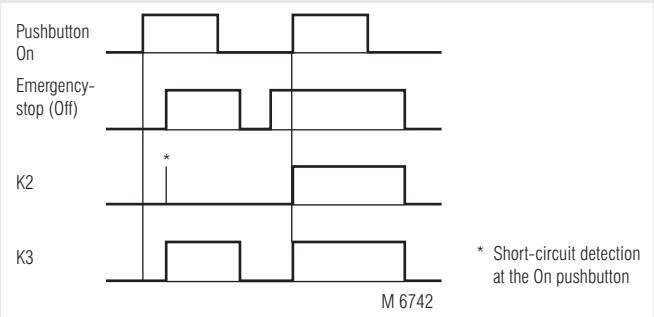
Emergency Stop module BD 5935
SAFEMASTER®

0221548

- **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**
  - **Category 4 to EN 954-1**
- Output: optionally 1 NO / 1 NC or 3 NO / 1 NC contacts
- Gold plated contacts to switch low loads (signal to PLC)
- 1- or 2-channel connection
- Line fault detection on ON pushbutton
- Operating state display
- LED display for channels 1 and 2
- Removable terminal strips
- 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
- Optionally automatic ON function or activation via the ON pushbutton
- Optionally cross fault detection in emergency-stop
- With fast auto start as option
- Width 45 mm

Function diagram

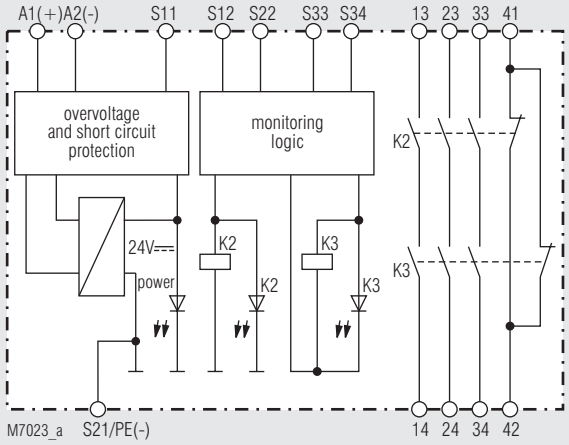


Approvals and marking

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

* see variants

Block diagram



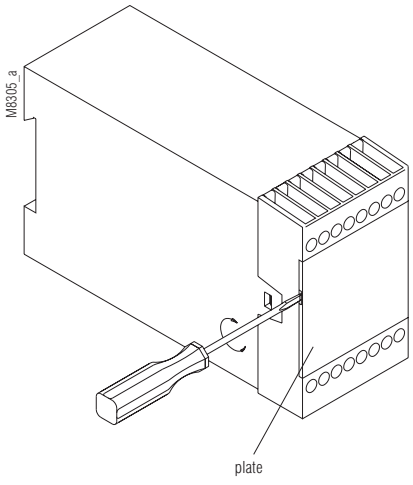
Applications

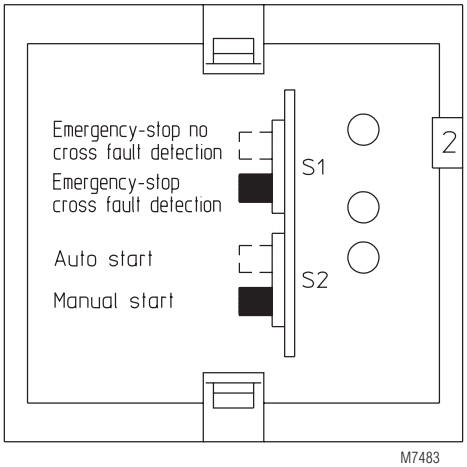
Protection of persons and machines
- Emergency-stop circuits on machines
- Monitoring of safety gates

Indication

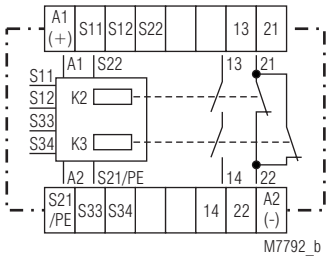
upper LED: on when supply voltage connected
lower LEDs: on when relay K2 and K3 active

Unit programming

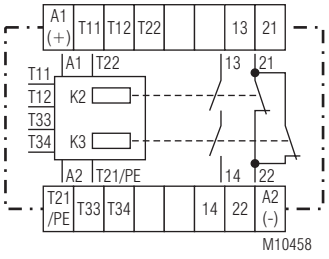




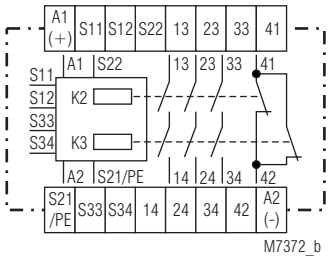
Schaltbilder



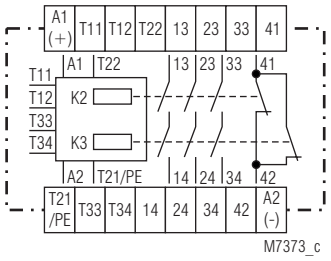
BD 5935.16



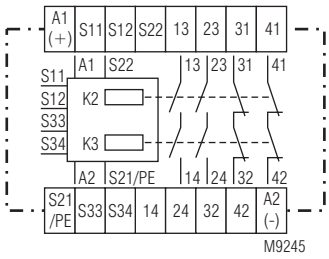
BD 5935.16/200



BD 5935.48



BD 5935.48/200



BD 5935.52

Notes

Line fault detection at the ON pushbutton:
If the ON pushbutton was already closed before the voltage was applied at S12, S22 (also in the case of line fault via the ON pushbutton), the output contacts cannot be switched on.
A line fault at the ON pushbutton which occured after activation of the unit is recognized when switching on takes place again and switching-on of the output contacts is prevented. If a line fault occurs at the ON pushbutton after the voltage has already been applied at S12 and S22, unwanted activation occures because this line fault can not be distinguished from the regular switching-on function. The PE testing terminal allows the units to be also operated in IT networks with insulation monitoring. It also serves as a reference point for checking the control voltage and as a connection contact in the event of an emergency-stop with cross fault detection.

Because of the gold-plated contacts the BD 5935 can be used to switch small loads 1 mVA ... 7 VA, 1 mW ... 7 W in the range of 0.1 ... 60 V, 1 ... 300 mA. The gold-plated contacts allow also to switch the maximum current but the gold plating will be burnt off. After that the contacts cannot be used any more to switch the small loads.

One or more extension modules BN 3081 or external contactors with forcibly guided contacts can be used to multiply the number of contacts of the emergency-stop module BD 5935.
The switches S1 and S2 are provided for the following selection possibilities: Automatic-start, manual-start and emergency-stop with or without cross fault detection. These switches are located behind the front cover panel (see unit programming diagrams).
Switch S2 is for selecting automatic or manual Start. In addition, terminals S33 and S34 must be jumpered for "automatic start function".
Selection of the operating mode with or without cross fault detection at the emergency-stop pushbutton is performed via the switch S1. The unit must be connected as shown in the application example.

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:	AC 24, 42, 48, 110, 115, 120, 127, 230, 240 V DC 24 V
Voltage range:	AC 0.85 ... 1.1 U_N
at 10% residual ripple:	DC 0.9 ... 1.2 U_N
at 48% residual ripple:	DC 0.8 ... 1.1 U_N
Nominal consumption:	AC approx. 4 VA, DC approx. 2 W
Nominal frequency:	50 / 60 Hz
Recovery time:	0.5 s after activating the emergency-stop button. If the line fault detection of the ON-button is be active, the device must stay off for approx. 5 sec.
Control voltage at S11:	DC 22 V
Control current via S12, S22:	approx. 35 mA ± 25 % at U_N
Minimum voltage at terminal S12, S22:	DC 21 V when unit is activated

Output

Contacts	
BD 5935.16:	1 NO / 1 NC contacts
BD 5935.48:	3 NO / 1 NC contacts The NO contacts are safety contacts. **ATTENTION! The NC contacts 21-22 or 41-42 can only be used for monitoring.**
BD 5935.52:	2 NO contacts / 2 NC contacts per contact path 2 contacts in series
Operate time	
activation via ON pushbutton:	50 ms - 25 % + 50 %
automatic ON function:	1 s - 25 % + 50 %, as option also with shorter on-delay (see variants)
Release time	
opening in secondary circuit (S12-S22):	25 ms - 25 % + 50 %
opening in supply circuit:	50 ms - 25 % + 50 %
Contact type:	relay, forcibly guided
Rated output voltage:	AC 250 V DC: see arc limit curve
Thermal current I_{th}:	see quadratic total current limit curve (max. 10 A in one contact path)
Switching capacity	
to AC 15	
for NO contact:	5 A / AC 250 V IEC/EN 60 947-5-1
for NC contact:	2 A / AC 250 V IEC/EN 60 947-5-1
to DC 13	
for NO contact:	4 A / DC 24 V IEC/EN 60 947-5-1
for NC contact:	4 A / DC 24 V IEC/EN 60 947-5-1
Electrical life	
to AC 15 at 2 A, AC 230 V:	10^5 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:	10 x 10^6 switching cycles

Technical Data

General Data

Operating mode:	Continuous operation	
Temperature range		
operation:	- 15 ... + 55 °C at max. 90% humidity	
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
Degree of protection:	Housing: IP 40*	IEC/EN 60 529
	Terminals: IP 20	IEC/EN 60 529
	* when front plate is removed to set switches, protection class IP 40 is not valid	
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 / 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:	Plus-minus terminal screws M3.5, box terminal with wire protection	
Mounting:	DIN rail	IEC/EN 60 715
Weight:	450 g	

Dimensions

Width x height x depth:	45 x 74 x 121 mm

Safety related data

Values according to EN ISO 13849-1:		
Category:	4	
PL:	e	
$MTTF_d$:	> 100	a
DC_{avg}:	99.0	%
d_{op}:	365	d/a (days/year)
h_{op}:	24	h/d (hours/day)
t_{cycle}:	2.60E+06	s/Zyklus
	≙ 1	/h (hour)

Values according to IEC/EN 62061 / IEC/EN 61508:		
SIL CL:	3	IEC/EN 62061
SIL	3	IEC/EN 61508
HFT*):	1	
DC_{avg}:	99.0	%
SFF	99.7	%
PFH_D:	2.78E-10	h^{-1}

*) 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.

Standard type

BD 5935.48 DC 24 V

Article number:	0045456	stock item
• Output:	3 NO / 1 NC contacts	
• Nominal voltage U_N:	DC 24 V	
• Width:	45 mm	

Variants

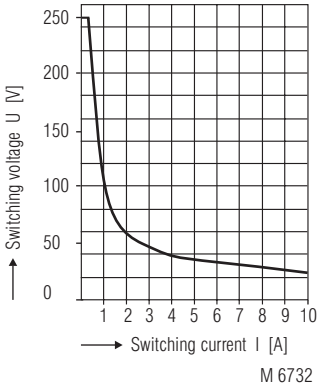
BD 5935._ _/61:	with UL-approval
BD 5935.48/200:	special terminal arrangement see diagram
BD 5935.48/324:	with fast auto start: typ. 500 ms, without line fault detection on ON-button
BD 5935.48/824:	with fast auto start: typ. 110 ms, without line fault detection on ON-button

Ordering example of Variants

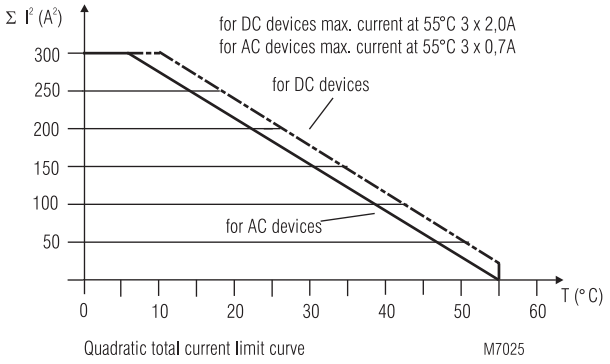
BD 5935 .48 /_ _ _ AC 230 V 50/60 Hz

- Nominal frequency
- Nominal voltage
- Variant, if required
- Contacts
- Type

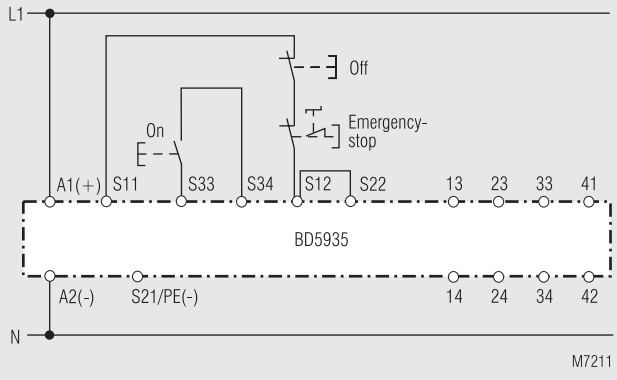
Characteristics



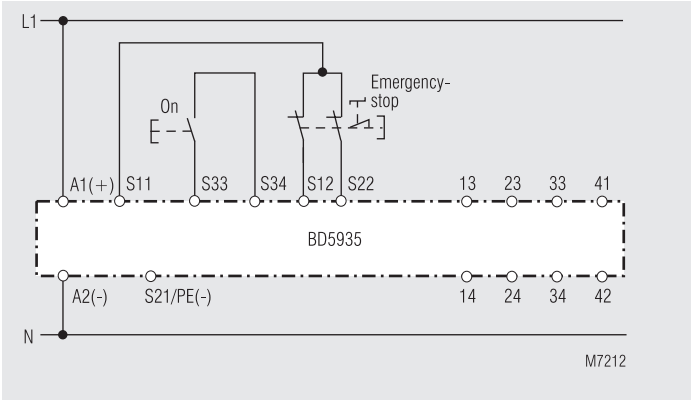
Arc limit curve under resistive load



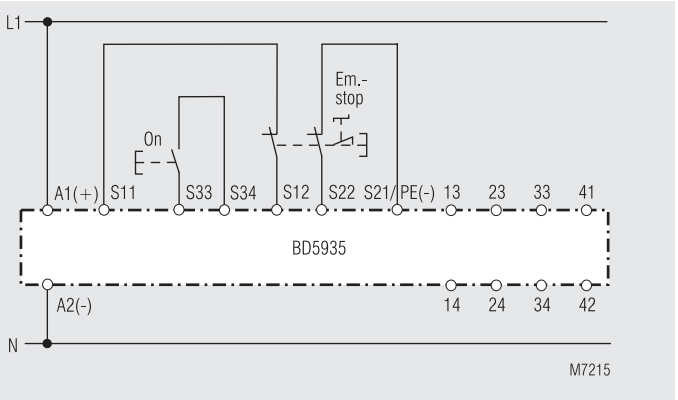
Application example



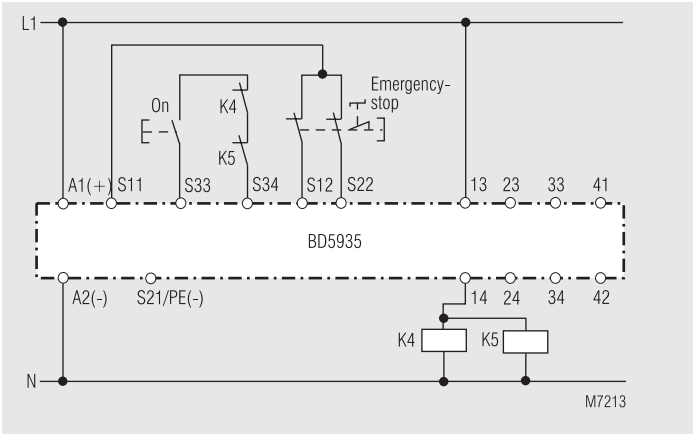
Single-channel emergency-stop circuit. This circuit has no redundancy in the emergency-stop control circuit.
Please note "Unit programming" !
Switches in pos.: S1 no cross fault detection
S2 manual start



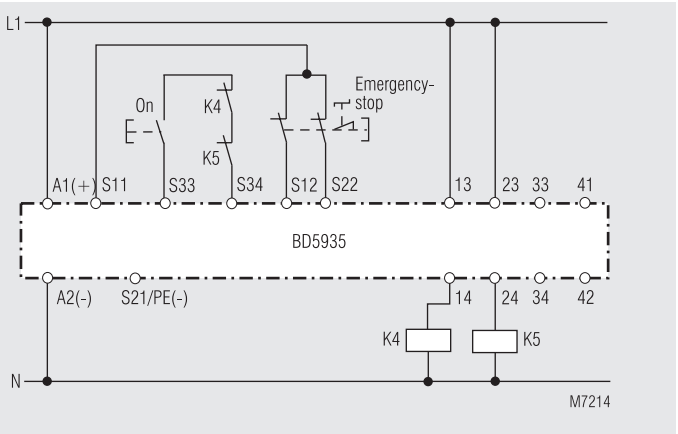
Two-channel emergency-stop circuit without cross fault detection.
Please note "Unit programming" !
Switches in pos.: S1 no cross fault detection
S2 manual start



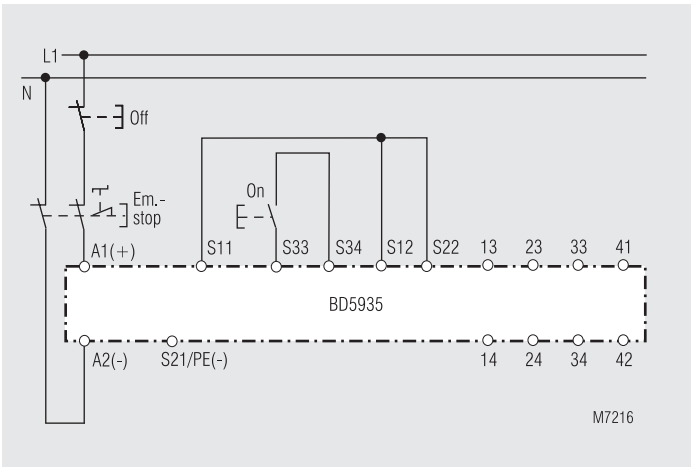
Two-channel emergency-stop circuit with cross fault detection.
Please note "Unit programming" !
Switches in pos.: S1 cross fault detection
S2 manual start



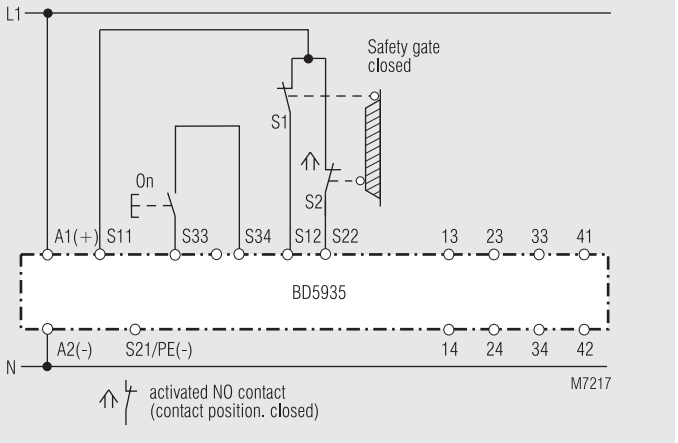
Contact reinforcement with external contactors, controlled with one contact path.
Please note "Unit programming" !
Switches in pos.: S1 no cross fault detection
S2 manual start



Contact reinforcement by external contators, controlled with 2 contact paths. With switching current > 10 A, the output contacts can be reinforced by external contactors with forcibly guided contacts. The function of the external contactors is monitored by looping the NC contacts into the making circuit (terminals S33-S34).
Please note "Unit programming" !
Switches in pos.: S1 no cross fault detection
S2 manual start



Two-pole emergency-stop with emergency-stop control device in the supply circuit.
Application for long emergency-stop loops in which the control voltage dropped below the minimum voltage of 21 V.
Important:
Single faults (line shorts over the emergency-stop control device) are not identified with this external circuit.
Please note "Unit programming" !
Switches in pos.: S1 no cross fault detection
S2 manual start



Two-channel monitoring of a safety gate.
The switch of S12 must close simultaneously with S22 or later.
Please note "Unit programming" !
Switches in pos.: S1 no cross fault detection
S2 manual start