

Circuit protection

Improving machine  
reliability and productivity.  
Build it in.



**EAT•N**

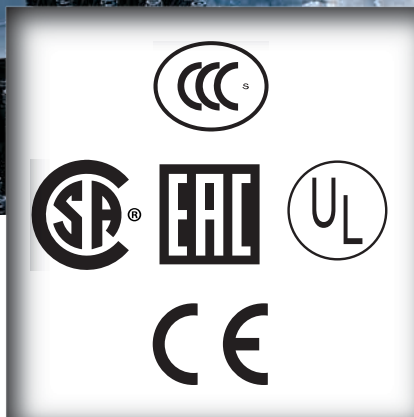
*Powering Business Worldwide*



# Everything you need to build more reliable machines and systems.

Your customers know what they want – machines they can rely on, that increase productivity and reduce costs. At the same time, their need to work to shorter product lifecycles requires you to design and build highly customized machines, or retrofit existing ones, faster.

When designed with our best-in-class electrical and hydraulic solutions, you can build your machines to meet all these demands and more, delivering higher levels of reliability, speed, energy efficiency and flexibility.



## Export-ready

Our global standard components have the approvals that enable you to reduce your total cost to design, build and market machines on the global stage, especially for the requirements of the North American market.



# Build it in.

## Broad offering for the global market

To help you build what you need to build; our broad offering provides the right technologies, aligned with unrivalled technical expertise across applications. This enables you to meet your customers' expectations and specifications more precisely, with machines that deliver on reliability, performance and legislative requirements.

### Reliability assured

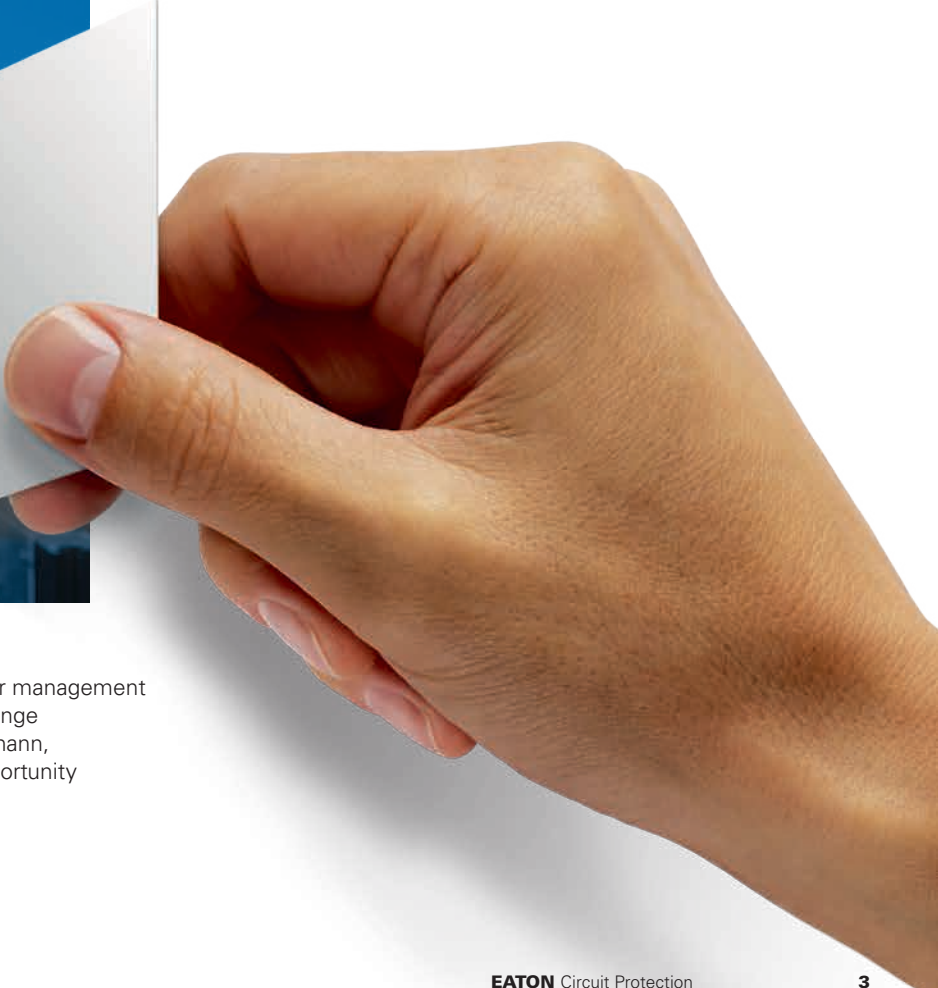
Our machine-building expertise helps to increase productivity, reduce machine downtime and simplify maintenance.

### Increasing safety

By reducing the risk of machine overload, damage and fire, we help you to safeguard equipment, materials, systems and your people.

### Credibility

With over 100 years of experience in serving the needs of machine builders, we understand the challenges you face every day. As technology moves on, we use our expertise to develop solutions you and your customers can rely on.



Reduce  
downtime  
and increase  
profitability

### Industry-leading names

As a world leader in critical circuit protection, power management and electrical safety, we have brought together a range of industry-leading names including Moeller, Bussmann, F&G and Heinemann. This gives our clients the opportunity to choose the best technologies from a broad offer.

# Circuit protection

Our comprehensive range of circuit protection to reliably protect people, machines and plant, in order to have a safe, productive production line.

## Solutions to meet your circuit protection needs

Our expertise and our value-added, modular approach to circuit protection means that we have a reliable solution to meet every application need regardless of machine complexity. Helping you to speed the machine design and build process while significantly reducing complexity and cost.

## Breadth and depth

Our comprehensive range of solutions enables you to overcome increasing complexity and risk to protect for short circuit, overload, overvoltage, arc fault or residual current and cover every aspect of circuit safety:

- Cable and system protection
- Operator protection
- Power conversion protection
- Long distance cable protection

## Single supplier

To keep you ahead of complex, changing customer needs and meet global acceptable standards, it's useful to be able to consolidate your supply network and source components from a single supplier. With Eaton, you can do exactly this.



## Cable and system protection



Residual current circuit breaker



Miniature circuit breaker

## Long distance cable protection



Modular fuse holder and fuse link

## Operator protection

in standard applications



Residual current circuit breaker

## Communication and visualization for more energy efficiency

BreakerVisu our logging and visualization system collect the data coming from single devices. This helps to control and optimize energy consumption. SmartWire-DT is only one solution to communicate in the system.





Industrial fuse link

Surge protection device

NZM circuit breaker



PKE 65 circuit breaker



SmartWire-DT® module for NZM



Energy measuring module XMC

## Communication and visualization



SmartWire-DT gateways



BreakerVisu visualization and logging

Heinemann hydraulic magnetic circuit breaker



Use the right technologies to minimize downtime

## Power conversion protection



Fuse bases for square body high speed fuse links



DIN 43653 High speed fuse links

Bolted tags high speed fuse links

## in variable frequency drive application



Combined RCD/ MCB devices



Modular fuse holder and fuse link



Residual current circuit breaker



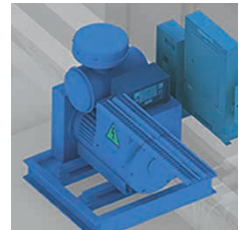
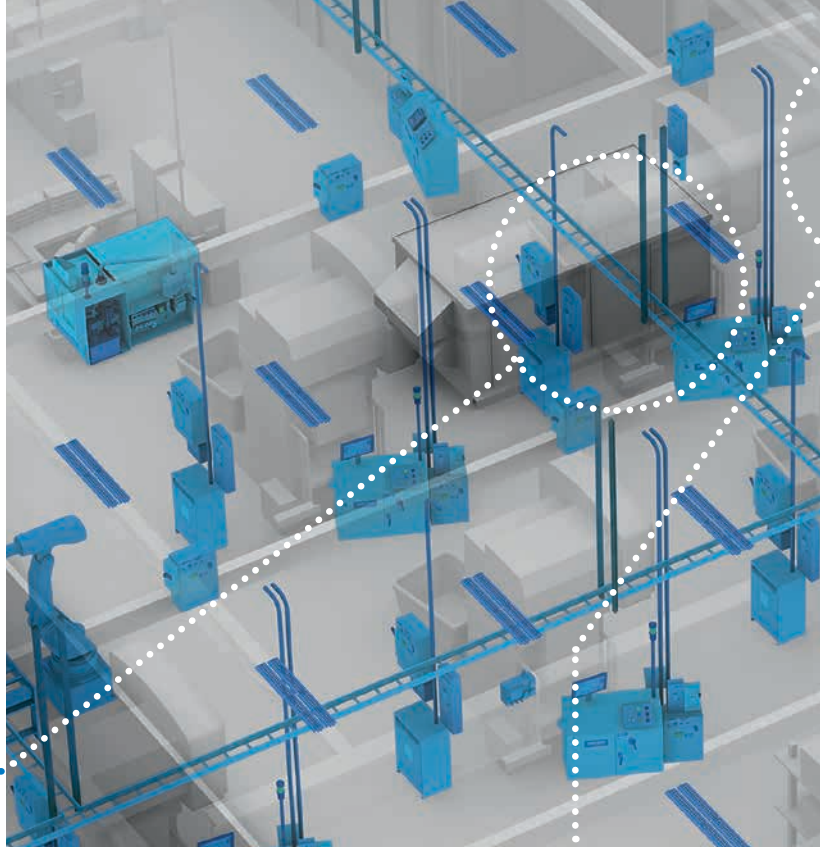
Variable frequency drive

### All protection technologies available for circuit protection:

- Electronic
- Thermomagnetic
- Hydraulic magnetic
- Fuses

# Circuit protection applications

To address your challenges, you need to select the right technology for the right application. Our solutions help to better protect, measure, operate and communicate, and increase the safety and reliability of your machines.



## Long-distance cable protection

### Applications

- Overload and short circuit protection where equipment requires long cables

### Your challenges

- Nuisance or non-tripping over long distances
- Nuisance tripping due to motor start current peak or capacitive circuits

### Our solutions

- Application-specific circuit breaker solutions
- High-inrush current capabilities

## Power conversion protection

### Applications

- Effective protection of sensitive power electronics against overcurrent

### Your challenges

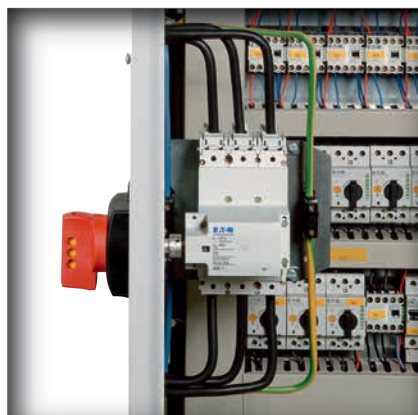
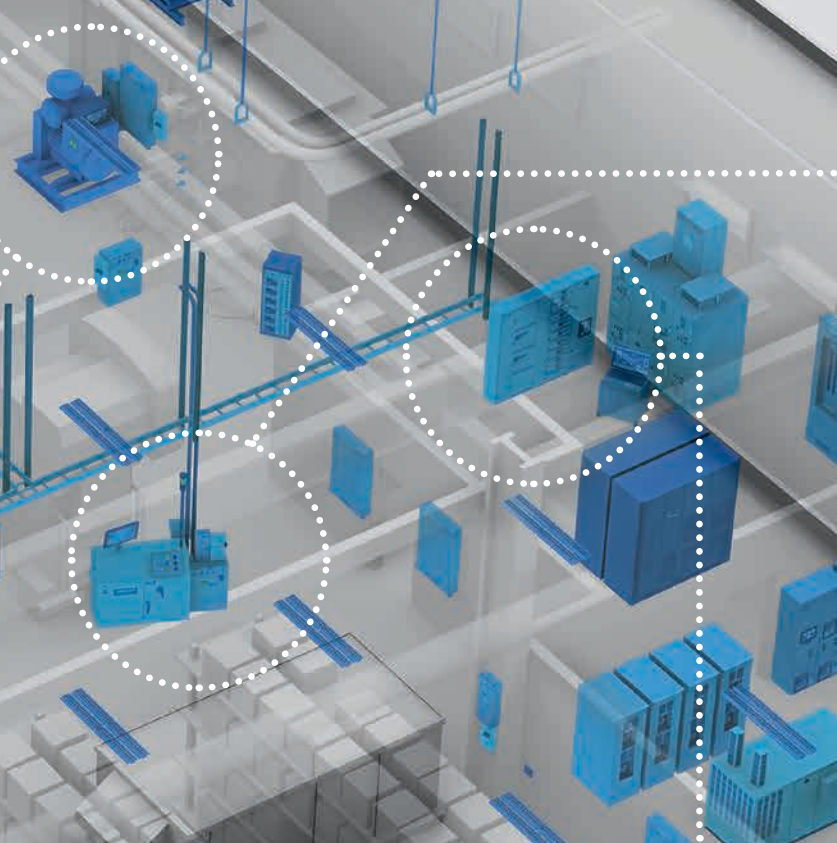
- Limited space
- Safe operation and indication
- Application-specific certification

### Our solutions

- Compact dimensions for a smaller footprint
- Suitable for DIN rail and/or screw mounting
- Global accreditation including IEC, UL, CSA and CCC



# Build it in.



## Cable and system protection

### Applications

- Effective protection against overload, short circuit and overvoltage

### Your challenges

- Limited space
- Safe operation and indication
- Global certification

### Our solutions

- Application-specific protection and visualisation devices
- SmartWire-DT provides unrivalled communications capabilities
- Global accreditation including IEC, UL, CSA and CCC

## Operator protection

### Standard applications

- Residual current protection on the machine

### Your challenges

- Detecting leakage currents
- Protecting humans against shocks
- Protecting equipment against damage

### Our solutions

- Broad RCD portfolio with application-specific protection
- Pre-warning functionality
- Global accreditation including IEC, UL, CSA and CCC

### Variable frequency drive applications

- Combination of drive and RCCB Type B




### Your challenges

- Insufficient protection against residual currents
- Nuisance tripping due to application-specific earth leakage currents

### Our solutions

- Wide selection of Type U, Type B, B+, Bfq RCCBs and drive combinations
- Application-specific functionality

# Our products

Product	RCCBs IEC & UL	Digital RCCBs	Digital RCCBs type B
			
<b>Product description</b>	Complete Range of residual current devices for worldwide use covering IEC/EN 61008 & UL1053 standard. Wide variety of nominal currents and a comprehensive range of accessories. The range contains RCCBs Type AC, A, U and R.	RCCB for fault or additional protection with digital features to keep system's up-time high. The digital protection provides prewarning of creeping currents. This supports the operator of the machinery to solve problems without unwanted downtimes. The digital RCCBs are available as Type A, B and B+.	All current sensitive RCCB for fault or additional protection with digital features to keep system's up-time high. The digital protection provides prewarning of creeping currents. This supports the operator of the machinery to solve problems without unwanted downtimes. In addition to the standard Type B, Eaton offers Type Bfq and B+ for variable frequency drives and fire protection.
<b>Rated current</b>	16 – 125 A	25 – 80 A	25 – 63 A
<b>Rated Voltage</b>	from 110 VAC up to 277/480 VAC	240/415 VAC	240/415 VAC
<b>Rated Tripping Current</b>	up to 500 mA	up to 300 mA	up to 300 mA
<b>Breaking capacity</b>	-	-	-
<b>Features</b>	<ul style="list-style-type: none"> <li>• 6 months test interval</li> <li>• World wide use (VDE, CCC, EAC)</li> <li>• Sensitivity: AC or AC and pulsating DC</li> <li>• IEC/EN 61008 + UL1053</li> </ul>	<ul style="list-style-type: none"> <li>• Real-time measurement of the residual current</li> <li>• Local pre-warning via LEDs</li> <li>• Remote pre-warning via potential free output</li> <li>• Yearly test interval</li> <li>• World wide use (VDE, CCC, EAC)</li> <li>• Sensitivity: Type A or type F (AC and pulsating DC)</li> </ul>	<ul style="list-style-type: none"> <li>• Real-time measurement of the residual current</li> <li>• Local pre-warning via LEDs</li> <li>• Remote pre-warning via potential free output</li> <li>• Yearly test interval</li> <li>• World wide use (VDE, CCC, EAC)</li> <li>• Suited for 50/60Hz</li> <li>• Sensitivity: all current sensitive</li> <li>• Short time delayed and selective</li> </ul>
<b>Applications</b>	Standard fault and additional protection in Industrial applications as: <ul style="list-style-type: none"> <li>• Machinery equipment</li> <li>• (RCCB Type F for machinery equipment with 1phase variable frequency drives)</li> <li>• Marine &amp; Offshore</li> <li>• Agriculture</li> </ul>	Standard fault and additional protection in industrial applications as: <ul style="list-style-type: none"> <li>• Machinery equipment</li> <li>• RCCB Type U for machinery equipment with 1phase variable frequency drives</li> <li>• Medical applications</li> <li>• RCCB Type R for X-Ray applications (1phase)</li> <li>• Marine &amp; Offshore</li> <li>• Agriculture</li> </ul>	Fault and additional protection in applications with 3phase frequency converts and DC systems: <ul style="list-style-type: none"> <li>• RCCB Type B for DC Systems (PV or UPS) and 3phase frequency converters industrial applications</li> <li>• RCCB Type B+ for fire risk applications as agriculture, petrol stations, Biogas plants</li> <li>• RCCB Type Bfq for powerful variable frequency drives in machinery equipment</li> </ul>



## RCBOs



Broadest range of RCBOs from 1+N up to 4poles in a very compact shape. Digital versions with pre-warning functionality. Voltage independent and dependent versions for global use.

up to 40 A

240/415 VAC

up to 300 mA

up to 10 kA

- Pre warning functionality
- Global approvals
- Broad range of accessories

Fits perfectly in applications with less space

- Combination of overcurrent, short-circuit and leakage current protection in one device.
- Especially for
  - Machinery equipment
  - Auxiliary Circuit
  - Marine & Offshore

## Miniature circuit breakers



When it comes to protecting and switching, the high quality, safe and reliable products of the xEffect Industrial series guarantees protection of people, installations and systems worldwide. Designed and approved for industrial and high end commercial applications, the MCB xEffect series includes auxiliaries, tripping modules, interlocks, busbars and accessories.

up to 125 A in 2 frame sizes

up to 277/480 VAC and 500 VDC

up to 25 kA

- Wide range of accessories
- EN60898-1, EN60947-2
- Tripping characteristics: B, C, D, K, S, Z
- Contact position indicator (red / green)
- IEC / CCC / UL and marine approvals

- Commercial and industrial energy distribution
- Protective device with outstanding performance for
  - Renewable Energy
  - Mining
  - Marine & Offshore
  - Data center

## Moulded case circuit breakers



Overload and short circuit protection for systems, generators, transformers and motor application covered with one product family. The MCCBs with its huge accessory assortment together with global availability and approval is the right choice for protection of demanding energy distribution applications in all industries.

20 – 1600 A in 4 frame sizes

up to 1000 VAC / 1500 VDC

-

25 up to 150 kA

- Wide range of accessories
- Thermal magnetic or electronic trip unit available
- Available as MCCB or switch disconnect
- Communication & diagnostics
- IEC / CCC / UL and marine approvals

- Commercial and industrial energy distribution
- Main switch in machines
- Switch Disconnect or protective device with outstanding performance for
  - Renewable Energy
  - Marine & Offshore
  - Data center

## System protective circuit breakers PKE



The PKE is a motor-protective and system-protective circuit-breaker with modular trip blocks and an electronically implemented overload protection feature. Combined with SmartWire-DT it delivers data such as instantaneous load currents, advance warnings for critical states, and comprehensive diagnostic data.

up to 65 A




690 VAC

-

50 kA

- Wide current setting range
- Modular design, with pluggable trip units
- Versatile use for motor protection and system protection purposes
- Increased availability, early warning of overload

- Main switch for machines
- Motor- and system protection in machines
- Motor control center
- Energy distribution boards
- Chemical Industry
- Oil and Gas
- Marine & Offshore
- Material Handling

Product	Surge protection devices	D&DO Fuse links and fuse bases	High speed cylindrical fuse links
			
<b>Product description</b>	Complete range of SPDs for the protection from transient overvoltage in energy supply systems, PV installations, wind energy systems and for data transfer.	D & DO (bottle fuse links) fuse links designed for none critical semiconductor or circuit protection. Available in standard sizes DI to DV or D01 to D03 according to IEC60269 standard.	Cylindrical fuse links for the protection of semiconductors on the input to drives, soft starters or low power conversion devices. Available in sizes 10 x 38 mm, 14 x 51 mm and 22 x 58 mm and ratings from 1 to 100 A
<b>Rated current</b>	-	2 – 200 A (standard sizes)	1 – 100 A (different sizes)
<b>Rated voltage</b>	70 V 690 VAC and 5 – 1000 V DC	400 V and 500 V	up to 700 V
<b>Breaking capacity</b>	-	50 kA	200 kA
<b>Features</b>	<ul style="list-style-type: none"> <li>• Robust and easy to install</li> <li>• All feasible configurations available, pluggable, wherever possible</li> <li>• Easy assembly with auxiliary contacts</li> <li>• Test classes: T1, T2, T1&amp;T2, T3</li> <li>• Lightning protection class I&amp;II and III and IV</li> </ul>	<ul style="list-style-type: none"> <li>• Unique sizes prevent incorrect fuse being installed during fuse link replacement</li> <li>• Built-in fuse operation indication helps with quick replacement reducing machine downtime</li> <li>• Comprehensive range of fuse holders, gauge rings and caps available</li> </ul>	<ul style="list-style-type: none"> <li>• Ultra rapid performance in very small platform</li> <li>• Low I<sup>2</sup>t (fault let-through) and good DC performance ensure optimum protection</li> <li>• Good cyclic loading withstand reduces nuisance operation</li> </ul>
<b>Applications</b>	<ul style="list-style-type: none"> <li>• Protection against overvoltage in all kind of buildings and renewable energy applications</li> </ul>	<ul style="list-style-type: none"> <li>• None critical power conversion equipment protection</li> <li>• UPS and drive protection</li> <li>• Back up protection for low power semiconductor devices</li> <li>• Industrial and commercial</li> </ul>	<ul style="list-style-type: none"> <li>• Small or low power UPS systems and AC drives</li> <li>• Low power applications where space is at a premium</li> <li>• Designed to protect power semiconductors</li> </ul>



## UL Low voltage fuse links, blocks and bases



UL Listed fuse links, bases and blocks offer unrivalled choice and performance for industrial and commercial applications. Available in a comprehensive range of voltage, current and sizes. They are suitable for applications or equipment to be exported to the USA or other UL markets.

0.5 A to 6000 A

up to 600 V

200 kA

- Industry standard fuse links for compliance with installations required in the USA and countries adhering to the UL standards
- Class leading performance and maximum current limitation available in most designs
- Comprehensive range of fuse blocks and holders available
- Available in class T, J, H, RK1, RK5 and class L

- Industrial and commercial
- Suitable for applications or equipment to be exported to the USA or other UL markets

## High speed – square body fuse links



A comprehensive range of DIN dimensioned, specially designed fuse links for semiconductor protection on medium to high power applications.

10 A to 5500 A

up to 690 V

up to 300 kA

- Extensive product range, available in many sizes, ratings and end connections
- Globally accredited (IEC and UL standards)
- High breaking capacity
- Very low I<sub>2t</sub> and energy let-through levels

- Low to high power AC and DC drives
- Motor drives
- Variable frequency drives
- High power rectifiers
- Power supplies
- Battery charging circuits
- IGBTs, Thyristors, Diodes, GTO devices protection
- High power field effect transistors

## High speed – British standard fuse links



A mature range of high performance fuse links for the protection of semiconductor devices or critical circuits.

240 V range from 6 to 900 A.  
690 V range from 6 to 710 A

240 V and 690 V

200 kA

- Established high performance fuse links for the protection of semiconductor devices
- Low I<sub>2t</sub> (fault let-through) and watts loss
- Excellent DC performance
- Meets the requirements of BS88-4 and IEC 60269-4
- Comprehensive range of fuse operation indicators and micro switches

- Low to medium power AC and DC drives
- Single and three phase rectifiers
- Variable frequency drives
- Power supplies
- Battery chargers
- IGBTs, Thyristors, Diodes, GTO devices protection
- High power field effect transistors

## Heinemann hydraulic magnetic circuit breakers



Hydraulic magnetic circuit breaker for both AC and DC supplies. It is to be applied in conjunction with a branch protector (if branch protection is required). The unit is DIN mounted and can have auxiliary contacts (NC or NO) on the same pole.

0.1 A to 63 A

80 VDC / 480 VAC

up to 5 kA

- High temperature stability without any derating
- In-rush robust (8x, 15x and 22xI<sub>n</sub>)
- Increased accuracy and reliability
- Immediate reset possible after tripping

- Branch and supplementary protection in harsh environment including :T° variation choc & vibrations. Avoids nuisance tripping on long cable protection and starting currents on capacitive circuits or motor starting

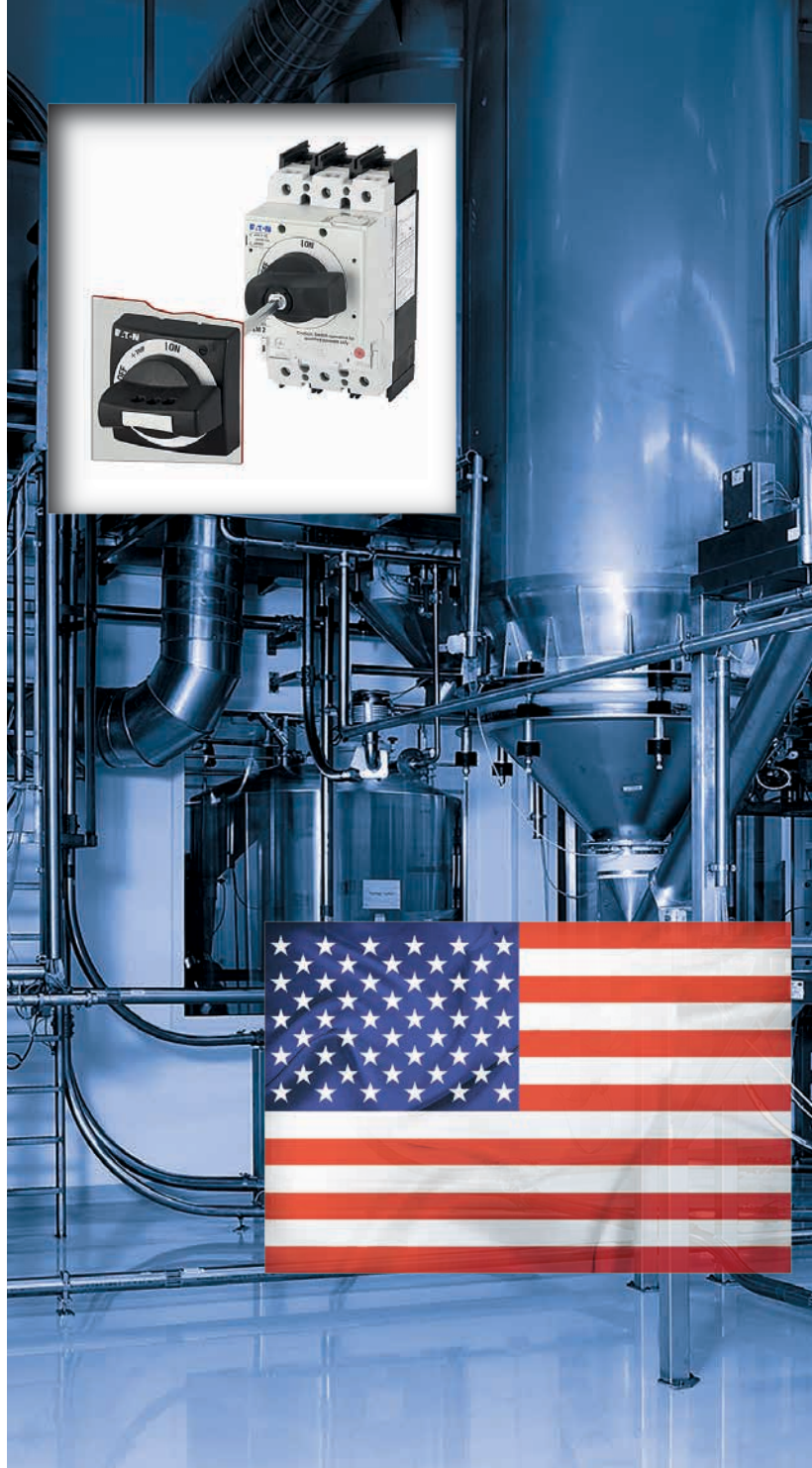
# Use our expertise to simplify global machine design and export.

European machine and system building and worldwide export are closely related. Many machine builders have export rates of more than 80%, with the North American market being one of the biggest.

This can present a significant challenge for machine and system builders, as standards and regulations in North America differ in a number of important ways from the IEC market. Product certifications are a requirement for export, as are individual component standards and localization installation practices, in addition to specialized market conventions.

To make the right decisions when designing a machine for the North American market you need a partner who is at home in both markets. Eaton has more than a hundred years of experience in this respect. In circuit protection, where the differences between the IEC market and the UL/CSA market are sizable, we are a leading company in the business.

Eaton can offer you guidance and training. We have solution partners who will help you to build control cabinets for the North American market which will meet local authority approval. This ensures compliance with UL 508 for control equipment and the regulations for molded case circuit breaker and switches (UL 489), disconnect switches (UL 98) or fuses (UL 248).



## Differences between North American and IEC markets

Special components, such as handles for main switches which can only be operated by the intentional switching of an additional handle when the control panel door is opened, are required in North America.

The differences between the markets are often lead to misunderstandings, improper component selection and assembly certification problems when dealing with local authorities in North America. Changes in regulations, as with the NEC 2017 for Short Circuit Current Ratings (SCCR) make it increasingly difficult.

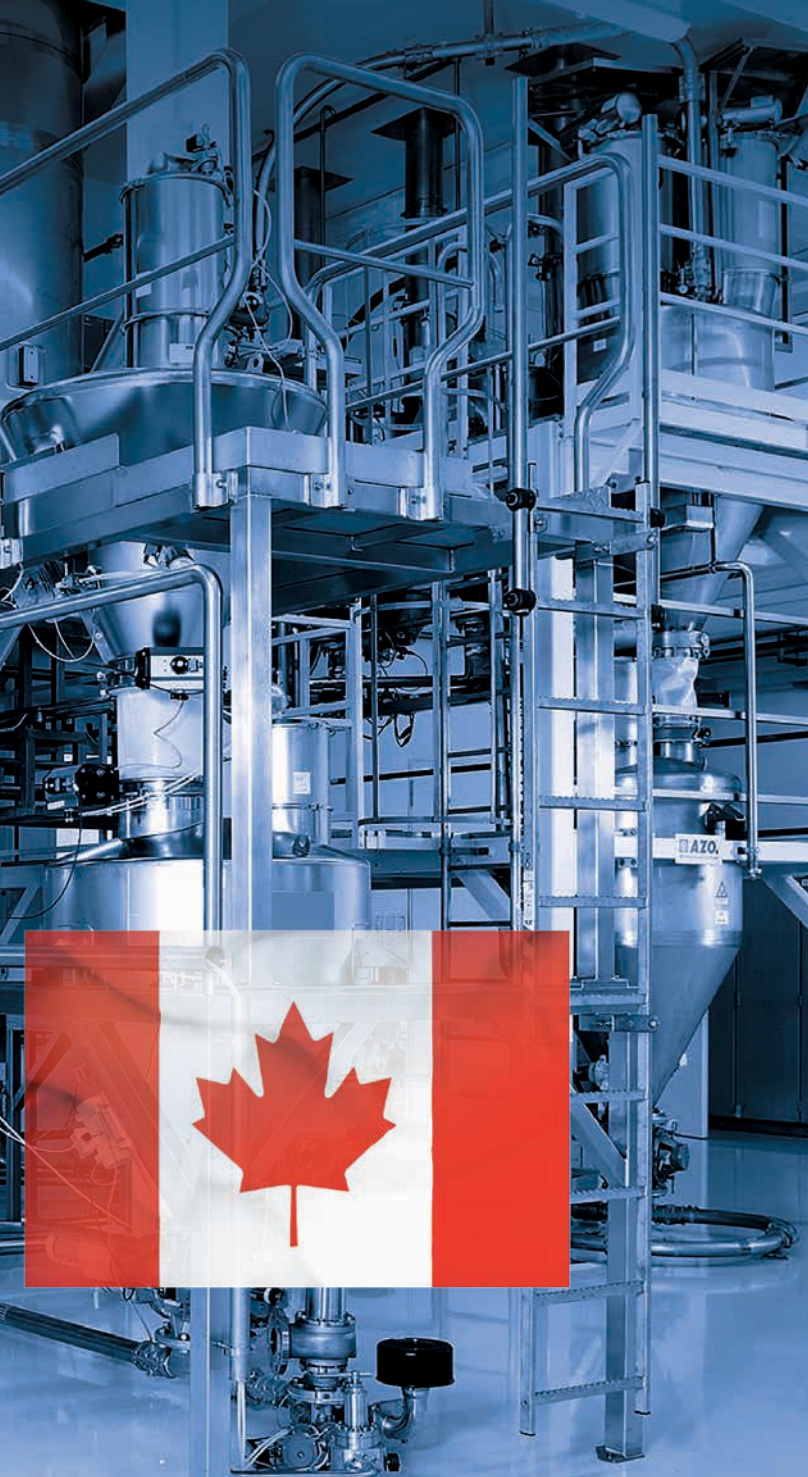
Areas of difference include:

- The Importance of Short Circuit Current Ratings (SCCR)
- In North America there are a variety of different network forms and voltages
- Importance of feeder and branch circuits
- Regulations for motor starters (Article 430 of the NEC)
- Different requirements for accessories like handles for main switches



SAE Schaltanlagenbau Erfurt, a partner of Eaton, is building Control panels for North America.





Eaton offers a broad information platform to give you the guidance you need in meeting these challenges. On our web page you will find:

- Videos which explain the difference between the UL and IEC market
- A range of white papers
- Our design guide for building control panels according to UL 508A
- Customer success stories and tools.

1. Current-limiting devices: Strengthening the weakest SCCR link.
2. Export relevant information on supply distribution networks in North America.
3. Special considerations governing the application of Manual Motor Controllers and Motor Starters in North America.
4. Electrical equipment of industrial machinery exported to North America. Including information about feeder and branch circuits.
5. Supply circuit disconnecting means with rotary handles in compliance with NFPA 79 and UL 508A.
6. Control panel design guide according to UL 508 A.

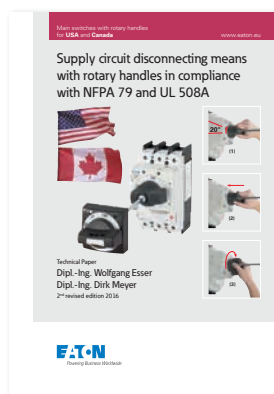
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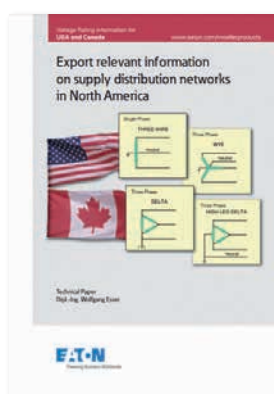
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For more information download our brochures at [www.eaton.eu/export](http://www.eaton.eu/export)

# Circuit protection system applications.



Agricultural machinery provides excellent reliability for preparing vegetables

König has chosen an automated solution and system protection from a single source, with FRC residual current circuit breakers.

**Background:** To clean the vegetables Renner operates six vegetable preparation machines that rinse and wash the soil off the vegetables as well as cut the roots and excess leaves. Renner must ensure that any shutdowns or power outages are minimized to guarantee the freshness of the vegetables.

**Challenge:** The challenges faced by König's customers, including Renner, are to reliably and safely prepare and pack vegetables, while maximising uptime.

"We wanted to design a system where the knives and brushes could be turned on separately, and the speed of the brushes be adjusted," explained Christian Stritzinger, industrial foreman in the electrical engineering team at König. "Furthermore, we required the conveyor belt which transports the vegetables through the system to be speed-controlled."

**Solution:** To enable continuous communication, König controls the variable speed-regulated motors with Eaton components and has installed the five variable speed starter PowerXL DE11 in the Renner machine, which are embedded in the SmartWire-DT strand.



## Results

Conventional type A FRC residual current circuit breakers are installed in the current machine for the protection of the operators as well as the machine.

"Everything from Eaton just fits together easily – the interplay of the components simplifies the development as well as the integration and operation of our machines immensely," said Stritzinger.

Consequently the reliability of the system is increased, ensuring that the vegetables are delivered fresh and crisp to the customer.





## New power distribution system for cereal manufacturer

**Background:** As the first manufacturer of oat flakes in Switzerland, Kentaur launched a "ready-to-eat" Bircher muesli on the market. The development to a leading producer of cereal flakes and pops took place gradually. Kentaur relies on the top quality products of Eaton for the new power distribution system in the incoming goods, raw materials processing and waste recycling areas: the good price/performance ratio of their durable products as well as their outstanding services were the reasons for choosing Eaton.

**Challenge:** At Kentaur, the constantly high quality of its products and production process is of key importance. During a routine inspection of the Kentaur switchboards, it was decided that the distribution system for the incoming goods, raw material processing and waste recycling areas needed renewing.

The following requirements had to be met: close compliance with all installation standards, optimum use of limited space and keeping within the budget set. The consistent use of circuit breakers instead of fuses in order to reduce downtimes was the first technical decision made. As Eaton products were already successfully in operation in Kentaur plants and machines, the project managers contacted Eaton. They jointly worked out a solution to meet requirements and standards stipulated and Eaton was then awarded the contract.

**Solution:** Eaton was then awarded the contract to provide a solution consisting of various circuit breakers (NZM1 80 A/ 100 A/ 125 A/ 160 A, NZM2 160 A/ 200 A/ 250 A, and NZM4 630 A) as well as several PFR residual current relays. The customer was impressed by the compactness of the PFR with a design matching that of the NZM circuit breaker and its functions.

### Results

"At Kentaur several production lines for different processing technologies are in operation round the clock. For this reason we must be able to fully rely on the quality of the electrical products in plants and in the power distribution systems. Eaton in Switzerland gave us highly expert advice, as well as offering a comprehensive service with very fast response times. A future-proof system for personnel and system protection is now in place."



## A safer, simpler and more efficient way of solar power collection

**Background:** Parabolic trough solar collectors harvest the sun's energy by focusing its radiation onto a circulating heat transfer medium such as steam, thermal oil or liquid salt. However, these mediums circulate in the solar field at high pressure, so in the event of a leak people and the environment are at risk. This risk is significant when you consider that a 50 MW power station can use around one million litres of thermal oil.

**Challenge:** These solar collectors are intended for installation in regions of strong, regular sunlight – often harsh, remote locations, so the electronic and electrical equipment installed into each collector has to be robust – and this includes the power distribution system and switchgear.

Maintenance visits for such equipment on these sites are costly and time-consuming, and finding highly trained staff can sometimes be an issue. Lack of locally available spares was another potential problem that had to be considered and allowed for.

**Solution:** Swiss company, Airtight Energy Manufacturing SA, developed an innovative parabolic trough solar connector using Eaton components including miniature circuit breakers and residual current devices as well as EMR4 measuring and monitoring relays and an NZM2 circuit breaker which is used as a main switch. The products are used primarily to monitor the cables and systems for over currents or short circuits.

### Results

Eaton's high quality, internationally qualified and supported components ensure high availability while allowing easy and fast installation and contributing to simplified maintenance.

## Better solutions for machine builders worldwide

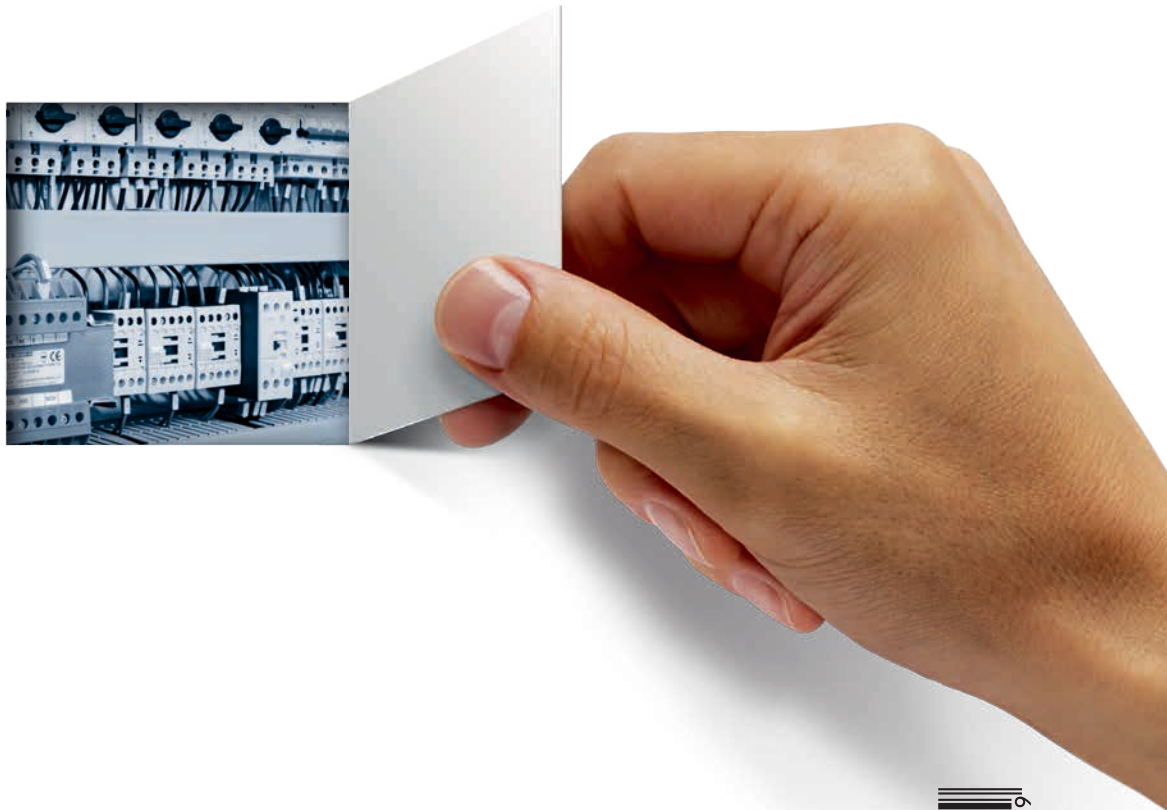
At Eaton, we provide compact and complex machine and system solutions for the world market.

These solutions are focused on helping end users to make tangible improvements in productivity and profitability with machines that are:

- Simpler, more compact and lower cost
- More reliable
- More energy-efficient
- Safer

We serve the electrical engineering of all parts of a machine. Our circuit protection solutions help to better protect people and assets. Our SmartWire-DT intelligent wiring system enables users to connect electrical and hydraulic devices, from controllers to sensors, reducing costs and increasing uptime. Our ergonomic human machine interfaces ranging from a reliable push button up to a innovative multi-touch HMI/PLC offer best in class solutions to operate and control. Finally our modern motor starter and drive solution for safer, more reliable and energy-efficient operation.

For more information, visit [www.eaton.eu/electrical](http://www.eaton.eu/electrical)



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