Protection against overload and short-circuit currents

Multi-channel device circuit breakers and motherboard solutions

Circuit breakers are used in almost all industries to increase availability. In the case of a new device circuit breaker board, remote signalling is divided into two groups – the entire board can be monitored via one or two PLC inputs (Figure 1).

A lot can be learned from applications that have become established in the market over many years – including with regard to ease of installation and space savings. The groups of loads to be protected should be optimally coordinated in order to provide adequate availability. Targeted shutdown must be ensured in the event of an error, and other system parts should not be affected by this.

Thermomagnetic circuit breakers trip immediately

If a manufacturer wants to establish a new standard on the market, they must be able to make it clear to their customers what the advantages are: system manufacturers always keep their ears open for benefits such as space savings, reduced installation time, and integrated potential distribution. In practice, protection for systems and loads is always designed according to the same model (Figure 2).

However, the number of loads or groups of loads to be protected varies from system to system. The standard configuration usually has 230 - 400 V AC on the primary side. The various sensors and actuators are supplied via 24 V DC switched-mode power supply units,
which are dimensioned with 10 to 40 A in most cases. Large systems often also use several power supply units in order to provide the required power. These are ultimately there to ensure that the system runs without interruption, where possible.

With planned reserves of between 20 and 50%, future system expansions are already taken into consideration in the planning phase. These reserves also serve as protection in the event of an error, as this is the only way that such high tripping currents can flow. It is here, for example, that thermomagnetic circuit breakers are used, which trip immediately in the event of an error. The other system parts then continue operating undisturbed.

**Other system parts protected against downtime**

Protection consists of multiple channels which protect the loads in the system. In order to configure selective protection, the individual devices are, for the most part, protected separately. However, device groups are also protected together – generally due to economic considerations. This definitely makes sense from a system viewpoint - if operation of the individual loads in the group is interdependent. The nominal current of the devices should be roughly the same in order to ensure that a suitable circuit breaker can be selected. If one device in the group fails, the entire group is shut down. Other groups continue working without interruption.

In the event of an overload, the thermomagnetic device circuit breakers trip mechanically with a delay with the aid of a bimetal. This is referred to as a thermal shutdown. If a short circuit occurs in the event of an error, a solenoid shuts down the protected device or even the system area immediately in order to protect further areas against downtime. There are three different characteristics available which are tailored to different loads. Each device circuit breaker offers a floating PDT contact and electrically isolates the protective path - both in the case of manual shutdown and in the event of an error.
Characteristics for different loads

Three characteristics offer appropriate protection for different loads:

- The fast-blow F1 characteristic protects devices with a low switch-on current.
- The SFB characteristic is an optimised C characteristic that was designed to protect devices with a higher switch-on current. This characteristic was developed in order to lower the amount of residual current flowing and enable longer cable paths - while still ensuring reliable tripping.
- The medium-blow M1 characteristic offers even slower tripping and is used for devices with sustained high switch-on currents.

With the new device circuit breaker boards, Phoenix Contact now offers a solution for series production of machines and process technology (Figure 3). The boards are compatible with the new thermomagnetic device circuit breakers in the CB product range. The board is conveniently supplied with up to 60 A via a central supply.

There is no need for any bridging thanks to the conductive paths. Three versions are available at present - with 4, 8, and 12 channels. They are designed as PCB solutions intended to accommodate the thermomagnetic device circuit breakers. This means that four to twelve channels are protected against the effects of overload and short-circuit currents.

Behind the protected outputs of the circuit breaker lie plug-in PCB terminal blocks with push-in connection technology – this enables installation time to be drastically reduced. Each protective path has five connection terminal blocks for the protected positive pole and five for the negative pole. This ensures quick and easy potential distribution. Each protective path therefore offers the option of supplying a group of five loads positively and negatively, without having to use terminal bases.
Series switchgear further standardised

All circuit breakers are monitored with the aid of integrated group signalling. If a circuit breaker is tripped as a result of an error, the signal circuit is interrupted and a message can be processed further. The groups can be divided into two signal groups of the same size in order to speed up error localisation.

If device circuit breaker boards are now used instead of the usual technology, a lot of space can be saved thanks to the low design width. In addition, the amount of accessories and installation time required to protect the loads of a machine are reduced significantly. The individual current paths can be adapted quickly - the circuit breaker is simply removed and replaced by the appropriate current value and characteristic.

Series switchgear can be further simplified and further standardised. With the device circuit breaker boards, Phoenix Contact offers a system solution that can be tailored to a wide range of applications (Figure 4). Even the number of channels and the way in which remote signalling is implemented can be adapted to specific requirements. The resulting boards can be ordered at any time as a standard item.

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Device circuit breaker boards – ideal for series production of machines and process technology

Device circuit breakers are typically used in 24 V DC switchgear. Here they provide effective and reliable protection against overload and short circuit for cables and devices. Further damage is prevented in this way and the production process does not have to be interrupted.

Ideal protection is achieved when appropriate circuit breakers are connected upstream of loads. This means that it is possible to immediately identify the part of the system where the error occurred and servicing can get under way straight away. If only a small number of critical system parts need to be protected, groups of loads can also be protected together. Device circuit breaker boards protect systems quickly and easily – with a low design width and integrated potential distribution. Device circuit breaker boards are therefore ideal for use in series production of machines or process technology.