

## Application Note DK9222-0319-0064

### Overcurrent protection

#### Keywords

- electronic overcurrent protection
- electronic protection
- selective 24 V DC protection
- potential distribution
- potential multiplication
- potential group protection
- reduced cross-section
- reduced cabling effort
- reduced space in the control cabinet

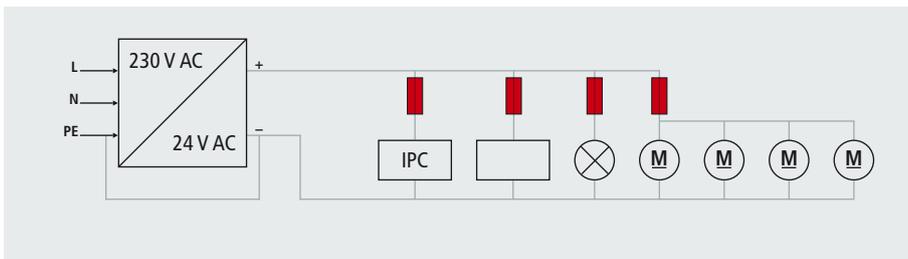
# 24 V DC overcurrent protection and power distribution

**This application example explains how 24 V DC can be protected, multiplied and distributed in the I/O environment. Typical installations are shown below in connection with various terminals. On account of the flexible and modular layout in the I/O system, the required space in the control cabinet and wiring effort can be reduced.**

**Protection in the 24 V DC environment is indispensable in order to protect consumers, cables and installation against overcurrent. Furthermore it is necessary in the event of a fault to switch off as quickly as possible before the supply voltage drops. If the 24 V DC voltage drops, this affects all connected consumers and thus the entire application. In addition to quickly switching off, it is a useful capability to only switch off the faulty path. This is possible if the consumers are protected individually or in groups. This is called selective protection in the 24 V DC environment.**

**Electronic overcurrent protection products are the right choice for fast, precise and selective protection in 24 V DC applications.**

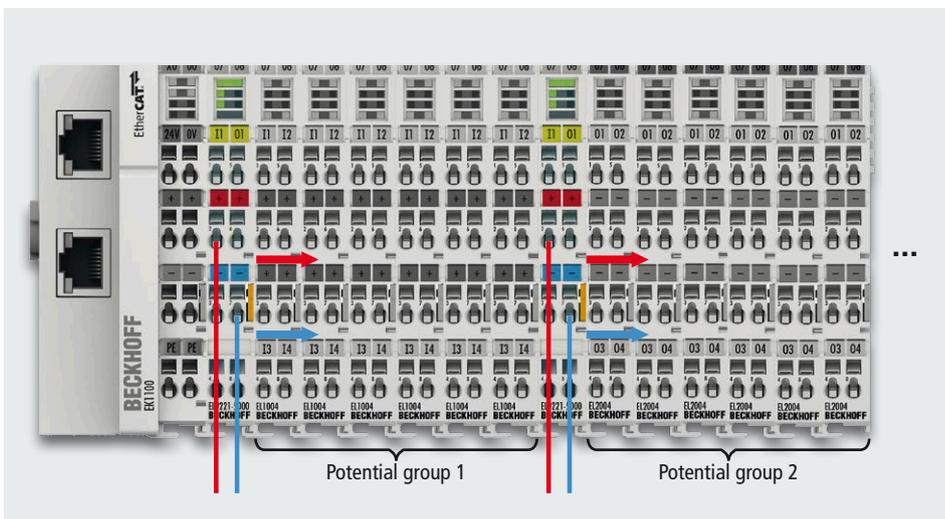
## 1.) Selective protection



Example of the selective protection of individual consumers and a potential group

## 2.) Protection of potential groups

The 24 V DC protection of potential groups can be simply and conveniently implemented within the Beckhoff I/O system. An overcurrent protection terminal is to be placed before the respective potential group. The protected 24 V DC voltage is fed into the potential group with both the 24 V and the 0 V potential at the same time via the power contacts. This results in a fast and space-saving installation, as additional passive I/O terminals are not required to collect the 0 V potential again.



Protection of potential groups via power contacts with the EL9221 overcurrent protection terminal

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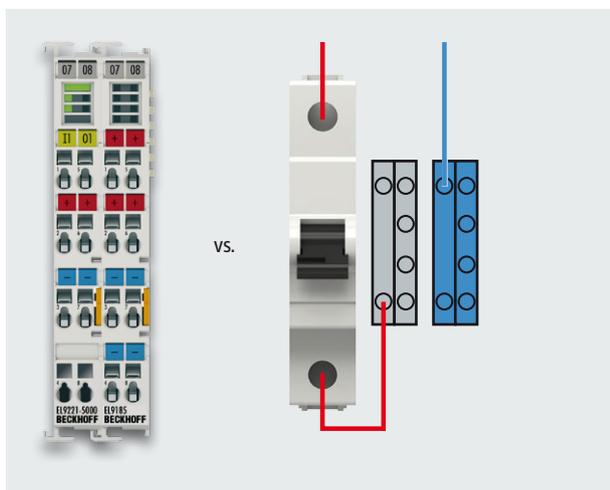
#### 3.) Potential distribution and potential multiplication

The conventional 24 V DC potential distribution is typically implemented with passive terminal blocks, i.e. the cable of the protected 24 V DC is applied to a terminal block. Here the potential is multiplied if necessary by several terminal blocks and fed to the respective consumers. The 0 V potential is collected again in the same way via several passive terminal blocks and fed back to the power supply unit.

This type of installation requires additional passive terminal blocks, cabling and above all installation time for the setup.

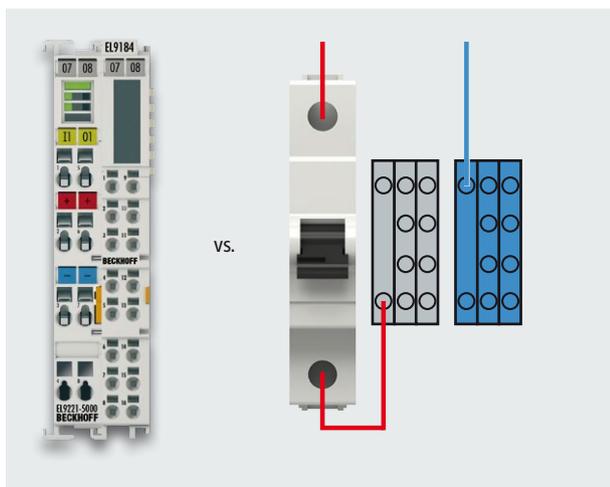
With the modular I/O system from Beckhoff, the use of passive terminal blocks is not required saving cabling effort and installation time. In addition, consumers in the I/O system are clearly connected "in pairs" to the 24 V and 0 V potentials. A tidy installation results, as not only the passive terminal blocks for the 24 V potential, but also the terminal blocks for the 0 V potential can be omitted.

#### a.) 4 x 24 V | 4 x 0 V

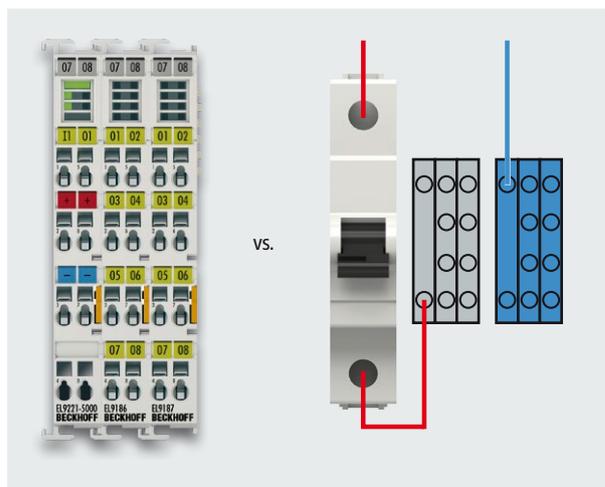


4-fold potential multiplication with EL9221 and EL9185 up to 2.5 mm<sup>2</sup>

## b.) 8 x 24 V | 8 x 0 V

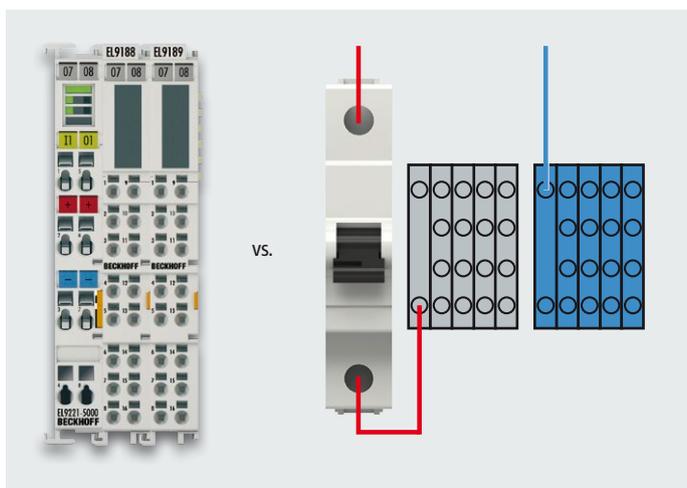


8-fold potential multiplication with EL9221 and EL9184 up to 1.5 mm<sup>2</sup>



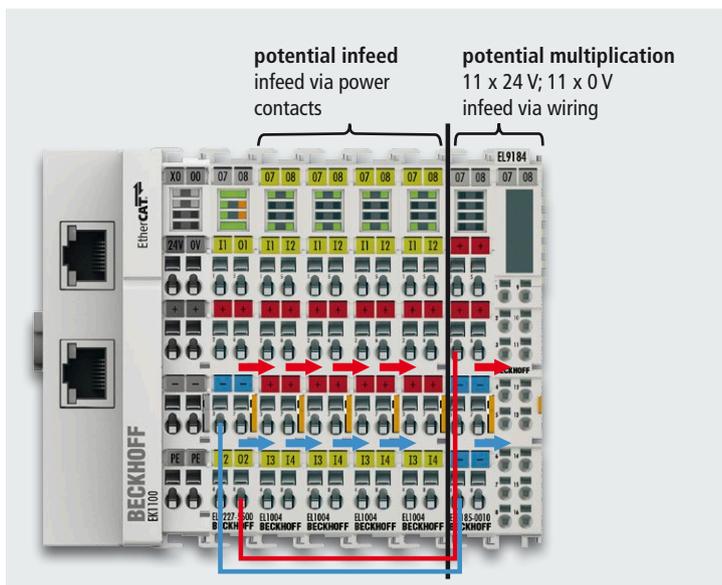
8-fold potential multiplication with EL9221, EL9186 and EL9187 up to 2.5 mm<sup>2</sup>

## c.) 16 x 24 V | 16 x 0 V



16-fold potential multiplication with EL9221, EL9188 and EL9189 up to 1.5 mm<sup>2</sup>

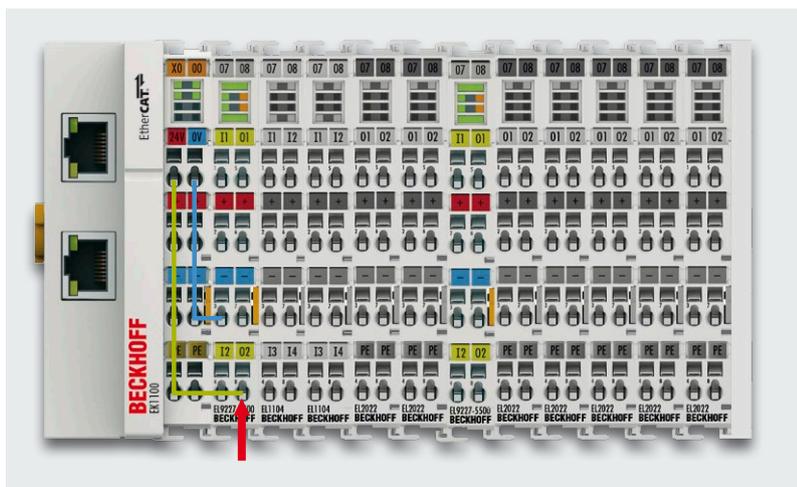
d.) 11 x 24 V | 11 x 0 V



potential infeed via EL9227 power contact and potential multiplication via wiring with an EL9185-0010 (2.5 mm<sup>2</sup>) and EL9184 (1.5 mm<sup>2</sup>)

#### 4.) Protection of Industrial PCs and Couplers

The EL9221, EL9222 and EL9227 electronic overcurrent protection terminals for EtherCAT are special in that the protection function is 100 % operational even without EtherCAT. This means that if the 24 V DC input voltage is applied, the protection is already active and 24 V DC is available at the outputs. It is therefore possible to protect Industrial PCs or Couplers that provide their own EtherCAT connection. A 2-channel version is suitable for this.

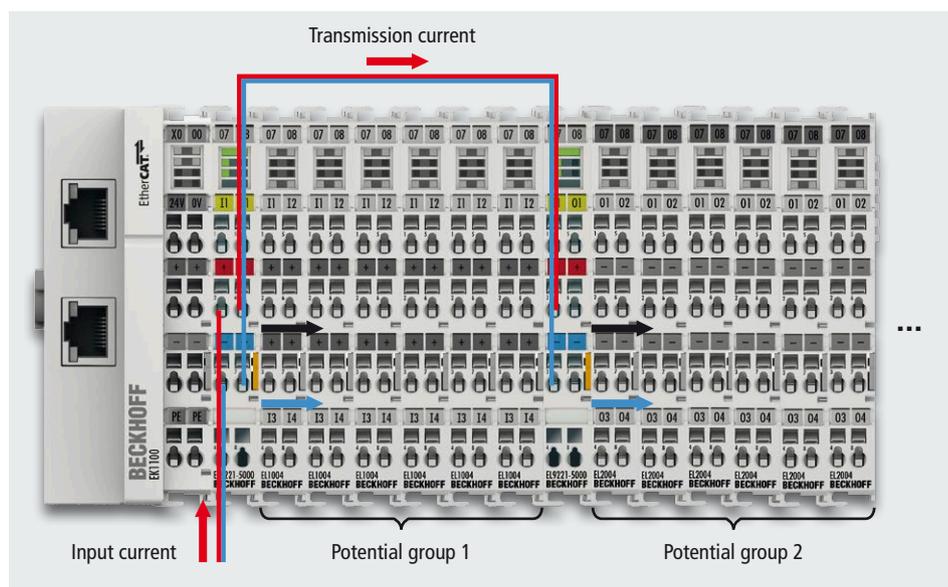


Protection of an EK1100 with EL9227 via output 2

## 5.) Bridging the input voltage

The input voltage of the overcurrent protection terminal can be bridged forwards to the next overcurrent protection terminal. Refer to the technical data for the maximum permitted input current. The following equation applies:

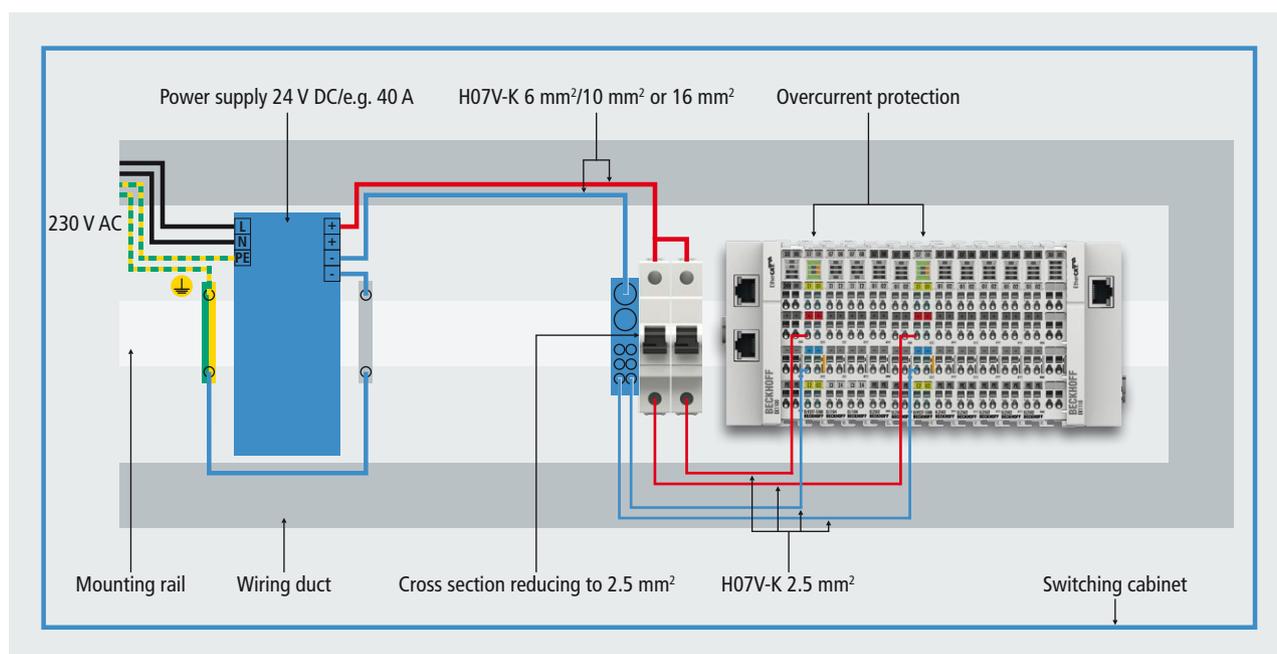
Input current = forwarding current + requirement of the first terminal



## 6.) Supply with larger cross-section

The electronic overcurrent protection terminals from the EL922x series feature integrated current and power limitation. This ensures that only a limited current can flow in the event of a fault. There is thus no limit at all to the size of the power supply units used. When using larger power supply units, for example for 40 A, the cable cross-section on the secondary side is usually larger than 2.5 mm<sup>2</sup>. This is not a problem, however, as standard-compliant connection is still possible. There are two possibilities to reduce the cross-section to 2.5 mm<sup>2</sup>.

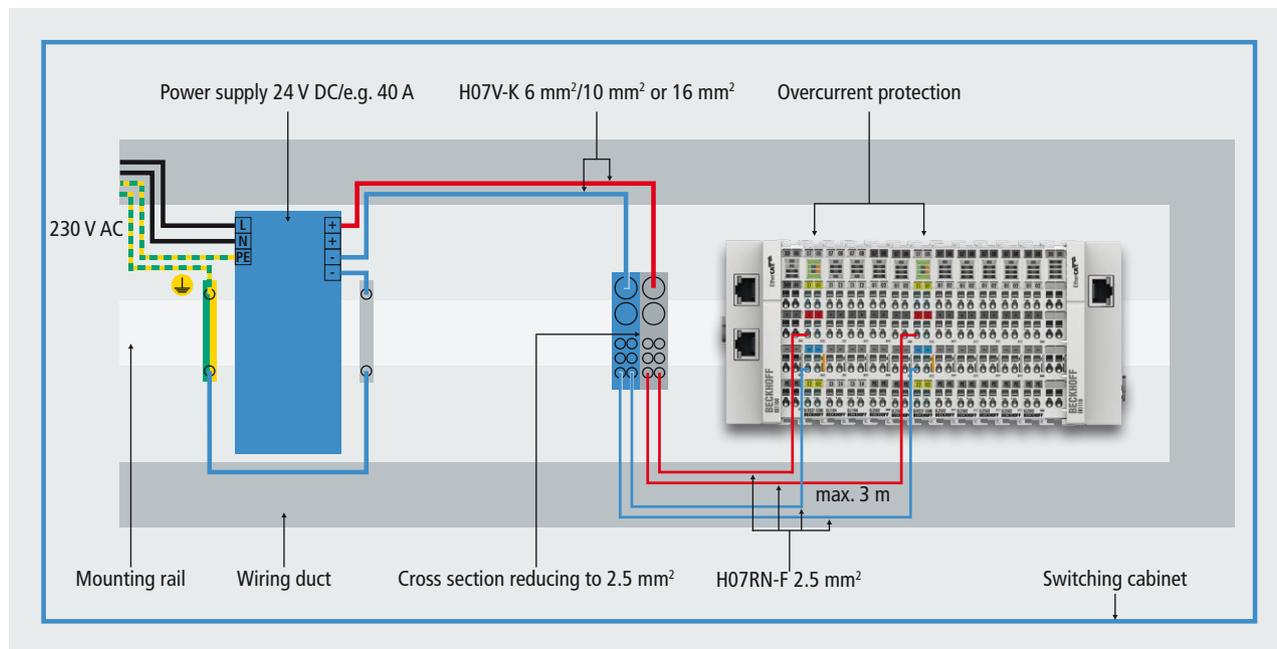
### a.) With back-up protection



Connection of an EL922x with reduced cross-section and back-up protection (circuit breaker)

## b.) Without back-up protection

A connection with reduced cross-section is also possible without back-up protection while ensuring standard compliance.



Standard-compliant connection of an EL922x with reduced cross-section without back-up protection

Applicable standard requirements have to be complied with.

### - DIN VDE 0100-430 (VDE 0100-430):2010-10

1. The cables with a reduced cross-section are no longer than 3 m.
2. The short-circuit risk is reduced to a minimum by laying cables of the type H07RN-F in a cable duct.
3. Laying of the cables in a cable duct classified V-0 according to UL94.

### - DIN EN 60204-1 (VDE 0113-1):2007-06

1. The current carrying capacity of the narrowed cables is maintained by the function of the overcurrent protection terminal with integrated protection against overload.
2. The cables with a reduced cross-section are no longer than 3 m.
3. The short-circuit risk is reduced to a minimum by laying cables of the type H07RN-F in a cable duct.

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#### - DIN EN 61439-1 (VDE 0660-600-1):2012-06

1. By laying cables of type H07RN-F, designed for short-circuit-proof and earth-leakage-proof installation, in a cable duct, it is safe to assume that no short-circuit will occur. The cable type H07RN-F conforms to the IEC 60245-4 standard (manufacturer's data), therefore no further requirements apply.
2. The cables with a reduced cross-section are no longer than 3 m.

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