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 75,000 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 17plus and 18plus modules ensuring ease of installation and saving space in control cabinets.

US patent number: US 6,490,141 B2

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 75,000 µF and on overload/short circuit.
- Electronic trip characteristic.
- Reliable overload disconnection with 1.1 x 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.
- Pluggable onto the modular 17plus and 18plus power distribution modules

Notes

- The user should ensure that the cable cross sections of the relevant load circuit are suitable for the current rating of the ESS20 used.
- Automatic start-up of machinery after shut down must be prevented (Machinery Directive 98/37/EG and EN 60204-1). In the event of a short circuit or overload the load circuit will be disconnected electronically by the ESS20.

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UK CA CE RoHS REACH

ESS20-0..

Technical data ($T_{ambient}$ = 25 °C, operating voltage U_S = DC 24 V)

Operating data	
Operating voltage U_S	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 (only in the event of a failure, before physical isolation)
Status indication by means of	**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 **potential-free signal contact** (change-over contact) **OFF-position of push button**
Reverse polarity protection of U_S	internal bimetal (fail-safe element) trips, push button moves into OFF position
Load circuit	
Load output	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 x I_N (1.05...1.35 x I_N)
Short-circuit current I_K	typically 1.8 x I_N / active current limitation
Trip time for physical isolation for electronic disconnection	see time/current characteristics typically 5 sec at I_{load} > 1.1 x I_N typically 5 sec...100 ms at I_{load} > 1.8 x I_N or 1.5 x I_N
Temperature disconnection	internal temperature monitoring with physical isolation
Low voltage monitoring load output	OFF at U_S < 7 V ON at U_S >16 V
Starting delay t_{start}	typically 0.3 sec after every switch-on and after applying U_S
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
Several load outputs must not be connected in parallel.	

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Technical data ($T_{ambient}$ = 25 °C, operating voltage U_S = DC 24 V)

Fault indication, signal output	
Fault indications	potential-free auxiliary contact change-over (SC-SO / SC-SI) simultaneously with physical isolation max. DC 30 V / 0.5 A, min. 10 V / 10 mA
Signal output ESS20-003 (group signalisation N/C)	blue push button in ON position: signal contact SC-SO is closed (SC-SI is copen) blue push button in OFF position: signal contact SC-SO 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) push button in OFF position when fail-safe element has tripped.
Blade terminals	6.3 mm to EN 60934-6.3-0.8
Housing material	plastics material
Mounting of housing	Pluggable onto E-T-A's 17plus, 18plus and SVSxx power distribution modules, that can be mounted side by side
Ambient temperature	0...+50 °C (without condensation, see EN 60204-1)
Storage temperature	-20...+70 °C
Humidity	96 hrs/95 % RH/40 °C to IEC 60068-2-78, test Cab. climate class 3K3 to EN 60721
Vibration	3 g, test to IEC 60068-2-6 test Fc
Degree of protection	housing: IP30 DIN 40050 terminals: IP00 DIN 40050
EMC (EMC directive, CE logo)	emission: EN 61000-6-3 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 installation area load circuit-signal contact	(see dimensions) test voltage AC 1000 V test voltage AC 500 V test voltage AC 500 V
Insulation resistance (OFF condition)	> 100 MΩ (DC 500 V) [LINE (+) – LOAD (+)]
Compliance	CE marking, UKCA
Approvals	UL 1077, File E67320 Supplementary Protectors for use in Electrical Equipment IEC/EN 60934 (fixed current ratings)
Dimensions (W x H x D)	12.5 x 105 x 60 mm
Mass	approx. 65 g

Approvals

Authority	Norm	Voltage ratings	Current ratings
VDE	EN 60934	DC 32 V	0.5 A...10 A
UL	UL 1077	DC 28 V	0.5 A...10 A

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

current rating I_N	typically voltage drop U_{ON} at I_N	active current limitation (typically)	max. load current at 100 % ON duty	
			T_U = 40 °C	T_U = 50 °C
0.5 A	100 m V	1.8 x I_N	0.5 A	0.5 A
1 A	140 mV	1.8 x I_N	1 A	1 A
2 A	180 mv	1.8 x I_N	2 A	2 A
3 A	140 mV	1.8 x I_N	3 A	3 A
4 A	190 mV	1.8 x I_N	4 A	4 A
6 A	280 mV	1.8 x I_N	6 A	5 A
8 A	220 mV	1.5 x I_N	8 A	7 A
10 A	280 mV	1.5 x I_N	10 A	9 A
1 A/2 A	140 mV/280 mV	1.8 x I_N	1 A/2 A	1 A/2 A
3 A/6 A	140 mV/280 mV	1.8 x I_N	3 A/6 A	3 A/5 A

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.

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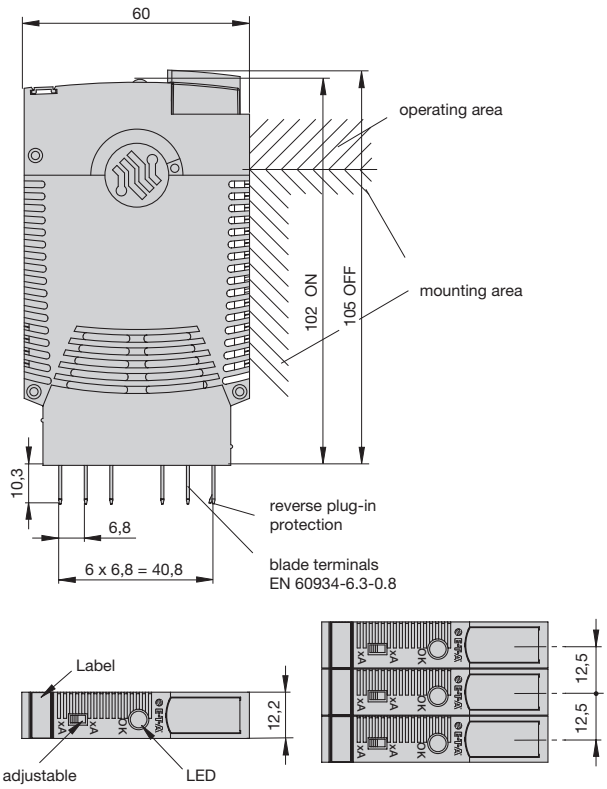
This is a metric design and millimeter dimensions take precedence (mm / inch)

Ordering information

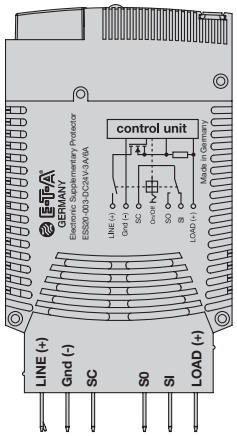
Type No.		
ESS20	Electronic Circuit Breaker with current limitation (e.g. typically 1.8 times rated current or 1.5 x I_N, see table 1)	
	Version	
	0	with physical isolation in the event of a failure
	Control input	
	0	without control input
	Signal output	
	3	signal contact changeover (group signalisation)
	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)
ESS20 - 0	0 3 - DC 24 V - 3 A/6 A	ordering example (recommended type)

Dimensions



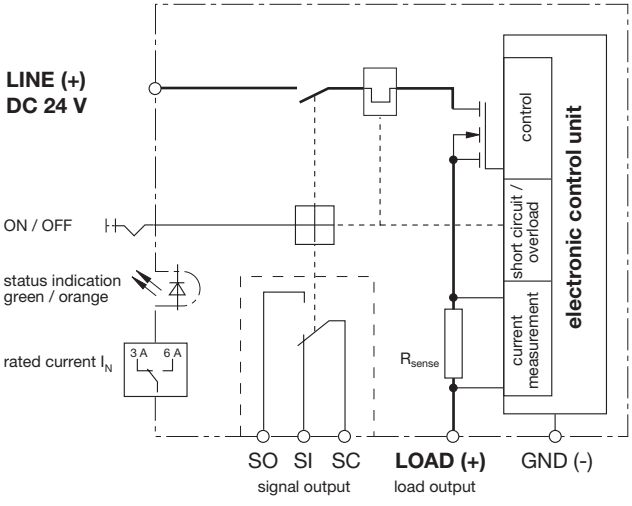
Terminal wiring diagrams (e. g. adjustable 3 A/6 A)

ESS20-003- ...



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

ESS20-003- ... (group signalisation with change over)



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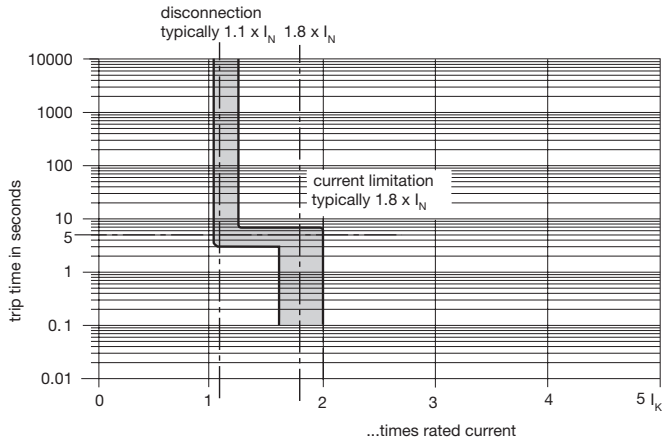
Time/Current characteristic curve (T_A = 25 °C)



*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

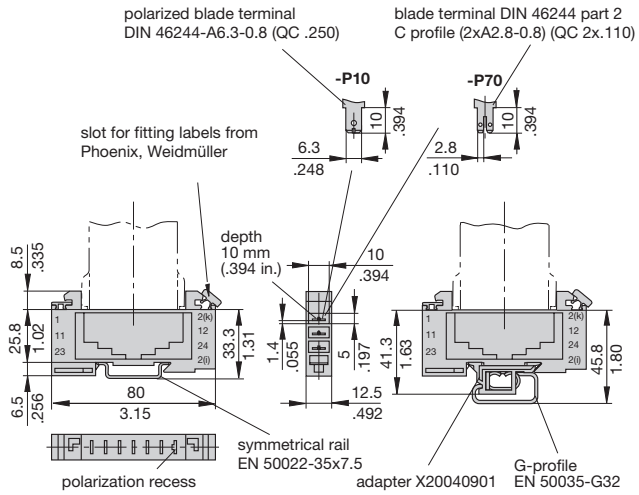
- The trip time is typically 5 s in the range between 1.1 and 1.8 x I_N*1).
- Electronic current limitation starts at typically 1.8 x I_N*1) which means that under all overload conditions (independent of the power supply and the resistance of the load circuit) the max. overload until disconnection will not exceed 1.8 x I_N*1) times the current rating. Trip time is between 100 ms (short circuit current I_K) and 5 sec (at overload with high line attenuation).
- Without the current limitation activated at typically 1.8 x I_N*1) 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

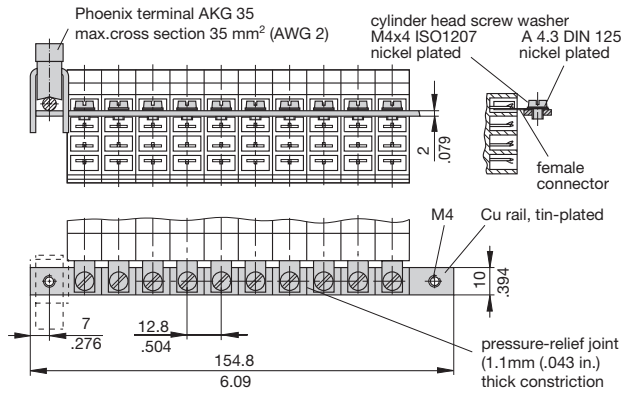
Reliable trip of ESS20 with different cable lengths and cross sections							
Resistivity of copper $_0$ = 0.0178 (Ohm x mm²) / m							
U_S = DC 19.2 V (= 80 % v. 24 V)	voltage drop of ESS20 and tolerance of trip point (typically 1.1 x I_N = 1.05...**1.35 x I_N**) have been taken into account.						
ESS20-selected rating I_N (in A) →	**3**	**6**					
e. g. trip current I_{ab} = 1.25 x I_N (in A) →	3.75	7.5	→ **ESS20 trips after 3...5 s**				
R_{max} in Ohm = (U_S / I_{ab}) - 0.050 →	**5.07**	**2.51**					
The ESS20 reliably trips from 0 Ohm to max. circuitry resistance R_{max}							
Cable cross section **A** in mm² →	0.14	0.25	0.34	0.5	0.75	1	1.5
cable length **L** in meter (= single length)	**cable resistance in Ohm = (R_0 x 2 x L) / A**						
5	1.27	0.71	0.52	0.36	0.24	0.18	0.12
10	2.54	1.42	1.05	0.71	0.47	0.36	0.24
15	3.81	2.14	1.57	1.07	0.71	0.53	0.36
20	5.09	2.85	2.09	1.42	0.95	0.71	0.47
25	6.36	3.56	2.62	1.78	1.19	0.89	0.59
30	7.63	4.27	3.14	2.14	1.42	1.07	0.71
35	8.90	4.98	3.66	2.49	1.66	1.25	0.83
40	10.17	5.70	4.19	2.85	1.90	1.42	0.95
45	11.44	6.41	4.71	3.20	2.14	1.60	1.07
50	12.71	7.12	5.24	3.56	2.37	1.78	1.19
75	19.07	10.68	7.85	5.34	3.56	2.67	1.78
100	25.34	14.24	10.47	7.12	4.75	3.56	2.37
125	31.79	17.80	13.09	8.90	5.93	4.45	2.97
150	38.14	21.36	15.71	10.68	7.12	5.34	3.56
175	44.50	24.92	18.32	12.46	8.31	6.23	4.15
200	50.86	28.48	20.94	14.24	9.49	7.12	4.75
225	57.21	32.04	23.56	16.02	10.68	8.01	5.34
250	63.57	35.60	26.18	17.80	11.87	8.90	5.93
Example 1:	max. length at 1.5 mm² and 3 A → **214 m**						
Example 2:	max. length at 1.5 mm² and 6 A → **106 m**						
Example 3:	mixed wiring: R1 = 40 m in 1.5 mm² and R2 = 5 m in 0.25 mm²: (Control cabinet – sensor/actuator level) R1 = 0.95 Ohm, R2 = 0.71 Ohm **Total (R1 + R2) = 1.66 Ohm**						

Accessories for ESS20-0..

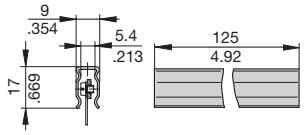
Single mounting sockets (with adapter)
(up to 16 A max. load)
17-P10-Si **17-P10-Si-20025**
17-P70-Si **17-P70-Si-20025**



Busbar (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



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



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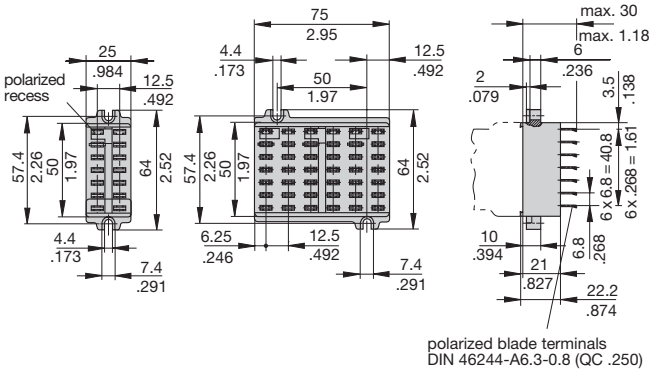
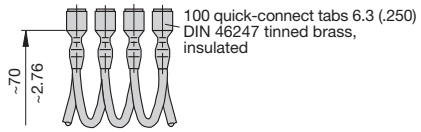
2-way mounting socket
23-P10-Si

6-way mounting socket
63-P10-Si

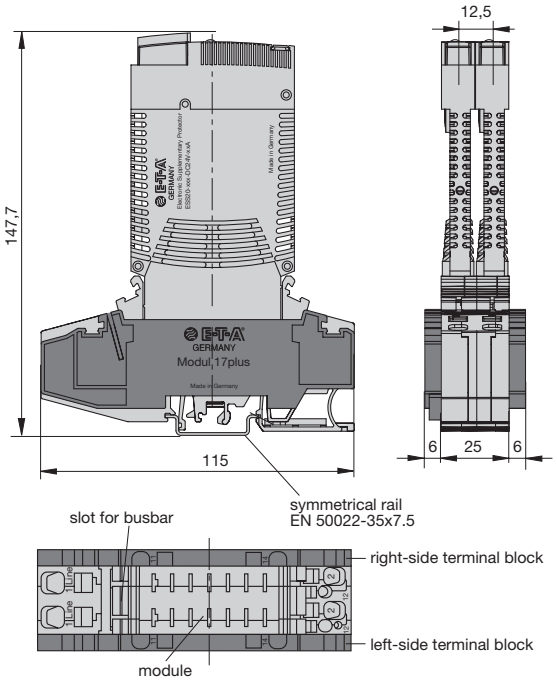


Connector bus links -P10
X 210 588 01/ 1.5 mm², (AWG 16), brown (up to 13 A max. load)
X 210 588 02/ 2.5 mm², (AWG 14), black (up to 20 A max. load)
X 210 588 03/ 2.5 mm², (AWG 14), red (up to 20 A max. load)
X 210 588 04/ 2.5 mm², (AWG 14), blue (up to 20 A max. load)



Dimensions

Module 17plus
For technical data see section Power Distribution Systems



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.

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E-T-A Circuit Breakers:

ESS20-003-DC24V-3A/6A ESS20-003-DC24V-2A ESS20-002-DC24V-2A ESS20-003-DC24V-6A ESS20-003-DC24V-8A ESS20-124-DC24V-0.5A ESS20-003-DC24V-10A ESS20-002-DC24V-4A ESS20-124-DC24V-10A ESS20-002-DC24V-3A ESS20-124-DC24V-4A ESS20-002-DC24V-1A ESS20-003-DC24V-1A ESS20-002-DC24V-6A ESS20-003-DC24V-0.5A ESS20-003-DC24V-4A ESS20-003-DC24V-1A/2A ESS20-124-DC24V-2A ESS20-002-DC24V-10A