SAFEMASTER
Two-Hand Safety Relay
BG 5933, BH 5933

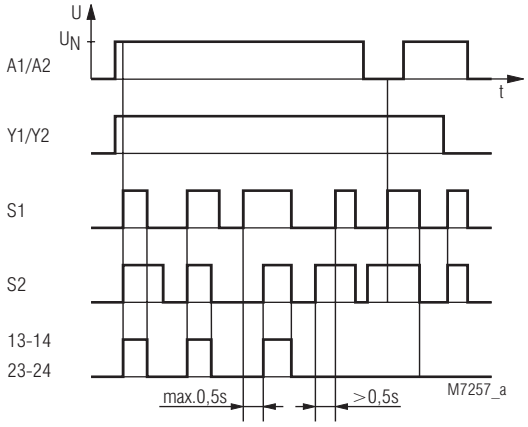
0230733

BG 5933

BH 5933

- **According to**
  - **Performance Level (PL) e and category 4 to EN ISO 13849-1: 2008**
  - **SIL Claimed Level (SIL CL) 3 to IEC/EN 62061**
  - **Safety Integrity Level (SIL) 3 to IEC/EN 61508**
  - **Safety Level Type III-C according to EN 574**
  - **the safety regulations for two-hand controls on power-operated presses in metalworking ZH 1-456**
- Inputs for 2 push buttons with 1 NC and 1 NO contact
- Output: 2 NO contacts, 1 NC contact or
  3 NO contacts, 1 NC contact
- Feedback circuit Y1 - Y2 to monitor external contactors used for reinforcement of contacts
- Overvoltage and short circuit protection
- 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
- BG 5933: width 22.5 mm
  BH 5933: width 45 mm

Function Diagram



1.) "S1, S2 activated" means, NC open and NO closed
2.) activated S1, switches "+"-potential
3.) activated S2, switches "-"-potential

Approvals and Markings

CE
TÜVRheinland Functional Safety Type Approved FS
c UL us LISTED Canada / USA

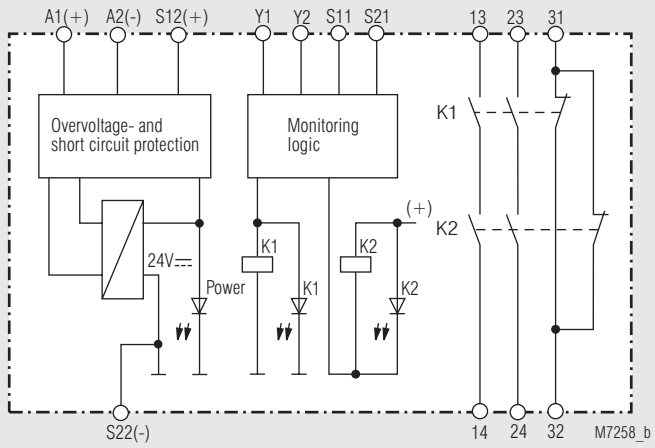
Applications

Designed for press controls in metalworking as well as in other working machines with dangerous closing movements.

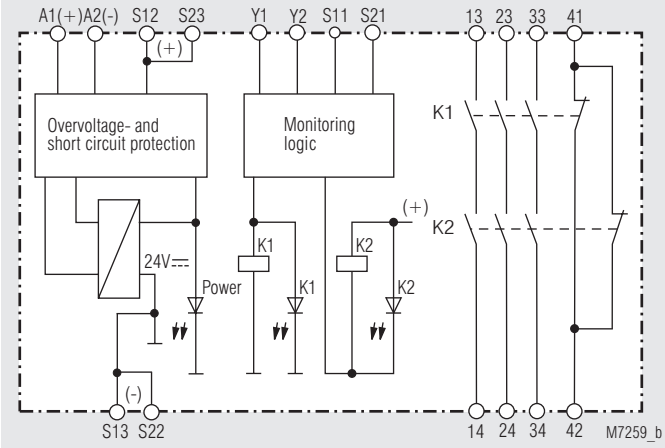
Indication

LED power-supply:	on, when operating voltage applied
LED K1:	on, when relay K1 active
LED K2:	on, when relay K2 active

Block Diagram

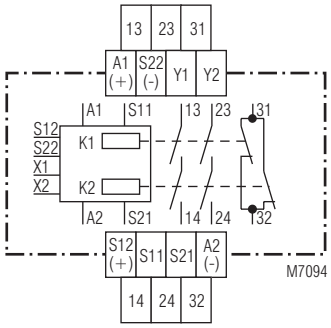


BG 5933

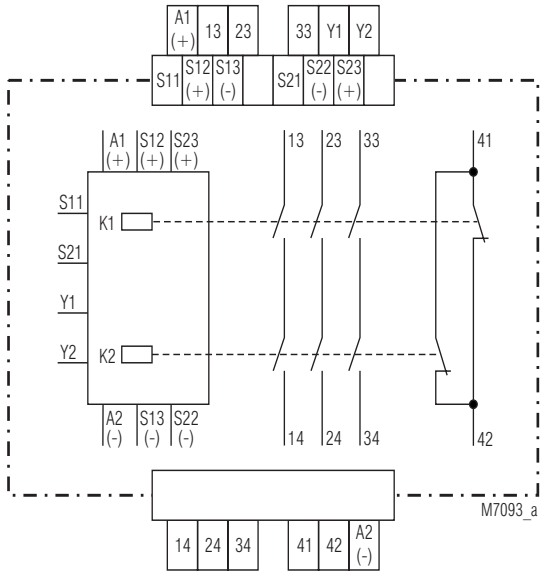


BH 5933

Circuit Diagrams



BG 5933.22



BH 5933.48

Connection Terminals

Terminal designation	Signal designation
A1 (+)	+ / L
A2 (-)	- / N
S11, S21, Y1, Y2	Inputs
S12(+), S13(-), S22(-), S23(+)	Outputs
13, 14, 23, 24, 33, 34	Forcibly guided NO contacts for release circuit
31, 32, 41, 42	Forcibly guided indicator output

Notes

If both buttons are pressed while switching on the operating voltage (e.g. after voltage failure) the output contacts do not energize.
The terminal S22 also serves as reference point for checking the control voltage.
On BG 5933 there is only one terminal S12 and S22.

Set-Up Instructions

The device has to be connected as shown in the application examples. When connecting the push-buttons in parallel or in series the safe function of the relay is disabled. Connected contactors (relays) must have forcibly guided contacts and have to be monitored in the feedback circuit.
To start a dangerous movement, 2 push buttons are used, each equipped with 1 NO and 1 NC contact. The output contacts will be switched if both push buttons are operated within ≤ 0.5 s. The buttons must be designed and installed in a way, that it is not possible to manipulate or to operate them without intention.
The distance between push buttons and dangerous area must be chosen in a way that it is not possible to reach the dangerous area after release of one button before the dangerous movement comes to standstill.

The safety distance "s" is calculated with the following formula:
s = v x t + C

a) moving speed of person v = 1 600 mm/s
b) stopping time of the machine t (s)
c) Additional safety distance C = 250 mm

If the risc of accessing the dangerous area is prohibited while the push buttons are pressed e.g. by covering the buttons, C can be 0. The minimum distance has to be in this case 100 mm. See also EN 574.

Technical Data

Input

Nominal voltage U_N:
BG 5933: AC 24 V; DC 24 V
BH 5933: AC 24, 42, 48, 110, 120, 127, 230, 240 V DC 24 V
Voltage range: AC 0.85 ... 1.1 U_N
at 10 % residual ripple: DC 0.9 ... 1.1 U_N
Nominal consumption: AC approx. 4 VA
DC approx. 2.3 W
Nominal frequency: 50 / 60 Hz
Delay time for simultaneity demand: max. 0.5 s
Recovery time: 1 s
Control contacts: 2 x (1 NO, 1 NC contacts)
Current via control contacts with DC 24 V:
NO contact: typ. 50 mA
NC contact: typ. 20 mA
Fuse protection: internal with PTC
Overvoltage protection: by MOV

Output

Contacts:
BG 5933.22: 2 NO, 1 NC contacts
BH 5933.48: 3 NO, 1 NC contacts

The NO contacts are safety contacts.
ATTENTION! The NC contacts 31-32 and 41-42 can only be used for monitoring.

Operate time: typ. 40 ms
Release time: typ. 15 ms
Contact type: relay, forcibly guided
Nominal output voltage: AC 250 V
DC: see continuous current limit curve
Switching of low loads: ≥ 100 mV
(contacts with 5 µ Au) ≥ 1 mA
Thermal current I_{th}: max. 5 A
(see continuous current limit curve)

Switching capacity
to AC 15:
NO contacts: 3 A / AC 230 V IEC/EN 60 947-5-1
NC contacts: 2 A / AC 230 V IEC/EN 60 947-5-1
to DC 13:
NO contacts: 1 A / DC 24 V IEC/EN 60 947-5-1
NC contacts: 1 A / DC 24 V IEC/EN 60 947-5-1
Electrical contact 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, DC 24 V: > 1.5 x 10^5 switching cycles
Permissible switching capacity: max. 1 800 switching cycles / h
Short circuit strength
max. fuse rating: 6 A gL IEC/EN 60 947-5-1
Line circuit breaker: C 8 A
Mechanical life: 10 x 10^6 switching cycles

Technical Data

General Data

Nominal operating mode:	continuous operation	
Temperature range		
operation:	- 15 ... + 55°C	
storage :	- 25 ... + 85 °C	
altitude:	< 2.000 m	
Clearance and creepage distances		
rated impuls voltage / pollution degree:	4 kV / 2 (basis insulation)	IEC 60 664-1
EMC		
Electrostatic discharge:	8 kV (air)	IEC/EN 61 000-4-2
Fast transients:	2 kV	IEC/EN 61 000-4-4
Surge voltages between wires for power supply:	1 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:	Thermoplast 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 / 055 / 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:	Terminal screws M3.5 Box terminals with self-lifting wire protection	
Mounting:	DIN rail	IEC/EN 60 715
Weight		
BG 5933:	200 g	
BH 5933:	400 g	

Dimensions

Width x height x depth	
BG 5933:	22.5 x 84 x 121 mm
BH 5933:	45.0 x 84 x 121 mm

Safety Related Data

Values according to EN ISO 13849-1:		
Category:	4	
PL:	e	
$MTTF_d$:	30.7	a
DC / DC_{avg}:	99.0	%
d_{op}:	220	d/a (days/year)
h_{op}:	12	h/d (hours/day)
t_{Zyklus}:	9.50E+01	s/Zyklus (BG 5933)
t_{Zyklus}:	1.40E+02	s/Zyklus (BH 5933)

Values according to IEC/EN 62061 / IEC/EN 61508:		
SIL CL:	3	IEC/EN 62061
SIL	3	IEC/EN 61508
HFT:	1	
DC / DC_{avg}:	99.0	%
SFF	99.7	%
PFH_D:	7.51E-9	h^{-1}
T_1:	20	a (year)

*) HFT = Hardware-Failure Tolerance

The values stated above are valid for the standard type.
Safety data for other variants are available on request.
The safety relevant data of the complete system has to be determined by the manufacturer of the system.

UL-Data

The safety functions were not evaluated by UL. Listing is accomplished according to requirements of Standard UL 508, "general use applications"

Nominal voltage U_N:	
BG 5933:	AC 24V , DC 24 V
BH 5933:	AC 24, 42, 48, 110, 120, 230 V DC 24V
Ambient temperature:	-15 … +55°C
Switching capacity:	
Ambient temperature 45°C:	Pilot duty B300 5A 250Vac G.P. 5A 24Vdc
Ambient temperature 55°C:	Pilot duty B300 4A 250Vac G.P. 4A 24Vdc
Wire connection:	60°C / 75°C copper conductors only AWG 20 - 12 Sol Torque 0.8 Nm AWG 20 - 14 Str Torque 0.8 Nm

Technical data that is not stated in the UL-Data, can be found in the technical data section.

Standard Type

BG 5933.22/61 DC 24 V

Article number:	0063397
• Output:	2 NO contacts, 1 NC contact
• Nominal voltage U_N:	DC 24 V
• Width:	22.5 mm

BH 5933.48/61 AC 230 V

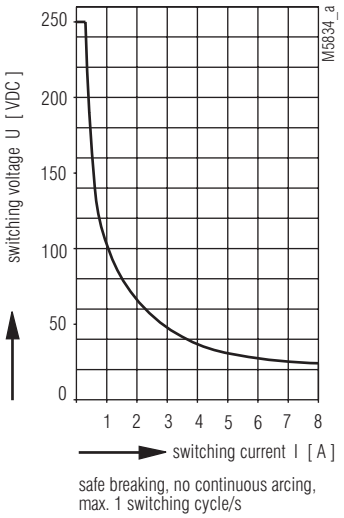
Article number:	0061926
• Output:	3 NO contacts, 1 NC contact
• Nominal voltage U_N:	AC 230 V
• Width:	45 mm

Ordering example

B_ 5933 .22 /61 DC 24 V

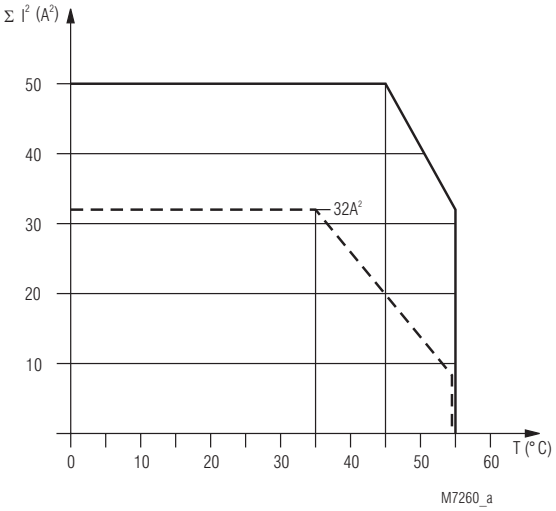
- DC 24 V: Nominal voltage
- /61: with UL approval
- .22: Contacts
- 5933: G: 22.5 mm width, H: 45 mm width

Characteristics



Limit curve for arc-free operation with resistive load

Characteristics



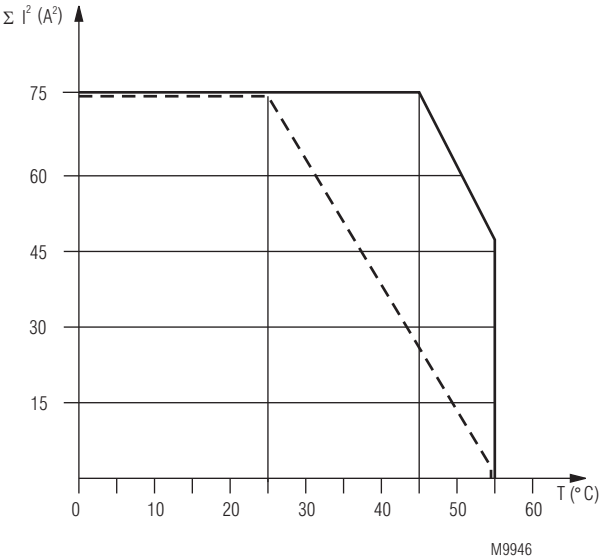
device mounted on distance with air circulation.
max. current at 55°C over
2 contactrows = 4A ≙ 2x4²A²=32A²

device mounted without distance heated by devices with same load,
max current at 55°C over
2 contactrows = 2A ≙ 2x2²A²=8A²

$\Sigma I^2 = I_1^2 + I_2^2$

I_1, I_2 - current in contactrows

Continuous current limit curve BG 5933



device mounted on distance with air circulation.
max. current at 55°C over
3 contactrows = 4A ≙ 3x4²A²=48A²

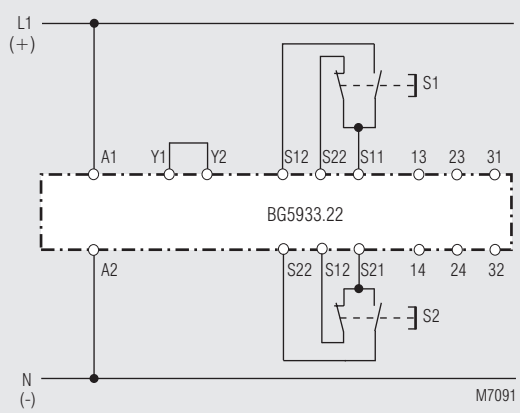
device mounted without distance heated by devices with same load,
max current at 55°C over
3 contactrows = 1A ≙ 3x1²A²=3A²

$\Sigma I^2 = I_1^2 + I_2^2 + I_3^2$

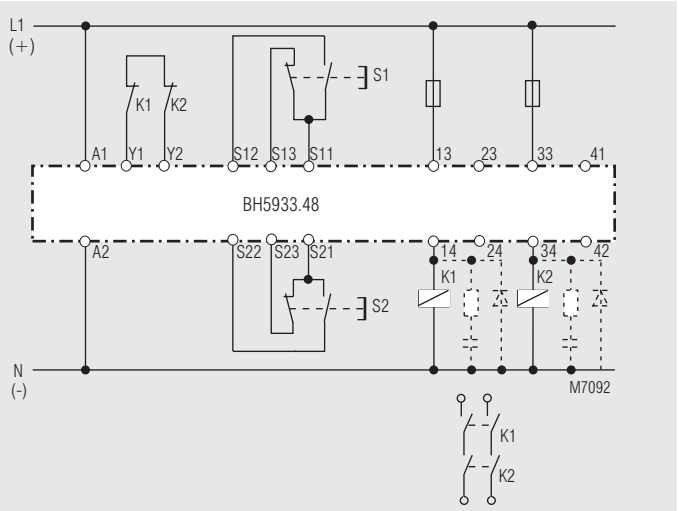
I_1, I_2, I_3 - current in contactrows

Continuous current limit curve BH 5933

Application Examples



Two-hand control
Suited up to SIL3, Performance Level e, Cat. 4



Two-hand control with contact reinforcement via external forcibly guided contactors. When switching inductive loads spark absorbers are recommended.
Suited up to SIL3, Performance Level e, Cat. 4