

## Description

E-T-A's ESS31-T electronic circuit breaker is only 12.5mm wide and selectively protects all DC 24 V load circuits, thereby increasing the uptime of machines and systems. This is achieved by a combination of active electronic current limitation in the event of a short circuit and overload disconnection at typically 1.2 times rated current. The ESS31-T responds faster than frequently used DC 24 V switch mode power supplies without tripping fast and thus prevents disastrous voltage dips of the supply. The ESS31-T is track-mountable and provides ease of installation for groups of devices with several circuits.

It works with a single trip curve for all loads. Even capacitive loads up to 40,000 µF can be handled very easily. Fixed current ratings from 0.5 A to 12 A are available. The integral fail-safe element (fuse) is adjusted to the circuit breaker's rated current and can thus very easily be synchronised with the wired cable cross section. This makes planning much easier.

Due to the approval to UL1077 "Supplementary Protector" and the UL Listed approval to UL60947/UL508, these circuit breakers can also be used in applications to UL 508A "Industrial Control Panels" without any problems and are also suitable for "field wiring". In addition, the integral physical isolation offers even more safety, because a circuit breaker in the OFF condition is really switched OFF.



ESS31-T

## Features

- Track-mountable
- Wiring via supply busbars LINE+ and 0 V
- Physical isolation in the event of a failure
- Active linear current limitation
- Capacitive loads up to 40,000 µF
- Fixed current ratings 0.5 A...12 A
- Approvals: UL, NEC Class 2, VDE

## Your benefits

- Fit for global use: approved to EN/IEC60934 (VDE) and UL1077 (Supplementary Protector), UL 1310 (NEC Class 2)
- Provides ease of maintenance and trouble-shooting, because physical isolation of contacts ensures genuine disconnection of load circuits
- Simplifies planning due to active current limitation as a clear planning factor
- Saves costs and time through fast and flexible mounting including integral power distribution solution

## Preferred types – for more details on all configurations please see order numbering code

Preferred types are E-T-A products most frequently used by E-T-A customers. We manufacture E-T-A preferred types in particularly high

volumes. Our preferred types are supplied at shorter lead times than non-standard versions.

| Preferred types    | Preferred ratings (A) |   |   |     |   |   |   |   |    |    |         |         |           |
|--------------------|-----------------------|---|---|-----|---|---|---|---|----|----|---------|---------|-----------|
|                    | 0.5                   | 1 | 2 | 3.6 | 3 | 4 | 6 | 8 | 10 | 12 | 2 (CL2) | 3 (CL2) | 3,6 (CL2) |
| ESS31-TC           |                       |   |   |     |   |   |   |   |    |    |         |         |           |
| ESS31-TC-001-DC24V | x                     | x | x |     | x | x | x | x | x  | x  |         |         | x         |

## Approvals



## Information online

For access to the latest documents please follow: [www.e-t-a.de/d354](http://www.e-t-a.de/d354)

## Compliances



**Technical data** ( $T_{amb} = 25\text{ °C}$ ,  $U_B = DC - 24\text{ V}$ )

**Operating data**

|  |  |
|--|--|
| Operating voltage $U_B$                                    | DC 24 V (18...30 V)  |
| Current ratings $I_N$                                      | <b>fixed rating:</b><br>Types ESS31-TC-...:<br>0.5 A, 1 A, 2 A, 3 A, 3.6 A, 4 A,<br>6 A, 8 A, 10 A, 12 A   |
| Standby current $I_0$<br>depending on the<br>signal output | in ON condition: typically 8 mA  |
| Trip current (bimetal)                                     | typically 0.4 A<br>(only in the event of a failure, until physical<br>disconnection)   |
| Visual status<br>indication                                | <ul style="list-style-type: none"> <li>● multicoloured LED:                             <ul style="list-style-type: none"> <li><b>Green:</b> <ul style="list-style-type: none"> <li>- device is ON (S1 = ON)</li> <li>load circuit connected</li> </ul> </li> <li><b>Orange:</b> <ul style="list-style-type: none"> <li>- overload or short circuit until<br/>electronic disconnection</li> </ul> </li> <li><b>Red:</b> <ul style="list-style-type: none"> <li>- device switched OFF electronically</li> <li>load circuit OFF</li> <li>- undervoltage (<math>U_B &lt; 8\text{ V}</math>)</li> </ul> </li> <li><b>OFF:</b> <ul style="list-style-type: none"> <li>- manually OFF (S1 = OFF)</li> <li>load circuit physically isolated<br/>or device is dead-voltage</li> </ul> </li> </ul> </li> <li>● Potential-free signal contact</li> <li>● On/off position of the switch S1</li> </ul> |

**Load circuit**

|  |  |
|--|--|
| Load output                                  | power MOSFET switching output<br>(plus switching)  |
| Overload and short<br>circuit disconnection  | typically $1.2 \times I_N$<br>with active current limitation   |
| Trip times for<br>electronic disconnection   | see time/current characteristic<br>overload trip time typically 500 ms<br>short circuit trip time depending on<br>current rating (see table 1) |
| for physical isolation                       | typically 5 s  |
| Temperature disconnection                    | internal temperature monitoring<br>with physical isolation   |
| Undervoltage<br>monitoring<br>of load output | with hysteresis, no reset required:<br>»OFF« at $U_B < 14\text{ V}$<br>»ON« at $U_B > 17\text{ V}$   |
| Switch-on delay $t_{Start}$                  | typically 2 ms after each ON operation,<br>reset and after applying of $U_B$   |
| Capacitive loads                             | up to 40,000 $\mu\text{F}$   |
| Free-wheeling diode                          | external free-wheeling diode<br>recommended for inductive load   |

**Technical data** ( $T_{amb} = 25\text{ °C}$ ,  $U_B = DC - 24\text{ V}$ )

|   |   |
|---|---|
| Parallel connection of<br>several load outputs          | not allowed   |
| <b>Signal output</b>                                    | <b>ESS31-TC-001/-002</b>  |
| Electrical data   | potential-free auxiliary contact<br>max. DC 30 V / 2 A min. DC 12 V / 10 mA   |
| Standard condition<br>LED green overload,               | $U_B$ is applied and switch S1 is ON and<br>no short circuit  |
| OFF condition LED off                                   | device switched off (switch S1 is OFF)<br>load circuit physically isolated<br>no operating voltage $U_B$                |
| Fault condition LED orange                              | overload conditions $> 1.2$ times rated<br>current until electronic disconnection                                       |
| Fault condition LED red                                 | electronic disconnection upon overload,<br>short circuit or undervoltage  |
| ESS31-TC-001  | single signal, make contact<br>contact open, terminal 13-14   |
| ESS31-TC-002  | single signal, break contact<br>contact closed, terminal 11-12  |
| <b>General data</b>                                     |   |
| Fault-safe element                                      | back-up fuse for ESS31-T.. <u>not required</u><br>due to integral redundant fail-safe ele-<br>ment (protective element) |
| <b>Terminals</b>  | <b>LINE+ / LOAD+ / 0V</b>   |
| - Screw terminals max. cable cross section              | M4  |
| - flexible with wire end ferrule w/wo plastic sleeve    | 0.5 – 10 mm <sup>2</sup>  |
| - multi-lead connection (2 identical cables)            |   |
| rigid / flexible  | 0.5 – 4 mm <sup>2</sup>   |
| - flexible with wire end ferrule without plastic sleeve | 0.5 – 2.5 mm <sup>2</sup>   |
| - flexible with TWIN wire end ferrule                   |   |
| with plastic sleeve                                     | 0.5 – 6 mm <sup>2</sup>   |
| - wire stripping length                                 | 10 mm   |
| - tightening torque (EN 60934)                          | 1.5 – 1.8 Nm  |
| <b>Terminals</b>  | <b>aux. contacts</b>  |
| - Screw terminals                                       | M3  |
| - max. cable cross section                              |   |
| - flexible with wire end ferrule w/wo plastic sleeve    | 0.25 – 2.5 mm <sup>2</sup>  |
| - wire stripping length                                 | 8 mm  |
| - tightening torque (EN 60934)                          | 0.5 – 0.6 Nm  |
| Housing material  | moulded   |
| Mounting  | Tragschiene nach EN 60715-35x7.5  |
| Ambient temperature                                     | 0...+50 °C (without condensation,<br>cf. EN 60204-1)  |
| Storage temperature                                     | -20...+70 °C  |
| Humidity  | 96 hrs / 95% RH 40 °C<br>to IEC 60068-2-78-Cab<br>climate class 3K3 to EN 60721   |
| Vibration   | 3 g test to IEC 60068-2-6, test Fc ,  |
| Protection class  | housing IP20 EN 60529<br>terminals IP20 EN 60529  |
| EMC requirements<br>(EMC directive, CE logo)            | emission: EN 61000-6-3<br>susceptibility: EN 61000-6-2  |
| Insulation co-ordination<br>(IEC 60934)                 | 0.5 kV / pollution degree 2<br>reinforced insulation in operating area  |
| Dielectric strength                                     | max. DC 30 V (load circuit)   |
| Insulation resistance<br>(OFF condition)                | $> 100\text{ M}\Omega$ (DC 500 V) between<br>LINE (+) and LOAD (+)  |
| Conformity  | CE marking  |
| Dimensions (w x h x d)                                  | 12.5 x 80 x 83 mm (tolerances to<br>DIN ISO 286 part 1 IT13)  |
| Mass  | approx. 70 g  |

## Preferred types

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volumes. Our preferred types are supplied at shorter lead times than non-standard versions.

| Preferred types    | Preferred ratings (A) |   |   |     |   |   |   |   |    |    |         |         |           |  |
|--------------------|-----------------------|---|---|-----|---|---|---|---|----|----|---------|---------|-----------|--|
|                    | 0.5                   | 1 | 2 | 3.6 | 3 | 4 | 6 | 8 | 10 | 12 | 2 (CL2) | 3 (CL2) | 3,6 (CL2) |  |
| ESS31-TC           |                       |   |   |     |   |   |   |   |    |    |         |         |           |  |
| ESS31-TC-001-DC24V | x                     | x | x |     | x | x | x | x | x  | x  |         |         | x         |  |

## Order numbering code

|   |  |
|---|--|
| <b>Type No.</b>   |  |
| <b>ESS31</b> Electronic Circuit Breaker, with current limitation  |  |
| <b>Mounting</b>   |  |
| <b>TC</b> rail mounting, with auxiliary contact                   |  |
| <b>Version</b>  |  |
| <b>0</b> with physical isolation in the event of a failure        |  |
| <b>Signal input</b>   |  |
| <b>0</b> without signal input                                     |  |
| <b>Signal output</b>  |  |
| <b>1</b> auxiliary make contact (min. 12 V/10 mA; max. 30 V/2 A)  |  |
| <b>2</b> auxiliary break contact (min. 12 V/10 mA; max. 30 V/2 A) |  |
| <b>Operating voltage</b>  |  |
| <b>DC 24 V</b> voltage rating DC 24 V                             |  |
| <b>Current rating</b>   |  |
| <b>0.5 A</b> (Class 2)  |  |
| <b>1 A</b> (Class 2)  |  |
| <b>2 A</b>  |  |
| <b>3 A</b>  |  |
| <b>3.6 A</b>  |  |
| <b>4 A</b>  |  |
| <b>6 A</b>  |  |
| <b>8 A</b>  |  |
| <b>10 A</b>   |  |
| <b>12 A</b>   |  |
| <b>Approvals</b>  |  |
| <b>CL2</b> Class 2 (only 2 A, 3 A and 3.6 A types)                |  |
| <b>ESS31 - TC-0 0 1 - DC 24 V-3,6 A - CL2</b> ordering example 1  |  |
| <b>ESS31 - TC-0 0 1 - DC 24 V-12 A</b> ordering example 2         |  |

## Application note

- The user has to ensure that the cable cross section of the load circuit in question complies with the current rating of the ESS31-T used.
- In addition special precautions must be taken in the system or machine (e.g. use of a safety PLC) which reliably prevent an automatic re-start of parts of the system (cf. Machinery Directive 2006/42/EG and EN 60204-1, Safety of Machinery). In the event of a failure (short circuit/overload) the load circuit will be disconnected electronically with physical isolation of the contacts by the ESS31-T.

## Custom designed versions

Looking for a version you cannot find in our ordering number code? Please get in touch. We will be pleased to find a solution for you.

**Table 1: Voltage drop, current limitation, trip times, fail-safe element, max. load current**

| current rating<br>$I_N$ | typical voltage drop $U_{ON}$ at $I_N$ | active current limitation typically | trip time $I_{SC}$ typically 1) | trip time $I_{OL}$ typically 2) | fail-safe element | max. load current at 100 % ON duty |                      |
|-------------------------|--|-------------------------------------|---------------------------------|---------------------------------|-------------------|------------------------------------|----------------------|
|                         |  |                                     |                                 |                                 |                   | $T_{AMB} = 40$<br>°C               | $T_{AMB} = 50$<br>°C |
| 0.5 A                   | 90 mV                                  | $1.2 \times I_N$                    | 500 ms                          | 500 ms                          | 2 A               | 0.5 A                              | 0.5 A                |
| 1 A                     | 100 mV                                 | $1.2 \times I_N$                    | 500 ms                          | 500 ms                          | 2 A               | 1 A                                | 1 A                  |
| 2 A                     | 110 mV                                 | $1.2 \times I_N$                    | 500 ms                          | 500 ms                          | 4 A               | 2 A                                | 2 A                  |
| 2 A CL2                 | 130 mV                                 | $1.2 \times I_N$                    | 500 ms                          | 500 ms                          | 4 A               | 2 A                                | 2 A                  |
| 3 A                     | 150 mV                                 | $1.2 \times I_N$                    | 500 ms                          | 500 ms                          | 6.3 A             | 3 A                                | 3 A                  |
| 3 A CL2                 | 200 mV                                 | $1.2 \times I_N$                    | 500 ms                          | 500 ms                          | 4 A               | 3 A                                | 3 A                  |
| 3.6 A                   | 155 mV                                 | $1.2 \times I_N$                    | 350 ms                          | 500 ms                          | 6.3 A             | 3.6 A                              | 3.6 A                |
| 3.6 A CL2               | 250 mV                                 | $1.05 \times I_N$                   | 450 ms                          | 500 ms                          | 4 A               | 3.6 A                              | 3.6 A                |
| 4 A                     | 160 mV                                 | $1.2 \times I_N$                    | 280 ms                          | 500 ms                          | 6.3 A             | 4 A                                | 4 A                  |
| 6 A                     | 170 mV                                 | $1.2 \times I_N$                    | 150 ms                          | 500 ms                          | 10 A              | 6 A                                | 5 A                  |
| 8 A                     | 190 mV                                 | $1.2 \times I_N$                    | 280 ms                          | 500 ms                          | 15 A              | 8 A                                | 7 A                  |
| 10 A                    | 210 mV                                 | $1.2 \times I_N$                    | 200 ms                          | 500 ms                          | 15 A              | 10 A                               | 9 A                  |
| 12 A                    | 220 mV                                 | $1.2 \times I_N$                    | 110 ms                          | 500 ms                          | 20 A              | 12 A                               | 10.8 A               |

Note: When mounted side-by-side without convection the devices can only carry max. 80 % of their rated current continuously (100 % ON duty) due to thermal effect.

1) short circuit  
2) overload

Effect of the ambient temperature on the tripping characteristics

| ambient temperature T [°C] | 0    | +10  | +23 | +30  | +40  | +50  |
|----------------------------|------|------|-----|------|------|------|
| temperature factor         | 0.88 | 0.93 | 1.0 | 1.04 | 1.12 | 1.22 |

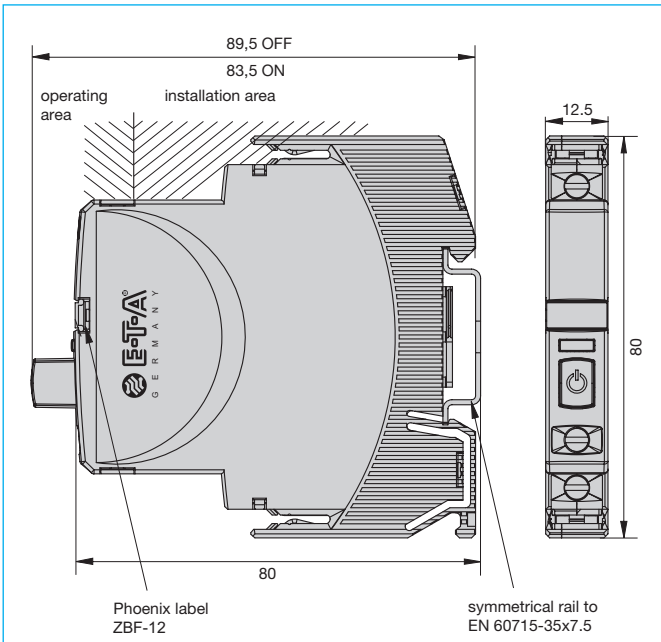
**Table 2: ESS31-T.. - versions**

| Version |      | Signal input |  |                        | Signal output:                   |   |  |                  |                       |                     |
|---------|------|--------------|--|------------------------|----------------------------------|---|--|------------------|-----------------------|---------------------|
|         |      |              |  |                        | Signal output F (signal contact) |   |  | Status output SF |                       |                     |
|         |      | without      | control input ON/OFF +24 V Control IN+ | reset input +24 V ↓ RE | without                          | single signal make contact (normally open NO) | single signal break contact (normally closed NC) | without          | status OUT +24 V = OK | status OUT 0 V = OK |
| -TC     | -001 | X            |  |                        |                                  | X   |  | X                |                       |                     |
| -TC     | -002 | X            |  |                        |                                  |   | X  | X                |                       |                     |

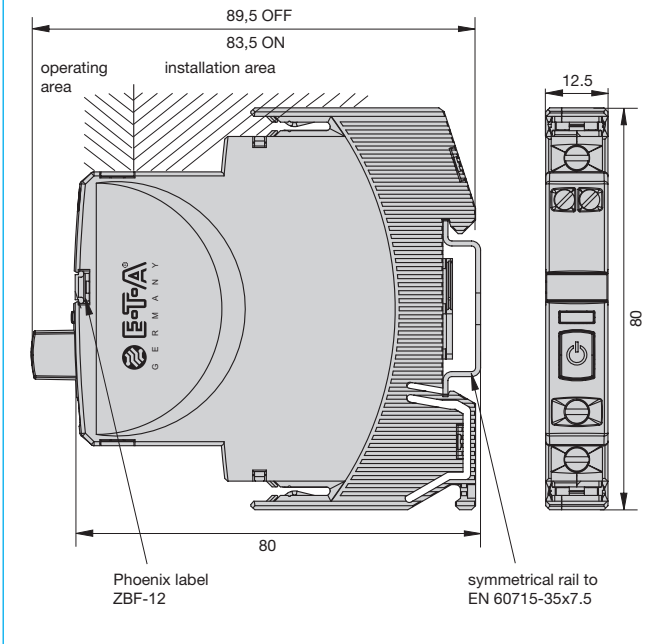
**Approvals ESS31-T**

| Approval authority | Standard                 | File-Certificate Nr. | Voltage rating | Current rating range       |
|--------------------|--------------------------|----------------------|----------------|----------------------------|
| UL                 | UL 2367                  | E306740              | DC 24 V        | 0.5 A...12 A               |
| UL                 | UL 1310 NEC Class2       | E306740              | DC 24 V        | 0.5 , 1 A, 2 A, 3 A, 3.6 A |
| UL                 | UL 1077 C22.2 No. 235-04 | E67320               | DC 24 V        | 0.5 A...12 A               |
| UL                 | cULuslisted UL 60947-4-1 | E362760              | DC 24 V        | 0.5 A...12 A               |
| VDE                | IEC/EN 60934 (VDE 0652)  | 40039681             | DC 24 V        | 0.5 A...12 A               |

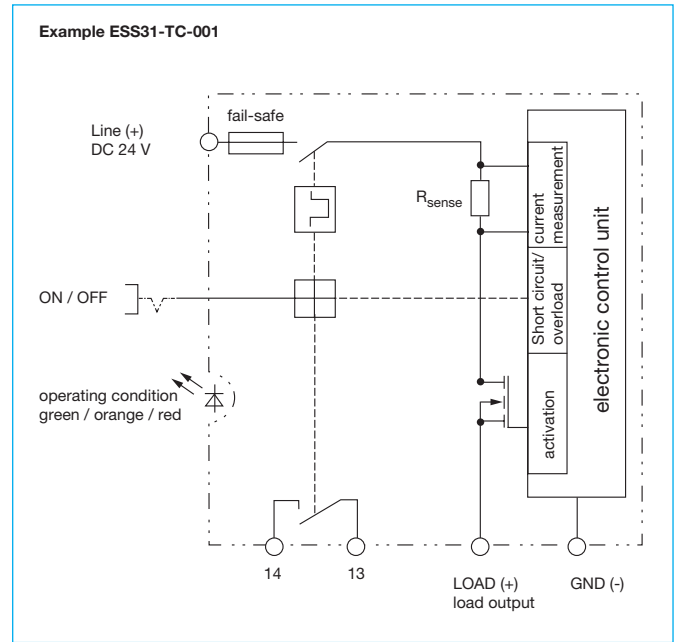
**Dimensions of the ESS31-T**



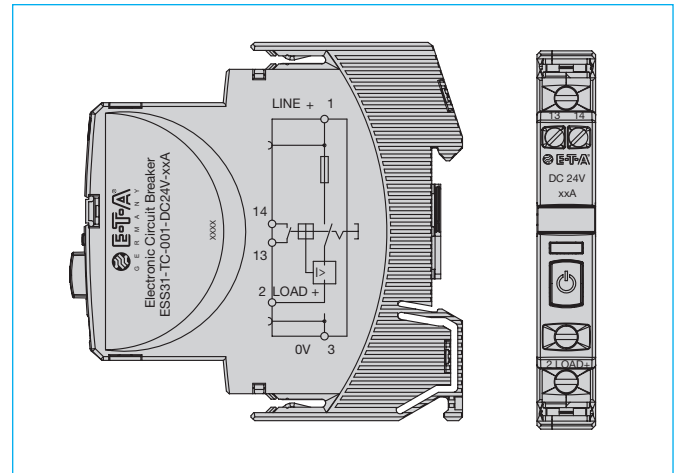
**Type-TC**



**Schematic diagram ESS31-T**



**Wiring diagram ESS31-TC-001-... (Example)**

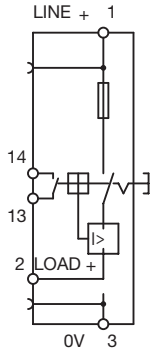


**ESS31-T Signal inputs / outputs (wiring diagrams)**

The auxiliary contacts are shown in OFF or fault condition

**ESS31-TC-001-.....**

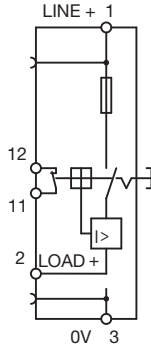
without signal input  
with signal output f  
single signal, make contact



operating condition  
13-14 closed  
fault condition  
13-14 open

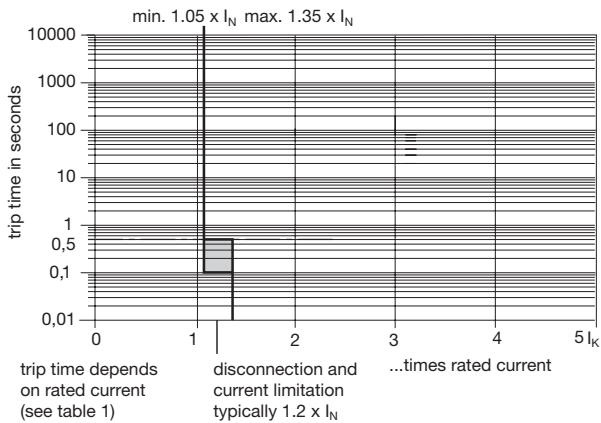
**ESS31-TC-002-.....**

without signal input  
with signal output f  
single signal, break contact



operating condition  
11-12 open  
fault condition  
11-12 closed

**Typical time/current characteristic ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )**

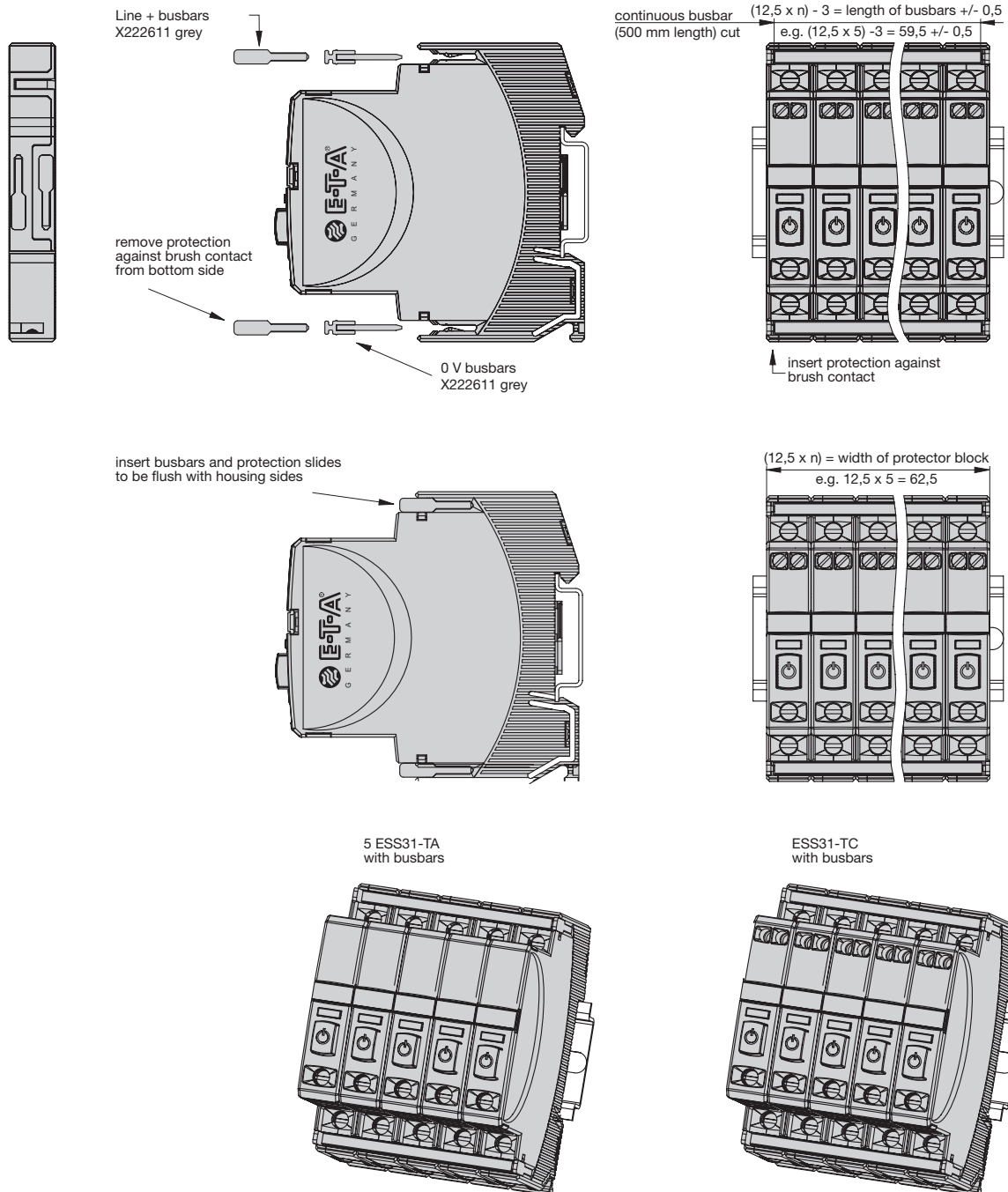


- The overload trip time is typically 500 ms (e.g. ESS31-T-...-6 A)
- **The electronic current limitation typically begins in at  $1.2 \times I_N$**   
This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.2 times rated current is applied until disconnection. The corresponding current limitation value  $I_{Limit}$  depends on the current rating of the device  $I_N$ .
- Without the current limitation getting into effect at typically  $1.2 \times I_N$  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.

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## Mounting examples for ESS31-T

The ESS31-T features an integral power distribution system



### Description of installation:

With a block of devices the busbars have to be inserted before wiring.  
Max. 10 plug-in cycles for busbars allowed.

### Recommendation:

The line entry busbars and signal busbars should be interrupted after 10 devices and line entry should start anew.

### Table of possible busbar lengths

| Number of devices               | 2  | 3    | 4  | 5    | 6  | 7    | 8  | 9     | 10  |
|---------------------------------|----|------|----|------|----|------|----|-------|-----|
| length of busbar [mm]<br>±0.5mm | 22 | 34.5 | 47 | 59.5 | 72 | 84.5 | 97 | 109.5 | 122 |

## Description

The ESS31-T has an integral power distribution system. The following wirings can be carried out with different plug-in type busbars:

- LINE +(DC 24 V)
- 0 V

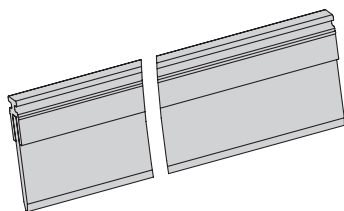
**Important:** The electronic devices ESS31-T require a 0 V connection.

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.

## Accessories / Technical data

### Busbars for LINE and 0 V

ampacity with one input  $I_{\max}$  50 A  
 (recommendation: central supply)  
 ampacity with two inputs  $I_{\max}$  63 A  
 grey insulated, length: 500 mm  
**X 222 611 02**



### Busbars for LINE and 0 V

grey insulated  
 max. 10 plug-in cycles allowed

**X 222 611 22**  
 (block of 2 ESS31-Ts), length: 22 mm  
 Packaging unit: 10 pcs

**X 222 611 34**  
 (block of 3 ESS31-Ts), length: 34.5 mm  
 Packaging unit: 10 pcs

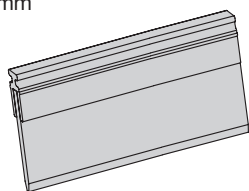
**X 222 611 47**  
 (block of 4 ESS31-Ts), length: 47 mm  
 Packaging unit: 10 pcs

**X 222 611 59**  
 (block of 5 ESS31-Ts), length: 59.5 mm  
 Packaging unit: 10 pcs

**X 222 611 72**  
 (block of 6 ESS31-Ts), length: 72 mm  
 Packaging unit: 4 pcs

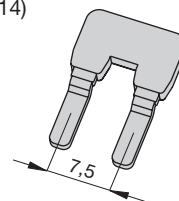
**X 222 611 97**  
 (block of 8 ESS31-Ts), length: 97 mm  
 Packaging unit: 4 pcs

**X 222 611 12**  
 (block of 10 ESS31-Ts), length: 122 mm  
 Packaging unit: 4 pcs



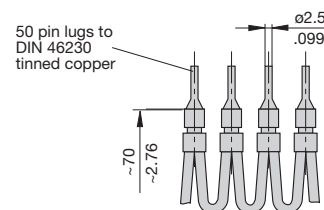
### Insulated wire bridge (for aux. contact)

optional as jumper for group signalling  
 (series connection of make contacts 13 - 14)  
**X 223 108 01**  
 Packaging unit: 10 pcs



### Connector bus link -K10

suitable for auxiliary contacts (series connection)  
**X 210 589 02** (1.5 mm<sup>2</sup>, brown),



### Supply module for LINE+ and 0V (without protection)

optional for all ESS31-T... versions if the corresponding loads are to be connected directly to all ESS31-Ts.

Ampacity  $I_{\max}$  50 A  
 Max. cable cross section see ESX10-T

Technical data see terminals of ESS31-T

### AD-TX-EM01

