

# Functional safety for persons, machines and the environment



**Safety Technology**  
Control the unexpected



Product Information

## Safety technology compliant

to EN ISO 13849-1 and IEC 62061

**EATON**

*Powering Business Worldwide*

**MOELLER** 

An Eaton Brand

# Safety Technology



## **Functional safety for persons, machines and the environment**

A machine poses dangers for persons, machines and the environment during its lifecycle – starting during its manufacture and continuing right up until it is disassembled. It is therefore essential to tackle the dangers posed by the machine in the construction phase and to reduce them by the introduction of a range of suitable measures. The EU machinery directive demands that no danger is posed by machines. However, as there is no such thing as 100 %

safety with technology, the objective is to reduce these sources of danger to a tolerable level of residual risk. The overall safety of a machine defines the state which is deemed to be free of unwarranted risks for persons or which is deemed to be danger free. The functional safety describes the fraction of the overall safety of a system that is dependent on the correct function of the safety-related systems and external devices in order to reduce the risks.

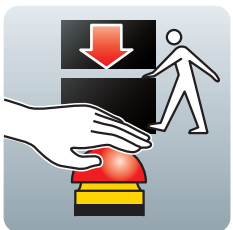
# Safety Technology

## Safety-related parts of control systems (SRP/CS)

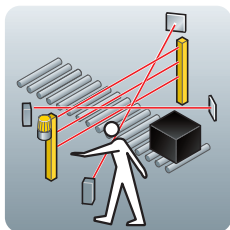
The elements of machine controls, which assume safety-related tasks are designated by international standards as “safety-related parts of control systems”. These elements can consist of hardware or software and be a separate or integral component of the machine control. Safety-related parts of control system each incorporate the entire functional chain of a safety function, consisting of the input level (sensor), the logic (safe signal processing) and the output level (actuator).

The general objective is to design these parts so that the safety of the control functions as well as the reaction of the control during a malfunction corresponds with the degree of risk reduction as determined in the risk analysis.

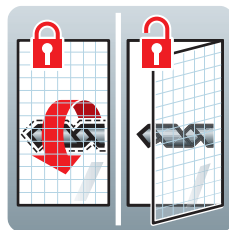
The higher the level of risk reduction to be provided by the safety-related parts of control system, the higher the safety level of the technical safety performance level demanded of the control section.



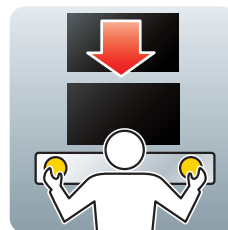
Circuits for stopping in an emergency



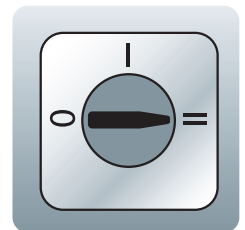
Optional with muting function



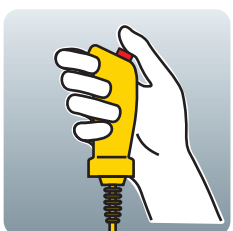
Contactor monitoring with and without interlock/mechanical securing action



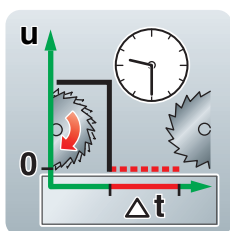
Safe operation via two-hand control



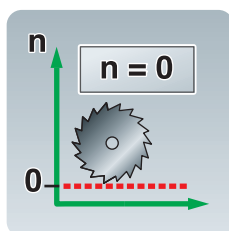
Operating mode selector switch



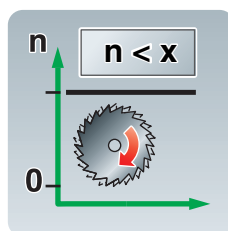
Permission switch



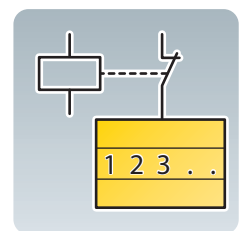
Safe timing relay



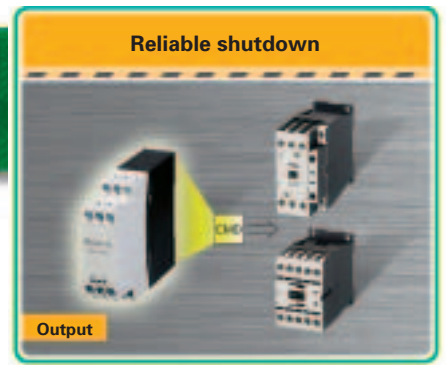
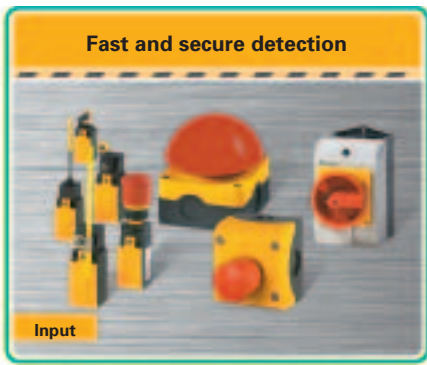
Standstill monitoring



Highest speed monitoring



Feedback loop monitoring (EDM)



**Avoiding dangers**

**Assuring machine safety by reduction of the risk**

The international standard EN ISO 12100-1 "Safety of machinery – Basic concepts, general principles for design" provides the constructor with detailed assistance in the identification of dangers and the risks to be examined, and contains design guidelines and methods for safe construction and reduction of risks.

The first steps deal with the area of risk analysis and risk assessment for achieving the required level of machine safety. For this purpose the EN 1050 (EN ISO 14121-1 in preparation) "Safety of machinery – Risk assessment – Principles" provides detailed requirements, which are to be implemented methodically in an iterative process and which are to be comprehensively documented. The technical measures for reduction of the danger are defined as the result.



**Protecting against dangers**

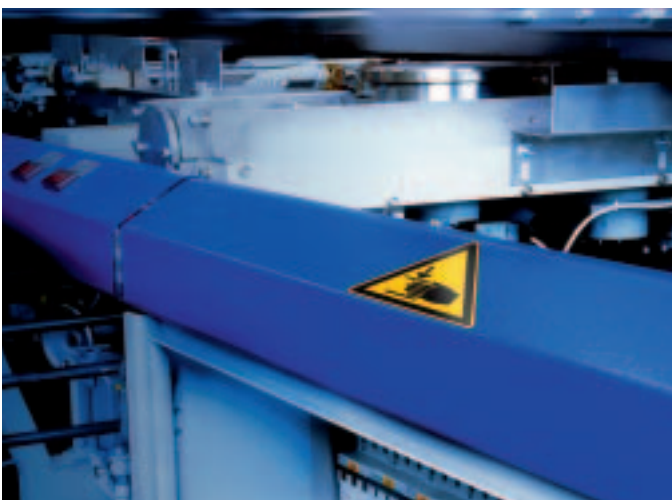
All protective measures which are used to eliminate the dangers or reduce the risks as a result of these protective measures are to be undertaken in a predefined sequence in compliance with the EN ISO 12100-1:

**1st step** → *Avoidance of dangers*: risk elimination and reduction through constructive measures during the planning and development phase of the machine

**2nd step** → *Protect against dangers*: reduction of the risks by the introduction of necessary protective measures

**3rd step** → *Indicate remaining sources of danger*: risk reduction through information/warnings concerning the residual risks

If the dangers cannot be avoided or sufficiently limited by the use of construction design measures, the protective devices are to be provided in the second step – safety-related parts of control systems (SRP/CS). These must be constructed and selected in such a way that the probability of functional faults is sufficiently minimal. If this is not possible, the faults which have occurred may not cause a loss of the safety function.



**Indicating remaining sources of danger**

As a supplement to the protective measures selected by the machine constructor, further protective measures for reduction of the residual risk may be necessary for the machine operator or machine users (e.g. personal protective equipment, training, etc.).

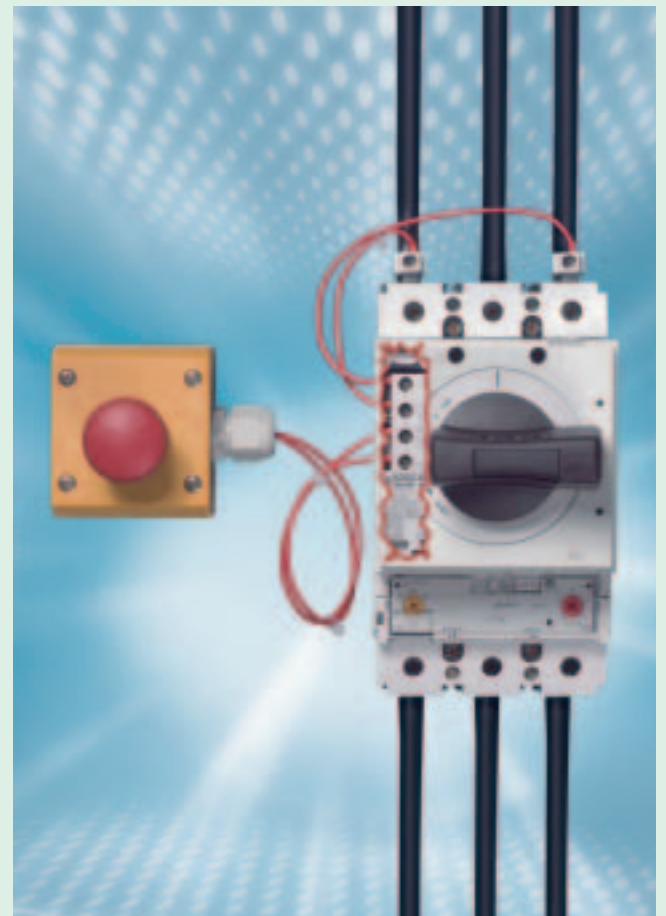
**Moeller offers you suitable components for reduction of the inherent risk through SRP/CS (step 2) with Safety Technology conforming to the highest demands of the international safety standards! Suitable safety functions are used depending on the area of application and required level of protection against danger.**

# Control the unexpected



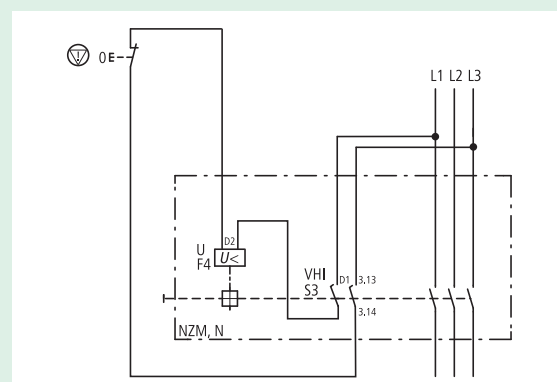
## Safety at a glance

A complete safety chain also involves that the impending danger or the danger that has arisen is explicitly and very visibly indicated. The signal tower SL from the control circuit devices range RMQ-Titan from Moeller, indicates the respective state of the machine both acoustically and/or optically in five colours with continuous, flashing or strobe light. The faster that the annunciation is perceived, even from a distance, the faster you can react safely and quickly to the unforeseeable states.



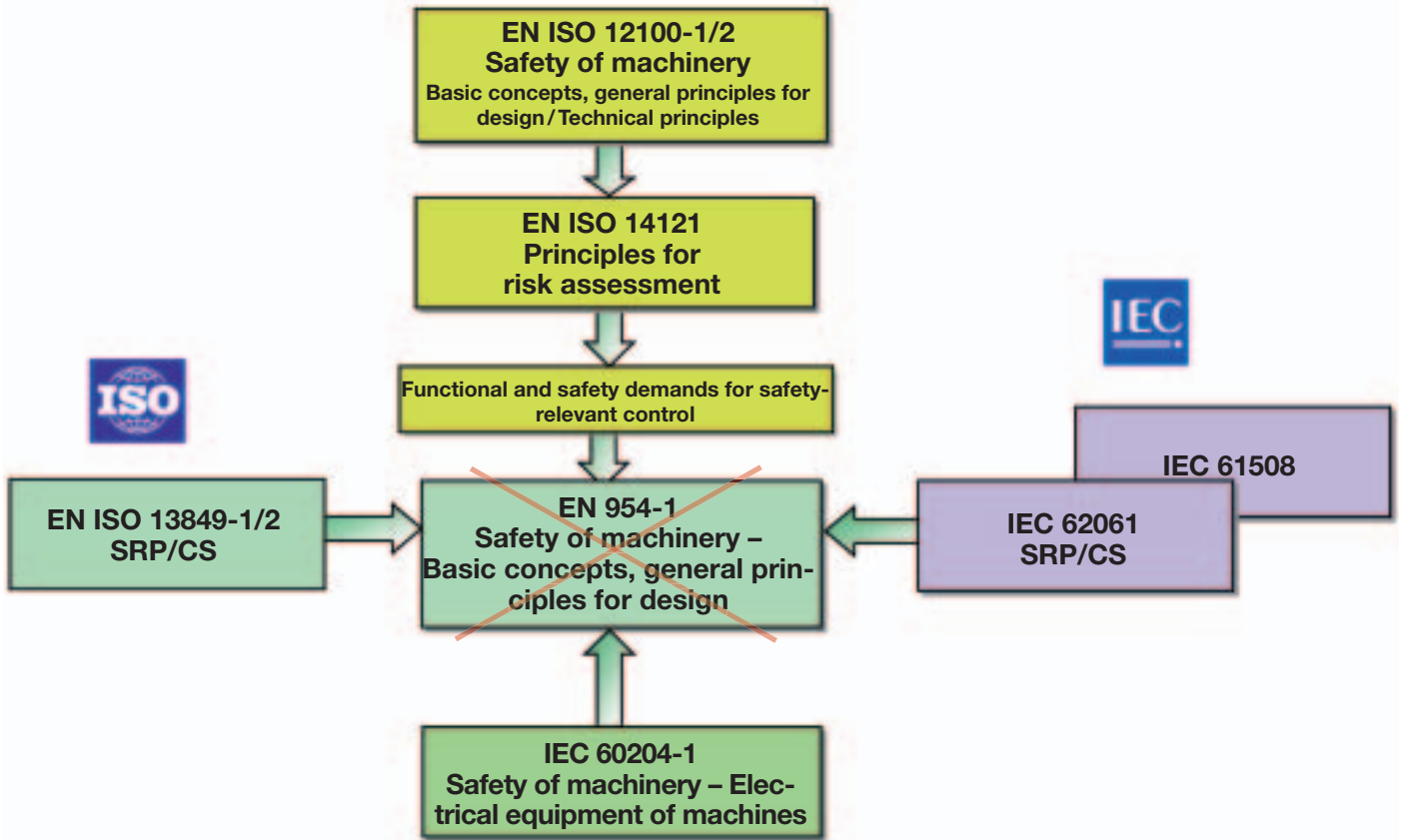
## Main switch application

The main switch application with an emergency-stop function up to 1600 A conform to IEC/EN 60204-1, VDE 0113 Part 1 can be easily and cost-effectively implemented with the new Moeller products. The voltage is switched off on all current conducting circuits are when the switch is switched off using the undervoltage release with two integrated early-make auxiliary contacts. Safety is guaranteed at all times in this manner when the switch is in the Off position. The early-make auxiliary contacts can always be installed – even if the circuit-breaker is equipped with a toggle-lever or rotary drive.



Quicklink ID:  
enter SAF9en at [www.moeller.net](http://www.moeller.net)

# Control the unexpected



## Definition of safety demands on the SRP/CS and their implementation

The following represented standards use different classification systems and definitions for the safety stages and are applied depending on the technology, risk categorisation and architecture.

## Previous EN 954-1 "Safety of machinery – Safety-related parts of control systems"

The European standard EN 954-1 has established itself in the area of machinery safety as the leading international state-of-the-art standard. The EN 954-1 defines control categories for allocation of different technical performance safety – *categories B, 1, 2, 3, 4*.

Validity of EN 954-1: transitional period until 28.12.2009, thereafter it will be superseded by the EN ISO 13849-1.

## New EN ISO 13849-1 "Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design"

At the end of 2006 the EN ISO 13849-1 was officially declared as the successor standard of the EN 954-1 and is already listed

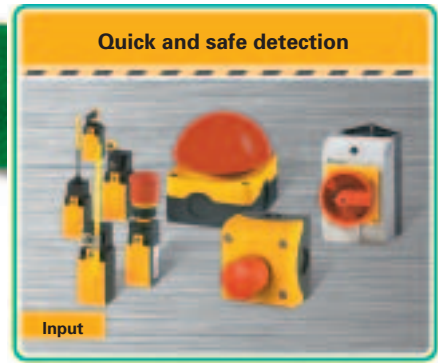
in the Official Journal of the European Community. With the EN ISO 13849-1 a quantitative observation of the safety functions beyond the qualitative approach of the EN 954-1 is applied. For the classification of different technical safety effectiveness, Performance Levels (PL) are defined in the EN ISO 13849-1. The five PL's (*a, b, c, d, e*) represent the average probability of a dangerous malfunction per hour.

## Alternative IEC 62061 "Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems"

IEC 62061 serves in the overall scope of the EN ISO 12100-1 as an alternative standard to the EN ISO 13849-1. The Safety Integrity Level SIL describes the technical safety performance in three stages (1, 2, 3).



Quicklink ID:  
enter SAF1en at [www.moeller.net](http://www.moeller.net)



## Quickly detect danger with Emergency-Stop actuators



Emergency-Stop actuator from the 16 mm control circuit device range **RMQ16**. With or without lighting is decided by the application.



Larger and optimally suited for operator actuation are the Emergency-Stop buttons from the 22 mm control circuit and signalling device **RMQ-Titan®**.



Moeller offers the foot and palm switch **FAK** (e.g.: for operation wearing gloves) for use in rugged and harsh environments.

The machine or system must be immediately stopped to protect persons, machines or systems in dangerous situations. An effective and conventional method allows the operator or persons located in the vicinity to decide if a dangerous situation exists.

Emergency-Stop switches are used to trigger the standstill of the system or machine. Moeller is a specialist for control circuit devices with Emergency-Stop functions – the Emergency-Stop button. Moeller Emergency-Stop buttons are suitable for most applications. Example: DIN EN 60204 "Safety of machinery – Electrical equipment of machines" (Emergency-Stop button). The devices must latch and stay-put independently, the contacts must be positively opening (see IEC 60947-5-1) and Moeller Emergency-Stop buttons are constructed compliant to the IEC 60547-5-1 standard!

For applications in explosive dust atmospheres (ATEX Zone 22) Moeller offers both the 22 mm RMQ-Titan control circuit device as well as the foot and palm switch FAK.

### Common properties of all Emergency-Stop actuators

- Developed, tested and constructed compliant to IEC, EN or even UL / CSA safety standards
- Tamper-proof compliant to DIN EN **ISO 13850**
- TÜV and / or BG (BG – Institute for Occupational Safety and Health / Germany)
- World-wide approvals (countries or shipping classifications)
- Indication if actuated or not actuated
- High degree of protection against dirt or water
- Larger operating temperature range
- Resistant to extremely high shock and vibration loading

# Control the unexpected



The key-operated buttons can be integrated into a master key system.



Illuminated Emergency-Stop buttons are flexible in use.



The ATEX approval enables use in explosion-hazardous areas.

## Tamper-proofing

An important factor for Emergency-Stop buttons is tamper-proofing and the positive opening of the contacts. If the Emergency-Stop button is actuated and if the N/C contacts open, the Moeller Emergency-Stop button automatically jumps to the stay-put position and remains in this position (N/C contacts in Emergency-Stop circuit remain opened) until the Emergency-Stop button is manually reset. This reset can be initiated by pulling (PULL), rotation (TWISTED) or with a key switch (KEY RESET).

There are two further specialities with the RMQ-Titan range:

- Key switches for resetting can be integrated in a master key system
- The Emergency-Stop button can be protected by a sealable shroud (reset by pulling or twisting) to prevent resetting after actuation. This is very useful if the Emergency-Stop button is to be protected against tampering. It is only possible to reset the Emergency-Stop button by breaking the seal.

## Illumination of the Emergency-Stop button

Versions with illumination are available in order to make Emergency-Stop buttons in a system or machine even more distinguishable. The integrated indicator lights can be used in different ways:

- Continuous light, dependent on the switch position of the Emergency-Stop button (high visibility)
- Continuous light until actuation of the Emergency-Stop button, subsequently with the signal light "OFF"
- Continuous light (highly visible until actuated, subsequently unlit, recognisable as actuated)
- No lighting when un-actuated, lit on actuation, (A quick method of detecting actuated Emergency-Stop buttons (is seldom used)).

## ATEX approval Zone 22 dust environments

In mills, shredders, silos etc., it is possible that explosive dust-atmospheres can evolve in a brief period in the operating areas of the system or machine. For these environments, Moeller offers both the 22 mm RMQ-Titan control circuit device as well as the foot and palm switch FAK with an ATEX approval for Zone 22.



Quicklink ID:  
enter SAF2en at [www.moeller.net](http://www.moeller.net)




## Movements safely under control with position switch LS-Titan®

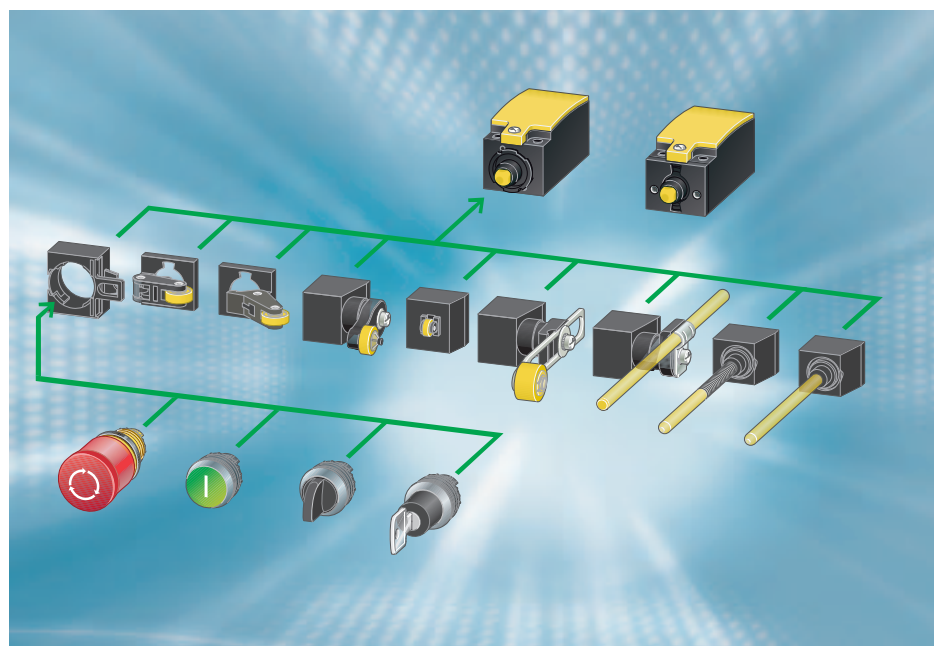


Safety position switches LS-Titan®

Safety of persons in manufacturing plants has the highest priority. By the installation of mobile protective mechanisms such as safety position switches, dangerous process will cease when a safety door or protective flap is opened.

Whether its in the area of wood processing or with printing machines, in the packaging industry or in car washes: the LS-Titan position switches are used wherever exact positioning is required. They mechanically detect the positions of moving parts and guarantee a safe indication of their positions. They are safe because they comply to the DIN EN 60947-5-1 standard and thus feature positively opening N/C contacts. This means that the actuation of the position switch will safely break the circuit and for example, that the machine will be switched off.


Positively opening position switches are marked with the following symbol: 



RMQ-Titan® and LS-Titan®: new combinations for your solutions

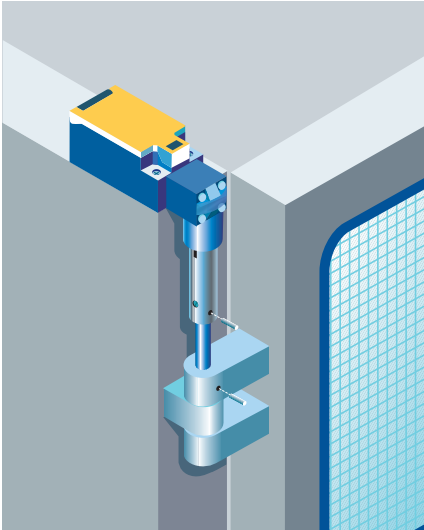
LS-Titan position switches are available either in robust metal or light plastic enclosure designs. Exchangeable operating heads enable flexible use for all applications.

Equipped with double-break contacts, they are also suitable for use in the configuration of redundant safety circuits. The switches featuring double break contacts are suitable for use with electronic devices in accordance with IEC/EN 61 131-2, enabling the safe exchange of information with any controller.



Quicklink ID:  
enter SAF3en at [www.moeller.net](http://www.moeller.net)

# Control the unexpected



## Safety for persons and processes, → door safety switch LSR...TS and hasp-operated switch LSR...TKG

The safety of all personnel working in production halls must be ensured at all times. Protective doors and hinged flaps keep people out of hazardous areas. Where an attempt is made to open a protected door or flap during operation, the LSR/TS hinge-operated switches and the LSR/TKG hasp-operated switches immediately disconnect the power supply to the machine or installation. Opening is registered at an angle of only 5 degrees, and so tampering is not possible. Wherever tampering must be absolutely prevented and protruding actuating levers would be unacceptable, door switches offer protection on tooling and packaging machines or in areas where robots operate. If the LSR hasp-operated switches are fitted inside a cover, tampering is completely eliminated.

## Safe locking → safety position switch LS...-ZBZ with mechanical securing action

By reliable securing and interlocking of protective doors, the LS...-ZBZ increases the safety standards for the protection of personnel and processes. The separately coded actuator is electromechanically interlocked in the operating head.

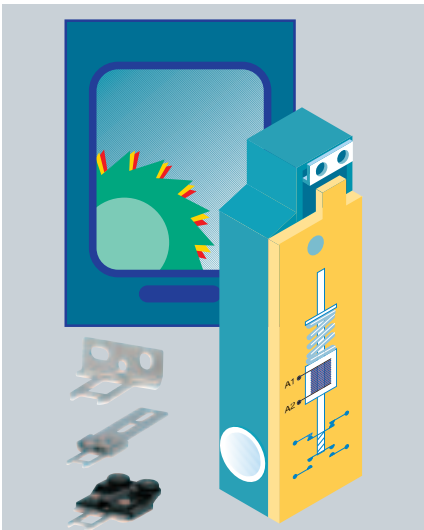
The LS...-ZBZ operates according to one of two principles: on the basis of magnet-powered or spring-powered interlocking.

The spring-powered interlock is optimally suited for enhanced personnel protection. The door or protective guard remains safely locked even in the event of power failure. In an emergency, the protective guard can be opened using an auxiliary release mechanism.

Magnet-powered interlock is used in personnel and process protection.

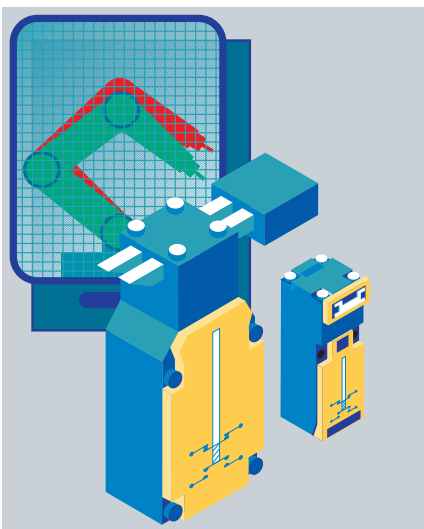
The protective cover is interlocked when operational voltage is applied, and can therefore be opened directly in the event of power failure.

If necessary, the safety door anti-tamper features will only disable after a waiting time. This ensures for example that saws must come to a standstill or process stages must be completed before the system or plant can be approached.



## Switching off danger → safety position switch LS... ZB with separate actuator

Safety position switches LS...-ZB and LS4-ZB are used on centrifuges, motor and gearbox covers, presses, etc. If the safety cover is opened, the actuator retracted from the operating head and the positively opening contacts switch off the voltage and the danger. Tampering with simple tools is ruled out through the use of separately coded actuators. LS...ZB and LS4...ZB comply with EN 1088 "Safety of machinery – Interlocking devices associated with guards". The selection of the necessary protective device is thus simplified.

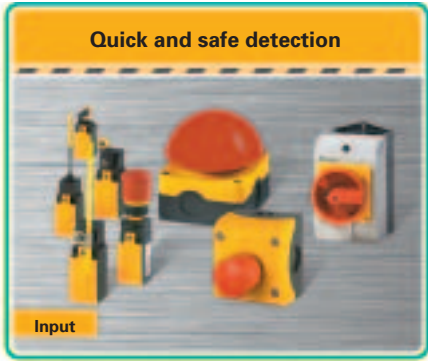


## Certified safety position switches

The safety position switch LS-Titan is certified by the German employers liability insurance association (BG).



Quicklink ID:  
enter SAF4en at [www.moeller.net](http://www.moeller.net)



## T rotary switches for safe switching, disconnection, control and operation



The high-performance, robust and compact T rotary switches and P switch-disconnectors are used in industry, trade and building engineering applications. The IP65 degree of protection with the top mounting switches and the switch front enable use in harsh environments. Ten basic switch types and four different construction types, in a whole range of standard switches and across a wide performance range are available. Customised circuits can also be implemented in addition to the standard configurations. The possibilities are almost unlimited. A comprehensive accessory range complements the switch range and rounds off the range of applications. The rotary switch T and the switch-disconnector P are approved conform to the ATEX directive 94/9 EC for EX-zone 22. The approval enables use in dust explosion hazardous areas.



Maintenance, manual override and safety switches perform important tasks as main switches. They prevent danger to persons, machines and manufactured goods. With maintenance and manual override switches, they isolate an electrical system from the mains.

### Main switch with Emergency-Stop function

Process and processing machines require a power disconnecting device in compliance with EN 60204-1. Furthermore, standstill in an emergency must also be assured.

Standstill in an emergency requires:

- The priority function and operation in all modes of operation
- The power supply, which is connected to the machine states which produce the danger, must switch off as fast as possible.

### Maintenance and manual override switches

Whole ranges of electric motors are required to operate the conveyor belts in conveyor systems. In conditioning plants, warehouses, airports etc., the individual conveyor belts are combined to a unit. The safety and availability of these systems demands that each individual drive can be isolated from the power supply. The isolation is performed using T and P manual override switches. The switch can be secured against reapplication of power using three padlocks in the off state. Maintenance and repair work can be completed in safety.

# Control the unexpected

## Power disconnecting devices and switchgear with Emergency-Stop function



Switch-disconnector P with Emergency-Stop function

### Switch-disconnector P

The switch-disconnectors P up to 315 A is compact and robust. The manual operator acts directly on the contacts. The contacts are positively opened on de-energization. In addition to their use as switch disconnectors with and without the Emergency-Stop function, P switch-disconnectors can be used as On-Off switches as well as maintenance, manual override or safety switches.

### Rotary switch T

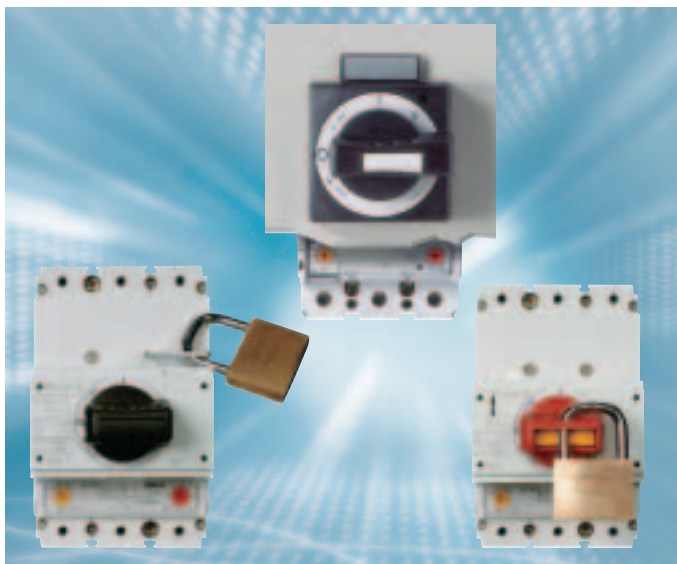
The rotary switch T represents a very flexible, compact and robust modular system. The rotary switch T has a widely varied range of application uses. Customised versions are available. The different rating sizes are available in up to four different construction types.



Rotary switch T

Moeller now offers the following in conformity with the manufacturers guidelines: ATEX directive 94/9 EC cam switch T and switch-disconnector P up to 315 A.

The switches are approved for device group II, with area of application "all except mining" as well as for category 3. The rotary switches and switch-disconnectors in surface mounting enclosures with the ATEX approval are used in dust hazard areas, for example in mills, metal grinding plants, wood processing and wood processes areas, cement factories, the aluminium industry, the foodstuffs industry, grain storage and processing facilities, agriculture, pharmaceutical industry, etc.



Circuit-breakers NZM

### Circuit-breakers NZM

Application related locking

- The rotary handle can be locked with padlocks and the door coupling rotary handle automatically locks the doors in the locked state.
- The second handle variant allows an additional locking arrangement directly on the switch. It is possible for example, to directly lock the individual switches on an extensive service distribution board.
- The handles are also available in a red-yellow contrasting colour design for the Emergency-Stop function.
- Automatic handle latching in switch positions enables the comfortable closing of control panel doors even when using several switches with differing switch positions.
- The positively opening switch contacts and the red-yellow colour design are compliant to the IEC safety requirements.



## Simple processing of logic with ESR5 and easySafety

Secure processing of different sensor signals for example, such as those of position switches, light barriers, two-hand controls, Emergency-Stop buttons, contact mats, etc. are monitored in the logic unit of the SRP/CS and evaluated in accordance with the application requirement. Whether ESR5 electronic safety relays or the new safety-oriented control

relay easySafety – the safe logic units from Moeller enable the realisation of applications in accordance with the international standards for compliance with the highest safety demands of category 4 to EN 954-1, PL e to EN ISO 13849-1, SIL CL 3 to IEC 62061 as well as SIL 3 to IEC 61508.



Safety guaranteed with ESR safety relays

### Economic monitoring with ESR5 safety relays

The electronic safety relays ESR5 provide many safety switching contacts and up to 4 enable and 2 signal current paths with an installation width of just 22.5 mm. In fault-free operation, the safety-relevant circuits are controlled by the electronics after the switch on command and the enable paths are enabled via the relay. The enable paths are interrupted immediately (Stop category 0) or after a time-delay (Stop category 1) and the motor is disconnected from the mains when the switch-off command is received, as well as during a fault. If more contacts are required, a contact extension module can provide them. In redundantly designed safety circuits a short-circuit will not cause danger, so that a renewed switch-on will lead to detection of the fault and switch on is safely prevented.

### The ESR5 product range incorporates safety relays for:

- Circuits for stopping in an emergency
- Monitoring of safety doors and light barriers
- Monitoring of two-hand controls
- Off-delayed circuits
- Delayed and non-delayed contact extensions




### Safely monitored Emergency-Stop circuits

The ESR5 electronic safety relay from Moeller switch several enable current paths for direct or time-delayed disconnection of the energy supply when the Emergency-Stop actuator is triggered. Depending on their configuration, they can detect faults such as cross short-circuits, earth faults or a short-circuit in the Emergency-Stop actuator circuit. These either lead to immediate disconnection or prevent restart as long as the fault is not remedied. The relays feature the option of monitored re-energization. In this case the enabling of the relay only occurs after the reset button is released.



### Monitoring mobile protective mechanisms

The monitoring of protective screens on machines and processing centres is another important function of the ESR5 electronic safety relay. Depending on the safety level, one or two position switches signal that the protective door is in the closed position. Instead of restart-monitoring, you can also implement an automatic start with the safety relays. Thus, you reduce the cycle times in production without dispensing with safety.



Quicklink ID:  
enter SAF5en at [www.moeller.net](http://www.moeller.net)

## Safety-oriented control relay easySafety



### All in one – safety and control relay combined in a single device

The safety-oriented control relay easySafety integrates not only safety, but also standard functions in just a single device – its all in one. The safety control relay easySafety certified by TÜV-Rheinland features a standard circuit diagram in addition to a safety circuit-diagram which incorporates the safety configuration. This circuit diagram can be used for standard tasks such as the processing of diagnostics messages or general control tasks of a machine. The simplicity of the easy-circuit diagram philosophy has been continued so that every one of today's easy users will immediately be at home. With its high number of safety function blocks, it opens a wide range of application possibilities to the users on just a single device. Users remain flexible and can immediately respond to current and future changing application demands. This saves financial resources and offers investment protection in the future, and also reduces the stockkeeping costs for special safety relays. Whether its in a simple or complex system, the necessary personnel and process protection are guaranteed by the compact easySafety.

### A wide range of safety functions

All conventional safety functions are selected from a list of safety function blocks and the sequence is defined by simple assignment of the safe inputs and outputs.

### The easySafety incorporates ready-made and tested safety function blocks

- Circuits for stopping in an emergency
- Light barrier monitoring, optional with muting
- Protective door monitoring with and without monitoring
- Monitoring of two-hand controls
- Hand or foot actuated permission switch
- Standstill monitoring
- Highest speed monitoring
- Safe timing relay
- Operating mode selector switch
- Starting elements
- Feedback circuit monitoring (EDM)

### Comfortable operation

The comfortable configuration environment is offered by the PC software easySoft-Safety. This is used to create and simulate the safety configuration into the classic easy wiring diagram language and to transfer it onto the device. Modifications or complete configurations can be undertaken directly on the device via the integrated display and keypad. The created configuration can be transferred using a memory card to the easySafety device.

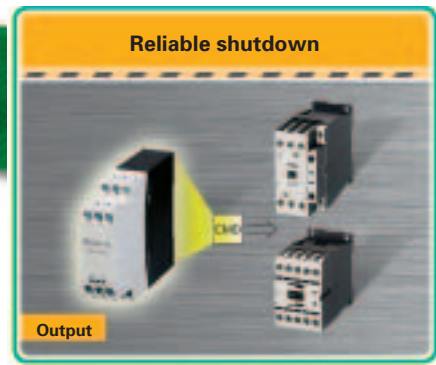
A strict separation between safety and standard tasks is assured by the use of separate circuit diagrams. On the one hand it avoids unauthorised actions or manipulation of safety sequences using separate passwords. On the other hand the operator still has the freedom to adapt the uncritical standard functions as well as machine diagnostics to applications. As the only small safety control with an integrated or separate display, the easySafety enables simple operation and direct diagnostics on devices of safety relevant and standard machine states.

### Flexible expansion

Using the integrated interfaces the expansion of the easySafety with standard functions becomes child's play. Whether with further base units from the easy family; central or distributed standard input/output expansion; communication modules, such as Profibus-DP, CANopen, DeviceNet or AS-i; the comprehensive easy accessories range leaves no application unsolved. This is the way to easily and cost-effectively exchange standard information.



Quicklink ID:  
enter SAF6en at [www.moeller.net](http://www.moeller.net)



## Reliable switch off with contactors DIL M



Continuous operation requires a high level of operating reliability of the components used. This is why the Moeller contactors DIL M have not just the best service life values in standard AC 3 operation, but is also excellently suited for heavy duty AC 4 inching operation. As a result, the safety is also enhanced during the set-up and retooling phases of machines and systems. Naturally, these devices also have properties which serve the needs of active safety, such as positively-driven contacts, safe isolation or protection against direct contact.

### Reliable monitoring with mirror contacts

Operational switching of motors, heating etc. is the typical task of the contactor DIL M. In hazardous situations the contactor DIL M is used to switch off the motor which drives the hazardous motion. The state of the contactor contacts are monitored here via mirror contacts.

If any main contact of a contactor is closed, no mirror contact (auxiliary NC contact) compliant to IEC EN 60947-4-1 may be closed. After the hazard has been eliminated it is possible to switch the system back on without danger based on the feedback from the mirror contacts.

### Positively driven auxiliary contacts for safety-relevant controls

Small control tasks – which require the duplication of contacts and the connection of large contactors to electronic outputs – are the typical tasks for contactor relay.

As soon as safety-relevant circuits are affected the NO and NC auxiliary contacts may not be closed simultaneously. Contactor relays DIL A features positively drives contacts conform to IEC EN 60947-5-1. They can be used to implement control functions in safety-relevant system sections without danger.

### Practical with safety

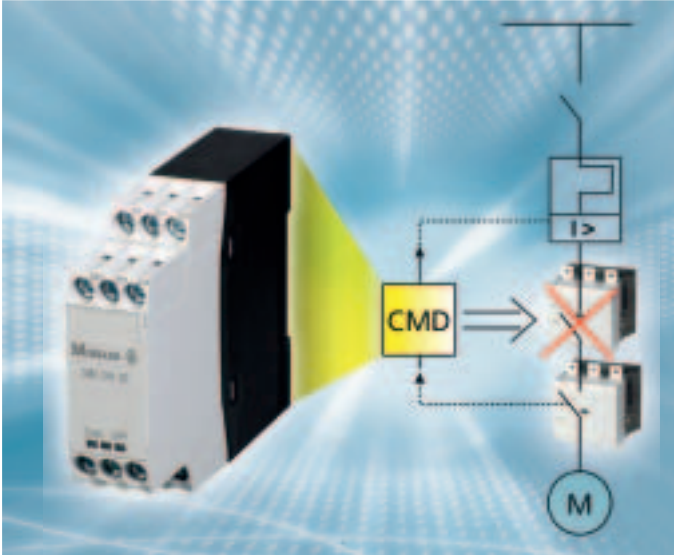
The auxiliary contact is also on board up to 38 A and a suppressor circuit is always included with DC operated contactors. On applications over 15 A the DC contactor features an electronic drive, which for example makes the use of coupling relays unnecessary. Contactors DIL M up to 170 A feature box terminals with two terminal chambers. Accordingly, differing conductor cross-sections can be securely wired, even on machines subject to a high level of vibration. The contactor DIL M and overload relay feature approvals for world markets. All devices comply with the demands compliant to IEC/EN 60947 and DIN VDE 0660 as well as to UL/CSA.



Quicklink ID:  
enter SAF7en at [www.moeller.net](http://www.moeller.net)

# Control the unexpected

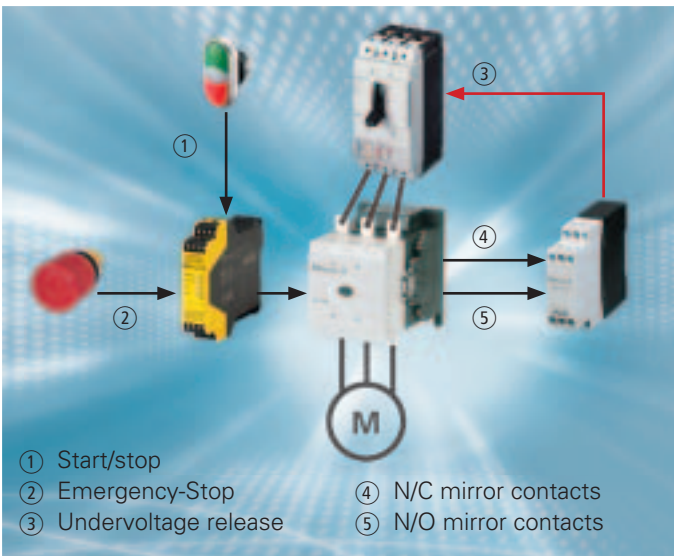
## Reliable switch off with contactor monitoring relay CMD



### Redundant design of contactor circuits is unnecessary

In almost all of today's applications system sections feature a safety-related design.

Safety-related control components are used in dangerous situations – for example when a protective screen is opened or the Emergency-Stop is actuated – for shutdown. A redundant shutdown system is often provided in order to avoid a failure of these system sections. A contactor is typically used as the shutdown device during danger. However, the contactors have a tendency to weld at the end of their lifespan, and for this reason two contactors are usually switched in series. A particularly costly method – especially with large contactors. The EN ISO 13849-1 compliant contactor monitoring relay CMD from Moeller makes this redundant design unnecessary.



### Applications

These types of combinations are used in Germany and Europe with safety-related applications. Up to now a series connection of two contactors was recommended for circuits of safety category 3 and 4 for compliance to the EN 954-1. Now you just need one contactor and the Moeller CMD. The contactor monitoring relay CMD serves Emergency-Stop applications compliant to EN 60204-1. It can also be used in the American car manufacturing industry, where solutions are also required which reliably detect the welding of the motor starter and which safely switch off the motor load. In its function as a safety component the CMD also receives the employers liability insurance association approval in addition to the CE mark. As a device for world markets it also receives the UL and CSA approval for the North American market.

The CMD (Contactor Monitoring Device) monitors the main contacts on a contactor for welding. To implement this, the CMD compares the control voltage of the contactor with the state of the main contacts, which are reliably signalled with a mirror contact (IEC EN 60947-4-1 Annex. F). If the contactor coil is de-energized and the contactor does drop-out, after a short delay, the CMD will trip the upstream circuit-breaker / motor-protective circuit-breaker or switch-disconnector using an undervoltage release. In addition the CMD monitors the functional operation of the internal relay, an additional auxiliary switch of the monitored contactor serves this purpose. For this the auxiliary N/C contact and N/O contacts are positively driven, where the latter is a mirror contact.

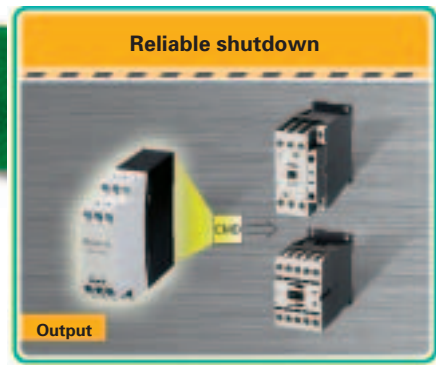
### Approved switchgear and controlgear assemblies

In order to guarantee the functional safety of the entire unit – consisting of a contactor, circuit-breaker and CMD – the CMD is only approved for defined Moeller contactors as well as Moeller motor-protective circuit-breakers/circuit-breakers/ or switch-disconnectors.

All DILM7 to DILH2000 contactors from the Moeller range can be monitored for welding using the CMD. All auxiliary N/C contacts of these contactors are mirror contacts and can be used for monitoring purposes. The motor-protective circuit-breaker PKZ2 can be used as an upstream motor-protective circuit-breaker/circuit-breaker or switch-disconnector, when equipped with an undervoltage release U-PKZ2 (18VDC). The same applies for the circuit-breaker NZM1 to NZM4 or switch-disconnector N1 to N4 – equipped with an undervoltage release NZM...XUV.



Quicklink ID:  
enter SAF8en at [www.moeller.net](http://www.moeller.net)



## Avoid damage, guarantee operational continuity



### ARCON® – the lightning fast airbag for your switchgear system

The effects of an arc can be compared those of an explosion. They range from injury of persons to massive damage to the switchgear systems, and can result in standstills which can last for weeks and may even necessitate a complete replacement of the switchgear system. In the worst case it may even lead to insolvency because the customers are forced to find another supplier. The factor of availability is highly relevant in today's competitive environment and a whole range of suitable protective measures must be undertaken to ensure it. Computer centres, tunnel services and energy supplies for continuous manufacturing processes in the chemical industry belong up to now to the main applications in which the Moeller arc-fault protection system ARCON® has been used.

#### Personnel protection

All renowned manufacturers of low-voltage switchgear systems today offer an arc-fault protected version of their switchgear systems. This personnel protection feature is tested however under conditions not found in practice on the enclosed switchgear system. The statistics of the BGETE have

shown that 2 out of 3 accidents occur on open switchgear systems. This fact needs to be considered and technical solutions offered, which provide effective protection that is also effective on open switchgear systems. For this reason Moeller engaged in fundamental research in conjunction with the Technical University Ilmenau and came to the conclusion that only extremely fast protection systems have a "real" chance or implementing personnel protection. ARCON® has achieved an unbeatable level of personnel protection with arc-quenching times of just 2 ms.

#### System protection

Low-voltage switchgear assemblies can be out of operation for weeks due to the effects of an arc fault. If no redundant energy supply is provided, an unwanted loss of production occurs. The only remedy here is an effective protection of systems which limits the effects of the arc fault to a minimum and which enables an immediate re-commissioning of the system. If ARCON® is used, the effects of the arc are limited to its base points. After elimination of the cause and exchange of the quenching device, the system can be put back into operation and the required availability can be re-established.

**Moeller addresses worldwide:  
[www.moeller.net/address](http://www.moeller.net/address)**

**E-Mail: [info@moeller.net](mailto:info@moeller.net)  
Internet: [www.moeller.net](http://www.moeller.net)  
[www.eaton.com](http://www.eaton.com)**

Issued by Moeller GmbH  
Hein-Moeller-Str. 7-11  
D-53115 Bonn

© 2007 by Moeller GmbH  
Subject to alterations  
W8700-7596 en ip 06/09  
Printed in Germany (07/09)  
Article No.: 115738



**EATON**

*Powering Business Worldwide*

Eaton's electrical business is a global leader in electrical control, power distribution, uninterruptible power supply and industrial automation products and services.

Eaton's global electrical brands, including Cutler-Hammer®, MGE Office Protection Systems™, Powerware®, Holec®, MEM®, Santak and Moeller, provide customer-driven PowerChain Management® solutions to serve the power system needs of the industrial, institutional, government, utility, commercial, residential, IT, mission critical and OEM markets worldwide.

**[www.eaton.com](http://www.eaton.com)**

