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Planning aspects

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Guideline DC 24 V Systems in Machine Construction and Process Control

- Planning aspects
  - Power supply, load characteristics
  - Protection, wiring
  - Requirements of the Machinery Directive and Low Voltage Directive
  - International standards and approvals
- Professional overcurrent protection and power distribution for DC 24 V systems
- Flexible power distribution for centralised and decentralised control cabinet concepts

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Requirements and planning aspects

Systematics of a DC 24 V system

Tasks and questions of electrical planning

1. Power supply
   - Type, manufacturer, current rating, output characteristics, behaviour in the overload range, price?
   - Utilisation rate of power supply in dynamic range of system?
   - Current reserve for simultaneity factors or system extensions (up to 80% utilisation)?

2. Load characteristics
   - What loads have to be protected?
   - What is the dynamic characteristic of the load current during switch-on or on duty in a group protection of several loads?

3. Overcurrent protection
   - Current rating and trip curve of circuit breaker: fast or delayed?
   - Total current consumption when protecting a group of devices?
   - Selectivity ensured in the event of short circuit/overload? Can the occurring short circuit currents be calculated?
   - Reaction of loads when the DC 24 V control voltage dips?

4. Wiring
   - What cable lengths have to be expected?
   - What are the cable cross sections in the string in questions: Sensor cables 0.25 mm², wiring 1 / 1.5 / 2.5 mm², mixed forms? $I^2t$ value, ampacity?
   - Can the breaker trip due to cable attenuation?
   - Wiring time for all load lines (plus, protected load output, minus, FE) and auxiliary contacts in the control cabinet?

DC 24 V control voltage level

Power supply

Supply voltage DC 24 V
   - DC 24 V control voltage: Switch-mode power supplies (SMPS) widely replace conventional transformer power supplies (TPS). Reasons: Size, weight, efficiency.
   - Output characteristics of the SMPS differ significantly from the TPS curve:
     - TPS: high overload capacity, as power $P = U \times I \sim$ const.
     - SMPS: Overload behaviour depends on manufacturer, type and current rating of the SMPS (5 A / 10 A / 20 A / 40 A): often the output voltage is turned down already at 1.1 ... 1.5 times rated current $\Rightarrow$ self-protection of the SMPS (I/U curve) or switch-off (foldback curve / hiccup mode).
   - What’s the use of a short-time boost function of the output current e.g. 3 times rated current for 20 ms, 6 times rated current for 12 ms?

Power supply

Characteristic curve of the switch-mode power supply

Schematic diagram of switch-mode power supply

Switch-mode power supply controller

Foldback

Hiccup
**DC control voltage level**

Load characteristics

*(switch-on, dynamic processes in operation)*

Electronic system components (PLC, safety technology, industrial computers, user terminals, sensors, drive controls, field bus modules, magnetic valve distributors etc.) have a high input capacity, i.e. high inrush currents. **Reason:** A great number of EMC and buffer capacitors in the DC24V input, number will continue to rise as the EMC standards for voltage dips in DC systems will be adjusted. DC24V motors (including brushless DC motors) and e.g. fans have high inrush currents.

---

**DC control voltage level**

Load characteristics / typical current-voltage curves

- **Drive control**
- **PLC**
- **DC drive**
- **Industrial PC**
- **Safety technology**
- **DC motor**
## Overcurrent protection
### Standards and Approvals

<table>
<thead>
<tr>
<th>Standard</th>
<th>IEC 60947-2 EN 60947-2 DIN EN 60947-2 VDE 0660-101</th>
<th>IEC 60934 EN 60934 DIN EN 60934 VDE 0642</th>
<th>IEC 60898 EN 60898 DIN EN 60898 VDE 0642</th>
<th>UL 489</th>
<th>UL 1077</th>
<th>UL 2367</th>
<th>UL 508 (is partly replaced by UL60947-4-1A)</th>
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<tbody>
<tr>
<td>Type</td>
<td>MCBs</td>
<td>CBEs</td>
<td>MCBs</td>
<td>CBEs</td>
<td>MCBs</td>
<td>CBEs</td>
<td>Electronic overcurrent protection</td>
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<tr>
<td>Application:</td>
<td>MCBs with main contact for connection to circuits up to AC 1000 V and DC 1500 V; is also used for: protection of cables and devices in industrial applications</td>
<td>Low-voltage switchgear and controlgear - Part 2: Circuit-breakers (moulded-case circuit breakers (MCCB))</td>
<td>Circuit breakers for equipment (CBE) for household and similar applications</td>
<td>Circuit breakers for overcurrent protection for household and similar installations (miniature circuit breakers MCB)</td>
<td>Molded-case circuit breakers for branch circuit protection</td>
<td>Supplementary Protection for Use in Electrical Equipment</td>
<td>Solid-state overcurrent protectors for supplementary overcurrent protection for secondary circuits</td>
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<tr>
<td>Application area</td>
<td>up to AC 1000V</td>
<td>up to DC 1500V</td>
<td>up to AC 440 V max. 125A, up to DC 250 V, max. 125A</td>
<td>up to AC 440 V max. 125A, up to DC 220 V, max. 125A</td>
<td>up to AC 600 V up to 220 V plus</td>
<td>up to AC 600 V up to DC 600 V</td>
<td>up to DC 60 V up to 1500 V</td>
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<td>Short circuit current</td>
<td>values which are reached, e.g. Isc = 5 kA</td>
<td>values which are reached, e.g. Isc = 800 A</td>
<td>max. 25kA (AC)</td>
<td>max. 10kA (DC)</td>
<td>5 kA / 10kA</td>
<td>200 A, 1 kA, 2 kA, 3.5 kA, 5 kA</td>
<td>min. 250A</td>
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<td>Dielectric strength</td>
<td>U ≤ 300V: 1.5kV, 5 s</td>
<td>U ≤ 800V: 2.0kV, 5 s</td>
<td>AC250V: 1.5kV / 1 min</td>
<td>AC440V: 2.0kV / 1 min</td>
<td>1 kV + 2 Un, 1 min</td>
<td>1 kV + 2 Un, 1 min</td>
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<td>E-T-A devices comply with the standard</td>
<td>4230-T (E)</td>
<td>4230-T (E)</td>
<td>4220-T (E), 8340, 8345</td>
<td>NO</td>
<td>4220-T (E)</td>
<td>201, 2210 2216-S, 4430-T, 4230-T (E)</td>
<td>ESX10 / ESX10-T / REF16-S</td>
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<td>Comment</td>
<td>Selected tests in accordance with this standard can be conducted. Self-certification.</td>
<td>Circuit breakers for equipment protection, protection of control voltages</td>
<td>not applicable to CBEs</td>
<td>not applicable to CBEs</td>
<td>Circuit breakers for equipment protection, protection of control voltages</td>
<td>Acc. to UL same application as CBEs due to integral current limitation</td>
<td>Typical applications in industrial switchgear acc. to UL same application as CBEs due to integral current limitation</td>
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</table>

### Electro-mechanical circuit breakers
#### thermal-magnetic

**Fast DC curves (A, Z, F1 or B) in the lower tolerance band:** Magnetic short circuit trip at 3 ... 5 x In or 4.5...7.5 x In of CBE

Start-up of electronic system components often not possible as a high inrush current trips the breaker.

**Medium delayed DC curves (C, M1):** trip at 7.5 ... 15 x In

SMPS cannot supply the current required for tripping the breaker, the output voltage is turned down (I/U curve) or disconnected (foldback, hiccup).

**MCBs to IEC / EN 60898**

#### C characteristics

**Thermal-magnetic, C characteristics / AC**

**Thermal:** trips between 1.13 and 1.45 times rated current

**Magnetic:** trips between 5 and 10 times rated current

**Thermal-magnetic, C characteristics / AC**

**Thermal:** as with AC, trips between 1.13 and 1.45 times rated current

**Magnetic:** trips between 7.5 and 15 times rated current
Short circuit in SMPS output
MCBs with C characteristics

The magnetic trip range of the C breaker is no longer in the acceptable overload range of the power supply: The DC 24 V output voltage breaks down.

Graphical calculation
Trip at short circuit SMPS / MCB with C characteristics

Often the power supply cannot provide the trip current required for magnetic tripping and turns down the output voltage.
Overcurrent protection with thermal-magnetic circuit breakers

### Characteristic curves

<table>
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<tr>
<th>Trip curve</th>
<th>Voltage DC factor</th>
<th>Manufacturer</th>
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<th>Rated current IN</th>
<th>T-u</th>
<th>T-o</th>
<th>M-u</th>
<th>M-o</th>
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<td>M1</td>
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</table>

#### Thermal Magnetic Circuit Breakers

- **trip curve standard / EU standard / UL standard / IEC standard**
- **trip level:... times of rated current**
- **magnetic trip level:... times of rated current**
- **thermal trip level:... times of rated current**
- **comparable magnetic (= undelayed) trip curves**

#### Ampacity of cables vs. current rating of protection

The ampacity of the cables has been added as follows:

- **rated cross section:**
  - 0.14 mm² to 0.5 mm² following VDE 0891 T1
  - 0.75 mm² to 150 mm² following VDE 0100 T1

- **Protection is provided by a blade fuse or an MCB**
- **Example:**
  - at 0.34 mm² ⇒ max. IN = 3 A at 30 °C

#### Caution:

This table is only an excerpt from the mentioned standards. Other vital parameters such as heat radiation on cables, laying modes and conditions, insulating materials of the cables as well as other ambient temperatures etc. have to be considered.
Wiring
Length, cross section, resistance

Line impedance defines the max. trip current in DC24V applications

trip current \( I = \frac{U}{R_{total}} \); \( I = 24 \, \text{V}/1.19 \, \text{Ohm}; \)
\( I = 20.17 \, \text{A bei 50 m}, 1.5 \, \text{mm}^2 \)

<table>
<thead>
<tr>
<th>cable cross section A in mm²</th>
<th>0.14;</th>
<th>0.25;</th>
<th>0.34;</th>
<th>0.5;</th>
<th>0.75;</th>
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<th>1.5;</th>
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<tr>
<td>total cable resistance ( R_{total} ) in Ohm</td>
<td>(( R_0 \times 2xL ))/A</td>
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<td>distance L in metres (one-way length)</td>
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<tr>
<td>31.79</td>
<td>17.80</td>
<td>13.09</td>
<td>8.90</td>
<td>5.93</td>
<td>4.45</td>
<td>2.97</td>
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<tr>
<td>38.14</td>
<td>21.36</td>
<td>15.71</td>
<td>10.68</td>
<td>7.12</td>
<td>5.34</td>
<td>3.56</td>
<td></td>
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<tr>
<td>44.50</td>
<td>24.92</td>
<td>18.32</td>
<td>12.46</td>
<td>8.31</td>
<td>6.23</td>
<td>4.15</td>
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<tr>
<td>50.86</td>
<td>28.48</td>
<td>20.94</td>
<td>14.24</td>
<td>9.49</td>
<td>7.12</td>
<td>4.75</td>
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<tr>
<td>57.21</td>
<td>32.04</td>
<td>23.56</td>
<td>16.02</td>
<td>10.68</td>
<td>8.01</td>
<td>5.34</td>
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<tr>
<td>63.57</td>
<td>35.60</td>
<td>26.18</td>
<td>17.80</td>
<td>11.87</td>
<td>8.90</td>
<td>5.93</td>
<td></td>
</tr>
</tbody>
</table>

E-T-A planning tool:
Easy calculation of a DC 24 V system

resistivity copper \( R_0 = 0.0178 \, \text{(Ohm x mm}^2)/\text{m} \)

cable cross section \( A \) in mm²

distance \( L \) in metres (one-way length)

total cable resistance \( R_{total} \) in Ohm = \( (R_0 \times 2xL)/A \)

Power supply

+ Un 24 V

Theoretical max. short circuit current

\( I_{max} = 10.5 \, \text{A} \)

Total load for power supply

\( I_{in} = 10 \, \text{A} \)

Overload 105%

\( I_{in} = 10.5 \, \text{A} \)

Total load for power supply

\( I_{in} = 15.8 \, \text{A} \)

Theoretical max. short circuit current

\( I_{in} = 5.2 \, \text{A} \)

Resistance of cable 1

<table>
<thead>
<tr>
<th>length</th>
<th>2 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>cross section</td>
<td>2.50 mm²</td>
</tr>
<tr>
<td>current rating</td>
<td>20A</td>
</tr>
<tr>
<td>resistance</td>
<td>0.09 Ohm</td>
</tr>
<tr>
<td>earliest magnetic trip at DC 1.05 x ( I_{in} ) 1.1 A</td>
<td></td>
</tr>
</tbody>
</table>

Voltage loss at rated load 1.1% = 0.26 V

Selectivity ensured

Resistance of cable 2

<table>
<thead>
<tr>
<th>length</th>
<th>9 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>cross section</td>
<td>0.50 mm²</td>
</tr>
<tr>
<td>resistance</td>
<td>0.32 Ohm</td>
</tr>
</tbody>
</table>

Resistance of cable 3

<table>
<thead>
<tr>
<th>length</th>
<th>1 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>cross section</td>
<td>0.50 mm²</td>
</tr>
<tr>
<td>resistance</td>
<td>0.04 Ohm</td>
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</table>

Resistance of cable 4

<table>
<thead>
<tr>
<th>length</th>
<th>6 m</th>
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</thead>
<tbody>
<tr>
<td>cross section</td>
<td>0.00 mm²</td>
</tr>
<tr>
<td>resistance</td>
<td>0.00 Ohm</td>
</tr>
</tbody>
</table>

Earliest magnetic trip at DC 1.05 x \( I_{in} \) 1.1 A

Reliable magnetic trip at DC 1.40 x \( I_{in} \) 1.1 A

Voltage loss at rated load 1.1% = 0.26 V

Selectivity ensured

Remaining load

\( I_{in} \) = 5.30 A

Cable cross section OK

Please observe the internationally valid standards and directives regarding ampacity.

Min. cable cross section in protected load path: 2.50 mm²
### Overview of electronic protection DC 24 V

#### Innovative and professional

<table>
<thead>
<tr>
<th>Product</th>
<th>ESS20-00x</th>
<th>ESS31-T</th>
<th>ESX10-TA</th>
<th>ESX10-TB</th>
<th>ESX10-TD</th>
<th>REF16-S1xx</th>
<th>ESS22-T</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technical Data</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated voltage</td>
<td>DC 24 V</td>
<td>DC 24 V</td>
<td>DC 24 V</td>
<td>DC 24 V</td>
<td>DC 24 V</td>
<td>DC 24 V</td>
<td>DC 24 V</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>DC 18...32 V</td>
<td>DC 18...32 V</td>
<td>DC 18...32 V</td>
<td>DC 18...32 V</td>
<td>DC 18...32 V</td>
<td>DC 18...32 V</td>
<td>DC 18...32 V</td>
</tr>
<tr>
<td>Current rating $I_N$</td>
<td>fixed current ratings 0,5A - 10A</td>
<td>fixed current ratings 0,5A - 12A</td>
<td>fixed current ratings 0,5A - 12A</td>
<td>fixed current ratings 0,5A - 16A</td>
<td>adjustable current ratings 0,5A/12A</td>
<td>fixed current ratings 0,5A - 10A</td>
<td>fixed current ratings 0,5A - 10A</td>
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<tr>
<td>Number of ways</td>
<td>1-way</td>
<td>1-way</td>
<td>1-way</td>
<td>1-way</td>
<td>1-way</td>
<td>1-way</td>
<td>1-way</td>
</tr>
<tr>
<td>Manual ON/OFF/reset</td>
<td>push button</td>
<td>push button</td>
<td>Slide switch</td>
<td>Slide switch</td>
<td>Slide switch</td>
<td>Slide switch</td>
<td>Slide switch</td>
</tr>
<tr>
<td>Trip (error)</td>
<td>electronically</td>
<td>electronically</td>
<td>electronically</td>
<td>electronically</td>
<td>electronically</td>
<td>electronically</td>
<td>electronically</td>
</tr>
<tr>
<td>Overload disconnection</td>
<td>typ. 1.1 x $I_N$</td>
<td>typ. 1.2 x $I_N$</td>
<td>typ. 1.1 x $I_N$</td>
<td>typ. 1.1 x $I_N$</td>
<td>typ. 1.1 x $I_N$</td>
<td>typ. 1.2 x $I_N$</td>
<td>typ. 1.1 x $I_N$</td>
</tr>
<tr>
<td>Overload trip time</td>
<td>typ. 3s</td>
<td>typ. 500ms</td>
<td>typ. 3s</td>
<td>typ. 3s</td>
<td>typ. 3s</td>
<td>typ. 130ms - 800ms</td>
<td>typ. 3s</td>
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<tr>
<td>Short circuit current</td>
<td>typ. 1.8 x $I_N$</td>
<td>typ. 1.2 x $I_N$</td>
<td>typ. 1.8 x $I_N$</td>
<td>typ. 1.8 x $I_N$</td>
<td>typ. 1.8 x $I_N$</td>
<td>typ. 1.4 x $I_N$</td>
<td>typ. 1.4 x $I_N$</td>
</tr>
<tr>
<td>Short circuit trip time</td>
<td>typ. 100ms - 3s</td>
<td>typ. 100ms - 3s</td>
<td>typ. 100ms - 3s</td>
<td>typ. 100ms - 3s</td>
<td>typ. 100ms - 3s</td>
<td>typ. 100ms - 3s</td>
<td>typ. 100ms - 3s</td>
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<tr>
<td>Max. switch-on capacity</td>
<td>75,000μF</td>
<td>up to 40,000μF</td>
<td>75,000μF</td>
<td>75,000μF</td>
<td>75,000μF</td>
<td>20,000μF</td>
<td>20,000μF</td>
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<tr>
<td>Signalling</td>
<td>make contact</td>
<td>break contact</td>
<td>make contact</td>
<td>break contact</td>
<td>make contact</td>
<td>break contact</td>
<td>break contact</td>
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<tr>
<td>Signal Input</td>
<td>without</td>
<td>without</td>
<td>remote ON/OFF</td>
<td>remote reset</td>
<td>remote ON/OFF</td>
<td>remote reset</td>
<td>remote ON/OFF</td>
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<tr>
<td>General Data</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Mounting method</td>
<td>plug-in on terminal block 17 plus or SVS for rail mounting</td>
<td>plug-in on terminal block 17 plus or SVS for rail mounting</td>
<td>plug-in on terminal block 17 plus or SVS for rail mounting</td>
<td>rail mounting</td>
<td>rail mounting</td>
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<td>rail mounting</td>
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<tr>
<td>Terminal design</td>
<td>spring-load terminals</td>
<td>spring-load terminals</td>
<td>spring-load terminals</td>
<td>screw terminals</td>
<td>screw terminals</td>
<td>screw terminals</td>
<td>screw terminals</td>
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<tr>
<td>Temperature range</td>
<td>0...+50 °C</td>
<td>0...+50 °C</td>
<td>0...+50 °C</td>
<td>0...+50 °C</td>
<td>0...+50 °C</td>
<td>0...+50 °C</td>
<td>0...+50 °C</td>
</tr>
<tr>
<td>Dimensions (w x h x d) without terminal block</td>
<td>12.5 x 105 x 60 mm</td>
<td>12.5 x 105 x 60 mm</td>
<td>12.5 x 120 x 60 mm</td>
<td>12.5 x 80 x 83 mm</td>
<td>12.5 x 80 x 83 mm</td>
<td>12.5 x 80 x 83 mm</td>
<td>12.1 x 52 x 45 mm</td>
</tr>
</tbody>
</table>
**Electronic circuit breaker**
ESS20 (single pole), plug-in type

**Product characteristics**
- rated voltage DC24V (18 ... 32 V), also battery-buffered
- current ratings:
  - adjustable: 1 A/2 A, 3 A/6 A
  - fixed: 0.5 A, 1 A, 2 A, 3 A, 4 A, 6 A, 8 A, 10 A
- electronic, current limiting trip curve
- with physical isolation in accordance with UL1077 and VDE approval to IEC/EN60934
- capacitive loads up to 75,000,000μF and motors possible
- aux. contact break contact or make contact
- LED status indication
- manual ON/OFF switch
- integral fail-safe element
- for power distribution systems
  - Module 17plus, SVSxx and **Power-D-Box**

**Features and benefits:**
- narrow width of only 12.5mm
- physical isolation
- plug-in type
- a single trip curve for all types of loads
- projectable protection through current limitation
- approval to UL1077 and VDE (IEC/EN60934)

---

**Electronic circuit breaker**
ESS31-T (single pole) for rail mounting

**Product characteristics**
- rated voltage DC24V (18 ... 30 V), also battery-buffered
- fixed current ratings:
  0.5 A, 1 A, 2 A, 3 A, 3.6 A, 4 A, 6 A, 8 A, 10 A, 12 A
- electronic, current limiting trip curve
- with physical isolation in accordance with UL1077 and VDE approval to IEC/EN60934
- capacitive loads up to 40,000μF and motors possible
- aux. contact N/C or N/O
- LED status indication
- manual ON/OFF switch
- integral fail-safe element
- for rail mounting and for mounting side-by-side
- integral power distribution system up to 40A load distribution

**Features and benefits:**
- narrow width of only 12.5 mm
- physical isolation
- a single trip curve for all types of loads
- reliable protection through current limitation
- approval to UL1077 and VDE (IEC/EN60934)

---

**Electronic circuit protector**
ESX10/ESX10-S (1-pole), pluggable

**Product characteristics**
- rated voltage DC24V (18 ... 32 V), also battery-buffered
- current ratings:
  - fixed: 0.5 A, 1 A, 2 A, 3 A, 4 A, 6 A, 8 A, 10 A, 12 A
  - adjustable: 1 A…10 A (ESX10-S...)
- electronic, current limiting trip curve
- approval to UL 2367 as overcurrent protector, UL508 UL 1604 class I div.2, CSA 22.2, GL, ATEX, NEC class 2 (max. 3A)
- capacitive loads up to 75,000 μF and motors possible
- aux. contact, status output SF, remote ON/OFF, remote reset
- LED status indication
- manual ON/OFF and reset switch
- integral fail-safe element
- for power distribution systems
  - Module 17plus, SVSxx and **Power-D-Box**

**Features and benefits:**
- narrow width of only 12.5mm
- plug-in type
- a single trip curve for all types of loads
- projectable protection through current limitation
- approval to UL 2367 as overcurrent protector
  - UL 508, UL 1604 class I div.2, CSA 22.2, GL, ATEX, NEC class 2 (max. 3 A)
Electronic circuit protector
ESX10-T (single pole) for rail mounting

Product characteristics
- rated voltage DC24V (18 ... 32 V), also battery-buffered
- current ratings:
  - fixed values: 0.5 A, 1 A, 2 A, 3 A, 4 A, 6 A, 8 A, 10 A, 12 A, 16 A
  - switchable: 0.5A/1A/2A, 2A/3A/4A, 2A/4A/6A, 6A/8A/10A
- electronic, current limiting trip curve
- capacitive loads up to 75,000 μF and motors possible
- aux. contact, status output SF, remote ON/OFF, remote reset
- LED status indication
- manual ON/OFF and reset switch
- integral fail-safe element
- approval to UL 2367 as overcurrent protector
  cUL 508, UL1604 class I div.2, CSA22.2, GL, ATEX,
  NEC class 2 (max. 3 A)
- for rail mounting and multi-way side-by-side mounting
- integral power distribution system up to 40 A load distribution

Features and benefits:
- narrow width of only 12.5 mm
- adjustable and fixed current ratings
- for rail mounting and mounting side-by-side
- a single trip curve for all types of loads
- projectable protection through current limitation
- approval to UL 2367 as overcurrent protector
  UL 508, UL 1604 class I div.2, CSA 22.2, GL, ATEX,
  NEC class 2 (max. 3 A)

Electronic circuit protector
REF16-S (single pole), plug-in type

Product characteristics
- rated voltage DC 24 V (18 ... 30 V)
- fixed current ratings:
  0.5 A, 1 A, 2 A, 3 A, 4 A, 6 A, 8 A, 10 A
- electronic, current limiting trip curve
- capacitive loads up to 20,000 μF and motors possible
- auxiliary contact, status output SF
  remote ON/OFF (relay function), remote reset
- LED status indication
- manual ON/OFF and reset switch
- integral fail-safe element
- approval to UL 2367 as «Overcurrent Protector», UL 508
- for socket 80PLUS (push-in terminals)
  and 81PLUS (screw terminals)

Features and benefits:
- narrow width of only 12.5mm
- fixed current ratings
- for rail mounting and mounting side-by-side
- a single trip curve for all types of loads
- projectable protection through current limitation
- approval to UL 2367 as overcurrent protector
  UL 508, UL 1604 class I div.2, CSA 22.2, GL, ATEX,
  NEC class 2 (max. 3 A)
Electronic circuit protector
ESS22-T (double pole)

Product characteristics
- Rated voltage DC24V (18 ... 32 V), also battery-buffered
- fixed current ratings:
  - 0.5 A, 1 A, 2 A, 3 A, 4 A, 6 A, 8 A, 10 A
- Electronic, current limiting trip curve
- With physical isolation in accordance with UL1077 and VDE approval to IEC/EN60934
- Capacitive loads up to 20,000 μF and motors possible
- Aux. contact N/O or N/C
- Remote ON/OFF, remote reset
- LED status indication
- Manual ON/OFF switch
- Integral fail-safe element
- For direct rail mounting

Features and benefits:
- Narrow width of only 22.5mm
- 2-pole physical isolation
- For direct rail mounting
- A single trip curve for all types of loads
- Projectable protection through current limitation
- Approval to UL1077 and VDE (IEC/EN60934)
- Meets the requirements of EN 60204-1, para 9.4.3.1 »Double pole protection of ungrounded DC 24 V systems«

Basic trip curve
Electronic overcurrent protection

Example: Electronic circuit breaker ESS20
Electronic current limitation to 1.8 x Iₙ at short circuit or start-up
- Time slot 100 ms... 3 s
  (Loading time for capacitive loads, start-up of DC motors)
- Electronic disconnection at overcurrent

![Diagram of Electronic circuit protector ESS22-T (2-pole)]

Electronic circuit breaker ESS20
Overcurrent protection with electronic circuit breakers

Characteristics of curves

<table>
<thead>
<tr>
<th>Electronic Circuit Breaker / Electronic Overcurrent Protector</th>
<th>overload trip level typically 1.1xIN</th>
<th>current limit at overload or short-circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>trip curve</td>
<td>trip curve comp.</td>
<td>voltage</td>
</tr>
<tr>
<td>EH, E, C, d</td>
<td>nur DC</td>
<td>E-T-A</td>
</tr>
<tr>
<td>E</td>
<td>nur DC</td>
<td>ESX10</td>
</tr>
<tr>
<td>E</td>
<td>nur DC</td>
<td>ESX10-T</td>
</tr>
</tbody>
</table>

Types of Circuit Breakers (electronic)

| trip curve | standard/ | standard/ | standard/ | remark |
| EH (electronic) | EN 60934 | UL 1077 | IEC 60934 | Supplementary Protector CBE (circuit breaker for equipment) |
| E (electronic) | open | UL 2367, UL 508 (UL 1077) | open | Solid-State or Electronic Overcurrent Protector |

- In a range of 1.1...1.8 x I_N the trip time is typically 3 s.
- The electronic current limitation typically begins at 1.8 x I_N. This means: under all overload conditions (dependent of power supply and load circuit resistance) typically 1.8 times rated current is applied until disconnection. The trip time varies between 100 ms and 3 s depending on the multiple of the current rating or at short circuit (I_N).
- Without the current limitation getting into effect at typically 1.8 x I_N there would be a much higher overcurrent in the event of an overload or short circuit.

**Overload disconnection (OL)** typically 1.1 x I_N (1.05...1.35 x I_N)

*1) current limitation typically 1.8 x I_N at I_N = 0.5 A...6 A
 current limitation typically 1.5 x I_N at I_N = 8 A...10 A
 current limitation typically 1.3 x I_N at I_N = 12 A
 current limitation typically 1.15 x I_N at I_N = 16 A

*2) Due to the integral current limitation, the types ESX10 or ESX10-T (just like type ESS20) can be used as "Supplementary Protectors" directly at the DC 24 V output of a circuit breaker for the protection of the cables and loads in the control cabinet.
Characteristic curves
Electronic overcurrent protection

Electronic circuit breaker ESS20
- In a range of 1.1...1.8 x I_N, the trip time is typically 5 s.
- Electronic current limitation typically starts at 1.8 x I_N. This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.8 times rated current is applied until disconnection. The trip time is between 100 ms (short circuit I_K up to approx. 5 s) (in the event of overload with high cable attenuation).
- Without the current limitation getting into effect at typically 1.8 x I_N there would be a much higher overcurrent in the event of an overload or short circuit.
- When the ESS20-0.. has detected an overload or short circuit condition, the LED will change from GREEN to ORANGE. The LED goes out when the circuit breaker has tripped.
- Reset of the circuit breaker is only possible after the integral bimetal has cooled down (approx. 10 s).

*1) current limitation typically 1.8 x I_N at I_N = 0.5 A...6 A
   current limitation typically 1.5 x I_N at I_N = 8 A...10 A

Electronic circuit breaker ESS31-T
- The overload trip time is typically 500 ms (e.g. ESS31-T-...-6 A)
- The electronic current limitation typically begins in at 1.2 x I_N. This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.2 times rated current is applied until disconnection. The corresponding current limitation value ILimit depends on the current rating of the device I_N.
- Without the current limitation getting into effect at typically 1.2 x I_N there would be a much higher overcurrent in the event of an overload or short circuit.
- Reset of the circuit breaker is only possible approximately 10 sec after tripping.

Electronic circuit protector ESX10...
- In a range of 1.1...1.8 x I_N the trip time is typically 3 s.
- The electronic current limitation typically begins in at 1.8 x I_N. This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.8 times rated current is applied until disconnection. The trip time varies between 100 ms and 3 s depending on the multiple of the current rating or at short circuit (I_K).
- Without the current limitation getting into effect at typically 1.8 x I_N there would be a much higher overcurrent in the event of an overload or short circuit.

*1) current limitation typically 1.8 x I_N at I_N = 0.5 A...6 A
   current limitation typically 1.5 x I_N at I_N = 8 A...10 A
   current limitation typically 1.3 x I_N at I_N = 12 A
Characteristic curves
Electronic overcurrent protection

Elektronic circuit protector ESX10-S
- In a range of 1.1...1.8 x I_N the trip time is typically 3 s (e.g. ESX10-TB-...-6A).
- The electronic current limitation typically begins in at 1.8 x I_N. This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.8 times rated current is applied until disconnection. The corresponding current limitation value I_Limit depends on the current rating of the device I_N (see table 1). The trip time varies between 100 ms and 3 s depending on the multiple of the current rating or at short circuit (I_K).
- Without the current limitation getting into effect at typically 1.8 x I_N there would be a much higher overcurrent in the event of an overload or short circuit.

Electronic overcurrent protector REF16-S
- The trip time is typically between 80 ms to 800 ms depending on the current rating (I_N).
- Electronic disconnection and/or current limitation begins at typically 1.25 times I_N. This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.25 times rated current is applied.
- Without the current limitation getting into effect at typically 1.25 x I_N there would be a much higher overcurrent in the event of an overload or short circuit.

Electronic circuit breaker ESS22-T
- In a range of 1.1...1.4 x I_N the trip time is typically 3 s.
- The electronic current limitation typically begins in at 1.4 x I_N. This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.4 times rated current is applied. The trip time varies between 100 ms and 3 s depending on the multiple of the current rating or at short circuit (I_K).
- Without the current limitation getting into effect at typically 1.4 x I_N there would be a much higher overcurrent in the event of an overload or short circuit.
Graphical calculation
Trip at short circuit SMPS / Electronic overcurrent protection

Active current limitation ensures trip at short circuit of the electronic overcurrent protection devices. The switch-mode power supply will not be overloaded and will reliably continue to supply the non-affected paths.

- **Reliable tripping**
  of ESS20, ESX10(-T) and REF16-S

**Different supply lines and cable cross sections**

_**rule of thumb** (*1):** ESS20/ESX10/REF16 rated 3 A can protect cable resistances of 5 Ω

_**rule of thumb** (*2): at 1.5 mm², 50 m distance = 100 m cable length = 1.2 Ω cable attenuation
Electronic overcurrent protection

Benefits

What are the user benefits of E-T-A’s electronic overcurrent protection devices?

We meet the requirements of the updated Machinery Directive 2006/42/EC and EN60204-1 "Safety of machinery and electrical equipment", because:

- The electronic overcurrent protectors provide selective overcurrent protection: The faulty path is disconnected, the remaining components of the control technology (PLC, safety components, sensors, actuators, bus modules etc.) remain unaffected.
- The DC24V control voltage remains stable even in the event of a short circuit or overcurrent.
- Reliable trip at 1.1 x IN is ensured even with small cable cross sections and long load lines.
- Availability of the plant is increased significantly, as trouble shooting and maintenance becomes much easier.
- MCBs often cannot ensure selectivity and cable protection in DC 24 V systems. The overload or short circuit current is always determined by the total circuit resistance $R_{total}$. ($R_{total} = \text{cable resistance} + \text{internal resistance of protective element} + \text{contact resistance of terminals}$)
- Planning a DC 24 V application becomes much easier as the active current limitation to typically 1.8 times rated current provides a reliable planning factor for designing the size of the switch-mode power supply to be used and the size of the cable cross sections.
- In addition the current limitation increases typical life of relay and safety contacts in load circuits.
- The plug-in types (ESX10, REF16-S) allow quick change of the rating.
- In the event of repair works, removing the component establishes physical isolation and the current path is protected against re-connection. The types ESS20 and ESS31-T ensure physical isolation in the event of a failure (by bimetal operation).

Using electronic overcurrent protection is also a considerable contribution to cost reduction of the entire system:

- Switch-mode power supplies can now be used without problems.
- The narrow width of only 12.5 mm including auxiliary contacts allows smaller control cabinets.
- The single way design allows adjustment to the application in question or to the number of required load outputs. There are no extra costs through unused load outputs.
- E-T-A’s electronic overcurrent protection holds a single trip curve for resistive, inductive and capacitive loads. Even DC drives can easily be actuated and protected with these protection devices. The selected current rating has only to be adjusted to the load current and the cable cross sections used. This makes planning much easier and helps to reduce costs for electrical design.
- Besides fixed current ratings, we can also offer switchable devices. They help to realise the entire overcurrent protection design with only one or two types.

The advantages of E-T-A’s electronic overcurrent breakers and protectors at a glance:

- small width
- adjustable and fixed current ratings
- only one trip curve required
- ease of planning
- high system and plant availability
- cost reduction
Electronic overcurrent protection

Overview of standards

- UL 1077 Supplementary Protectors for Use in Electrical Equipment
- UL 2367 Solid State Overcurrent Protectors
- UL 508 Industrial Control Equipment
- UL 1604 Electrical Equipment for Use in Class I and II, Division 2, and Class III Hazardous (Classified) Locations
- UL 489 Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures
- UL 60950-1 Information Technology Equipment - Safety - Part 1 General Requirements
- UL 508A Industrial Control Panels (requirements for control cabinets)

Excerpt from the UL508 approval of the ESX10-T (example):
The UL approval document of type ESX10-T (to UL508), file no. E322549 shows an information on page 2 under "General" that the ESX10-T can even be used as a "Supplementary Protector" due to its integral current limitation. (page 1)

(1) UL Comment

GENERAL:
These devices are single pole electronic over-current switches which limit the overload current to 180 percent of rated current. They are intended to provide supplementary protection within electrical equipment.

<table>
<thead>
<tr>
<th>Approval mark</th>
<th>Type</th>
<th>Approvals / Standards as per 17 March 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESS20</td>
<td>ESS20 Electronic Circuit Breaker</td>
<td>UL 1077: Supplementary Protectors for Use in Electrical Equipment, File E67320</td>
</tr>
<tr>
<td>ESS31-T</td>
<td>ESS31-T Electronic Circuit Breaker</td>
<td>UL 1077: Supplementary Protectors for Use in Electrical Equipment, File E67320</td>
</tr>
<tr>
<td>ESX10-T</td>
<td>ESX10-T Electronic Overcurrent Protector</td>
<td>UL 2367: Solid State Overcurrent Protectors File E306740</td>
</tr>
<tr>
<td>UL 508: Industrial Control Equipment File E322549</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSA C22.2 No. 142 &gt; UL 508</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UL1604: Electrical Equipment for Use in Hazardous Locations Class I div 2, Groups A, B, C, D; TC T5; File E329004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSA C22.2 No. 213 &gt; UL 1604</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UL comment &gt; see (1)</td>
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<tr>
<td>REF16-S</td>
<td>REF16-S Electronic Overcurrent Protector</td>
<td>UL 2367: Solid State Overcurrent Protectors File E306740</td>
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<td>UL 508: Industrial Control Equipment File E322549</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSA C22.2 No. 14 &gt; UL 508</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UL comment &gt; see (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SVS</td>
<td>SVS Power Distribution System ESS20/ESX10</td>
<td>UL 508: Industrial Control Equipment</td>
</tr>
<tr>
<td>UL 508: Industrial Control Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comment: UL approval for SVS under discussion, components (pcb, terminal blocks etc.) UL approved</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Space-saving design, application and wiring
Electronic overcurrent protection

installation width: 18 mm + 9 mm = 27 mm

installations width: 12.5 mm each

-50%!

MCB and signalling module
Flexible power distribution
for centralised and decentralised control cabinet concepts

Standard solutions
Modular power distribution Module 17plus

- modular power distribution system, total current max. 32A/50A
- two-way terminal block
- DC24V supply via busbars
- load output (protected): 1 x per way
- signal supply via left and right terminal blocks
- signalling already pre-wired, external protection required
- for all types ESS20-..., ESX10-1.., 2210-S21.

Standard solutions
Socket 80Plus / 81Plus

- modular sockets, total current max. 32A/41A
- single way design
- PT terminals (80Plus)
- screw terminals (81Plus)
- retaining clips for a tight fit of the breakers
- DC 24 V+ and GND can bridged via jumpers
- load output (protected):
  - 2 x per way (80Plus), 1 x per way 81Plus
- signal supply
- signalling variants via busbars
- for all breakers type REF16-S and 2216-S
## Customer-specific solutions

### Power distribution system SVS

<table>
<thead>
<tr>
<th>Product</th>
<th>Number of slots</th>
<th>Dimensions: d x w x h (without CBE, including rail) tolerance to DIN ISO 269 part 1 IT13</th>
<th>Fitted with</th>
<th>Max. ampacity</th>
<th>Operating voltage</th>
<th>Supply terminals</th>
<th>Load outputs per slot</th>
<th>Minus outputs per load</th>
<th>Signalling</th>
<th>Termination cross-sections</th>
<th>Remote (control input)</th>
<th>Specials to customer</th>
<th>Bus-capable, connection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SVS02-x</strong></td>
<td>4/9/12/16</td>
<td>4 ways 52.1 x 109.5 x 105.4 8 ways 52.1 x 171.5 x 105.4 12 ways 52.1 x 235.5 x 105.4 16 ways 52.1 x 296.5 x 105.4</td>
<td>224 DC (max. 32 V DC)</td>
<td>40 A cont. load b) max. 8 A c) max. 0.5 A</td>
<td>24 V DC</td>
<td>a) +UB b) DC 24 V- c) FE</td>
<td>5 outputs per slot 1 x L+L group output (+) 1 x L-L protected load output 2 x minus 1 x FE</td>
<td>2 x per way</td>
<td>terminal X31 5-pole external supply via insulated wire bridge (SC) external supply +24 V signal output (group signalling) (+) additional output -24 V (FE) additional output FE</td>
<td>group signalling, supply X31, signal-circuit protected on power distribution system</td>
<td>a) screw terminals max. 10 mm² b) 101 plug-in type connector c) ESX10 plug-in type screw terminals max. 2.5 mm² (without wire end ferrules)</td>
<td>n/a</td>
<td>by means of the Tel CBE screen/ST20 sub-assemblies can be protected via group output L+L electronic voltage, L-L load voltage</td>
</tr>
</tbody>
</table>

### SVS04-x

<table>
<thead>
<tr>
<th>Product</th>
<th>Number of slots</th>
<th>Dimensions: d x w x h (without CBE, including rail) tolerance to DIN ISO 269 part 1 IT13</th>
<th>Fitted with</th>
<th>Max. ampacity</th>
<th>Operating voltage</th>
<th>Supply terminals</th>
<th>Load outputs per slot</th>
<th>Minus outputs per load</th>
<th>Signalling</th>
<th>Termination cross-sections</th>
<th>Remote (control input)</th>
<th>Specials to customer</th>
<th>Bus-capable, connection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SVS04-x</strong></td>
<td>4/9/13/16</td>
<td>4 ways 52.1 x 125.5 x 105.4 8 ways 52.1 x 167.5 x 105.4 12 ways 52.1 x 211.5 x 105.4</td>
<td>224 DC (max. 32 V DC)</td>
<td>40 A cont. load b) max. 8 A c) max. 0.5 A</td>
<td>24 V DC</td>
<td>a) +UB b) DC 24 V- c) FE</td>
<td>5 outputs per slot 1 x L+L group output (+) 1 x L-L protected load output 2 x minus 1 x FE</td>
<td>15 x terminals X1-X10-V24 Version X01</td>
<td>terminal X31 5-pole external supply via insulated wire bridge (SC) external supply +24 V signal output (group signalling) (+) additional output -24 V (FE) additional output FE</td>
<td>group signalling, two-group signalling supply X31 aux. circuit protected on distribution rail</td>
<td>a) screw terminals max. 10 mm² b) 101 plug-in type screw terminals or C10 screwless spring-loaded terminals max. 2.5 mm² (without wire end ferrules)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

### SVS14-x

<table>
<thead>
<tr>
<th>Product</th>
<th>Number of slots</th>
<th>Dimensions: d x w x h (without CBE, including rail) tolerance to DIN ISO 269 part 1 IT13</th>
<th>Fitted with</th>
<th>Max. ampacity</th>
<th>Operating voltage</th>
<th>Supply terminals</th>
<th>Load outputs per slot</th>
<th>Minus outputs per load</th>
<th>Signalling</th>
<th>Termination cross-sections</th>
<th>Remote (control input)</th>
<th>Specials to customer</th>
<th>Bus-capable, connection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SVS14-x</strong></td>
<td>4/9/13/16</td>
<td>10 ways 64.5 x 104 x 184 vertical mounting position</td>
<td>224 DC (max. 32 V DC)</td>
<td>25 A max. b) max. 8 A c) max. 0.5 A</td>
<td>24 V DC</td>
<td>a) +UB b) DC 24 V- c) FE</td>
<td>2 outputs per slot 2 x minus 1 x per way</td>
<td>1 x per way</td>
<td>terminal X31 2-pole (S1) external supply 24 V DC (+) signal output</td>
<td>group signalling, supply X31, signal-circuit protected on power distribution system</td>
<td>a) screw terminals marked max. 16 mm² b) 2-pole double-level terminal with screw terminals max. 4 mm² marked</td>
<td>n/a</td>
<td>Caution: Provide external protection for signalling (0.5 A/Relay) integral ammeter</td>
</tr>
</tbody>
</table>
### SVS16

<table>
<thead>
<tr>
<th>Product</th>
<th>Number of slots</th>
<th>Dimensions: d x w x h (without CBE, including rail) tolerance to DIN ISO 266 part 1 IT13</th>
<th>Fitted with</th>
<th>Max. Amperity</th>
<th>Total Current</th>
<th>Operating Voltage</th>
<th>Supply Terminals</th>
<th>Load Outputs</th>
<th>Minus Outputs</th>
<th>Signalling</th>
<th>Termination Cross-sections</th>
<th>Remote</th>
<th>Specials</th>
<th>Bus-capable, Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/8/12/16</td>
<td>8 ways</td>
<td>56.5 x 284 x 127.8</td>
<td>4/8/10-1x5</td>
<td>Max. 40 A</td>
<td>Max. 8 A</td>
<td>24 V DC</td>
<td>+/+/+/+/fuse</td>
<td>2 x slot</td>
<td>1 x per slot</td>
<td>X31.3</td>
<td>Supply bus module</td>
<td>140</td>
<td>n/a</td>
<td>PROFIBUS</td>
</tr>
<tr>
<td></td>
<td>16 ways</td>
<td>56.5 x 284 x 127.8</td>
<td>4/8/10-1x5</td>
<td>Max. 40 A</td>
<td>Max. 8 A</td>
<td>24 V DC</td>
<td>+/+/+/+/fuse</td>
<td>2 x slot</td>
<td>1 x per slot</td>
<td>X31.3</td>
<td>Supply bus module</td>
<td>140</td>
<td>n/a</td>
<td>PROFIBUS</td>
</tr>
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</table>

### SVS18

<table>
<thead>
<tr>
<th>Product</th>
<th>Number of slots</th>
<th>Dimensions: d x w x h (without CBE, including rail) tolerance to DIN ISO 266 part 1 IT13</th>
<th>Fitted with</th>
<th>Max. Amperity</th>
<th>Total Current</th>
<th>Operating Voltage</th>
<th>Supply Terminals</th>
<th>Load Outputs</th>
<th>Minus Outputs</th>
<th>Signalling</th>
<th>Termination Cross-sections</th>
<th>Remote</th>
<th>Specials</th>
<th>Bus-capable, Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>10 ways</td>
<td>50 x 185 x 142.3</td>
<td>ESX10-103</td>
<td>Max. 6 A</td>
<td>Max. 6 A</td>
<td>24 V DC</td>
<td>+/+/+/+/fuse</td>
<td>4 x slot</td>
<td>2 x per slot</td>
<td>X31.3</td>
<td>Total current of 13 A</td>
<td>140</td>
<td>n/a</td>
<td>PROFIBUS</td>
</tr>
</tbody>
</table>

### SVS20

<table>
<thead>
<tr>
<th>Product</th>
<th>Number of slots</th>
<th>Dimensions: d x w x h (without CBE, including rail) tolerance to DIN ISO 266 part 1 IT13</th>
<th>Fitted with</th>
<th>Max. Amperity</th>
<th>Total Current</th>
<th>Operating Voltage</th>
<th>Supply Terminals</th>
<th>Load Outputs</th>
<th>Minus Outputs</th>
<th>Signalling</th>
<th>Termination Cross-sections</th>
<th>Remote</th>
<th>Specials</th>
<th>Bus-capable, Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>8 ways</td>
<td>56.4 x 210 x 142.3</td>
<td>ESX20-003</td>
<td>Max. 40 A</td>
<td>Max. 8 A</td>
<td>24 V DC</td>
<td>+/+/+/+/fuse</td>
<td>10 x slot</td>
<td>5 x per way</td>
<td>X31.4</td>
<td>Signal output</td>
<td>140</td>
<td>n/a</td>
<td>PROFIBUS</td>
</tr>
</tbody>
</table>
ControlPlex® Board
Intelligent power distribution system SVS100

Intelligent DC 24 V Power Distribution System

Fieldbus versions
- PROFIBUS-DP
- Modbus-RTU
- DeviceNet
- CC-Link
- CANopen
- Interbus
- ...

Ethernet versions
- Profinet
- EtherNet/IP
- EtherCAT
- Modbus-TCP
- ...

ControlPlex®
Intelligent power distribution system SVS100

ControlPlex® consists of SVS100-PWR and SVS100-COM
- Power distribution backplane for 16 ways (or 8 ways)
- Supply +24 V, 0 V, PE 2 x 10 mm² each, max. 40 A
- All terminals: spring-loaded terminals or push-in
- To be used in decentralised IP67 systems and at the same time as IP20 solution
- Voltage supply for all ways F1 to F16 and of the loads is effected directly from the DC24V supply. The supply for the electronic control unit (COM module) can also be fed separately
- Protection for SVS100-COM is already integrated
- Additional integral total current measurement on the SVS100 (max. 50A)
- Complete wiring of US1, US2, 0 V, 0 V, PE per slot
- Joint US1 supply (SVS100-16-PWR)
  A) 1 x US1 via F1 (7 x US2 output to F2, F3, …, F8)
  B) 1 x US1 via F9 (7 x US2 output to F10, F11, …, F16)
- Extendable to 64 ways by way of cascading of the power distribution systems
ControlPlex® Board
Intelligent power distribution system SVS100

ControlPlex® for electronic circuit protectors type ESX50D-S, plug-in types for F1 to F16, parameterisable current rating 1…10 A, per software with internal communication interface (right unit)

ESX50D version: “OFFLINE” rating adjustment directly on the unit via selector switch 1 A … 10 A (left unit)

Features of type ESX50D-S
● A single trip curve for all types of loads (capacitive load up to 40,000μF, DC motors etc.)
● Adjustable alarm values for the load current, e.g. 90% (50% ... 100%)
● Indication of input voltage, load current, load voltage, limit values, unit temperature
● Status indication system voltage (“DC24V OK”)
● Status indication per way (overload/short circuit)
● Adjustment of switch-on delay/disconnection sequences per software (e.g. for PROFlenergy)
● QUIT/RESET and ON and OFF operation per way possible (e.g. for PROFlenergy)
● Additional manual reset on the device possible
● Multicoloured LED, to be switched off ONLINE & OFFLINE, “Sleep Mode” (e.g. PROFlenergy)

● History memory (“HISTOMEMO”), event-triggered recording of measuring values

ControlPlex® Software and user dialogue platform
● Clear lay-out “At a glance: Everything hunky-dory”.
● Parameterisable via USB or directly via communication interface e.g. current rating 1 A to 10 A in 1 A steps, limit values, switch-on sequences ...

Optional: current rating adjustable directly on the unit
● All adjustments can be saved (internally or externally), documentation serves as a test record of machine/system. All future changes or replacements will be recorded.
● Ease of start-off without manual, only “Windows” and “Mouse” knowledge required.
● Start-up configuration is saved for machine approval, system documentation etc.
● Overcurrent parameters are not accessible to the user. The only electronic trip curve for all DC 24 V load types makes electrical planning easy!
Customer-specific solutions from Power-D-Box® to control cabinet

Standard 19" box
PDB-P-L-ESS20-30A0-B1
● for the electronic circuit breaker ESS20

Special version 19" box S438 with de-coupling diodes
19BGT-3-ESS20-30R2RB-B1GR-LS438
● for the electronic circuit breaker ESS20
Customer-specific solutions
from Power-D-Box® to control cabinet

Control cabinet SBG T018
- Economic and space-saving control cabinet design
- Saves up to 50% of costs through use of cascadable power
distribution systems for DC24V with slots for electronic circuit
breakers

New possibilities provided by additional electronic sub-assemblies:
- Intelligent alarm processing
- Remote control
- Bus connection
- Emergency functions
- Redundancy

control cabinet SBG T018

power supplies, diode de-coupling and protection

load distribution modules

de-coupling module
Customer-specific solutions from Power-D-Box® to control cabinet

Demo control cabinet T029

Redundant power supply with diode de-coupling

Power Distribution Module (PDM) for ESS20, 2216 and REF16

Power distribution systems SVS for ESX10-S and ESS20

High current distribution by means of X8345-D01 and hydraulic-magnetic Circuit Breaker Type 8345
**Customer-specific solutions**
from **Power-D-Box®** to control cabinet

AC power distribution system **SBG-V0071** for 10 load circuits protected with thermal-magnetic Circuit breaker **2216** and main switch (back-up fuse) through 2-pole, hydraulic-magnetic circuit breaker **8340-F**.

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**front view**

**top view**

**side view**

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**printed circuit board**

- line entry 16 mm² spring-loaded terminals max. 30 A
- auxiliary contacts 2.5 mm² spring-loaded terminals
- load terminals 2.5 mm² spring-loaded terminals max. 10 A
- LED green
Customer-specific solutions from Power-D-Box® to control cabinet

Power supply and protection module SBG-V0057 with SMPS 20A and for eight load circuits, protected by electronic circuit protector type REF16 for installation in control cabinets, compatible with servo outputs for motor drives.
Customer-specific solutions from Power-D-Box® to control cabinet

Power Distribution Module (PDM) and Power Distribution Box (PDB) for thermal-magnetic circuit breaker type 2216 and electronic circuit protector type REF16-S

- Redundant (2 x 15 ways) or non-redundant (1 x 30 ways)
- Mounting on rear wall in control cabinet (PDM) or in 19" rack (PDB)
- Spring-loaded terminals on the rear or front
- Line entry up to 2 x 80A
- Group signalling
- Voltage monitoring optional
E-T-A
A globe-spanning network

Europe
- Belgium
- Bosnia/Herzegovina
- Bulgaria
- Denmark
- Germany
- Finland
- France
- Ireland
- Italy
- Croatia
- Luxemburg
- Macedonia
- Montenegro
- Netherlands
- Norway
- Austria
- Poland
- Portugal
- Russia
- Sweden
- Switzerland
- Serbia
- Slovakia
- Slovenia
- Spain
- Czech Republic
- Turkey
- Hungary
- United Kingdom

America
- Argentina
- Brazil
- Chile
- Canada
- Mexico
- USA

Asia
- Brunei
- China
- Hong Kong
- India
- Indonesia
- Japan
- Korea
- Malaysia
- Philippines
- Singapore
- Taiwan
- Thailand

Africa
- South Africa
- Tunisia

Oceania
- Australia
- New Zealand