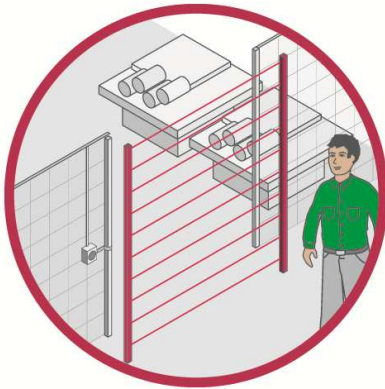


# Perimeter Guarding with Embedded Safety Module

Light curtain / Contactor

Cat.4 PL e, SIL 3 / Stop Category 0



## Function:

- Safety-related stop function initiated by safety light curtain (ESPE Type 4 according to EN/IEC 61496-1 and EN/IEC 61496-2).
- An interruption of the detection field causes the safety outputs to open. The deactivation of the safety outputs results in the switching-off of the motor power supply by means of the contactors (K3 and K4) to help to prevent possible hazardous movements or states.
- The safety light curtain receivers and outputs are cyclically tested and monitored by the safety light curtain to detect possible failures.

## Typical applications:

Palletizing stations with automatic control system where pallets would pass frequently through the hazardous area.

## Design:



- The safety function employs well-tried safety principles and is robust in the event of one component failure by means of two contactors (K3 and K4) and a light curtain (B1 and B2).
- A contactor fault is detected by the safety module at the next demand upon the safety function by the restart interlock pushbutton.
- The start function (S) must be located outside the hazardous area and at a point from which the potential danger is visible. It can be realized by the PLC as well.
- The light curtain (B1 and B2) has direct opening semiconductor outputs in accordance with IEC 61496-1, 2 and EN 61496-1 and is regarded as well-tried component.
- The safety module satisfies the requirements for performance level up to PL e according to EN ISO 13849-1 and safety integrity level SIL<sub>CL</sub> 3 according to EN/IEC 62061.
- The contactors (K3 and K4) have mirror contacts in accordance with EN/IEC 60947-4-1, meaning that the normally closed auxiliary contacts cannot be in the closed state unless the main poles are open. They are also considered as well-tried components.
- Protection against overcurrent must be provided in accordance with EN/IEC 60947-4-1.

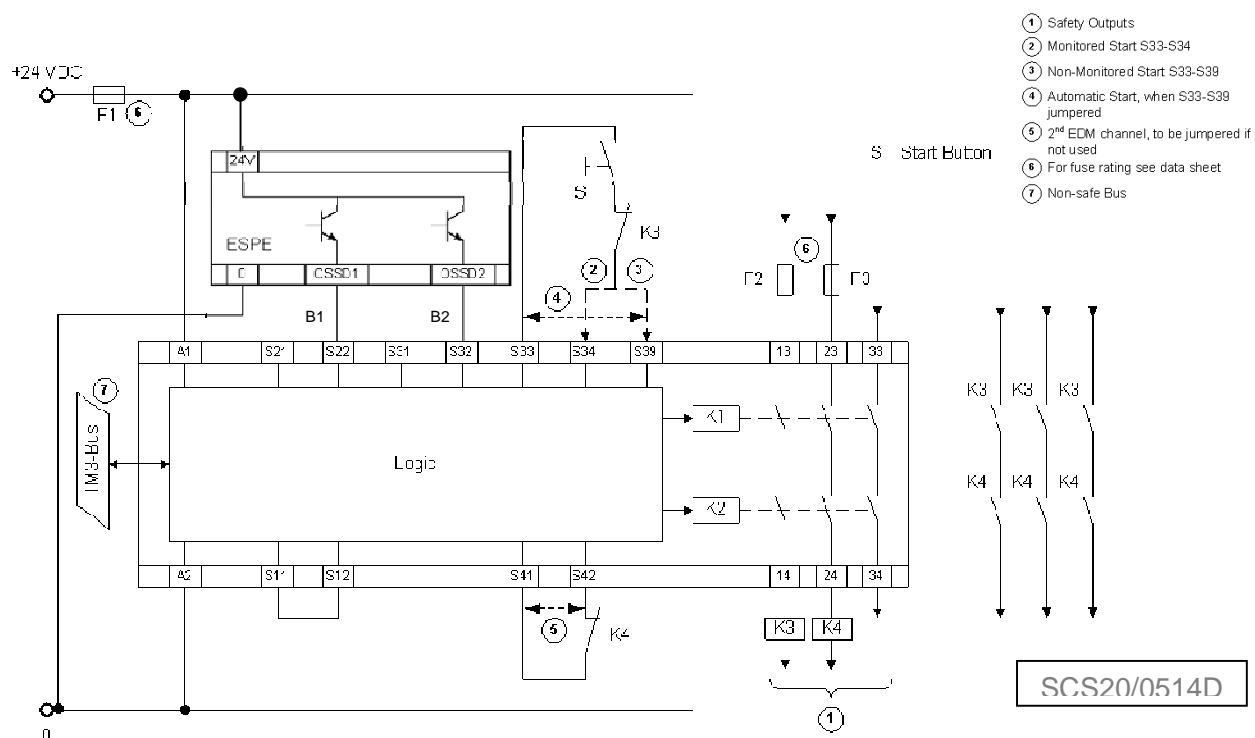
# Perimeter Guarding with Embedded Safety Module

## Safety Chain Products:

- Safety light curtain - [Preventa XUSL](#)
- Safety Module - [Modicon TM3SAK6R\(G\)](#)
- Contactor - [TeSys D](#)

## Related Products:

- Switches, pushbuttons - [Harmony XB4](#)
- Switch mode Power supply - [Phaseo ABL8](#)
- Modular beacon and tower light - [Harmony XVB](#)



# Perimeter Guarding with Embedded Safety Module

## Chain structure:

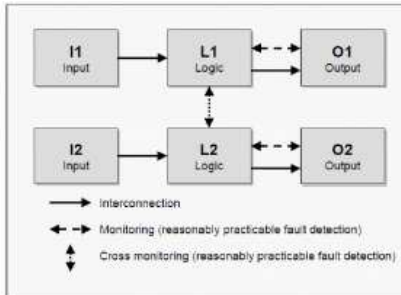


Figure 1

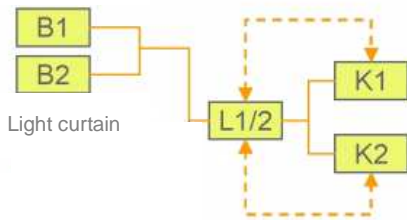


Figure 2

- The circuit diagram SCS20/0514D is a conceptual schematic diagram and is limited to present the safety function with only the relevant safety components.
- For the designated architecture of category 4, two redundant channels are implemented. This light curtains family offers muting function too.
- The circuit arrangement can be divided into three function blocks per channel with the input (I), logic (L) and output (O) blocks on each channel.
- The possibility of fault detection by monitoring the outputs is indicated by the broken lines (see figure 1).
- The functional channel can be represented by a light curtain actuating two semiconductor switches (i.e. B1 and B2) that would correspond to the input (see figure 2).
- The safety module (TM3SAK6R(G)) corresponds to the logic block (L1/L2), which maintains the internal redundancy of the safety circuits required for this architecture.
- The output block is represented by two redundant contactors (K3 and K4) that are monitored by the logic block (safety module) to detect any failure.
- The complete wiring must be in accordance to EN 60204-1 and the necessary means to avoid short circuits has to be provided (EN ISO 13849-2 Table D.4).
- The start functionality (S) can be realized as well by means of a PLC output. Re-start is not considered safety relevant operation. If the light curtain is interrupted re-start has no effect.

Cycle time (s)	60
Number of hours' operation per day	12
Number of days' operation per year	220
Number of operations per year	158400

## Safety level calculation:

- A required performance level (PL<sub>r</sub>) must be specified for each intended safety function following a risk evaluation. The performance level (PL) attained by the control system must be validated by verifying if it is greater than or equal to the PL<sub>r</sub>.
- At 220 working days per year, 12 working hours per day and a cycle time of 1 minute, the number of operations (n<sub>op</sub>) would be 158 400 per year.
- Mean time to dangerous failure (MTTF<sub>d</sub>) values exceeding 100 years will be limited to this value in order for the component reliability not to be overstated in comparison with the other main influencing variables such as the architecture or tests.

		Values	
		Channel 1	Channel 2
Input device XUSL	PL	e	
	Category	4	
	PFH <sub>d</sub> resulting (1/h)	4,90E-08	
Logic TM3SAK6R(G)	PL	e	
	Category	4	
	PFH <sub>d</sub> resulting (1/h)	5,00E-09	
Output TeSys D	PL	e	
	Category	4	
	MTTF <sub>d</sub> resulting (years)	100	100
	DC <sub>avg</sub>	99%	99%
	CCF	65	65
	PFH <sub>d</sub> resulting (1/h)	2,47E-08	
	PL attained	e	
Safety function	PFH <sub>d</sub> resulting (1/h)	7,87E-08	

# Perimeter Guarding with Embedded Safety Module

ENVIRONMENTAL CONDITIONS	Light curtain Preventa XUSL outside of a cabinet	Safety module TM 3SAK6R/G and Contactor - TeSys D inside a cabinet
General		
Degree of protection according to IEC/EN 60529	IP 65	
Terminals:		IP 20
Enclosure:		IP 20
Ambient operating temperature (horizontal installation)	-10...55 °C	- 10...+55 °C (+ 14...+ 130 °F)
For use in max. height above sea of		2000 m (6560 ft)
Storage temperature	-25...75 °C	- 40...+70 °C (- 40...158 °F)
For storage in max. relative humidity of	≤ 95 % without condensation	95 %, non condensing
For storage in height above sea level of		0...3000 m (0...9842 ft)
Overvoltage category		III (4 kV)
Pollution degree		2
Rated insulation voltage according to IEC/EN 60664-1		~ 300 V
Supply		
Supply voltage	24 V DC (+/- 20%)	SELV/PELV c 24 V – 15/+20 %
Max. protection		4 A fuse gG
Rated power		
Bus 5 VDC		0.2 W
External Supply 24 VDC		2.4 W
Output circuit		
Max. current per output path		6:00 A
The sum of simultaneous currents on all of the outputs is limited to		Σ I <sub>th</sub> ≤ 18 A
Protection of outputs		max.: 4 A fuse gG or 6 A fast blow
Maximum switching capacity of outputs		
AC-15		~ 230 V, 5 A
DC-13		24 VDC, 4 A

- These values are therefore limited to 100 years ("high").
- A PFH<sub>d</sub> value of 5 x 10<sup>-9</sup> is stated for the safety module (TM3SAK6R(G)). This value comes directly from the safety device data and it is certified by an accepted standards body.
- For the redundant contactors K3 and K4, the B10 value corresponds under nominal load to an electrical lifetime of 10 000 000 switching cycles. If 50% of failures are assumed to be dangerous, the B10<sub>d</sub> value is 20 000 000 operations. With the assumed value for n<sub>op</sub>, it results in a MTTF<sub>d</sub> of 1262,6 years for each component. These values are therefore limited to 100 years ("high").
- The combination of channel 1 and channel 2 results in a DC of 99% (high) as K3 and K4 are monitored by the safety logic.
- Measures against common cause failures (Annex F of EN ISO 13849-1) must attain at least 65 points (i.e. separation (15), overvoltage protection etc. (15) and environmental conditions (25+10)).
- The safety-related control system corresponds to category 4 with high MTTF<sub>d</sub>. The complete functional safety chain results in average probability of dangerous failure (PFH<sub>d</sub>) of 7.87 x 10<sup>-8</sup>. This corresponds to PL e and SIL 3.

## ATTENTION

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