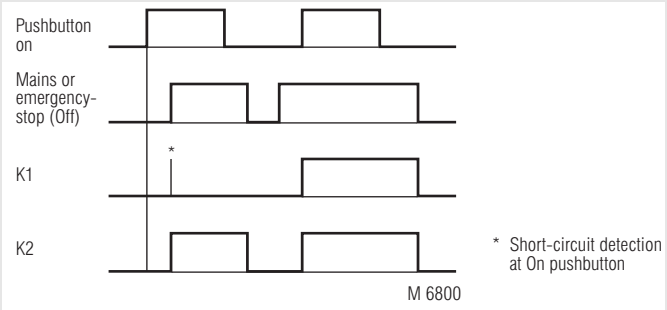
Safety technique

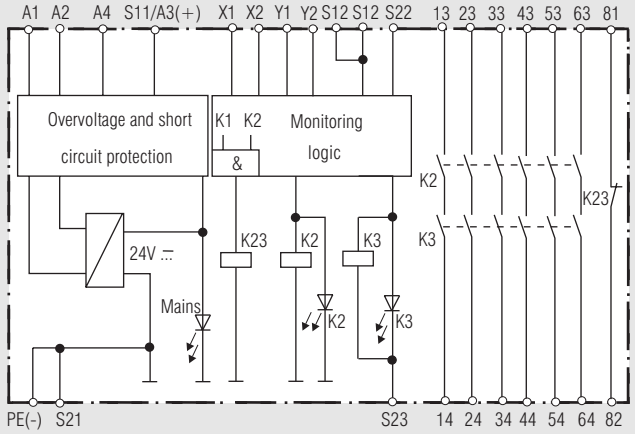
Emergency stop module BO 5988 safemaster

0221562

Function diagram



Block diagram



- According to EC Directive for machines 98/37/EG
- According to IEC/EN 60204-1
- Safety category 4 according to EN 954-1
- Output: max. 6 NO, 1 NC contacts or 1 NO contact for AC 250 V
- Optionally with release delayed NO contact to 10 min
- 1-channel or 2-channel connection
- Line fault detection at On pushbutton
- Optionally automatic On function after connection of operating voltage or activation via On pushbutton
- Optionally cross fault detection in emergency stop control circuit
- Optionally dual voltage version
- Feedback circuit X1-X2 for monitoring external contactors
- Integrated short-circuit and overvoltage protection
- Optionally with protective seperation to IEC/EN 60 140, IEC/EN 60 947-1
- LED displays for channels 1 and 2 and supply
- Removable terminal strips
- Wire connection: also 2 x 1,5 mm² stranded ferruled (isolated), DIN 46 228-1/-2/-3-4 or 2 x 2,5 mm² stranded ferruled DIN 46 228-1/-2/-3
- Width 100 mm

Approvals and marking

ET | Canada | Canada / USA | CE

* see variants

Applications

Protection of people and machines
- Emergency stop circuits on machines
- Monitoring of safety gates

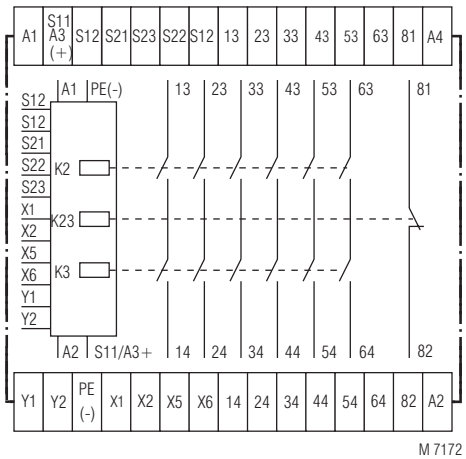
Indication

LED power supply:	on, when operating voltage present
LED K2:	on, when supply on relay K2
LED K3:	on, when supply on relay K3
only at BO 5988/4_ _, BO 5988/5_ _:	
LED KT2, KT3:	on, when delayed contacts are energised

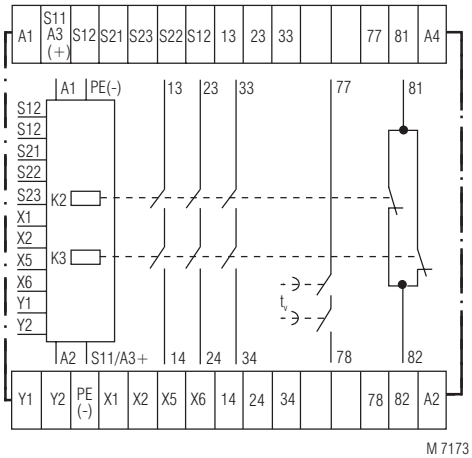
Note

Safety category 4 according to EN 954-1 only at applications with cross fault detection.
At delayed contacts: Safety category 3 according to EN 954-1 for delays up to 30 s max. For longer delays category 1.
In applications at category 4 (DIN EN 954-1) with contact outputs the safety functions have to be tested at least once a month.

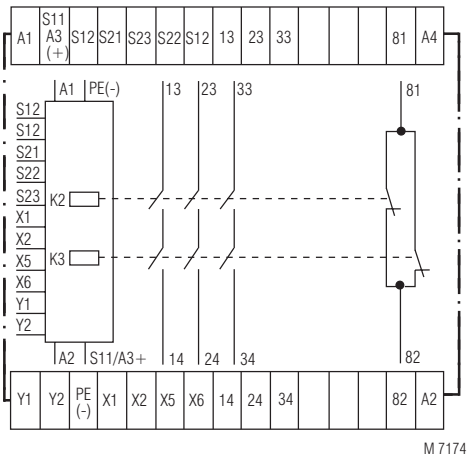
Circuit diagrams



BO 5988.61



BO 5988.47



BO 5988.48

Notes

Jumper assignment for functions:
Activation via On pushbutton / or automatic On function

On push-button Y1 - Y2	Jumper X5 - X6	Function
		The output contacts are switches only after operation of the On pushbutton. Line fault monitoring at the On pushbutton
 M8687		Automatic On function for operating voltage Off/On or after emergency stop release

Line fault detection at the On pushbutton:
The output contacts cannot be closed if the On pushbutton is already closed before the voltage is applied to S12, S22 (also in the event of a line fault at the On pushbutton).
A line fault at the On pushbutton which occures after activation of the device is recognized when swichting-on takes place again and closing of the output contacts is then prevented.
If a line fault occurs at the On pushbutton after the voltage is already present at S12, S22, undesired activation will take place, because this line fault does not differ from the normal closing function.
The gold-plated contacts of the BO 5988 also mean that this module is suitable for switching small loads of 1 mVA ... 7 VA, 1 mW ... 7 W in the range 0,1 ... 60 V, 1 ... 300 mA. The contacts also permit the maximum switching current. However, since the gold plating is burnt off at this current level, the device is no longer suitable for switching small loads after this.
The PE terminal permits operation of the device in IT systems with insulation monitoring and also serves as a reference point for testing the control voltage. The internal short-circuit protection will be bridged on DC devices, if the protective ground is connected to terminal PE.
One or more extension modules BN 3081 or external contactors with positively-driven contacts may be used to multiply the number of contacts of the emergency stop module BO 5988.

ATTENTION - AUTOMATIC START!

According to IEC/EN 60 204-1 part 9.2.5.4.2 it is not allowed to restart automatically after emergency stop. Therefore the machine control has to disable the automatic start after emergency stop.

Technical data

Input

Nominal voltage U_N

BO 5988.--/-00:	DC 24 V
BO 5988.--/-24:	DC 24 V[1] + AC 24 V[2]
	DC 24 V[1] + AC 48 V[2]
	DC 24 V[1] + AC 110 V[2]
	DC 24 V[1] + AC 230 V[2]
	DC 24 V[1] + AC 240 V[2]
	[1] at terminals A3-A4
	[2] at terminals A1-A2
Voltage range:	AC 0,8 ... 1,1 U_N
at 10 % residual ripple:	DC 0,9 ... 1,2 U_N
at 48 % residual ripple:	DC 0,8 ... 1,1 U_N
Nominal consumption:	AC: approx. 6 VA, DC: approx. 3 W
Nominal frequency:	50 / 60 Hz
Control voltage	
at S11:	typ. DC + 24 V
at S21:	0 V
Control current:	typ. DC 110 mA
Minimum voltage	
at terminals S12, S22:	DC 21 V with activated device
Recovery time:	2 s
	A minimum switch-off time of 20 s must be observed if the line fault monitoring function at the On push-button is active

Technical data

Output

Contact

BO 5988.48:	3 NO, 1 NC indicator contact
BO 5988.61:	6 NO, 1 NC indicator contact
BO 5988.62:	6 NO, 1 NO indictor contact
BO 5988.47:	3 NO, 1 NC indicator contact
	1 NO release delayed
	The NO contacts 13...63 / 14...64 are safety contacts.
	ATTENTION! The NC contacts 81-82 or one NO contact 83-84 can only be used for monitoring.
Operate time	
manual restart:	typ. 30 ms
automatic restart:	1 s
Release time	
opening in secondary circuit (S12-S22):	30 ms $\pm$ 50 %
opening in supply circuit	
BO5988.47, BO 5988.48:	100 ms + 50 %
BO 5988.61, BO 5988.62:	50 ms + 50 %
Time delay t_v:	Auxiliary supply is not necessary during elapse of time:
BO 5988.47/1 _ _ :	0,1 ... 1 s 0,3 ... 3 s
	0,5 ... 5 s 1 ... 10 s
BO 5988.47/2 _ _ :	1 s, 3 s, 5 s, 10 s
	Auxiliary supply must be connected during elapse of time:
BO 5988.47/4 _ _:	0,1 ... 1 s 0,1 ... 1 min
	0,3 ... 3 s 0,3 ... 3 min
	1 ... 10 s 0,5 ... 5 min
	3 ... 30 s 1 ... 10 min
BO 5988.47/5 _ _ :	1 s, 3 s, 10, 30 s
	1 min, 3 min, 5 min, 10 min
Repeat accuracy	
BO 5988.47/1 _ _ and BO 5988.47/2 _ _ :	$\pm$ 15 % of setting value
BO 5988.47/4 _ _ and BO 5988.47/5 _ _ :	$\pm$ 1 % of setting value
Contact type:	Relay, positively-driven
Nominal output voltage:	AC 250 V
	DC: see limit curve for arc-free operation
Signalling contact of BO 5988.61 and BO 5988.62:	AC 10 ... 250 V, DC 10 ... 120 V for AC/DC 0,1 ... 1 A
Thermal current I_{th}:	see total current limit curve (max. 10 A in one contact path)
release delayed NO contact 77-78 at BO 5988.47:	max. 8 A
Switching capacity	
to AC 15	
NO contact:	5 A / AC 230 V IEC/EN 60 947-5-1
NC contact:	2 A / AC 230 V IEC/EN 60 947-5-1
BO 5988.47	
release delayed NO contact:	3 A / AC 230V IEC/EN 60 947-5-1
to DC 13	
NO contact:	4 A / DC 24 V IEC/EN 60 947-5-1
NC contact:	4 A / DC 24 V IEC/EN 60 947-5-1
to DC 13	
NC contact:	10 A / 24 V > 10^5
	On: 0,4 s, Off: 9,6 s
Electrical life	
to AC 15 at 2 A, AC 230 V:	10^5 switching cycles IEC/EN 60 947-5-1
to DC 13 at 2 A, AC 230 V:	> 240 x 10^3 switching cycles IEC/EN 60 947-5-1
Permissible operating frequency:	600 switching cycles / h
Short circuit strength	
max. fuse rating:	6 A gL IEC/EN 60 947-5-1
max. line circuit breaker:	C 10 A
Mechanical life:	30 x 10^6 switching cycles

General data

Operating mode:	Continuous operation
Temperature range:	- 15 ... + 50°C

Technical data

Clearance and creepage distances		
overvoltage category / contamination level:	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:	2 kV	IEC/EN 61 000-4-4
Surge voltages between		
wires for power supply:	0,5 kV	IEC/EN 61 000-4-5
between wire and ground:	2 kV	IEC/EN 61 000-4-5
HF-wire guided:	10 V	IEC/EN 61 000-4-6
Interference suppression:	Limit value class B	EN 55 011
Degree of protection:	Housing: IP 40	IEC/EN 60 529
	Terminals: IP 20	IEC/EN 60 529
Housing:	Thermoplastic with V0 behaviour according to UL subject 94	
Vibration resistance:	Amplitude 0,35 mm frequency 10 ... 55 Hz	IEC/EN 60 068-2-6
Climate resistance:	15 / 050 / 04	IEC/EN 60 068-1
Terminal designation:	EN 50 005	
Wire connection:	1 x 4 mm² solid or 1 x 2,5 mm² stranded ferruled (isolated) or 2 x 1,5 mm² stranded ferruled (isolated) DIN 46 228-1/-2/-3/-4 or 2 x 2,5 mm² stranded ferruled DIN 46 228-1/-2/-3	
Wire fixing:	Plus-minus terminal screws M 3,5 box terminal with wire protection	
Mounting:	DIN rail	IEC/EN 60 715
Weight:	850 g	

Dimensions

Width x height x depth: 100 x 74 x 121 mm

Standard types

BO 5988.61/024 DC 24 V + AC 230 V 50 / 60 Hz
Article number: 0040375 stock item
- Dual voltage version
- Output: 6 NO contacts, 1 NC contact as monitoring contact
- Width: 100 mm

BO 5988.47/124 DC 24 V + AC 230 V 50 / 60 Hz 1 ...10 s
Article number: 0040430 stock item
- Dual voltage version
- Output: 3 NO contacts, 1 NC contact as monitoring contact, 1 release delayed NO contact
- With adjustable time delay t_v to 10 s
- Width: 100 mm

Variants

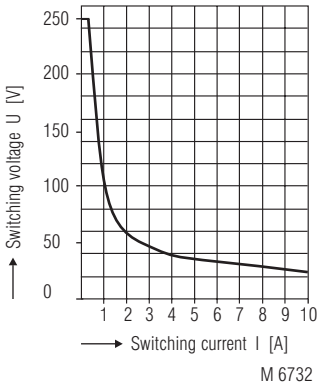
BO 5988._ _ /60: with CSA approval
BO 5988._ _ /61: with UL approval (Canada/USA)
Auxiliary supply is not nesseary during elapse of time:
BO 5988.47 / 1 _ _: 3 NO / 1 NC contacts + t_v adjustable
BO 5988.47 / 2 _ _: 3 NO / 1 NC contacts + t_v fixed
Auxiliary supply must be connected during elapse of time:
BO 5988.47 / 4 _ _: 3 NO / 1 NC contacts + t_v adjustable
BO 5988.47 / 5 _ _: 3 NO / 1 NC contacts + t_v fixed
Without time delay t_v:
BO 5988.48 / 0_ _ : 3 NO / 1 NC contacts
BO 5988.61 / 0_ _ : 6 NO / 1 NC contacts as monitoring contact
BO 5988.62 / 0_ _ : 6 NO / 1 NC contacts as monitoring contact
BO 5988. _ _ / _00: single voltage model
BO 5988. _ _ / _24: dual voltage model
BO 5988.61 / 106:
Protective seperation of control and load circuits according to IEC/EN 61 140, IEC/EN 60 947 4 kV / 2 referred to overvoltage category II with basic insulation to IEC 60 664 of 2,5 kV / 2.
BO 5988.61 / 324: Dual voltage model 0,5 s operate delay with automatic restart

Ordering example for Variants

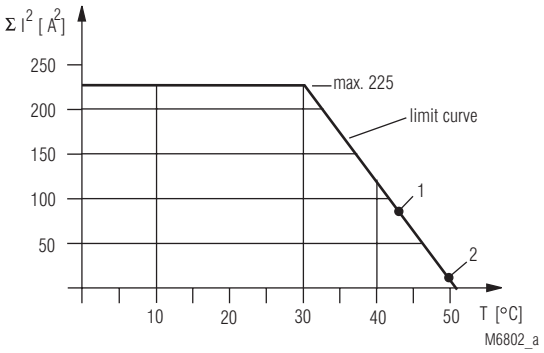
BO 5988.47/124 1 ... 10 s DC 24 V + AC 230 V 50 / 60 Hz

- 50 / 60 Hz: Nominal frequency
- DC 24 V + AC 230 V: Nominal voltage
- 1 ... 10 s: Time delay
- 47: 00: 1 nominal voltage; 24: 2 nominal votlages
- 124: 0: without t_v; without auxiliary supply during time elapse: 1: t_v adjustable, 2: t_v fixed; with auxiliary supply during time elapse: 4: t_v adjustable, 5: t_v fixed
- BO 5988.47/124: Contacts
- BO 5988.47/124: Type

Characteristics



Limit curve for arc-free operation with resistive load



Total current limit curve
It is necessary to use the square of the currents in order to obtain a linear limit curve.

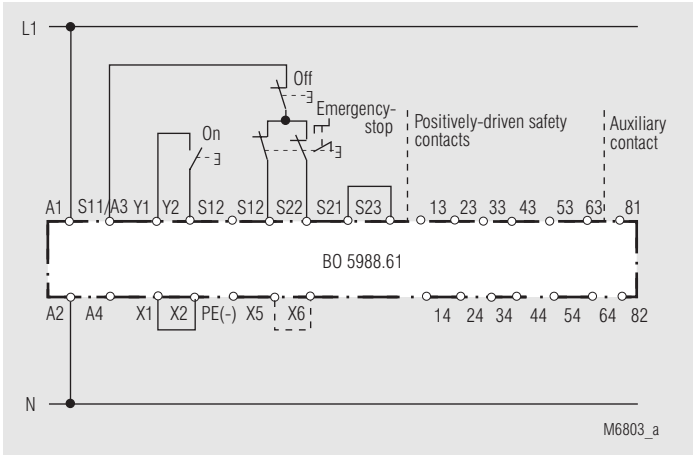
General formula for determination of the maximum ambient temperature
A) Sum of currents² per safety contact = value on scale ΣI^2 (A^2)
B) Max. ambient temperature T = Cross point of scale ΣI^2 (A^2) with limit curve

Example 1
A) $(4A)^2 + (4A)^2 + (4A)^2 + (4A)^2 + (4A)^2 + (4A)^2 = 96\ A^2$ (Scale ΣI^2)
B) Max. ambient temperature T = 43°C (point 1)

Example 2
A) $(0,5\ A)^2 + (1\ A)^2 + (2\ A)^2 + (1\ A)^2 = 6,25\ A^2$ (Scale ΣI^2)
B) Max. ambient temperature T = 49°C (point 2)

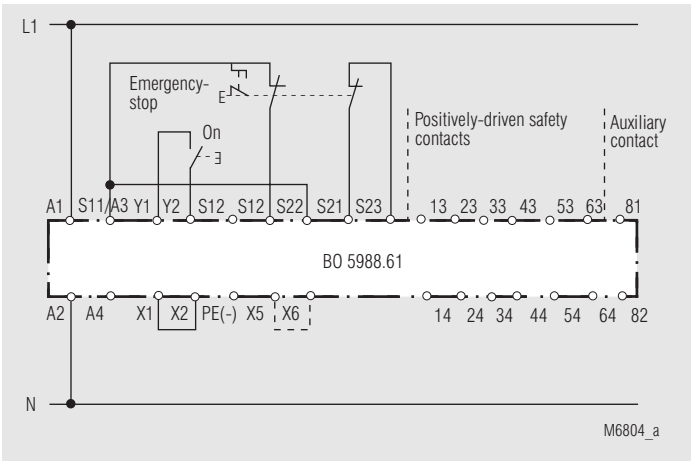
Please note:
The total current² can still be 1,5 A^2 at 50°C , i.e. 0,5 A per safety contact
A) $(0,5\ A)^2 + (0,5\ A)^2 + (0,5\ A)^2 + (0,5\ A)^2 + (0,5\ A)^2 + (0,5\ A)^2 = 1,5\ A^2$
B) Max. ambient temperature = 50°C

Application examples

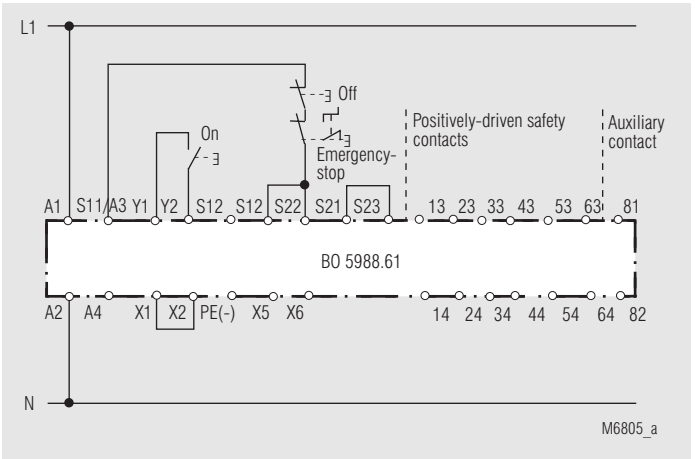


Two-channel emergency stop circuit without cross fault detection.
Activation via On pushbutton. - - - Jumper X5 - X6:
A jumper must be fitted X5 - X6 for the automatic On function.
The On pushbutton is not required.

Application examples

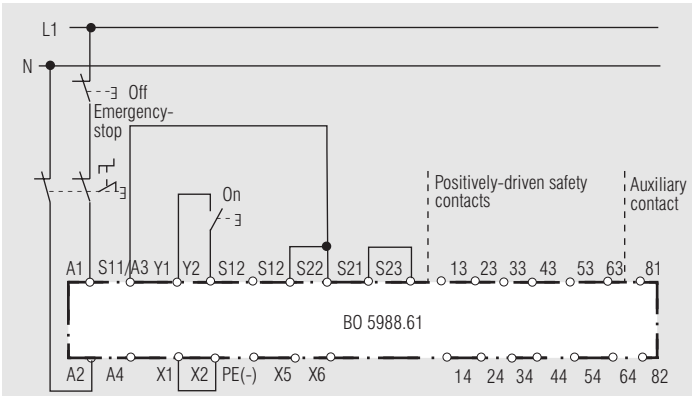


Two-channel emergency-stop circuit with cross fault detection.
Activation via On pushbutton. - - - Jumper X5 - X6:
A jumper must be fitted X5 - X6 for the automatic On function.
The On pushbutton is not required.

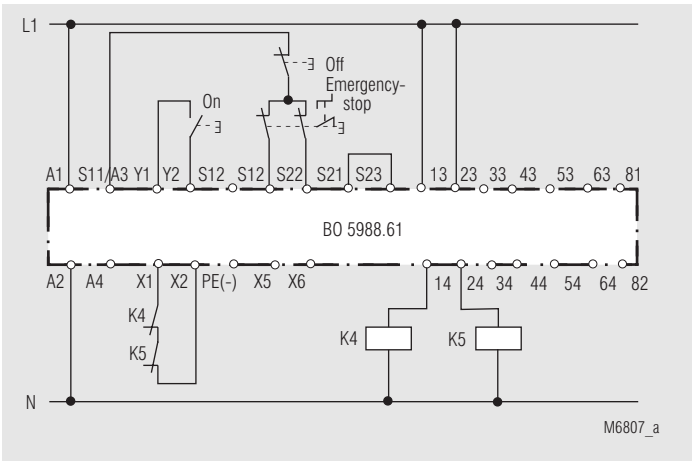


One-channel emergency stop circuit. This circuit does not have any redundancy in the emergency stop control device circuit.

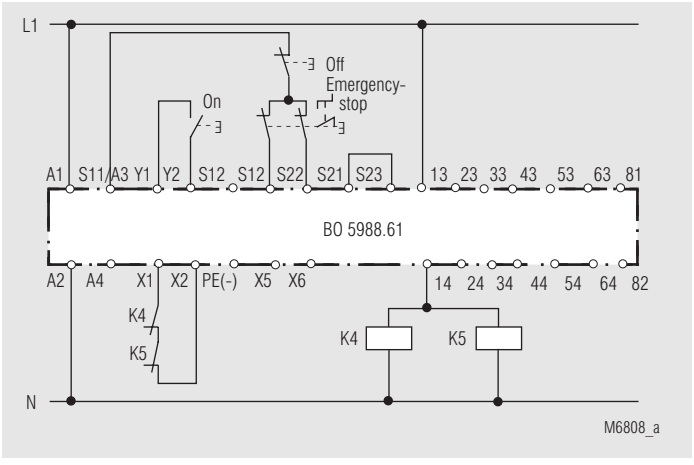
Application examples



Two-pole emergency stop circuit with emergency stop control device in the supply circuit.
Application for long emergency stop loops where the control voltage drops below the minimum voltage of 21 V.
Attention:
Single faults (e.g. line faults at the emergency stop control device) are not detected with this external circuit configuration.

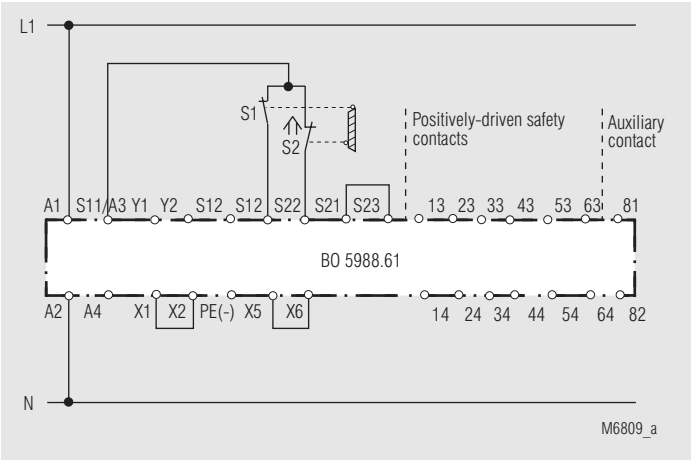


Contact reinforcement by external contactors, two-channel.
The output contacts can be reinforced by external contactors with positively-driven contacts for switching currents > 8 A. Functioning of the external contactors is monitored by looping the NC contacts into the closing circuit (terminals X1 - X2).



Contact reinformcement by external contactors with reduced safety level.

Application examples



Two-channel monitoring of a safety gate. S1 must not close before S2