

Power management in on-board electrical systems of agricultural and construction machinery





E-T-A: Safety first.



For over six decades the E-T-A registered mark has been recognised as a symbol of safety and reliability throughout the field of equipment protection. With headquarters in Altdorf, Germany, E-T-A is an international group of companies and a world leader in the design, development and manufacturing of circuit breakers for the protection of components, equipment and systems against overload and short circuit. Today the E-T-A product range is one of the widest available with a solution for almost every application.

Research & Development.

As a privately owned group, we are committed to maintaining a high level of research and development investment to ensure we remain at the forefront of circuit protection technology. E-T-A has over 1300 highly qualified personnel worldwide. Our products combine innovative, leading-edge designs with proven low cost of ownership, and exceptional safety and reliability. They are fully approved by internationally respected authorities including VDE, UL and CSA.

In addition to our own R & D activity we work closely with universities and are funding several advanced technology programmes addressing industry's needs for tomorrow.

Our commitment to environmental protection and conservation of natural resources has been widely acclaimed and is a high priority throughout the E-T-A organisation, including our other manufacturing sites in the USA, Tunisia and Indonesia.

State-of-the-art production.

E-T-A products are manufactured by means of ultramodern production facilities, meeting highest quality requirements. As a matter of course, E-T-A has certifications in place to ISO 9001:2001 and TS 16949.

Worldwide support.

E-T-A's network of subsidiary companies and representatives provide sales and support over 60 countries around the world. Product specialists will assist in the selection of the correct solution for your application. Whether you require individual circuit breakers, a complete system solution, battery management or control devices you will be able to specify E-T-A products confident in the knowledge you will not be disappointed.





E-T-A product in construction and agricultural machinery

Construction machinery and agricultural vehicles have one thing in common: they have to be robust and readily available at all times. Downtimes have to be prevented under all circumstances as idle machinery does not “earn” money, but it only costs.

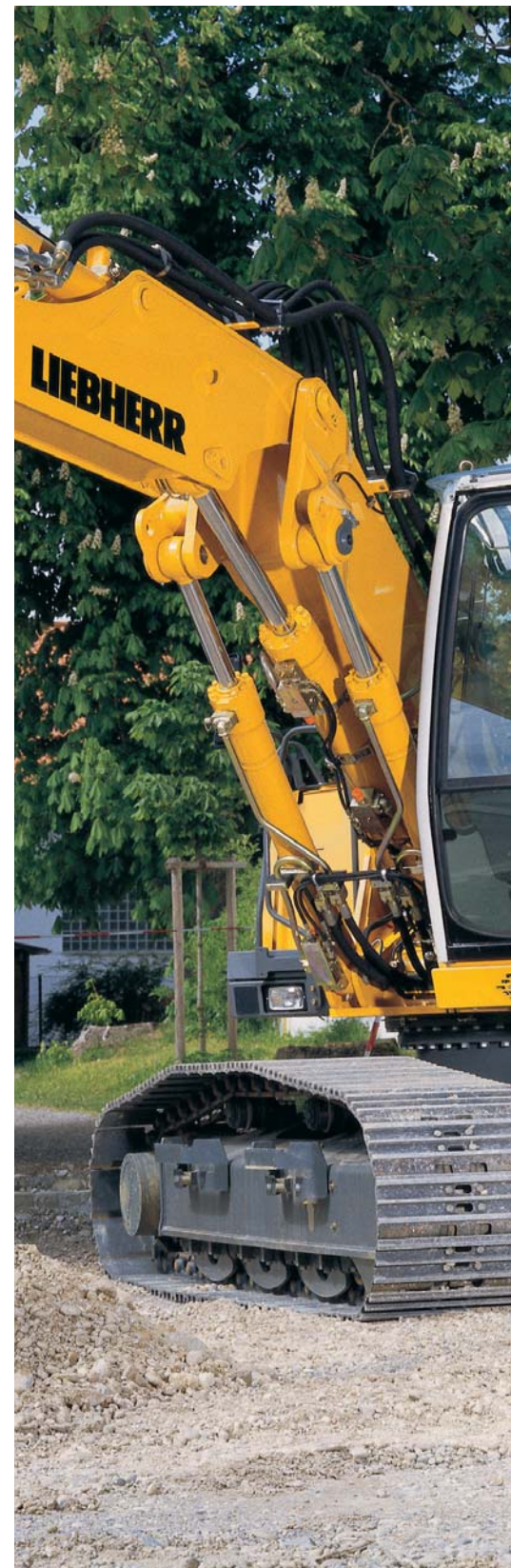
This is all the more important for leased machinery. But also seasonal machinery such as harvesters has to be fully functional during the short time when it comes to use.

No one can afford a standstill due to a failure of the electrical on-board system. Blown fuses can be a nightmare when a replacement is not ready to hand. A jammed relay may put a machine out of service for hours.

For more than 60 years E-T-A has been a reliable partner when it comes to enhancing safety and reliability of machinery. We have always been supporting our customers with designing their electrical equipment, among them many major manufacturers of construction machinery.

Circuit breakers installed a million times over have the confidence of companies like Grimme for their harvesters, Kässbohrer (snowcats), Liebherr and Mecalac (excavators), Terex (construction machinery) or Wirtgen GmbH (asphalt cutters). They all rely on the quality of E-T-A products.

Our sophisticated power management and protection concepts reliably protect wiring and loads against short circuit or overload and support the Design Engineers working on their various tasks.





Why E-T-A? Ideal cable protection



Connection of line-load-protection

The ideal protection of on-board electrical systems accounts for both cable harnesses and the loads themselves.

The thermal properties of cables can easily be visualised in a current-time chart as a characteristic curve. The critical range lies above this range: the cable may get so hot that a fire hazard cannot be excluded.

Such a chart can also be used to show the trip characteristics of a standard blade fuse and of a circuit breaker for equipment protection as well as the start-up behaviour of a load. Our example shows the curve of a fan motor.

Protection near the line – reliable and cost-effective

The diagram shows that the trip curve of the protective elements has to lie exactly between the line curve and load curve:

If the trip curve of the fuse or circuit breaker and the line curve have an intersection point, the cable may burn out before the protective element trips and this would cause considerable damage.

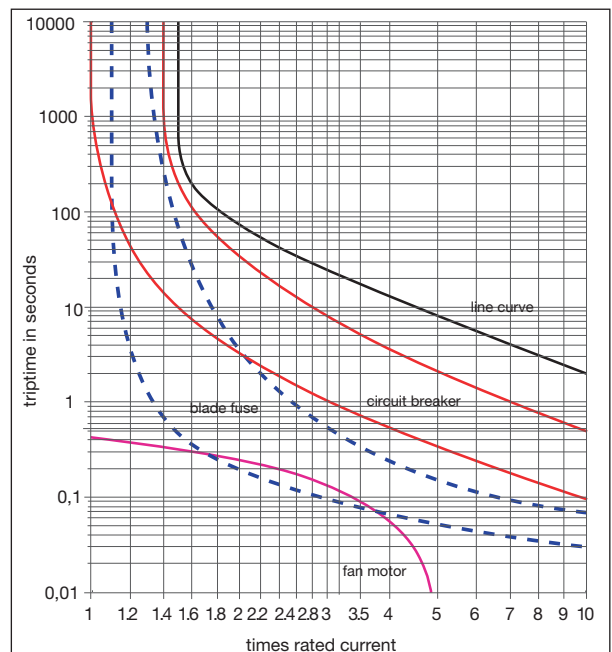
It is similar with the load curve: in the event of an intersection – as shown in the chart –, the fuse or circuit breaker will trip although no damage

needs to be expected. Normally the cable cross section has been oversized in such a case which leads to additional weight and costs.

The closer the trip curve of the line protection to the line curve, the better the protection of the line.

Temperature

For critical thermal environmental conditions there are circuit breakers with temperature compensation. They are fitted with an additional bimetal which depends only on the ambient temperature and thus renders the tripping bimetal independent of the ambient temperature.



Protection based on the line characteristic curve: start-up behaviour of an automotive fan motor



Circuit breakers – Your benefit counts.

The advantages of circuit breakers compared to blade fuses are obvious:

Maintenance-free

Unlike blade fuses circuit breakers are maintenance-free in the event of a failure. This provides ease of handling and significantly reduces costs over the entire life span.

A wealth of type configurations

Depending on the application E-T-A circuit breakers can be provided with various kinds of reset features (SAE types I, II, III and III*). Select the ideal product for any application:

- Autoreset (circuit breaker resets automatically as soon as the short circuit or overload has been remedied)
- Modified reset (circuit breaker resets by switching the ignition on and off)
- Manual reset (circuit breaker is reset by actuating its reset button)
- With additional manual release facility (manual disconnection of the circuit for maintenance or service works or a longer downtime or transportation of the machine).

Clear visual status indication

Even in a crowded fuse box the tripped circuit breaker can easily be identified because of its protruding reset button.

High availability

In the event of a tripped circuit breaker the user can easily reset the breaker and continue working. Deadlines can be met without losing time.

Enhanced safety

Blown fuses are often replaced by unsuitable, but available fuses with a different rating or even bridged by

inappropriate substitutes. These hazards are excluded by the use of resettable circuit breakers.

User-friendliness

Automatic reset operation makes our circuit breakers suitable for inaccessible locations as they do not have to be actuated nor replaced.

Robust design

Circuit breakers do not age and are not prone to corrosion or wear through shock, or current or voltage peaks. Nuisance tripping is a disadvantage of aged blade fuses in the event of inrush peaks, but is prevented with thermal circuit by the bimetal's inertia.

Directly interchangeable

The automotive circuit breaker types 1610, 1170 and 1620 have the same ATO or MINI footprint as blade fuses (DIN 72581-3) and can therefore directly replace the fuses. This feature makes our circuit breakers interesting for optional equipment in OEM applications as well as in the retrofit business.

Minimum power loss

The voltage drop of circuit breakers is normally lower than with blade fuses. Higher cross sections lead to very low internal resistance values which in turn means less power loss and less gas consumption.





Compact design 1610 and 1620



Circuit breaker type 1620

One tends to think that installation space is not a problem with big construction machines – but far from it!

The integration of more and more functions by keeping the same outer dimensions leads to downsizing also in mobile work machinery.

E-T-A's response to this tendency is the design of the MINI circuit breaker type 1620. Its development has been based on type 1610, a circuit breaker which has been sold a million times over in the past few years. Unlike the 1610, type 1620 features a MINI footprint and offers all types of reset (autoreset, modified, reset button and manual release facility).

Rated voltage:

DC 32 V (autoreset only DC 12 V)

Current rating range:

5...30 A



Circuit breaker type 1620

Circuit breaker type 1610

The extremely compact design of the circuit breaker 1610 has been installed a million times over in many applications. It features various reset possibilities, ensuring versatility.

Rated voltage:

DC 32 V (autoreset only DC 12 V)

Current rating range:

5...30 A



Circuit breaker type 1610

- space-saving design
- various reset types



Circuit breakers and power distribution systems

Circuit breaker type 1170

Type 1170 is a fully featured breaker for the protection of loads and electrical systems. Its snap-action mechanism, trip-free mechanism and rupture capacity of 400 A provide comprehensive safety.

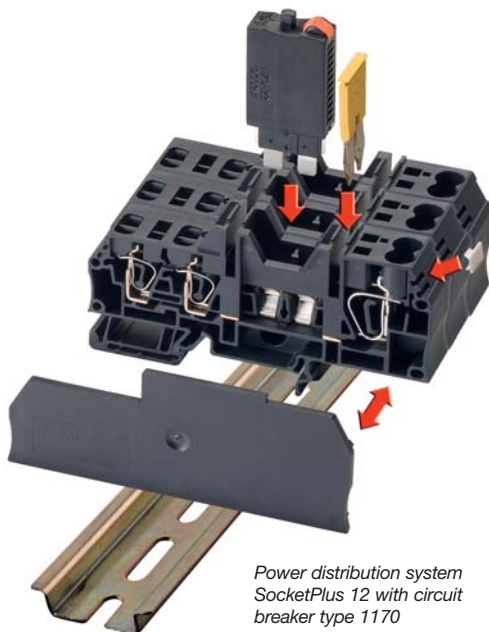
The snap-action mechanism ensures switch-on operation without detrimental arcing while the trip-free mechanism ensures reliable disconnection even with the reset button blocked. The retaining clips of the circuit breaker ensure a good electrical connection and tight fit in the terminal block.

Rated voltage:

DC 28 V

Current rating range:

3...25 A



Power distribution system SocketPlus 12 with circuit breaker type 1170

Power distribution system

SocketPlus 12

The power distribution system SocketPlus 12 has been designed particularly for rail mounting (TS35) in combination with the circuit breaker type 1170. It can be bridged both on the input and output side which allows a great number of different circuit designs. Spring-loaded terminals provide ease of mounting.

The power distribution system SocketPlus 12 has two terminals on the input side and four on the output side which obviate additional potential terminals. This helps to save valuable installation space and of course costs.

Rated voltage:

DC 32 V

Rated current:

57 A (cross connector 41 A)

Cable cross section:

load input	2 x 0.5...10 mm ² rigid
	2 x 0.5...6 mm ² with wire end ferrule
load output	4 x 0.5...4 mm ² rigid
	4 x 0.5...2,5 mm ² with wire end ferrule

- spring-loaded terminals ensure ease of mounting
- can be bridged on input and output side
- excellent price-performance ratio



- snap-action mechanism
- trip-free mechanism
- robust design



Robust and reliable: thermal circuit breakers



Photo: Wirtgen GmbH, Windhagen/Germany

Thermal circuit breaker type 3131

Less wiring time, more advantages and additional functions – this is the competitive edge of a combination of circuit breaker and rocker-actuated ON/OFF switch. Various design models and numerous technical configurations make the thermal circuit breaker type 3131 the ideal solution for challenging tasks in controlling and monitoring of vehicles. It is also available as a three-position-switch.

Rated voltage:

DC 32 V

Current rating range:

0,1...20 A



Circuit breaker type 3131

Circuit breakers type 412, 413, 483, 4120 and 452

These circuit breakers offer a superior level of performance, unrivalled in the market. They are qualified for the most severe conditions, with exceptional shock and vibration resistance. They are ideally suited to the protection of heavy current main distribution cables, and rigorous demands of construction and other off-road vehicles. Push/pull actuation avoids the danger of accidental disconnection of critical circuits.

For particularly critical applications where large cable sizes are used and there is the risk of short circuit, we offer the thermal-magnetic type 452. This combines the operational benefits of thermal actuation with the high fault rating capability of a fast magnetic circuit breaker.

Rated voltage:

DC 28 V, AC 115 V (400 Hz)

Current rating ranges:

1...25 A (type 4120)

1...35 A (type 483)

6...35 A (type 412)

30...90 A (type 413)

50...125 A (type 452)



Top right: Circuit breaker type 4120 and 583
Bottom: Circuit breaker type 412, 413 and 452



Power Relays – tough and robust

Power Relays PR60/PR80 Battery Master Switch BMS01

The robust electro-mechanical power relays PR60 and PR80 have been designed for reliable switching of high currents and are ideally suited to the use under harshest environmental conditions.

The monstable PR60 and the bistable PR80 are often used as battery isolation switches in the field and are able to reliably disconnect currents up to 300A. Both models offer various mounting styles, and a high level of protection (IP 67) against water or dust ingress which facilitates installation in almost every type of vehicle and mounting position.

The single pole or double pole battery master switch type BMS01 provides numerous functions such as a defined deactivation of the vehicle's electronic system before switching off the battery as well as low voltage monitoring with corresponding signalling or disconnection.

In addition it meets the ADR requirements, the European regulations covering the transportation of hazardous goods.

Rated voltage:

DC 28 V

Current ratings:

100, 200, 300 A (PR 60 / PR 80)

200 A (BMS01)



Power Relays PR60/PR80



Battery Master Switch BMS01





Electronic relays for wear-free switching operation



Electronic Smart Power Relays E-1048-8-D/C/S/I

Construction machinery, agricultural and other off-road vehicles are often exposed to shock and vibration. A solid state relay is therefore recommendable for switching of smaller loads as it is unsusceptible to shock and vibration having no moveable parts.

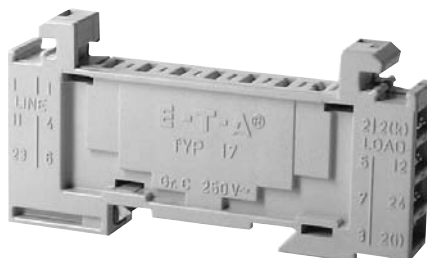
As a positive side-effect the relay can be placed anywhere in the vehicle as the installation does not have to be in a particularly low-vibration spot.

Undesired effects such as long chattering times, arcing and contact wear are excluded when a solid state relay is used.

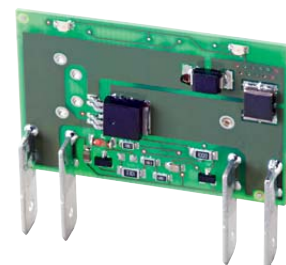
Integral additional functions such as overload and short circuit protection simplify the entire power management as they obviate additional protection and additional interfaces.

In addition the solid state relay offers a time-current characteristic which tolerates high start-up currents of e.g. motors for a certain period of time.

The extremely low power consumption – approximately one fifth of standard electro-mechanical relays – disburdens the battery and reduces diesel consumption. Heat build-up is also reduced by approximately 30 K.



Socket type 17P10 Si



Electronic monitoring relay type E-1048-8-S



Smart Power Relays Series E-1048-8

Optional outputs for control signalling (load is activated), group signalling (load has been disconnected due to short circuit or overcurrent) and an analogue output (voltage output proportional to load current) allow permanent monitoring of the loads.

Wire break monitoring is available as an option, where the load circuit is permanently monitored with regard to wire breakage in the ON and OFF condition.

The housing models Dice and Cubic fit into standard automotive fuse blocks to ISO 7588, while the footprint of the Inline

and Slimline models are particularly suited to track or pcb mounting. The electronic relays can be connected in parallel to allow switching of higher currents.

Rated voltage:
DC 28 V

Current ratings:
1...30 A (type DICE)
1...25 A (type CUBIC)
1...25 A (type SLIMLINE)
1...20 A (type INLINE)
1...200 A (type MULTISLIM, only available for special projects)

- shock and vibration proof
- no contact wear
- long endurance
- low power consumption
- minimum heat build-up



Electronic monitoring relays type Smart Power Relay E-1048-8D, ...8C, ...8I

E-T-A

Worldwide Service Network



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Photos: E-T-A, Grimme Landmaschinenfabrik GmbH & Co. KG,
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Liebherr Hydraulikbagger GmbH, Mecalac, Terex GmbH,
Wirtgen GmbH (Windhagen/Germany)



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