Safety Technique

SAFEMASTER C
Multifunctional Safety Timer
UG 6961

DOLD

Circuit Diagram

UG 6961.02   UG 6961.04

Connection Terminals

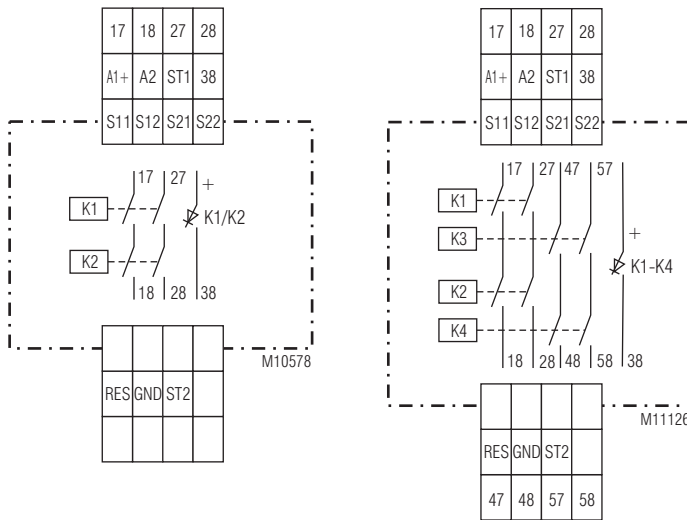| Terminal designation	Signal designation
A1 +	DC 24 V
A2	0 V
17, 18, 27, 28, 47, 48, 57, 58	Forcibly guided NO contacts for delay contacts
38	Semiconductor monitoring output
GND	Reference potential for Semiconductor monitoring output
S11, S21	control output
S12, S22, ST1, ST2, RES	control input

Your Advantage
- **Various delay functions adjustable at device:**
  - Release delay
  - Release delay retriggerable
  - On delay
  - Fleeting on make / break
  - Delay function settable via potentiometer
- **Various safety functions defined:**
  - E-Stop
  - Safety gate
  - Two-hand control
  - Safety mat / Safety edge
  - Exclusive or contacts
  - Light curtain
- Manual or auto start

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 and IEC/EN 61511**
- Acc. to EN 50156-1 for furnaces
- Line fault detection on On-button:
- Manual restart or automatic restart
- With or without cross fault monitoring
- 2-channel
- Forcibly guided output contacts
- Output: max. 4 NO instantaneous semiconductor monitoring output
- LED indicator for operation, delay contects and failure
- As option with pluggable terminal blocks for easy exchange of devices
  - with screw terminals
  - or with cage clamp terminals
- Width: 22.5 mm

Approvals and Marking

CE   TÜVRheinland CERTIFIED   Functional Safety Type Approved www.tuv.com ID 0600000000

Application

Provide an on-delay or off-delay when a activating a safety function. It can be used to protect people and machines in applications with e-stop buttons, safety gates, light curtains with selftesting (Type 4) acc. to IEC/EN 61 496-1, 2-hand controls for presses as well as other production machinery with dangerous closing action (Type III C to EN 574) and for safety mats, safety edges and tape switches with a max. switching current of 15 mA.
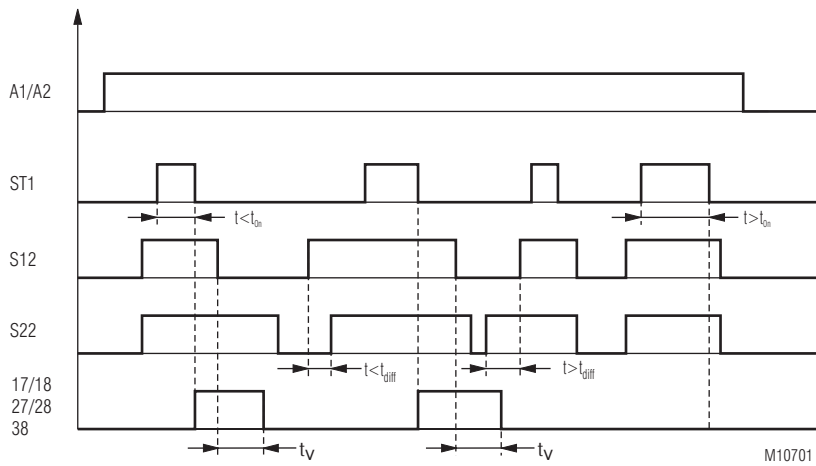
Indicators

green LED ON:	on, when supply connected
rred LED ERR:	on, at internal error
	flashes at external error
green LED K1/K2 (.02) e.g. K1-K4 (.04):	on, when relay K1 and K2 (.02) energized, e.g. when relay K1, K2, K3 and K4 (.04) energized
	flashes during time delay

Function Diagram
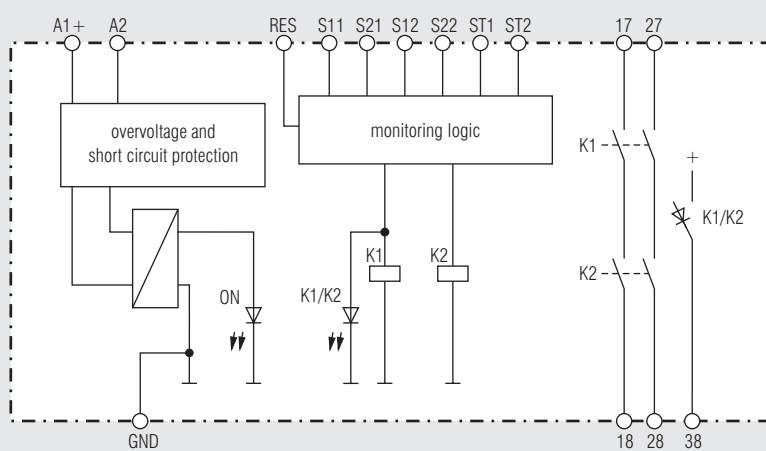

t_{diff}: max. time delay for simultaneity demand
dependent on selected safety function
E-Stop, safety gate, safety mat t_{diff}: max. 3s
Light curtais t_{diff}: max. 1s
Two-hand control t_{diff}: max. 0,5s
other times on request

t_{Ein}: max. actuation time of start button
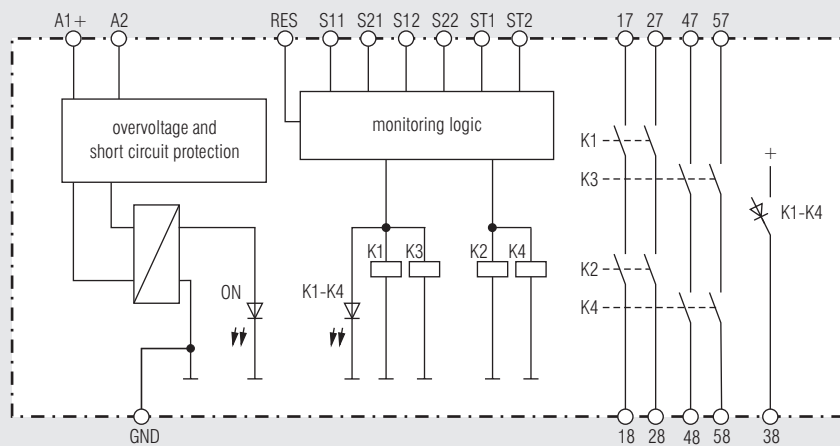Standard t_{On}: max. 3s
other times on request

t_V: Time delay
Example: release delay

Block Diagram

UG 6961.02

M11030

UG 6961.04

M11132

Practical Notes

Operating mode
Manual or auto start is chosen by wiring. On manual start S21 has to be connected to ST1! via an NO push button. For auto start S21 is connected to ST2. If both inputs are connected to S21 the unit goes into safe failure mode. A restart or new start of the device has to be made.
Only an automatic start at safety function two-hand control /3_ _ is possible.

Line fault detection e.g. monitoring of ON-button
If the On-button pressed more than 3 s the adequate output contacts of the safety function can't be switch. The output contacts can be energized when the On-button pressed again ($0.1\ s < t_{ON} < 3\ s$).
A line fault is detected if the On-button more than 10 s is actuated. The output contacts of the adeauate safety function can only be energized with a reset or re-start with on an off switching of power supply.

⚠ ATTENTION - AUTOMATIC START!
According to IEC/EN 60 204-1 part 9.2.5.4.2 and 10.8.3 it is not allowed to restart automatically after emergency stop.
Therefore the machine control has to disable the automatic start after emergency stop.

Reset and external failures:
The reset input is used to reset external failures (application failures or removable external failures as e.g. a line fault on reset button). If the reset signal is connected to the input for more than 3 sec the unit makes a reset. A new reset is only possible when the reset signal had been switched off temporarily.
If an external failure occurs because both input channels of a safety function did not switch on or off within the simultanious time, a reset is only possible if both channels are switched to off state after removing failure cause.

Setting delay mode
On the variant /_0_ the delay mode can be set via rotary switch t_{Fkt}.
Possible functions:

t_{Fkt}	Function
1	Release delay
2	Release delay retriggerable
3	On delay
4	Fleeting on make
5	Fleeting on break

Adjusting the time delay
With rotary switch t_{max} the time range for the delayed contacts is selected. With rotary switch t the time is adjusted within the selected range in 10 % steps.
Example: required time = 0.8 s

1. Example:
$t_{max} = 1\ s$; $t = 0.8 \geq t_v = t_{max} \times t = 1\ s \times 0.8 = 0.8\ s$

2. Example:
$t_{max} = 2\ s$; $t = 0.4 \geq t_v = t_{max} \times t = 2\ s \times 0.4 = 0.8\ s$

Repeat accuracy
The repeat accuracy of the delayed contact depends on different factors:

Repeat accuracy t_W = system reaction time[1] ± 1 % of t_v

[1] Pick up or drop off time depending on delay mode

Technical Data

Input

Nominal voltage U_N:	DC 24 V
Voltage range:	$0.8 ... 1.1\ U_N$
Nominal consumption:	typ. 1.9 W
Short-circuit protection:	Internal PTC
Overvoltage protection:	Internal VDR
Duty-cycle ON button:	$0.1\ s < t_{EIN} < 3\ s$
Duty-cycle Reset button:	> 3 s

Safety function
Safety mat / safety edge (4)
max. permitted
safety edge contact resistance: 1000 Ω
switching current at short circuit: typ. 15 mA at U_N
Light curtains (8)
control current via S12, S22: typ. 8 mA at U_N
Min. voltage on terminals
S12, S22 when relay activated: DC 10 V

Output

Contacts

UG 6961.02	2 NO contacts
UG 6961.04	4 NO contacts

The NO contacts can be used for safe braking.

Delay t_v
ranges at /_ _0:
8 time ranges in one unit (seconds or minutes) settable via rotational switch

0.1 ... 1	1.0 ... 10
0.2 ... 2	3.0 ... 30
0.3 ... 3	10 ... 100
0.5 ... 5	30 ... 300

other times on request
fixed at /_ _1: seconds or minutes
1, 2, 3, 5, 10, 30, 100, 300
other times on request

Time setting in 10% steps of max. time range value
Repeat accuracy: see formula
Thermal current I_{th}: max. 8 A
(see quadratic total current limit curve)*)
*) see datasheet UG 6961 on **www.dold.com**

Safety function
E-Stop (1) (6), Safety gate (2) (7), Exclusive or contacts (5)
Start up at U_N: < 65 ms
Release delay at U_N and disconnecting the supply: < 40 ms
Release delay at U_N and disconnecting S12,S22: < 60 ms

Two-hand control (3)
Start up at U_N: < 110 ms
Release delay at U_N and disconnecting the supply: < 40 ms
Release delay at U_N and disconnecting S12,S22: < 60 ms
simultaneity demand: max. 0,5 s

Safety mat (4)
Start up at U_N: < 85 ms
Release delay at U_N and disconnecting the supply: < 40 ms
Release delay at U_N and disconnecting S12,S22: < 60 ms

Light curtains (8)
Start up at U_N: < 35 ms
Release delay at U_N and disconnecting the supply: < 40 ms
Release delay at U_N and disconnecting S12,S22: < 25 ms

Switching capacity
to AC 15

NO contacts:	3 A / AC 230 V	IEC/EN 60 947-5-1

to DC 13

NO contacts:	2 A / DC 24 V	IEC/EN 60 947-5-1

Electrical life

at 5 A, AC 230 V cos φ = 1:	> 2.2 x 10^5 switching cycles
Perm. operating frequency:	max. 1800 switching cycles / h

Short circuit strength

max. fuse rating:	6 A gL	IEC/EN 60 947-5-1
Mechanical life:	10 x 10^6 switching cycles	

Semiconductor monitoring output

(not safety):	max. 50 mA DC 24 V, plus switching

General Data

Nominal operating mode:	continuous operation

Temperature range

Operation:	- 15 ... + 55 °C
Storage:	- 25 ... + 85 °C
Altitude:	< 2.000 m

Clearance and creepage distance

rated impuls voltage / pollution degree:	4 kV / 3 (base insulation) IEC 60 664-1

EMC

Electrostatic discharge (ESD):	15 kV (air)	IEC/EN 61 000-4-2
HF irradiation:	30 V / m	IEC/EN 61 000-4-3
Fast transients:	4 kV	IEC/EN 61 000-4-4

Surge voltage
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	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 VO behaviour according to UL subj. 94	
Vibration resistance:	Amplitude 0,35 mm Frequency 10 ... 55 Hz,	IEC/EN 60 068-2-6
Klimate resistance:	15 / 055 / 04	IEC/EN 60 068-1
Terminal designation:	EN 50 005	
Wire connection:		DIN 46 228-1/-2/-3/-4

Terminal block
with screw terminal

Cross section:	1 x 0.25 ... 2.5 mm² solid oder stranded ferruled (isolated) or 2 x 0.25 ... 1.0 mm² solid or stranded ferruled (isolated)
Insulation of wires or sleeve length:	7 mm

Terminal block
with cage clamp terminals
PC

Cross section:	1 x 0.25 ... 2.5 mm² solid or stranded ferruled (isolated)
Insulation of wires or sleeve length:	10 mm

PT

Cross section:	1 x 0.25 ... 1.5 mm² solid or stranded ferruled (isolated)
Insulation of wires or sleeve length:	8 mm
Wire fixing:	captive slotted screw or cage clamp terminals
Mounting:	DIN rail IEC/EN 60 715
Weight:	approx. 210 g

Dimensions

Width x height x depth:

UG 6961 PS:	22.5 x 110 x 120.3 mm
UG 6961 PC, PT:	22.5 x 120 x 120.3 mm

Safety Related Data

Values according to EN ISO 13849-1:

Category:	4	
PL:	e	
$MTTF_d$:	215.7	a
DC_{avg}:	99.0	%
d_{op}:	365	d/a (days/year)
h_{op}:	24	h/d (hours/day)
t_{cycle}:	3600	s/cycle
	≙ 1	/h (hour)

Values according to IEC/EN 62061 / IEC/EN 61508 / IEC/EN 61511:

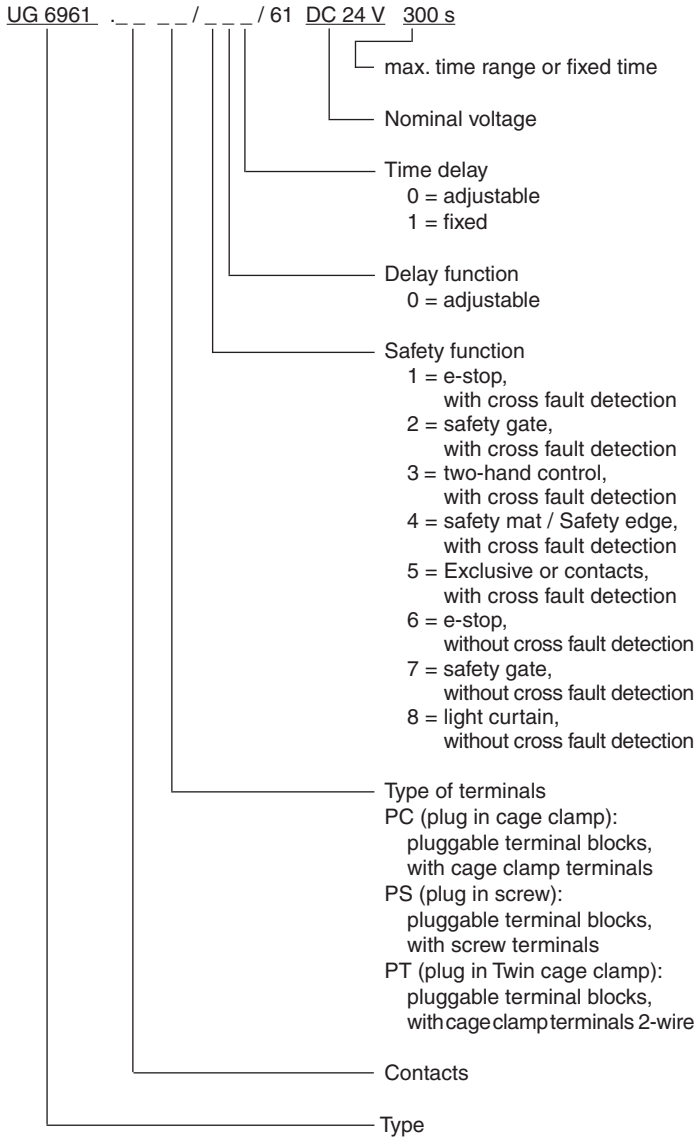|		
SIL CL:	3	IEC/EN 62061
SIL:	3	IEC/EN 61508 / IEC/EN 61511
HFT[*):	1	
DC_{avg}:	99.0	%
SFF:	99.6	%
PFH_D:	2.33E-10	h^{-1}
PFD:	1.99E-05	
T_1:	20	a (year)

[*) HFT = Hardware failure tolerance

Info   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.
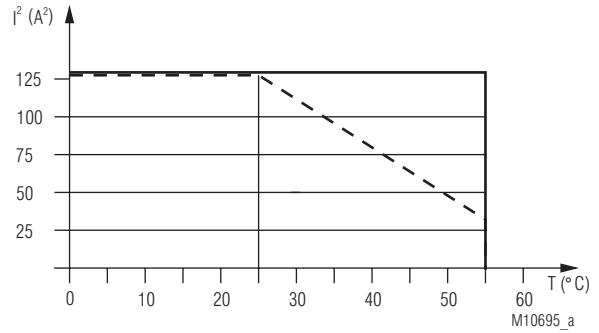
Standard Type

UG 6961.02PS/100/61 DC24V 300 s
Article number: 0065425
- Safety function: e-stop
- Delay function: adjustable
- Time delay: adjustable
- Output: 2 NO contacts
- Nominal voltage: DC 24 V
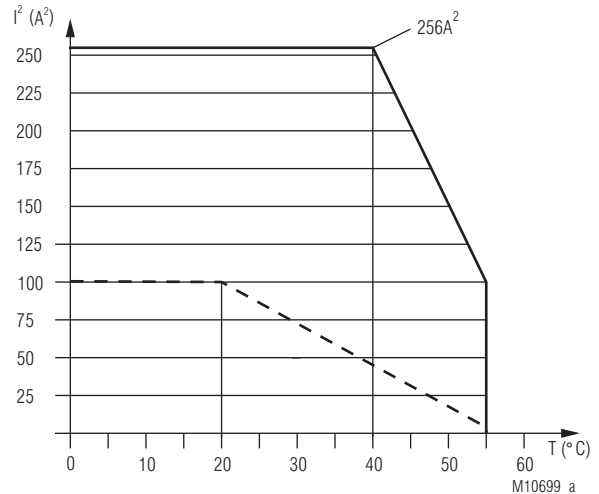- Width: 22.5 mm

Variants

UG 6961 . _ _ _ / _ _ _ / 61 DC 24 V 300 s

- max. time range or fixed time
- Nominal voltage
- Time delay
  - 0 = adjustable
  - 1 = fixed
- Delay function
  - 0 = adjustable
- Safety function
  - 1 = e-stop,
    with cross fault detection
  - 2 = safety gate,
    with cross fault detection
  - 3 = two-hand control,
    with cross fault detection
  - 4 = safety mat / Safety edge,
    with cross fault detection
  - 5 = Exclusive or contacts,
    with cross fault detection
  - 6 = e-stop,
    without cross fault detection
  - 7 = safety gate,
    without cross fault detection
  - 8 = light curtain,
    without cross fault detection
- Type of terminals
  PC (plug in cage clamp):
    pluggable terminal blocks,
    with cage clamp terminals
  PS (plug in screw):
    pluggable terminal blocks,
    with screw terminals
  PT (plug in Twin cage clamp):
    pluggable terminal blocks,
    with cage clamp terminals 2-wire
- Contacts
- Type

Options with Pluggable Terminal Blocks
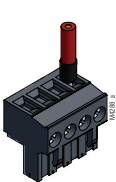
Screw terminal
(PS/plugin screw)

Cage clamp terminal
(PC/plugin cage clamp)

TWIN Cage clamp terminal
(PT/plugin TWIN cage clamp)

Characteristic

device free-standing
max. current at 55°C over
2 contact path = 8A $\cong$ 2x8^{2}A^2 = 128A^2

device mounted without distance heated by
devices with same load,
max. current at 55°C over
2 contact path = 4A $\cong$ 2x4^{2}A^2 = 32A^2

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

I_1, I_2 - current in contact paths

UG 6961.02
Quadratic total current limit curve

device free-standing
max. current at 55°C over
4 contact path = 5A $\cong$ 4x5^{2}A^2 = 100A^2

device mounted without distance heated by
devices with same load,
max. current at 55°C over
4 contact path = 1A $\cong$ 4x1^{2}A^2 = 4A^2
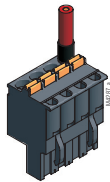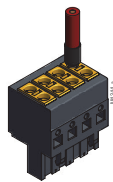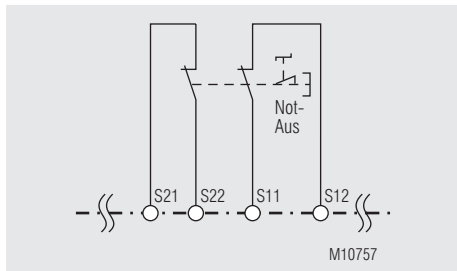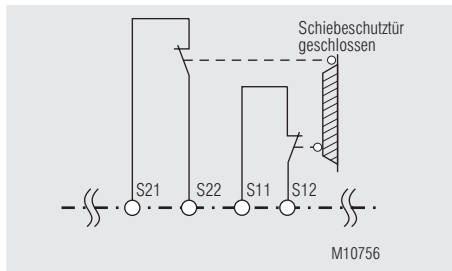
$$\Sigma\, I^2 = I_1^2 + I_2^2 + I_3^2 + I_4^2$$

I_1, I_2, I_3, I_4 - current in contact paths

UG 6961.04
Quadratic total current limit curve
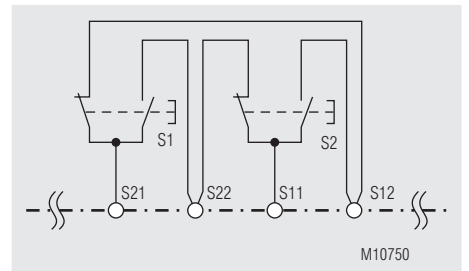
Application Examples with safety function

M10738_c
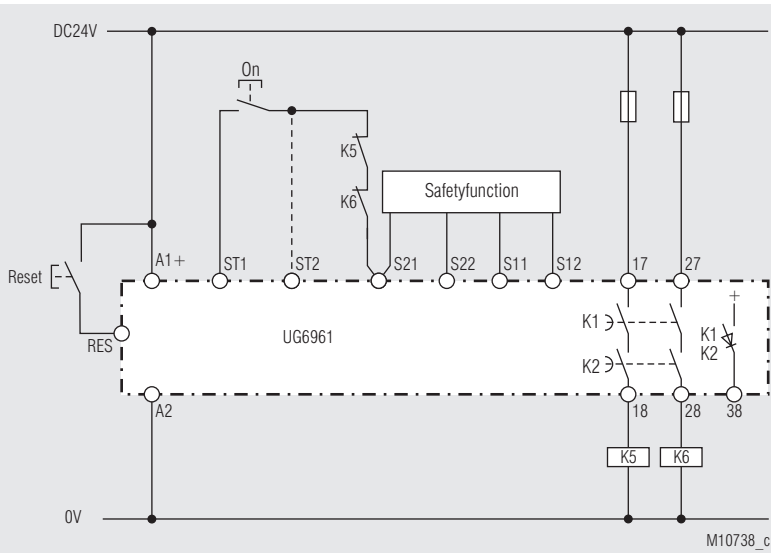
Safetyfunction: see below, Manual-Start (for automatic start make a bridge to ST2 instead of ON button).
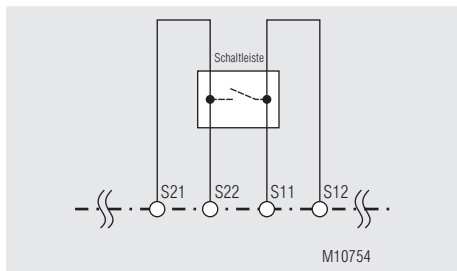Delay function: release delay (1)

M10757

Fct.: E-stop (1),
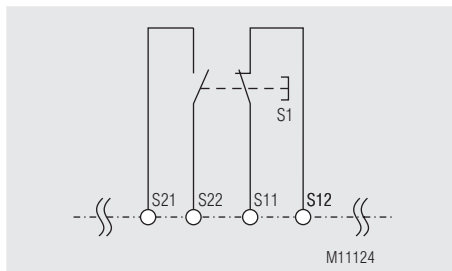   with cross fault detection
    SIL 3, PL e, Cat. 4

M10756

Fct.: Safety gate (2),
    with cross fault detection
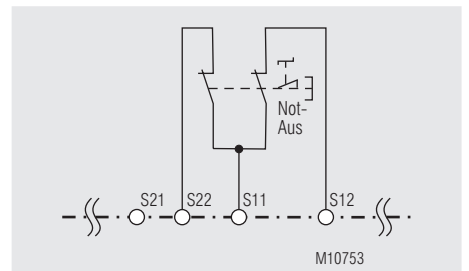   SIL 3, PL e, Cat. 4

M10750

Fct.: Two-hand control (3),
    with cross fault detection
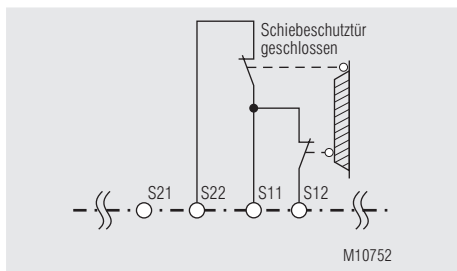   SIL 3, PL e, Cat. 4
    Type III C to EN 574

M10754

Fct.: Safety mat / Safety edge (4),
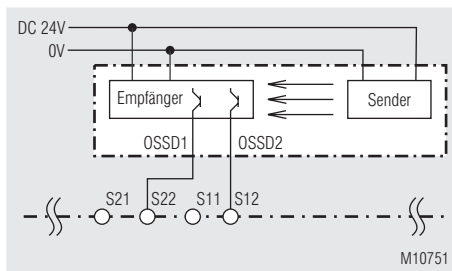   with cross fault detection
    SIL 3, PL e, Cat. 4

M11124

Fct.: Exclusive or contacts (5),
    with cross fault detection
    SIL 3, PL e, Kat. 4

M10753

Fct.: E-Stop (6),
    without cross fault detection
    SIL 3, PL e, Cat. 4 [1]

M10752

Fct.: Safety gate (7),
    without cross fault detection
    SIL 3, PL e, Cat. 4 [1]

M10751

Fct.: Light curtain (8),
    without cross fault detection
    SIL 3, PL e, Cat. 4 [2]

[1] To achieve the stated safety classification the
    wiring has to be done with crossfault monitoring.
[2] To achieve the stated safety classification
    light curtains with selftest (type 4) according
    to IEC/EN 61496-1 have to be used.