

Description

The electronic circuit breaker ESS1 is designed to ensure selective disconnection of individual loads in industrial systems which are powered by a DC 24 V switch mode power supply. Selectivity means that the ESS1 responds faster to overload or short circuit conditions than the power supply.

The ESS1 has four major tasks:

- In the event of an overload or short circuit in a load circuit, even the shortest break-down of the output voltage of the power supply to values below 18 V must be prevented under all circumstances.**

Otherwise all other components fed by the power supply will respond unpredictably to the voltage dip. Result: reset, re-start, standstill of components or whole system. The voltage dip is caused by the characteristic overcurrent behaviour of the power supply (straight characteristic curve, fold-back curve, hiccup mode etc.).

- Selective protection/disconnection must be ensured even at worst-case overload conditions.**

Long feed lines prevent the occurrence of a significant short circuit current (see table 1).

- The current limited switch-on of loads with high input capacitance must be ensured without increase of rated current adjustment.**

Electronic DC 24 V components contain big input capacitors for suppression or back-up of voltage dips.

- Fault indication**

Features

- Electronic circuit breaker for protecting system components (sensors, actuators, field bus couplers, control units etc.) which are powered by a DC 24 V switch mode power supply.
- Connection of all load types (resistive, inductive, capacitive).
- Alternative current ratings (3 A or 6 A) can be selected by means of the switch on the device.
- Overload- and short-circuit proof switching output with active limitation of inrush and short-circuit currents.
- Overload-dependent trip characteristics ("thermal-magnetic circuit breaker style", but much narrower trip curve tolerances).
- Power Mosfet switching output, high side switch.
- Additional disconnection by electromechanical switch in the event of overload.
- RED actuator button: reset or manual trip.
- Visual status indication:
GREEN LED: O.K. signal
YELLOW LEDs (40, 60, 80, 100 % of rated current): load current indication
RED LED (110 %): flashing or lighted after tripping
- Fault indication through auxiliary contact (N/C, break contact).
- Integral thermal circuit breaker (with VDE, UL, CSA approval) serving as a fail-safe element in the load circuit and providing reverse polarity protection.
- Option: control input



ESS1-.../SVS1-...

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

Operating data

Operating voltage U_S	DC 24 V (DC 18...32 V)
Current rating I_N	3 A or 6 A (selected by means of a switch)
Current consumption I_0 (load output non-conductive)	typically 13 mA
OK signal	GREEN LED lighted when operating voltage is applied
Reverse polarity protection U_S	integral with the device -> internal fail-safe-element tripped (see »Reset« on connection side), LEDs are unlit
Insulation voltage	AC 500 V (control circuit, load circuit, fault indication)

Load circuit

Load output	Power-MOSFET switching output (high side switch)
Max. data of load (100 % ON duty)	DC 24 V / 5 A (resistive, inductive, capacitive, lamp load)
Voltage drop at I_N	typically 220 mV / 3 A typically 440 mV / 6 A
Overload disconnection	typically $1.1 \times I_N$
Trip times	see time/current characteristic curve: $t_{v1}: I_{\text{load}} > 1.05...2 \times I_N$ typ. 5 s, LED RED (110 %) flashing until disconnection occurs $t_{v2}: I_{\text{load}} > 2 \times I_N$ typ. 5 s...100 ms, LED RED (110 %) lighting after disconnection, fault indication F closed
Short-circuit current I_K	active current limitation max. $2 \times I_N$ (6 A or 12 A)
Trip time t_K (at I_K)	typically 100 ms
Temperature disconnection:	internal temperature monitoring with physical isolation, LED RED (110 %) lighting after disconnection, fault indication F
Load current indication	4 YELLOW LEDs (40, 60, 80, 100 %) or 1 RED LED (110 %) signalling utilization of the set current rating in % (e. g. higher than 40 %)
Starting delay t_{start}	typically 1 s upon application of U_S after each switch-on
Free-wheeling circuit	integral bi-directional transil diode; external free-wheeling diode recommended for inductive loads
Disconnection of load circuit	single pole (switch contact) - by manual operation of the RED button - upon electronic fault disconnection (overload, short-circuit)

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

Several load outputs must not be connected in parallel

Control circuit (option)

Control input EC/EO - **to customer requirement:** possibly physically isolated via opto coupler/ control voltage U_S/ control current I_S / switching frequency f_{max} / control signal (U_S = >>1<<) Switching times /t_{on} / t_{off}/ leakage current/ protection

Fault indication

Fault indication F potential-free auxiliary contact (SC-S0), break contact (N/C), DC 30 V / max. 1 A

Status of fault indication Contact closed in the event of power failure or when the switch (RED button) has tripped upon:
 - overload/short-circuit in the load circuit (RED LED lights). The fault indicated by that LED is stored until the RED operating button is reset.
 - manual disconnection of the device

Signal delay typically 150 ms

Reverse polarity of U_S internal fail-safe element will trip

General data

Ambient temperature 0...40 °C (without condensation, see EN 60204-1)

Storage temperature -20...+70 °C

Blade terminals 6.3 mm to DIN 46244-A6.3-0.8 for E-T-A Power distribution system SVS1-xx-...

Backup fuse for ESS1 not required because of the integral redundant fail-safe element (thermal E-T-A circuit breaker)

Housing material aluminium

Mounting of housing Plug-in for distribution system SVS1 for symmetric rail mounting

Vibration 3 g, test to IEC 60068-2-6 test Fc

Degree of protection Housing: IP20 DIN 40050/IEC 529
 Terminals: IP00 DIN 40050/IEC 529

EMC Emission: EN 50081-1
 Susceptibility: EN 61000-6-2

Dimensions (W x H x D) 17.5 x 100 x 55 mm

Mass approx. 80 g

Ordering information

Type No.

ESS1 Electronic Circuit Breaker for DC 24 V applications

Version

0 standard

Control input

0 without control input

1 with control input 8.5 V...30 V (option)

Signal output

0 without auxiliary contact

1 with auxiliary contact (N/O)

Input voltage

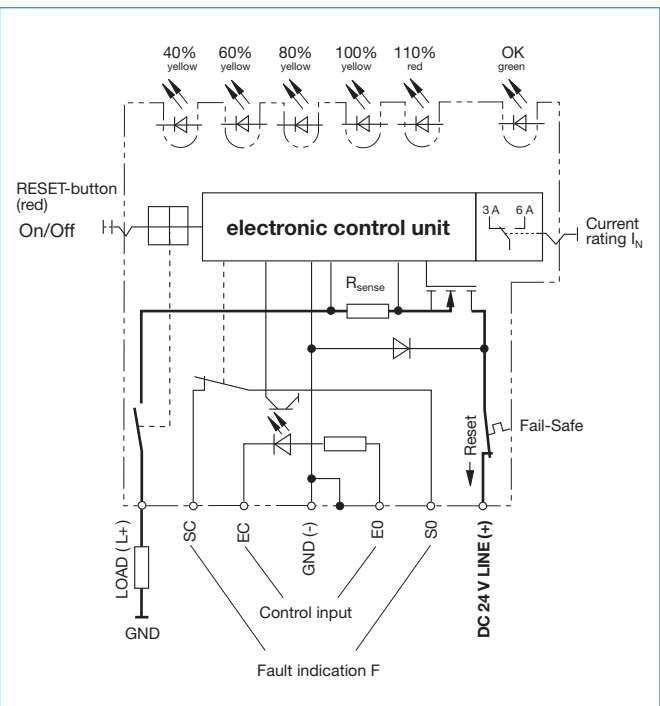
DC 24 V voltage rating DC 24 V (18...32 V)

Current rating

3 A/6 A adjustable (by slide switch)

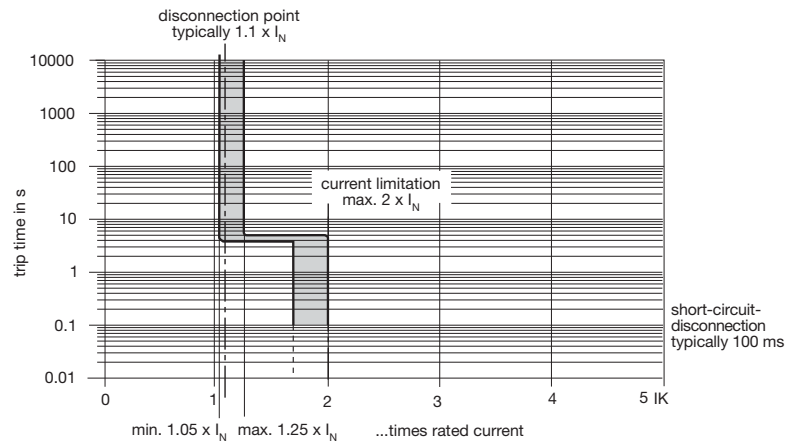
ESS1 - 0 0 1 - DC 24 V - 3 A/6 A ordering example

Basic circuit diagram



Shown on the switched-off and de-energised condition. The red reset button is in the tripped (OFF) position, the auxiliary contacts of the fault indication (SC-S0) are closed.

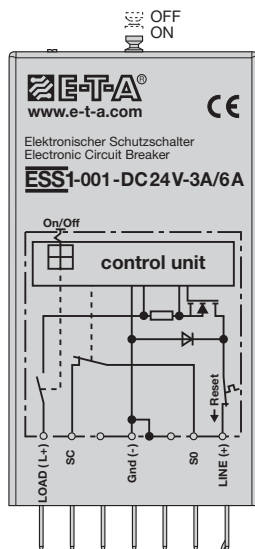
Time/Current characteristic curve ($T_A = 25\text{ }^\circ\text{C}$)



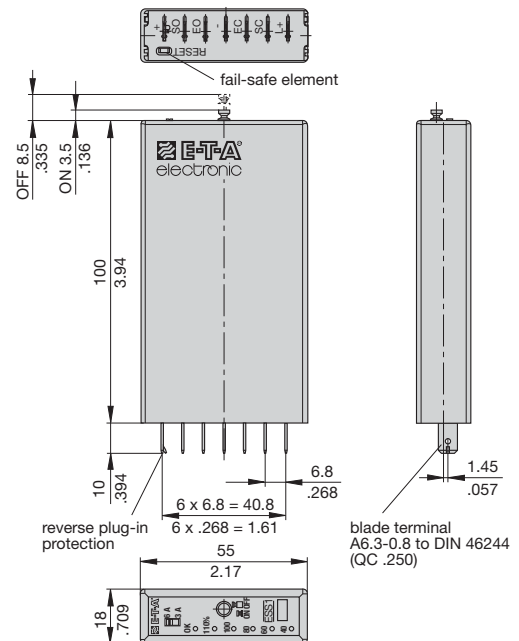
Explanation of the characteristic curve:

- The trip time is typically 5 s in the range between $1.05 \times I_N$ and $2 \times I_N$.
- Electronic current limitation starts at $2 \times I_N$ 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 two times the current rating.
- Without the current limitation activated at $2 \times I_N$ a much higher overload current would flow in the event of an overload or short circuit.
- Trip time after activation of current limitation is between 5 s and 100 ms (short circuit).

Terminal wiring diagram



Dimensions



This is a metric design and millimeter dimensions take precedence ($\frac{\text{mm}}{\text{inch}}$)

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Matrix of the ESS1 switching conditions

Operating mode (unit without Control input)	Trouble-free operation	Overload: $I_{load} = 1.1...2 \times I_N$	Short-circuit: $I_{load} > 2 \times I_N$	temperature disconnection ($> 150\text{ °C} /$ 302 °F) *	internal- failure **)
Load output	ON = <i>conductive</i>	OFF = <i>non-conductive</i>	OFF = <i>non-conductive</i>	OFF = <i>non-cond.</i>	
Load circuit 1-pole discon. (through switching contact)	no	yes, after approx. 5 s	yes, after approx. 5 s...100 ms	yes, after approx. 60 ms	
Indication					
GREEN LED O. K.-signal	lighted	lighted	lighted	lighted	not lighted
RED LED ($I > 110\%$ von I_N)	not lighted	LED flashes for approx. 5 sec, LED flashes momentarily, lighted after tripping	LED flashes for approx. 5 sec, LED flashes momentarily, lighted after tripping	LED flashes momentarily, lighted after tripping	
YELLOW LEDs Load current indication ($> 40, 60,$ $80, 100\%$ von I_N)	0...4 LEDs lighted, dependent on load current	none of the LEDs lighted after tripping	none of the LEDs lighted after tripping	none of the LEDs lighted after tripping	
Fault indication F aux. contact	open	closed	closed	closed	
RED actuator/ reset button	ON	tripped	tripped	tripped	

- With manual operation (RED button pulled):
fault indication F, RED LED also lighted.

* Upon response of the internal temperature control (chip
temperature of power semiconductors is $+150\text{ °C} / +302\text{ °F}$ for a
short period of time) the load current is disconnected. The circuit
breaker trips and the red LED ($I > 110\%$) is lighted.

If the ESS1 is to be switched off again, a short cooling down
period must be taken into account due to the temperature
hysteresis of the semiconductor chip. The cooling down period
will be approx. 5 sec dependent on the energy absorption
(behaviour similar to thermal circuit breaker).

**) Electronic control unit defective
- internal fail-safe element has tripped (see »reset«
on terminal side of the ESS1).

Table 1: Electronic Circuit Breaker ESS1 for DC 24 V

Reliable trip of ESS1 with different cable lengths and cross sections

Specific conductivity of copper $\rho_0 =$	0.0178 (Ohm x mm ²) / m		
$U_S = \text{DC } 19.2\text{ V}$ (= 80 % v. 24 V)	voltage drop of ESS1 and tolerance of trip point (typically $1.1 \times I_N = 1.05...1.25 \times I_N$) have been taken into account.		
ESS1-selected rating I_N (in A) →	3	6	→ ESS1 trips after typically 5 s
trip current $I_{ab} = \text{max. } 1.25 \times I_N$ (in A) →	3.75	7.5	
R_{max} in Ohm = $(U_S / I_{ab}) - 0.050$ →	5.07	2.51	

The ESS1 reliably trips from 0 Ohm to max. circuitry resistance R_{max}

Cable cross section A in mm ² →	0.14	0.25	0.34	0.5	0.75	1	1.5
cable length L in meter (= single length) ↓	cable resistance in Ohm = $(R_0 \times 2 \times L) / A$						
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

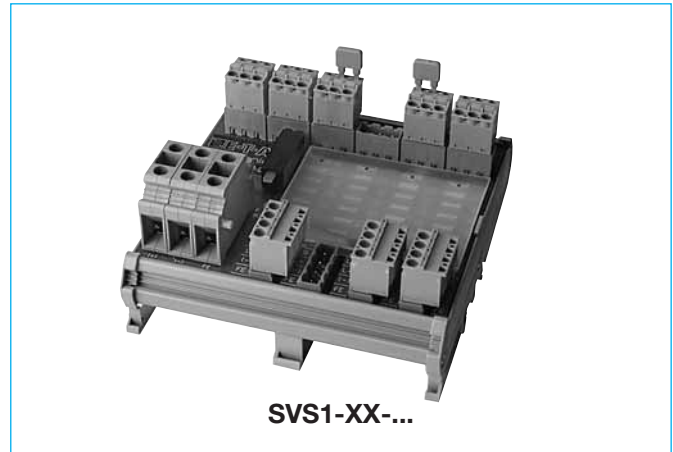
Example 1:	max. length at 1.5 mm ² and 3 A	214 m →
Example 2:	max. length at 1.5 mm ² and 6 A	106 m →
Example 3:	mixed wiring: (Control cabinet – sensor/actuator level)	$R_1 = 40\text{ m in } 1.5\text{ mm}^2$ and $R_2 = 5\text{ m in } 0.25\text{ mm}^2$: $R_1 = 0.95\text{ Ohm}$, $R_2 = 0.71\text{ Ohm}$ Total (R1 + R2) = 1.66 Ohm

Description

The E-T-A power distribution system SVS1 is designed to accommodate the electronic circuit breaker series ESSx. It distributes the current supplied by a switch mode power supply up to 40 A to 4, 8, 12 or 16 channels. Mains connection is via screw terminals. The individual circuit breakers can be plugged in. Loads are connected via cage clamp screwless terminals. The power distribution includes integral wiring of the signalisation of the individual channels which can be combined to group signals A and B. The SVS1 can be snapped onto a DIN symmetrical rail.

Features

- Power distribution system for short-circuit limited DC 24 V applications up to max. 40 A continuous load
- Three screw terminals (max. 10 mm²/AWG 8) for:
 - DC 24 V (+) (green)
 - DC 24 V (-) (green)
 - FE (functional earth) (green)
 for connecting the switched-mode power supply
- Modular design ESS1-positions:
 - SVS1-16-...: 16 channels - SVS1-12-...: 12 channels
 - SVS1-08-...: 8 channels - SVS1-04-...: 4 channels
- Load outputs (L) per channel (complete with screwless spring-loaded terminals, wiring 4 x max. 2.5 mm² (AWG 14)/ without connector sleeve):
 - (LB) group output (+) internally bridged across all channels (for special applications)
 - (L+) load output (+), per channel
 - (-) DC 24 V (-)
 - (FE) functional earth
- Signal output (S) per channel (complete with screwless spring-loaded terminals, wiring 3 x max. 2.5 mm² (AWG 14)/ without connector sleeve):
 - (S0) single output
 - (SA) signal group A
 - (SB) signal group B
- 2 Group signal outputs (output or further connection) (complete with screwless spring-loaded terminals, wiring 3 x max. 2.5 mm² (AWG 14)/ without connector sleeve):
 - (SAS) signal group A --> group signal
 - (SBS) signal group B --> group signal
 - (SCS) common return wire for groups A/B (protected by a 1 Amp. E-T-A Circuit Breaker F/SCS)
- Option: control input (E) - not used -



SVS1-XX-...

Ordering information

Type

- SVS1** Power distribution system
- Short-circuit limited DC 24 V applications
 - Max. 40 A continuous load
 - 3 screw terminals max. 10 mm² (AWG 8) for
 - DC 24 V (+) /DC 24 V (-) / functional earth FE

Version, number of channels (K)

- 04** 4 channels (K1...K4)
- 08** 8 channels (K1...K8)
- 12** 12 channels (K1...K12)
- 16** 16 channels (K1...K16)

Load outputs (L) per channel

- L2** load (+), load (-) (on request)
- L3** load (+), load (-), FE (on request)
- L4** 4 load outputs per channel
 - (LB) group output (+) internally bridged across all channels
 - (L+) load output (+), per channel
 - (-) DC 24 V (-)
 - (FE) functional earth

Signal outputs (S)

- S0** without signal outputs (option)
- S1** - with signal output (S) per channel:
 - (S0) single output
 - (SA) signal group A
 - (SB) signal group B
- with group signal outputs:
 - (SAS) signal group A group signal
 - (SBS) signal-group B group signal
 - (SCS) common return wire for groups A/B

Control input (E)

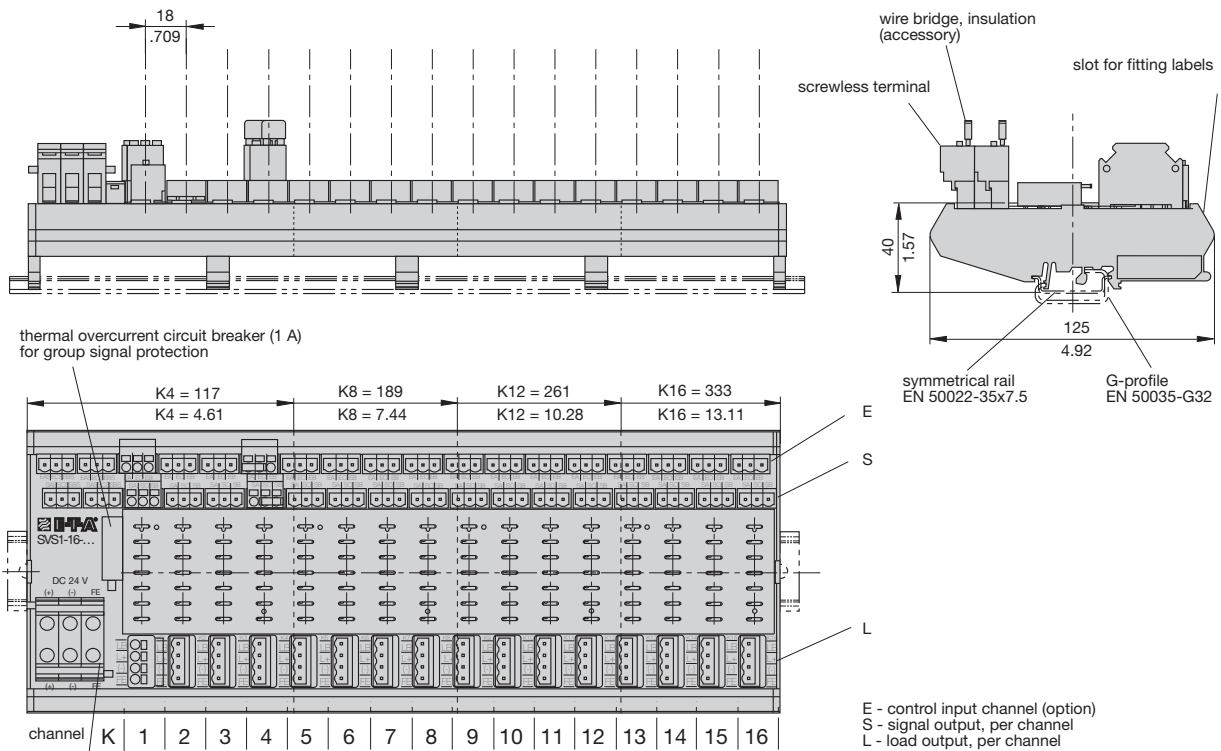
- E0** without control input
- E1** with control input (E) per channel (option)

Fitting variants

- C0** not fitted
- C1** complete with screwless spring-loaded terminals max. 2.5 mm² (AWG 14) without connector sleeve

SVS1 - 16 - L4 - S1 - E0 - C1 ordering example

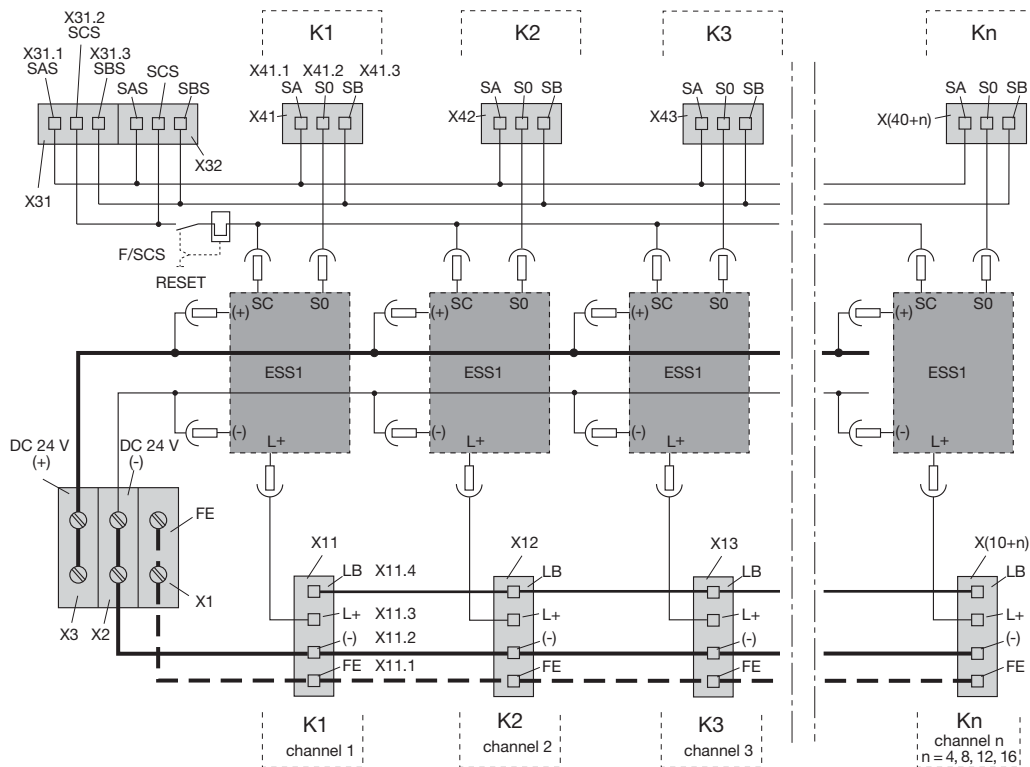
Dimensions SVS1-16



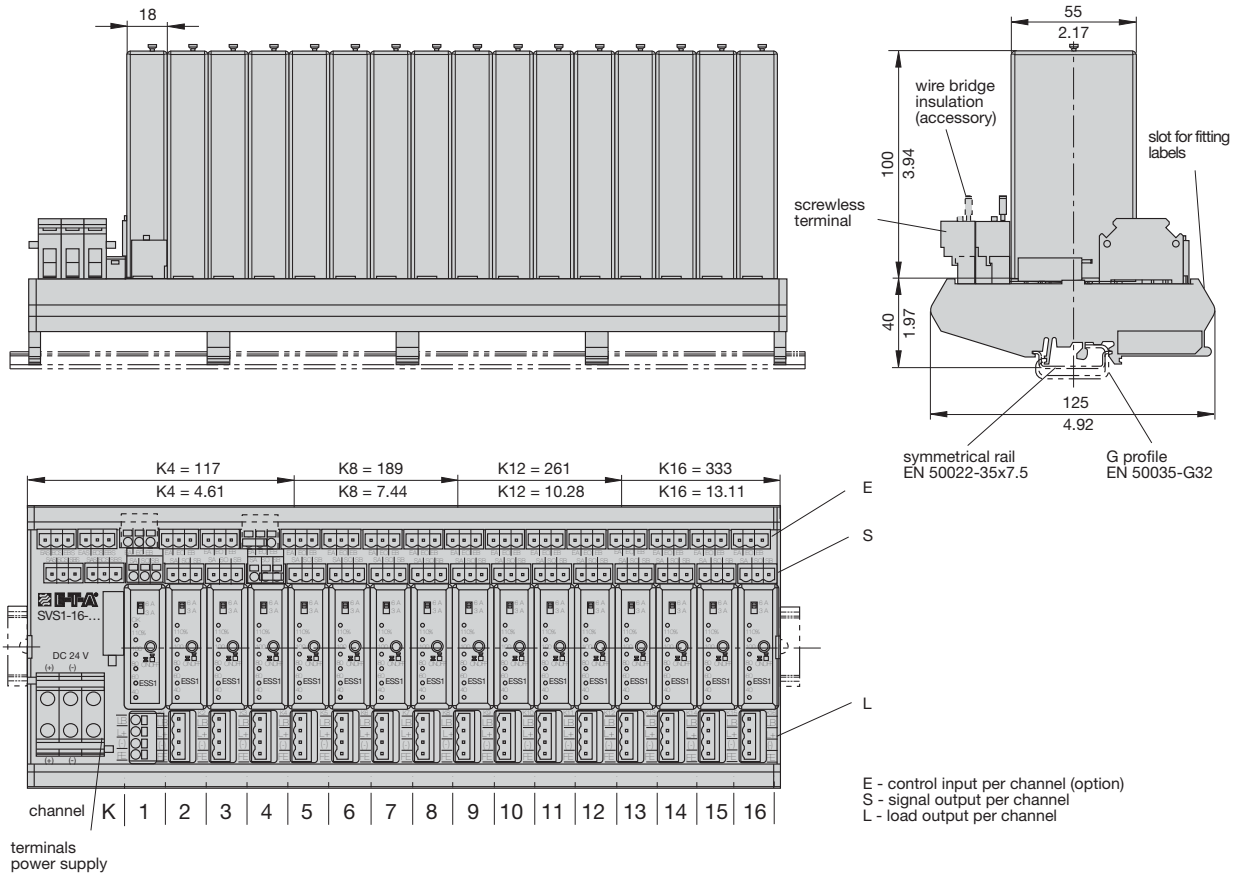
terminals
power supply

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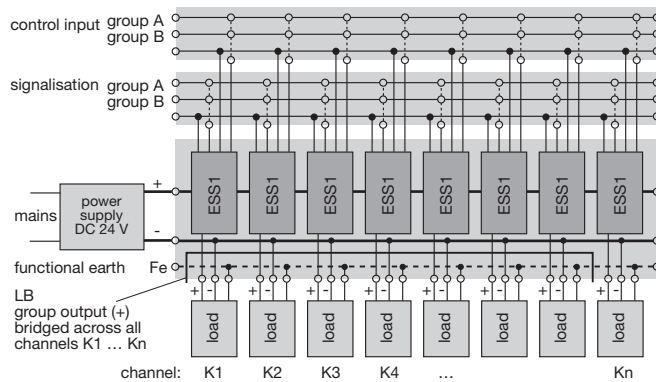
Connection diagram SVS1-(n)



Dimensions SVS1-16, fitted with ESS1



Schematic diagram SVS1-(n)



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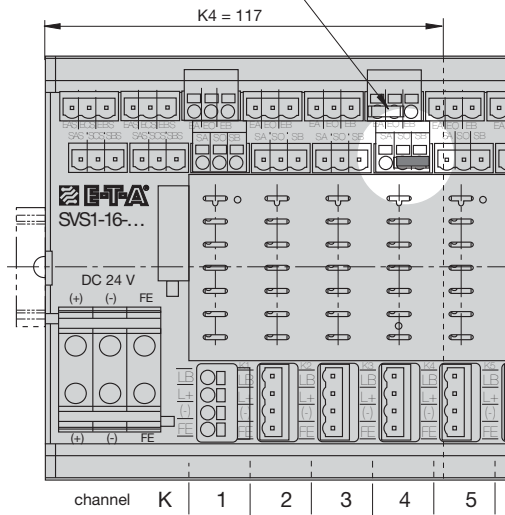
Example of signal group

Signal output of channel K4:

Insulated wire bridge (accessory) placed:
[S0] Π [SB]

This means that [S0] of K4 has been assigned to the group signal of signal group B [SBS].

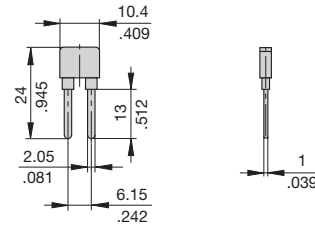
[S0] single output
[SB] signal group B
[SA] signal group A



Accessories

Insulated wire bridge Y 303 881 08

- Group connection of signal outputs (S0) - (SA) or (S0) - (SB)
- Group connection of control inputs (option)



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