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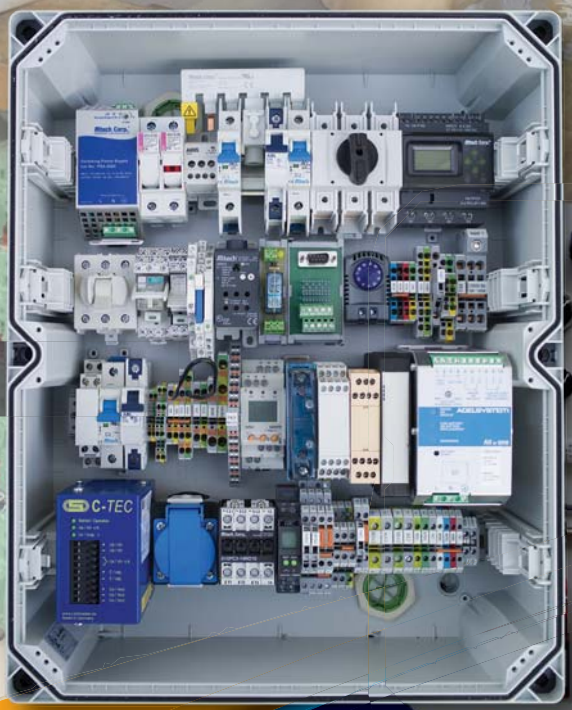

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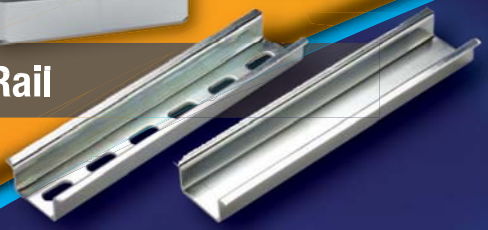

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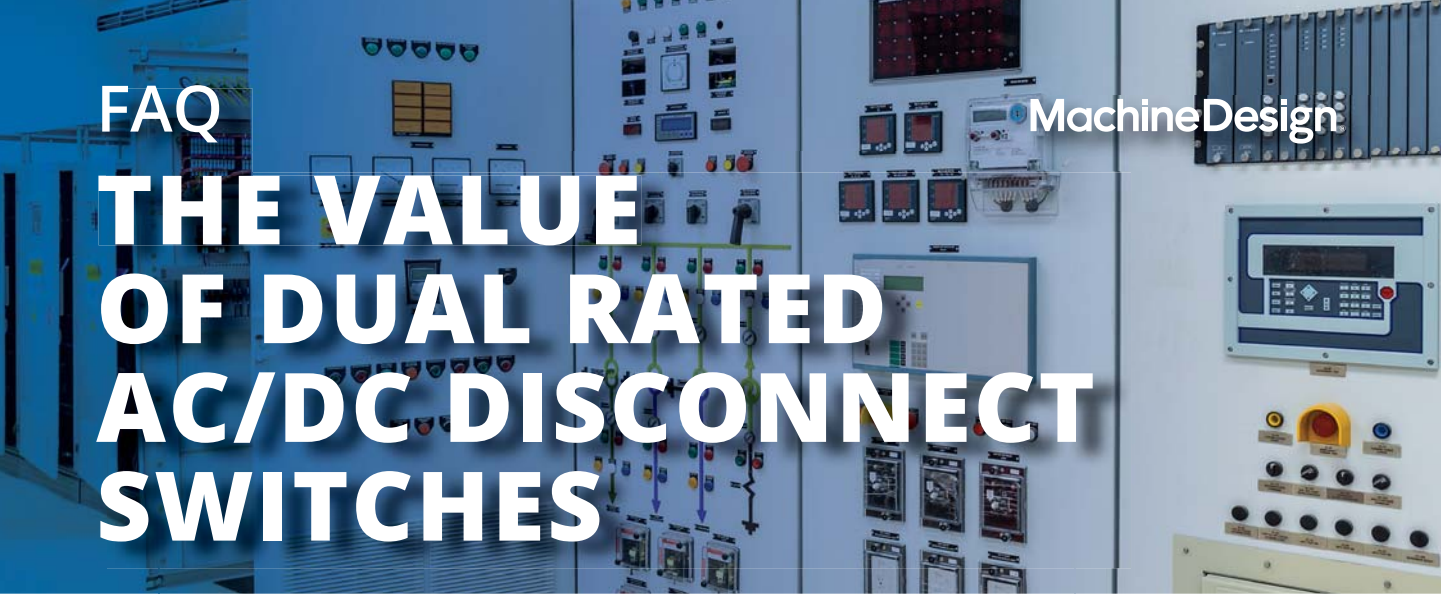

FAQ

Machine Design

THE VALUE OF DUAL RATED AC/DC DISCONNECT SWITCHES

Q: Why is it necessary for me to have a disconnect switch installed in my application?

A: The main function of a safety disconnect switch is to protect personnel from harm and equipment from damage. Disconnect switches are used to guarantee that a specific electrical circuit is de-energized in the case of an emergency failure, service requirement, or maintenance operation. Disconnect switches have become critical components for electrical distribution systems whether for plantwide use or isolated areas so that technicians can provide repair and maintenance of one machine while the rest of the facility operates normally. In addition, the National Electric Code mandates that disconnect switches are used in all industrial and manufacturing facilities.

Q: What does a DC motor disconnect switch do?

A: An AC disconnect switch is designed to separate the inverter from the electrical grid, while a DC disconnect switch is designed to separate the equipment from the DC source. Until recently, users had to purchase each of these separately, but companies have created innovative products, like the dual rated disconnect switch that combines both functions for ease of use. The switches must be installed in such a way that incoming power can be quickly shut off whenever an emergency occurs.

Q: How is it possible that these disconnect switches have evolved to this point?

A: A number of factors pull together whenever there is an advancement. Innovation, of course, is an ongoing thing, but other aspects can push technology forward more quickly. For example, as markets change, the availability of materials changes, and the needs of manufacturing change, design teams adjust to meet those situations. At that point, engineers are tasked with not only coming up with new devices to meet present challenges, but to project into the future as well. Only companies with a history in the market have the insights needed to provide this type of innovation.

Q: Could you further discuss some of the technologies used inside these disconnect switches?

A: High-grade plastics are used to make the switch bodies, which are designed to handle most harsh environments on the factory floor. The tough bodies also operate within a wide temperature range and provide users with a shock resistant and chemical resistant product. Contact quality inside the device was also something the design team focused on. Silver plated contacts and rivets were used throughout the device in order to assure long life and better conductivity.

Q: With the dual rated disconnect switch, do I need additional panel or control room space?

A: Not at all. Technology advancements have added to an engineering team's ability to design products with greater capabilities while maintaining the same form factor. In fact, with smaller areas of real estate being available in such applications as robotics and lab equipment, disconnect switches are often mounted close to the device. This meant that size was a critical factor in the design.

Q: What specific products are on the market now that meet these challenges?

A: At this time, Altech has recently introduced the LSF series of disconnect switches that are the only DC switches available in a compact frame size that is dual rated for AC and DC. Due to the needs of the industry, these switches have been made available for mounting in multiple ways, including with an integrated base and DIN-rail mounting, and a separate RT version with integrated door mounting and side panel mounting.

Q: Could you supply some technical details concerning these disconnect switches?

A: Basically, the RT devices are provided with rear facing terminals to make them easy to install. For electrical box installations, there are two mounting versions that are dependent strictly on user requirements.

The first option is an extended handle application where the shaft sticks out beyond the electrical box for easy access and interlocks with an external handle so that the box cannot be opened until power is turned off *(see Figure 1)*. Frame size it only 36mm (W) x 71mm (H) x 46mm (D), without integrated switching knob and panel mount tabs.

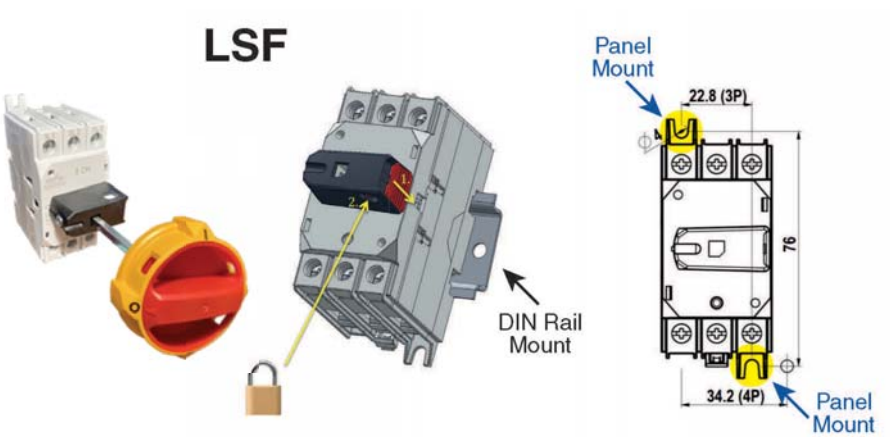

Figure 1: The extended handle application uses a long shaft that sticks out beyond the electrical box for easy access.

Q: Could you supply some technical details concerning these disconnect switches? ***(continued)***

The other option is a panel mount version. This disconnect switch is typically installed in a side panel and requires users to drill a small 22.5mm hole into their panel. The hole is used to accommodate the rear-mounted disconnect switch *(see Figure 2)*. Once installed, a knob is attached to the front of the panel for easy access.

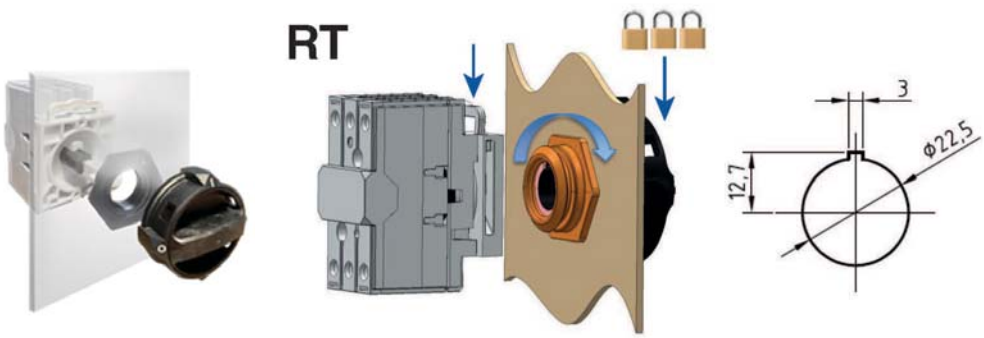

Figure 2: The panel mount option for the LSF series disconnect switch is easy to install.

Both mounting options have only three parts, unlike most other products on the market that have multiple parts and can be complex to install. The entire LSF series of disconnect switches are available for a wide variety of applications. They are available in 16A, 30A, and 40A versions and offer UL 60947-4-1 certification.

Q: Are there any other important design features I need to know about?

A: There is another feature that has to do with the switch's make/break operation, which is independent from the operator's turning speed. The actuator arm essentially has nothing to do with changing the switch's state. Internally, the switch is spring loaded so that the DC current cannot arc or burn up the contacts after multiple uses. The switch is turned to a certain point and then snaps into place and cannot be backed off.

Q: While incorporating new designs and new technologies, does this affect supply chain deliveries?

A: Great question. When thought through properly, design and automation go hand-in-hand with supply chain considerations. New designs, such as the LSF series, go through rigorous analysis to assure that quality is maintained through the entire line of products being manufactured and that an equal amount of attention is paid to the availability of materials and the reduction of the number of component parts—all aimed at maximizing supply chain capabilities while minimizing the challenges.

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From the Editor

By Rehana Begg, Editor-in-Chief

A Nod to Agile Management During Uncertain Times

A special editorial message on the occasion of Altech's anniversary.

THIS SPECIAL EDITION of *Machine Design* is sponsored by Altech Corporation. On Altech's 40th anniversary, producing this issue has given us the pleasure of sharing in the celebration.

In an interview with *Machine Design*, Altech's president, Mario Meise, talked about the past, present and future of the company that his father, Heinz Meise, founded 40 years ago. This milestone year understandably represents much more than an homage to the company's history and the appreciation Meise has for the members of his team. It is also a moment of reflection.

Machine Design rarely features leadership profiles, but the biographical framing for an anniversary issue is not only apropos but it was made palpable during the conversation with Mario Meise and his son, Taylor. Altech's experience working through the COVID-19 pandemic is a case history that makes clear how the "perfect storm" of supply chain disruption—including labor shortages, morphing supply chains and pressure on budgets—affected hundreds of thousands of small and large businesses. For its part, Altech exemplifies how one company worked to increase resilience, find equilibrium and prioritize sustainability when hit with shocks.

Several articles in this issue benefit from Altech's insider knowledge. Members of their team contributed reference articles on key components and solutions in Altech's portfolio. It is packed with serviceable information that readers will want to bookmark, from guidance on DC uninterruptible power supply (DC UPS) systems, to the essentials of miniature circuit breakers and safety derived from disconnect switches. These articles will pay dividends.

Four decades in business by any measurement is cause for celebration. Here's to many more years of success and innovation. Congratulations! ■

Reach me at rbegg@endeavorb2b.com.

Courtesy Altech Corp.

The Principals Behind **40 Years** at Altech's Helm

Why the multigenerational leadership style behind Altech Corporation is built on listening to the market.

by Rehana Begg, Editor-in-Chief

IN A RAPIDLY EVOLVING WORLD, guiding an organization to be responsive is a formidable challenge. Building a business for long-term success requires focusing on big-picture, sustainable decisions and being prepared to adjust when necessary. It also means steering clear of myopic behavior.

This is the overarching message Mario Meise, president, Altech Corporation, conveys when he hops on a Zoom call with *Machine Design* to talk about 40 years as a supplier of industrial control components and instrumentation. Four decades is a significant milestone for any family-run business, and for Meise, it is a moment to reflect on what it takes to remain resilient.

Starting With Spare Parts

When Heinz Meise founded Altech Corporation in 1984, his business vision was to source spare parts for users of European equipment in the United States.

It was a business he was credentialed to pursue. As an electronics engineer, Heinz had worked on rocket systems while still in German service and stationed in Texas.

Heinz Meise

"My father's first job was with a company called AEG Telefunken, which was back then a contemporary to Siemens," recalled Meise. "Unfortunately, now it's a defunct company, other than when it pertains to appliances in Germany. They used to build power stations, transformer stations, all sorts of different things."

Tired of corporate life, Heinz Meise ventured into his own startup. Supported by his wife, Estela Meise, he anchored his company headquarters in Flemington, N.J. because of the proximity to major highways, major airports and major ports.

"Somewhere between Germany, Texas and New Jersey, that's where I came to be," mused Meise. "I must have been in my mid to early teens, but I remember my dad asking me in his study, 'I'm going to start my own company; what should we name it?'"

That early memory of involvement in decision-making provides a perspicuous glimpse into generational leadership and the unique dynamics that involve family ties, succession planning and being considerate of the viewpoints of different generations.

Meise was 27 when he was entrusted with the responsibility of running the company. "I literally grew up with the business," he said. "I've done every job in the company. I've put together assemblies, I've picked up freight from the airport, I've taken orders to the airport late at night, no matter what. We started with spare parts, essentially."

Meise's son, Taylor Meise, is on the call, too. "I became the warehouse manager in April 2020," said Taylor, whose transition to a full-time role in the company follows a conspicuously similar pattern. Like his father, Taylor honed his skill set from the ground up, first by helping to label packages in the warehouse and performing odd jobs, and later to doing anything from packing, shipping and receiving to making assemblies, taking pallets to distributors and driving scrap to the scrapyard.

Leading Through Difficult Times

Out of 33.2 million small businesses in the United States, few can report of not being challenged to adapt their supply chains to the ebb and flow of the market. And even though economic cycles move from expansion to contraction and back again, leaders can only confirm their organizations are truly resilient when they face adversity and overcome challenges.

Altech is no different. For Mario, there are two standout events: the Great Recession and the COVID pandemic.

"We survived 2008; everybody did," Meise said. "Interestingly enough, we did very well during COVID."

The manufacturing sector suffered severe consequences from the 2008 recession. Even though the recession ended in June 2009, economic weakness persisted. From peak to trough, U.S. GDP fell by 4.3%. Economic historians typify it as the "deepest recession since World War II." Globally, the speed of orders dried up and production was cut back.

Amidst the uncertain demand environment, firms following just-in-time inventory practices were hit hard. Despite the headwinds, Altech was able to bounce back, Meise intimated.

When the COVID pandemic hit in March 2020, it brought a whole new set of challenges. Lockdowns, shelter-in-place orders and travel restrictions triggered unprecedented disruption to production and supply chains and left some businesses unable to cope.

Mario Meise

> *"I literally grew up with the business. I've done every job in the company. I've put together assemblies, I've picked up freight from the airport, I've taken orders to the airport late at night, no matter what. We started with spare parts, essentially."*
> *— Mario Meise, President, Altech Corp.*

Even though Altech was deemed an essential business, its operations were not immune to the knock-on effects, pointed out Taylor, who has since been promoted to product manager.

"The infrastructure that was already in place was designed for just-in-time inventory," said Taylor. "The second you stuck a wrench into years of just-in-time delivery and logistics, it was like a train crash. It really made people question where their raw materials and product come from and how it gets here."

The Importance of Empathy in Leadership

Researchers who study crisis and leadership observe that during times of uncertainty, human instinct may cause leaders to downplay an ambiguous threat until the situation becomes clearer and thereby delay action. It takes a unique style of leadership, they note, to ignore this natural tendency to downplay and delay.

That was not the case for Taylor.

That Taylor could take on more responsibility just as the World Health Organization declared the COVID-19 viral disease a pandemic on March 11, 2020, was opportune. The pandemic triggered unprecedented disruption to production and supply chains and left many businesses unable to cope.

"[The pandemic], quite frankly, was one of the hardest challenges I had faced to that point," said Taylor. "There were a lot of unknowns at the time, which added to the fear and civic concern. No one really knew what was going on."

Taylor Meise

He recalled watching New York's then-governor, Andrew Cuomo, share daily briefs during the early days of the pandemic and witnessing the supply chain effects firsthand, as small ships were coming into New York City.

Altech responded without delay with accommodation for employees. "We made some major changes, specifically in how we treat our employees and how we pay them," said Taylor. Altech paid for their gasoline and wear-and-tear on vehicles, as well as increased employees' sick leave. Moreover, Altech started profit sharing to increase employees' compensation.

The biggest accomplishment, stressed Taylor, was reassuring employees that the company had their backs. "I think they really appreciated it," he said. "And it really gave me an appreciation for the things that matter when it comes to running an operation."

Right-sizing Against Short-term Strains and Long-Term Vulnerability

Arguably, the main factor that determines a business's inventory positioning strategy is the type of supply chain it relies on. At the strategic level, Meise looks at the big picture for meaning. He understands firsthand the value of preparing as early as possible for difficult times. Altech's position all along has been to "carry a lot of inventory to serve our customers better," said Meise. By posturing for variability and reacting decisively to safeguard internal and external supply chains, it is possible to maintain business as usual while issues are sorted out.

"COVID taught everybody the virtue of patience," said Meise. "Everybody was in the same boat. Everybody had a hard time getting things. So, everybody relaxed and wasn't pushing so hard." The result of this was that people were more understanding of lead times and product availability, reflected Meise.

"Still, no matter how much inventory you carry, there is always one customer, one distributor, one client, who won't be satisfied because they need it yesterday," Meise added.

There's a fine line between holding more stock and overstocking, and Meise remains solidified in his approach to expanding the business based on the best execution fit for Altech. "I've always been one for incremental growth," he said. "We built this building in 1992, added to it in 1994 and we've been the same size ever since. Only during COVID did we bump up against the limits of our warehouse space. And we had to get creative to generate more space within this space. That said, we don't try to bite off more than we can chew. But we'll have to expand the building at some point."

Adaptability While Maintaining Course

These days, persistent supply chain issues are buoyed by international conflicts, sustainability issues, labor shortages and financial downturns.

"With recent supply chain issues coming up, we had been expediting nicely but placing double inventory because nobody knew when or how they would get inventory they needed to finish a project," Meise said. "This has resulted in the supply chain getting very full."

Meise pointed out that interest rates have increased in certain economic hubs. "When interest rates go up, projects become more expensive, projects get postponed, the cost of manufacturing becomes expensive and the cost of goods gets more expensive as well," he explained. "So, demand goes down and we have a state where everybody has a lot of inventory, followed by a decline in business—to the point where clients are not taking the inventory."

"[The pandemic], quite frankly, was one of the hardest challenges I had faced to that point. There were a lot of unknowns at the time, which added to the fear and civic concern. No one really knew what was going on."
— Taylor Meise, Product Manager, Altech Corp.

He has also observed that the level of patience he witnessed through the pandemic ("where everybody is trying to help each other") is starting to wane. "The past few years really shone a light on how fragile this global economy really is," said Meise. "And it's leading a lot of countries, a lot of companies to onshore a lot of [components and materials] they had offshored over the past 40 years."

Figuring Out an Optimal Strategy

Times of adversity and recovery from major events ultimately influence the decision-making approach that leaders must take. To this end, the pandemic has been a big stress test for Altech. Current disruptions—trade embargoes, geopolitics, a rise in regulations, ESG and labor shortages—signal a new set of risks.

Meise is listening carefully to what the market needs him to do. Fortunately, Altech's small footprint enables the company to react quickly, he said.

Strengthening the business from within by investing in people and processes is just one tactic to hedge against risk. For instance, adhering to standards and complying with certifications, including ISO programs, provides a framework for upholding world-class practices. Meise contends that the ISO certification itself is as much about the structure it provides internally as it is about the prestige that comes with certification. For one, it simplifies tasks because the process is already established. "We document what we do, we do what we document," he said. "We already have traditions in place."

At weekly stand-up meetings, Altech's project managers discuss everything from product design, supplier issues and logistics issues, to environmental and global issues. The conversation also extends to supply chain threats. "Employees dealing internationally with our suppliers are aware of what's happening with each other's suppliers," Mario said.

The topic of discussion at their recent meeting was the impact of competition from China and the ensuing protectionist steps by U.S. President Joe Biden to impose an increase in the tariff rate on certain steel and aluminum products of Chinese origin. For both Meise and Taylor, the issue of anti-dumping and countervailing probes on aluminium products merited discussion.

Collecting, analyzing and disseminating intelligence will help the team understand how events relate, why they are meaningful to the organization and help them identify ways to address vulnerabilities early on. "It's always important to know what's happening on a real-time basis," said Meise.

Finding Value in Giving Recognition

Conscious leaders engage in the natural disorder of the market and don't recoil; they know that the backdrop of economic chaos is not their story alone, but in a sense, the narrative arc that most small businesses live through. Today was Altech's turn to tell the story of how it pivots as necessary—and to give hope.

For Meise, that means staying humble and taking care of staff to foster resilience. He still banks on his mother, Estela Meise, who is Altech's CFO, and his daughter, Naomie Meise, who is being mentored in the marketing department.

"The most important knowledge base is the knowledge your people hold," he said.

Taylor echoed his father's sentiment. "Knowing when to listen, using the information properly and being willing to take risks and follow your gut in this regard," he reflected. "There's a whole network of people that are affected by everything that we do. And we owe it to them, not only to run a sound business, but we owe it to them because this is how they make a living."

Both principals agree there's much to be said about maintaining foundational values. And for Meise, the task at hand is to press on with a purposeful refrain: "Being steadfast is important, holding on to certain traditions are important, and still being open to change—listening to your staff, listening to your son's thoughts, supporting and having your staff's back. My door here is always open." ■

> *"There's a whole network of people that are affected by everything that we do. And we owe it to them, not only to run a sound business, but we owe it to them because this is how they make a living." — Taylor Meise*

Estela Meise

Naomie Meise

FAQ

MachineDesign

Selecting PCB Connectors for Your Applications

Eliminating design challenges before they arise.

Printed circuit board (PCB) connectors are a critical component for a wide variety of applications from desktop electronics to industrial equipment and machines. Selecting the right connector for your application takes forethought and a deep understanding of needs.

Q1: Why is connector selection so important?

Like a swinging door that is broken, a connector that has exceeded its insertion or flex range can disrupt power and data from flowing into and out of the PCB properly. It also matters how your connector is attached to the board and the outside world—whether soldered directly to the board or a pluggable solution is preferred. The proper PCB connector can save time and costs for installation, maintenance, and replacement. In today's market, there are also concerns about purchasing knock-offs of popular connectors that provide substandard quality to the user. Paying attention to your connector choice early in your design can save time, money, and your reputation.

Q2: What is the most important point to consider when selecting a PCB connector?

One of the first things to take into consideration is the environment the connector will be used in when selecting the connection technology of the PCB Terminal Block–screw or spring connection. An automobile application would need to handle shock and vibration where spring type connections are preferred. Remote systems may have wider temperature concerns, while a factory floor application may need to be dust and moisture resistant. Although enclosures are often used to protect electronic components, PCB connectors can be in direct contact with the outside world, or the closest component to the outside world. Keeping the environment a priority early in your selection process will provide critical information when considering how long your connector will last in the field.

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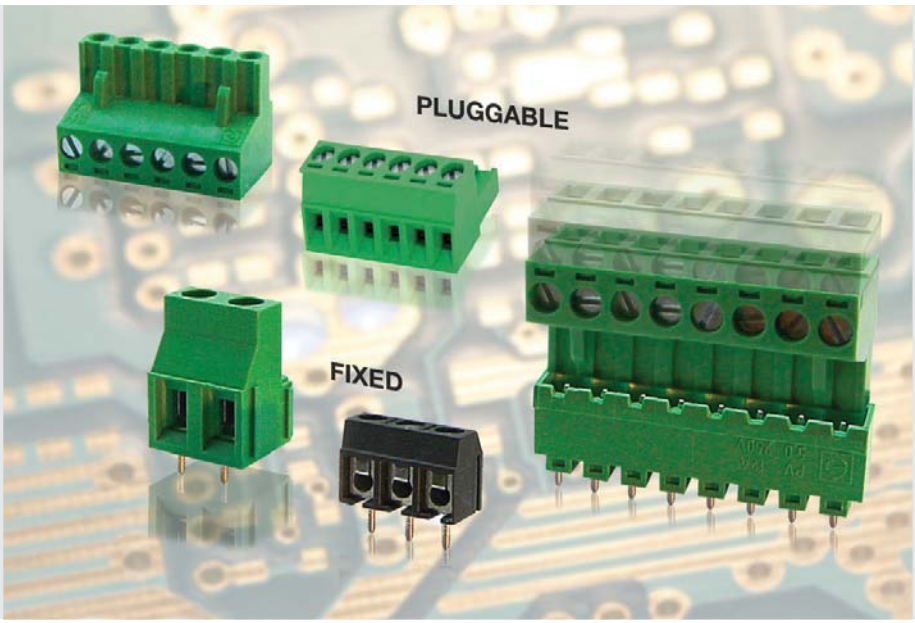
Q3: What electrical specifications should we be most concerned with?

We'll start with current ratings. This can be tricky because you'll want to know the maximum current per pin as well as a maximum current for all pins. It helps to know how many pins in a connector will be carrying current (and how much current) at any one time. If the current carried over any single pin increases, then the number of pins carrying current must decrease, and vice versa. Typically, a connector specification is provided for a defined ambient temperature, which can also affect the connector. Next, you'll want to think about the voltage rating of the connector, which depends on the spacing between contacts and insulating material used to secure the contacts in place. Balancing these two electrical specifications will help in connector selection.

Q4: Are there any other issues to consider when selecting a PCB Block?

Other valuable considerations include mechanical specifications such as the size and shape the connector needs to be. The required current and voltage ratings discussed above limit the size. Higher amperage ratings increase the size of the terminal block. Low current and voltage ratings allow for more compact board designs. Also what is the overall feel (pressure) when inserted or removed. You may have to get samples, which are often available through vendor demo kits, so you can try the connectors before purchasing hundreds of them for your application. Finally, check for existing standards that must be met. UL and IEC are the most common approvals. Knowing if your end system will be shipped out of the country may limit what connector types you can use and still be certified.



Q5: How important are the materials used to manufacture the connectors?

Very important. You'll want to be sure that all machined metal parts are electrolytically plated to increase wear, abrasion, and provide corrosion resistance. Tin-plated solder pins can satisfy the most demanding current and voltage requirements. The connector housings should provide excellent strength and temperature resistance as well and be precision-molded from some form of self-extinguishing polyamide or glass-filled polyester for safety. V0 grade plastics are very common.

Q6: What should we look for as far as labeling?

Depending on the company you decide to work with, most manufacturers incorporate some method of marking connectors to identify them. For example, Altech provides their customers the ability to order hot stamp, inkjet, or laser imprinting for permanent marking of large quantities of connectors.

Q7: Once we've decided on a connector, will there be various ways to provide them for use?

Bulk packaging in different standard packs is how they are usually supplied. Special packaging is often available for connectors to fit specific production requirements. The three basic types include tube packaging, which is used for gravity feed systems making connectors easily available for automatic placement machines; tape and reel packaging, which helps to feed components into automation machinery and eliminates orientation errors from occurring; and tray packaging, which works well with pick-and-place machines.

Q8: What other information would be helpful when selecting PCB connectors?

Consider the company you partner with. Stock levels are key when selectin a supplier. Check their standard availabilities to be sure you can get the parts you need when you need them. Be aware of how accessible company services are and that you work well with their team so you get prompt answers when you have questions. Most importantly, partner companies need to have a complete line for you to choose from so you can decrease the need for multiple vendors as your products and applications evolve.

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Direct Current Uninterruptible Power Supplies for Industrial Applications

DC UPSs are designed to safeguard operations and maintain productivity during unforeseen power disruptions.

All images courtesy of Altech Corp.

by Laszlo Gyorgypal, Product and Quality Control Manager, Altech Corp.
Edited by Sharon Spielman, Technical Editor

DIRECT CURRENT uninterruptible power supply (DC UPS) systems act as a cornerstone in safeguarding critical operations and sustaining productivity by providing uninterrupted power supply during unforeseen power disruptions.

Here, we explore the essential features and functions of DC UPS systems; their diverse topologies; the role of battery technology in enhancing runtime and reliability; the significance of monitoring and management software for optimized performance; and the considerations regarding size capacity and scalability.

Features and Functions of DC UPSs

A DC UPS serves a similar purpose to its alternating current (AC) counterpart but operates with AC or DC power sources and is tailored for applications where DC power is used. Essential features and functions of a DC UPS in safeguarding electronic equipment during power fluctuations and outages include battery backup for the whole system; voltage regulation for the load; surge protection for the system; monitoring and alarms functions; automatic or controlled shutdown capability; higher efficiency than AC back-up systems; remote monitoring and management ability; easy customization for specific applications; and simple maintenance and serviceability. Overall, a DC UPS is a critical component for ensuring continuous operation and protecting against power disruptions in DC-powered applications.

DC UPS Topology Affects Performance, Suitability for Different Load Types

The topology of a DC UPS refers to the specific design and configuration of its components, including how power is processed and delivered to connected loads. Different topologies—including line interactive, double conversion (online UPS), Delta conversion, ferroresonant, and pulse width modulation (PWM) or switch mode—influence UPS performance in different ways

Line interactive UPS systems typically regulate voltage using an automatic voltage regulator (AVR). They switch to battery power during outages or severe voltage fluctuations and offer basic protection against power disturbances and are suitable for moderate loads. Commonly used for industrial machines and equipment where moderate power protection and voltage regulation are sufficient, they can handle motor-driven loads and other equipment that requires stable voltage but may tolerate brief interruptions during switchover to battery power.

Online UPS systems continuously convert AC power to DC and then back to AC, providing the cleanest and most reliable power output. They offer zero transfer time to battery mode, ensuring seamless operation without interruptions. These are ideal for critical machine design applications where even the smallest power interruption can cause significant disruption or damage. They provide high-quality power suitable for sensitive electronic loads, precision instruments, medical equipment and CNC machines. The constant conversion ensures consistent voltage and frequency, making them versatile for a wide range of loads.

Delta conversion UPS systems are a variation of the double conversion topology, designed to improve efficiency and reduce operating costs compared to traditional online UPSs.

They feature faster response times and less energy loss during operation. These are suitable for applications where high efficiency and lower operating costs are priorities, while still maintaining excellent power quality. They can handle various machine design loads, including industrial automation systems, robotics and other equipment requiring reliable and efficient power protection.

Ferroresonant UPS systems use a ferroresonant transformer to regulate voltage, providing a constant output even when input voltage fluctuates. They offer robust protection against voltage sags and surges. These systems are suitable for rugged industrial environments where equipment is exposed to frequent voltage fluctuations and harsh conditions. They are often used in manufacturing plants, telecommunications and heavy machinery applications where consistent voltage regulation is critical for reliable operation.

PWM UPS systems use pulse width modulation techniques to regulate voltage and provide battery backup during outages. They are efficient and compact, suitable for smaller-scale applications or where space and cost are constraints. They can protect sensitive electronic loads such as control panels, small motors and programmable logic controllers (PLCs) effectively.

Machine design applications require careful consideration of UPS topology to ensure compatibility with the equipment's power requirements and operational needs. Choosing the right UPS topology involves evaluating factors such as load sensitivity, tolerance to power interruptions, efficiency goals and environmental conditions where the equipment operates.

Battery Technology's Influence on Runtime, Reliability of a DC UPS

When it comes to determining the runtime and reliability of a DC UPS, battery technology influences aspects such as runtime, reliability, performance under load and safety and environmental considerations.

Regarding runtime, factors such as capacity, battery type and configuration must be considered. The capacity of the batteries, measured in ampere-hours (Ah) or watt-hours (Wh), directly determines how long the UPS can provide backup power. Higher capacity batteries can sustain the load for a longer duration before needing recharging.

Different battery chemistries, such as lead-acid, lithium-ion or nickel-cadmium, have varying energy densities and discharge characteristics. Lithium-ion batteries generally offer higher energy density and lighter weight compared to traditional lead-acid batteries, potentially providing longer runtime for a given size and weight.

The number and configuration of batteries in the UPS affect the total capacity and thus the runtime. UPS systems can be configured with multiple battery strings or modules to increase overall capacity and extend runtime as needed.

Regarding reliability, it is necessary to consider cycle life, temperature sensitivity and maintenance requirements. Battery technology impacts how many charge-discharge cycles a battery can endure before its capacity significantly degrades. Lithium-ion batteries typically have longer cycle life compared to lead-acid batteries, which may require periodic maintenance and replacement.

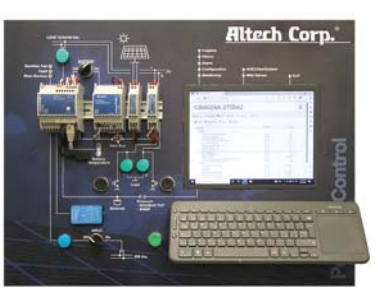
Some battery chemistries are more sensitive to temperature variations. Ensuring the UPS environment is within recommended temperature ranges for the batteries helps maintain reliability and longevity.

Battery technology influences maintenance needs. Lead-acid batteries often require periodic checks for electrolyte levels and terminal corrosion, while lithium-ion batteries generally require less maintenance but may need firmware updates or occasional monitoring for optimal performance.

Discharge rate and efficiency affect the performance under load. Different battery chemistries have varying discharge characteristics. Some batteries can discharge at higher rates without significant voltage drops or heat generation, which is crucial for UPS systems powering equipment with sudden high-power demands. Battery technology affects how efficiently the UPS converts stored energy into usable electrical power. Modern battery technologies like lithium-ion generally offer higher efficiency compared to older battery types, minimizing energy loss during charging and discharging cycles.

When it comes to safety features, advanced battery technologies often include built-in safety features such as thermal management systems, overcharge protection and internal cell monitoring to prevent hazardous conditions like thermal runaway.

Additionally, battery technology choice can impact environmental considerations such as recyclability, disposal requirements and energy efficiency during production and operation.



Importance of Monitoring and Management Software

Monitoring and management software are important for optimizing the operation and efficiency of a DC UPS. For example, monitoring software provides real-time visibility into the status and performance of the UPS system. It allows operators to monitor parameters such as battery voltage, current load, temperature and runtime remaining. This real-time data helps in proactive maintenance and troubleshooting, ensuring the UPS operates within optimal parameters.

Additionally, the software can generate alerts and notifications for critical events such as power outages, battery faults or system failures. These alerts enable prompt response and intervention, reducing downtime and minimizing the risk of damage to connected equipment.

Many UPS monitoring software solutions offer remote management capabilities, which allows administrators to monitor and manage UPS systems from a central location or via a web-based interface. Remote management facilitates quick diagnosis of issues, remote configuration changes and firmware updates without needing physical access to the UPS unit.

Also, monitoring software typically logs historical data related to UPS performance and power events. This data can be analyzed to identify trends, predict maintenance needs and optimize UPS settings for improved efficiency and reliability over time. It helps in making informed decisions regarding UPS capacity planning and load management.

The software also allows administrators to monitor the load on the UPS and ensure it operates within its capacity limits. This helps in distributing loads evenly across multiple UPS units if necessary, optimizing overall efficiency and extending battery life.

Advanced monitoring software provides insights into battery health, including state of charge, temperature and expected lifespan. This information helps in proactive battery maintenance, such as scheduling replacements before batteries reach the end of their useful life, thus minimizing the risk of unexpected failures.

This software can also contribute to energy efficiency by providing data on energy consumption patterns and efficiency metrics. This information allows operators to identify opportunities for energy savings, optimize UPS configurations and implement energy management strategies to reduce operating costs.

Many industries have regulatory requirements or standards regarding power management and uptime. Monitoring software helps in generating reports and documenting UPS performance metrics for compliance purposes, audits or internal reporting.

Specifying a DC UPC for an Industrial Application

Factors such as size, capacity and scalability are important considerations when selecting a DC UPS for specific industrial applications.

The physical size of the DC UPS unit is important, especially in industrial environments where space may be limited or where the UPS needs to be integrated into existing equipment or control panels. Mounting options also need to be considered, including whether the UPS can be rack-mounted, wall-mounted or placed in a cabinet. The size and form factor should align with the available space and installation requirements of the application.

The capacity of the DC UPS should match or exceed the power requirements of the equipment it is intended to protect. This includes considering both the continuous power demand (in watts or kilowatts) and the peak power demand during startup or operation.

Battery capacity determines the runtime of the UPS during a power outage. Larger battery capacities provide longer backup times, which is critical for applications where extended downtime can lead to significant production losses or safety risks.

Industrial applications may require scalability to accommodate future growth or changes in power requirements. A DC UPS that supports modular expansion of battery capacity or power output allows for scalability without needing to replace the entire UPS unit.

Scalability can also refer to redundancy options, where multiple UPS units can be paralleled or configured in a redundant setup to ensure continuous operation even if one unit fails.

Let's take a look at how DC UPS can be used in specific industrial applications, including process control, telecommunications, medical equipment and data centers.

- For applications such as process control systems or manufacturing automation, reliability and uptime are critical. UPS systems with high reliability, redundancy options and remote monitoring capabilities are typically preferred.
- Telecommunication equipment requires UPS systems that can handle varying loads and provide seamless power transfer to battery backup during outages.
- UPS systems for medical equipment must meet stringent reliability and safety standards, with features such as medical-grade isolation and compliance with healthcare regulations.
- Data center UPS systems require high efficiency, scalability to support increasing IT loads, and advanced monitoring capabilities for optimizing energy usage and maintaining uptime.

It is also important to know the operating environment and protection levels required. Considerations include temperature extremes, humidity levels and exposure to dust or contaminants. The UPS should be rated for the environmental conditions of the industrial setting to ensure reliable operation. And some industrial environments may require UPS systems with higher levels of ingress protection (IP rating) to withstand harsh conditions or potential exposure to water or chemicals.

Selecting a DC UPS for specific industrial applications involves evaluating size, capacity and scalability alongside the specific operational and environmental requirements of the application. A well-chosen UPS system ensures reliable power protection, minimizes downtime and supports the continuity of critical operations in industrial settings. ■

MachineDesign

FAQ

Why Should You Incorporate Push-In Terminals in Your Next DIN Rail Application?

Interfacing different pieces of equipment in today's automation products means that design engineers must select terminal blocks that are more versatile and compact, and that offer higher densities.

DIN-Rail terminal blocks are used throughout multiple industries, integrating components within an individual machine to integrating multiple machines into a complete factory system. Both electrical and electronic devices are easily integrated using multi-use terminal blocks for a wide variety of industries, including aerospace, medical, oil & gas, automotive, semiconductor, packaging, transportation, power industry, and more.

What features should I consider when selecting a DIN-Rail terminal block?

Service life is the most important factor when selecting a DIN-Rail terminal block. Beyond that, engineers will want to consider ease and speed of installation, low maintenance capabilities, high efficiencies under multiple environmental conditions, and a high-density, compact design.

What are the basic types of DIN-Rail terminal blocks used today?

A variety of different DIN-Rail terminal blocks are available on the market. Some standard terminal blocks that have been available and incorporated for years include the screw type blocks. These devices have been used inside panels and junction boxes in factories and warehouses, and for distribution of electricity in homes and apartments. These terminal blocks have been around for a long time and are highly dependent on human interaction due to the need for screw-tightening at various torque values. These terminal blocks also require the use of different handheld tools, and some provide a locking feature to guarantee connection and prevent screw loosening.

The spring clamp or cage clamp terminal block offers an interconnection that requires less human interaction. These devices need a standard tool, such as a screwdriver, to open the spring, but specific torques are not required. A preloaded spring is used to keep the wire safely in place. Solid or stranded wire can be used to create a secure connection in less time than using a screw type terminal. Since these terminals have a natural resistance to shock and vibration, they are often used in applications such as automotive, elevators, and machine tools.

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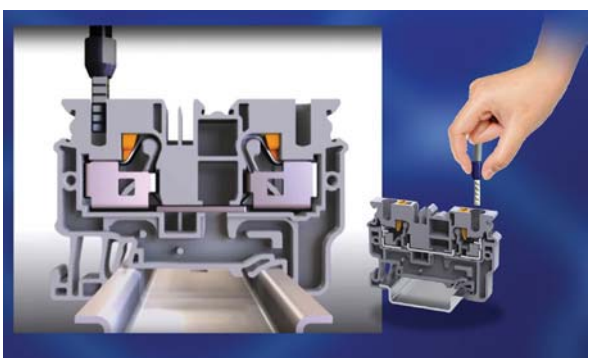
How are push-in DIN-Rail terminal blocks different than other types on the market?

The most important aspect is that no tools are required to secure a wire into a push-in terminal block. This aspect alone saves time on installation and maintenance endeavors. Due to advancements in materials and the changes in users' needs, push-in terminals can offer additional benefits as well.



How do push-in DIN-Rail terminal blocks operate?

Users can simply push solid wires or stranded wires with ferrules directly into the terminal block for the fastest and most reliable connectivity on the market today *(see Figure 1)*. With minimal human interaction, these terminal blocks are ideal for use with automated and robotic wiring operations. This benefit alone has OEMs switching from established technologies to push-in technology.

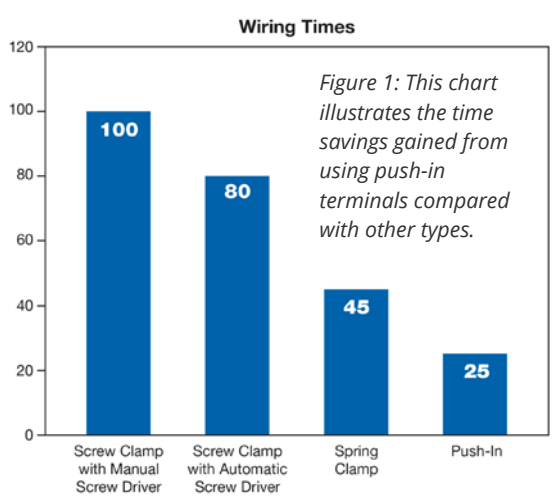


Figure 1: This chart illustrates the time savings gained from using push-in terminals compared with other types.

Do I have to worry about shock and vibration more if I incorporate push-in technology?

Not at all. In fact, switching to push-in technology also provides safety and reliability due to the terminal blocks' large pull-out force that is required to remove a wire once it's in place *(see Figure 2).*

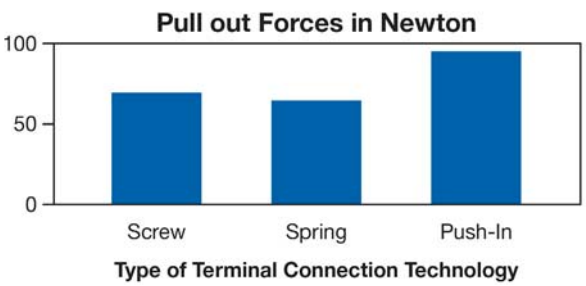


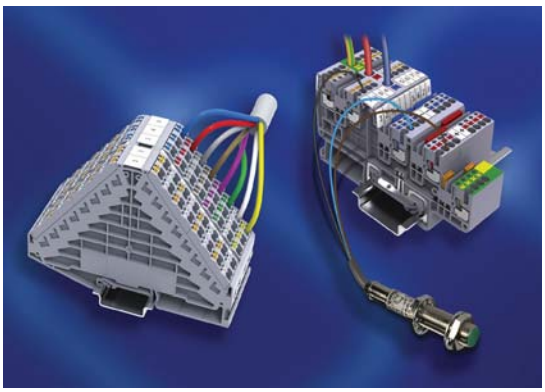
Figure 2: Pull-out forces for push-in terminal blocks are greater than that of screw or spring type terminal blocks, making them highly reliable for low maintenance and long-life applications.

How can end users benefit from push-in technology?

The key benefit gained while using push-in terminal block technology for end users is how well it streamlines the installation process for interconnecting all types of devices, including sensors, I/O, and DCS systems for process and automation control. Push-in terminals have minimum insertion force requirements — even to connect small wire sizes. The terminal blocks are designed to withstand harsh environmental conditions as those found in marine applications as well as chemical plants due to the use of non-ferrous metals in the connection components.

Are push-in DIN-Rail terminal blocks available for high-density designs?

The unique design of these terminal blocks allows them to be thinner than standard terminal blocks, even with a 600V capacity. Size reduction has allowed for 33% more wire density without compromising voltage stress, pollution degree, or surge voltage. For example, a compact 3.5mm wide terminal block thickness allows a 14AWG (1.5 sq mm) wire to be connected. In addition, specially designed terminal blocks are available for specific applications, such as those on the following page.



This photo shows specially designed terminal blocks, such as the sensor and actuator terminal block and the marshalling terminal block.

What other benefits might I want to know about when considering push-in DIN-Rail terminal blocks?

Push-in terminal blocks offer independent rows for the insertion of jumpers for shorting different types of terminal blocks without using external jumper wires. Markers can also be attached easily for identification purposes. These markers are visible from any angle inside a panel or enclosure for quick recognition. Push-in DIN-Rail terminal blocks also come in seven different colors for global electrical system use.

Are push-in DIN-Rail terminal blocks available in a variety of versions?

Push-in terminal blocks purchased through Altech are available in single-level, double-level, and multi-level versions, all of which have grounding versions as well as fused terminal blocks for several fuse types and sizes. Also, special sensor and actuator, knife disconnect, and marshalling terminal blocks, plus a wide variety of accessories are available.

design FAQs

Specifying and Customizing Non-Metallic Industrial Enclosures

MachineDesign

FREQUENTLY ASKED QUESTIONS

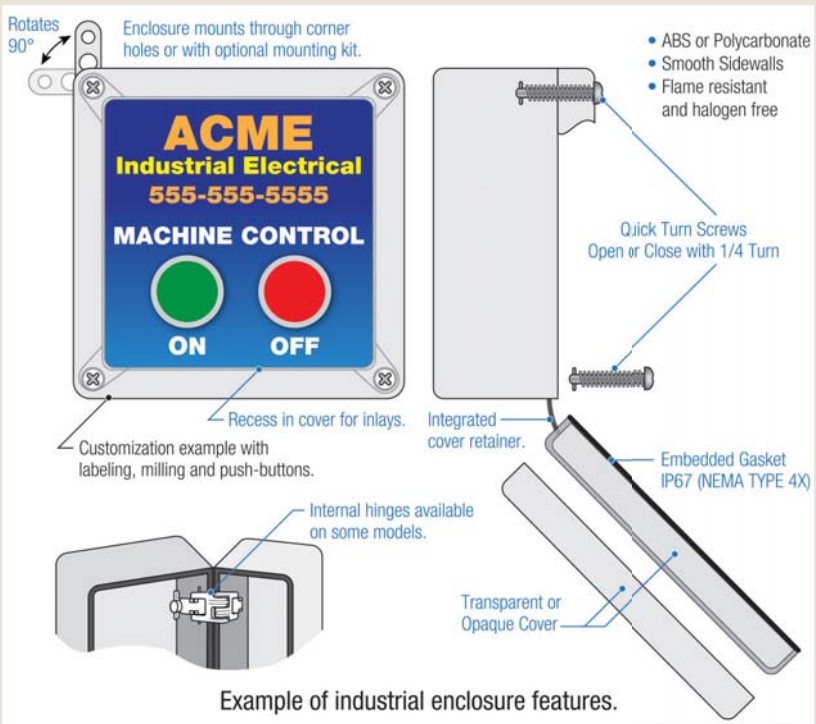
Q: I'm just starting my search for an enclosure for my application. Any suggestions?

A: Consider collecting and writing down all your eventual needs and then find a company that offers whatever you require all in one place. This will save additional time in researching vendors to perform secondary tasks such as providing custom printing or milling custom openings in the enclosure. But first, be sure to get the enclosure that meets your specific needs. Some companies offer an enclosure finder on their website to make narrowing your choices easier.

Q: What are some of the features of a standard enclosure that I might want to look for?

A: Dependent on how often you expect your enclosure to be opened and closed, you might want to make sure it is equipped with quick-turn screws that provide quarter-turn operation. For control circuits, consider an enclosure that offers a cover recess so that you can incorporate your own detailed label inlay or membrane keypad. An integrated cover retainer or hinge kit can make using the enclosure easier. Most applications also require some type of mounting provisions inside the enclosure so look for integral mounting studs.

Q: My company is involved in a number of different industries in the machine tool and automation industry. How might I provide a solution for a variety of space and mounting challenges?



Example of industrial enclosure features.

A: Look for enclosures that are equally flexible and available in multiple sizes. For example, there are enclosures available that offer corner-hole mounting as well as those having optional mounting kits that flip 90 degrees for vertical or horizontal space requirements. Another consideration might be using an enclosure that's equipped with internal hinges.

Q: What about products that have to function in different environments?

A: Enclosures are available that are flame resistant, water-tight, and halogen free. Companies such as Altech offer enclosures in different materials and with different ratings. For example, their TG enclosures are available in ABS and Polycarbonate. ABS enclosures are ideal for indoor use while the company's Polycarbonate enclosures, on the other hand, are suitable for indoor or outdoor use in remote or harsh applications. Their Polycarbonate enclosures are also UL Approved to meet the needs of most industries. Both versions are available in sixteen different sizes, have gray or transparent covers, and smooth sidewalls.

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Q: Since we make more than one model of our machines, can we get different customization for each?

A: Enclosures can be customized per company or per system or machine. Look for a company that can provide printing or labeling and milling so you don't have to go outside and look for those services separately. In fact, completely customized industrial enclosures not only help with branding, but also provide a more professional appearance overall.

Q: Are there other benefits to selecting customized enclosures?

A: Other benefits include stronger branding, more professional appearance, competitive pricing, and the elimination of legend plates or additional labels and reduction of label waste. If you're using an enclosure with a recessed cover design, high-performance overlays are perfect, plus you can get digital printing on short production runs for efficiency and flexibility. Screen printing is also available for larger production runs. The idea is for companies to be able to make the enclosure look as though it is an integral part of their equipment.

Q: All these features are very beneficial. Do heavy-duty enclosure models offer these features?

A: You'll want to check with the manufacturer, but be sure your choices are protection rated. For example, the plastic enclosures mentioned earlier offer a Class IP 67 rating. They are not only dustproof, but also reliably protect installed electrical or electronic equipment against ingress of water during short-term submersion. The Polycarbonate versions have passed NEMA 4X Type approval through UL. This means they have undergone rigorous testing for impact, corrosion, dust and water resistance as well as UV exposure testing. Enclosures are meant to satisfy demanding applications and provide protection in harsh industrial environments even for highly sensitive electronics.

PROBLEM

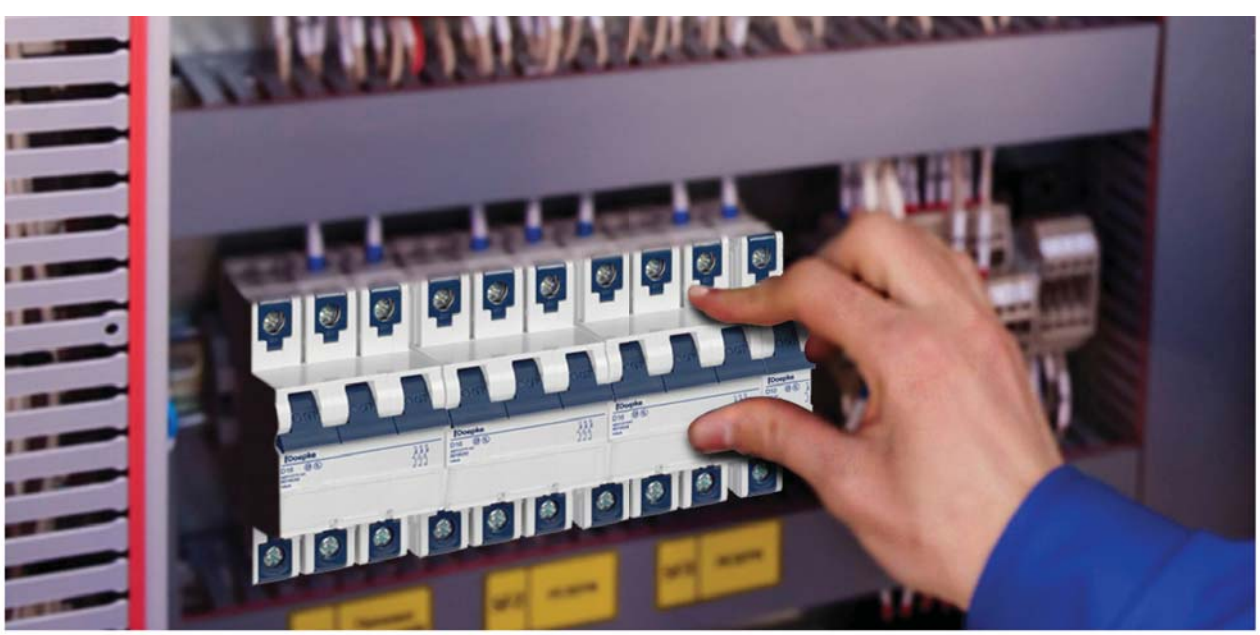
Providing Worldwide Capabilities for Cost Effective Circuit Breaker Designs

The global circuit breaker market size in 2017 was valued in excess of $13 billion USD and is anticipated to surpass an annual installation of over 40 million units by 2024. The rising demand for replacement of mechanical and electromechanical devices across manufacturing and industry is expected to drive this demand even further. Maintaining a stock of required circuit breakers can be costly, particularly when you have to keep multiple types on the shelf.

Problem:

Staying ahead by designing and manufacturing the right product for the multi-billion-dollar circuit breaker market is key to maintaining a strong grasp on your market share. In a worldwide market, original equipment manufacturers (OEMs) are particularly concerned about how many individual components they need to stock for particular pieces of equipment being built and delivered for overseas use. This particularly holds true when countries don't always share the same requirements and standards.

In addition, maintaining a wide variety of stocked circuit breakers to meet the needs of maintenance, repair, and replacement can become costly. This is particularly the case when considering how different countries want their wiring to interface within a single machine, as well as with their factory in general. Purchasing different circuit breakers simply because the system requirement is either a box terminal or screw terminal, creates headaches from design through manufacturing and beyond. There had to be a solution.



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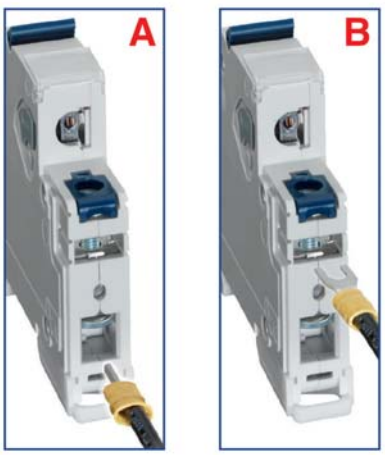
Unique Standard Dual Connection Terminals



A Box terminal for solid conductors or flexible conductors with or without cable lug.
B Screw terminal for forked cable lug.

The above illustration shows the three unique standard dual connection terminals available on the series UL489 circuit breaker.

Solution:

After years of supplying OEMs and end-users with a wide variety of circuit breaker designs, Altech found it was continually required to deliver a similar circuit breaker product with differing connection terminals, such as box terminals and screw terminals able to handle either forked or ring-type connectors, as explained here.

Screw terminations are specifically designed to mount the connecting wires using either a forked connector or ring connector. In a general sense, screw terminals are composed of a terminal with a threaded hold and a specifically sized screw based on the current and voltage specifications of the circuit breaker. Most screw terminals are available with the corners of the bus terminal bent slightly upward to offer a more secured connection for fork or ring connectors. Box wire connector terminals, on the other hand, are typically used for high-current applications and consist of a box lug and screw. These terminals are designed for direct wire connections. Because of the variety of terminal connections needed, Altech designed its UL489 series circuit breaker with a unique standard dual connection terminal. These circuit breakers are offered for use with different types of terminal connections.

Of course, each circuit breaker manufactured is designed to deliver high reliability through the company's standard high-quality manufacturing, with technically correct specifications for each different application it might fit into.

The company is a proven leader in DIN rail mounted breakers with ratings up to 63A that meet UL489, UL508 or UL1077 approvals, with short circuit interrupt capacity of up to 10kA. Some of the relevant features offered through the UL489 series dual terminal circuit breakers include Altech's molded case design with hinged terminal cover for access to terminal screws using a broad range of screwdrivers, a clear-hinged cover to protect the designated marking area, and flexible replaceable terminal barriers to reduce the possibility of breakage if accidentally dropped.

The dual terminal breakers also provide a DIN clip which can be released when necessary, as well as individual part numbers shown on each circuit breaker that are legible when installed in the panel.

The greatest value a company can offer is to focus on its customers' needs and innovate in a way to solve their challenges. The creation of the dual terminal circuit breaker is just one more reason Altech has held its superior position in the industrial marketplace. The UL489 will not only save OEMs and end users money in stocking, but will provide easy replacement of systems already in the field.

https://www.altechcorp.com/

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.

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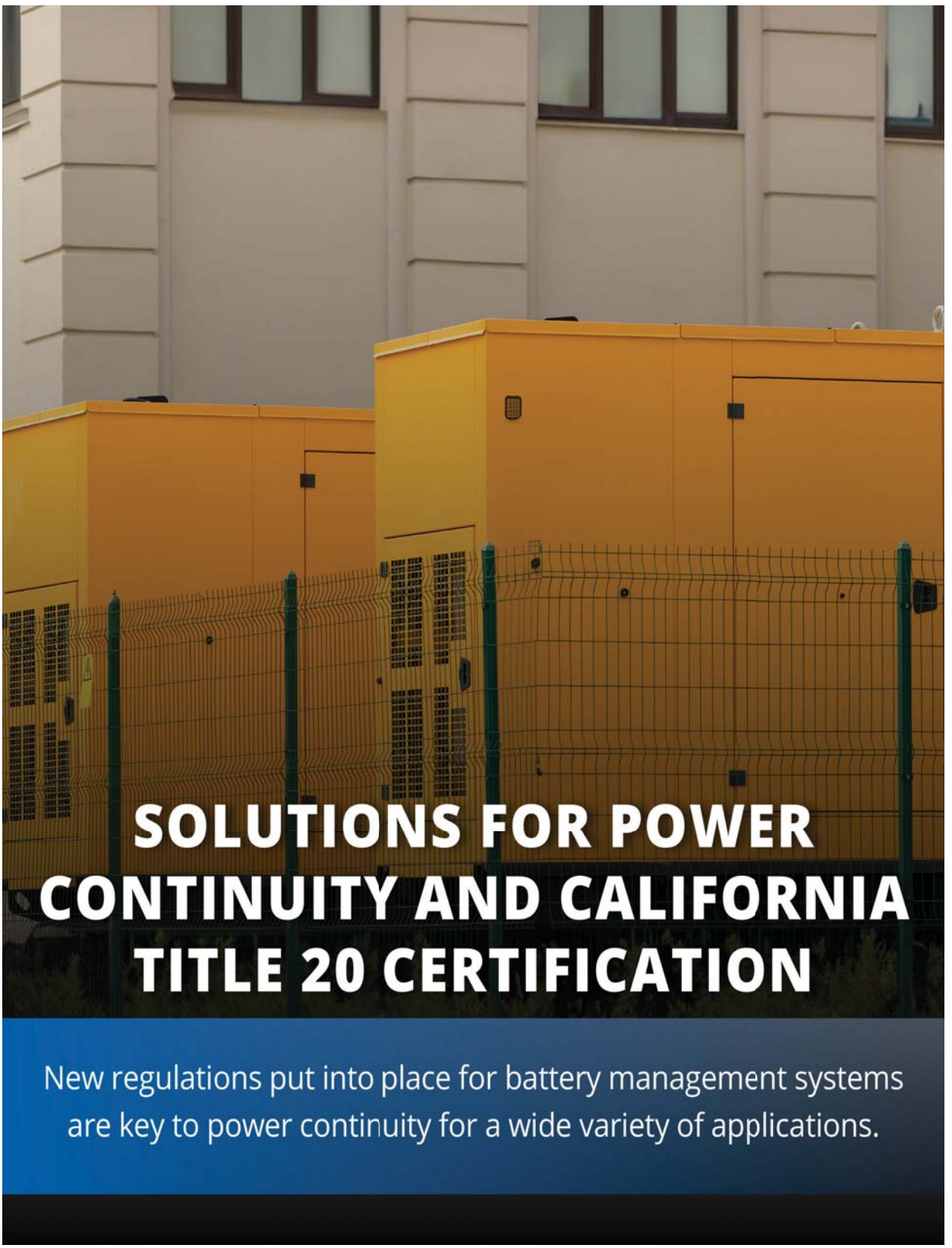

SOLUTIONS FOR POWER CONTINUITY AND CALIFORNIA TITLE 20 CERTIFICATION

New regulations put into place for battery management systems are key to power continuity for a wide variety of applications.

Power continuity has become a major focus in many industries, particularly for environmental monitoring of wind and solar power systems, water and wastewater treatment, and engine starter batteries for battery chargers. The latest battery chargers are also tasked with providing testing and communications as an essential part of their operation. This means that they are required to meet a number of standards and certifications, such as UL1236, the standard for safety battery chargers used for charging engine-starter batteries, such as those for the genset market, fire pump controllers, and lighting mobile towers.

This battery care philosophy is why Altech's CB12245AJ battery charger includes CANbus J1939 protocol communications onboard. CANbus allows customers to integrate battery voltage and battery status with their controller to monitor the condition of the batteries regularly using more than 50 key parameters.

The CB12245AJ battery charger is housed in a durable enclosure, is easy to install and configure, and has a Din rail bracket *(see Figure 1)*. Once batteries have been charged, the CB charger checks battery life status and keeps the battery fully charged at all times. These chargers offer four charging stages — recovery, boost, absorption, and float — and an accurate battery diagnosis capability. The units are compact, offer CANbus integration, provide temperature compensation, are IP 20 protected, and can charge all battery types, including AGM, Gel, NiCd, NiMH, and Li-Ion. These battery chargers can be integrated with various OEM installations or panels and smart energy controllers.

Figure 1: Altech's CB12245AJ battery charger offers a wide range of features for use under California's Title 20 certification.

For customers searching for a device that doesn't require a complex power supply recharging system with backup module, the CB battery charger product line provides a reliable, high-tech solution. These battery chargers have a range of microprocessor power supplies that can charge a sealed lead battery to optimize performance and durability. Based on switching technology, they provide voltage stabilization at a set value, even in a no-load condition. These devices also include alarm messages for a number of situations, including "battery to be replaced," "low battery," "AC power not present," and "inverted connection." Units are designed for protection against short circuits, overloads, output overvoltage fluctuations, and polarity reversals.

CALIFORNIA TITLE 20 CERTIFICATION REQUIREMENTS

The California Energy Commission (CEC) adopted battery charger system regulations that included efficiency standards and test procedures for backup battery charger systems, limiting which systems could be sold or used in California. Backup battery charger systems must adhere to the State of California's energy efficiency regulations, including those devices used for engine generator starting, whether in automotive, marine, off-highway, or any other standby power applications. The regulation that initially applied only to consumer chargers is also effective for commercial products. Only battery chargers the State of California certifies and lists in the California Appliance Efficiency Database can be legally sold in California for use in California.

These regulations were focused on products with a primary function to provide backup power only during a power failure that is "off" when regular power is available. The regulations also apply to products with a primary function to operate under all conditions, regardless of the power source. This second function concerns products that are often "on" continuously, such as alarm systems, that provide monitoring, sensing, and communications; and that also offer battery backup so that these functions continue to perform during a power failure.

The test procedure part of the Title 20 documents applies to backup battery charger systems that operate at all covered systems regardless of their operating voltage. Testing is performed by disabling any optional functions performed by controllers that are not associated with the battery charging process.

Meeting all the state's requirements, Altech worked with their partners to produce a certified battery charger that is accurate, rugged, and provides long life for genset engine start applications. The units automatically adjust outputs to meet the changing needs of the battery system, allowing the battery to provide maximum performance. The CB12245AJ offers fully automated charging modes, output protection modes, and adjustable charging current capabilities. Easy battery diagnosis and fault identification can be performed by LED or external devices connected to fault status contacts. The units offer efficiencies of up to 91% through the use of the latest switching technology. Even under harsh conditions, these battery chargers provide a dependable solution to users and are CEC-certified *(see Figure 2)*. All units in the CB battery charger line can be powered with 110V/220V or 277V (96VAC-305VAC voltage range) and the input voltage is set automatically. This makes this unit one of the most sought after products on the market and any customer can use this product anywhere in the world without any adjustment or additional input setting.

THE NEED FOR LOAD PROTECTION

Solutions for power continuity include monitoring and control, battery backup systems, interfaces, and charging and testing — which we've been covering here. Load protection is equally important, particularly in complex applications. Protecting your load from short circuit and overcurrent conditions is essential to your overall operating system. In addition, brown-outs and voltage dips are two of the leading causes of power interruption. In many cases when multiple loads are connected to one system, and an overload or short happens, the system will have a power dip or a brown-out. Altech has a series of electronic circuit breakers specifically designed for this application.

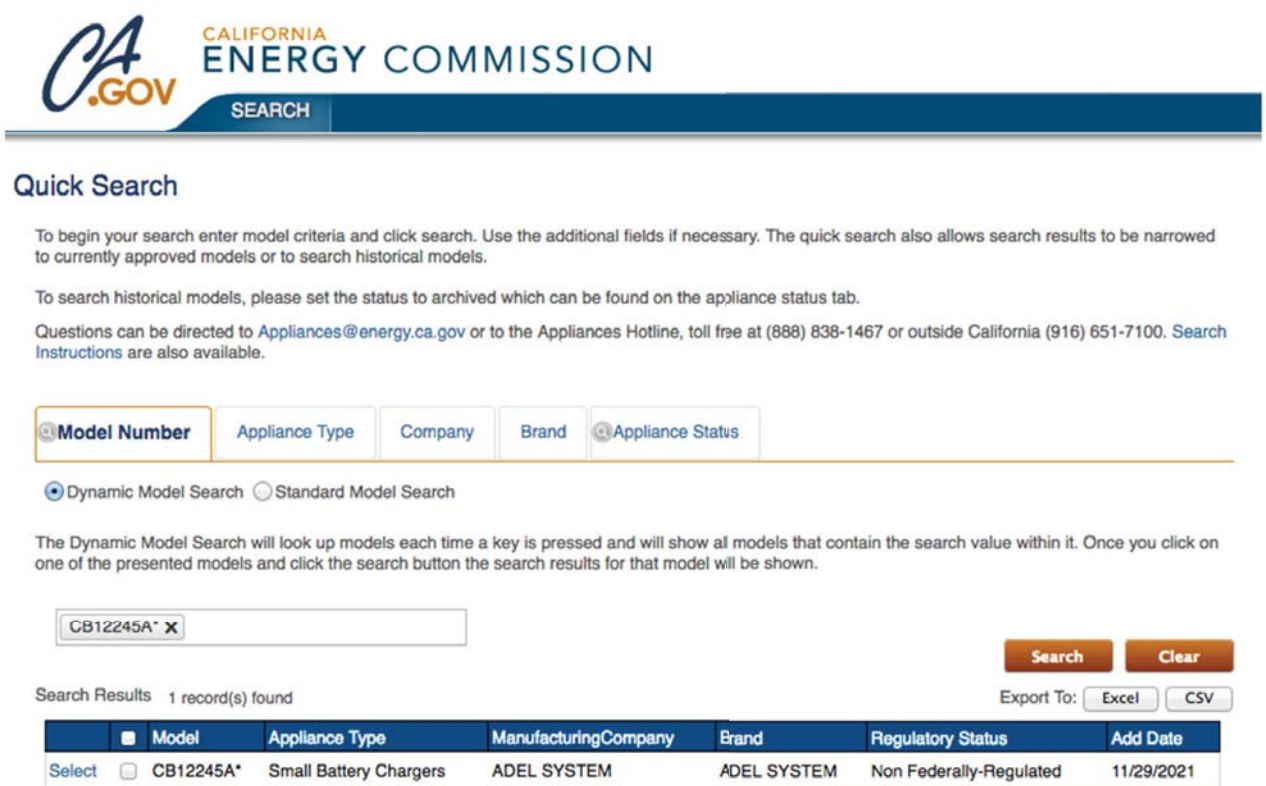

Figure 2: This screenshot from the CEC indicates that the CB122 45A is listed as certified.

The MRF102 is a two-channel electronic circuit breaker with DIN rail mounting *(see Figure 3)*. The unit is designed for current distribution and protection of 12V or 24V load circuits (9V DC to 32V DC voltage range). The rated output current can be individually set for each channel at a rate of 1A through 10A via push button operation. Thanks to electronic locking, unintentional adjustment of current values is not possible, keeping your system safe.

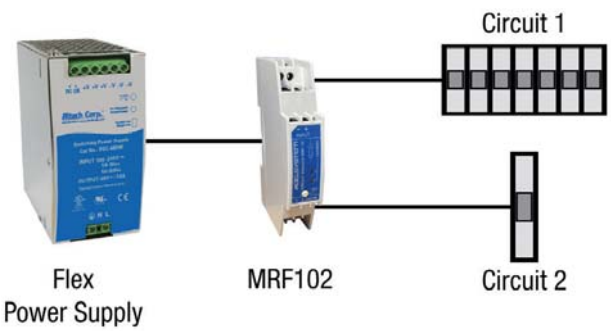

Figure 3: Once you've connected your power solution to your system, an electronic circuit breaker can protect the load from undue stress.

The electronic circuit breaker will secure your system components from damage and separate the load outputs. If something goes wrong with any of the connected loads, an alarm signal will be initiated visibly and/or sent to your control panel. Only the affected load will get the alarm, while all other loads stay unaffected and continue to operate *(see Figure 4)*. With a width of only 18mm, these circuit breakers save space in your control panel. Even when connecting two units together in series, these devices remain one of the smallest and smartest solutions on the market.

CONCLUSION

Adhering to California Title 20 certification specifications focusing on efficiency standards and test procedures for backup battery charger systems is now a requirement. Companies such as Altech have designed their devices to meet these challenges and provide the maximum support and operational safety to your application. The company's CB12245AJ battery charger also provides a rugged design for various harsh environments. Staying on top of the latest federal or state regulations means having the expertise to adapt to an ever-changing market.

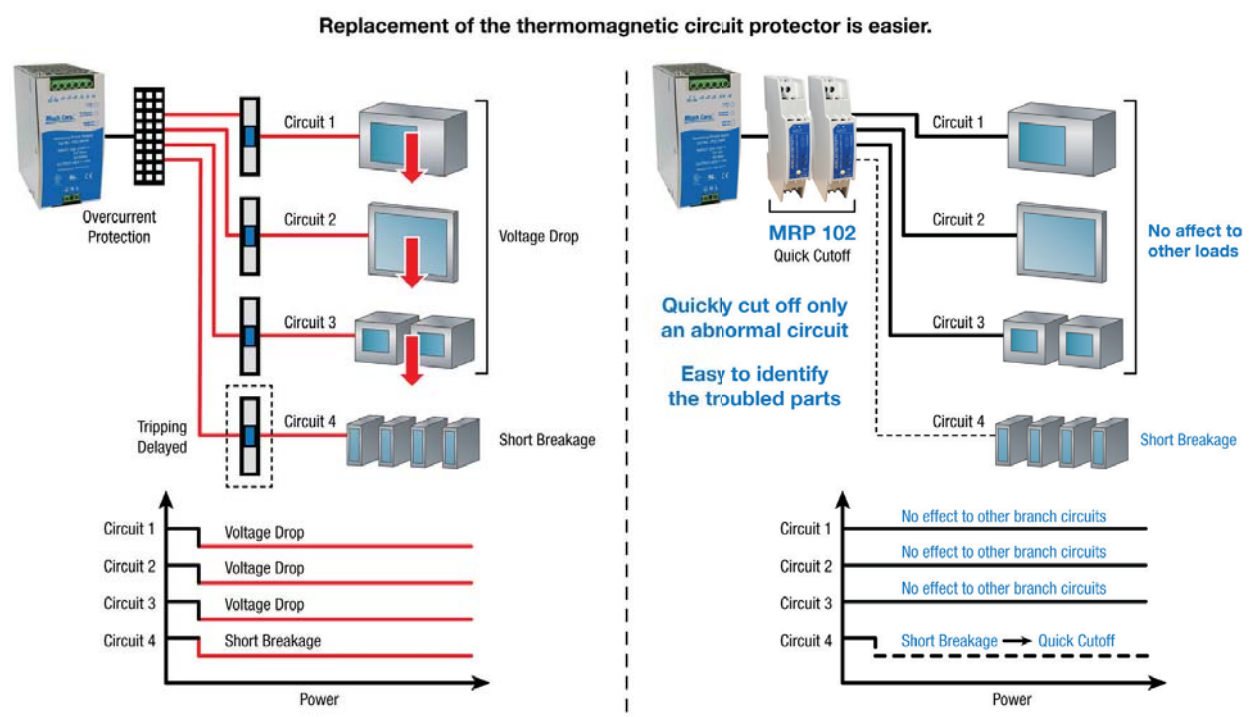

Figure 4: When using an electronic circuit breaker to protect your system, note that abnormal circuits are quickly cut off to prevent damage that could impact other systems

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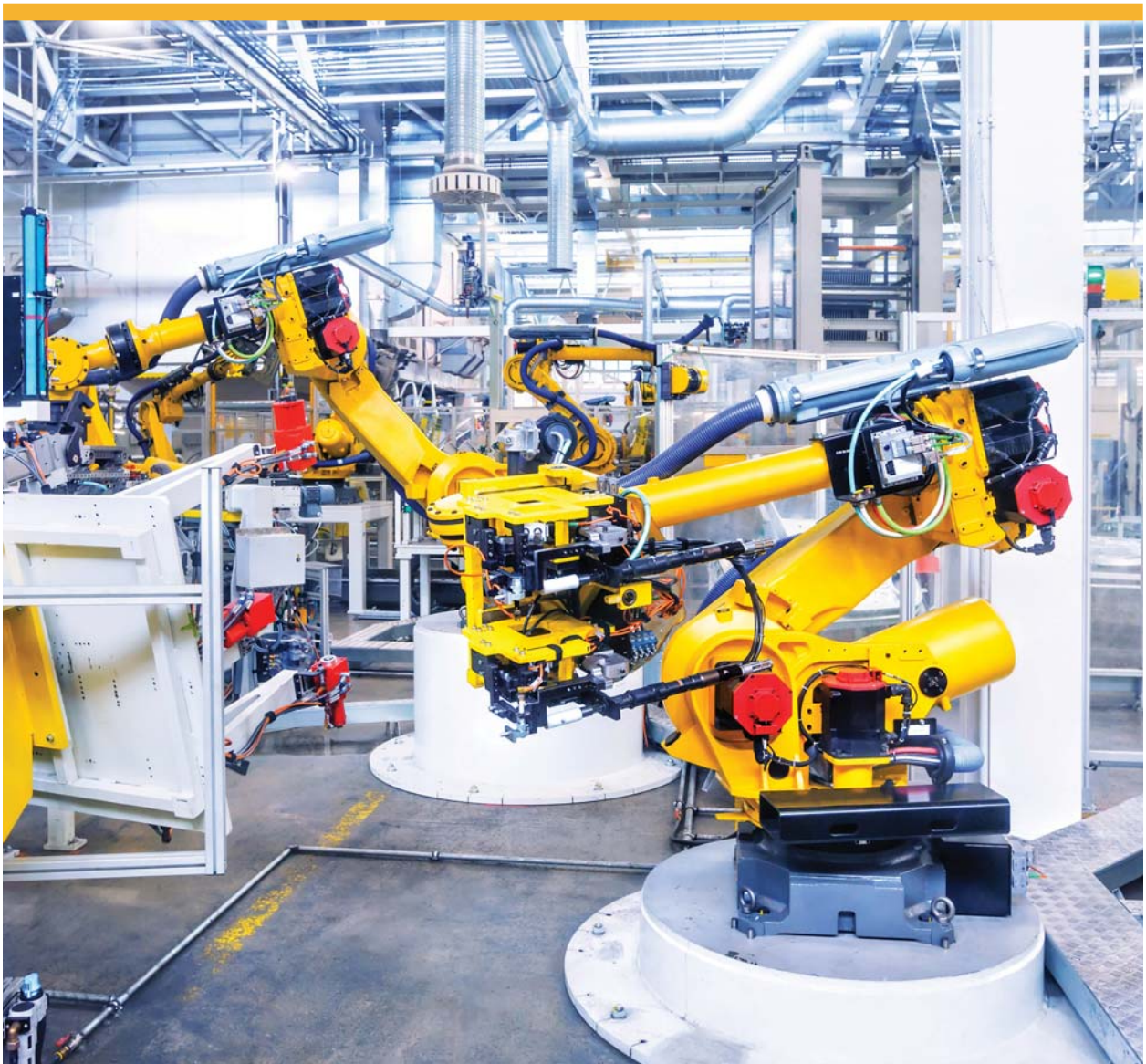
NEW PLUGGABLE SAFETY SYSTEM SIMPLIFIES INSTALLATION, IMPROVES DIAGNOSTICS AND SAFETY



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.

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.

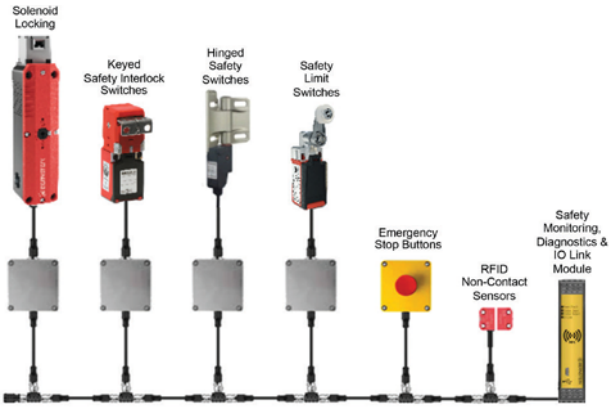


Figure 1: Be sure to incorporate a variety of key safety features into your application.

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 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.

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

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.

Figure 4: SEU transition box.

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.

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.

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)*.

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

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.

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

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.

Q&A WITH KLAUS TUM

Explore key insights into miniature circuit breakers, including how they differ from fuses, what selection criteria to consider and their coordination with protective devices for optimal electrical safety.

by **Sharon Spielman**, Technical Editor

Operational Insights and Selection Considerations for **Miniature Circuit Breakers**

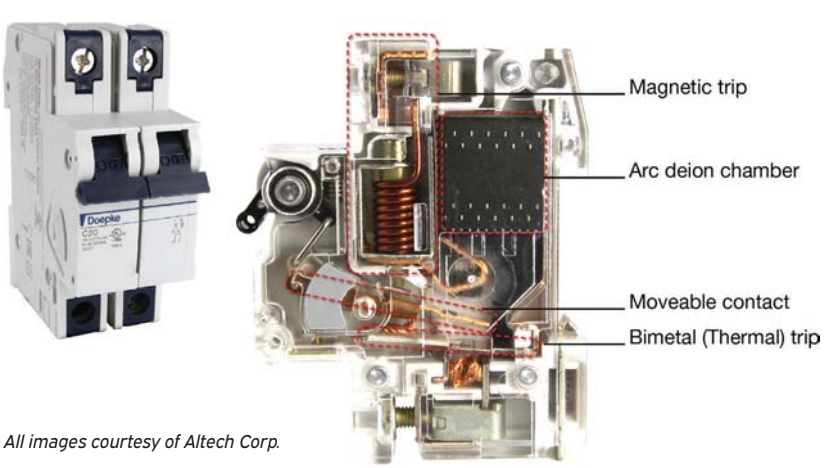
IN TODAY'S INDUSTRIAL electrical systems, the importance of effective protection and reliable operation cannot be overstated. *Machine Design* reached out to Klaus Tum, product director at Altech, to learn about the essential aspects of miniature circuit breakers (MCBs), a component used to safeguard electrical circuits.

From how MCBs differ from fuses to what factors to consider when specifying MCBs to the various tripping mechanisms used in them, Tum offers a valuable perspective into the functionality and application of miniature circuit breakers.

Editor's Note: Questions and responses have been edited for clarity.

***Machine Design:* How do miniature circuit breakers differ from fuses in terms of operation and protection?**

Klaus Tum: The main difference is that MCBs can be reset after they experience a fault (scenario) exceeding their trip parameters. Their trip mechanism consists of an electro-mechanical mechanism (a solenoid, which consists of a magnetic coil, housing and plunger/armature) that will react to the rapidly increasing current of a short circuit. The magnetic field in the magnetic coil will accelerate the armature in a way that it immediately hits the moveable contact of the MCB to break the circuit.



All images courtesy of Altech Corp.

When it comes to slower increasing and smaller currents (overloads), the MCB employs a bimetallic strip that will bend according to the trip parameters and that will eventually hit the moveable contact on the other side of the pivot point to break the circuit. The arc (energy that consists of mostly fire) fault (especially when it comes to short circuits) will be guided into the so-called arc deion chamber and the arc will get extinguished there.

Fuses, on the other hand, need to be replaced every time they see a catastrophic fault. Fuses usually consist of a cylindrical (or sometimes) square ceramic (or sometimes glass) housing, filled with either sand or sometimes air (smaller fuses with lower amperage and voltage ratings) and conductive tips on both sides that are internally connected using a (specialty) wire that could be made of any kind of conductive metal such as copper, aluminum, alloys, etc. In case of a short circuit, the sand inside the fuse housing will suppress the energy of the fault, and the connecting wire will melt.

***MD:* What factors should be considered when selecting a miniature circuit breaker for a specific application of machine design?**

KT: When selecting mini circuit breakers, the following factors should be considered:

- Amperage and voltage ratings needed for the panel/circuits
- Available short circuit current at the installation point and therefore needed kA rating of the MCBTrip curve to avoid nuisance tripping.

***MD:* Can you explain the importance of coordination between miniature circuit breakers and other protective devices in a machine's electrical system?**

KT: MCBs are usually employed "at the lower end" of the circuits, meaning closer or right upstream of the load. The reason for that is that they come in amperage ratings all the way down to 300 mA and can therefore be sized according to the full load amp (FLA) of the load better. Larger molded case circuit breakers (MCCBs) usually stop at 15 A and don't go lower.

In addition, a smaller single load does not usually generate a high (short circuit) fault current and therefore the industry average of 10 kA short circuit interrupt capacity is usually sufficient. Therefore, MCBs protect mostly a single load and larger MCCBs protect a bank of smaller loads. The MCCBs need to be size (amperage rating, kA rating, etc.) so they don't trip when only one of the downstream loads experience a fault condition. Taking care of that fault is the "job" of the MCB. In close cases, the trip curves of the different devices need also be considered (selective coordination).

DLS9 Series—3 Pole D-Trip

***MD:* What are the main types of tripping mechanisms used in miniature circuit breakers, and when is each type typically employed?**

KT: Thermal-magnetic trip mechanisms are the most widely used in MCCBs, all kinds of MCBs (tested to different UL standards such as UL 489, UL 508 and UL 1077). The main reason is that fault conditions "generate" heat and the MCB should react to that heat accordingly. The drawback is that the MCB will also react to heat or temperature that the environment around it (MCBs next to it, atmospheric temperature inside and outside of the panel installation) generates. These temperature effects can offset by properly sizing the MCB, utilizing cooling spacers (for cooling) between breakers or employing HVAC measures inside the panel.

Hydraulic-magnetic trip mechanisms are used in 3% to 5% of the MCBs on the market and are only provided by a few manufactures. It's essentially the solenoid setup for the "magnetic" portion explained above housed in an oil filled chamber; or, in other words, they operate on the magnetic force produced by the load current flowing through a series connected solenoid coil, which is wound around a hermetically sealed tube containing an iron core, a spring and a dampening fluid.

The advantage of this kind of MCBs is that they can be used in hot and cold environments without the need of over or under sizing them. In addition, they don't react to heat fluctuations. The big disadvantage of these MCBs is that they don't (automatically) react to the heat the fault condition generates.

***MD:* How does the breaking capacity of a miniature circuit breaker impact its suitability for different machine design applications?**

KT: The breaking (or interrupt) capacity of 10 kA (to maybe 14 kA, in some rare cases) limits the application of MCBs to smaller panels or downstream loads of larger panels. ■

Safety First—The Role of **Disconnect Switches** in Industrial Applications

Now let's explore the essential functions, applications and selection considerations of disconnect switches, with insights from Altech's Tum.

DISCONNECT SWITCHES play an important role in ensuring the safety and efficiency of industrial machinery. As key components in electrical systems, they provide a reliable means for safety isolating equipment during maintenance and emergency situations.

Here, we dive into primary functions, variations in applications and considerations for selecting the right switch. We also look at the distinctions of making and breaking capacities and assess how these factors influence the overall reliability and efficiency of machine operations.

Editor's Note: Questions and responses have been edited for clarity.

***Machine Design:* What are the primary functions of disconnect switches and**

machine design, and how do they enhance safety and maintenance procedures?
Klaus Tum: The primary function of a disconnect switch is to safely turn the power on and off. A disconnect switch usually is part of the power circuit of a panel that controls various aspects of machine operations. The use of a shaft and external door interlock handle along with the disconnect will ensure that the panel door can only be opened when the power is turned off.

Disconnect switches can also be used in secondary and/or control circuits to control power to an individual circuit or a bank of individual circuits. The disconnects are then used with different handles or door mount kits as they sit on the inside of the panel and where the door interlock function is not necessary or required.

KEM325UL-Y/R

***MD:* How do the various types of disconnect switches—such as fused, non-fused and enclosed switches—differ in their applications within industrial machinery?**
KT: Fused disconnect switches are used in place of large, molded case circuit breakers (MCCBs). Non-fused disconnect switches are used when the application requires a "power" switch and circuit protection is provided by other means such as a large MCCB, miniature circuit breakers (MCBs), fuse, etc., downstream.

Enclosed disconnect switches are predominately used close to the load. For example, the National Electric Code (NEC) requires a "local" disconnect in line of sight of a motor. They are also used on the outside of panels where the control of a certain circuit is essential, but access to adjacent circuits inside the panel is not necessary.

***MD:* What are the key considerations when selecting a disconnect switch for a specific machine design to ensure compliance with safety standards?**
KT: Key considerations include electrical ratings, type of load, location and environment, safety standards compliance, mechanical durability, mounting options, isolation capability, operation mode, indicators and accessibility, cost, availability and compatibility.

The switch should be rated for the maximum voltage and current it will encounter in the application. It should also be able to withstand potential short circuit currents without failing. Regarding the type of load, consider whether it is resistive, inductive or capacitive, as this will affect the type of switch and its features, such as arc suppression.

Operate the switch within the temperature range specified by the manufacturer. For outdoor or harsh environments, look for switches with appropriate ingress protection (IP) ratings for durability against moisture, dust and other elements.

Confirm that the switch complies with relevant safety standards, including panel rating (UL 508A, UL power distribution or lighting panel, NFPA79, etc.), kAIC rating, UL Type rating (environmental rating such as UL Type 4, 4X, 12, etc.), OSHA and NEC requirements.

Ensure the switch will meet the operational demands of the application, including the number of operations expected over its lifetime. Mounting options are another thing to consider. The switch should be mountable in the intended orientation and in the space available in the machine design. Additionally, there should be sufficient isolation from the power supply to ensure that maintenance can be performed safely.

Finally, evaluate the cost-effectiveness of the switch in relation to the budget of the machine design without sacrificing quality and compliance standards.

RT316 Series

***MD:* Can you explain the significance of the "making" and "breaking" capacities of a disconnect switch in relation to its performance in electrical circuits?**
KT: In short, making is closing the circuit; breaking is opening the circuit. Altech/Katko disconnect switches do not differentiate between the two operations. The internal switching mechanism is mirrored in both directions (of operation). They are UL tested during short circuit tests (so-called "O" and "CO" shots) and overload/endurance tests (6,000 operations under current load/4,000 operations with no load) to simulate these making and breaking conditions.

***MD:* How do disconnect switches contribute to the overall reliability and efficiency of machine operations, particularly in critical environments?**
KT: If properly selected, the disconnect switch is built so robustly that it can be considered almost your last line of "defense," meaning it should be one of the last things that ever breaks in an application, therefore contributing to the safety and reliability of the installation. ■

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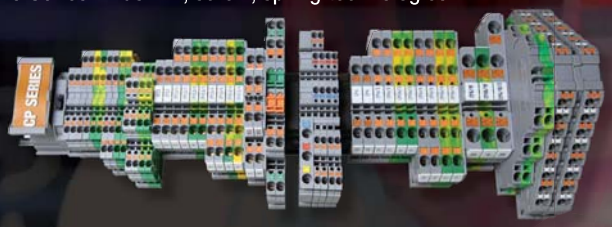

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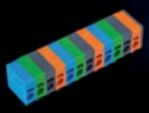

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Unlocking IO-Link:
What it is and Why it Matters for Modern Automation

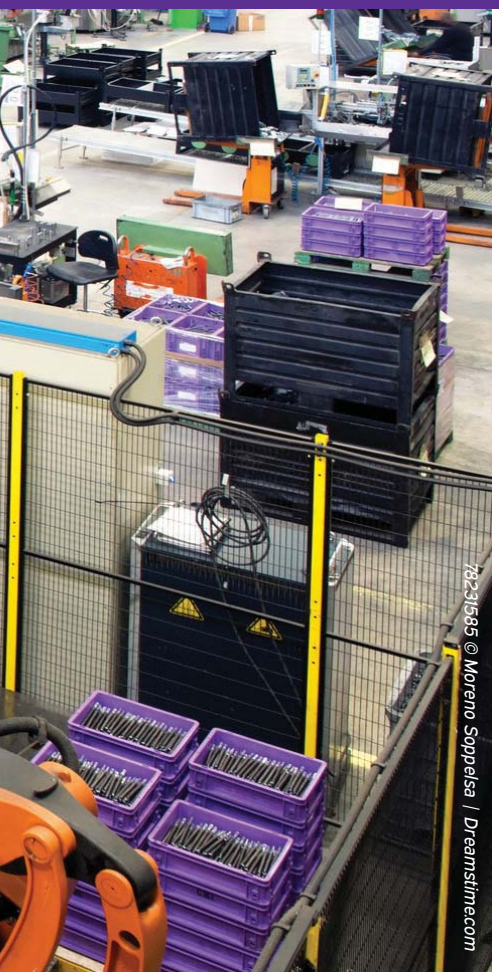
IO-Link enhances process transparency and seamlessly integrates into existing control architectures. But what exactly is it, and why is it essential for modern industrial automation?

by **Rehana Begg,** Editor-in-Chief

THE USE OF IO-LINK as a communication protocol in industrial plants has seen remarkable expansion over the past several years.

The total number of installed IO-Link nodes reached 51.6 million by the end of 2023, according to the industry trade group PROFIBUS & PROFINET International's (PI's) annual survey of newly installed nodes. Last year, 15.9 million IO-Link devices were installed, which represents a record growth of 89% compared to the 8.4 million devices installed in 2022.

The growth should come as no surprise to any plant already using IO-Link to expand access to the lowest field level machine and equipment data, including configuration data, identification data and diagnostics.



A commonly held misconception about IO-Link is that it can replace EtherNet/IP or Profinet. Rather, it is a complementary networking technology that can enable better overall performance and reliability.

What Exactly is IO-Link?

IO-Link is the first globally standardized input/output technology designed for communicating with sensors and actuators and for connecting to an automation system.

Unlike fieldbus, it is not a proprietary communication protocol, but rather a recognized international standard (IEC 61131-9) that ensures compatibility and interoperability between devices from different manufacturers.

As described in IEC 61131-9, IO-Link is a point-to-point communication protocol, which means it connects two devices directly. This makes it straightforward to implement because it uses the same cables and connectors that engineers are already familiar with.

IO-Link provides bidirectional communication. In other words, data flows both ways between the control system and field devices. The setup provides real-time process data and diagnostic information from the sensors and actuators, enabling more precise control and faster troubleshooting.

In essence, an IO-Link device—such as an intelligent sensor, actuator or mechatronic component—makes use of existing connection technology and elevates it by adding smart communication capabilities that make automation systems more efficient and responsive. IO-Link is touted as being as easy to use as the traditional 3-wire setup, only more powerful and versatile. A typical IO-Link system consists of an IO-Link master, IO-Link devices and the cables that connect IO-Link devices to the IO-Link master's ports.

Why is IO-Link Important?

A commonly held misconception about IO-Link is that it can replace EtherNet/IP or Profinet. Rather, it is a complementary networking technology that can enable better overall performance and reliability.

IO-Link was designed as a simple, universal or open standard, and is intended to simplify the smart sensor and intelligent device connectivity on the factory floor. No special cabling or connectors are needed. It requires only standard M12/M8/M5 cables.

A useful analogy, as described in a blog on sensor and automation specialist Balluff's website, is to think of IO-Link as a USB for industrial automation. This characterization is useful in proffering IO-Link's role in enabling one of the most important operational objectives: to ensure equipment availability.

Five Considerations That Make IO-Link Essential in Machine Builds

Communicate with equipment at the lowest level. IO-Link provides two-way communication between sensors and actuators and low-level control systems. IO-Link smart devices can provide data on temperature, stress levels, error codes, configuration and parameter issues.

Replace analog signals with digital signals that enable real-time monitoring. IO-Link communication provides detailed diagnostic information based on raw sensor values thereby enabling predictive maintenance and quicker troubleshooting. This results in uptime and reliability gains and increasing equipment life span.

Increase compatibility with standard equipment. IO-Link uses standard unshielded 3-wire cables, which simplifies wiring and reduces installation costs. Since there is no need for special cables, connectors or complex fieldbus networks, installation can be cost-effective and easier to deploy.

Ensure better device management and better data quality. Devices can be configured remotely, which streamlines setup and adjustment processes.

Offer a high degree of scalability and flexibility. Companies of all sizes can benefit, as IO-Link enables a modular approach to system design and fosters scalability. New sensors or actuators can be added to the system without significant changes to the overall architecture, which provides flexibility for future expansions.

Helping Manufacturers Futureproof Processes

Designed to accommodate future technological advancements, IO-Link offers advanced communication capabilities, along with ease of integration, improved diagnostics and remote management capabilities. With standardized interfaces, more data can be collected and made available for optimizing industrial processes. ■

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