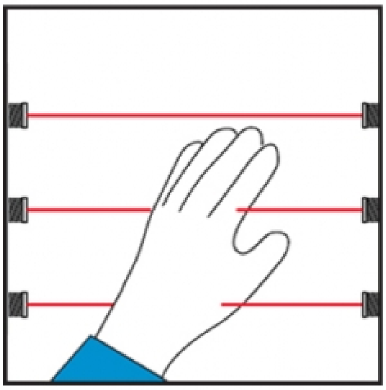
Safety Chain Solution - Light curtain

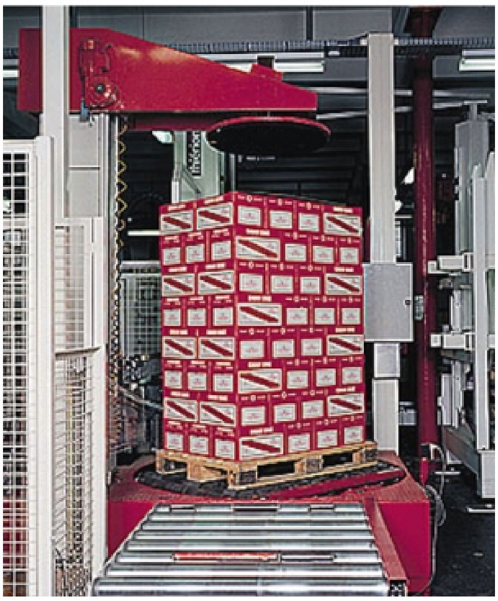
PL c, SIL 1

Right diagnostic level to achieve increased reliability



Function:

- Safety-related stop function initiated by several single-beam photo-electric devices used as protective equipment (ESPE Type 2 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 contactor (K1) to help to prevent possible hazardous movements or states
- The photo-electric devices (B1...B4) are cyclically tested and monitored by the safety module to detect possible failures.
- A muting function can be enabled by means of photo-electric sensors (A1, A2). It allows the light curtain's detection function to be temporary inhibited without triggering the stop function.
- During the muting time interval, materials can be transported through the hazardous area and the muting indicator light (H1) indicates to the operator this temporary disabling of protection.



Typical applications:

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

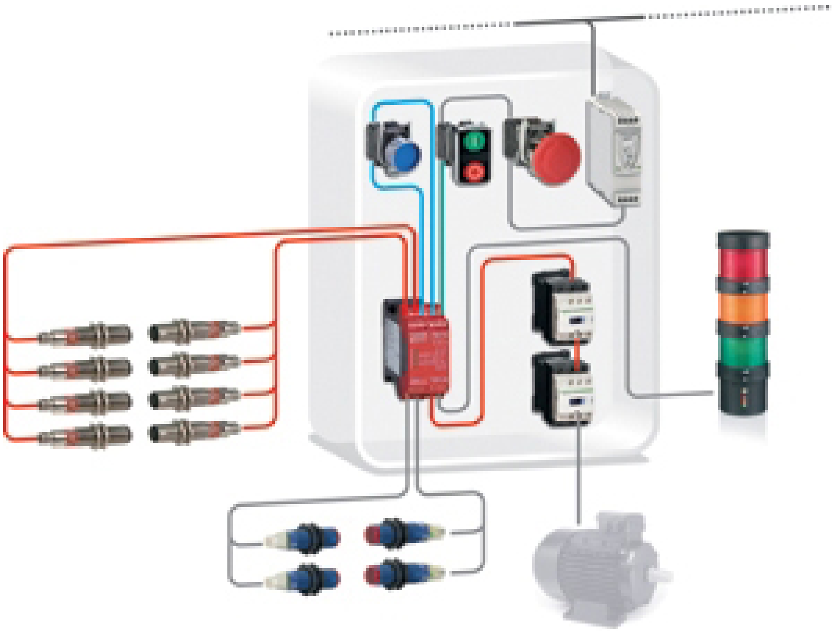
Safety Chain Solution - Light curtain

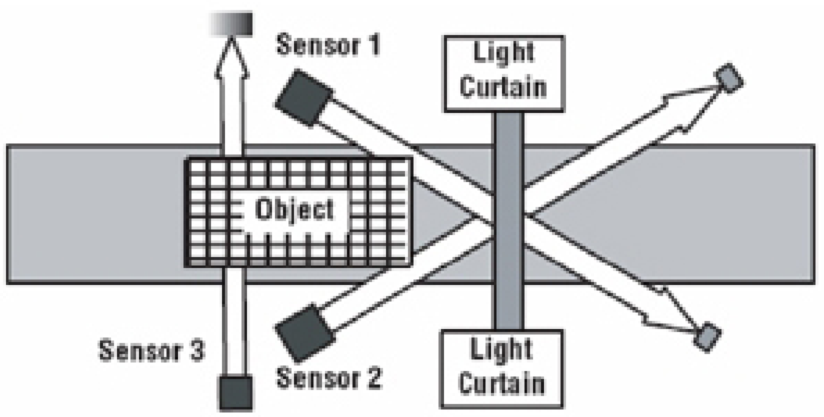
Design:

- The safety function employs well-tried safety principles and it is tested periodically by its control system in order to detect failures.
- Special photo-electric devices with adequate optical characteristics (aperture angle, extraneous light immunity) in accordance with EN/IEC 61496-2 are employed.
- The access to the hazardous area must be protected by using the four-beam light barrier in consideration of the necessary mounting height in accordance with EN/IEC TS 62046 and correct positioning with respect to the approach speed of the machine operator in accordance with EN ISO 13855.
- The test rate must be at least 100 X the rate of intrusion into the protected zone.
- The safety module satisfies the requirements for performance level PL c in accordance with EN ISO 13849-1 and SILCL 1 in accordance with EN/IEC 62061.
- The start (S2) and the restart interlock (S1) must be located outside the hazardous area and at a point from which the potential danger is visible.
- The muting state must be displayed by an indicator light clearly visible to the operator at the access point to the hazardous area.
- The ‘muting' light as well as individual muting sensors are checked directly by the safety module.
- The undetected access of persons through hazardous area during the muting interval must be prevented by the geometrical arrangement of the muting sensors and the correspondent timing of the control system (see figure 1).
- The contactors (K1 and K2) have mirror contacts in accordance with EN/IEC 60947-4-1.
- Overcurrent protection must be provided in accordance with EN/IEC 60947-4-1.

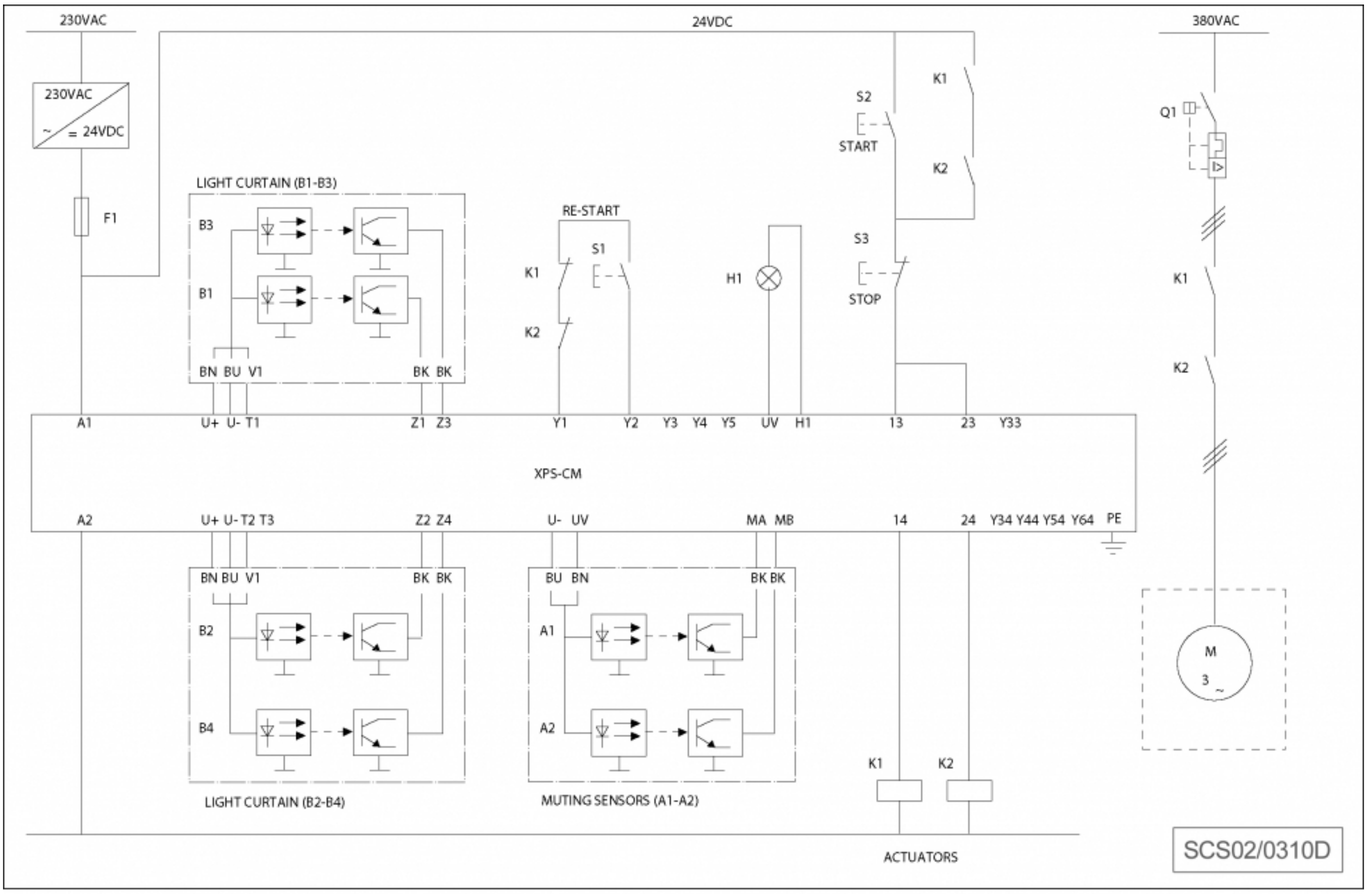
Related products

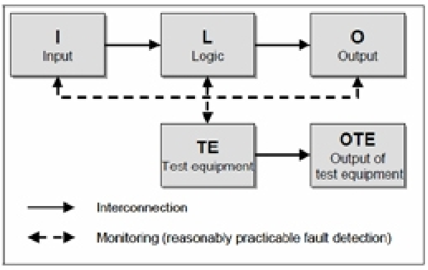
- Switches, pushbuttons, emergency stop - Harmony XB4
- Switch mode Power supply - Phaseo ABL8
- Safety light curtains, single-beam for body detections - Preventa XU2S
- Photo-electric sensors - OsiSense XU
- Safety Module - Preventa XPSCM
- Contactor - Tesys D
- Modular beacon and tower lights - Harmony XVB





Safety Chain Solution - Light curtain





Light curtain

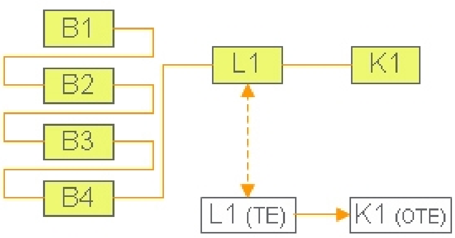


Figure 2

Chain structure:

- The circuit diagram SCS02/0310D 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 2 the calculation of the reliability data considers the functional channel having input (I), logic (L) and output (O) blocks, and indirectly the function blocks of the test channel (TE).
- In this case, the input block represents the single-beam photo-electric devices (B1 to B4) and the safety module (XPSCM) corresponds to the logic (L1) and test (TE) blocks.
- The output is represented by a contactor (K1) that corresponds to the test equipment output (see figure 2).
- The complete wiring must be in accordance with EN 60204-1 and measures to avoid short circuits have to be provided (EN ISO 13849-2 Table D.4).

Safety Chain Solution - Light curtain

Cycle time (s)	120
Number of hours' operation per day (h)	8
Number of days' operation per year	220
Number of operations per year (n_{op})	52800

		Values
Input (light beam) XU2	PFH_d (1/h)	4.48×10^{-7}
Input (light beam) XU2	PFH_d (1/h)	4.48×10^{-7}
Input (light beam) XU2	PFH_d (1/h)	4.48×10^{-7}
Input (light beam) XU2	PFH_d (1/h)	4.48×10^{-7}
Input (light barrier)	PFH_d resulting (1/h)	1.79×10^{-6}
Logic (safety module) XPSCM	PFH_d (1/h)	3.12×10^{-7}
Output (contactor) LC1 (low load)	B10 (operations)	1 000 000
	% dangerous failure	73
	$B10_d$ (operations)	1 369 863
	$T10_d$ (years)	26
	$MTTF_d$ (years)	259.4
	$MTTF_d$ resulting (years)	100
	PFH_d resulting	2.47×10^{-8}
Safety function	$MTTF_d$ resulting (years)	12.5 (medium)
	DC_{avg} resulting (%)	84 (low)
	PFH_d resulting (1/h)	**2.13×10^{-6}**
	PL attained	c
	SIL attained	1

Safety level calculation:

- A required performance level (PLr) must be specified for each intended safety function. The performance level (PL) attained by the control system must be validated by verifying if it is greater than or equal to the PLr.
- At 220 working days per year, 8 working hours per day and a cycle time of 120 seconds, the number of operations (nop) would be 52 800.
- Mean time to dangerous failure (MTTFd) 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 testing.
- A PFHd value of 4.48×10^{-7} is stated for each photo-electric single beam device (B1 to B4). If we assume 4 beams are used for the application, then we must use 4 times this value, which results in a total value of 1.79×10^{-6}. For the safety module (L1) 3.12×10^{-7} is stated. These values come directly from the safety device data and are certified by an accepted standards body.
- For the contactor (K1), the B10 value corresponds under nominal load to an electrical lifetime of 1 000 000 switching cycles.
  If 73% of failures are assumed to be dangerous, the B10d value is 1 369 863 operations. With the assumed value for nop, it results in a MTTFd of 259,4 years for K1. This value is therefore limited to 100 years ("high").
- Measures against common cause failures (Annex F of EN ISO 13849-1) must attain at least 65 points, i.e. separation (15), well-tried components (5), over-voltage protection etc. (15) and environmental conditions (25+10).
- The safety-related control system corresponds to category 2 with medium MTTFd. The complete functional safety chain results in a DCavg 84 % (low) and average probability of dangerous failure (PFHd) of 2.13×10^{-6} per hour.
- This corresponds to PL c and SIL 1.

SCS02/0310 - 03-03-2010

Schneider Electric Industries S.A.S
Head Office
35 rue Joseph Monier
CS 30323
92506 Rueil-Malmaison
www.schneider-electric.com

As standards, specifications and designs change from time to time, please ask for confirmation of the information given in this publication.
Design : Schneider Electric
Photos : Schneider Electric