

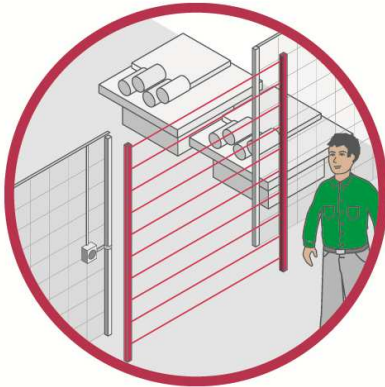
# Perimeter Guarding with Embedded Safety Module

Light curtain / Variable Speed Drive

Cat.3 PL d, SIL 2 / Stop Category 1



## Function:



- Safety-related stop function initiated by a safety light curtain (ESPE Type 4 according to EN/IEC 61496-1 and EN/IEC 61496-2). Controlled stopping with power maintained to the drive to achieve stopping (i.e. braking), then cut-off of power when standstill is reached (Safe Stop 1).
- The hazardous movement is interrupted either if the stop button (S2) or the emergency stop device (S3) is actuated. An interruption of the detection field initiates the functional stopping of the drive, i.e. by a braking ramp (stop category 1 in accordance with EN/IEC 60204-1).
- After the frequency monitored by the drive has elapsed, the drive is halted, by the 'safe torque off' (STO) safety function integrated within it, which prevents the motor from restarting unintentionally.
- The switching of the Llx inputs is monitored by the drive. The power stage is disabled when the time offset is exceeded.

## Typical applications:

Machines that use drives in their movements due to high speed and precision needed (i.e. textile, wood-working or simple packaging machines), when the delayed initiation of the stopping in the event of a fault must not involve an unacceptably high residual risk.

## Design:

- The safety function employs well-tried safety principles and is robust in the event of one channel failure by means of a SS1 inputs of ATV32
- A light curtain fault is detected by the safety module at the next demand upon the safety function by the restart interlock pushbutton.
- The start button (S) must be located outside the hazardous area and at a point from which the potential danger is visible.
- The light curtains (B1 and B2) have semiconductor outputs in accordance with IEC 61496-1, 2 and EN 61496-1 and are regarded as well-tried components.
- The safety module satisfies the requirements for performance level up to PL d according to EN ISO 13849-1 and SIL<sub>CL</sub> 2 according to EN/IEC 62061.



# Perimeter Guarding with Embedded Safety Module

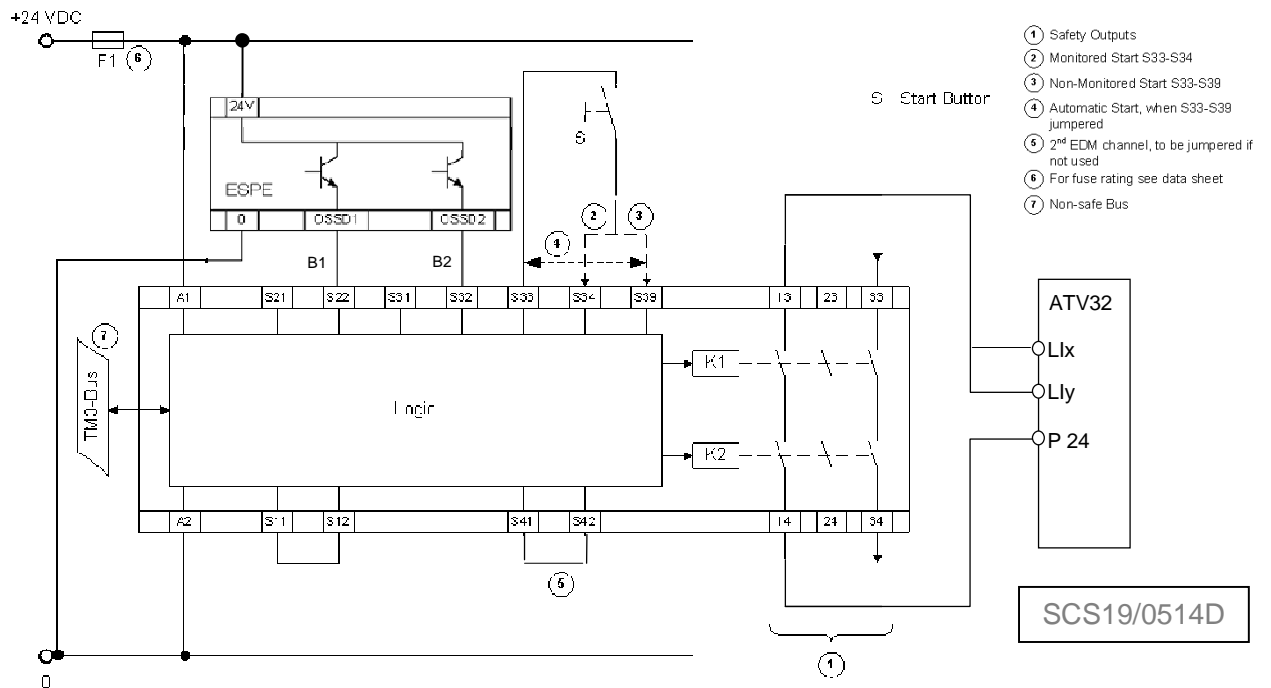
- Protection against overcurrent must be provided in accordance with EN/IEC 60947-4-1.
- The mounting position of the light curtain has to follow the requirements for safety distance according to ISO 13855.

## Safety Chain Products:

- Safety light curtain - [Preventa XUSL](#)
- Safety Module - [Modicon TM3SAFL5R\(G\)](#)
- Variable Speed Drive - [Altivar 32](#)

## Related Products:

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



# Perimeter Guarding with Embedded Safety Module

## Chain structure:

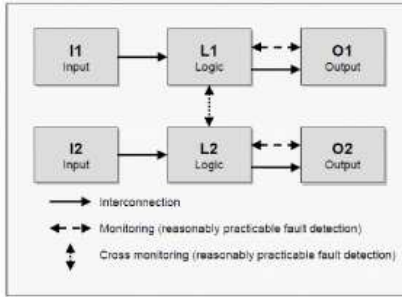


Figure 1

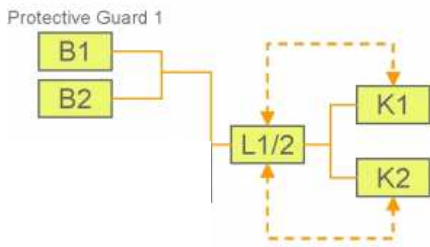


Figure 2

- The circuit diagram SCS19/0514D 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 3, two redundant channels are implemented.
- 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).
- Since each light curtain forms part of a dedicated safety function, the calculation of the performance level considers only one of them.
- The functional channel can be represented by a single curtain actuating two switches (i.e. B1 and B2) that would correspond to the input (see figure 2).
- The safety module (TM3SAFL5R(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 not by STO but SS1. After reaching almost zero speed ATV turns automatically to STO. SS1 to be connected to two inputs of the ATV (please consult the Altivar 32 safety manual) that are developed according IEC 61508 and are able to detect any drive internal 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).

## Safety level calculation:

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

		Values	
		Channel 1	Channel 2
Input device XUSL	PL	e	
	Category	4	
	PFH <sub>d</sub> resulting (1/h)	4,90E-08	
Logic TM3SAFL5R(G)	PL	d	
	Category	3	
	PFH <sub>d</sub> resulting (1/h)	5,00E-09	
ATV32 STO	PL	d	
	Category	3	
	PFH <sub>d</sub> resulting (1/h)	9,67E-08	
Safety function	PL attained	d	
	PFH <sub>d</sub> resulting (1/h)	1,51E-07	

- 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 (nop) would be 158 400.
- 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.
- These values are therefore limited to 100 years ("high").

# Perimeter Guarding with Embedded Safety Module

ENVIRONMENTAL CONDITIONS	Light curtain Preventa XUSL outside of a cabinet	Safety module TM3SAFL5R/G and Altivar 32 with STO inputs
General		
Degree of protection according to IEC/EN 60529	IP 65	IP 20
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		$\sum I_{th} \leq 18 \text{ A}$
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

- A PFH<sub>d</sub> value of  $5 \times 10^{-9}$  is stated for the safety module (TM3SAFL5R(G)). This value comes directly from the safety device data and it is certified by an accepted standards body.
- 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 3 with high MTTF<sub>d</sub>. The complete functional safety chain results in average probability of dangerous failure (PFH<sub>d</sub>) of  $6.22 \times 10^{-8}$ .
- The combination of all safety modules results in PL d and SIL 2.

## ATTENTION

The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric Industries SAS nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein.

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