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ECP...

Selective circuit breaker

CLIPLINE

Data sheet
100464_en_05

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1 Description

The **ECP...** electronic circuit breaker, which has a design width of just 12.5 mm, selectively protects all 24 V DC load circuits. This is achieved using a combination of active electronic current limitation and proven circuit breaker technology including electrical isolation. The ECP... can be plugged onto the proven TMCP SOCKET M base, which ensures quick and easy mounting.

The ECP... can be used in applications that cover all aspects of the switched-mode power supply unit. In the event of an overload, switched-mode power supply units reduce the output voltage, which means that all the connected loads are no longer sufficiently supplied. This means that if an error occurs in one load of a system, the voltage will be affected in all load circuits.

The ECP... solves this problem by always limiting the maximum possible current to 1.8 times (or 1.5 times) the value of the set nominal current. Capacitive loads can thus be switched on and loads are only switched off in the event of an overload or short circuit.

An LED and integrated signal contacts indicate the operating and error states.

1.1 Properties

- Selective load protection with electrical isolation in the event of an error
- All load types can be connected (small DC motors, etc. on request)
- Active current limitation is typically $1.8 \times I_N$ (or typically $1.5 \times I_N$ at $I_N = 8 \text{ A}$ or 10 A) when capacitive loads up to $20,000 \mu\text{F}$ are switched on and in the event of overload/short circuit
- Electronic shutdown characteristic curve
- Safe overload shutdown from $1.1 \times I_N$, even for long load cables or low cable cross-sections
- Nominal current can be selected in fixed current strengths from $1 \text{ A} \dots 10 \text{ A}$ or set to two levels ($1 \text{ A}/2 \text{ A}$ or $3 \text{ A}/6 \text{ A}$) using switches on the device
- Manual on/off switch (push/push actuation)
- Clear indication
- Design width of just 12.5 mm per channel
- Can be plugged into a modular base



NOTE: Make sure that the cable cross-section of the relevant load circuit is adapted to the nominal current of the ECP... used.



Make sure you always use the latest documentation.
It can be downloaded at www.phoenixcontact.net/download.



This data sheet is valid for all products listed on the following page:

2 Ordering data

Selective circuit breaker

Description	Type	Order No.	Pcs./Pkt.
Selective circuit breaker , can be plugged into a TMCP base, indication by means of two-color LED, floating signal contact, on/off pushbutton			
1 A/2 A nominal current	ECP 1-2	0912018	5
2 A nominal current	ECP 2	0911034	5
3 A/6 A nominal current	ECP 3-6	0916536	5
3 A nominal current	ECP 3	0911047	5
6 A nominal current	ECP 6	0912033	5
8 A nominal current	ECP 8	0912019	5
10 A nominal current	ECP 10	0912020	5

Accessories

Description	Type	Order No.	Pcs./Pkt.
Modular base , 2-pos., designed to accommodate two 1-pos. circuit breakers, width of 12.5 mm per position	TMCP SOCKET M	0916589	10
Base termination elements , can be plugged into both the left and right-hand side, contain the connections for the reset inputs/group query	TMCP CONNECT LR	0916592	3
Spring lock , for mechanical locking if mounted overhead, 1-pos.	ECP-LOCK	0912021	10
Zack marker strip , 10-section, for labeling the center of the terminal block	ZB 6	See CLIPLINE catalog	
Fixed bridge , plug-in, not insulated, 500 mm long, can be cut to length, for distribution of the supply potential in the base, $I_{max} = 50 A$	FBST 500 TMCP	0916615	20
Continuous plug-in bridge , 500 m long, can be cut to length, for potential distribution, $I_{max} = 32 A$, red	FBST 500-PLC RD	2966786	20
Continuous plug-in bridge , 500 m long, can be cut to length, for potential distribution, $I_{max} = 32 A$, blue	FBST 500-PLC BU	2966692	20
Signal bridge , plug-in, for bridging group indication when there is a free slot on the TMCP SOCKET M base, $I_{max} = 1 A$	TCMP SB	0916602	6

3 Technical data

Operating data

Nominal voltage	24 V DC
DC supply voltage	18 V DC ... 32 V DC
Nominal current I_N	Depending on the selected item version: Fixed current strength: 2 A, 3 A, 4 A, 6 A, 8 A, 10 A Adjustable: 1 A/2 A or 3 A/6 A
Current consumption I_0	13 mA, typical
Tripping current (bimetal)	0.3 A, typical (only in the event of an error, until electrically shut down)
Indication of the operating state	<ul style="list-style-type: none"> – Two-color LED <ul style="list-style-type: none"> Green: Device switched on/Power MOSFET controlled Orange: In the event of overload or short circuit until electrically isolated OFF: OFF position of pushbutton – Floating signal contact – OFF position of pushbutton
Protection against polarity reversal of U_B	Internal bimetal (failsafe element) triggered, pushbutton moves to OFF position

Load circuit

Load output	Power MOSFET output (positive switching)
Overload shutdown	$1.1 \times I_N$ (1.05 ... 1.35 $\times I_N$), typical
Short circuit current I_K	Active current limitation, $1.8 \times I_N$ or $1.5 \times I_N$, maximum (See "Time-current characteristic" on page 5)

Load circuit (continued)	
Shutdown time	5 s at $I_L > 1.1 \times I_N$, typical 5 s ... 0.1 s at $I_L > 1.8 \times I_N$ (or $1.5 \times I_N$), typical See "Voltage drop, current limitation, maximum load current" on page 4
R_i when plugged in	$\approx 50 \text{ m}\Omega$
Temperature shutdown	Internal temperature monitoring with electrical isolation
Undervoltage monitoring of load output	With hysteresis, no reset required: OFF at $U_B < 8 \text{ V}$ ON at $U_B > 16 \text{ V}$
Switch-on delay t_{Start}	0.3 s, typical after each switch-on and after applying U_B
Electrical isolation of the load circuit	Single-pos. (switch contact) – By push/push actuation of the blue pushbutton – After electronic error shutdown (overload, short circuit) – In the event of polarity reversal
Free running circuit	External free-wheeling diode recommended on inductive load
Parallel connection of multiple load outputs	Not permitted
Auxiliary contacts	Pin 11 (GND) Pin 12 (individual indication) Pin 13/14 (group query)
Switching capacity I_{CN}	Active current limitation
Error message, signal output	
Error message F	Floating signal contact, switches simultaneously with electrical isolation, 30 V DC/0.5 A, maximum; 10 V/ 0 mA, minimum
Group indication	Pushbutton ON: Signal contact SC-S0 is closed (SC-SI is open) OFF: Signal contact SC-S0 is open (SC-SI is closed)
Optical indication	LED lights up orange (until electrically isolated)
General data	
Width x length	12.5 mm x 60 mm
Weight	65 g
Service life at $1 \times I_N$	10,000
Height	
On NS 35/7.5... DIN rail	144 mm
On NS 35/15... DIN rail	151.5 mm
Ambient temperature	0°C ... +50°C (no condensation, see EN 60204-1)
Storage temperature	-20°C ... +70°C
Insulation material	PA-F
Inflammability class according to UL 94	V0
Backup fuse	Not required, since a redundant failsafe element is integrated. If the failsafe element has been triggered, the pushbutton is in the OFF position.
Housing fixing	Can be plugged into TMCP SOCKET M modular base
Slip-on connections	6.3 mm according to DIN 46244-A6.3-0.8
Humid heat	96 h/95% relative humidity/40°C according to IEC 60068-2-78, Test Cab climatic class 3K3 according to EN 60721
Degree of protection	Housing: IP30, DIN 40050 Terminal blocks: IP00, DIN 40050

Tests/approvals

Conformance with EMC Directive 2004/108/EC

Noise emission: EN 50081-1

Noise immunity: EN 61000-6-2

Isolation coordination (IEC 60934)

0.5 kV/pollution degree 2, increased isolation in the actuation area

Dielectric strength

Actuation area: 1000 V AC test voltage

Installation area: 500 V AC test voltage

Load circuit signal contact: 500 V AC test voltage

Insulation resistance (OFF state)

> 100 M Ω (500 V DC) between LINE (+) - LOAD (+)

Vibration resistance

3g, test according to IEC 60068-2-6 Test Fc

Approvals



UL 1077, File E140459 Supplementary Protectors for Use in Electrical Equipment

CE

Voltage drop, current limitation, maximum load current

Nominal current I_N	Typical voltage drop U_{ON} at I_N	Active current limitation (typical)	Maximum load current at 100% operating factor, $T_A = 40^\circ\text{C}$	Maximum load current at 100% operating factor, $T_A = 50^\circ\text{C}$
2 A	180 mV	$1.8 \times I_N$	2 A	2 A
3 A	140 mV	$1.8 \times I_N$	3 A	3 A
4 A	190 mV	$1.8 \times I_N$	4 A	4 A
6 A	280 mV	$1.8 \times I_N$	6 A	5 A
8 A	220 mV	$1.5 \times I_N$	8 A	7 A
10 A	280 mV	$1.5 \times I_N$	10 A	9 A
1 A/2 A	140 mV/280 mV	$1.8 \times I_N$	1 A/2 A	1 A/2 A
3 A/6 A	140 mV/280 mV	$1.8 \times I_N$	3 A/6 A	3 A/5 A



When mounted in rows without convection cooling, due to the thermal effect during continuous operation (100% operating factor) the nominal device current must only be led to a maximum of 80%.

3.1 Block diagram

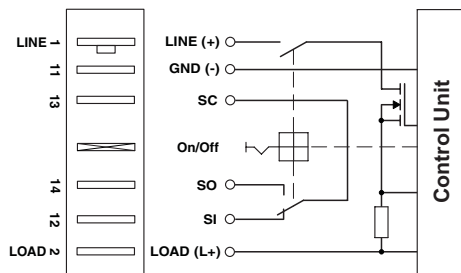


Figure 1 Block diagram

3.2 Dimensions

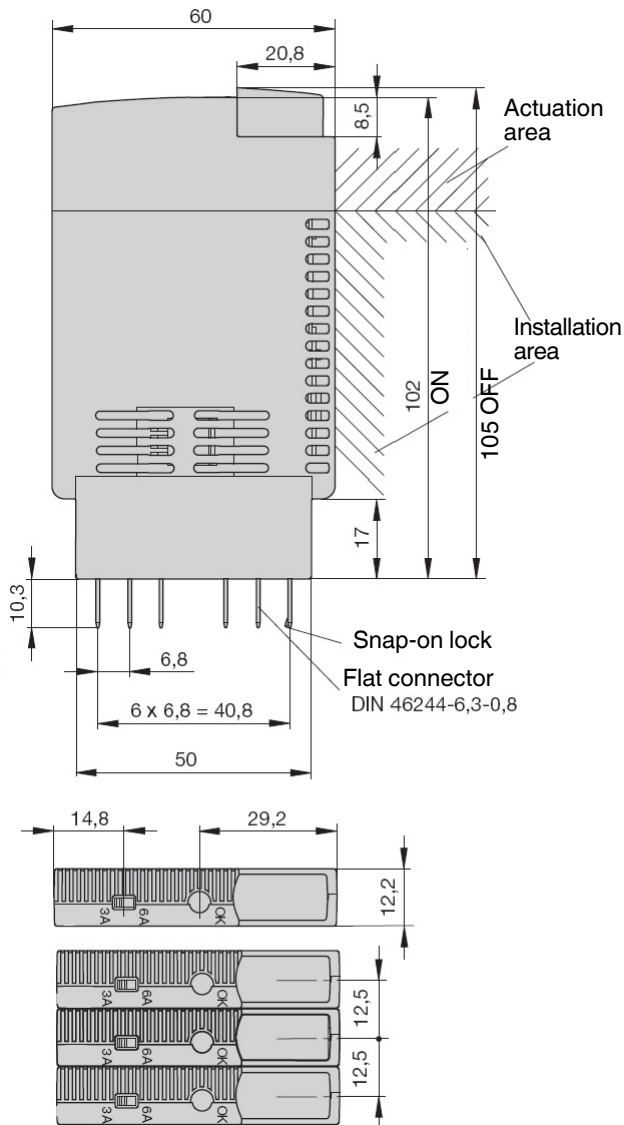


Figure 2 Dimensions (in mm)

3.3 Time-current characteristic ($T_A = 25^\circ\text{C}$)

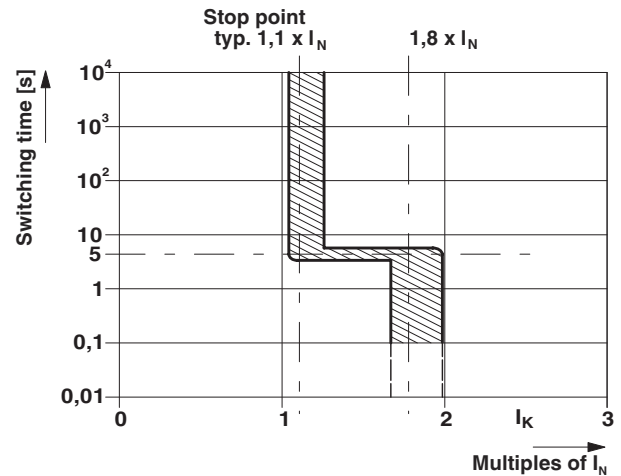


Figure 3 Time-current characteristic

- In the $1.1 \dots 1.8 \times I_N^*$ range, the typical shutdown time is 5 s.
 - The electronic current limitation is typically activated from $1.8 \times I_N^*$. This means that under all overload conditions (regardless of the current supply and load circuit resistance), 1.8 times the nominal current* typically flows until shutdown. The shutdown time ranges from 100 ms (short circuit (I_K)) to 5 s (in the event of overload with high cable attenuation)).
 - Without the current limitation typically activated at $1.8 \times I_N^*$, a significantly higher overcurrent would flow in the event of an overload or short circuit.
 - If the ECP... has detected an overload or short-circuit condition, the LED changes from green to orange. When the circuit breaker trips, the LED goes out.
 - The circuit breaker cannot be reset until the integrated bimetal has cooled down (approximately 10 s).
- * Typical current limitation $1.8 \times I_N$ at $I_N = 0.5 \text{ A} \dots 6 \text{ A}$
 Typical current limitation $1.5 \times I_N$ at $I_N = 8 \text{ A} \text{ or } 10 \text{ A}$

3.4 Safe shutdown

Safe shutdown of the ECP... for various supply line lengths and cable cross-sections								
Specific electrical resistance of electrolytic copper $\rho_0 = 0.0178 (\Omega \times \text{mm}^2)/\text{m}$								
$U_B = 19.2 \text{ V DC}$ (80% of 24 V DC)			The voltage drop at the ECP... and the tolerance of the shutdown point (typically $1.1 \times I_N = 1.05 \dots 1.35 \times I_N$) have already been taken into consideration.					
ECP... nominal current setting I_N (in A) →			3 A		6 A		→ ECP... shuts down after typically 3 s ... 5 s	
E.g., Shutdown current $I_{\text{off}} = 1.25 \text{ A} \times I_N$ (in A) →			3.75 A		7.5 A			
R_{max} in Ohm = $(U_B/I_{\text{off}}) - 0.050 \Omega^1$ →			5.07 Ω		2.51 Ω			
ECP... safely trips from 0 Ω up to maximum circuit resistance R_{max}								
Cable cross-section A in mm^2 →		0.14 mm^2	0.25 mm^2	0.34 mm^2	0.5 mm^2	0.75 mm^2	1 mm^2	1.5 mm^2
Distance L in meters (= single length) ↓		Total cable resistance in Ohm = $(R_0 \times 2 \times L)/A$						
		↓	↓	↓	↓	↓	↓	↓
5 m		1.27 Ω	0.71 Ω	0.52 Ω	0.36 Ω	0.24 Ω	0.18 Ω	0.12 Ω
10 m		2.54 Ω	1.42 Ω	1.05 Ω	0.71 Ω	0.47 Ω	0.36 Ω	0.24 Ω
15 m		3.81 Ω	2.14 Ω	1.57 Ω	1.07 Ω	0.71 Ω	0.53 Ω	0.36 Ω
20 m		5.09 Ω	2.85 Ω	2.09 Ω	1.42 Ω	0.95 Ω	0.71 Ω	0.47 Ω
25 m		6.36 Ω	3.56 Ω	2.62 Ω	1.78 Ω	1.19 Ω	0.89 Ω	0.59 Ω
30 m		7.63 Ω	4.27 Ω	3.14 Ω	2.14 Ω	1.42 Ω	1.07 Ω	0.71 Ω
35 m		8.90 Ω	4.98 Ω	3.66 Ω	2.49 Ω	1.66 Ω	1.25 Ω	0.83 Ω
40 m		10.17 Ω	5.70 Ω	4.19 Ω	2.85 Ω	1.90 Ω	1.42 Ω	0.95 Ω
45 m		11.44 Ω	6.41 Ω	4.71 Ω	3.20 Ω	2.14 Ω	1.60 Ω	1.07 Ω
50 m		12.71 Ω	7.12 Ω	5.24 Ω	3.56 Ω	2.37 Ω	1.78 Ω	1.19 Ω
75 m		19.07 Ω	10.68 Ω	7.85 Ω	5.34 Ω	3.56 Ω	2.67 Ω	1.78 Ω
100 m		25.34 Ω	14.24 Ω	10.47 Ω	7.12 Ω	4.75 Ω	3.56 Ω	2.37 Ω
125 m		31.79 Ω	17.80 Ω	13.09 Ω	8.90 Ω	5.93 Ω	4.45 Ω	2.97 Ω
150 m		38.14 Ω	21.36 Ω	15.71 Ω	10.68 Ω	7.12 Ω	5.34 Ω	3.56 Ω
175 m		44.50 Ω	24.92 Ω	18.32 Ω	12.46 Ω	8.31 Ω	6.23 Ω	4.15 Ω
200 m		50.86 Ω	28.48 Ω	20.94 Ω	14.24 Ω	9.49 Ω	7.12 Ω	4.75 Ω
225 m		57.21 Ω	32.04 Ω	23.56 Ω	16.02 Ω	10.68 Ω	8.01 Ω	5.34 Ω
250 m		63.57 Ω	35.60 Ω	26.18 Ω	17.80 Ω	11.87 Ω	8.90 Ω	5.93 Ω
Example 1: Maximum permissible distance for 1.5 mm^2 and 3 A → Approximately 200 m²								
Example 2: Maximum permissible distance for 1.5 mm^2 and 6 A → Approximately 100 m								
Example 3: Mixed wiring: (Control cabinet --- sensor/actuator level)								
					R1 = 40 m in 1.5 mm^2 and R2 = 5 m in 0.25 mm^2			
					R1 = 0.95 Ohm, R2 = 0.71 Ohm			
					Total (R1 + R2) = 1.66 Ohm			

¹ Internal resistance of miniature circuit breakers

² Shutdown current $I_{\text{off}} = 3 \text{ A} \times 1.25 \text{ A} = 3.75 \text{ A}$
 Maximum circuit resistance $R_{\text{max}} = U_B/I_{\text{off}} - 0.050 \Omega$ (internal resistance of miniature circuit breakers)
 $R_{\text{max}} = (19.2 \text{ V}/3.75 \text{ A}) - 0.050 \Omega = 5.07 \Omega$
 In the table, the calculated value of 5.07 Ω lies between 200 m and 225 m (4.75 Ω and 5.34 Ω).
 Therefore a distance of around 200 m can be covered.

4 Mounting on a modular base

The TMCP SOCKET M base is snapped onto a DIN rail and can accommodate two ECP... devices.

The two-channel bases are modular, which means that larger distribution systems can be created. A connection element is inserted at both the start and end of the system.

Current distribution on the individual channels with a common supply (positive pole) is achieved by inserting a power rail in the slot provided on the connection side of the modules.

All electrical connections are established using spring-cage terminal blocks. The reference potential for the ECP... (GND pin 11) is also looped through and led to the side connection elements.

By connecting together the individual bases, all the internal wiring is established for the ground potential and group error message.

The ECP... has an integrated signal contact (PDT). The SC-S0 contact is used for the group error message. The contacts for this indication are already connected in series in the bases and are connected to the side connection elements via two connections (13, 14).

In each base, the series circuit can be contacted using a test socket and any interruptions can thus be determined.

4.1 Technical data

TMCP SOCKET M

Test contact for testing group indication on a cable interrupt	$\varnothing = 2 \text{ mm}$
Nominal voltage (without ECP...)	433 V AC; 65 V DC
Nominal current (without ECP...)	
LINE supply (1)	50 A
LOAD output (2)	25 A
Reference potential GND (11)	10 A
Individual indication (12)	1.0 A (with ECP...: 0.5 A)
Group indication (13-14)	1.0 A (with ECP...: 0.5 A)
Internal resistance (without ECP...)	
LINE-LOAD (1-2)	5 m Ω
Indication (13-14) for each module	8 m Ω /each position plus each additional aligned module: +5 m Ω
Supply rail for current distribution	Uninsulated power rail $I_{\text{max}} 50 \text{ A}$ (the uninsulated power rail is inserted fully and is therefore safe to touch)
Dielectric strength of base (without ECP...)	
Between main circuits (without power rail)	1500 V
Main circuit to signal circuit	1500 V
Signal circuit to signal circuit	1500 V
Weight	
Central part	85 g, approximately
Connection elements (pair)	30 g, approximately
Approval	Meets standard UL 60950

4.2 Dimensions with base

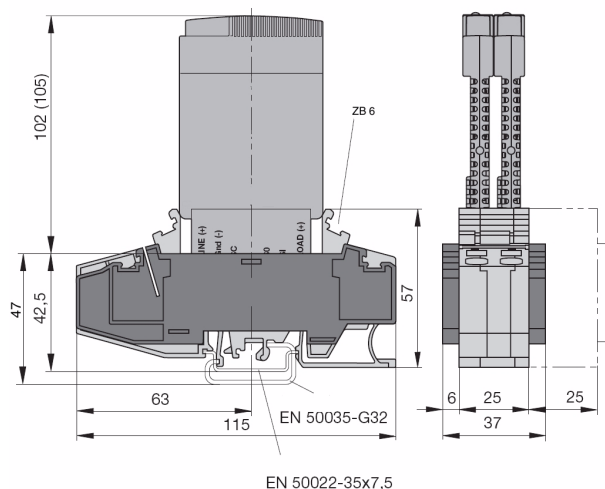


Figure 4 Dimensions (in mm)

4.3 Assembly

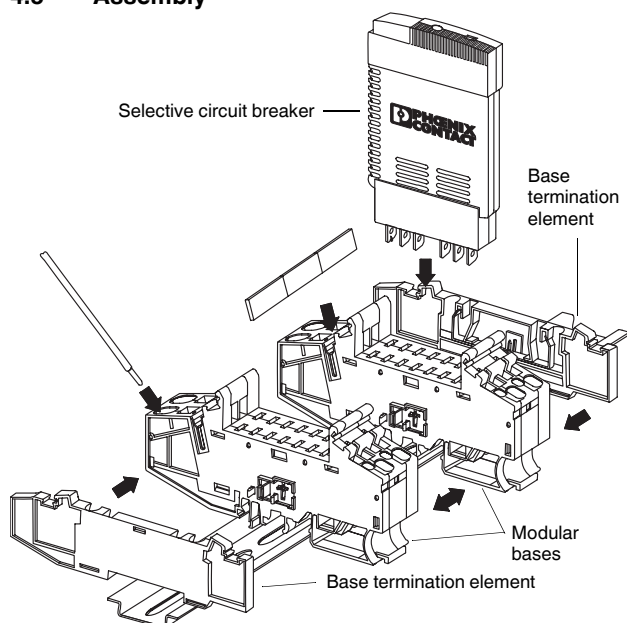


Figure 5 Assembly

To assemble, proceed as follows:

- Snap TMCP SOCKET M base onto an NS 35 DIN rail according to EN 60751.
- Push bases together.
- Snap on TMCP CONNECT LR base termination elements to the left and right-hand side.
- Cut FBST 500... power rails to length as required and insert in bases.
- Insert connecting cables in the spring-cage terminal blocks (see "Connecting spring-cage terminal blocks" on page 8 and "Pin assignment on base" on page 8).
- Insert ECP....
- If necessary, secure the ECP... and base using a clamp (see "Locking the base and ECP..." on page 9).

4.4 Connecting spring-cage terminal blocks

Spring-cage terminal blocks for solid wires and stranded cables with and without ferrules.

Use the specified screwdriver size (SD) to release the spring cage.

Connection	Spring-cage terminal blocks for	Screwdriver size (SD)
LINE supply (1)	1.5 ... 10 mm ²	SD 2 (0.8 x 4.0 mm)
LOAD output (2)	0.25 ... 4 mm ²	SD 1 (0.6 x 3.5 mm)
Reference potential GND or group indication connections (11 or 13, 14)	0.25 ... 2.5 mm ²	SD 1 (0.6 x 3.5 mm)
Individual indication connection (12)	0.25 ... 1.5 mm ²	SD 0 (0.4 x 2.5 mm)

4.5 Pin assignment on base

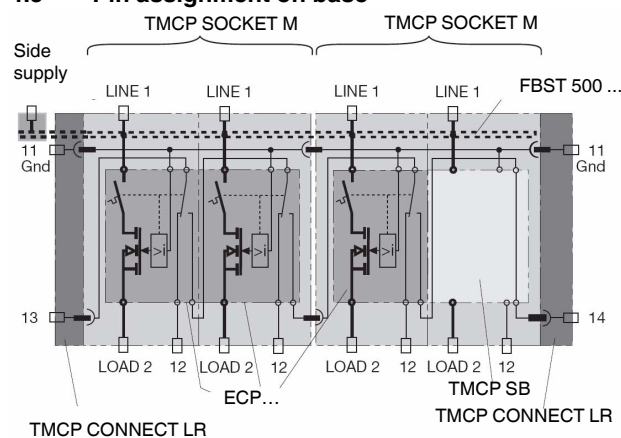


Figure 6 Connection diagram

PIN Assignment

11	GND
13, 14	Group indication connection

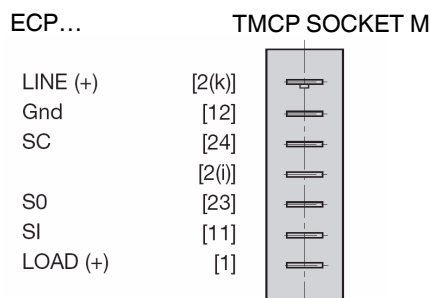


Figure 7 Pin assignment

4.6 Locking the base and ECP...

If mounted overhead, the ECP... must be connected to the base using the ECP-LOCK clamp.

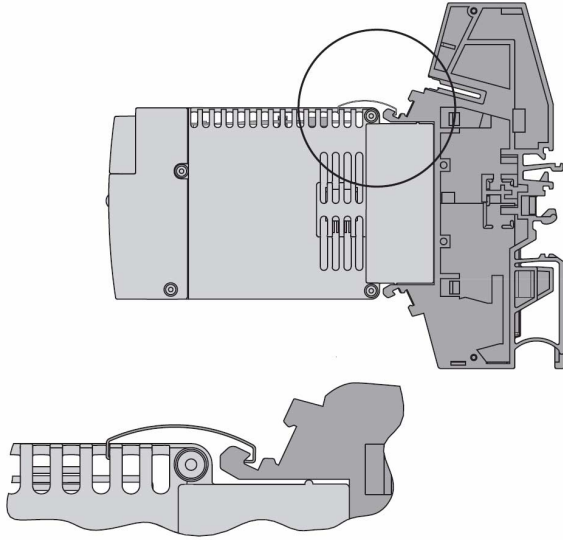


Figure 8 Mounting the ECP-LOCK

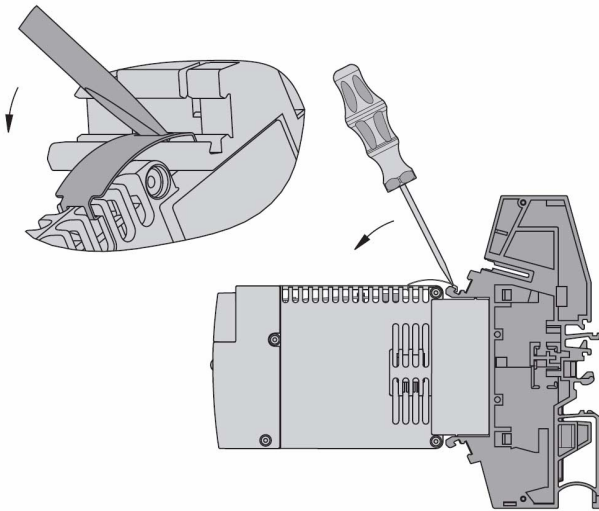


Figure 9 Removing the ECP-LOCK