

## Description

Type REF16-S is an extension of the product group »Electronic Overcurrent Protection« for DC 24 V applications.

It provides selective protection for all DC 24 V load circuits at a width of only 12.5 mm. This is achieved by a combination of active electronic current limitation in the event of a short circuit and overload disconnection at typically 1.25 times rated current. Plugged into an E-T-A socket, which is available with screw terminals or screwless terminals, the REF16-S provides ease of installation. The sockets allow power distribution and signalling via plug-in type jumpers. In addition the REF16-S latches on when plugged into the socket and by means of coding pins a clear assignment to current ratings or slots is possible. Dimensions are in compliance with the standard DIN 43880 for the installation of built-in units.

DC 24 V switch-mode power supplies are widely used in automation. In the event of an overload, however, they turn down the output voltage which is meant to supply all connected loads. Therefore a failure occurring in an individual load of the system causes a voltage dip in all other load circuits. This does not only lead to an undefined fault status, but may even cause a stoppage of the machinery or plant.

The REF16-S responds much faster to overload conditions than the switch-mode power supply. It limits the max. possible overcurrent to typically 1.25 times rated current (see table 1). This allows connection of capacitive loads up to 20,000  $\mu\text{F}$  with disconnection only in the event of overload or short circuit. For optimal adjustment to the load conditions the REF16-S can be selected in fixed values of 0.5 A...10 A. Status and failure indication is provided by a multi-coloured LED, a potential-free signal contact or by means of an integral short-circuit-proof status output. Remote actuation is possible by a remote reset signal or a remote control signal ON/OFF. The manual ON/OFF button on the device allows intentional start-up of individual load circuits.

As soon as the REF16-S identifies an overload or short circuit condition in a load circuit, it will block the load output transistor and interrupt the current flow in the faulty circuit. Upon remedy of the failure, the load output of the REF16-S will be re-activated by an electronic reset signal or by manual operation of the ON/OFF button.

## Features and benefits

- Selective load protection, electronic trip characteristics
- Active current limitation when connecting capacitive loads up to 20,000  $\mu\text{F}$  and in the event of overload/short circuit
- Fixed current ratings 0.5 A...10 A
- Reliable overload disconnection at typically  $1.25 \times I_N$ , even with long load lines or small cable cross sections
- Low voltage monitoring
- Manual ON/OFF button (S1)
- Control input IN+ for remote ON/OFF signal
- Clear status indication through LED,  $\overline{\text{SF}}$  signal contact F or status output SF/SF
- Electronic reset input RE
- Integral fail-safe element, adjusted to current rating
- Width per channel only 12.5 mm
- Plug-in type for sockets to be mounted side-by-side, with screwless or screw terminals
- Protector plus socket comply with the dimensional requirements of DIN 43880

## Approvals

Authority	Standard	Rated voltage	Current ratings
UL	UL 2367	DC 24 V	0,5 A...10 A
UL *)	UL 508 CSA C22.2 No. 14	DC 24 V	0,5 A...10 A
GL	Rules & Guidelines VI-7-2	DC 24 V	0,5 A...10 A

\*) cULus (listed) using with socket 80PLUS or socket 81PLUS



## Technical data

### Operating data

Operating voltage $U_S$	DC 24 V (18...30 V)
Terminals	LINE+ (1) GND (12(b))
Current rating $I_N$	fixed current ratings: 0.5 A, 1 A, 2 A, 3 A, 4 A, 6 A, 8 A, 10 A
Closed current $I_O$	ON condition: typically 8 mA with status output SF: typically 11 mA with signal output F: typically 17 mA

Status indication by means of

• multi-colour LED:

**Green:**

- unit is ON, load circuit is activated

**Orange:**

- in the event of overload or short circuit until electronic disconnection

**Red:**

- after disconnection on grounds of overload or short circuit

- short circuit until disconnection

- low voltage in ON condition

- device switched OFF via control input IN+

**OFF:**

- manually switched off via ON/OFF button no operating voltage

- status output SF

• potential-free signal contacts F

• status output SF/SF

• ON/OFF/ condition of switch S1

### Load circuit

Load output	Power-MOSFET switching output (high side switch)
Terminal	LOAD+ (2)
Overload and short circuit disconnection	typically $1.25 \times I_N$ with active current limitation
Trip times	see time / current characteristic typically 80...800 ms depending on rated current (see table 1)
Temperature disconnection	internal temperature monitoring an electronic disconnection
Low voltage monitoring of operating voltage	OFF: at typically < 14 V ON: at typically > 17 V with automatic ON/OFF

## Technical data

Starting delay $t_{Start}$	typically 2 ms after every switch-on after reset and after applying $U_S$
Disconnection of load circuit	electronic disconnection without physical isolation
Leakage current in load circuit in OFF condition	typically 1 mA
Capacitive loads	up to 20,000 $\mu$ F
Free-wheeling circuit	external free-wheeling diode recommended with inductive load

Several load outputs must not be connected in parallel

### Signal output SF / REF16-S101/102

Electrical data	potential-free signal contact max. DC 30 V / 0.5 A, min. 10 V / 10 mA
REF16-S101 terminal: Si (11(a))/Si (14(c))	auxiliary contact, make contact open in OFF or fault condition
REF16-S102 terminal: Si (11(a))/Si (14(c))	auxiliary contact, break contact closed in OFF or fault condition

### Status output SF / REF16-S114/124

#### Statusausgang SF / REF16-S117/127

Electrical data	Plus-switching signal output, connects $U_B$ to terminal SF (14(c)) Data: DC 24 V / max. 0.2 A (short-circuit-proof). The status output is internally blocked against GND with a 10 kOhm resistor.
Status output SF	REF16-S114/124, at $U_B = + 24$ V Connection: SF (14(c)) + 24 V level at status output anytime when: <ul style="list-style-type: none"> <li>● device is in operating condition</li> <li>● load output is connected/green LED is lighted</li> </ul> 0 V level at status output anytime when: <ul style="list-style-type: none"> <li>● device is OFF or in error mode</li> </ul>
Status output $\overline{SF}$	REF16-S117/127, at $U_B = + 24$ V Connection: SF (14(c)) 0 V level at status output anytime when: <ul style="list-style-type: none"> <li>● device is in operating condition</li> <li>● load output is connected / green LED is lighted</li> </ul> + 24 V level at status output anytime when: <ul style="list-style-type: none"> <li>● device is OFF or in error mode</li> </ul>

### Signal delay of signal output (F) or status output (SF)

OK condition	typically 20 ms
Fault condition	typically 200 ms
Display of fault condition	signal output or status output is in fault condition when <ul style="list-style-type: none"> <li>● the unit is in the OFF condition               <ul style="list-style-type: none"> <li>- due to an overcurrent disconnection</li> <li>- due to power failure</li> <li>- due to low voltage</li> <li>- due to ON/OFF button operation</li> <li>- due to external control input</li> </ul> </li> </ul>

## Technical data

### Control input IN+ / REF16-S114/117

Electrical data	voltage: max. + DC 30 V high > DC 8 V $\leq$ DC 30 V low $\leq$ DC 3 V > 0 V power consumption typically 2.6 mA (+ DC 24 V) signal delay typically 5 ms
Control signal IN + terminal: IN+ (11(a))	+ 24 V level (HIGH): device will be switched on by a remote ON/OFF signal. 0 V level (LOW): device will be switched off by a remote ON/OFF signal
Switch S1 ON/OFF	Unit can only be switched on with S1 if a HIGH level is applied to IN+

### Reset input RE / REF16-S124/127

Electrical data	voltage: max. + DC 30 V high > DC 8 V $\leq$ DC 30 V low $\leq$ DC 3 V > 0 V power consumption typically 2.6 mA (+ DC 24 V) min. pulse duration 20 ms
Reset signal RE terminal: RE (11(a))	The electronically blocked REF16-S124/127 may remotely be reset via an external momentary switch due to the falling edge of a + DC 24 V pulse. This reset signal can be applied to all devices connected in parallel. Such a wiring is made possible by means of the socket accessory. Its effect will be that all blocked devices will be reset. Switched on devices remain unaffected.

## General data

Fail-safe element	integral fail-safe element adjusted to current rating (back-up fuse) see table 1
Blade terminals	6.3 mm to DIN 46244-A6.3-0.8
Housing material	moulded
Mounting	plug-in type with sockets including coding pins and retaining clips
Ambient temperature	-25...+50 °C (without condensation, see EN 60204-1)
Storage temperature	-40...+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	IEC 60529, DIN VDE 0470 operating area: IP30 terminal area: IP00
EMC requirements (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	max. DC 32 V (load circuit)
Insulation resistance (OFF condition)	n/a, only electronic disconnection
Approvals	CE-logo UL 2367, File # E306740, UL 508, File # E322549, GL, Certificate # 61469-13HH
Dimensions (W x H x D)	12.1 x 52 x 45 mm
Mass	approx. 20 g

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

Rated current $I_N$	typical voltage drop $U_{ON}$ at $I_N$	typical active current limitation	trip time	fail-safe element	max. load current at 100 % ON duty	
					$T_U = 40\text{ °C}$	$T_U = 50\text{ °C}$
0.5 A	85 mV	$1.25 \times I_N$	800 ms	2 A	0.5 A	0.5 A
1 A	140 mV	$1.25 \times I_N$	800 ms	2 A	1 A	1 A
2 A	100 mV	$1.25 \times I_N$	400 ms	4 A	2 A	2 A
3 A	120 mV	$1.25 \times I_N$	300 ms	6.3 A	3 A	3 A
4 A	100 mV	$1.25 \times I_N$	200 ms	6.3 A	4 A	4 A
6 A	130 mV	$1.25 \times I_N$	130 ms	10 A	6 A	5 A
8 A	100 mV	$1.25 \times I_N$	100 ms	15 A	8 A	7.2 A
10 A	120 mV	$1.25 \times I_N$	80 ms	15 A	10 A	9 A

**Caution:**

When mounted side-by-side without convection, the REF16-S should not carry more than 80 % of its rated load continuously (100 % ON duty) due to thermal effects.

**Ordering information**

**Type No.**

<b>REF16</b>	Electronic circuit breaker with current limit
<b>Mounting and design</b>	
<b>S</b>	plug-in type
<b>Version</b>	
<b>1</b>	without physical isolation
<b>Signal input</b>	
<b>0</b>	without signal input
<b>1</b>	with control input IN+ (only REF16-S114, REF16-S117)
<b>2</b>	with reset input RE (only REF16-S124, REF16-S127)
<b>Signal output</b>	
<b>0</b>	without signal output (only REF16-S100)
<b>1</b>	signal output F
	signal contact, make contact (only REF16-S101)
<b>2</b>	signal output F
	signal contact, break contact (only REF16-S102)
<b>4</b>	status output SF (only REF16-S114, REF16-124)
<b>7</b>	status output SF inverted (only REF16-S117, REF16-S127)
<b>Operating voltage</b>	
<b>DC 24 V</b>	rated voltage DC 24 V
	<b>Rated current</b>
	<b>0.5 A</b>
	<b>1 A</b>
	<b>2 A</b>
	<b>3 A</b>
	<b>4 A</b>
	<b>6 A</b>
	<b>8 A</b> (only REF16-S100/114/124/117/127)
	<b>10 A</b> (only REF16-S100/114/124/117/127)

REF16 - S 1 0 1 - DC 24 V 4 A ordering example

**Class 2**

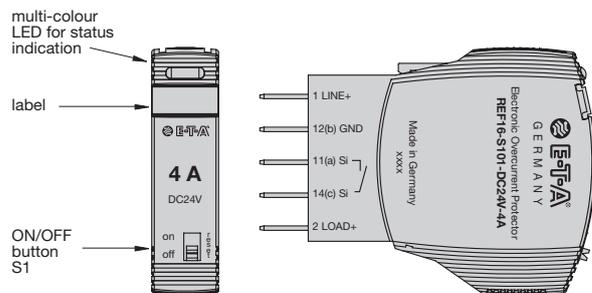
Meets requirement for Class 2 current limitation (REF16-S...-0,5 A/1 A/2 A/3 A)

**Caution**

- The user has to ensure that the cable cross sections of the relevant load circuit are suitable for the current rating of the REF16-S used.
- Automatic start-up of the machinery after a shut-down must be prevented (Machinery Directive 2006/42/EG and EN 60204-1), e.g. by means of a safety PLC. In the event of a short circuit or overload the load circuit will be disconnected electronically by the REF16-S.

**Terminals**

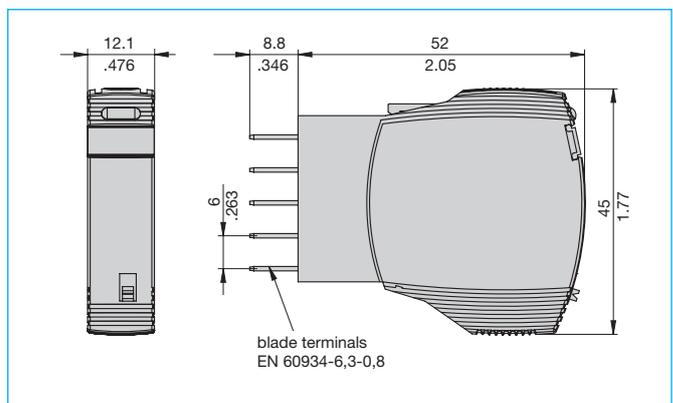
**Example of REF16-S101-DC24V-4A**



**Pin assignment**

Pin no.	1	12(b)	11(a)	14(c)	2
REF16-S101/102	LINE+	GND	Si	Si	LOAD+
REF16-S114	LINE+	GND	IN+	SF + 24 V	LOAD+
REF16-S124	LINE+	GND	RE	SF + 24 V	LOAD+
REF16-S117	LINE+	GND	IN+	SF	LOAD +
REF16-S127	LINE+	GND	RE	SF	LOAD +

**Dimensions**



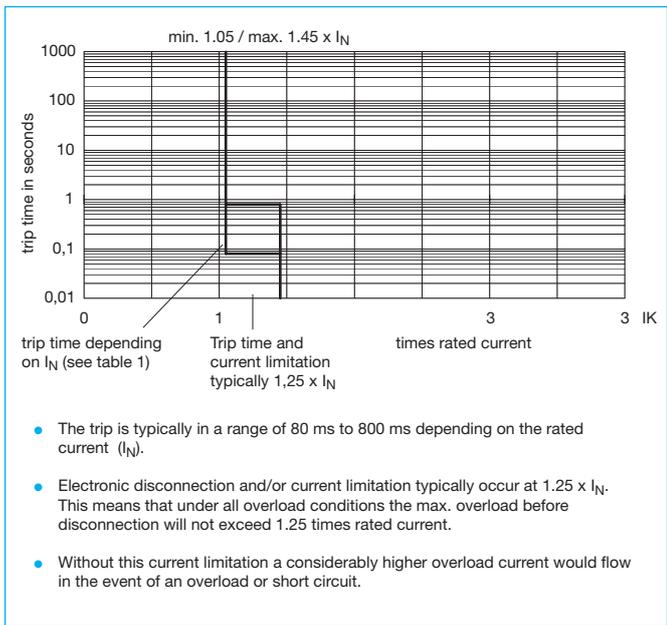
**Description**

Single pole, with PT connection technology, to accommodate 1-pole circuit protector type REF16-S.

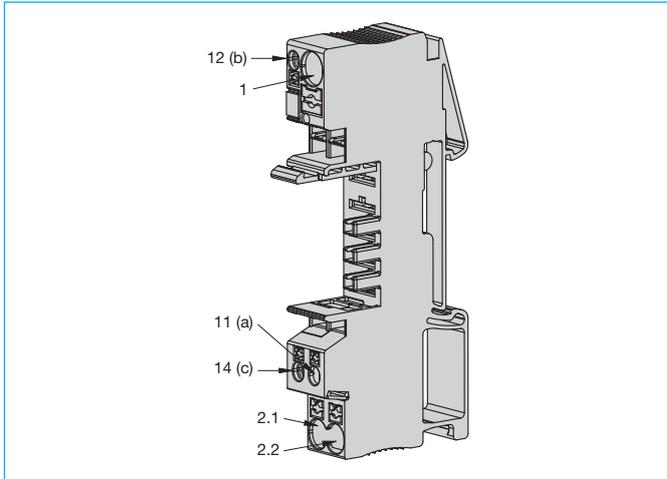
**Part number: 80PLUS-PT01**

- Push-in design: push the stripped wire (cross section  $\geq 0.25 \text{ mm}^2$ , rigid or with wire end ferrule) into the round hole of the terminal without using a tool
- For smaller cable cross sections or flexible wires without wire end ferrule you have to push in the orange push button to open the spring.
- For release push in the orange push button with a screw driver.

**Time/current characteristic ( $T_U = 25 \text{ }^\circ\text{C}$ )**

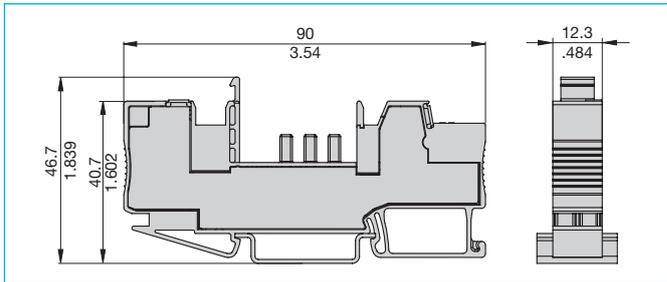


**Line connection**



1	LINE +
2.1 / 2.2	LOAD +
11 (a)	Si or IN+ or RE
14 (c)	Si or SF
12 (b)	GND

**Dimensions**

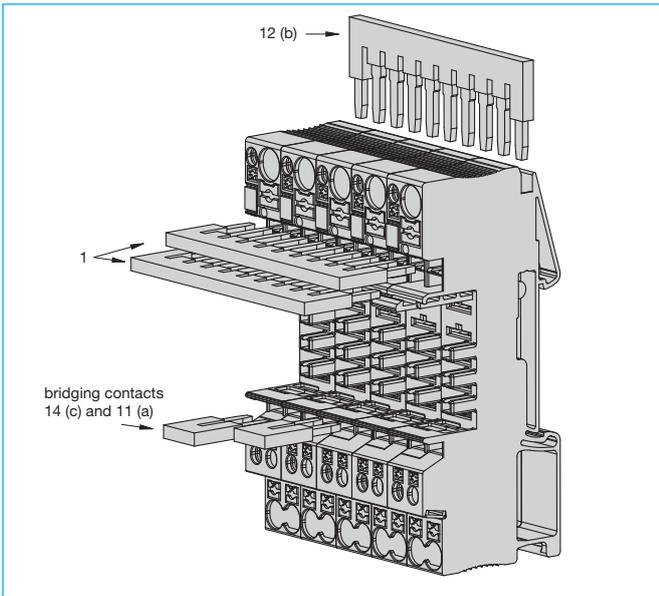


**Cable cross section**

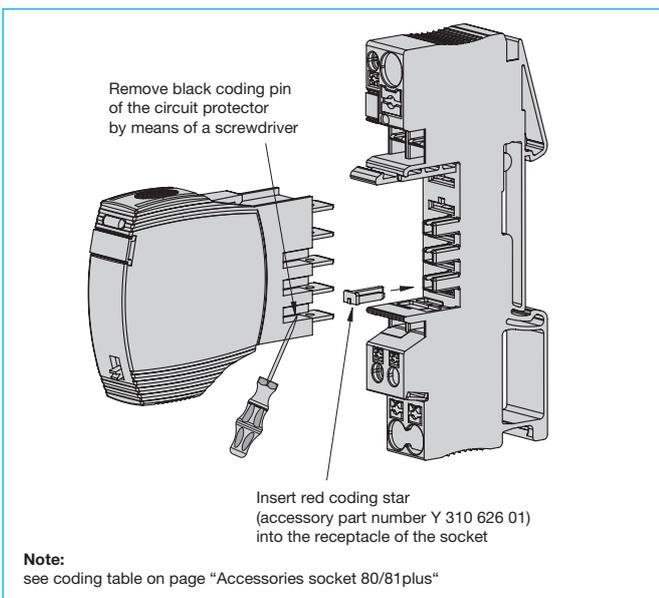
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	Cross section when opening the push-in terminal	Cable cross section directly pluggable	stripped wire length
terminal 1 (line)	- rigid: 0.5...6 mm <sup>2</sup> - flexible: 0.5...6 mm <sup>2</sup> - flexible with wire end ferrule: (with plastic sleeve) 0.5...6 mm <sup>2</sup> (10 mm <sup>2</sup> ) - flexible with wire end ferrule: (without plastic sleeve) 0.5...6 mm <sup>2</sup> - flexible with TWIN-wire end ferrule 0.5...1 mm <sup>2</sup>	- rigid 1...6 mm <sup>2</sup> - flexible with wire end ferrule: (with plastic sleeve) 0.5...6 mm <sup>2</sup> (10 mm <sup>2</sup> ) - flexible with wire end ferrule: (without plastic sleeve) 0.5...6 mm <sup>2</sup>	12 mm
terminals 2.1 and 2.2 (load)	- rigid: 0.2...6 mm <sup>2</sup> - flexible: 0.2...4 mm <sup>2</sup> - flexible with wire end ferrule: (with plastic sleeve) 0.25...4 mm <sup>2</sup> - flexible with wire end ferrule: (without plastic sleeve) 0.25...4 mm <sup>2</sup> - flexible with TWIN-wire end ferrule: 0.5...1 mm <sup>2</sup>	- rigid: 0.5...6 mm <sup>2</sup> - flexible with wire end ferrule: (with plastic sleeve) 0.75...4 mm <sup>2</sup> - flexible with wire end ferrule: (without plastic sleeve) 0.5...4 mm <sup>2</sup>	12 mm
terminals 11, 12 and 14 (signalling)	- rigid: 0.14...1.5 mm <sup>2</sup> - flexible: 0.14...1.5 mm <sup>2</sup> - flexible with wire end ferrule: (with plastic housing) 0.14...1.5 mm <sup>2</sup> - flexible with wire end ferrule: (without plastic sleeve) 0.14...1 mm <sup>2</sup>	- rigid: 0.25...1.5 mm <sup>2</sup> - flexible with wire end ferrule: (with plastic housing) 0.34...1.5 mm <sup>2</sup> - flexible with wire end ferrule: (without plastic sleeve) 0.34...1 mm <sup>2</sup>	8 mm

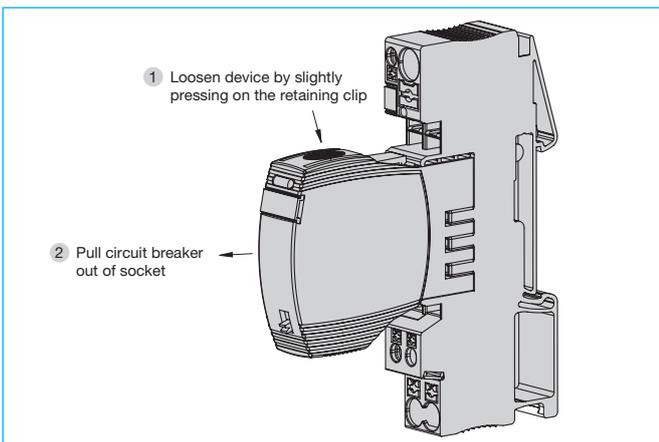
**Insertion of busbars/jumpers**



**Coding of REF16-S and socket 80plus following the lock-key-principle**

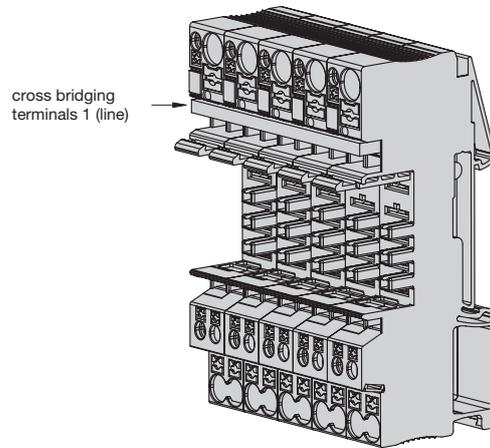


**Replacing a REF16-S**

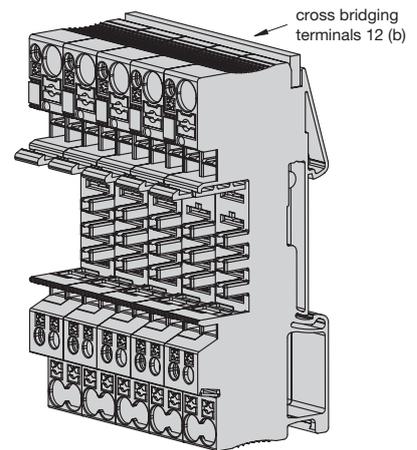


**Application examples**

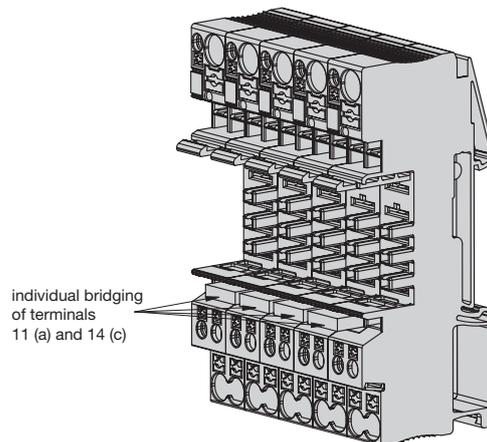
**Common line entry**



**Common line entry GND**



**Series connection of aux. contacts (REF16-S101)**

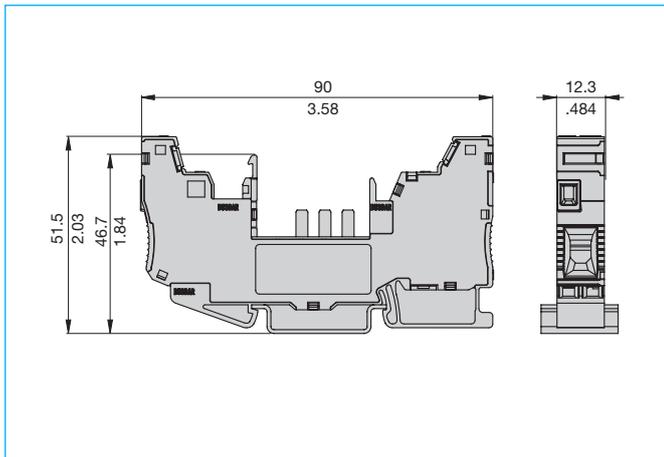


**Description**

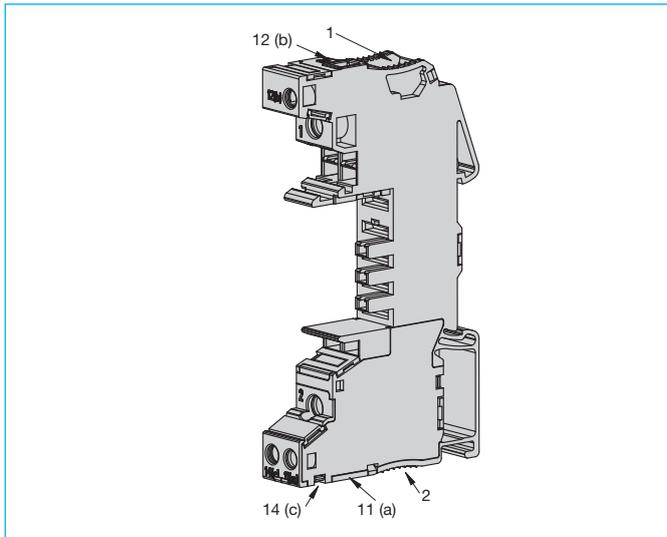
Single pole, with PT connection technology, to accommodate 1-pole circuit protector type REF16-S.

Part number: 81PLUS-UT01

**Dimensions**



**Line connection**



1	LINE +
2	LOAD +
11 (a)	Si or IN+ or RE
14 (c)	Si or SF
12 (b)	GND

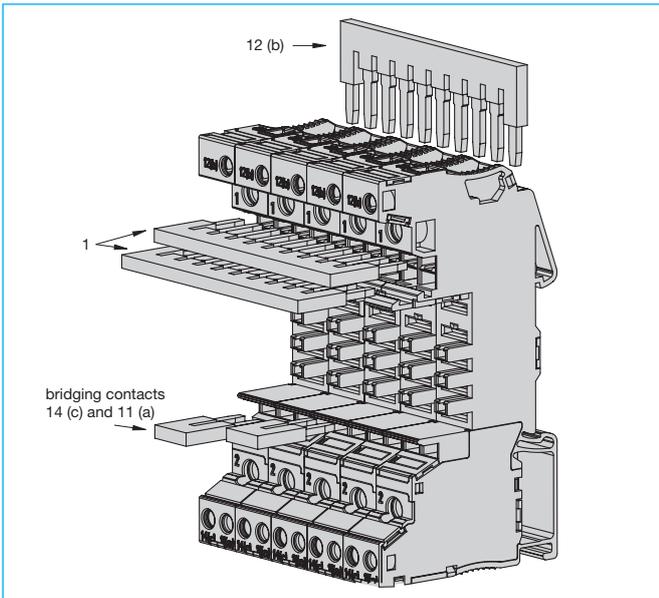
**Cable cross section**

	thread size	max. cable cross section		stripped wire length	tightening torque
terminals 1 (line) and 2 (load)	M4	<b>Wire</b> - rigid (single-wire or multistrand) - flexible: - flexible with wire end ferrule: (with and without plastic sleeve) - flexible with TWIN-wire end ferrule:	0.5...16 mm <sup>2</sup> 0.5...10 mm <sup>2</sup> 0.5...10 mm <sup>2</sup> 0.5...6 mm <sup>2</sup>	10 mm	1.2 Nm
		<b>Multi-lead connection (two wires with identical cross section)</b> - rigid (single-wire or multistrand) - flexible: - flexible with TWIN-wire end ferrule (without plastic sleeve)	0.5...4 mm <sup>2</sup> 0.5...4 mm <sup>2</sup> 0.5...2.5 mm <sup>2</sup>		
terminals 11, 12 and 14 (signalling)	M3	<b>Wire</b> - rigid: - flexible: - flexible with wire end ferrule: (with and without plastic sleeve)	0.14...4 mm <sup>2</sup> 0.14...4 mm <sup>2</sup> 0.14...2.5 mm <sup>2</sup>	9 mm	0.5 Nm
		<b>Multi-lead connection (two wires with identical cross section)</b> - rigid: - flexible: - flexible with TWIN AEH: (with plastic sleeve) - flexible with AEH: (without plastic sleeve)	0.14...1.5 mm <sup>2</sup> 0.14...1.5 mm <sup>2</sup> 0.5...1.5 mm <sup>2</sup> 0.14...1.5 mm <sup>2</sup>		

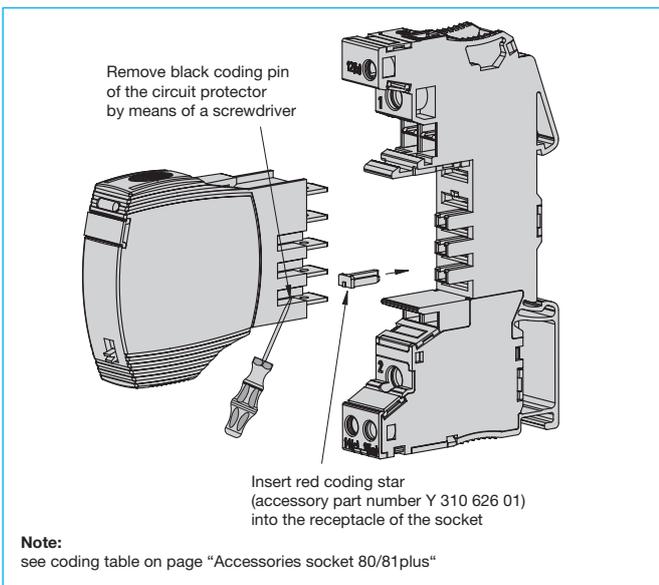
This is a metric design and millimeter dimensions take precedence ( $\frac{\text{mm}}{\text{inch}}$ )

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.

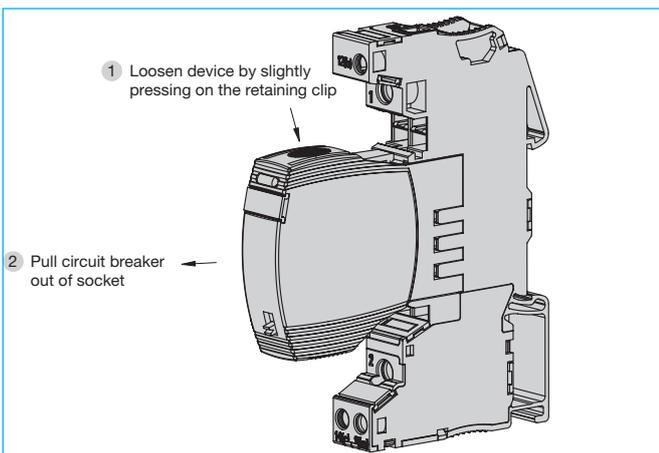
**Insertion of busbars/jumpers**



**Coding of REF16-S and socket 81plus following the lock-key-principle**

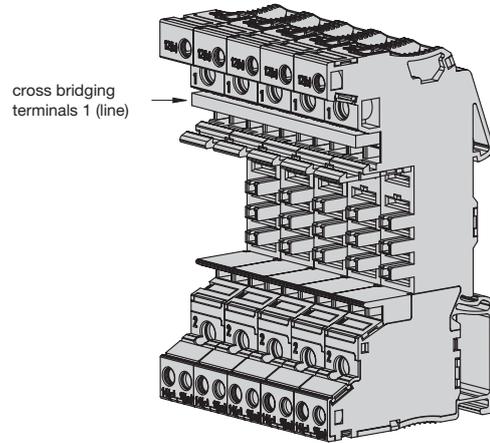


**Replacing a REF16-S**

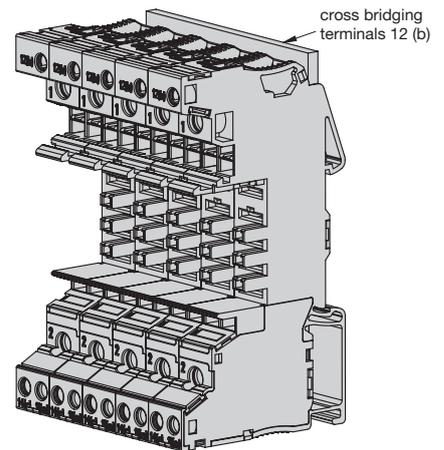


**Application examples**

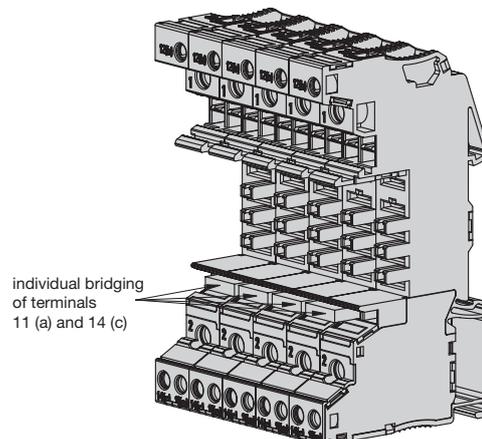
**Common line entry**



**Common line entry GND**



**Series connection of aux. contacts (REF16-S101)**



## Accessories

Accessories for Socket 80plus and Socket 81plus	part number	packing qty
busbar, for cross-bridging in the bridge shaft, red, 2 poles *	Y 310 624 01	50
busbar, for cross-bridging in the bridge shaft, red, 4 poles *	Y 310 625 01	50
busbar, for cross-bridging in the bridge shaft, red, 10 poles *	Y 308 823 11	10
busbar, for cross-bridging in the bridge shaft, blue, 2 poles *	Y 310 624 02	50
busbar, for cross-bridging in the bridge shaft, blue, 4 poles *	Y 310 625 02	50
busbar, for cross-bridging in the bridge shaft, blue, 10 poles *	Y 308 823 12	10
busbar, for cross-bridging in the bridge shaft, grey, 2 poles *	Y 310 624 03	50
busbar, for cross-bridging in the bridge shaft, grey, 10 poles *	Y 308 823 13	10
coding star, red, with 4 coding pins each	Y 310 626 01	50
label	X 222 977 50	50
busbar/jumper, 10 poles 	coding star 	label 

\* Max. bridge current: 32 A

When using two busbars/jumpers (in both bridge shafts of terminal 1), the max. current capacity is 41 A.

**Caution:**

When using busbars/jumpers for bridging the aux. contacts (11(a), 12(b) and 14(c)), the max. bridge current is 4 A.

## Coding table

**Coding example:**

Avoid hazardous oversize current ratings

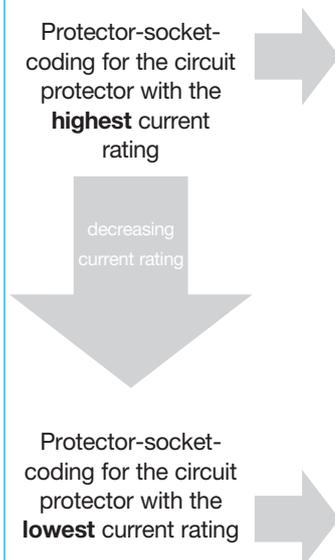
**Your benefit:**

Coded electronic overcurrent protector can no longer be inserted into slots with a lower current rating coding.

**Coding of electronic overcurrent protector and sockets**

**Sockets:** Insert coding pins in accordance with coding table into receptacles of the sockets.

**Electronic Overcurrent Protector:** Remove coding pins in accordance with coding table by means of screw driver.



Coding table	Example
Protector 1 1 1	10 A
Socket 0 0 0	
Protector 1 1 0	8 A
Socket 0 0 1	
Protector 1 0 1	6 A
Socket 0 1 0	
Protector 1 0 0	4 A
Socket 0 1 1	
Protector 0 1 1	3 A
Socket 1 0 0	
Protector 0 1 0	2 A
Socket 1 0 1	
Protector 0 0 1	1 A
Socket 1 1 0	
Protector 0 0 0	0.5 A
Socket 1 1 1	

1: With PIN / 0: No PIN

