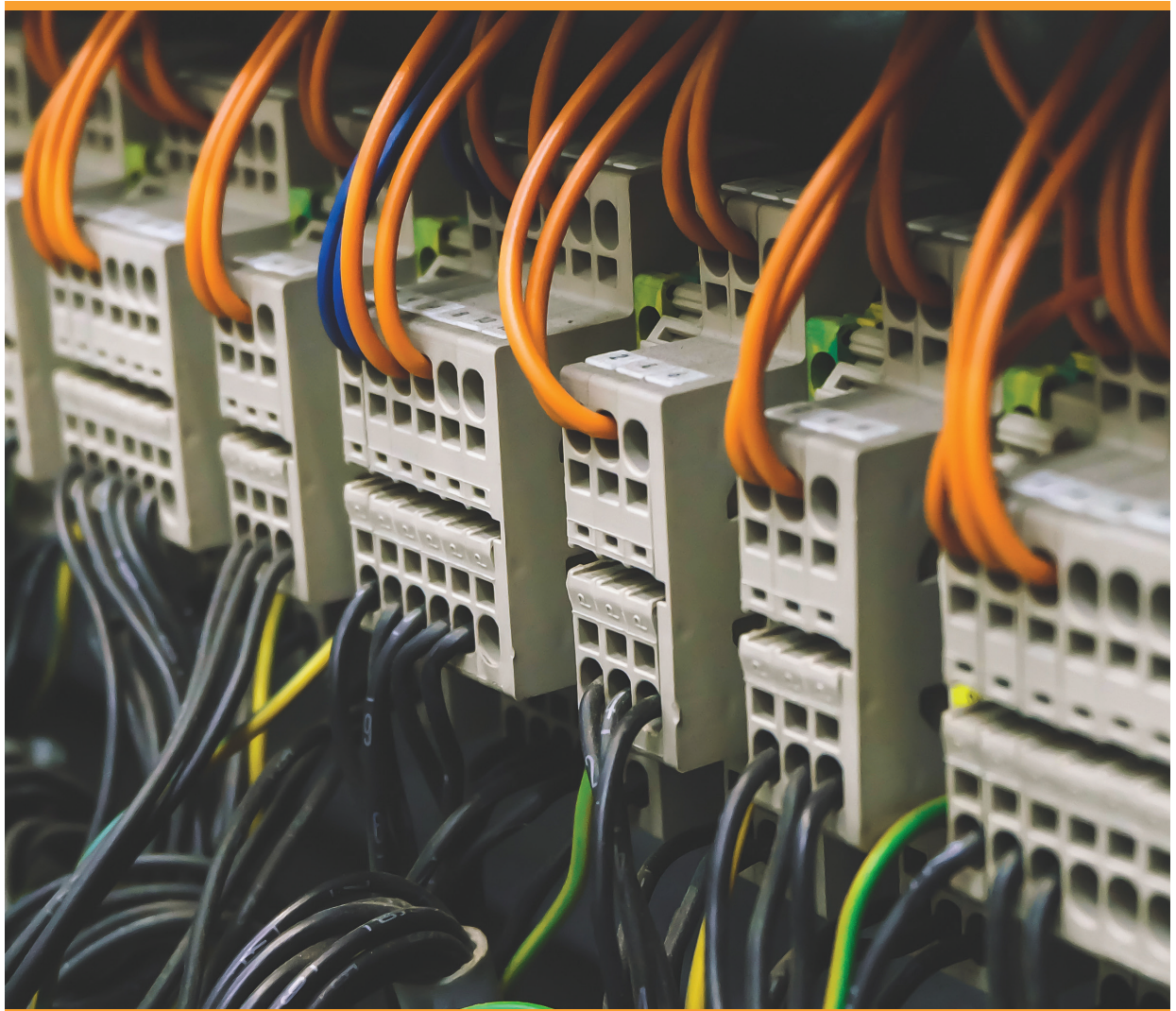
## Conclusion

DIN rail systems are used to save time and costs, allowing components to simply snap or slide into place rather than panel mounting each component separately. This is particularly advantageous for equipment that is operated near and around humans, such as the growing cobot industry. Power supplies for these systems are a key component and must meet the latest certifications as well as operate efficiently. Altech, once again, has stayed abreast of all the latest requirements for the wide variety of industries they serve and are able to supply components that offer high performance at reasonable costs.

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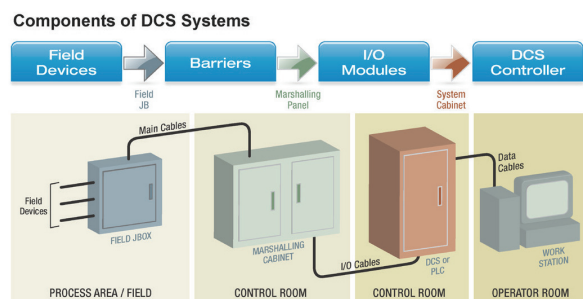
# UNDERSTANDING TERMINAL BLOCKS USED IN DISTRIBUTED CONTROL SYSTEMS



Distributed control is an important part of any factory or processing plant. Autonomous controllers, distributed throughout a system, provide many control loops for operations to take place, eliminating the bottleneck of a single central supervisory control. With the multitude of smart sensors and transducers, motors and encoders, and a range of other devices, industries are being forced to evolve so that control can be distributed throughout a facility. Companies with multiple locations are particularly interested in methods by which all the facilities can work together. Interconnection, through the use of specific terminal block technologies, between elements of a distributed control system is necessary to maintain a smooth operation.

## Components of a Distributed Control System

Each distributed controller, regardless of application, has a standard method of operation (see Figure 1), which starts with field devices. Sensors and transducers are connected directly to the process or piece of factory equipment. Devices include digital sensors such as 0 or 24 VDC or 24 VAC devices and digital actuators such as infrared object counters. Similarly, analog sensors such as 4-20mA and 1-30V devices and analog actuators such as flow control valves are at the manufacturing floor end. These field devices are wired through a field junction box for easy distribution.



**Figure 1:** Illustration of standard distributed control system configuration.

Making sure your sensor or actuator is properly wired into the field junction box is critical (see Figure 2). Altech supports the distributed control system by providing users with a range of DIN Rail terminal blocks capable of interconnecting each segment of the system. Since digital and analog devices provide input signals with one, two, three, and four-wire configurations for a wide variety of uses, the proper terminal block and wiring configuration must be used. Simply put, one-wire connections carry only the sensor signal and nothing else. A two-wire sensor has a signal connection along with a supply connection. The three-wire digital sensor also has a supply grounding wire, and the four-wire sensor incorporates an additional earth ground—used for field sensors.



**Figure 2:** Field junction boxes are located near the sensors and actuators wired to them.

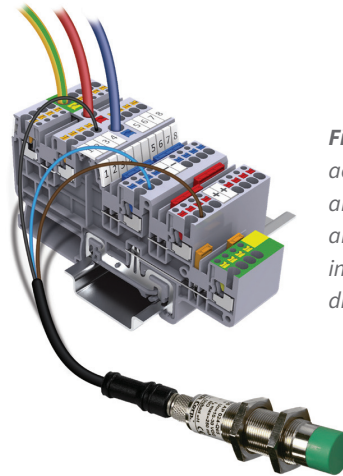
Terminal blocks are used to increase safety and circuit integrity by isolating, fusing, grounding, and otherwise protecting components in an electrical circuit. Standard function for terminal blocks used in field junction boxes is called a feed through block, which means that only the sensor line needs to be “fed through” the terminal block. Ground terminals can be tied together in this case because the sensors share a common ground. This makes the terminal blocks suitable for multiple connections that are insulated from one another. Other types include fused disconnect terminal blocks and



fused disconnect with failure indication. The same standard types of terminal blocks are also available for digital actuators.

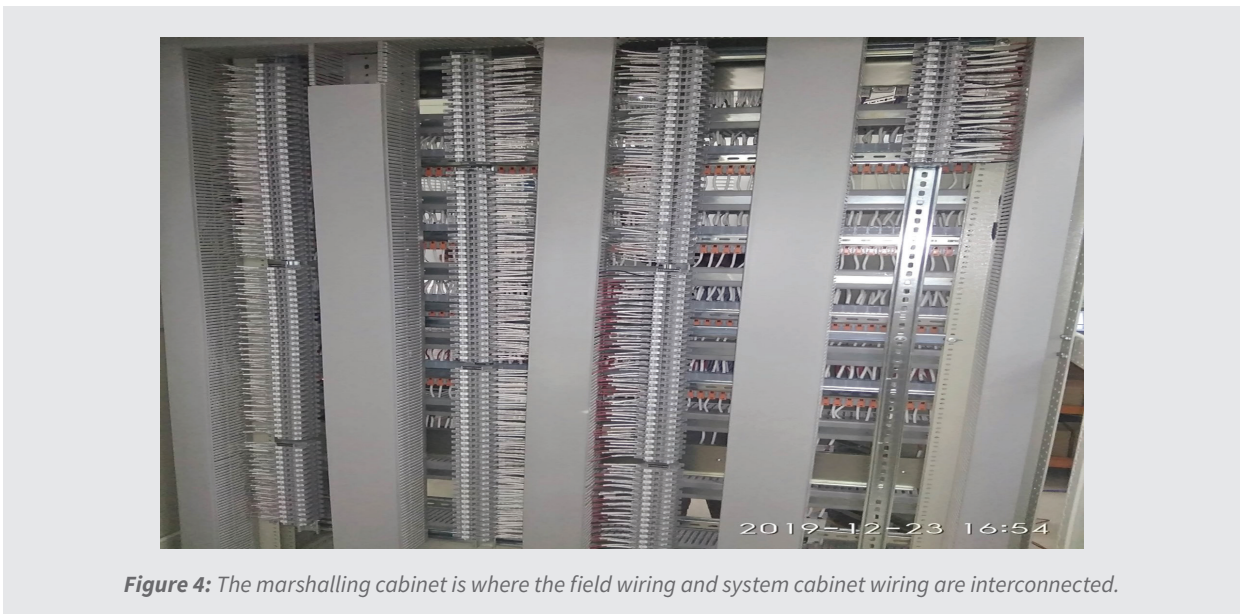
Analog sensors are similarly designed as digital sensors except that the terminal blocks often have to accommodate shielded wires that are used to protect the analog signals from electromagnetic interference, which can interfere with proper output. Terminal boxes for analog signals come in the same, feed through, fused disconnect, and fuse disconnect with failure indication types that digital sensors do.

Sensor and actuator terminal blocks (see Figure 3) from Altech offer key benefits over other products on the market. For example, the company's fused/unfused terminal blocks have an outer profile that matches their feed through terminal block for ease of installation and use. All feed through terminal can be jumpered, thereby eliminating the need for external wire loops at the input. A number of types of cable connections are available, including screw, high performance screw, spring, and push-in.



**Figure 3:** Sensor and actuator terminal blocks are just 3.5mm thick and offer fast and easy installation in several different configurations.

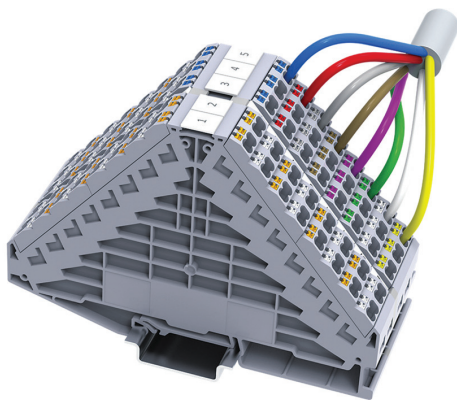
Once the connections from all the field devices have been made inside the field junction box, the appropriate cables are run through the marshalling panel—which is for connections of much higher densities. The marshalling cabinet is the interface between the system cabinet and the field junction boxes. So, not only are the main cables from the field junction box coming



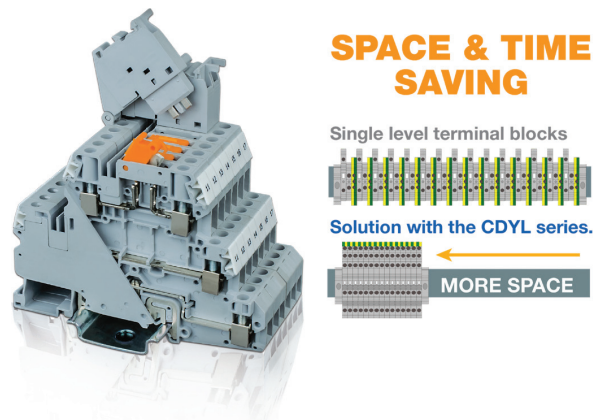
**Figure 4:** The marshalling cabinet is where the field wiring and system cabinet wiring are interconnected.

into the marshalling cabinet, but the cables from the system cabinet I/O cards are also terminated in the marshalling cabinet. Marshalling Panels provide cross wiring functionality between field instruments and the control system. By having this type of interface, input and output issues can be quickly identified and maintenance personnel can perform routine functions in the field without jeopardizing the heart of the control system.

The marshalling cabinet (see Figure 4) segregates digital and analog I/O connections in eight or 16 input form before going to respective I/O cards through barriers or relays. Altech has available eight, 16, and 32 connection assemblies with feedthrough or disconnect terminals and offers an eight-level terminal for extra dense wiring. The same goes for analog signals, except that for analog signals that carry pair wire termination, it is suggested that shield clamps be used. In general, where high volumes of signals are being passed through the junction box, compact designs are an essential part of the design decision being made early in the design cycle.



**Figure 5:** Eight-level terminal blocks handle large numbers of wires.



**Figure 6:** The CYDL multi-function terminal blocks provide users with maximum space and time savings.

Marshalling terminal blocks for distributed control systems must handle large numbers of wires, which is why Altech's eight-level terminal blocks (see Figure 5) are ideal. They help to simplify complex wiring in the process and power generation industries. These terminal blocks are extremely compact at only 9mm thick and 120mm wide. By increasing the wiring density, these marshalling terminal blocks save users a lot of valuable space. In addition, the company offers multilevel fuse terminal blocks that provide a fuse fail indication for high-level functionality, a middle level feed through portion, and a bottom level earthing connection. Combination terminal blocks can save over 50 percent of space over other terminal blocks on the market (see Figure 6).

Distributed control system components from field sensors and actuators through to the controller are subjected to a wide variety of conditions. In harsh and hazardous conditions, devices must be protected.

**Table 1: Hazardous Zone Categorization**

Zone	Description	State
Zone 0:	Area where an explosive atmosphere is permanently or frequently present as a mixture of air and flammable materials	Gas, vapor, or mist
Zone 20:	Area in which an explosive atmosphere is present in form of a cloud of flammable dust in air permanently or often	Cloud of dust
Zone 1:	Area where it must be expected that an explosive atmosphere is present occasionally in normal operation	Gas, vapor, or mist
Zone 21:	Area where it must be expected that an explosive atmosphere is occasionally present during normal operation	Cloud of dust
Zone 2:	Area where it must not be expected during normal operation that an explosive atmosphere is present but might occur momentarily	Gas, vapor, or mist
Zone 22:	Area where it must not be expected during normal operation that an explosive atmosphere is present but might occur momentarily	Cloud of dust

One categorization occurs in different zones based on the presence of flammable or explosive gasses and the time a device might be exposed to them (see Table 1: Hazardous Zone Categorizations).

### Conclusion

Regardless of your application, you'll need to use terminal blocks that are capable of handling your every need. When selecting a supplier, be sure you know their capabilities. Your supplier should understand your application needs, as well as be able to offer insight and suggestions into which products to use. Whether you are working in discrete manufacturing or process control industries, incorporating the right terminal blocks will save you time and money for years to come.

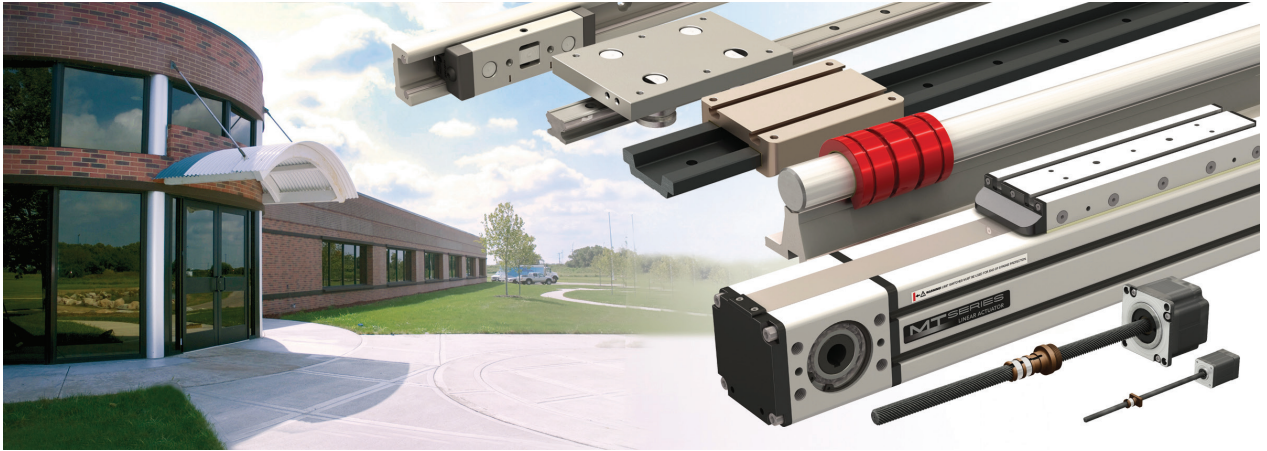


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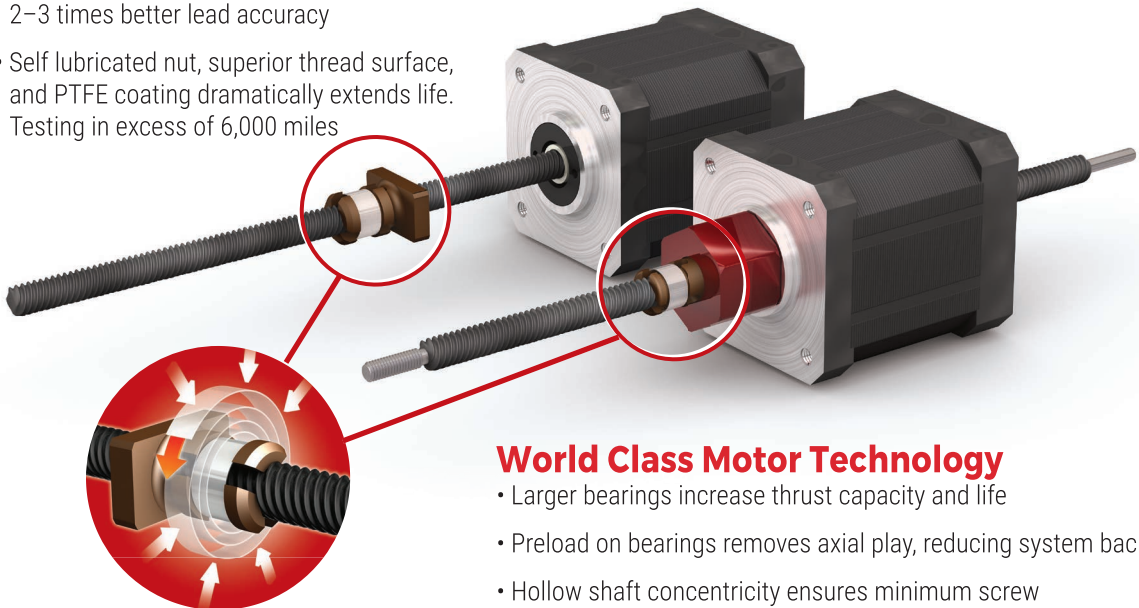


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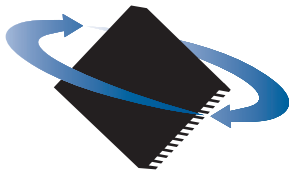
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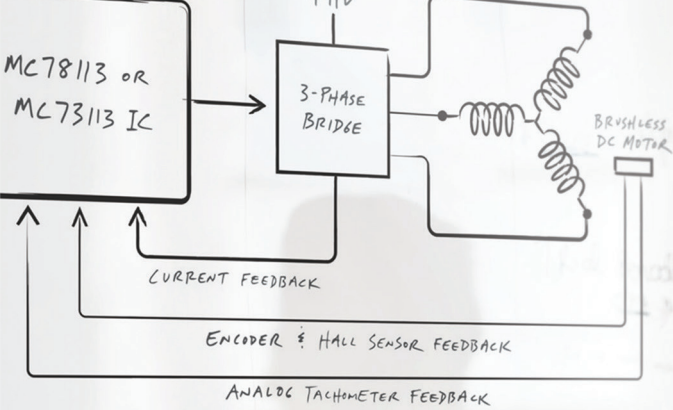
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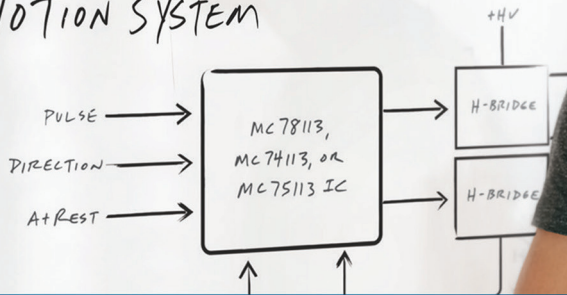
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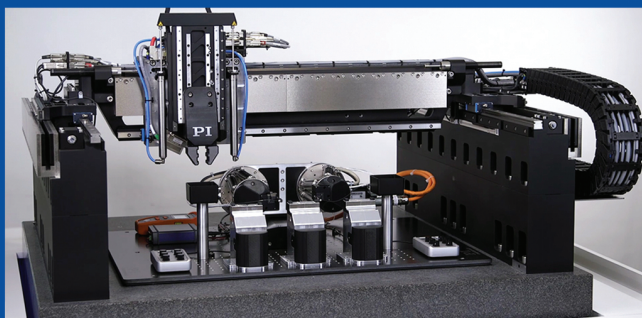
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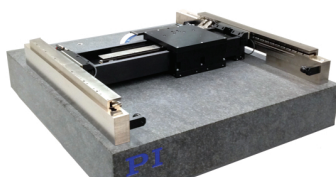
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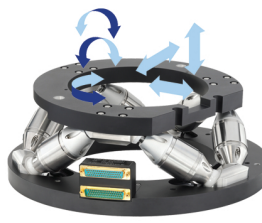
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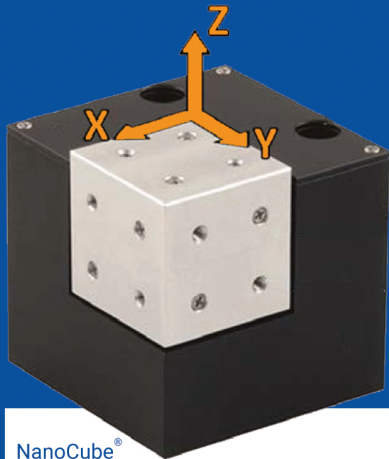
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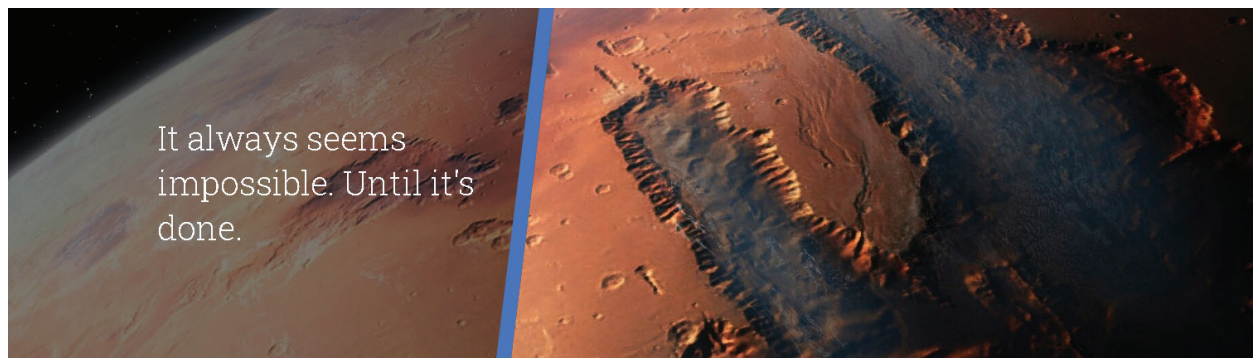


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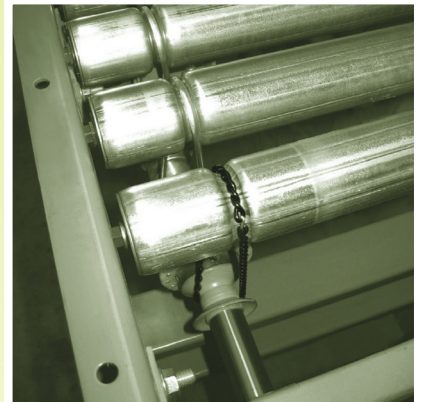
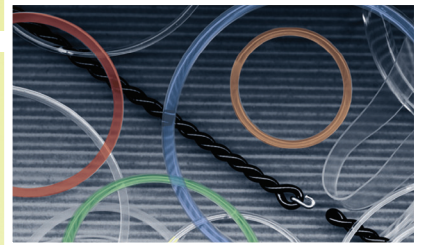
As an ISO 9001 certified company, we are committed to continuous improvement — in processes, products and efficiency. Pyramid manufactures drive belts of the finest polyurethane and pride ourselves on our exceptional customer service, competitive pricing and excellent lead times. Our staff of dedicated, trained employees truly care about product quality.

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FAX | 914-347-1567

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## SCHMERSAL - THE DNA OF SAFETY

**M**achine safety is a complex topic. Companies are increasingly calling on qualified specialists for support. For Schmersal, safety is in our genes – our company is now managed by the third generation of the Schmersal family. But that's not the only reason machine safety is part of our DNA: 75 years of competence and expertise allows us to develop excellent safety solutions for individual plants, for machine builders, and operators.

Since 1945, Schmersal has been industry leader in the design and manufacture of machine safety products, industrial switches, position sensors, and control accessories for a wide variety of applications. As safety requirements have changed over the years, Schmersal products have evolved as well. We're constantly adding new innovations to our range of products, such as:

- Electronic safety switches utilizing RFID technology
- "High" level coding of switches for tamper resistance, to ISO 14119
- Bi-Stable locking of solenoids
- Bluetooth interface for Safety Light Curtains

Schmersal is your one-stop shop for developing safety solutions - combining the building blocks of safety rated components with control systems and software for customized and comprehensive safety systems.

Motivated by the vision of safe working environments and leveraging our vast experience in machine safety systems, Schmersal also offers machine builders and production facilities qualified services related to machine safety in support of our considerable range of safety products and system solutions. Through seminars and training, risk assessments, technical support, consultancy and integration program services we support safety engineers with first-hand specialist knowledge.

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LED status indicators  
visible from 3 sides  
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or emergency exit (T)  
options.







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## Schmersal Safety Light Curtains with Bluetooth interface

Schmersal SLC440 safety light curtains are now available with an integrated Bluetooth interface for data sharing with smartphones & tablets.

The SLC440 BLE uses the Bluetooth Low Energy system for secure data transmission, up to 5 meters. The data transmitted from the safety light curtains is accessible by the Schmersal **SLC Assist App**, available for Android and iOS smartphones and tablets.

The SLC440 offers many integrated functions including fixed blanking, floating blanking, fixed blanking with movable edge region, double reset, contactor control (EDM), automatic mode, restart mode, and beam coding.

This unprecedented access to the operational data of the Safety Light Curtain has many advantages:

- The app serves as an installation alignment aid as it displays the signal strength of each beam.
- Real time monitoring of the active operation mode, the status of the OSSD outputs and the status of the protective field provides the information necessary to quickly resolve faults.
- The app can provide documentation on the light curtain, either emailed or saved to the smartphone or tablet.
- Additionally, you can see which functions have been enabled and their parameterized settings.

Contact us to learn more about this innovation in safety light curtains  
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## MADE IN GERMANY — QUALITY BY TRADITION, THE HEART OF SIKA

Founded in 1901, we invented the industrial thermometer. Today, we develop and manufacture a wide range of products for temperature, pressure, and flow measuring instruments. We also manufacture a full line of pressure and temperature calibration products. Your success is our goal by meeting your needs with precision German engineering. As your preferred supplier, we want you to benefit from our experience and worldwide network of subsidiaries and channel partners.

### WE MEASURE UP

SIKA's produced over 15 million dial and digital thermometers including industrial thermometers, thermo-sensors, and digital reference sensors.

We replicate customer applications in our labs, test for service life, and extreme stress from thermal shocks and vibrations. It's a prerequisite to our commitment to quality and workmanship.

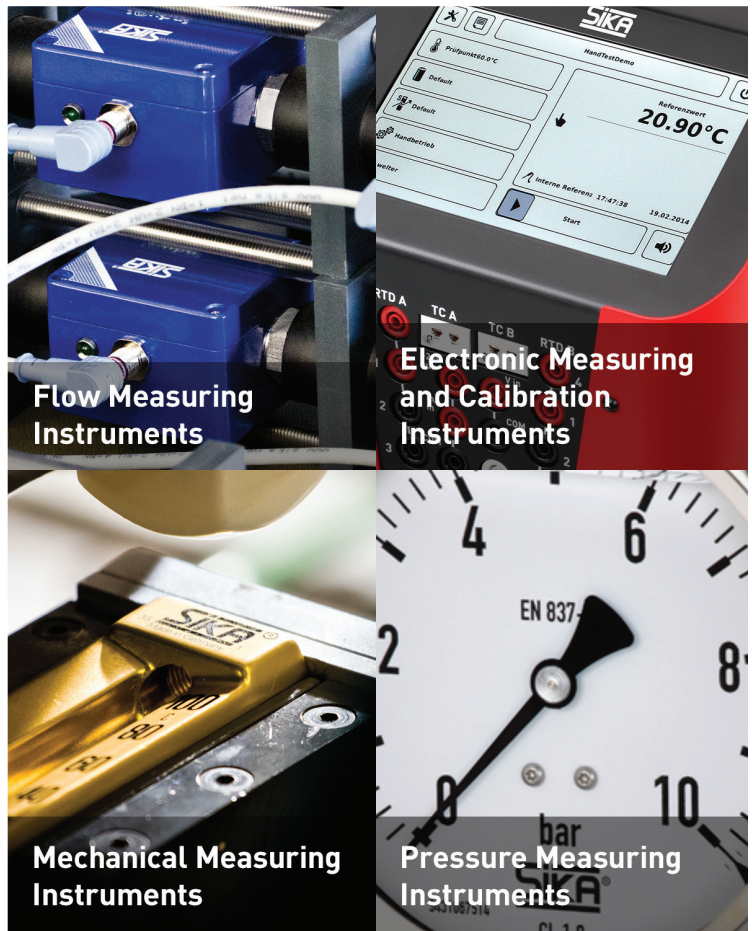
SIKA pressure products include bourdon tube, differential, diaphragm, and capsule element pressure gauges and sensors. We offer a variety of configurations for most industrial class applications.

50 years of international experience in flow measurement technology has evolved to the SIKA VVX32 and VVX40 vortex flow sensors — industrial flow meters with no moving parts. Built for the rigors of commercial and industrial applications while providing a reliable and accurate flow signal, not only for volume OEM manufactures but also for the system integrators.

Our calibration products include hydraulic and pneumatic pressure pumps and digital reference gauges. The integrated vacuum generation enables working in the vacuum range down to -950 mbar — available with different accuracies to meet the requirements of most applications.

The portable hydraulic and pneumatic pressure pumps from SIKA are a clever solution for testing, adjusting, and calibrating pressure gauges and sensors — commonly used in metrology labs and in the field.

We also offer a full line of multi-function temperature calibrators for marine, industrial, and laboratory grade environments providing fast and reliable calibration by simply



Flow Measuring Instruments

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Pressure Measuring Instruments

changing between micro-bath, dry-block, infrared, and surface functions. Our laboratory grade calibrators offer the worlds fastest response times with stabilities to 0.05 C (0.09 F).

### OUR HERITAGE

SIKA Dr. Siebert & Kuhn GmbH is based in Kaufungen Germany. Founded in 1901 by Dr. Carl Siebert and Albert Kuhn, is a fourth generation family owned and operated company.



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- No moving parts
- Nominal diameters 1 ¼" and 1 ½"
- Multiple output signals
- Optional temperature sensor

Our new vortex flow sensors, the SIKA VVX32 and VVX40 are industrial flow meters with no moving parts. Built for the rigors of commercial and industrial applications while providing a reliable and accurate flow signal, not only for volume OEM manufactures but also for the system integrators. Multiple output signals available along with a variety of optional temperature sensors.

## WE MEASURE...

### PRESSURE



Bourdon tube, differential, diaphragm, and capsule element pressure gauges offer a wide range of pressure and accuracy options for most industrial applications.

### TEMPERATURE



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Smalley stocks over 10,000 standard parts across 30 configurations and 400 sizes, ready for delivery. If a standard part doesn't meet your requirements, you'll work with our team of over 30 industry-specialized engineers to quickly create an economical custom part in the material of your choice, all without new tooling. Prototype or production volume, our No-Tooling-Charges™ manufacturing process meets the design flexibility your application, budget, and timeline requires.

While all of our manufacturing is produced in our U.S. based 300,000 ft<sup>2</sup> facility, our global network of offices, engineers, and distribution partners allows you to quickly receive parts and support from anywhere in the world. Smalley's dedication to quality and manufacturing excellence has earned us multiple service and quality awards as well as the trust of OEMs worldwide.



## CREATING APPLICATION-SPECIFIC SOLUTIONS

From everyday consumer products such as the smartwatch on your wrist to life-saving medical devices such as robotic surgical instruments, Smalley has helped tens of thousands of engineers and professionals create application-specific solutions across every industry.

Smalley has paved the way to become the world leader in rings and springs because of our personalized application-support, industry expertise, and customer-driven commitment.

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- **Safe and easy installation** requiring no special tools
- **Groove interchangeable** with stamped rings

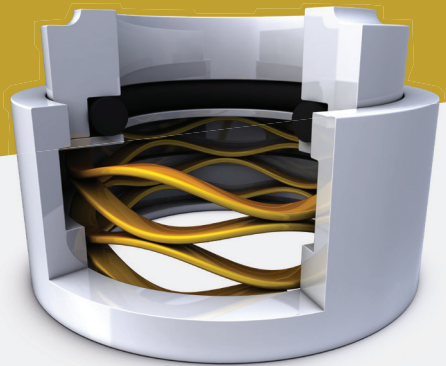
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- **Easy customization**, design around your application with No-Tooling-Charges™

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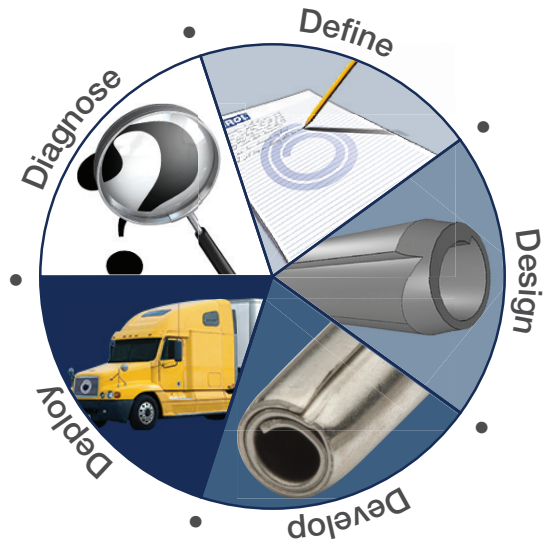
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## PROVIDING FASTENING SOLUTIONS SINCE 1948!

**S**PIROL provides high quality engineered fasteners and shims that improve the quality of your assembly, extend the life of your products and reduce your manufacturing costs.

SPIROL's Application Engineers have 73 years of experience in design, manufacturing, and installation of engineered fasteners. In addition to a comprehensive line of engineered fasteners & shims, SPIROL offers installation equipment to facilitate cost-effective, high quality assembly of your products.

They partner with your team starting in the design stage until the product launches to ensure your quality, performance and assembly objectives are completely satisfied.



### Application Engineering Support

Through partnering with companies in the design stage, SPIROL not only helps design the engineered component used for fastening and joining, but they also make the critical recommendations for the interface between their product and your assembly.

### Local Design, Global Supply

SPIROL has Application Engineers throughout the world to assist you in your designs, supported by state-of-the-art manufacturing centers and worldwide stocking facilities to simplify the logistics of delivering your product.



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SPIROL is the only manufacturer of engineered fasteners that offers a total integrated solution. Since the invention of the Coiled Spring Pin in 1948, SPIROL continues to introduce new products and improve existing ones — passing substantial savings on to you. Their diverse product line includes Coiled Spring Pins, Slotted Spring Pins, Solid Pins, Disc Springs, Alignment Dowels and Bushings, Spacers, Compression Limiters, Inserts for Plastics, Shims, and Installation Equipment. Most heat-treating and finishing processes are performed in-house to ensure consistent quality. You benefit from a choice of over 30,000 standard products, no tooling or development costs, and ultra-responsive delivery.

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Since 1948!

# Innovative fastening solutions. Lower assembly costs.



Coiled Spring Pins



Solid Pins



Slotted Spring Pins



Alignment Dowels & Bushings



Ground Hollow Dowels



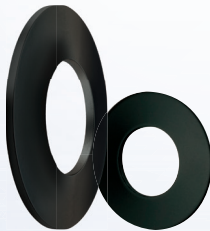
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Compression Limiters



Spacers



Disc Springs



Precision Metal Shims & Washers



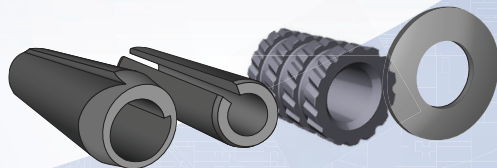
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## MANUFACTURER OF LITHIUM BATTERIES PROVEN TO LAST FOR 40 YEARS

**T**ADIRAN is the leading manufacturer of bobbin-type lithium thionyl chloride ( $\text{LiSOCl}_2$ ) batteries that power remote wireless devices. Tadiran industrial grade  $\text{LiSOCl}_2$  batteries feature extraordinarily high energy density and high capacity along with the widest possible temperature range, making them ideal for use in harsh environments. Tadiran XOL Series bobbin-type  $\text{LiSOCl}_2$  batteries feature an annual self-discharge rate of just 0.7% per year, enabling certain wireless devices to operate for up to 40 years, up to 4X longer than competing batteries that have annual self-discharge rates of up to 3% per year. For applications that require periodic high pulses to power advanced two-way wireless communications and remote shut-off capabilities, Tadiran offers PulsesPlus® batteries that combine a standard bobbin-type  $\text{LiSOCl}_2$  cell that provides low background current with a patented hybrid layer capacitor (HLC) that delivers periodic high pulses. The patented HLC features a unique end-of-life voltage plateau that can be interpreted for low battery status alerts.

### INDUSTRIAL GRADE LI-ION RECHARGEABLE BATTERIES

To meet the growing demand for remote energy harvesting applications, Tadiran manufactures TLI Series industrial grade Lithium-ion (Li-ion) batteries that significantly outperform consumer grade Li-ion rechargeable batteries. Unlike consumer grade Li-ion batteries that have a limited lifespan of approximately 5 years and 500 full recharge cycles, TLI Series batteries can operate for up to 20 years and 5,000 full recharge cycles. TLI Series batteries also feature an extended temperature range and can deliver the high pulses required for advanced wireless communications, making them ideal for long-term deployments in remote locations and extreme environments.



### HIGH ENERGY LITHIUM BATTERIES

For applications requiring extended storage life followed by high current drain, Tadiran offers TLM Series lithium metal oxide batteries. Packing powerful amounts of energy into small spaces, TLM Series batteries are utilized in medical applications such as portable defibrillators. They also allow battery-operated surgical drills to be smaller and more ergonomic to reduce fatigue while at the same time delivering the high torque required for efficient drilling cycles. TLM Series batteries also provide a lower cost COTS solution for military applications. For example, TLM batteries enable more miniaturized guided munitions to be periodically tested for system readiness whereas legacy reserve/thermal batteries are bulkier and do not permit system readiness testing without exhausting the battery.





## DOES THIS MAKE SENSE?

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## DOES THIS MAKE SENSE?

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\* Tadiran LiSOCL2 batteries feature the lowest annual self-discharge rate of any competitive battery, less than 1% per year, enabling these batteries to operate over 40 years depending on device operating usage. However, this is not an expressed or implied warranty, as each application differs in terms of annual energy consumption and/or operating environment.

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The Lee Company story of innovation never ends. Ongoing research, design, and development helps us advance the technology behind our products to transform the most demanding challenges into deliverable solutions. This commitment to technology allows Lee to foster creativity and offer the best products and technical support available.

The Lee Company now employs over 1000 people and occupies over 1 million square feet of modern manufacturing space at three sites in Westbrook and Essex, CT. Sales offices are located throughout the USA and the company is represented worldwide by wholly owned subsidiaries, distributors and agents.

### ELECTRO-FLUIDIC SYSTEMS DIVISION

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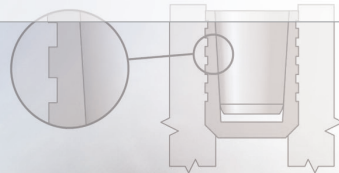


### PRECISION MICROHYDRAULICS DIVISION

**THE PRECISION MICROHYDRAULICS DIVISION** supplies expansion plugs, high pressure solenoid valves, single and multi-orifice restrictors, nozzles, safety screens, check valves, relief valves, flow controls and shuttle valves to a wide range of industries. These include hydraulic and pneumatic applications on commercial and military aircraft, spacecraft, missiles, naval vessels, machine tools, downhole oil tools, power generation equipment, motorsports, etc.



The Lee Company



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**A**t Xometry, we created a proprietary software platform to enable product designers and engineers to instantly access the capacity of a network of manufacturing facilities. Our platform makes it possible for customers to receive instant pricing, expected lead times and manufacturability feedback in seconds. At the push of a button, the network is able to deliver high-quality parts at consistently fast lead times while offering very low prices.

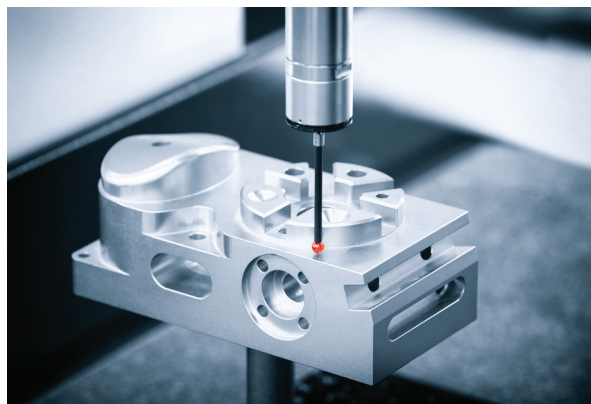
We make it easy for all customers — from startups to Fortune 100 companies — to access manufacturing on demand by providing the most efficient way to source high-quality custom parts. We're dedicated to providing an innovative way for customers to easily work with a broad network of manufacturing facilities.

Xometry launched in 2014 and has grown rapidly, driven by the ease of our instant quoting platform, our manufacturing expertise, and our relentless devotion to helping customers with their project engineering needs. In 2018, Xometry acquired MakeTime, another leader in the manufacturing-on-demand space to create the single largest manufacturing partner network in the industry. In 2019, Xometry acquired Shift, Europe's largest CNC manufacturing network. Our partner network now spans the globe to support the needs of customers and to help drive the business of local machine shops and manufacturing facilities. Partners do not pay to sign up for our network. Our algorithm sends jobs to a list of carefully vetted facilities with matched capabilities. Xometry's Project Engineering team is always responsible for making sure the parts are done correctly and on time.



Our capabilities include **CNC Machining, Sheet Metal Fabrication, Direct Metal Laser Sintering (DMLS), Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM), HP Multi Jet Fusion, PolyJet 3D, Die Casting, Binder Jetting, Urethane Casting, Finishing Services, and Injection Molding**. We can produce a wide range of quantities, from single-use prototypes to hundreds of thousands of molded parts. Some of our top customers include NASA, BMW, GE, Bosch, and Dell Technologies. We are ITAR registered and AS9100 and ISO 9001:2015 certified and all of the work we do is covered by the Xometry Quality Guarantee.

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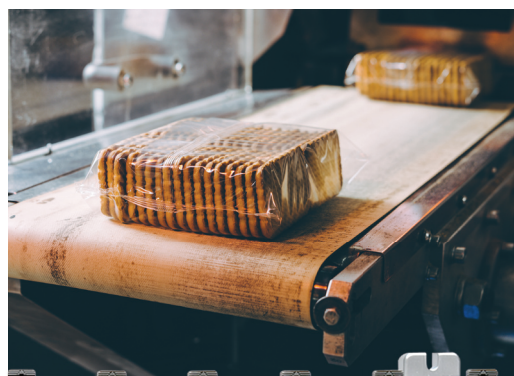
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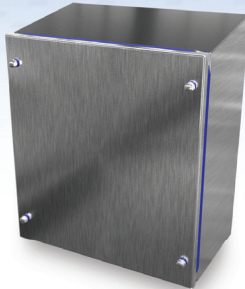
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