MINISTART
Softstarter with braking function
BL 9028

Translation of the original instructions

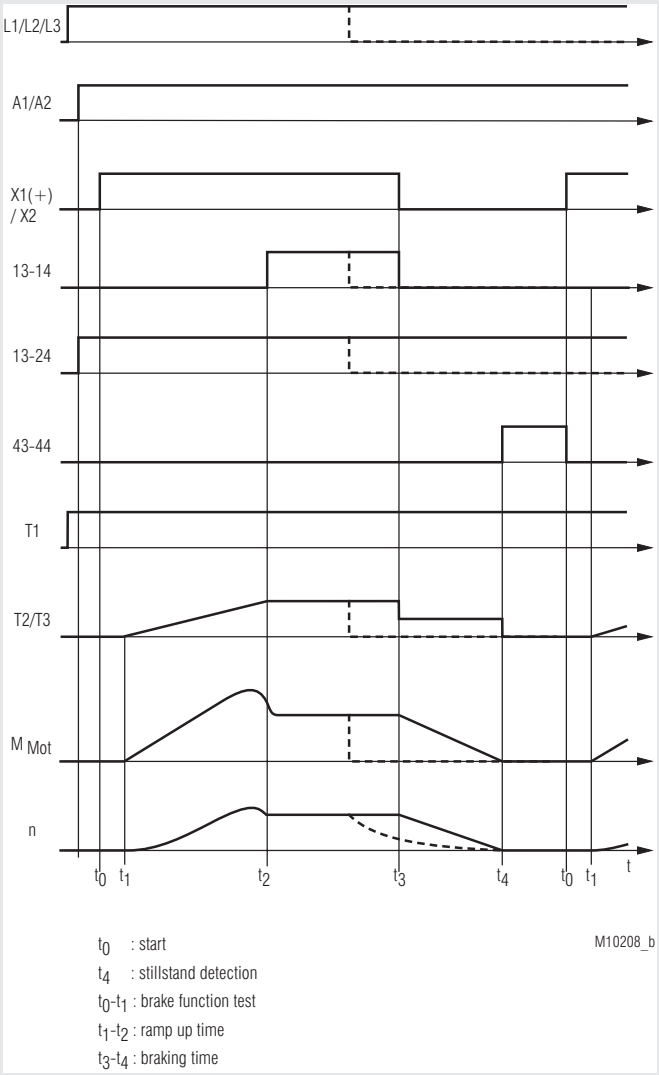
DOLD

- According to IEC/EN 60947-4-2
- 2-phase motor control
- For motors up to 11 kW at 3 AC 400 V
- Separate settings for start and brake time, as well as starting and braking torque
- No braking contactor necessary
- Function test of brake circuit before softstart
- With automatic standstill detection
- Current monitoring
  - to protect the power semiconductors
  - for device protection at stalled motor
- Maintenance- and wearfree
- Auxiliary DC 24 V
- Monitors undervoltage and phase sequence
- With input to detect motor temperature via PTC (variant /_1_)
- 3 relay outputs for indicaiton of status and fault with LED-indication
- Width: 112.5 mm

Product Description

Softstarters are electronic devices designed to enable 1-phase or 3-phase induction motors to start smoothly. By means of internal current monitoring we realise different protective functions, when stalling the motor or during heavy duty starting. The semiconductors are bridged after softstart by relay contacts. This reduces power dissipation and heating. The device parameters are adjusted using potentiometers. LEDs indicate the status of the device.

Function diagram



Approvals and Marking

CE

Applications

- Motor with gear, belt or chain drive
- Fans, pumps, conveyor systems, compressors
- Woodworking machines, centrifuges
- Packing machines, door-drives

Function

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.

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 until the motor standstill is detected but not longer (max. 20 s) through the motor windings.

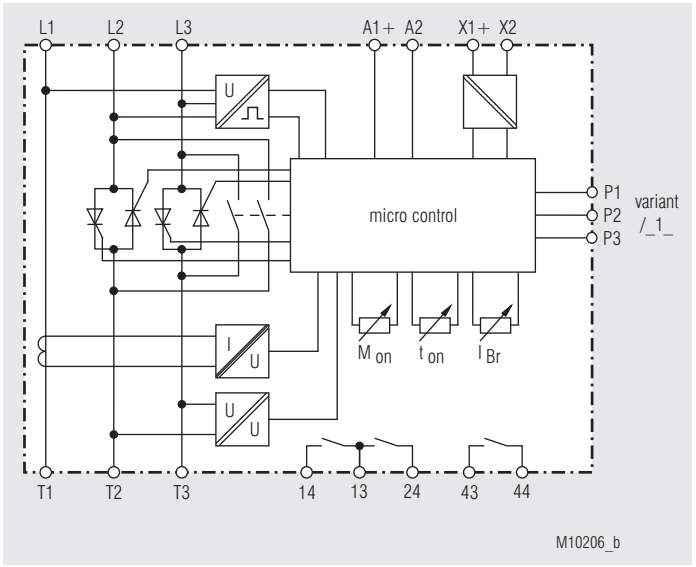
Monitoring relay 1 (contact 13-14)
The relay energizes at the end of the softstart ramp and de-energizes at the beginning of the braking cycle. (operation with bridged semiconductors). When a failure occurs the relay de-energizes when the semiconductors switch off.

Monitoring relay 2 (contact 13-24)
This relay energises as soon as the unit is ready for operation after connecting it to power. If any error occurs the monitoring relay 2 will be de-energized immediately. The power output will be switched off.

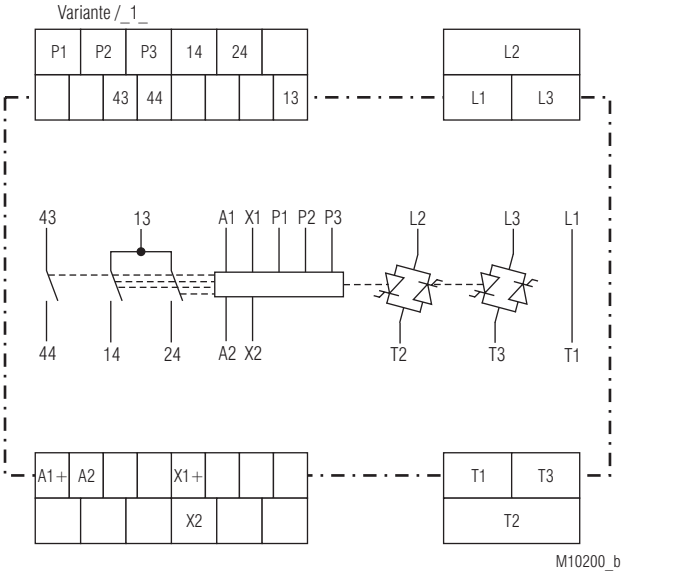
Monitoring relay 4 (contact 43-44)
This relay is energized when motor standstill is detected. It will be reset by starting the motor. The monitoring relay 4 is de-energized if an error occurs.

Input P1/P2/P3 to monitor the motor temperature (variant /_1_)
To monitor overtemperature onnb the motor a bimetallic contact can be connected to P2 / P3. When overtemperature is detected the power semiconductors switch off and all relays de-energize.
On P1/P2 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 all relays de-energise.
The fault is reset by disconnecting the power supply temporarily after the temperature on the motor is down again.

Block Diagram



Circuit Diagram



Terminal Connection

Terminal designation	Signal description
X1, X2	Start-/Stop-Signal
13, 14	Monitoring relay 1 bridging operation
13, 24	Monitoring relay 2 Ready
43, 44	Monitoring relay4 Standstill
A1(+) , A2	Auxiliary voltage DC 24 V
L1, L2, L3	Phase voltage
T1, T2, T3	Motor connection
P1, P2 , P3	PTC thermal sensor, bi-metal contact

Indicators

Green LED: perm. on: - When auxiliary supply connected or bypass relay energized
flasher light: - While starting and breaking

Monitoring relay 1
Yellow LED: perm. on: - When contact 13-14 switched on

Monitoring relay 2
Yellow LED: perm. on: - When contact 13-24 switched on

Monitoring relay 4
Yellow LED: perm. on: - When contact 43-44 switched on
Red LED: steady
flashing: - Motor current is > 3 x device current
Red LED: flasher light :- Error
1*): - Overtemperature on thyristor (internal)
2*): - Overtemperature on motor or broken wire in sensor circuit P_1 / P_2 or bi-metal contact at sensor circuit P_2 / P_3 has tripped (ooen)
3*): - Short circuit on sensor circuit P_1 / P_2
4*): - Phase failure
5*): - Incorrect phase sequence, exchange connections on L1 and L2
6*): - Incorrect frequency
7*): - Incorrect brake circuit
9*): - Incorrect internal temperature sensor
10*): - Incorrect RAM
13*): - Overcurrent
14*): - Brake current to high
15*): - Overcurrent at end of ramp up
16*): - Internal communication error
17*): - Overcurrent on bridging relay

1-17*) = Number of flashing pulses in short sequence

Monitoring Features

- If standstill is not detected, the braking cycle is interrupted after 20 s.
- The brake current switches off after 0.5 sec standstill detection.
- After activation of the start input mains frequency, phase sequence and presence of all 3 phases is checked.
- Internal temperature monitoring protects the thyristors. By switching on or off of the power supply this fault can be reset after the temperature has dropped.
- To protect the power circuit the current is monitored in L1-T1. If the fixed settings are exceeded, the device switches off and a failure indication is displayed by a red LED.
- Monitoring of phases and phase shift protects the motor or the system. After removing the fault this error can be reset by switching the power supply on and off.
- External bimetallic switches or PTC-thermo sensors are used to monitor motors on thermal overload. (variant /_1_). Overload results in disconnection of the motor and failure indication via the red error LED. After a cooling down period for the motor, the failure can be reset reset switching the power supply OFF and ON again.

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.
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:	3 AC 200 V -10 % ... 480 V + 10 %	
Nominal frequency:	50 / 60 Hz	
Nominal motor power P_N		
at 400 V:	11 kW	
Switching frequency		
at 3 x I_N, 5 s, ϑ_U = 45°C:	20 / h	
max. permissable braking current:	50 $A_{eff.}$	
Min. motor power:	0.1 P_N	
Start torque:	20 ... 80 %	
Ramp time:	1 ... 20 s	
Braking time:	Max. 20 s	
Braking delay:	750 ms	
Braking voltage:	DC 10 ... 90 V	
Start delay:	250 ms	
Auxiliary voltage U_H		
model DC 24 V:	A1/A2, DC 24 V, + 10 %, - 15 %	
Power consumption:	2 W	
Residual ripple max.:	5 %	
Max. semiconductor fuse:	6600 A^2s	

Inputs

Control input X1, X2:	DC 24 V / 2.5 mA / edge triggered

Input P2 / P3 for bi-metal contact

Switching current:	DC 1 mA
Switch voltage:	DC 5 V

Input P1 / P2 for PTC-sensor

Thermal sensor:	According to DIN 44081
Number of sensors:	1 ... 6 in series
Response value:	3 kΩ
Measuring voltage:	Max. DC 5V

Monitoring Output

Contacts:	3 x 1 NO contacts	
Thermal continous current I_{th}:	4 A	
Switching capacity		
to AC 15		
NO contact:	3 A / 230 V	IEC/EN 60947-5-1
Electrical life:		
to AC 15 at 3 A,		
AC 230 V:	2 x 10^5 switch. cycl.	IEC/EN 60947-5-1
Short circuit strength		
max. fuse rating:	4 A gG / gL	IEC/EN 60947-5-1

General Data

Temperature range		
Operation:	0 ... + 45 °C	
Storage:	- 25 ... + 75 °C	
Altitude:	< 2000 m	
Clearance and creepage distances		
Rated impulse voltage / pollution degree		
Control voltage to auxiliary voltage, motor voltage:	4 kV / 2	IEC 60664-1
Auxiliary voltage to motor voltage:	4 kV / 2	IEC 60664-1
motor voltage to heat sink:	6 kV / 2	IEC 60664-1
EMC		
Electrostatic discharge:	8 kV (air)	IEC/EN 61000-4-2
HF-irradiation		
80 MHz ... 1 GHz:	10 V / m	IEC/EN 61000-4-3
1 GHz ... 2,5 GHz:	3 V / m	IEC/EN 61000-4-3
2,5 GHz ... 6 GHz:	1 V / m	IEC/EN 61000-4-3
Fast transients:	2 kV	IEC/EN 61000-4-4
Surge voltages between		
wire for power supply:	1 kV	IEC/EN 61000-4-5
between wire and ground:	2 kV	IEC/EN 61000-4-5
HF wire guided:	10 V	IEC/EN 61000-4-6

Technical Data

Interference emission		
Wire guided:	Limit value class A	IEC/EN 60947-4-2
Radio irradiation:	Limit value class A	IEC/EN 60947-4-2
	The device is designed for the usage under industrial conditions (Class A, EN 55011). When connected to a low voltage public system (Class B, EN 55011) radio interference can be generated. To avoid this, appropriate measures have to be taken.	
Degree of protection:		
Housing:	IP 40	IEC/EN 60529
Terminals:	IP 20	IEC/EN 60529
Vibration resistance		IEC/EN 60068-2-6
Frequency range:	10 ... 100 Hz	
Amplitude:	0.35mm peak to peak up to 54 Hz	
Acceleration:	Above 54 Hz constant acceleration 4 g	
Climate resistance:	0 / 045 / 04	IEC/EN 60068-1
Wire connection		
Load terminals:	1 x 10 mm^2 solid 1 x 6 mm^2 stranded ferruled	
Control terminals:	1 x 4 mm^2 solid or 1 x 2.5 mm^2 stranded ferruled (isolated) or 2 x 1.5 mm^2 stranded ferruled (isolated) DIN 46228-1/-2/-3/-4 or 2 x 2.5 mm^2 stranded ferruled DIN 46228-1/-2/-3	
Stripping length:	10 mm	
Wire fixing		
Load terminals:	Plus-minus terminal screws M4 box terminals with wire protection	
Fixing torque:	1.2 Nm	
Control terminals:	Plus-minus terminal screws M3.5 box terminals with wire protection	
Fixing torque:	0.8 Nm	
Mounting:	DIN rail mounting	IEC/EN 60715
Weight:	1135 g	

Dimensions

Width x height x depth:	112.5 x 85 x 121 mm

Standard Type

BL 9028.03 3 AC 200 ... 480 V 50/60 Hz U_H DC 24 V 11 kW

Article number:	0068352
• Nominal motor power at 3 AC 400 V:	11 kW
• Control input X1, X2:	DC 24 V
• Width:	112.5 mm

Variant

BL 9028.03/_1_:	Motor protection with bi-metal contact or PTC thermal sensor

Ordering Example

BL 9028. 03/ _ _ _ 3 AC 200...480 V 50/60 Hz U_H DC 24 V 11 kW

- 11 kW — Nom. motor power at 3 AC 400 V
- DC 24 V — Aux./Control voltage
- 50/60 Hz — Nom. frequency
- 3 AC 200...480 V — Phase / motor voltage
- Variant
  - 0 = Standard
  - 0 = Standard
  - 1 = Input P1/P2/P3 for motor temp. monitoring
  - 0 = With standstill detection
- 03 — Contacts
- BL 9028. — Type

Control input X1, X2

With BL 9028 softstart begins by closing switch S and braking starts when opening switch S. When closing S during braking, softstart begins again. A new start can only be made, after the braking cycle is completed. The control input is triggered with rising edge.

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

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 leads to interruption of the softstart and to fault message 15.

Braking:
Press stop button and adjust with potentiometer „I_{Br}“ the braking current to the desired value. Please adjust the braking current high enough so that the brake time is shorter than 20 sec. The brake current should be limited to 1.8 ... 2 x I_N of the motor. If the brake function at 1.8 ... 2 times of rated current has not finshed within 20 sec the load is too high. The next larger motor shoud be used. To avoid an overload of the device and the motor, the brake current should be measured with a moving coil instrument in the motor connecting line T1.

Function test of brake circuit:
Before starting the motor the function of the braking circuit is tested by a short braking attempt. If no current flows during the test the device goes into failure mode. By disconnecting and reconnecting of the auxiliary voltage the fault can be reset.

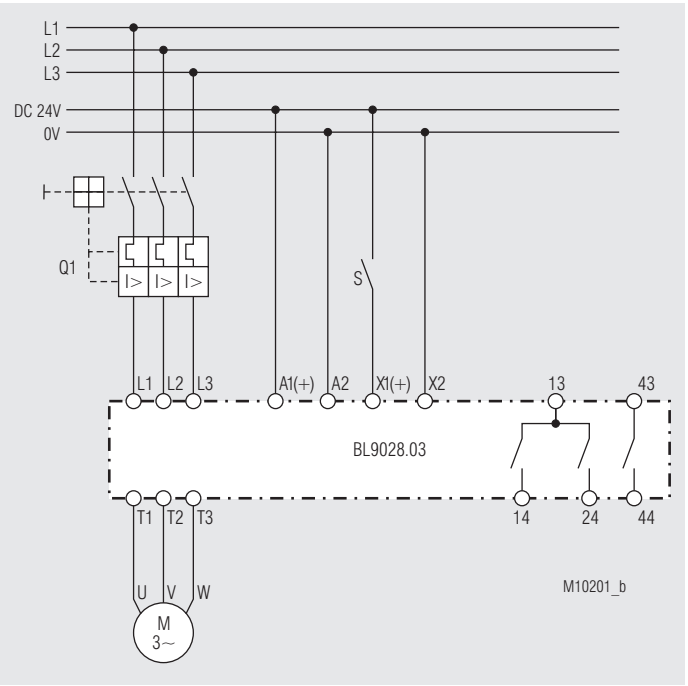
Temperature monitoring:
BL 9028 features overtemperature monitoring of its internal power semiconductors. The unit is therefore protected against overheating during the set up procedure. BL 9028 can be reset after the semiconductors have cooled down by momentarily removing the auxiliary supply voltage.

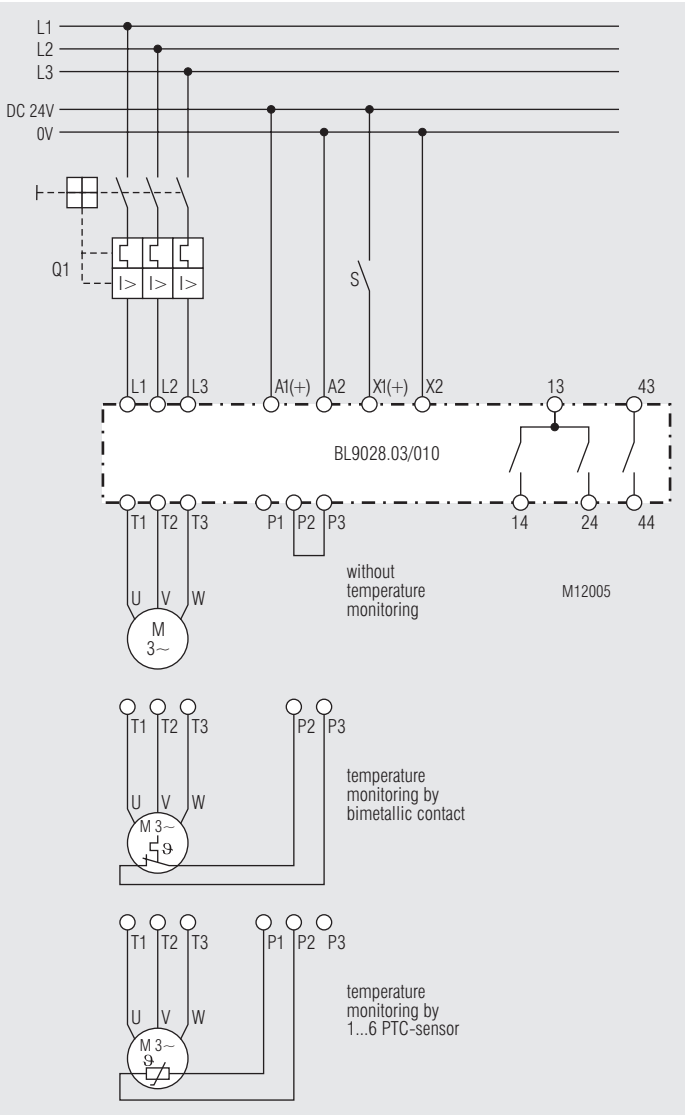
Monitoring of the power circuit:
To protect the power circuit against overcurrent the current is monitored in L1-T1. To high starting current, braking current or current at stalled motor result in disconnecting the motor current and failure indication by flashing code (see Indicators).

Safety Notes

- Never clear a fault when the device is switched on.
- 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 Examples





Fault Indication by Flashing Code

During normal operation failure messages may occur. The messages are indicated by a flashing sequence of the „Error“ LED.

Flashes	Fault	Reason	Failure recovery
1 x	Overtemperature on power unit	Permitted duty cycle exceeded	Reduce duty-cycle Wait till heat sink cools down
2 x	Overtemperature on motor or broken wire in thermistor circuit	High duty-cycle on motor or broken wire	Decrease duty-cycle. Repair wiring of temperature sensor
3 x	Short circuit in thermistor circuit	Squeeze conduit, defective soldering point	Check connection wire, repair
4 x	Phase failure	Defective fuse	Change fuse
			Check voltage range
5 x	Decrease phase sequence	Connection L1, L2, L3 incorrect	Correct connetion sequence see application
6 x	Mains frequency is out of tolerance	Wrong mains frequency	Device not suitable for the frequency. Contact manufacturer.
7 x	Broken ciruit	Cable break	Check wiring
		Defective braking relay	The unit has to repaired
9 x	Incorrect internal temperature sensor	Defective component or temperature out of range	Check temp. range The unit has to repaired
10 x	RAM defective	Defective component	The unit has to repaired
13 x	Overcurrent on power semiconductors	Gravitational start	Prolonging ramp up time. Set starting torque lower. Use unit with higher ranges
		Motor blocked	Remove blockage
14 x	Brake current to high	Braking current adjusted over permitted value	Back off potentiometer I_{Br}
15 x	Overcurrent on ramp	Gravitational start, ramp time to short or starting torque to high	Prolonging ramp up time. Set starting torque lower. Use unit with higher ranges
16 x	Communication error internal	Defective component	The unit has to repaired
17 x	Overcurrent on bridging relay	Motor blockage	Remove blocking