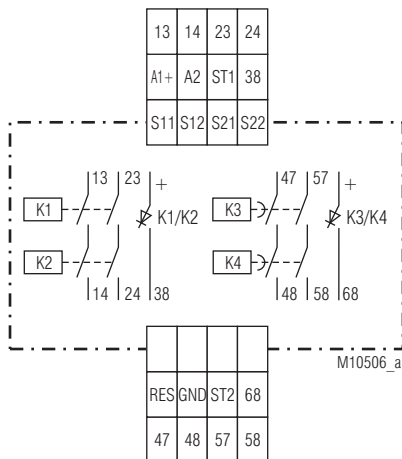




Product Description

The multifunction safety timer UG 6960 provides protection of men and machines by enabling and disabling a safety circuit. This is done by the adjusted time delay function. Simply select 1 out of 5 delay functions with a rotary switch – ready. The adjusted time is safe over the complete setting range. The UG 6960 is available for different safety functions. It has safe delayed and instantaneous contacts.

Circuit Diagram



Connection Terminals

Terminal designation	Signal description
A1 +	DC 24 V
A2	0 V
13, 14, 23, 24	Forcibly guided NO contacts for release circuit
47, 48, 57, 58	Forcibly guided NO contacts for delayed contacts
38, 68	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
- Instantaneous contact and safety delayed contacts
- Protection against manipulation by sealable transparent cover

Features

- **According to**
 - Performance Level (PL) e and category 4 to EN ISO 13849-1
 - 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: 2 NO instantaneous contact and 2 NO contacts delayed
- 1 semiconductor output for instantaneous contacts
- 1 semiconductor output for delayed contacts
- LED indicator for operation, safety function, time delay 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 Markings

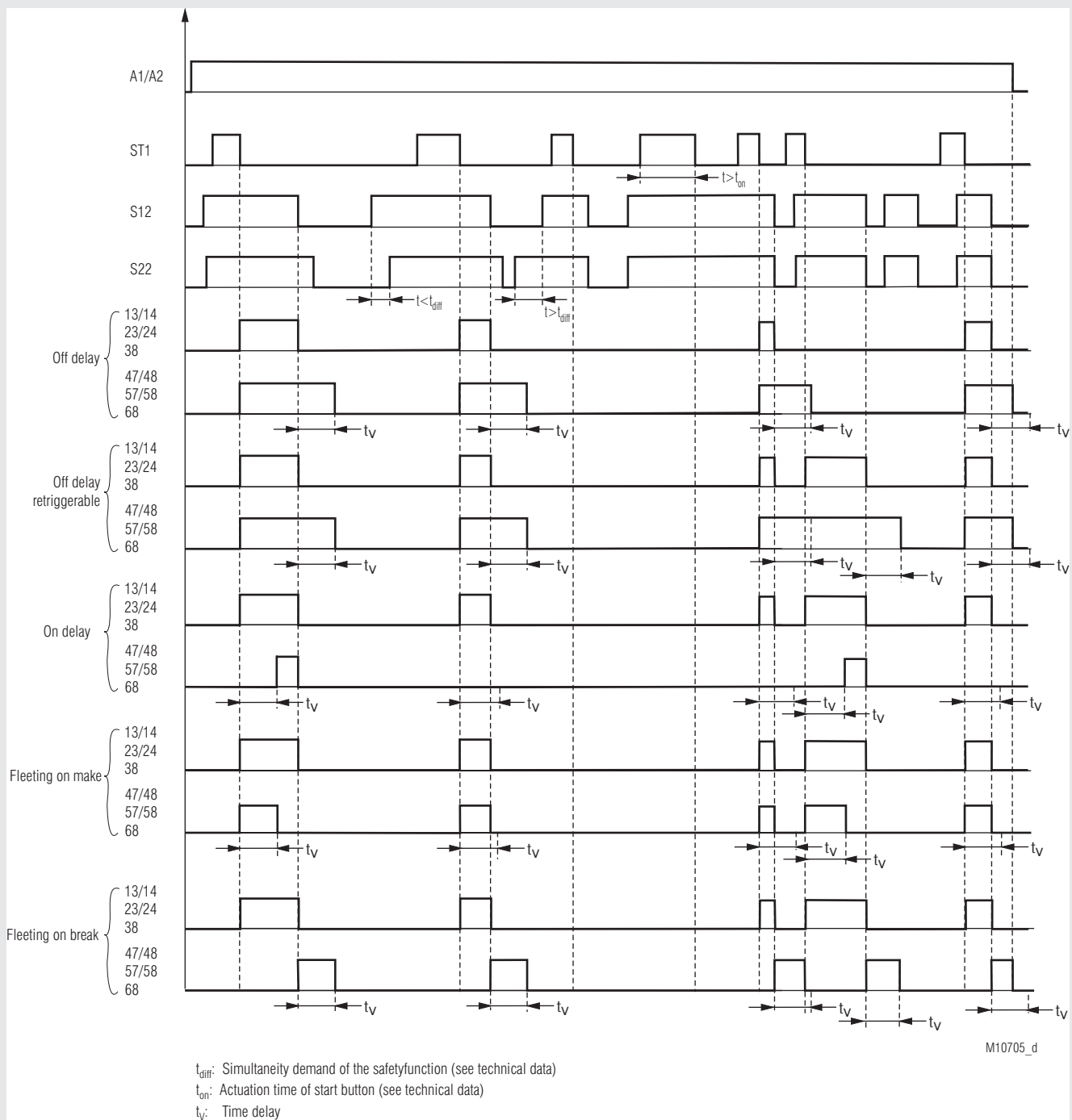


Application

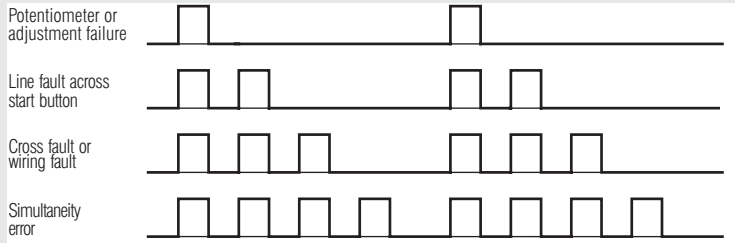
Protect people and machines in applications with e-stop buttons, safety gates, light curtains with selftesting (Type 4) acc. to IEC/EN 61 496-1, 2-hand controls for presses as well as other production machinery with dangerous closing action (Type III C to EN ISO 13851) and for safety mats, safety edges and tape switches with a max. switching current of 15 mA.

Indicators

- Green LED ON: On, when supply connected
- Red LED ERR: On, at internal error
flashes at external error
- Green LED K1/K2: On, when relay K1 and K2 energized (instantaneous contact)
Flashes at external errors (see flashing codes)
- Green LED K3/K4: On, when relay K3 and K4 energized (delayed contacts)
Flashes during time delay

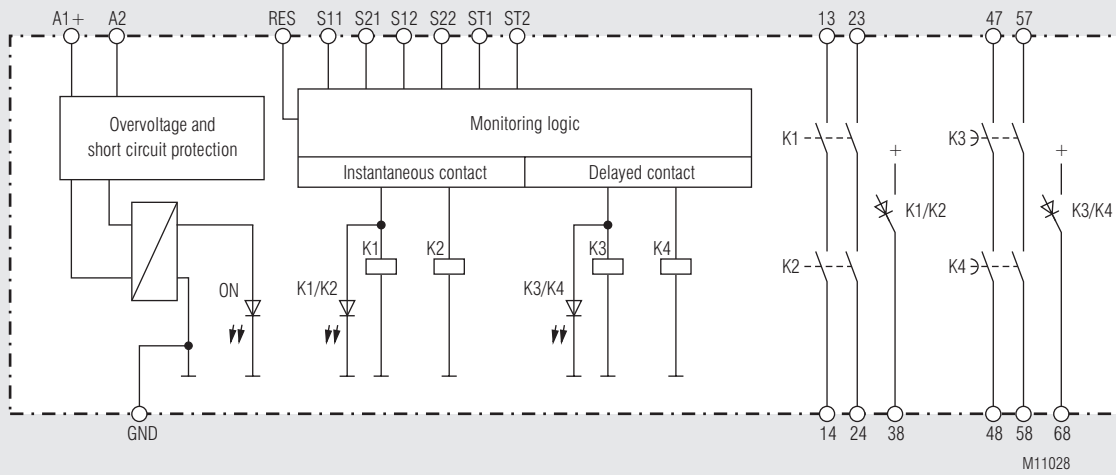


Fault Indication by Flashing Code on K1/K2



M10697_a

Block Diagrams



M11028

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 ($0.1 \text{ s} < t_{\text{ON}} < 3 \text{ s}$).

A line fault is detected if the On-button more than 10 s is actuated. The output contacts of the adequate safety function can only be energized with a reset or re-start with on an off switching of power supply.

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 simultaneous 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

Description of the time delay functions

Off delay

If the sensors/switches of the safety function are switched off or an external failure in the safety function is detected, the adjusted time delay is started. After elapse of the delay time the delayed contacts switch off. Restarting of the output contacts is only possible after the time is fully elapsed.

Off delay retriggerable

If the sensors/switches of the safety function are switched off or an external failure in the safety function is detected, the adjusted time delay is started. After elapse of the delay time the delayed contacts switch off. On before the time is elapsed, or the the external failure is removed and reset and the starting conditions are fulfilled (manual or auto start) the delayed contacts remain switched on.

On delay

If the sensors/switches of the safety function are switched on the adjusted time delay is started. After elapse of the delay time the delayed contacts switch on. If the sensors/switches of the safety function are switched off before the time is elapsed, the time is stopped and the delayed safety contacts remain switched off. When the sensors/switches of the safety function are switched on again then the time delay is started from the beginning.

Practical Notes

Fleeting on make

If the sensors/switches of the safety function are switched on, the delayed contacts are switched on and the adjusted time delay is started. After elapse of the delay time the delayed contacts switch off.

If the sensors/switches of the safety function are switched off before the time is elapsed the delayed safety contacts are also switched off.

Fleeting on break

If the sensors/switches of the safety function are switched off or an external failure in the safety function is detected, the delayed safety contacts are switched on and the adjusted time delay is started.

After elapse of the delay time the delayed contacts switch off. If the sensors/switches of the safety function are switched off before the time is elapsed the delayed safety contacts are also switched off again.

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:

$$t_{\text{max}} = 1 \text{ s} ; t = 0.8 \geq t_v = t_{\text{max}} \times t = 1 \text{ s} \times 0.8 = 0.8 \text{ s}$$

2. Example:

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

Repeat accuracy

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

Repeat accuracy $t_w = \text{system reaction time}^1 \pm 1 \% \text{ of } t_v$

¹⁾ Pick up or drop off time depending on delay mode

Operating Potentiometer

Poti " t_{Fkt} " Adjustment of delay function

Poti " t_{max} " Adjustment of time range

Poti " t " Fine adjustment at time range

Technical Data

Input

Nominal voltage U_N:	DC 24 V
Voltage range:	0.8 ... 1.1 U_N
Nominal consumption:	Typ. 3.2 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	2 NO instantaneous contacts 2 NO delayed 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

fixed at /_ _1:

other times on request
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)

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

Simultaneity demand: < 3 s

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: < 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

Simultaneity demand: < 1 s

Technical Data

Switching capacity

to AC 15: 3 A / AC 230 V IEC/EN 60947-5-1

to DC 13

Instantaneous contacts: 2 A / DC 24 V IEC/EN 60947-5-1

Delayed contact: 3 A / DC 24 V IEC/EN 60947-5-1

to DC 13

Instantaneous contacts: 4 A / DC 24 V at 0.1 Hz

Electrical life

at 5 A, AC 230 V $\cos \varphi = 1$: > 1.5 x 10⁵ switching cycles

Permissible operating frequency

instantaneous contact: Max. 1800 switching cycles / h

delayed contact: Max. 360 switching cycles / h

Short circuit strength

max. fuse rating: 6 A gG / gL IEC/EN 60947-5-1

Mechanical life: 10 x 10⁶ switching cycles

Semiconductor monitoring output

(not safety): 1 for instantaneous contact

1 for delayed contact

max. 50 mA DC 24 V, plus switching
(see quadratic total current limit curve)

General Data

Nominal operating mode: Continuous operation

Temperature range

Operation: - 25 ... + 60 °C

(see quadratic total current limit curve)

At an altitude of > 2000 m the maximum

permissible temperature reduces by

0.5°C / 100 m

Storage: - 40 ... + 85 °C

Altitude,

Clearance and creepage distance

rated impulse voltage /

pollution degree:

IEC 60664-1

≤ 2000 m > 2000 m up to ≤ 4000 m

4 kV / 2 2,5 kV / 2

EMC IEC/EN 61326-3-1, IEC/EN 62061

Interference suppression: Limit value class B EN 55011

Degree of protection

Housing: IP 40 IEC/EN 60529

Terminals: IP 20 IEC/EN 60529

Housing: Thermoplastic with VO behaviour

according to UL subj. 94

Vibration resistance: Amplitude 0,35 mm

Frequency 10 ... 55 Hz, IEC/EN 60068-2-6

25 / 060 / 04 IEC/EN 60068-1

Climate resistance:

Terminal designation:

Wire fixing:

EN 50 005

Captive slotted screw

or cage clamp terminals

Mounting: DIN rail IEC/EN 60715

Weight: Approx. 250 g

Dimensions

Width x height x depth:

UG 6960 PS: 22.5 x 110 x 120.3 mm

UG 6960 PC, PT: 22.5 x 120 x 120.3 mm

UL-Data

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

Ambient temperature: -15 ... +55°C

Altitude: ≤ 2000 m

Switching capacity:

Ambient temperature 55°C Pilot duty B300, R300
5A 250Vac Resistive or G.P.
5A 24Vdc Resistive

Ambient temperature 40°C: Pilot duty B300, R300
8A 250Vac Resistive or G.P.
8A 24Vdc G.P.

Wire connection: 60°C / 75°C copper conductors only
PS-terminal: AWG 28 - 12 Sol/Str Torque 0.5 Nm
PC-terminal: AWG 24 - 12 Sol/Str
PT-terminal: AWG 24 - 16 Sol/str



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

Standard Type

UG 6960.04PS/100/61 DC24V 300 s

Article number: 0065424

- Safety function: e-stop
- Delay function: adjustable
- Time delay: adjustable
- Output: 2 NO contacts instantaneous contacts
2 NO contacts delayed contacts
- Nominal voltage: DC 24 V
- Width: 22.5 mm

Variants

UG 6960 .04 / /61 DC 24 V 300 s

Max. time range or fixed time

Nominal voltage

UL-approval

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

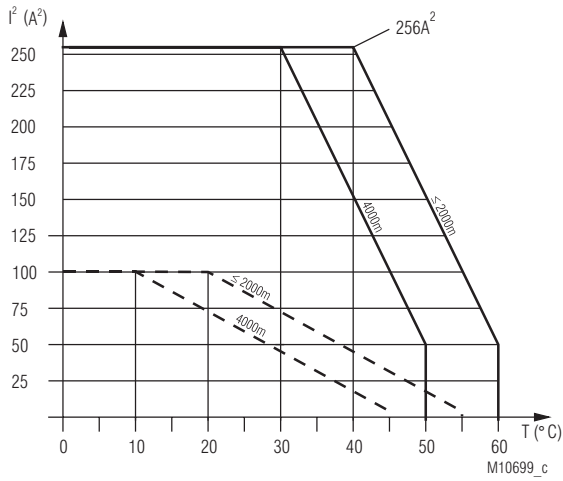
Troubleshooting

Failure	Potential cause
LED "ON" does not light up	- Power supply A1+/A2 not connected
LED "ERR" flashes in relation 1:1	- Under- or overvoltage (check power supply A1+/A2)
LED "ERR" flashes in relation 4:1	- external failure (see flashing code)
LED "ERR" continuously on	- system error (if cannot be removed after restart unit must be replaced)

Maintenance and Repairs

- The device contains no parts that require maintenance.
- In case of failure, do not open the device but send it to manufacturer for repair.

Characteristics



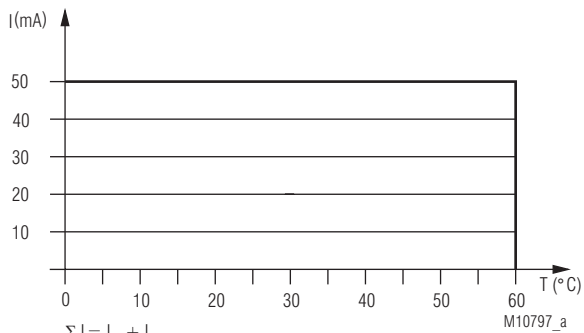
- Device free-standing.
Max. current at 60°C (≤ 2000m) or 50 °C (4000m) over
4 contact path = $3,5A \cong 4 \times 3,5^2 A^2 = 100A^2$
- - - Device mounted without distance heated by
devices with same load.
Max. current at 55°C (≤ 2000m) or 45 °C (4000m) over
4 contact path = $1A \cong 4 \times 1^2 A^2 = 4A^2$

$$\Sigma I^2 = I_1^2 + I_2^2 + I_3^2 + I_4^2$$

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

Quadratic total current limit curve output contacts.

From an altitude of > 2,000 m the curve is adjusted by - 0,5 °C / 100 m
(see example for 4,000 m).



$$\Sigma I = I_{38} + I_{68}$$

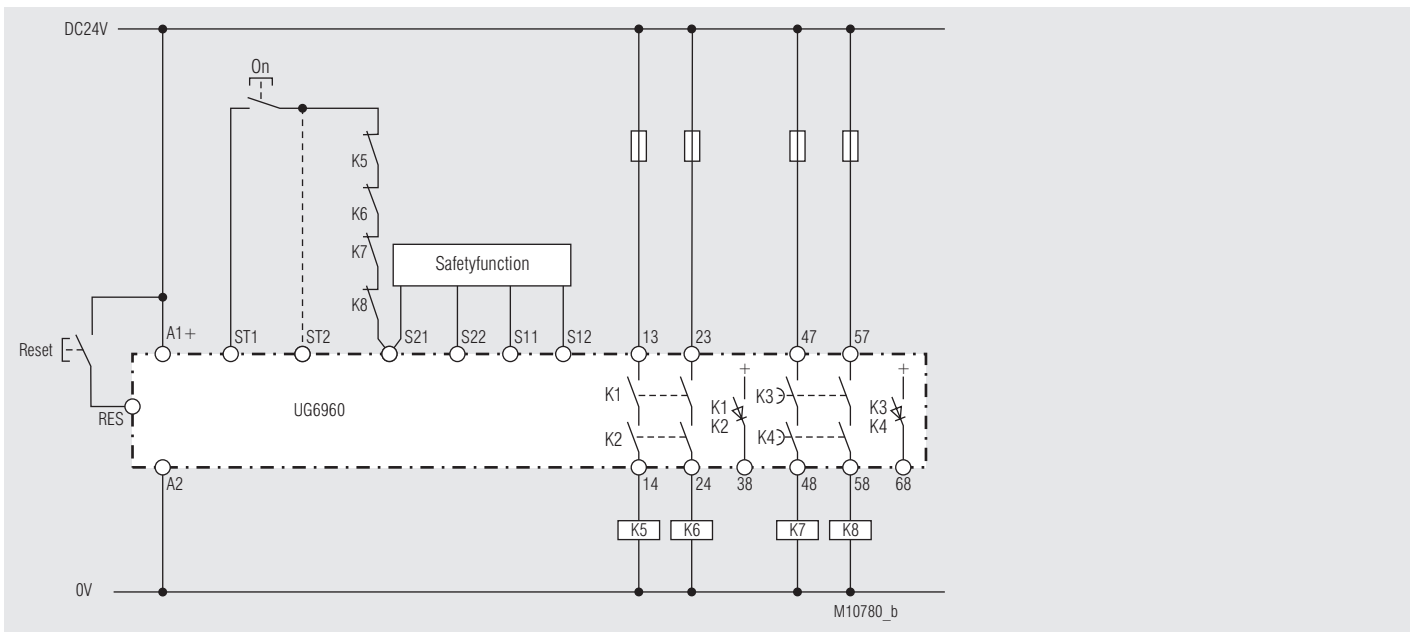
z.B. : $\Sigma I = 35mA + 15mA = 50mA$

I_{38} - Current semiconductor output 38

I_{68} - Current semiconductor output 68

Quadratic total current limit curve semiconductor monitoring outputs.

Application Examples with safety function

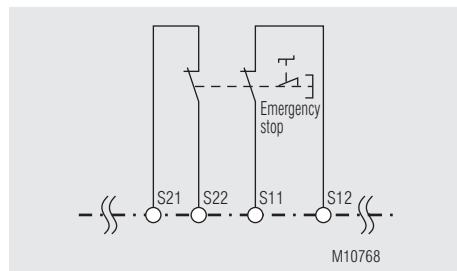


Safetyfunction: see below, Manual-Start (for automatic start make a bridge to ST2 instead of ON button).

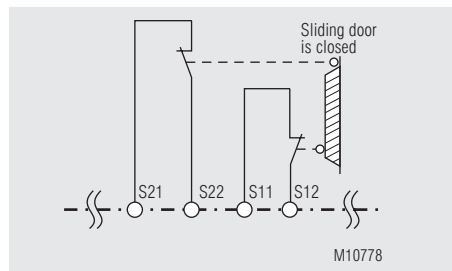
Delay function: release delay (1)

K1/K2 instantaneous contact, K3/K4 delayed contact

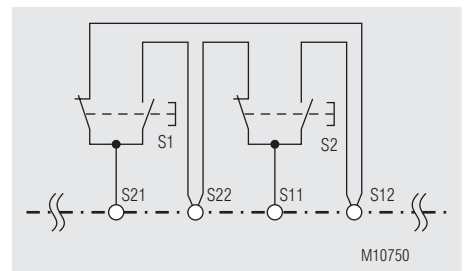
Contact reinforcement by external contactors. The correct function of the external contactors is monitored by connecting the NC contacts into the start circuit (manual start: terminals S21-ST1, auto start: S21-ST2).



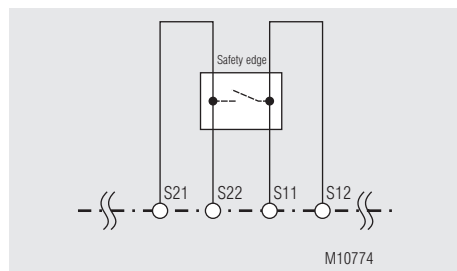
Fct.: E-stop (1),
with cross fault detection
SIL 3, PL e, Cat. 4



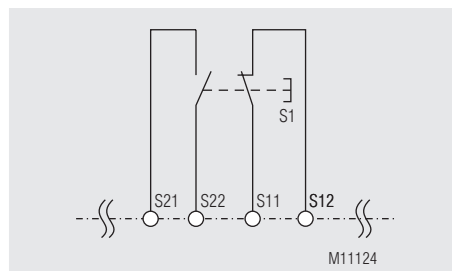
Fct.: Safety gate (2),
with cross fault detection
SIL 3, PL e, Cat. 4



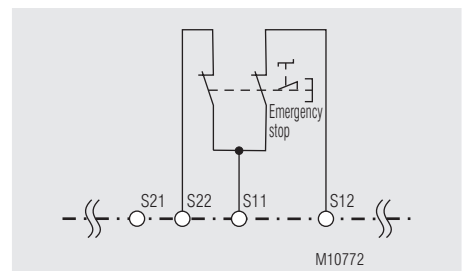
Fct.: Two-hand control (3),
with cross fault detection
SIL 3, PL e, Cat. 4
Type III C to EN ISO 13851



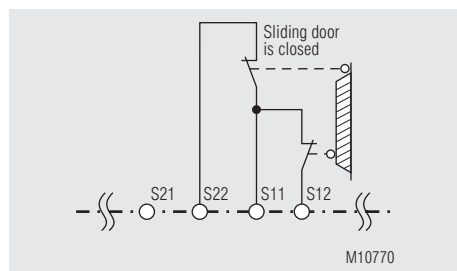
Fct.: Safety mat / Safety edge (4),
with cross fault detection
SIL 3, PL e, Cat. 4



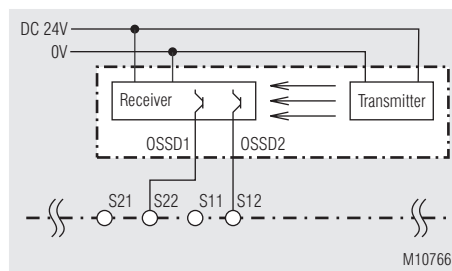
Fct.: Exclusive or contacts (5),
with cross fault detection
SIL 3, PL e, Cat. 4



Fct.: E-Stop (6),
without cross fault detection
SIL 3, PL e, Cat. 4¹⁾



Fct.: Safety gate (7),
without cross fault detection
SIL 3, PL e, Cat. 4¹⁾



Fct.: Light curtain (8),
without cross fault detection
SIL 3, PL e, Cat. 4²⁾

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.