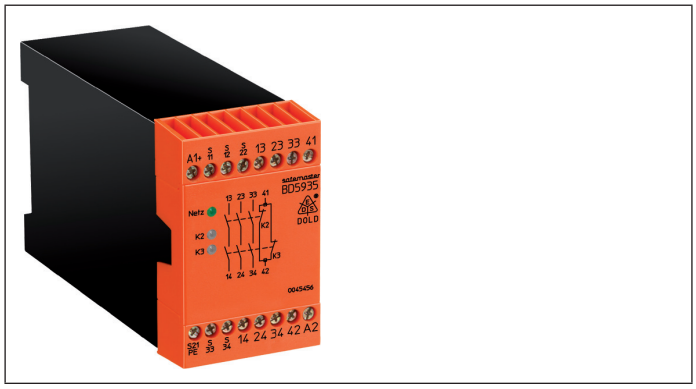
SAFEMASTER
Emergency Stop Module
BD 5935

0221548



Product Description

The BD 5935 is used to interrupt a safety circuit in a safe way. It can be used to protect people and machines in applications with e-stop buttons and safety gates.

Your Advantages

- Safe disconnection of electrical circuits
- Line fault detection on ON pushbutton
- Gold plated contacts to switch low loads (signal to PLC)
- Optionally cross fault detection in emergency stop circuit
- Easy exchange of devices by removable terminal strips

Features

- **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**
- 1- or 2-channel connection
- Operating state display
- LED display for channels 1 and 2
- 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
- Output: optionally 1 NO / 1 NC or 3 NO / 1 NC contacts
- Optionally automatic ON function or activation via the ON pushbutton
- With fast auto start as option
- Width 45 mm

Function Diagram

Approvals and Markings

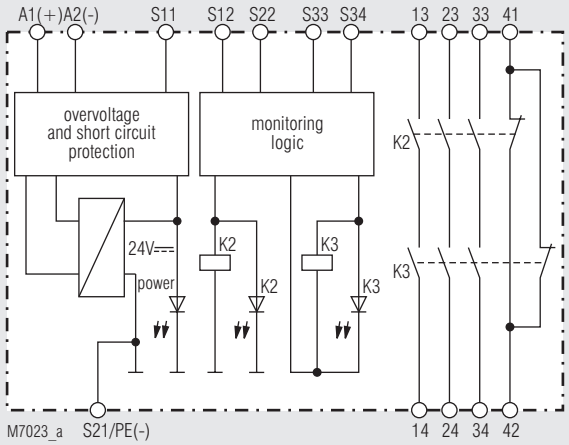
Product Safety Functional Safety
TÜVRheinland CERTIFIED
www.tuv.com ID 0600000000
Canada / USA
A025518

* see variants

Applications

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

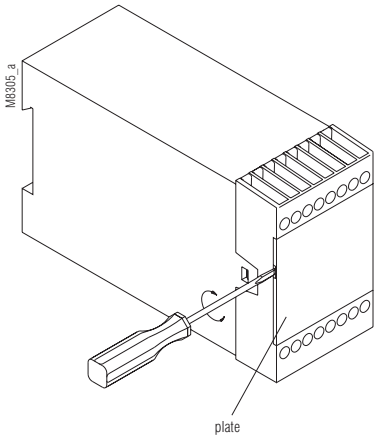
Block Diagram

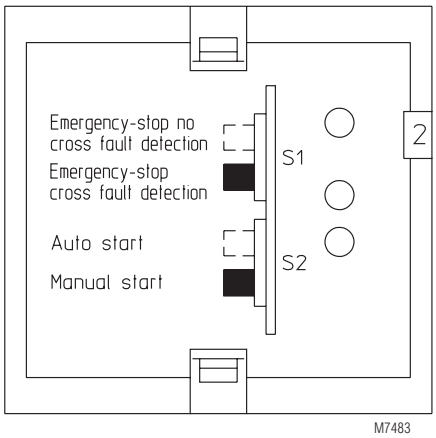


Indication

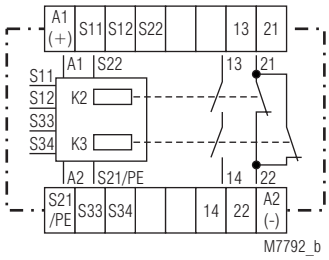
upper LED:	on when supply voltage connected
lower LEDs:	on when relay K2 and K3 active

Unit Programming

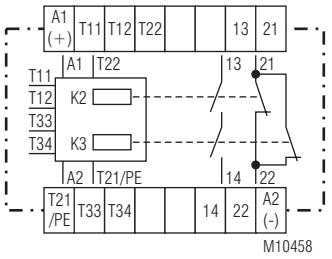




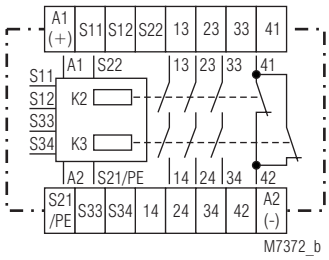
Circuit Diagrams



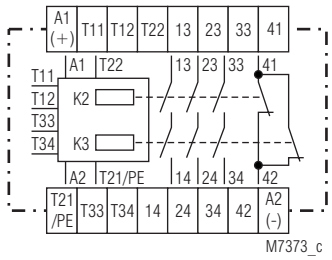
BD 5935.16



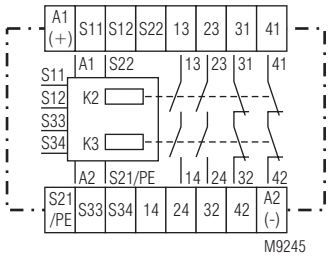
BD 5935.16/200



BD 5935.48



BD 5935.48/200



BD 5935.52

Connection Terminals

Terminal designation	Signal designation
A1(+)	+ / L
A2 (-)	- / N
S12, S22, S33, S34, T12, T22, T33, T34	Inputs
S11, S21/PE, T11, T21/PE,	Outputs
13, 14, 23, 24, 33, 34	Forcibly guided NO contacts for release circuit
21, 22, 31, 32, 41, 42	Forcibly guided indicator output

Notes

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
Contacts

BD 5935.16:	1 NO / 1 NC contacts
BD 5935.48:	3 NO / 1 NC contacts
BD 5935.52:	2 NO contacts / 2 NC contacts

The NO contacts are safety contacts.
ATTENTION! The NC contacts 21-22, 31-32 and 41-42 can only be used for monitoring.

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		
NO contact:	5 A / AC 250 V	IEC/EN 60 947-5-1
NC contact:	2 A / AC 250 V	IEC/EN 60 947-5-1
to DC 13		
NO contact:	2 A / DC 24 V	IEC/EN 60 947-5-1
NC contact:	2 A / DC 24 V	IEC/EN 60 947-5-1
to DC 13		
NO contact:	6 A / DC 24 V at 0.1 Hz	
NC contact:	6 A / DC 24 V at 0.1 Hz	

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:

NO contact:	10 A gL	IEC/EN 60 947-5-1
NC contact:	6 A gL	IEC/EN 60 947-5-1

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 impulse voltage / pollution degree:	4 kV / 2 (basis insulation) IEC 60 664-1
EMC:	IEC/EN 62 061
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 * 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 IEC/EN 60 068-2-6 frequency 10 ... 55 Hz
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
Fixing torque:	0.8 Nm
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	
$MTTF_d$:	238,4	a
DC_{avg}:	99.0	%
d_{op}:	365	d/a (days/year)
h_{op}:	24	h/d (hours/day)
t_{cycle}:	3600	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:	1.95E-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.

CCC-Data

Nominal voltage U_N: AC 24, 42, 48, 110, 115, 120, 127, 230 V
DC 24 V

Thermal current I_{th}: see quadratic total current limit curve (max. 5 A in one contact path)

Switching capacity to AC 15		
NO contact:	2 A / AC 230 V	IEC/EN 60 947-5-1
to DC 13		
NO contact:	1 A / DC 24 V	IEC/EN 60 947-5-1

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

Standard Type

BD 5935.48 DC 24 V

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

Variants

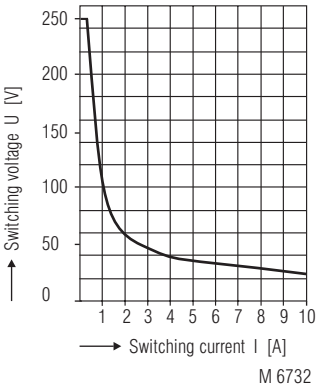
BD 5935._ _/61:	with UL-approval
BD 5935.48/200:	special terminal arrangement see diagram
BD 5935.48/324:	with fast auto start: typ. 500 ms, without line fault detection on ON-button
BD 5935.48/824:	with fast auto start: typ. 110 ms, without line fault detection on ON-button

Ordering example of Variants

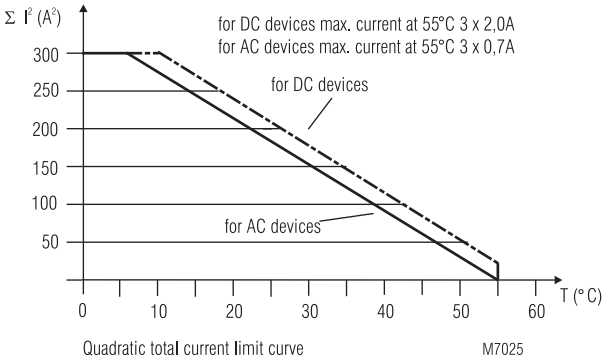
BD 5935 .48 /_ _ _ AC 230 V 50/60 Hz

- 50/60 Hz: Nominal frequency
- AC 230 V: Nominal voltage
- /_ _ _: Variant, if required
- .48: Contacts
- BD 5935: Type

Characteristics

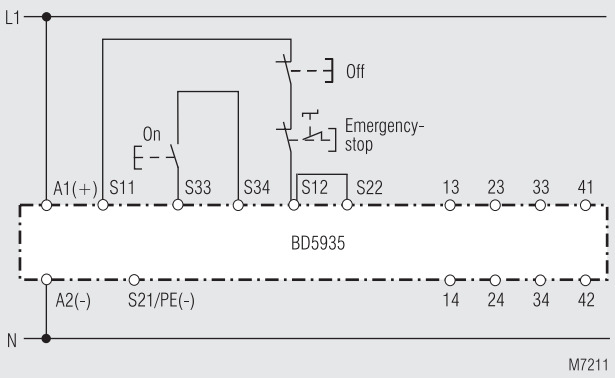


Arc limit curve under resistive load

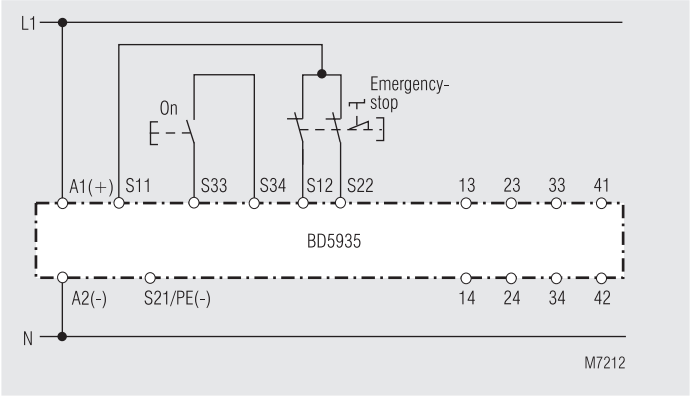


Quadratic total current limit curve

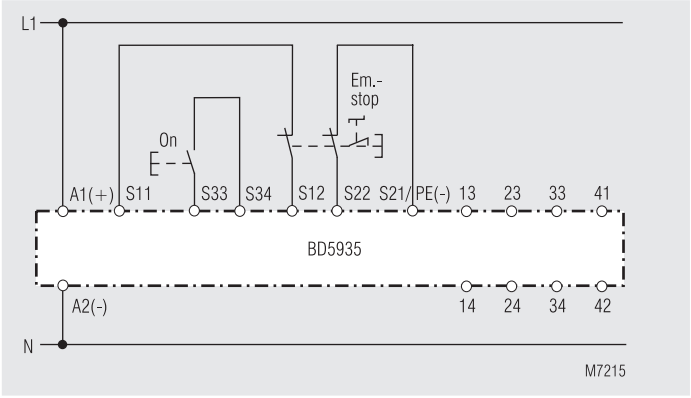
Application Example



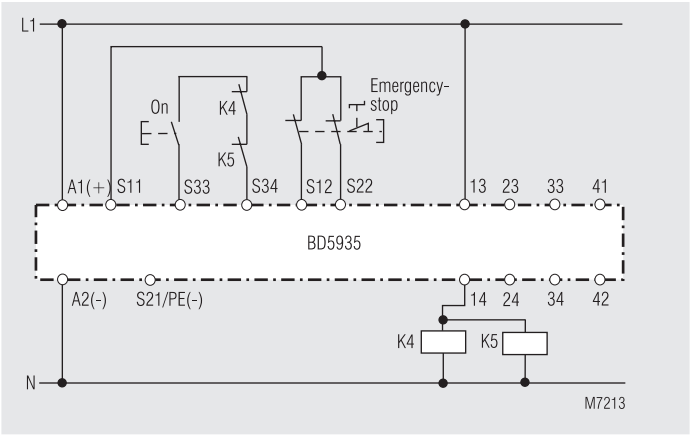
Single-channel emergency-stop circuit. This circuit has no redundancy in the emergency-stop control circuit.
Please note "Unit programming" !
Switches in pos.: S1 no cross fault detection
S2 manual start
Suited up tos SIL2, Performance Level d, Cat. 3



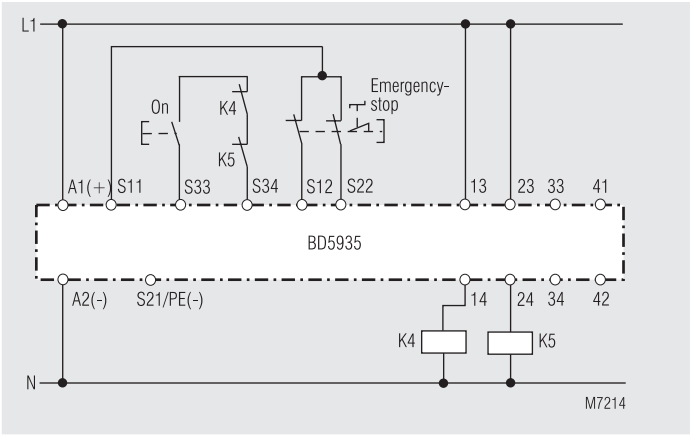
Two-channel emergency-stop circuit without cross fault detection.
Please note "Unit programming" !
Switches in pos.: S1 no cross fault detection
S2 manual start
Suited up to SIL3, Performance Level e, Cat. 4



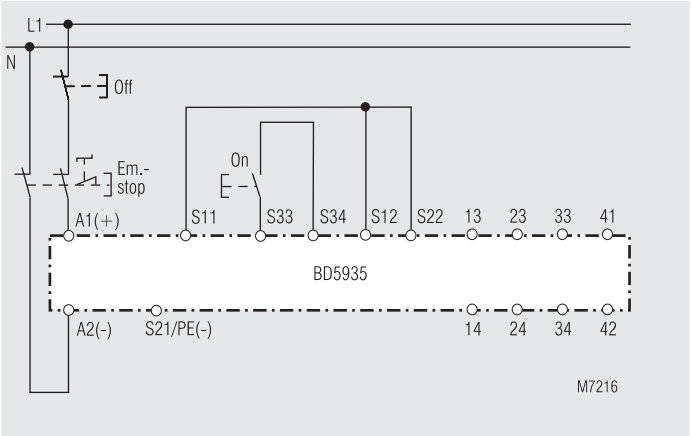
Two-channel emergency-stop circuit with cross fault detection.
Please note "Unit programming" !
Switches in pos.: S1 cross fault detection
S2 manual start
Suited up to SIL3, Performance Level e, Cat. 4



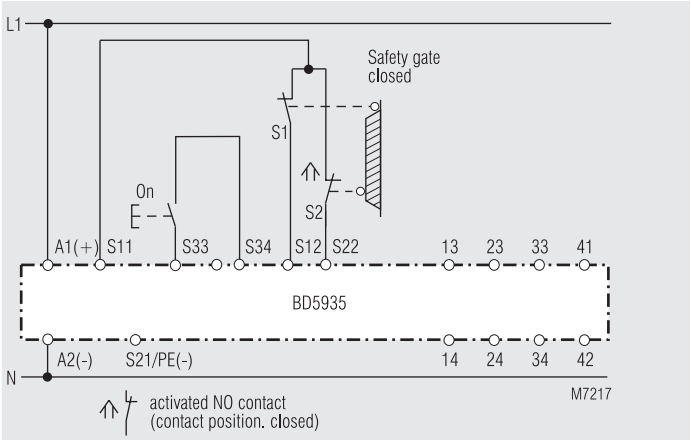
Contact reinforcement with external contactors, controlled with one contact path.
Please note "Unit programming" !
Switches in pos.: S1 no cross fault detection
S2 manual start
Suited up to SIL3, Performance Level e, Cat. 4



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
Suited up to SIL3, Performance Level e, Cat. 4



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
Suited up to SIL3, Performance Level e, Cat. 4



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
Suited up to SIL3, Performance Level e, Cat. 4