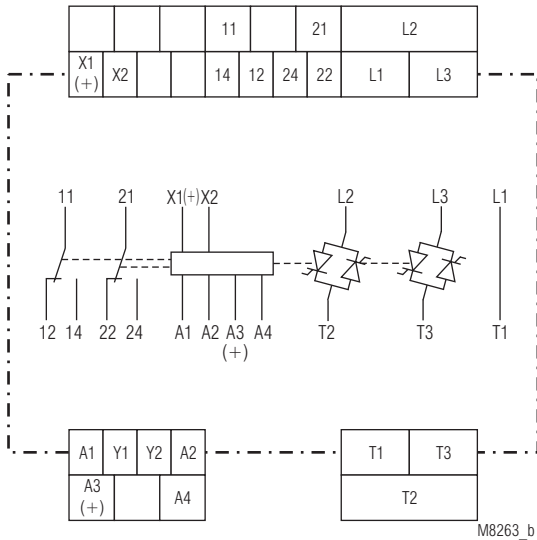


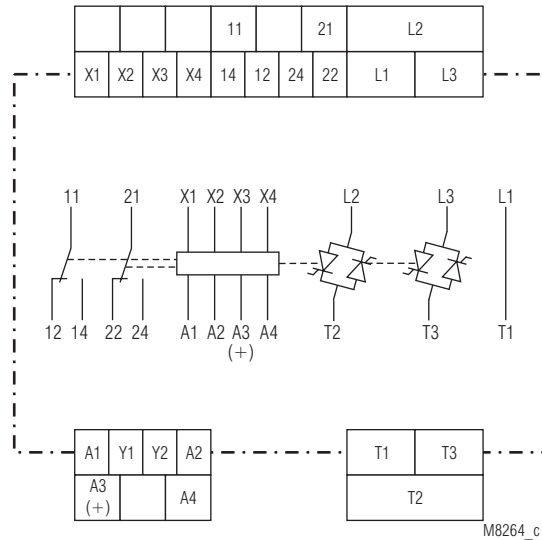


Circuit Diagrams



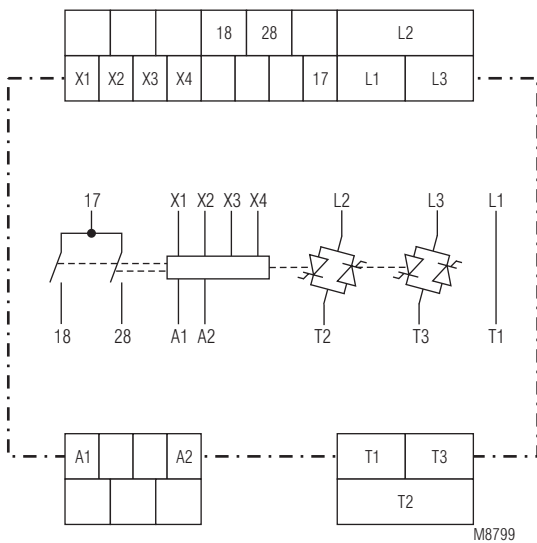
BI 9028.38

M8263\_b



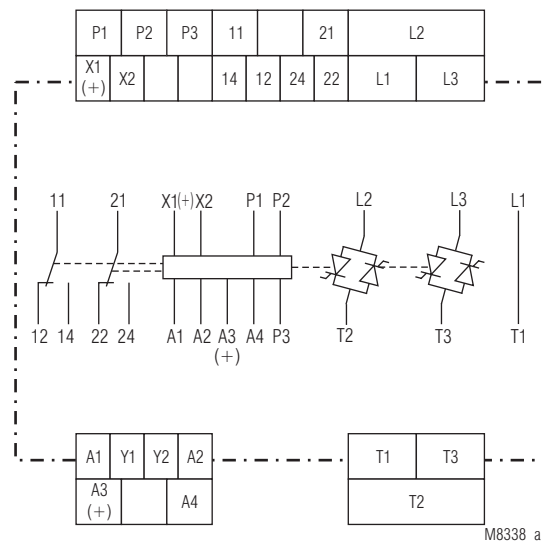
BI 9028.38/001

M8264\_c



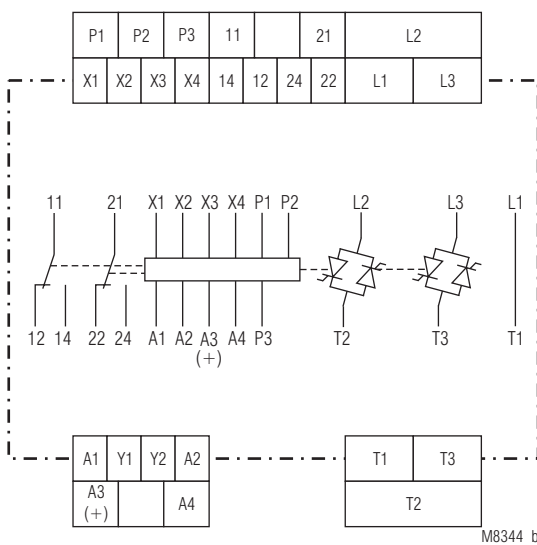
BI 9028.38/001, UH = AC 400 V

M8799



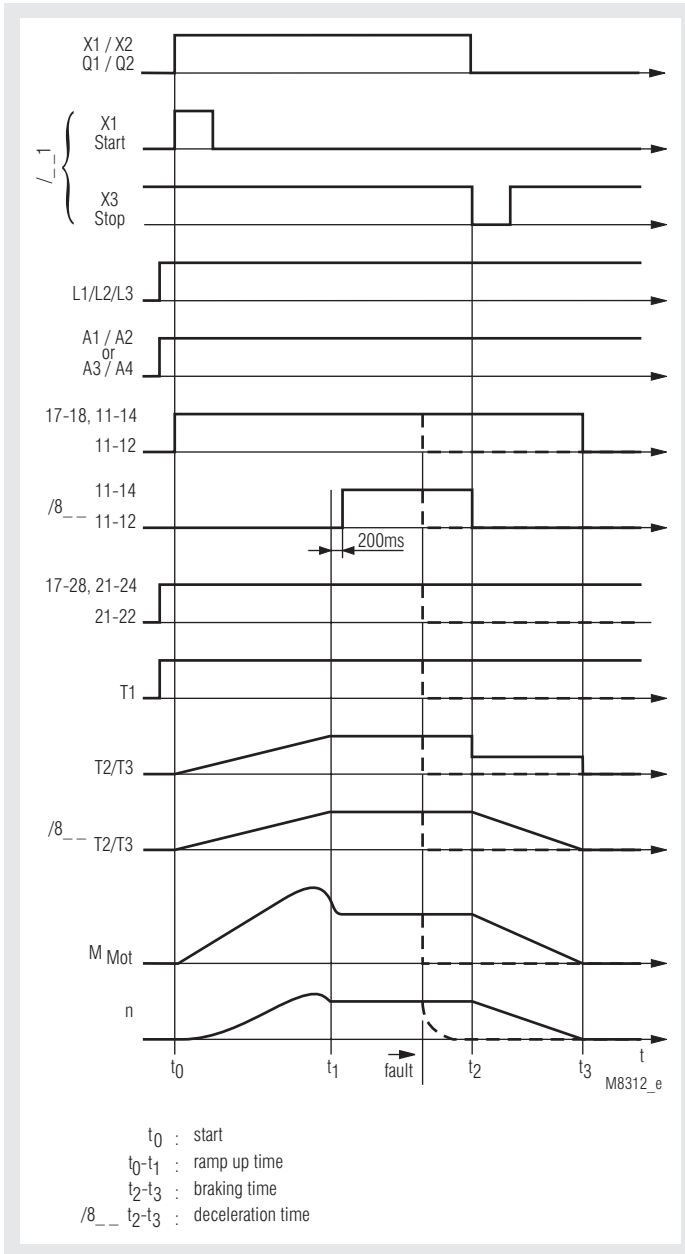
BI 9028.38/010

M8338\_a

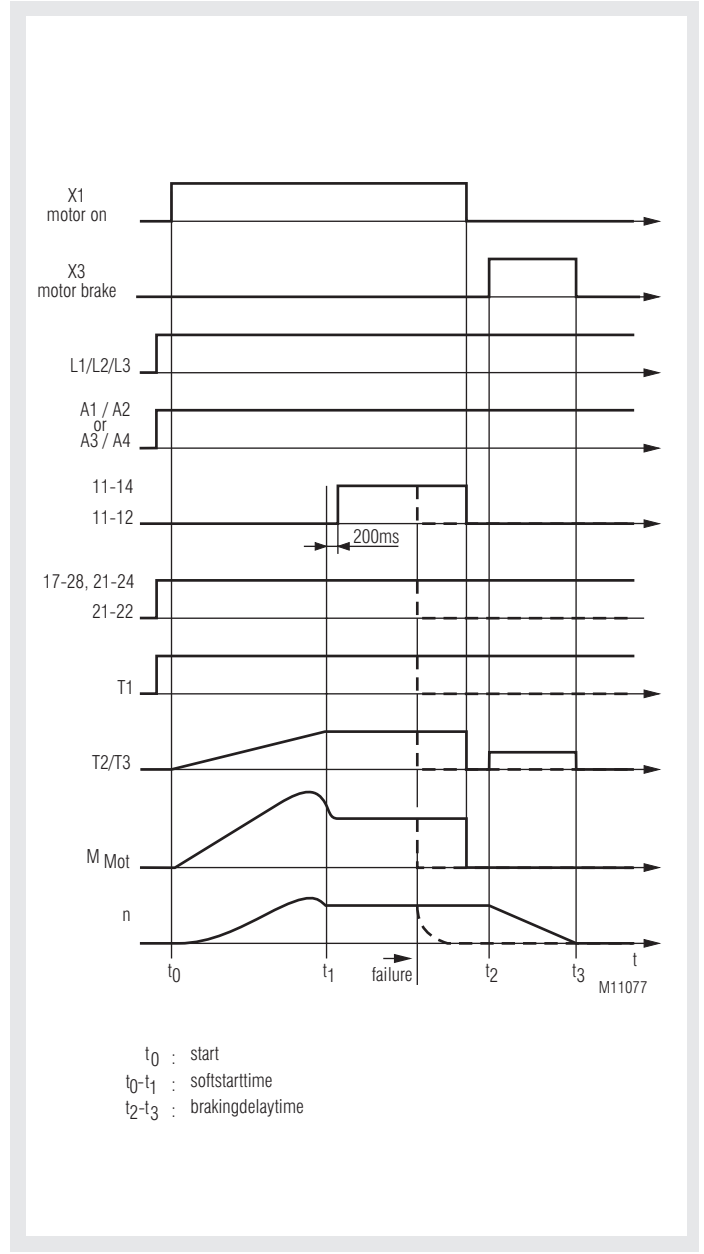


BI 9028.38/011

M8344\_b



BI 9028.38/\_1\_1



BI 9028.38/5\_

## Function

Softstarters are electronic devices designed to enable 1-phase or 3-phase induction motors to start smoothly. The devices slowly ramps up the current on two phases, therefore allowing the motor torque to build up slowly. This reduces the mechanical stress on the machine and prevents damage to conveyed material.

These features allow cost saving constructions of mechanical gear. External motor or brake contactors are not necessary.

### Start/Stop switch

When the motor is on full speed after the starting with start/stop switch S the semiconductors are bridged with internal relay contacts to prevent internal power losses and heat built up.

When stopping the motor via start/stop switch S braking is started. The braking current flows for the adjusted time through the motor windings.

On variant /\_ \_ 1 the start and stop function is realised via bush buttons.

On variant /5\_ \_ the softstart and brake function are separate switching via control input X1, X3.

### Monitoring relay 1 (contact 11-12-14 / 17-18)

The relay energises with the start command and de-energises after finish of braking. When a fault occurs the relay de-energises when the semiconductors switch off. The monitoring relay 1 can be used to activate a mechanical holding brake. With the variant BI 9028/8\_ \_ and BI 9028/5\_ \_ the relay switches when the semiconductors are bridged.

### Monitoring relay 2 (contact 21-22-24 / 17-28)

This relay energises as soon as the unit is ready for operation after connecting it to power. On internal overtemperature, phase failure, wrong phase sequence and overtemperature on the motor (variant BI 9028/\_ 1\_) the relay 2 de-energises. The power semiconductors are switched off. The internal temperature monitoring protects the thyristors. The temperature monitoring of the motor (variant BI 9028/\_ 1\_) has an input for a bimetallic contact or PTCs. The fault is reset by disconnecting the power supply temporarily after the temperature is down again.

Phase failure and phase sequence monitoring protect motor and plant. The fault is reset by disconnecting the power supply temporarily.

### Input P<sub>1</sub> / P<sub>2</sub> / P<sub>3</sub> to monitor the motor temperature on variant BI 9028/\_ 1\_

To monitor overtemperature on the motor a bimetallic contact can be connected to P<sub>2</sub>/P<sub>3</sub>. When overtemperature is detected the power semiconductors switch off and relay 2 de-energises.

On P<sub>1</sub> / P<sub>2</sub> up to 6 PTC sensors can be connected. On detection of overtemperature, short circuit or broken wire (in sensor circuit) the power semiconductors switch off and relay 1 + 2 de-energise.

The fault is reset by disconnecting the power supply temporarily after the temperature on the motor is down again. After every reset the unit has to be started again via control input or start/stop button.

## Indication

green LED: Continuous light: when auxiliary supply connected  
Flashing light: while starting and braking

### Monitoring relay 1

yellow LED: Continuous light: when contact 11-12-14 / 17-18 switched on

### Monitoring relay 2

yellow LED: Continuous light: when contact 21-22-24 / 17-28 switched on

Flashing light: when contact 21-22-24 / 17-28 switched off

- 1\*): overtemperature on thyristor (internal)
- 2\*): overtemperature on motor or broken wire in sensor circuit P<sub>1</sub>/P<sub>2</sub> variant /01\_
- 3\*): short circuit on sensor circuit P<sub>1</sub>/P<sub>2</sub> variant /01\_
- 4\*): phase failure
- 5\*): incorrect phase sequence, exchange connections on L1 and L2
- 6\*): incorrect frequency
- 7\*): heat sink temperature sensor defective
- 8\*): braking time exceeded

1-8\*) = Number of flashing pulses in short sequence

## Notes

Variation of speed is not possible with this device. Without load a softstart cannot be achieved. It is recommended that the softstart is protected by superfast semiconductor fuses rated as per the current rating of the softstart or motor. However, standard line and motor protection is acceptable, but for high starting frequencies motor winding temperature monitoring is recommended. The softstarter must not be operated with capacitive load e.g. power factor compensation on the output.

The current in the 3 phases is different due to 2-phase control. To avoid false tripping of the motor overload it is recommended to select a suitable overload for this application.

In respect to safety of persons and plant only qualified staff is allowed to work on this device.

## Technical Data

### Phase / motor

#### voltage L1/L2/L3

with auxiliary voltage: 3 AC 200 V -10 % ... 480V + 10 %

without auxiliary voltage: 3 AC 200 V ± 10 %

Nominal frequency: 50 / 60 Hz

	Width		
	67.5 mm	90 mm	90 mm
Nominal motor power P <sub>N</sub> at 400 V:	7.5 kW	11 kW	15 kW
Switching frequency at 3 x I <sub>N</sub> , 5 s, v <sub>U</sub> = 20°C:	10 / h	45 / h	30 / h
permissible braking current	35 A	50 A	65 A

Min. motor power: approx. 0.1 P<sub>N</sub>

Start torque: 20 ... 80 %

Ramp time: 1 ... 20 s

Braking time: 1 ... 20 s

Braking delay: 0.5 s

### Deceleration torque

BI 9028/8\_ \_: 20 ... 80 %

### Deceleration time

BI 9028/8\_ \_: 1 ... 20 s

Recovery time: 200 ms

### Auxiliary voltage:

Model AC 115/230 V:

A1/A2, AC 115 V, +10%, -15%: bridge A1 - Y1

bridge A2 - Y2

A1/A2, AC 230 V, +10%, -15%: bridge Y1 - Y2

A3(+)/A4, DC 24 V, +10%, -15%: polarity protected

Model AC 400 V:

A1/A2, AC 400 V, +10%, -15%: no bridge

Power consumption: 3 W

Residual ripple max.: 5 %

### Max. semiconductor fuse

BI 9028 / 7.5 kW: 1800 A<sup>2</sup> s

BI 9028 / 11 kW: 6600 A<sup>2</sup> s

## Inputs

### Control input X1/X2

voltage: AC/DC 24 - 230 V

Softstart when: > 20 V

Braking when: < 5 V

### BI 9028/0\_ 1:

Control input X1/X4, X3/X4: volt free contact

### alternative

### Control input X1/X2, X3/X2

Voltage: AC/DC 24 V

Softstart when: > 15 V

Braking when: < 5 V

Control input Q1/Q2: volt free contact

Switching current: DC 10 mA

Switching voltage: DC 24 V

### Input P<sub>2</sub> / P<sub>3</sub> for bimetallic contact

Current: approx. 1 mA (= switch closed)

Voltage: approx. 5 V (= switch open)

### Input P<sub>1</sub> / P<sub>2</sub> for PTC-sensor

Temperature sensor: according to DIN 44081/082

Number of sensors: 1 ... 6 in series

Response value: 3.2 ... 3.8 kΩ

Reset value: 1.5 ... 1.8 kΩ

Load in measuring circuit: < 5 mW (at R = 1.5 kΩ)

Broken wire detection: > 3.1 kΩ

## Technical Data

<b>Measuring voltage:</b>	≤ 2 V (at R = 1.5 kΩ)
<b>Measuring current:</b>	≤ 1 mA (at R = 1.5 kΩ)
<b>Voltage, when broken wire in sensor circuit:</b>	DC approx. 5 V
<b>Current, when short circuit in sensor circuit:</b>	DC approx. 0.5 mA

## Monitoring Output

### Contacts

BI 9028.38:	2 x 1 changeover contacts
BI 90.28.38 (U <sub>H</sub> = AC 400 V):	2 x 1 NO contacts

**Thermal continuous current I<sub>m</sub>:** 4 A

### Switching capacity

to AC 15

NO contact:	3 A / 230 V	IEC/EN 60 947-5-1
NC contact:	1 A / 230 V	IEC/EN 60 947-5-1

### Electrical life:

to AC 15 at 3 A,  
AC 230 V: 2 x 10<sup>5</sup> switching cycles

### Short circuit strength

**max. fuse rating:** 4 A gL IEC/EN 60 947-5-1

## General Data

<b>Temperature range:</b>	0 ... + 45 °C
<b>Storage temperature:</b>	- 25 ... + 75 °C

### Clearance and creepage distances

rated impuls voltage /  
pollution degree

Control voltage to auxiliary  
voltage, motor voltage:

	6 kV / 2	IEC 60 664-1
Auxiliary to motor voltage:	4 kV / 2	IEC 60 664-1

### EMC

Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
HF-irradiation:	10 V/m	IEC/EN 61 000-4-3
Fast transients:	4 kV	IEC/EN 61 000-4-4

Surge voltages  
between

wire for power supply:	1 kV	IEC/EN 61 000-4-5
between wire and ground:	2 kV	IEC/EN 61 000-4-5

### Degree of protection

Housing:	IP 40	IEC/EN 60 529
Terminals:	IP 20	IEC/EN 60 529

**Vibration resistance:** Amplitude 0.35 mm IEC/EN 60 068-2-6  
frequency: 10 ... 55 Hz

**Climate resistance:** 0 / 055 / 04 IEC/EN 60 068-1

### Wire connection

Load terminals:	1 x 10 mm <sup>2</sup> solid 1 x 6 mm <sup>2</sup> stranded ferruled 1 x 4 mm <sup>2</sup> solid or 1 x 2.5 mm <sup>2</sup> stranded ferruled (isolated) or 2 x 1.5 mm <sup>2</sup> stranded ferruled (isolated) DIN 46 228-1/-2/-3/-4 or 2 x 2.5 mm <sup>2</sup> stranded ferruled DIN 46 228-1/-2/-3
Control terminals:	Plus-minus terminal screws M4 box terminals with wire protection Plus-minus terminal screws M4 box terminals with wire protection DIN rail mounting IEC/EN 60 715

### Wire fixing

Load terminals:	Plus-minus terminal screws M4 box terminals with wire protection
Control terminals:	Plus-minus terminal screws M4 box terminals with wire protection

### Mounting:

### Weight:

Width 67.5 mm:	630 g
Width 90 mm:	780 g

## Dimensions

### Width x height x depth:

BI 9028 up to 7.5 kW:	67.5 x 85 x 121 mm
BI 9028 up to 15 kW:	90 x 85 x 121 mm

## Standard type

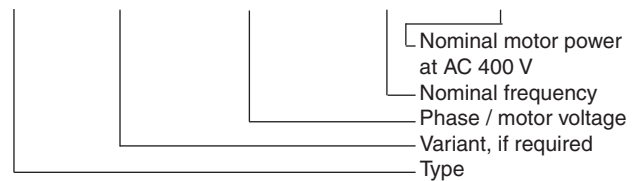
BI 9028.38	3 AC 200 ... 480 V	50/60 Hz	7.5 kW
Article number:	0054984		
• Motor voltage:	3 AC 200 ... 480 V		
• Nominal motor power at AC 400 V:	7.5 kW		
• Control input X1/X2			
• Width:	67.5 mm		

## Variants

BI 9028.38/_ _1:	volt free contacts for start and stop X1, X2, X3, X4
BI 9028.38/_ _1_:	input P <sub>1</sub> / P <sub>2</sub> / P <sub>3</sub> to monitor the motor temperature
BI 9028.38/8_ _:	Softstop function instead of brake
BI 9028.38/_ _2:	volt free control unit on terminals Q1/Q2
BI 9028.38/5_ _:	softstart and brake function switching via control input X1, X3

## Ordering example for variants:

BI 9028.38 / \_ \_ 3 AC 200 ... 480 V 50/60 Hz 11 kW



## Control Input

With BI 9028 softstart begins by closing switch S and braking starts when opening switch S. When closing S during braking, softstart begins again.

With BI 9028/0\_1 softstart begins by pressing the "Start" button (X1). By actuating the "Stop" button (X3) braking is started. Pressing the "Start" button during braking activates the softstart again. If "Start" and "Stop" are activated simultaneously within 0.1 s the stop function has priority.

On BI 9028/\_ \_2 softstarts begins when closing the contact on Q1/Q2. By opening this contact braking or softstop is started. If Q1/Q2 is permanently closed softstart is started when applying the mains voltage on L1/L2/L3. Start of braking or softstop can only be started by opening Q1/Q2.

With BI9028/5\_ \_ softstat begins with activation of input X1. The motor is connected to voltage until the signal is disconnected from the control input. With the signal on control input X3 the braking cycle is started (DC-brake) The braking cycle is finished when the signal on X3 is disconnected or on BI 9028/511 latest 60 seconds after start of the braking cycle the user has to make sure that only one control input is active.

## Adjustment Facilities

Potentiometer	Description	Initial setting
$M_{on}$	Starting voltage	fully anti-clockwise
$t_{on}$	Ramp-up time	fully clockwise
$I_{Br}$	Braking current	fully anti-clockwise
$t_{Br}$	Braking time	fully clockwise
$M_{off}$	Deceleration voltage time	fully anti-clockwise
$t_{off}$	Deceleration time	fully clockwise

## Set-up Procedure

### Softstart:

1. Start the motor via control input X1/X2 and turn potentiometer " $M_{on}$ " up until the motor starts to turn without excessive humming.
2. Adjust potentiometer " $t_{on}$ " to give desired ramp time.
3. On correct setting the motor should accelerate up to nominal speed. If the start takes too long fuses may blow, especially on motors with high inertia.

- **Attention:** If the ramp-up time is adjusted to short, the internal bridging contact closes before the motor is on full speed. This may damage the bridging contactor or bridging relay.



### Softstop:

- During softstop the device has to be connected to the voltage.
- Select softstop by opening control input X1/X2; Q1/Q2
- Turn potentiometer  $M_{off}$  to the left, until the motor starts visibly to slow down at the initiation of the softstop cycle.
- Adjust  $t_{off}$  until the required stopping time is achieved.

### Braking:

The braking time  $t_{Br}$  and the braking current  $I_{Br}$  (max.  $2 I_N$  with star connected and max.  $2.8 I_N$  with delta connected motors, do not exceed max. permissible braking current!) is adjusted on BI 9028. The time has to be adjusted in a way that the current is flowing until the motor is on standstill.

To avoid overload of braking device and motor, the braking current should be checked with a moving iron instrument (see connection diagram). The procedure für BI 9028/001 is the same.

## Temperature Monitoring

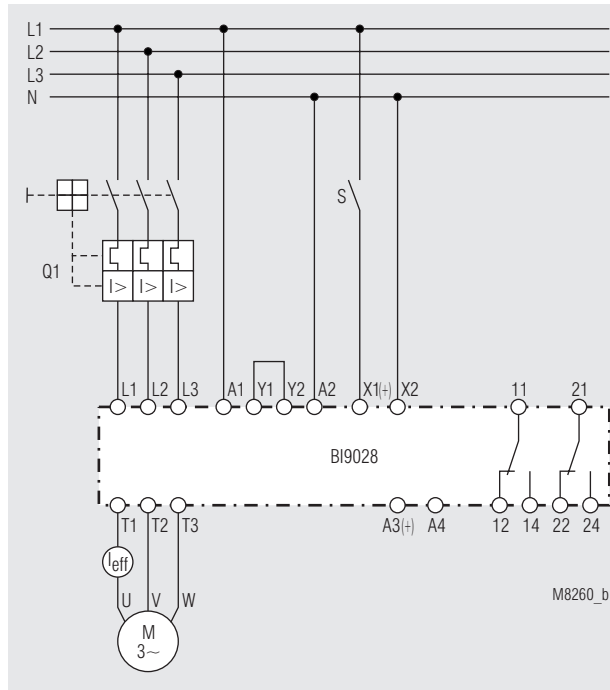
BI 9028 features overtemperature monitoring of its internal power semiconductors. The unit is therefore protected against overheating during the set up procedure. BI 9028 can be reset after the semiconductors have cooled down by momentarily removing the auxiliary supply voltage.

## Safety Notes

- Never clear a fault when the device is switched on.
- **Attention:** This device can be started by potential-free contact, while connected directly to the mains without contactor (see application example). Please note, that even if the motor is at rest, it is not physically separated from the mains. Because of this the motor **must** be disconnected from the mains via the corresponding manual motor starter.
- The user must ensure that the device and the necessary components are mounted and connected according to the locally applicable regulations and technical standards.
- Adjustments may only be carried out by qualified specialist staff and the applicable safety rules must be observed.

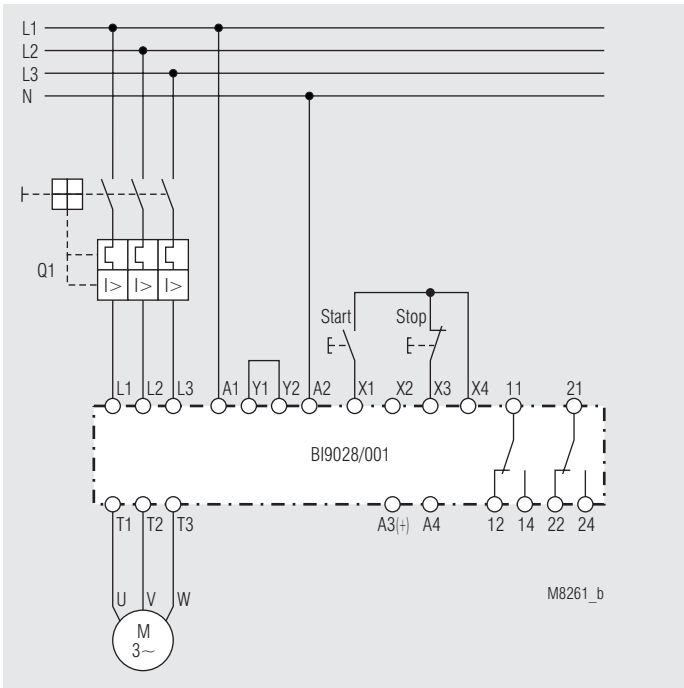


## Connection Example

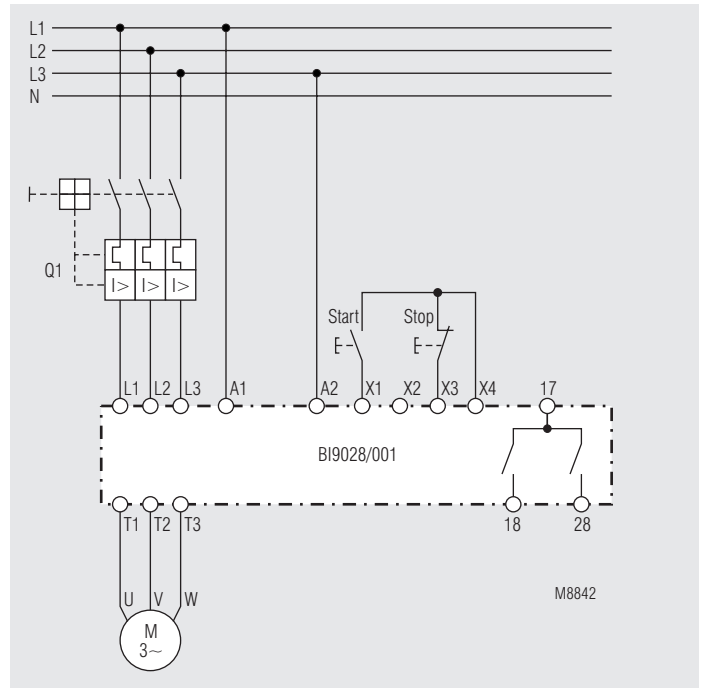


BI 9028 softstart and brake function with switch S

### Connection Examples

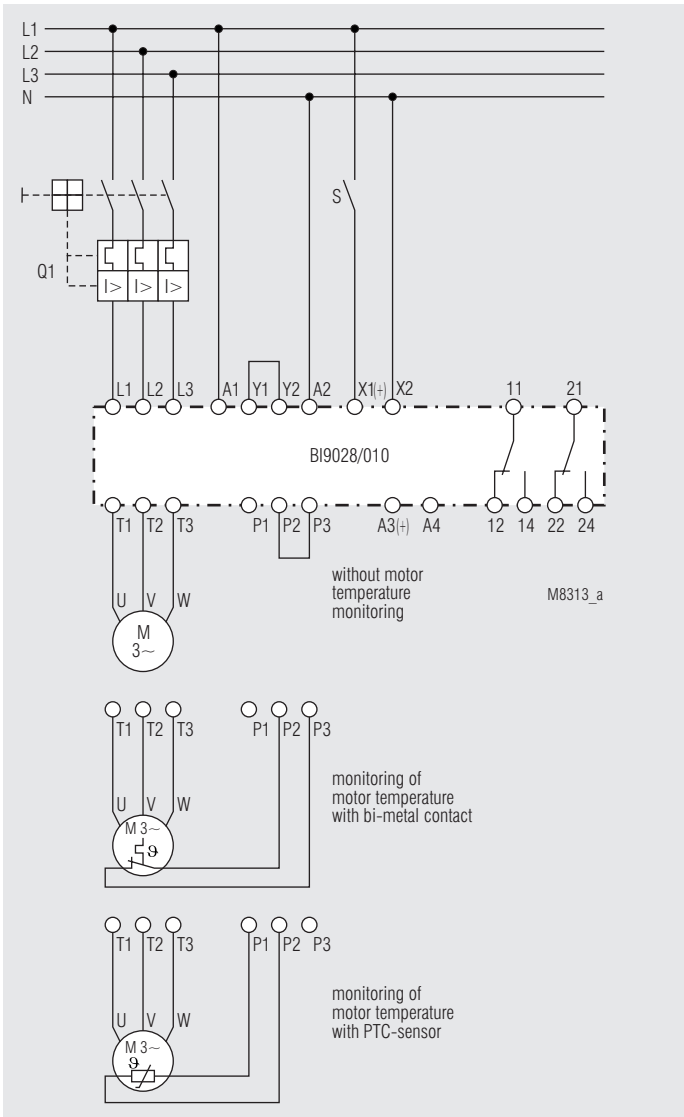


BI 9028/001 softstart with start-button, brake function with stop-button

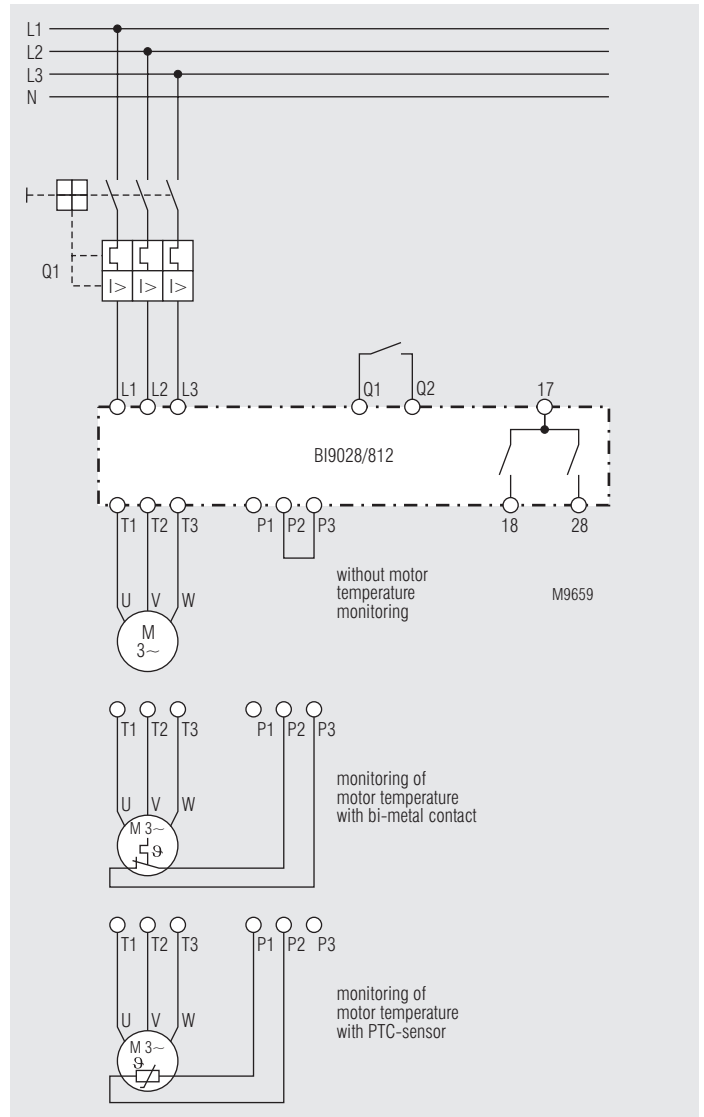


BI 9028/001,  $U_H = AC\ 400\ V$

### Connection Examples

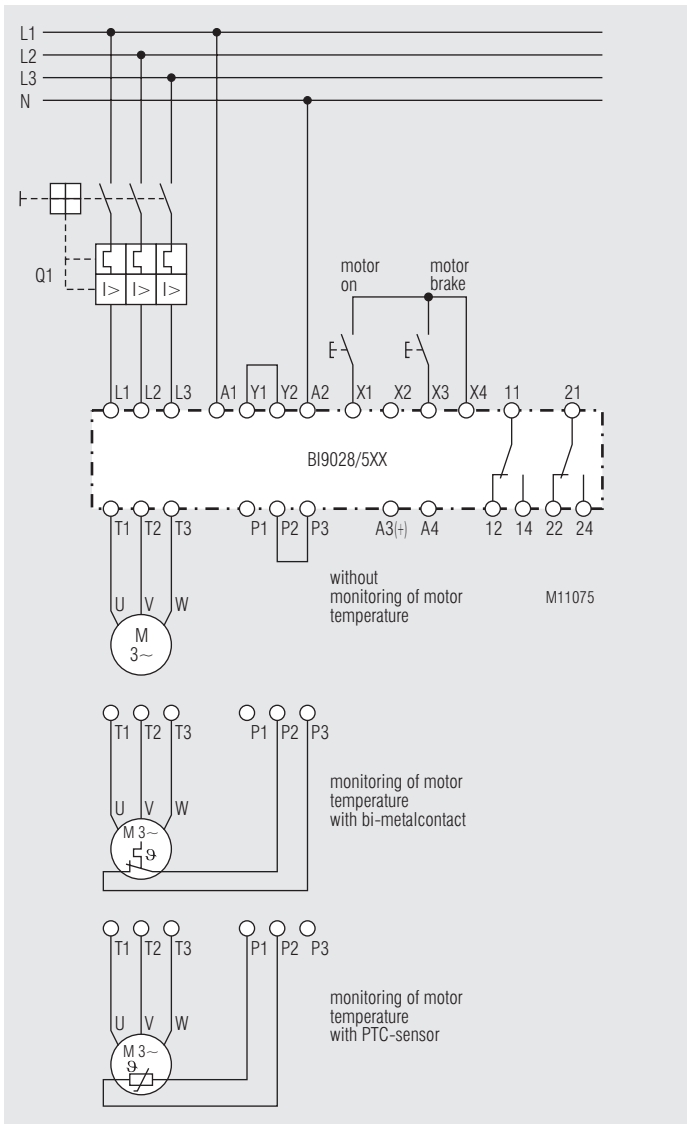


BI 9028/010 softstart and brake function with motor temperature monitoring

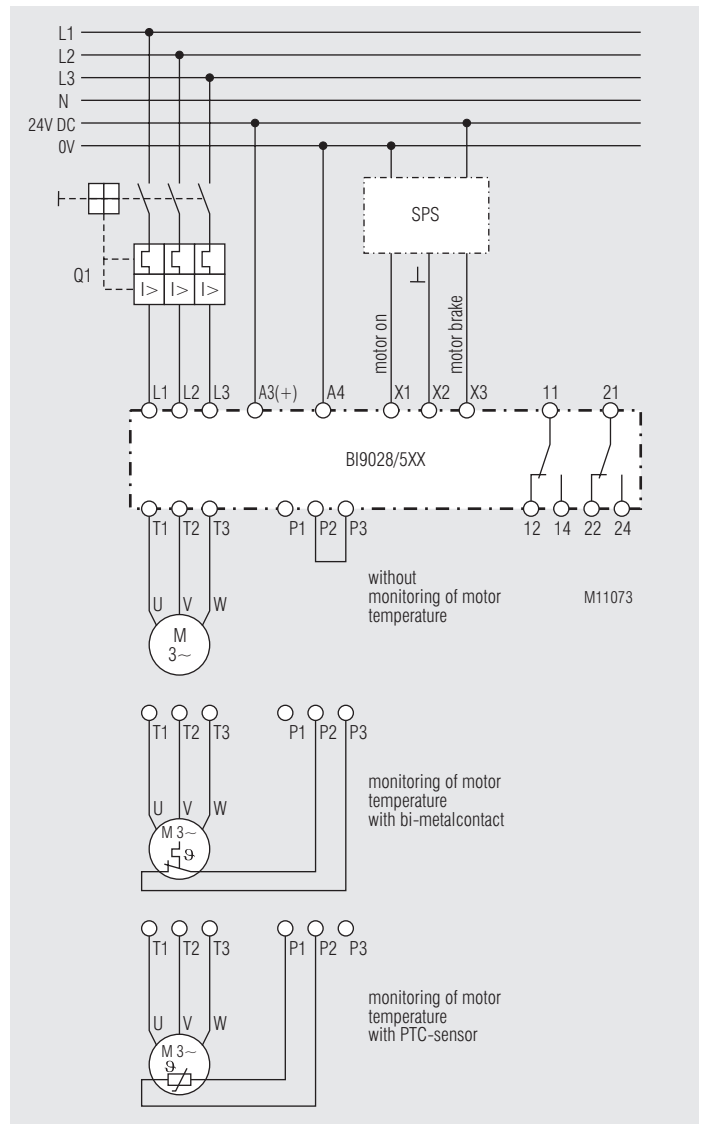


BI 9028/010 softstart - softstop with monitoring of motor temperature without auxiliary voltage.

## Connection Examples



BI 9028/5\_ \_softstart and brake function switching via separate control inputs, auxiliary voltage  $U_H = AC\ 230\ V$



BI 9028/5\_ \_softstart and brake function switching via separate control inputs, auxiliary voltage  $U_H = DC\ 24\ V$