Electronic Circuit Breaker ESS20-0..

Description

Electronic circuit breaker type ESS20-0.. is designed to ensure selective disconnection of individual loads in systems which are powered by a DC 24 V switch-mode power supply.

DC 24 V power supplies, which are widely used in industry today, will shut down the output in the event of an overload with the result that one faulty load in the system can lead to complete disconnection of all loads. As well as an unidentified failure this also means stoppage of the whole system.

Through selective disconnection the ESS20-0.. responds much faster to overload or short circuit conditions than the switch-mode power supply. This is achieved by a combination of active current limitation and well-proven circuit breaker technology including physical isolation. The ESS20-0.. limits the highest possible current to 1.8 or 1.5 times the selected rated current of the circuit breaker. Thus it is possible to switch on capacitive loads of up to 20,000 μF lamp loads, but they are disconnected only in the event of an overload or short circuit.

For optimal adjustment to the application conditions the current rating of the ESS20-0.. can be selected in fixed values from 0.5 A..10 A and in adjustable variants 1 A/2 A or 3 A/6 A. Failure and status indication are provided by a bicolour LED and an integral signal contact.

The ESS20-0.. features a width of only 12.5 mm and can be plugged into the E-T-A power distribution socket Module 17plus and SVS02/SVS04 (for ESS20-003) ensuring ease of installation and saving space in control cabinets.

Features

- Selective load protection with physical isolation in the event of a fault.
- All types of loads can be connected (small DC motors etc. on request).
- Active current limitation (1.8 or 1.5 times rated current $I_N = 8$ A or 10 A) for safe connection of capacitive loads up to 20,000 μF and on overload/short circuit.
- Electronic trip characteristic.
- Reliable overload disconnection with $1.1 \times I_N$ plus, even with long load lines or small cable cross sections (see table 2).
- Selectable current ratings (fixed values 0.5 A..10 A or two steps: 1 A/2 A or 3 A/6 A).
- Manual ON/OFF button (push-push actuation).
- Clear status and failure indication.
- Width per unit only 12.5 mm.
- Plug-in mounting utilising power distribution system Module 17plus or SVS02/SVS04 (for ESS20-003), see product group 7.

Approvals

<table>
<thead>
<tr>
<th>Authority</th>
<th>Voltage rating</th>
<th>Current ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL 1077</td>
<td>DC 24 V</td>
<td>0.5...10 A</td>
</tr>
</tbody>
</table>

Technical data ($T_{ambient} = 25 \, ^\circ C$, operating voltage $U_B = DC 24 \, V$)

Operating data

Operating voltage $U_B = DC 24 \, V\, (18...32 \, V)$

Current rating $I_N$

- fixed current ratings: 0.5 A, 1 A, 2 A, 3 A, 4 A, 6 A, 8 A, 10 A
- switchable: 1 A/2 A or 3 A/6 A

Power consumption typically 13 mA.

Trip current (bimetal) typically 0.3 A

Status indication

- bicolour LED:
  - GREEN: unit is ON, power-MOSFET is switched on
  - ORANGE: in the event of overload or short circuit until physical isolation
  - LED not lighted: push button in OFF position

Load circuit

- Power-MOSFET switching output (high side switch)

Max. data of load with side-by-side mounting see table 1

Voltage drop at $I_N$ see table 1

Overload disconnection typically 1.1 $I_N$ (1.05...1.35 $I_N$)

Short-circuit current $I_K$ typically 1.8 $I_N$ / active current limitation

Trip time see time/current characteristics

for physical isolation typically 5 sec at $I_{load} > 1.1 \times I_N$

for electronic disconnection typically 5 sec...100 ms at $I_{load} > 1.8 \times I_N$ or 1.5 $I_N$

Temperature disconnection internal temperature monitoring with physical isolation

Low voltage monitoring

- load output ON at $U_B > 16 \, V$
- OFF at $U_B < 8 \, V$

Starting delay $t_{start}$ typically 0.3 sec after every switch-on and after applying $U_B$

Disconnection of load circuit

- single pole (switch contact)
  - by push-push actuation of the blue push button
  - upon electronic fault disconnection (overload, short circuit)
  - with reverse polarity

Free-wheeling circuit external free-wheeling diode recommended with inductive load

Attention: the user has to make sure that the cable cross sections of the relevant load circuit are suitable for the current rating of the ESS20 used.
Technical data (T_{ambient} = 25 °C, operating voltage U_{op} = DC 24 V)

Fault indication, signal output

Fault indications potential-free auxiliary contact change-over (SC-SO / SC-SI) simultaneously with physical isolation

Signal output ESS20-001 (single signalisation N/O)
- blue push button in ON position: signal contact SC-SI is closed
- blue push button in OFF position: signal contact SC-SO is open

Signal output ESS20-003 (group signalisation N/C)
- blue push button in ON position: signal contact SC-SC is closed (SC-SI is open)
- blue push button in OFF position: signal contact SC-SC is open (SC-SI is closed)

Visual indication LED lighted in ORANGE (until physical isolation)

General data

Backup fuse for ESS20-0.. not required because of the integral redundant fail-safe element (thermal E-T-A circuit breaker)

Blade terminals 6.3 mm to DIN 46244-A6.3-0.8

Housing material plastics material

Mounting of housing plug-in mounting utilising power distribution system Module 17plus or SVS02

Ambient temperature 0...+50 °C (without condensation, see EN60204-1)

Storage temperature -20...+70 °C

Humidity 96 hrs/95 % RH/40 °C to IEC 60068-2-78-Cab climate class 3K3 to EN 60721

Vibration 3 g, test to IEC 68-2-6 test Fc

Degree of protection housing: IP30 DIN 40050
- terminals: IP00 DIN 40050

EMC (EMC directive, CE logo)
- emission: EN 50081-1
- susceptibility: EN 61000-6-2

Insulation co-ordination (IEC 60934)
- 0.5 kV/2 pollution degree 2
- re-inforced insulation in operating area

Dielectric strength
- operating area (see dimensions)
- test voltage AC 1000 V

Installation area test voltage AC 500 V

Insulation resistance (OFF condition) > 100 MΩ (DC 500 V)
- [LINE (+) – LOAD (+)]

Approvals UL 1077, File E67320
- Supplementary Protectors for use in Electrical Equipment
- CE logo

Dimensions (W x H x D) 12.5 x 105 x 60 mm

Mass approx. 65 g

Table 1: voltage drop, current limitation, max. load current

<table>
<thead>
<tr>
<th>Current rating</th>
<th>Typically voltage drop U_{op} at I_{op}</th>
<th>Active current limitation (typically)</th>
<th>Max. load current at 100 % ON duty T_{op} = 40 °C</th>
<th>T_{op} = 55 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 A</td>
<td>100 mV</td>
<td>1.8 x I_{op}</td>
<td>0.5 A</td>
<td>0.5 A</td>
</tr>
<tr>
<td>1 A</td>
<td>140 mV</td>
<td>1.8 x I_{op}</td>
<td>1 A</td>
<td>1 A</td>
</tr>
<tr>
<td>2 A</td>
<td>180 mV</td>
<td>1.8 x I_{op}</td>
<td>2 A</td>
<td>2 A</td>
</tr>
<tr>
<td>3 A</td>
<td>140 mV</td>
<td>1.8 x I_{op}</td>
<td>3 A</td>
<td>3 A</td>
</tr>
<tr>
<td>4 A</td>
<td>190 mV</td>
<td>1.8 x I_{op}</td>
<td>4 A</td>
<td>4 A</td>
</tr>
<tr>
<td>6 A</td>
<td>280 mV</td>
<td>1.8 x I_{op}</td>
<td>6 A</td>
<td>5 A</td>
</tr>
<tr>
<td>8 A</td>
<td>220 mV</td>
<td>1.5 x I_{op}</td>
<td>8 A</td>
<td>7 A</td>
</tr>
<tr>
<td>10 A</td>
<td>280 mV</td>
<td>1.5 x I_{op}</td>
<td>10 A</td>
<td>9 A</td>
</tr>
<tr>
<td>1 A/2 A</td>
<td>140 mV/280 mV</td>
<td>1.8 x I_{op}</td>
<td>1 A/2 A</td>
<td>1 A/2 A</td>
</tr>
<tr>
<td>3 A/6 A</td>
<td>140 mV/280 mV</td>
<td>1.8 x I_{op}</td>
<td>3 A/6 A</td>
<td>3 A/6 A</td>
</tr>
</tbody>
</table>

Attention: when mounted side-by-side without convection the ESS20-0.. should not carry more than 80 % of its rated load with 100 % ON duty because of the integral thermal circuit breaker.

Ordering information

Type No.
ESS20 Electronic Circuit Breaker with current limitation (e.g. typically 1.8 times rated current or 1.5 x I_{op}, see table 1)

Version

Control input
- 0 without control input
  - Signal output
    - 1 signal contact N/O (single signalisation)
    - 2 signal contact N/C (single signalisation)
    - 3 signal contact changeover (group signalisation)

Operating voltage
- DC 24 V
  - rated voltage DC 24 V
    - Current rating
      - 0.5 A
      - 1 A
      - 2 A
      - 3 A
      - 4 A
      - 6 A
      - 8 A
      - 10 A
      - 1 A/2 A (selectable)
      - 3 A/6 A (selectable)

Attention: the user has to make sure that the cable cross sections of the relevant load circuit are suitable for the current rating of the ESS20 used.

Dimensions

This is a metric design and millimeter dimensions take precedence (mm) over inch ("").

Table: Voltage Drop, Current Limitation, Max. Load Current
### Terminal wiring diagrams (e.g. adjustable 3 A / 6 A)

**ESS20-001-...**

**ESS20-002-...**

**ESS20-003-...**

### Basic circuit diagrams (e.g. adjustable 3 A / 6 A)

**ESS20-001-... (single signalisation N/O)**

**ESS20-002-... (single signalisation N/C)**

**ESS20-003-... (group signalisation with change over)**
Electronic Circuit Breaker ESS20-0..

Time/Current characteristic curve \((T_A = 25 \, ^\circ C)\)

*\(^1)\) current limitation typically 1.8 \(x I_N\) times rated current at 
  \(I_N = 0.5 \, A...6 \, A\) 
  current limitation typically 1.5 \(x I_N\) times rated current at 
  \(I_N = 8 \, A...10 \, A\)

- The trip time is typically 5 s in the range between 1.1 and 1.8 \(x I_N\)
- Electronic current limitation starts at typically 1.8 \(x I_N\) which means that under all overload conditions (independent of the power supply and the resistance of the load circuit) the max. overload until disconnection will not exceed 1.8 \(x I_N\) times the current rating. Trip time is between 100 ms (short circuit current \(I_W\)) and 5 sec (at overload with high line attenuation).
- Without the current limitation activated at typically 1.8 \(x I_N\) a considerably higher overload current would flow in the event of an overload or short circuit.
- After detection of an overload or short circuit the LED changes colour from GREEN to ORANGE. The LED will no longer be lighted after the circuit breaker has tripped.
- Resetting the circuit breaker is not possible before the integral bimetal has cooled down (approx. 10 sec).

### Table 2: Reliable trip of ESS20

<table>
<thead>
<tr>
<th>Cable cross section (A) in (mm^2)</th>
<th>0.14</th>
<th>0.25</th>
<th>0.34</th>
<th>0.5</th>
<th>0.75</th>
<th>1</th>
<th>1.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>cable length (L) in meter (= single length)</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>cable resistance in Ohm = ((R_0 \times 2 \times L) / A)</td>
<td>1.27</td>
<td>2.54</td>
<td>3.81</td>
<td>5.09</td>
<td>6.36</td>
<td>7.63</td>
<td>8.90</td>
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<td></td>
<td></td>
<td></td>
<td>25.00</td>
</tr>
</tbody>
</table>

**Example 1:** max. length at 1.5 \(mm^2\) and 3 A 214 m

**Example 2:** max. wiring: R1 = 40 m in 1.5 \(mm^2\) and R2 = 5 m in 0.25 \(mm^2\), (Control cabinet – sensor/actuator level) R1 = 0.95 Ohm, R2 = 0.71 Ohm

**Example 3:** mixed wiring: R1 = 40 m in 1.5 \(mm^2\) and R2 = 5 m in 0.25 \(mm^2\): Total \((R1 + R2) = 1.66 \, Ohm\)

**Example:** max. length at 1.5 mm² and 6 A 106 m
Module 17plus is a power distribution system for use with electronic circuit breaker ESS20-0.. Each module accommodates two breakers with an individual housing width of only 12.5 mm and fits onto all industry standard mounting rails. The two-way modules can be interconnected to provide as many ways as required with a terminal block fitted at each end for connection of signalling circuits. A distribution busbar can be fitted on the supply side of the modules (positive pole) though each pole of multipole circuit breakers must be individually connected. Electrical connections are by means of spring-loaded terminals. The reference potential for the ESS20-0.. (Gnd pin 11) is also looped through and connected to the terminals at the sides. The integral make contact of the ESS20-001 (SC-SI) can be tapped at terminal 12 of the relevant channel (individual signalisation). The integral make contact of the ESS20-002 (SC-SI) can be tapped at terminal 12 of the relevant channel (individual signalisation). The ESS20-003 has an integral signal contact (change-over contact). The contact SC-SO is used for group fault signalisation. For this purpose the contacts for signalisation are connected in series in the Module 17plus and are connected to the terminal blocks via two terminals (13,14). It is possible with a test probe to contact the series connection in each module and detect possible interruptions. All internal wirings for the ground potential and the group signal are established by the modular mounting of the individual Modules 17plus.

Technical data

<table>
<thead>
<tr>
<th>Connection</th>
<th>Spring-loaded terminals for solid conductors and stranded cables with and without wire end ferrules. Please use appropriate screw driver size (SD) for removing the spring loaded terminals.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINE feed (1)</td>
<td>0.5-6 mm² (AWG 10), SD 2 (0.8x4.0) spring-loaded terminals for 0.25-4 mm² (AWG 12), SD 1 (0.6x3.5)</td>
</tr>
<tr>
<td>LOAD output (2)</td>
<td></td>
</tr>
<tr>
<td>Reference potential Gnd/group signal terminals (11 or 13, 14):</td>
<td>spring-loaded terminals for 0.25-2.5 mm² (AWG 14), SD 1 (0.6x3.5)</td>
</tr>
<tr>
<td>Individual signal terminal (12)</td>
<td>spring-loaded terminal for 0.25-1.5 mm² (AWG 16), SD 0 (0.4x2.5)</td>
</tr>
</tbody>
</table>

Test probe for testing the group signal for line interruption: ≤ 2 mm ø

Voltage rating

<table>
<thead>
<tr>
<th>(without ESS20-0..):</th>
<th>AC 433 V; DC 65 V</th>
</tr>
</thead>
</table>

Current rating

<table>
<thead>
<tr>
<th>(without ESS20-0..):</th>
<th>LINE feed (1) 50 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOAD output (2)</td>
<td>25 A</td>
</tr>
<tr>
<td>Reference potential Gnd (11)</td>
<td>10 A</td>
</tr>
<tr>
<td>Individual signal (12)</td>
<td>1 A (with ESS20-0..: 0.5 A)</td>
</tr>
<tr>
<td>Group signal (13-14)</td>
<td>1 A (with ESS20-0..: 0.5 A)</td>
</tr>
</tbody>
</table>

Internal resistance values

<table>
<thead>
<tr>
<th>(without ESS20-0..):</th>
<th>LINE-LOAD (1-2) ≤ 5 mΩ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group signal (13-14) per module</td>
<td>≤ 8 mΩ per pole + 5 mΩ for each additional module</td>
</tr>
</tbody>
</table>

Busbar for power distribution

<table>
<thead>
<tr>
<th>insulated busbar (blue or red):</th>
<th>( I_{\text{max}} ) 32 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>non-insulated busbar:</td>
<td>( I_{\text{max}} ) 50 A</td>
</tr>
</tbody>
</table>

(The non-insulated busbar, too, meets brush contact safety standards when fitted.)

Dielectric strength of Module 17plus (without ESS20-0..)

| between main circuits (without busbar): | 1,500 V |
| main circuit to auxiliary circuit:     | 1,500 V |
| between auxiliary circuits:            | 1,500 V |

Mass:

| Module 17plus (centre piece) | approx. 85 g |
| terminal blocks (pair)       | approx. 30 g |

Ordering information

<table>
<thead>
<tr>
<th>17PLUS-Q02-00</th>
<th>Module 17plus, centre piece, two-way</th>
</tr>
</thead>
<tbody>
<tr>
<td>17PLUS-QA0-LR</td>
<td>one each left- and right-side terminal block for supply feed from the side by means of screw terminal, connection of signalisation etc.</td>
</tr>
</tbody>
</table>

Pin configuration, fitted with ESS20-0..

<table>
<thead>
<tr>
<th>ESS20-0.. Module 17 plus</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINE (+)</td>
</tr>
<tr>
<td>Gnd (11)</td>
</tr>
<tr>
<td>SC (13)</td>
</tr>
<tr>
<td>S0 (14)</td>
</tr>
<tr>
<td>SI (12)</td>
</tr>
<tr>
<td>LOAD (+)</td>
</tr>
</tbody>
</table>

Pin configuration, fitted with ESS20-0..
Dimensions

- C-profile EN 50035-G32
- Symmetrical rail EN 50022-35x7.5

Installation example

3. Snap on right-side and left-side terminal blocks.
4. Cut busbar to required length and fit on supply side of the modules.
5. Connect line feed with spring-loaded terminals.
6. Plug in ESS20-0..

Connection diagram for ESS20-001

1. Gnd
2. LINE
3. LOAD
4. Jumper

Connection diagram for ESS20-003

1. Gnd
2. LINE
3. LOAD
4. Jumper

Installation:

- Clip modules onto DIN rails.
- Push modules together (side-by-side).
- Snap on right-side and left-side terminal blocks.
- Cut busbar to required length and fit on supply side of the modules.
- Connect line feed with spring-loaded terminals.
- Plug in ESS20-0..

This is a metric design and millimeter dimensions take precedence (mm / inch).
### Accessories

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Code</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Busbar 32 A</strong></td>
<td>blue insulation, 500 mm/19.68 in.</td>
<td>X 222 005 01</td>
<td></td>
</tr>
<tr>
<td><strong>Busbar 50 A</strong></td>
<td>non-insulated, 500 mm/19.68 in.</td>
<td>Y 307 016 01</td>
<td></td>
</tr>
<tr>
<td><strong>Busbar 50 A</strong></td>
<td>non-insulated, 500 mm/19.68 in.</td>
<td>Y 307 016 11</td>
<td></td>
</tr>
<tr>
<td><strong>End bracket</strong></td>
<td></td>
<td>X 222 004 01</td>
<td></td>
</tr>
<tr>
<td><strong>Screw terminal for busbar</strong></td>
<td>non insulated</td>
<td>X 211 156 01</td>
<td></td>
</tr>
<tr>
<td><strong>Jumper</strong></td>
<td></td>
<td>X 222 066 01</td>
<td></td>
</tr>
</tbody>
</table>

### Accessories for ESS20-0..

**Retaining clip Y 307 754 01**

- Length: 18.5 mm
- Width: 1.17 mm
- Height: 4.5 mm
- Thickness: 0.79 mm

### Mounting of retaining clip

ESS20 with retaining clip Y 307 754 01 for power distribution system module 17plus

- ESS20 with retaining clip Y 307 754 01

### Removal of retaining clip Y 307 754 01

- Removal of retaining clip Y 307 754 01

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This is a metric design and millimeter dimensions take precedence (mm) over inch (in).
ESS20-0.. - Accessories for ESS20-0..

Single mounting sockets
(up to 16 A max. load)
17-P10-Si
17-P70-Si

2-way mounting socket
23-P10-Si
63-P10-Si
(retaining clip Y 300 581 03 available on request)

Bus bar (10-way) (supplied as a complete package)
for type 17 socket
(for max. 100 A continuous load),
more positions available on request
X 211 157 01 with terminal
X 211 157 02 without terminal

Connector bus links - P10
X 210 588 02/ 2.5 mm², (AWG 14), black (up to 20 A max. load)
X 210 588 03/ 2.5 mm², (AWG 14), red (up to 20 A max. load)
X 210 588 04/ 2.5 mm², (AWG 14), blue (up to 20 A max. load)

Insulating sleeving for bus bar (10-way)
Y 303 824 01

This is a metric design and millimeter dimensions take precedence.

All dimensions without tolerances are for reference only. In the interest of improved design, performance and cost effectiveness the right to make changes in these specifications without notice is reserved. Product markings may not be exactly as the ordering codes. Errors and omissions excepted.