

Solutions for the machine building industry



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A company with a vision

Welcome to E-T-A

Founded in 1948, E-T-A pioneered the development of precision performance circuit breakers for equipment protection and is now the market leader in the field of overcurrent protection and power distribution. We produce a wide range of circuit breakers and electronic circuit protectors, solid state relays and remote power controllers, power relays and system solutions for global markets in our production facilities in Germany, Tunisia, Indonesia and the USA.

One thing is always at the heart of our endeavours: E-T-A products provide protection. In everything we do, with each and every unit we produce that our customers install in their applications, we protect man and machine against the effects of overcurrent and short circuit.

For this purpose we offer mechanical and electronic solutions, single components

or entire systems, standardised or customer-specific. We ensure that the current, without which our modern life is simply unthinkable, remains manageable. We ensure that it does not cause any damage in the event of a failure.

The protection of lives is at the core of our endeavours.

This is also a matter of value protection. We ensure that the equipment and systems where our solutions are installed do not get damaged by the consequences of overcurrent and short circuit. We ensure permanent function, smooth production and eventually the profitability of the target products, No matter if it is an assembly line, a chemical

production plant, a machine tool or if it is only one component or an entire system including power supply.

We know that you want to offer your customers the best possible solution. You'll manage even better by using E-T-A's superior quality solutions. We hope we can support you with our products and make the world a little safer.

Please do not hesitate to get in touch.



*Dr. Clifford Sell and Dr. Jennifer Sell
Directors of E-T-A Elektrotechnische Apparate GmbH*

How to set up a DC 24 V power supply

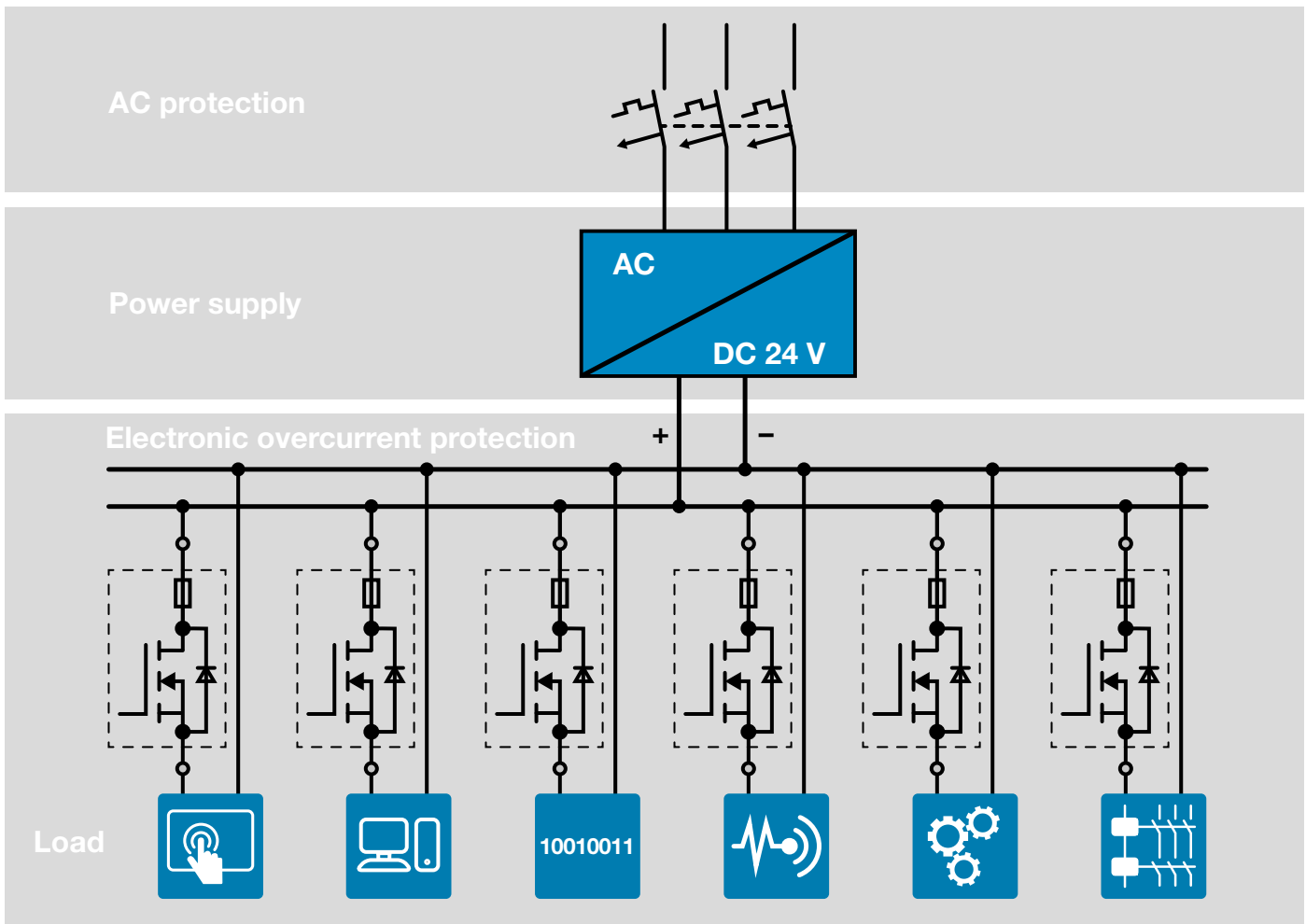
Good to know

Control voltage in the voltage rating range of DC 24 V or DC 48 V continues to be on the rise. Control systems, sensors, actuators, safety and drive engineering systems are powered with DC 24 V. This can only work if the necessary components are rated correctly, including the AC protection as well as the switch mode power supply and the DC overcurrent

protection. These constituent parts form the core of any automation solution and ensure trouble-free machine operation.

More and more frequently, smart communication protection systems are used here. They make monitoring and remote maintenance of the control voltage level easier. Any user wants to have maximum machine uptime and this can be achieved when all components are matched

so that they work together perfectly. When selecting the suitable products, fundamental challenges have to be faced which are explained in detail in this brochure.



Typical design of a DC 24 V supply

Fundamental challenges

Why do miniature circuit breakers (MCBs) not trip at the output of a switch mode power supply?

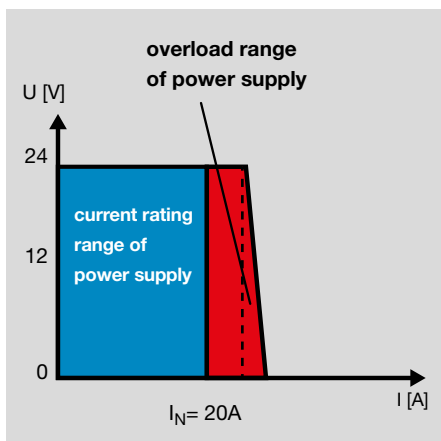
Switch mode power supplies have meanwhile become state-of-the-art in the DC 24 V systems of machine and panel builders and actually indispensable. They are characterised by a compact design and high reliability in continuous operation mode. However, in the overload range they can offer only very limited power reserves.

These are frequently only 1.5 times rated current. If we look at the example of a 20 A switch mode power supply, it means: $20 \text{ A} \times 1.5 = 30 \text{ A}$.

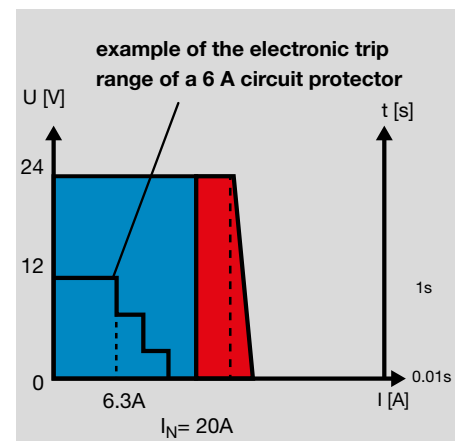
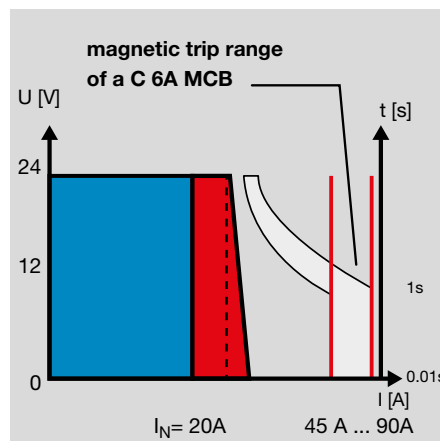
Even if an overload or short circuit theoretically exceeds this, the power supply would practically protect itself and turn down the output voltage correspondingly. If an MCB is operated at such an output for protection purposes, this MCB is technically not capable of

disconnection. The current required to trip an MCB simply cannot be provided by the power supply. Electronic circuit protectors, however, have a specific characteristic curve which ensures tripping nevertheless.

Exclusively the faulty path is disconnected due to selective protection. This makes trouble-shooting much easier and increases machine uptime.



The magnetic trip range of an MCB with C characteristic (45 A ... 90 A) is not always within the allowed overload range of the 20A power supply: the DC 24 V output voltage breaks down.



The electronic trip range is within the admissible overload range of the 20 A power supply. The DC 24 V supply remains stable.

Why do long cable lengths and too small cable cross sections aggravate the tripping problems with switch mode power supplies?

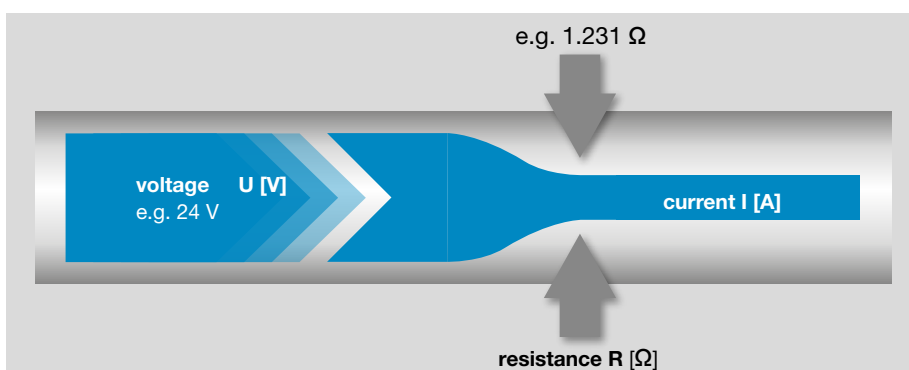
Long cable lengths and small cable cross sections lead to higher cable resistances.

Increased resistance limits the actually available current and can cause undesired disturbances. The available current I is determined by the supply voltage U and the total resistance R .

Hence the following applies:

$$I_{\max} = U_{\text{supply}} / R_{\text{tot}}$$

$$I_{\max} = U_{\text{supply}} / (R_{\text{line}} + R_{\text{transition resistance}} + R_{\text{overcurrent protective device}}).$$



$$R_{\text{total}} = R_{\text{line}} + R_{\text{MCB C6A}}$$

$$R_{\text{total}} = 1.19 \Omega + 0.041 \Omega = 1.231 \Omega$$

$$U = R \times I$$

$$I = U / R$$

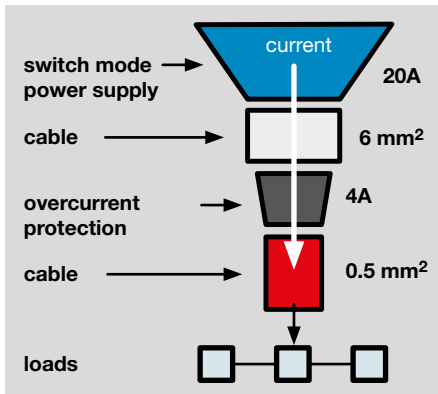
$$I = 24 \text{ V} / 1.231 \Omega$$

$$I = 19.5 \text{ A}$$

Example:
 $R_{\text{line}} = 50 \text{ m} / 1.5 \text{ mm}^2$
 MCB C6A

The Ohmic law aggravates the tripping problems with switch mode power supplies.

Fundamental challenges



Users in the machine building industry have to strictly observe the harmonised European standard DIN EN 60204-1 (VDE 0113-1). Cables are destroyed by overcurrent. Circuit breakers protect the cables against the consequences of overcurrent.

Why do I have to protect my cables?

Circuits require protection against overcurrent. The section on overcurrent protection of control circuits (section 7.2.4 of DIN VDE 0113-1) says that circuits are to be protected by overcurrent protection equipment. For cable protection, the maximum capacitance of the conductor must be taken into account in addition to the type of installation and the ambient temperature. It depends on the cross section and thus on the maximum current per time unit (I^2t value), e.g. in the event of a short circuit. A copper cable with a cross section of 0.5 mm^2 can carry max.

9 A in accordance with VDE 0891 T1 at 30°C ambient temperature. Smaller cross sections are very often used when connecting actuators and sensors.

In order to avoid overload of the selected cables in the event of a failure, the circuit breakers need to be selected in accordance with the cables installed. Both the active current limitation and the time-controlled disconnection offer perfect protection in the event of a short circuit or overload. Both types of function limit the max. I^2t value and thus offer precise overcurrent protection.



Information on standard-compliant protection in the machine building industry

Other challenges of DC 24 V protection

What do I need to observe for the North American market?

A lot of machinery and equipment manufactured in Europe is in the end delivered to North America. For this market, it is paramount to have components approved to UL standards which are accepted both by European and North American UL inspectors. The switching and control cabinets must comply with UL508A (»Industrial Control Panel«). For

protection of the DC 24 V control voltage, it is mandatory to have circuit breakers at least with UL1077 approval, so-called »Supplementary Protectors«. The **ESS31 electronic circuit breaker** fully meets this requirement and can therefore be used to UL508A.

Electronic circuit protectors

Purely electronic circuit protectors normally have an approval to UL508listed (»Industrial Control Equipment«) and/

or UL2367 (»Solid State Overcurrent Protector«). UL2367 can for some circuit protectors up to 4A be supplemented by the approval UL1310 (Class 2 Power Unit NEC Class 2). Thus these devices can also be used in secondary circuits to UL508A. Due to the »listed« approval, a »procedure description« is not required.



NEC Class2

UL approvals are required for the North American market.

Why do intelligent protection solutions help to increase machine uptime?

Increasing machine uptime to have a machinery that keeps producing on an invariably high level is in the focus of machine and panel builders. The field bus systems PROFINET and EtherCAT as well as the IO link point-to-point connection offer unrivalled system transparency through quick implementation, many available components and the transmission of measuring values and status information. It allows early detection of fault conditions on the machinery and prevention of unexpected standstills.

The intelligent **EM12-T** and **CPC12-T** **ControlPlex®** modules have a communication interface. Via these interfaces, the status

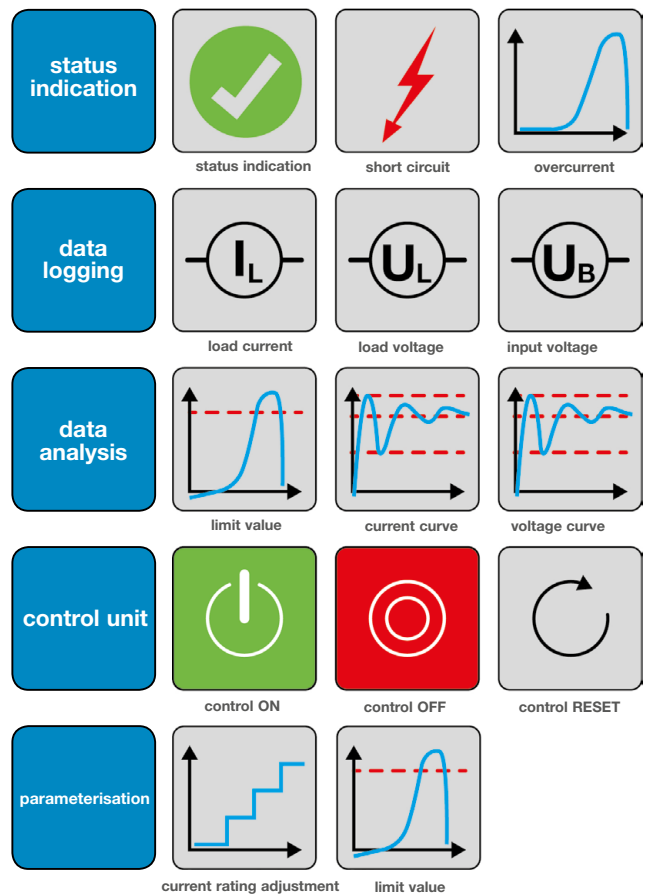
information and important measuring values are transmitted to the superordinate control system, depending on the system type, EtherCAT, PROFINET or IO link.



Information on industry 4.0 – condition monitoring and predictive maintenance



EM12D-T10 supply module CPC12-EC controller

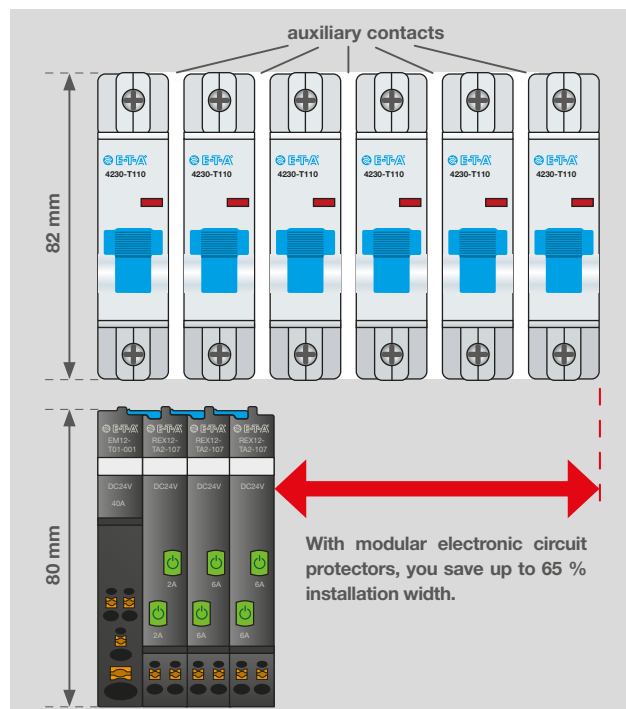


Intelligent protection offers a range of information for preventive maintenance and remote services.

How to create the urgently required space in control cabinets?

Saving space in control cabinets is a topical subject in machine building. Many end customers do not only wish to have smaller control cabinets, but also additional space in reserve of at least 20% to 30%. This would allow later revisions or extensions. With modular electronic circuit protectors, the user saves up to 65% space in the control cabinet. For ease of integration into an application, we can of course provide ePlan macros in EDS-format.

Meets the requirements of many customers: E-T-A's electronic circuit protectors provide more space in the control cabinet.



Other challenges of DC 24 V protection

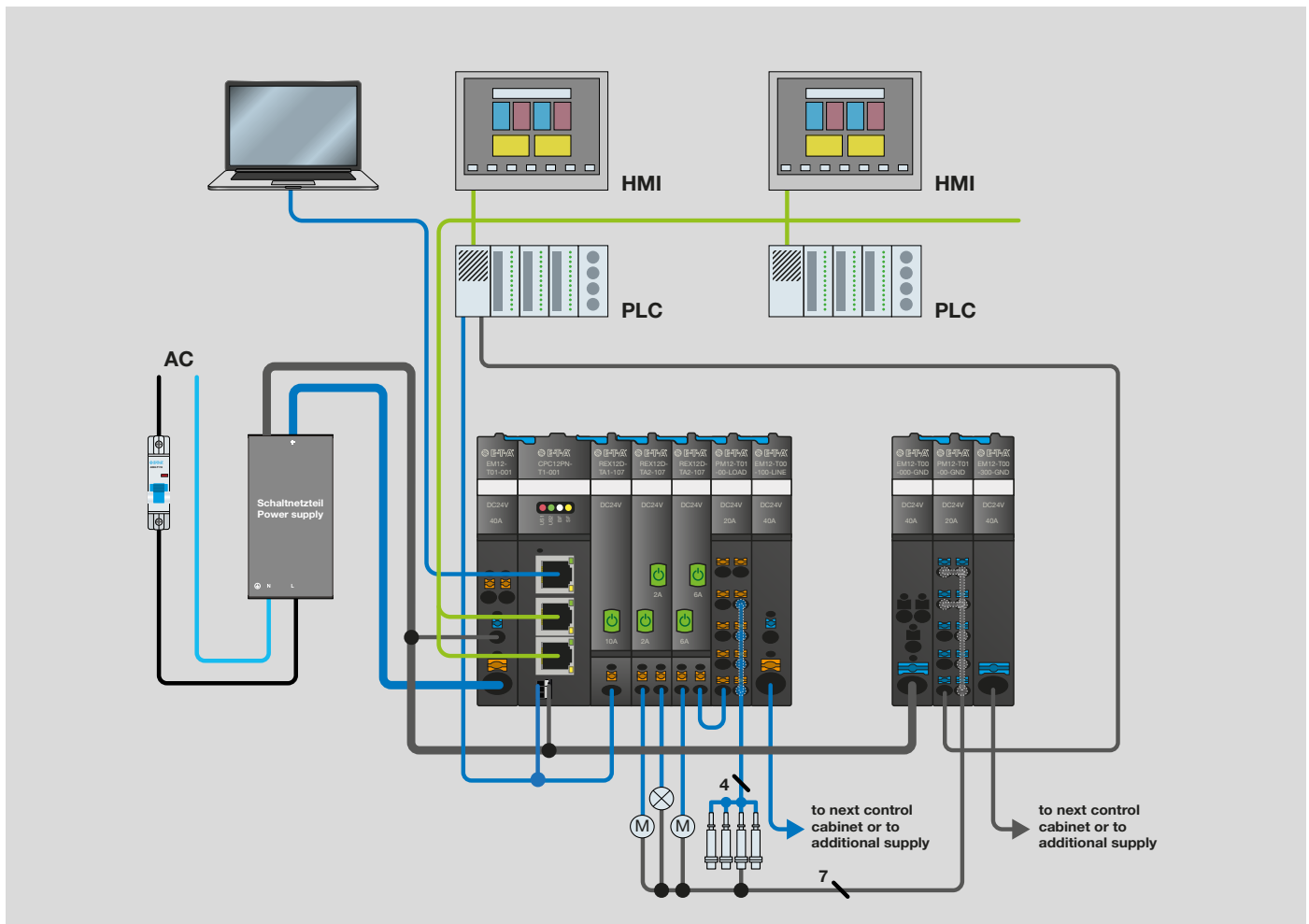
How can clearly structured power distribution solutions increase machine uptime?

Frequently, terminal blocks are used for the distribution of DC 24 V applications. It very often causes completely unclear layouts and complex wiring structures in the control cabinet.

The +output of the DC 24 V supply is connected with the terminal blocks by means of suitable cables. From there,

the user wires up the sub-supply with the protective elements and finally with the loads. In order to close the circuit, the load must be wired up with the negative distribution. The latter is mostly placed at a certain distance.

Placing the distribution directly beside the protection generates a clearly structured wiring. In the same system, the +DC 24 V distribution can very easily be built up with the minus distribution 0V and loads can clearly be assigned.



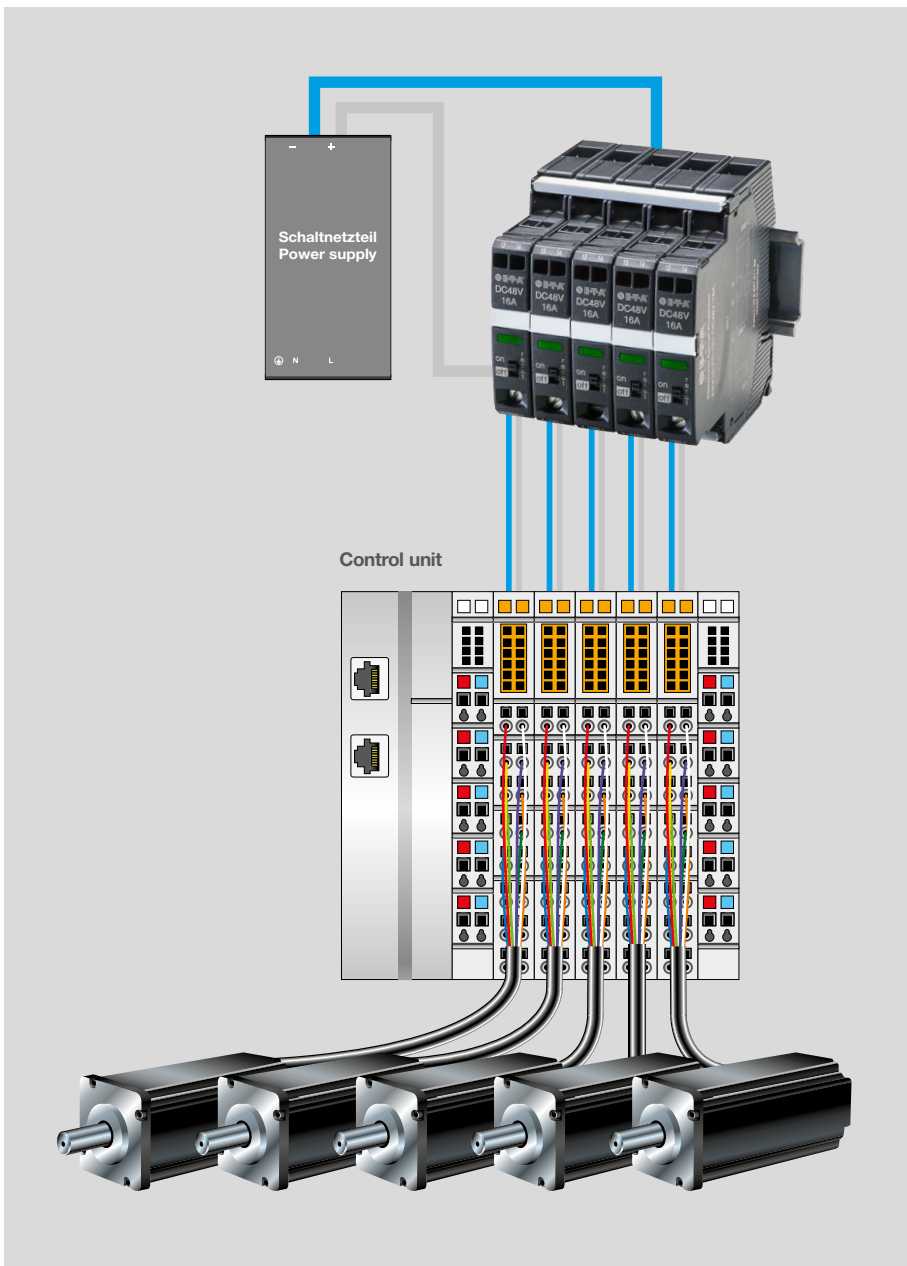
Clearly structured power distribution solutions make trouble-shooting easier through a clear wiring assignment.

What do you have to observe when selecting overcurrent protection for drives?

Today many applications in mechanical engineering require precise positioning, quick transportation or powerful actions

like lifting or lowering. In order to be able to realise these complex processes in the applications precisely enough and in the desired speed, DC motors are used as well as multiphase motors and servomotors. These drives are electronic DC 48 V loads in the applications. Therefore, they require

a protection against the consequences of overcurrent and short circuit.



*The robust design ensures unrivalled stability for selective protection of more loads powered by a DC 48 V supply. The **ESX10-TC-101-DC 48 V** electronic circuit protector provides superior performance and functional reliability, especially for the protection of power trains like DC motors, multiphase motors, servomotors and their control technology.*



*ESX10-TC-101-DC 48 V
electronic circuit protector*

Overcurrent protection for drives must tolerate inrush currents.

Typical set-up of a DC 24 V protection

AC protection

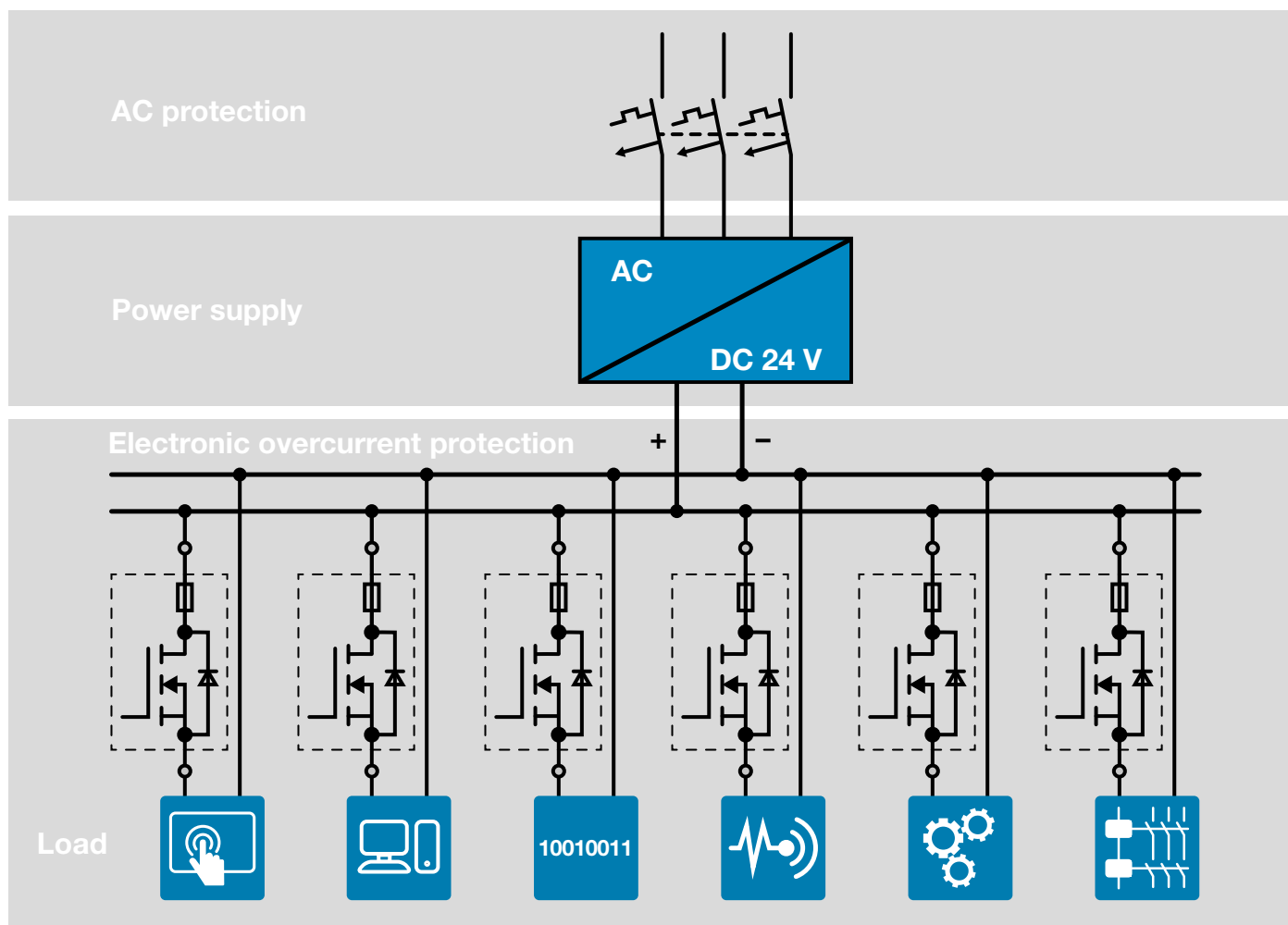
AC protection provided by MCBs is the prerequisite for protection of the line leading to the switch mode power supply. In the event of short circuit or overcurrent, the MCB will reliably trip to prevent hazardous situations caused by high leakage currents.

Switch mode power supply

The switch mode power supply transforms the AC 230 V/400 V voltage into DC 24 V which is very frequently required in machine building. The current limited by the switch mode power supply is now available for the load supply.

Electronic overcurrent protection

The loads and their supply lines require protection against the consequential damages of overload and short circuit. Electronic overcurrent protection is the most reliable solution. For this application range, E-T-A offers a great number of professional solutions in a compact design for your machinery.



4230 thermal-magnetic MCB



Benefits

- **Global and comprehensive application range** through meeting all relevant standards
- **High safety level** for the entire machinery through reliable cable protection
- **Reduced wiring time** through flexible systems for conductor connection and terminal blocks in all current ratings

Switch mode power supply



Benefits

- **Superior reliability** because the switch mode power supply and the overcurrent protection equipment are perfectly matched
- **Reduced system cost** through a very high performance at a very low installation width
- **Enhanced machine uptime** through a long life span and reliable deployment

Electronic overcurrent protection



Benefits

- **Cost-saving design** with a flexible and innovative mounting and connection technology without accessories
- **Minimum space requirement** through a compact design with a width of only 12.5 mm, even with two channels
- **Enhanced machine uptime** through selectivity, quick trouble-shooting, transparency and remote diagnosis with PROFINET, EtherCAT and IO link connection

Typical solutions for

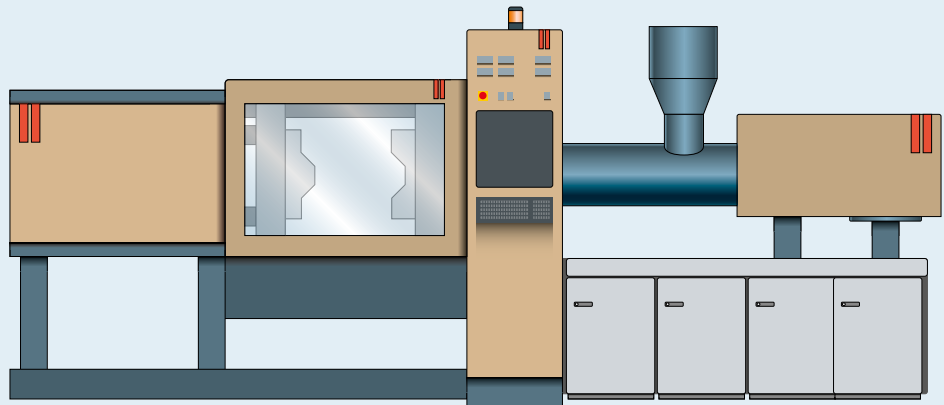
Injection-moulding machines



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Injection-moulding machine for production of moulded parts

Manufacturers of injection-moulding machines often complain about shortage of space in their control cabinets. The compact design of E-T-A's DC 24 V overcurrent protection solutions, compliant with the relevant standards, create the desperately needed space in the control cabinet. The components' modular design additionally makes handling of the devices easier for the end customer.



Cable protection in accordance with EN 60204-1

NEC Class2 to UL1310 up to 4A



REX12-T electronic circuit protector

Cost-conscious, standard-compliant overcurrent protection

REX12 electronic circuit protector

The flexible and compact all-in-one solution consists of various, perfectly matched components and has been especially designed for the cost-conscious machine building industry.

It starts with the EM12 supply module, which can process up to 40 A supply current at DC 24 V and which provides group signalisation for error indication. Single or double channel REX12 devices can then easily be mounted side by side to the supply module in any optional sequence.

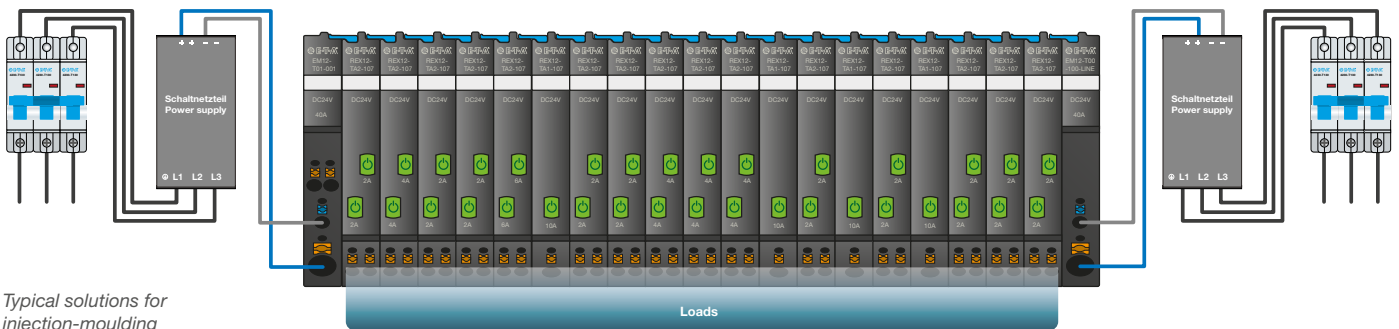
They are available in standard current ratings from 1 A to 10 A. They are followed by the PM12 potential distribution modules for plus and minus distribution.

Connection of the only 12.5 mm wide modules is exclusively with push-in terminals which allow no-tool time-saving wiring.

Besides the approval to UL508listed and NEC Class2, the REX12-T also meets the requirements of cable protection to EN60204-1.

Your benefits

- **Reduction of cost and time,** no further accessories required
- **50 % space savings** thanks to modules that are only 12.5 mm wide
- **Overcurrent protection compliant with the relevant standards** since fail-safe elements match the current rating



Typical solutions for injection-moulding machines



EM12-T supply module



© KraussMaffei

Typical solutions for

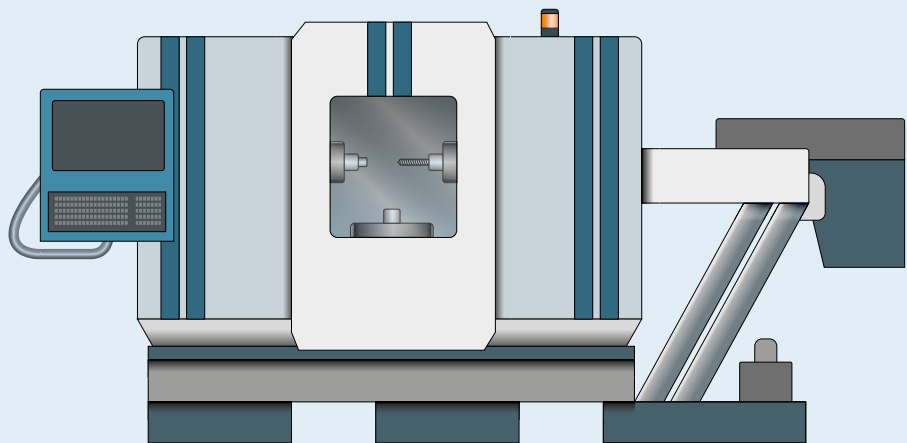
Machine tools



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Machine tools for the metalcutting surface treatment of workpieces

In industrial use, utilisation and permanent availability of machines must be ensured around the clock. In order to avoid unnecessary failures, E-T-A's overcurrent protection solutions provide maximum transparency in machine tools as well as quick trouble-shooting and failure resolution. In combination with remote diagnosis, they enable a significantly enhanced machine uptime.



NEC Class2 to UL1310
up to 4A



The ControlPlex® controller is also available as EtherCAT version.

Intelligent overcurrent protection with IO link/PROFINET REX12D electronic circuit protector

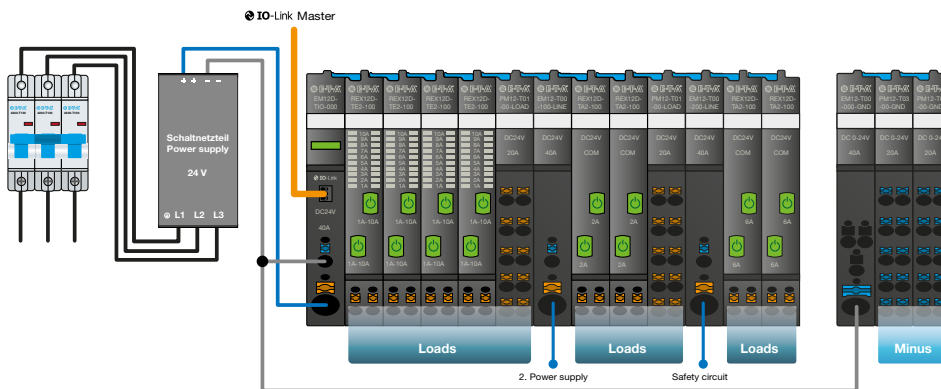
The REX12D series combines the advantages of the flexible and compact REX all-in-one solution with the properties of a digital and intelligent circuit protector with IO link/PROFINET and EtherCAT connection.

The devices combine the well-proven quality of the DC 24 V overcurrent protection with the communication capabilities of the **Control Plex®** system. Smart communication via PROFINET, EtherCAT or IO link allows complete transparency of the DC24V power supply and provides all necessary information for a reliable production process at an early stage.

Data of up to 32 channels of REX12D overcurrent protection can easily be transmitted to the smart control system or the IO link master via the **EM12D-T** and the **CPC12-T** communication modules. No additional accessories are required for the electrical and mechanical connection of the individual components. Early notification in the event of any disturbances and a fast response to current problems increase machine uptime, are cost-effective and improve the overall stability of the production process significantly.

Your benefits

- **Enhanced machine uptime** through improved transparency and remote diagnosis by means of connection to only one IO link master port
- **Ease of PLC integration** through pre-cut functional modules and libraries
- **Reduced inventory** because one adjustable device covers current ratings from of 1 A to 10 A



Typical solutions for machine tools



REX12D adjustable electronic circuit protectors



EM12-T-GND and PM12-T potential distribution modules

Typical solutions for

Packaging machines

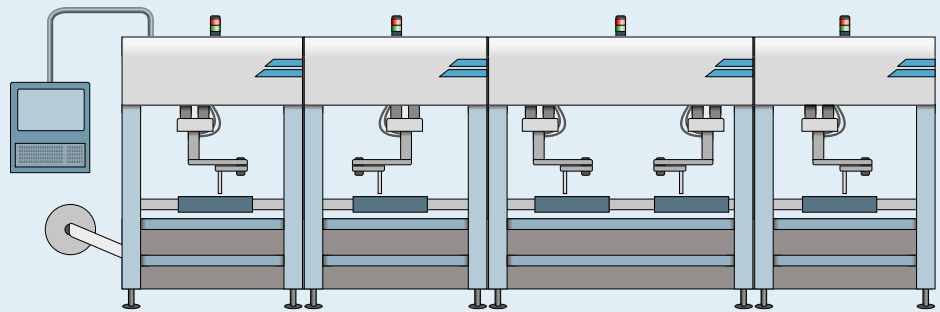


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Packaging machine for shaping, filling, closing and packing of goods

Manufacturers of packaging machines depend on the permanent and reliable uptime of their machines. Besides unrivalled operational reliability with overcurrent protection in compliance with relevant standards, E-T-A's protection

solutions also ensure compact and clearly structured power distribution in control cabinets.



NEC Class2



ESX10- TB electronic circuit protector with active current limitation



ESS31-T electronic circuit breaker with physical isolation

Versatile overcurrent protection with current limitation

Electronic overcurrent protection with ESX10 and ESS31

The **ESX10** is a single-channelled electronic overcurrent protection device for the selective protection of DC 12 V, 24 V and 48 V applications.

Active current limitation offers optimum protection for the switch mode power supply. Inrush currents of capacitive loads are tolerated, current peaks limited.

Besides fixed current ratings from 0.5 A to 25 A, adjustable devices are also available. In the event of a failure, the device disconnects the faulty path after maximum 3 seconds. Thus, selective disconnection increases machine uptime.

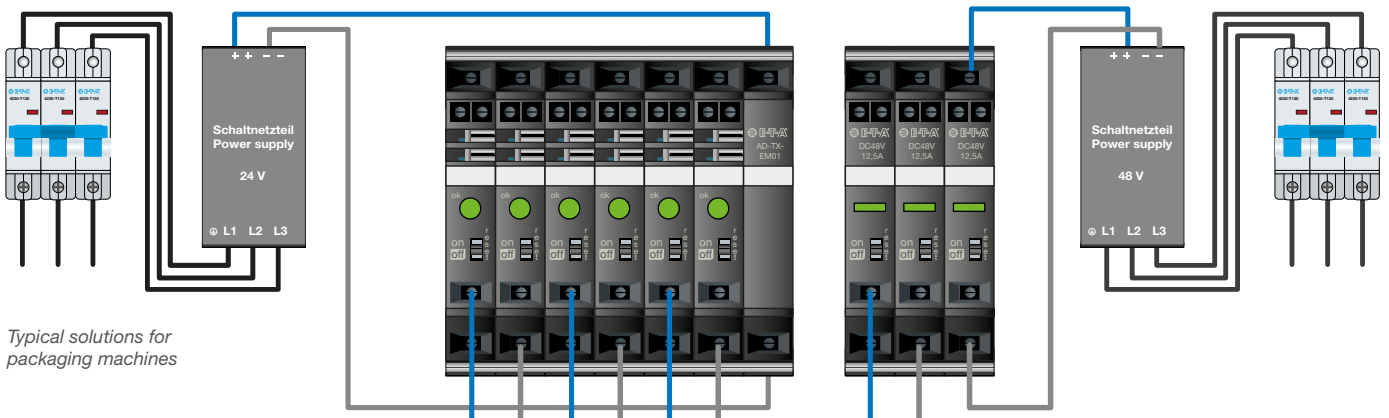
ESS31

The **ESS31** circuit breaker combines standard electronic overcurrent protection with active current limitation and physical isolation. Selective protection excludes voltage feedback since the breaker disconnects overload currents within 500 ms at 1.2 times rated current. With a single characteristic curve, E-T-A's **ESS31** offers standard-compliant protection, even with long load lines or small cable cross sections.

In addition, the ESS31 can be used everywhere in the world thanks to comprehensive approvals such as UL1077, UL60947 and EN/IEC60934.

Your benefits

- **Individual use world-wide** thanks to a comprehensive range of international approvals
- **Enhanced stability** of the DC 12 V, DC 24 V and DC 48 V supply through integral linear current limitation
- **Reduced complexity** of the application through integral wiring solution



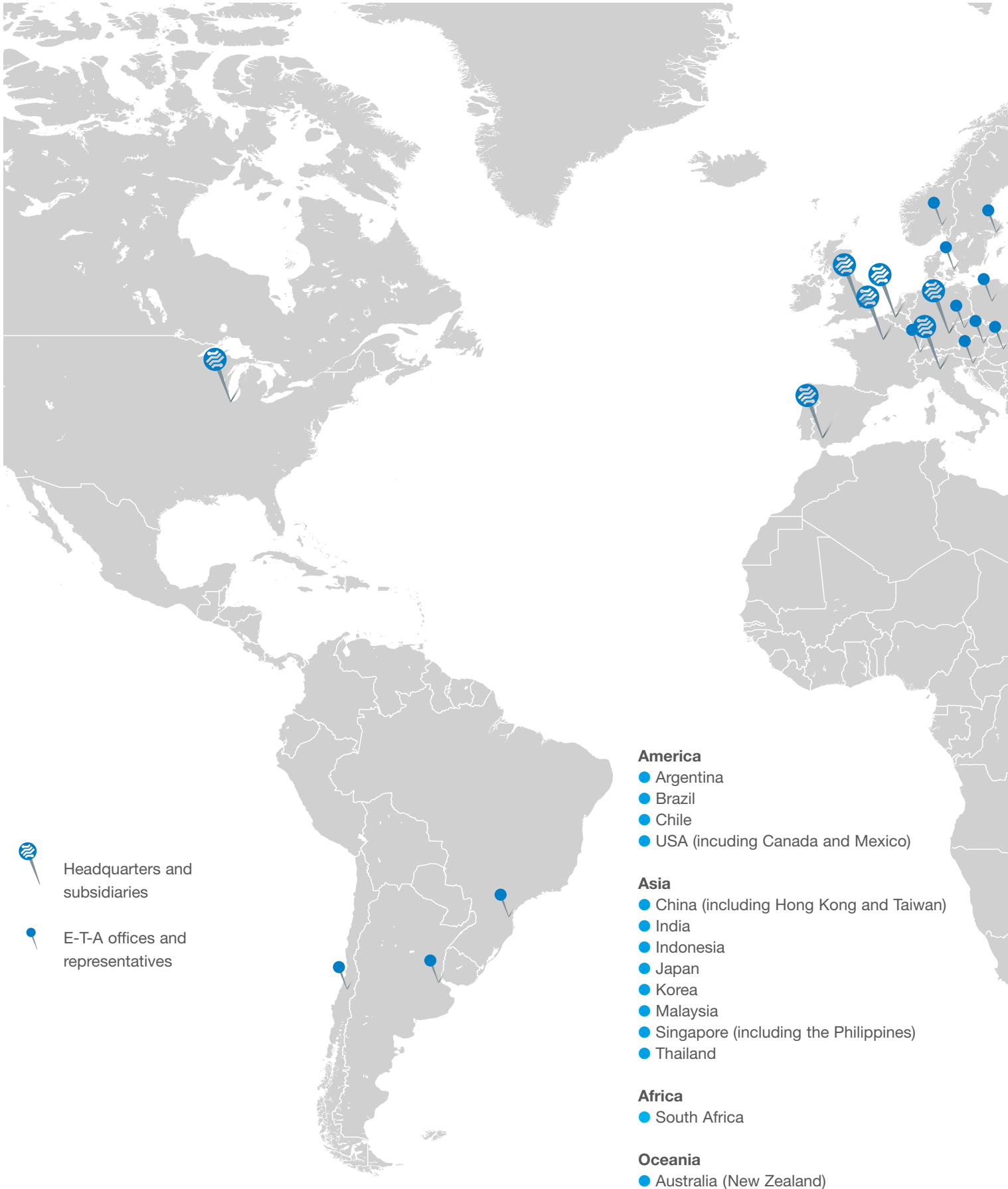
Typical solutions for packaging machines



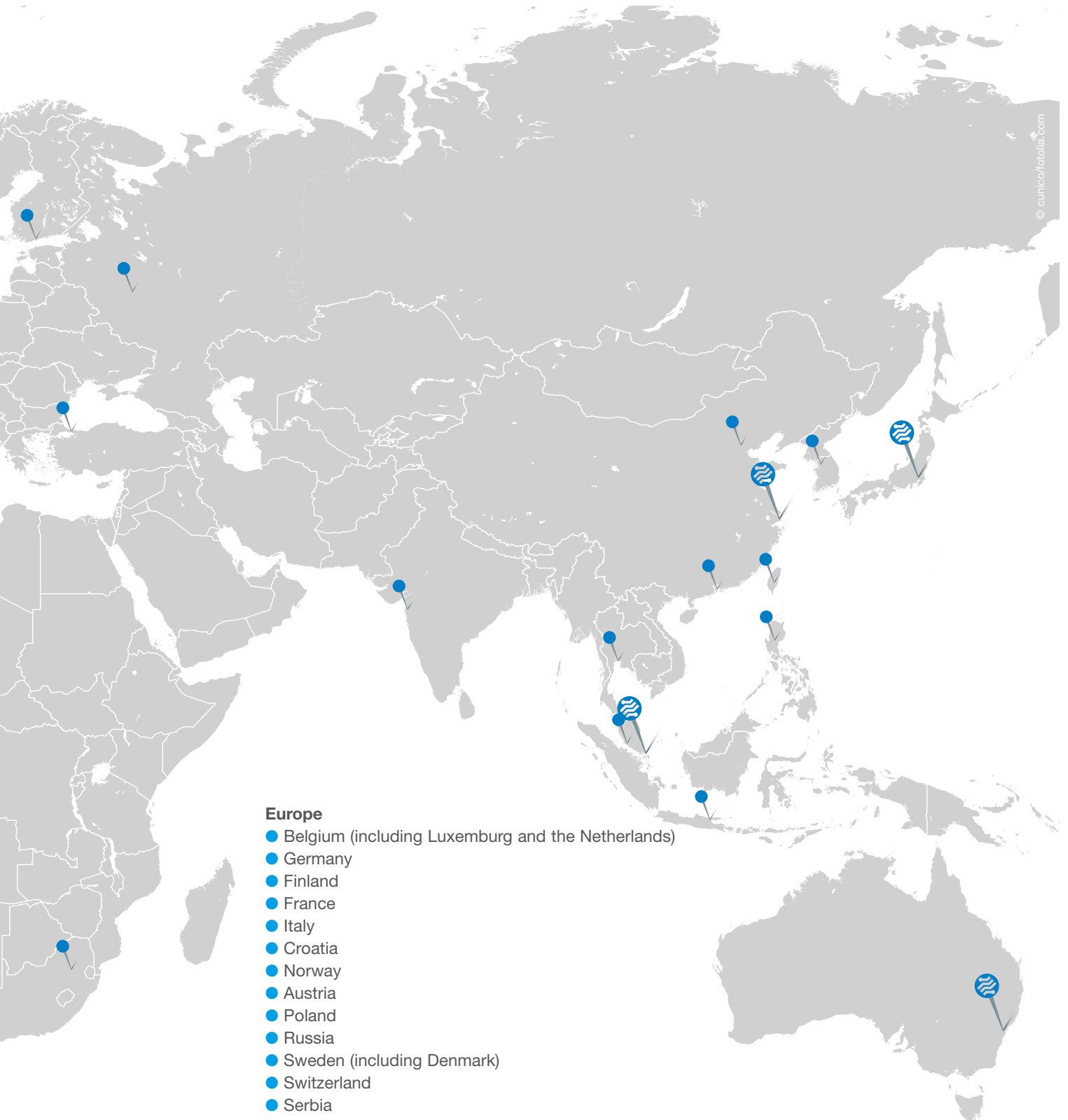
ESX10-TC electronic circuit protector for 48 V applications



E-T-A your global partner for overcurrent protection



For information on our global network please visit: www.e-t-a.de/contact



B_Maschinenbau_e_261020D

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