E-T-A Electronic circuit breaker ESS31-T...-DC 24 V

Description

The model ESS31-T extends our product group of electronic overcurrent protection devices for DC 24 V applications. At a width of only 12.5 mm it provides selective protection for all DC 24 V load circuits. 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 is track-mountable and provides ease of installation for groups of devices with several circuits. DC 24 V switch-mode power supplies are widely used in automation today. In the event of an overload, however, they turn down the output voltage which is intended to power all connected loads. So if there is a failure in a single load of the system, the supply voltage will break down also in all other load circuits. Not only does this frequently cause undefined fault conditions, but it can even lead to machine stoppages or system downtimes.

In this context selectivity means that type ESS31-T responds faster to any overload or short circuit conditions in a load circuit than the switch-mode power supply. This is ensured by the combination of active electronic current limitation and well-proven circuit breaker technology including physical isolation.

The max. possible overcurrent is limited to typically 1.2 times rated current (see table 1). This allows switching on capacitive loads of up to 40,000 µF, but a disconnection will only be effected in the event of an overload or short circuit. For adjustment to the load conditions the current rating can be selected in fixed values from 0.5 A to 12 A. Visual status indication is by means of a multicoloured LED and by integral signal outputs. The manual ON/OFF switch on the device itself allows start-up of certain individual load circuits and reset after disconnection on grounds of overcurrent.

As soon as the ESS31-T detects an overload or short circuit in its load circuit, it blocks the load output transistor and disconnects the current flow in the faulty circuit. After remedy of the failure, the load output of the ESS31-T is re-activated manually by actuating the ON/OFF switch of the device.

US patent number: US 6,490,141 B2
US patent number: US 8,237,311 B2

Features and Benefits

- Selective load protection with physical isolation in the event of a failure
- All types of loads can be connected (DC 24 V motors upon request)
- Active current limitation when switching on capacitive loads up to 40,000 µF and in case of overload/short circuit
- Fixed current ratings from 0.5 A to 12 A
- Reliable overload disconnection typically from 1.2 x I_N even with long load lines or small cable cross sections
- Manuel ON/OFF switch (push-push actuation)
- Clear status indication by means of LED
- Integral fail-safe element, adjusted to current rating
- Width per channel only 12.5 mm
- For direct rail mounting
- Ease of wiring via entry line busbars LINE+ and 0 V

Approvals ESS31-TC

Approval authority	Standard	Rated voltage	Current ratings
VDE	EN 60934	DC 30 V	0.5 A...12 A
UL	UL 1077	DC 30 V	0.5 A...12 A

ESS31-T

Technical data (T_{amb} = 25 °C, U_B = DC – 24 V)

Operating data	
Operating voltage U_B	DC 24 V (18...30 V)
Current ratings I_N	**fixed rating:** Types ESS31-TC-...: 0.5 A, 1 A, 2 A, 3 A, 3.6 A, 4 A, 6 A, 8 A, 10 A, 12 A
Standby current I_0 depending on the signal output	in ON condition: typically 8 mA
Trip current (bimetal)	typically 0.4 A (only in the event of a failure, until physical disconnection)
Visual status indication	• multicoloured LED: **Green:** - device is ON (S1 = ON) load circuit connected **Orange:** - overload or short circuit until electronic disconnection **Red:** - device switched OFF electronically load circuit OFF - undervoltage (U_B < 8 V) **OFF:** - manually OFF (S1 = OFF) load circuit physically isolated or device is dead-voltage • Potential-free signal contact • On/off position of the switch S1
Load circuit	
Load output	power MOSFET switching output (plus switching)
Overload and short circuit disconnection	typically 1.2 x I_N with active current limitation
Trip times for electronic disconnection	see time/current characteristic overload trip time typically 500 ms short circuit trip time depending on current rating (see table 1)
for physical isolation	typically 5 s
Temperature disconnection	internal temperature monitoring with physical isolation
Undervoltage monitoring of load output	with hysteresis, no reset required: »OFF« at U_B < 14 V »ON« at U_B > 17 V
Switch-on delay t_{Start}	typically 2 ms after each ON operation, reset and after applying of U_B
Capacitive loads	up to 40,000 µF
Free-wheeling diode	external free-wheeling diode recommended for inductive load

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Technical data (T_{amb} = 25 °C, U_B = DC – 24 V)

Parallel connection of several load outputs	not allowed
Signal output	**ESS31-TC-001/-002**
Electrical data	potential-free auxiliary contact max. DC 30 V / 2 A min. DC 12 V / 10 mA
Standard condition LED green overload,	U_B is applied and switch S1 is ON and no short circuit
OFF condition LED off	device switched off (switch S1 is OFF) load circuit physically isolated no operating voltage U_B
Fault condition LED orange	overload conditoins > 1.2 times rated current until electronic disconnection
Fault condition LED red	electronic disconnection upon overload, short circuit or undervoltage
ESS31-TC-001	single signal, make contact contact open, terminal 13-14
ESS31-TC-002	single signal, break contact contact closed, terminal 11-12
General data	
Fail-safe element	back-up fuse for ESS31-T.. not required due to integral redundant fail-safe ele- ment (protective element)
Terminals	**LINE+ / LOAD+ / 0V**
- Screw terminals max. cable cross section	M4
- flexible with wire end ferrule w/wo plastic sleeve	0.5 – 10 mm²
- multi-lead connection (2 identical cables) rigid / flexible	0.5 – 4 mm²
- flexible with wire end ferrule without plastic sleeve	0.5 – 2.5 mm²
- flexible with TWIN wire end ferrule with plastic sleeve	0.5 – 6 mm²
- wire stripping length	10 mm
- tightening torque (EN 60934)	1.5 – 1.8 Nm
Terminals	**aux. contacts**
- Screw terminals	M3
- max. cable cross section	
- flexible with wire end ferrule w/wo plastic sleeve	0.25 – 2.5 mm²
- wire stripping length	8 mm
- tightening torque (EN 60934)	0.5 – 0.6 Nm
Housing material	moulded
Mounting	symmetrical rail to EN 50022-35 x 7.5
Ambient temperature	0...+50 °C (without condensation, cf. EN 60204-1)
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 60068-2-6, test Fc ,
Protection class	housing IP20 EN 60529 terminals IP20 EN 60529
EMC requirements (EMC directive, CE logo)	emission: EN 61000-6-3 susceptibility: EN 61000-6-2
Insulation co-ordination (IEC 60934)	0.5 kV / pollution degree 2 reinforced insulation in operating area
Dielectric strength	max. DC 30 V (load circuit)
Insulation resistance (OFF condition)	> 100 MΩ (DC 500 V) between LINE (+) and LOAD (+)
Dimensions (w x h x d)	12.5 x 80 x 83 mm (tolerances to DIN ISO 286 part 1 IT13)
Mass	approx. 70 g

Order numbering code

Type No.
ESS31 Electronic Circuit Breaker, with current limitation

Mounting
TC rail mounting, with auxiliary contact

Version
0 with physical isolation in the event of a failure

Signal input
0 without signal input

Signal output
1 auxiliary make contact (min. 12 V/10 mA; max. 30 V/2 A)
2 auxiliary break contact (min. 12 V/10 mA; max. 30 V/2 A)

Operating voltage
DC 24 V voltage rating DC 24 V

Current rating
0.5 A
1 A
2 A
3 A
3.6 A
4 A
6 A
8 A
10 A
12 A

ESS31 - TC - 0 0 1 - DC 24 V - 6 A ordering example

Class 2
Meets requirement for Class 2 current limitation
(ESS31-T...-0,5 A/1 A/2 A/3 A/3,6 A)

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.

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

current rating 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 °C	T_{AMB} = 50 °C
0.5 A	90 mV	1,2 x I_N	500 ms	500 ms	2 A	0.5 A	0.5 A
1 A	100 mV	1,2 x I_N	500 ms	500 ms	2 A	1 A	1 A
2 A	110 mV	1,2 x I_N	500 ms	500 ms	4 A	2 A	2 A
3 A	150 mV	1,2 x I_N	500 ms	500 ms	6.3 A	3 A	3 A
3.6 A	155 mV	1,2 x I_N	350 ms	500 ms	6.3 A	3.6 A	3.6 A
4 A	160 mV	1.2 x I_N	280 ms	500 ms	6.3 A	4 A	4 A
6 A	170 mV	1,2 x I_N	150 ms	500 ms	10 A	6 A	5 A
8 A	190 mV	1.2 x I_N	280 ms	500 ms	15 A	8 A	7 A
10 A	210 mV	1.2 x I_N	200 ms	500 ms	15 A	10 A	9 A
12 A	220 mV	1.2 x 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

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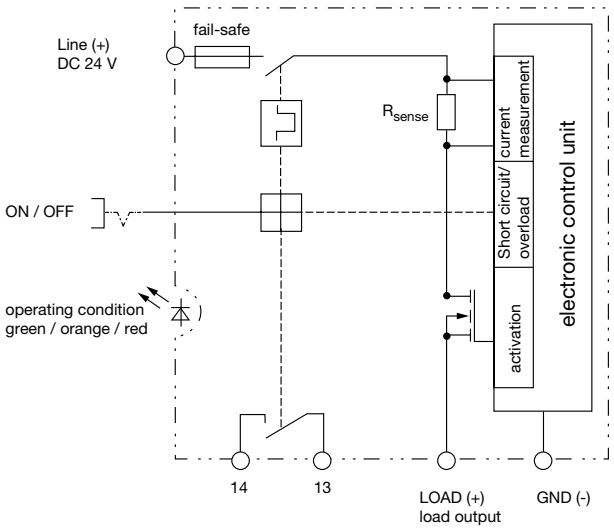
Table 2: ESS31-T.. - versions

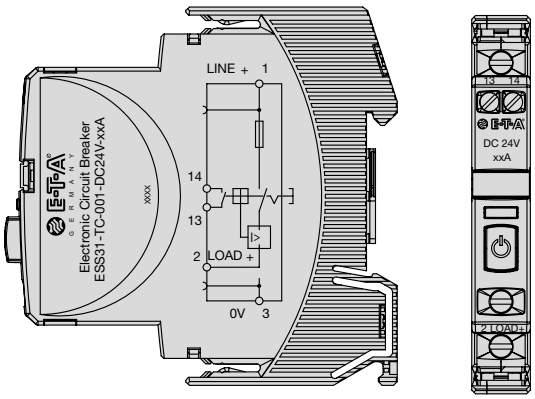
Version		Signal input			Signal output:					
					Signal output F (signal contact)			Status output SF		
ESS31-...		without	control input ON/OFF +24 V Control IN+	reset input +24 V ↓ RE	without	single signal make contact (normally open NO)	single signal break contact (normally closed NC)	without	status OUT +24 V = OK	status OUT 0 V = OK
-TC	-001	X				X		X		
-TC	-002	X					X	X		

Schematic diagram ESS31-T

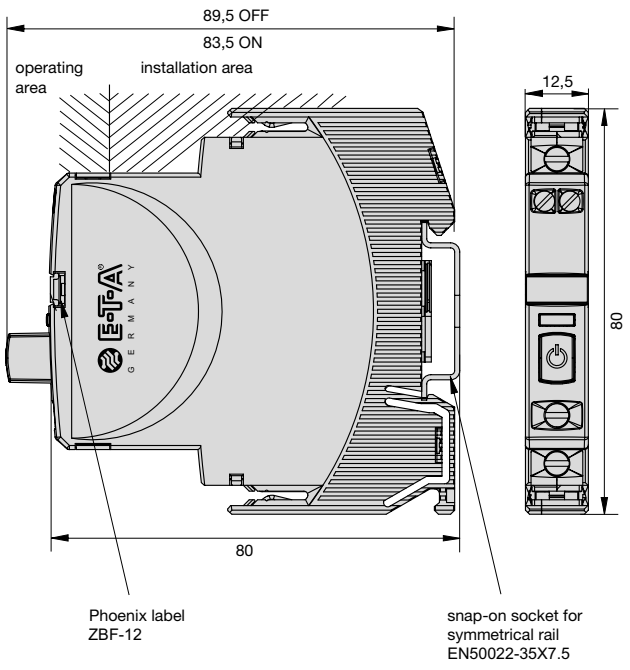
Example ESS31-TC-001



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



Dimensions of the ESS31-TC version

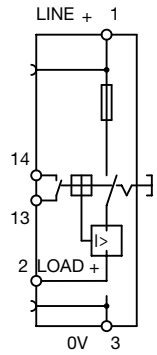


ESS31-T Signal inputs / outputs (wiring diagrams)

The auxiliary contacts are shown in OFF or fault condition

ESS31-TC-001-.....

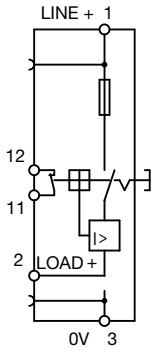
without signal input
with signal output f
single singnal, make contact



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

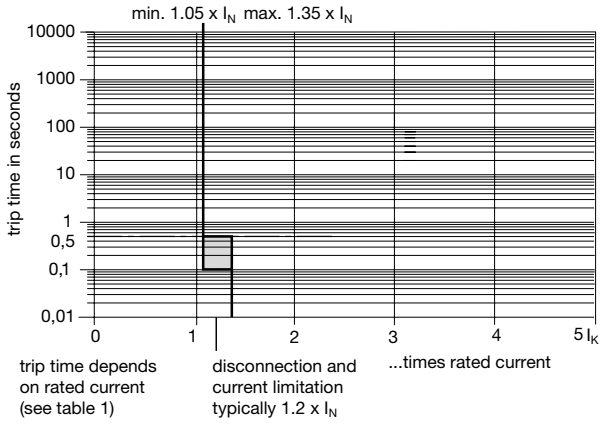
ESS31-TC-002-.....

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



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

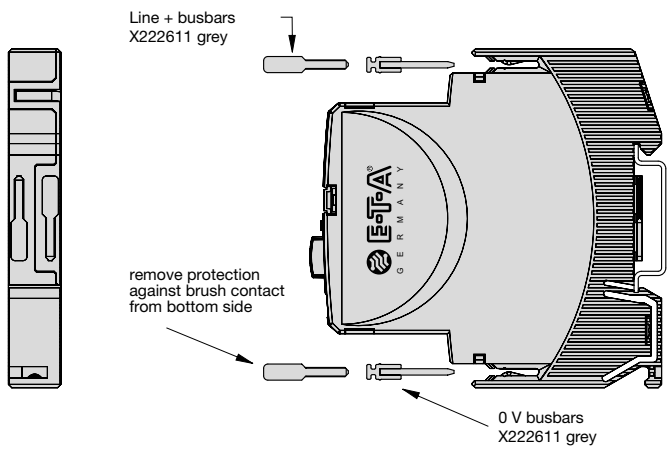
Typical time/current characteristic (T_{amb} = 25 °C)

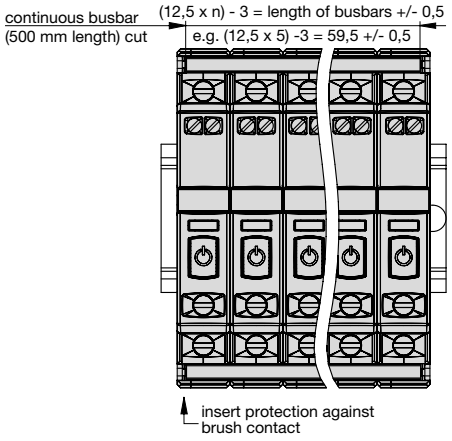


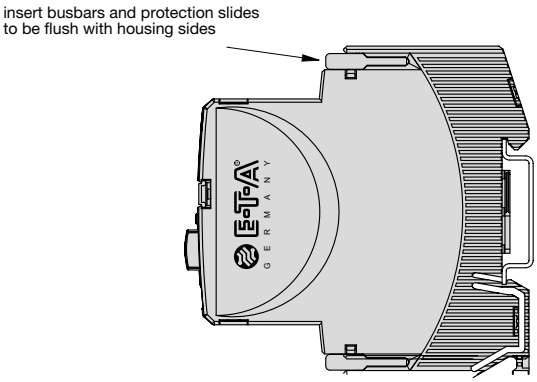
- The overload trip time is typically 500 ms (e.g. ESS31-T-…-6 A)
- **The electronic current limitation typically begiins at 1.2 x I_N** This means: under all overload conditions (independent of power supply and load circuit resistance) typically 1.2 times rated current is applied until disconnection. The corresponding current limitation value I_{Limit} 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.

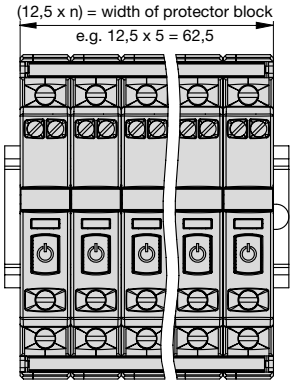
Mounting examples for ESS31-T

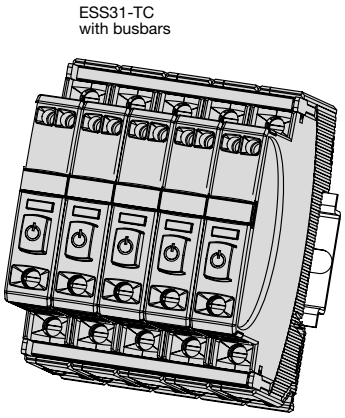
The ESS31-T features an integral power distribution system











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] ±0.5mm	22	34.5	47	59.5	72	84.5	97	109.5	122

Description

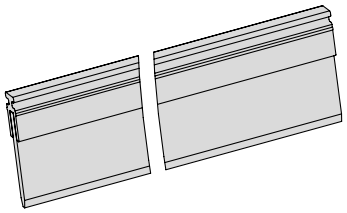
The ESS31-T has an integral power distribution system. The following wirings can be carried out with different plug-in type busbars:

- 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

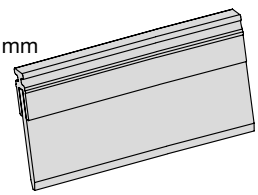
X 222 611 47
(block of 4 ESS31-Ts), length: 47 mm
Packaging unit: 10 pcs

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

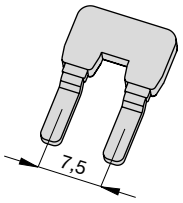
X 222 611 72
(block of 6 ESS31-Ts), length: 72 mm
Packaging unit: 4 pcs

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

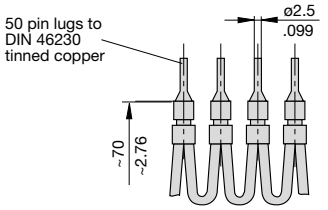
X 222 611 12
(block of 10 ESS31-Ts), length: 122 mm
Packaging unit: 4 pcs



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 mm², brown),



Passive supply module for LINE+ and 0 V (without protection)
optional for all types ESS31-T versions allowing to connect the loads in question to all ESS31-T.

Ampacity I_{ma} 50 A
Max. cable cross section 0.5 - 10 mm²

Technical Data
see terminals of ESS31-T
AD-TX-EM01