whitepaper

Inductive safety sensors

The PI-Safe inductive safety sensors can generally be installed in all those applications that require a non-contact and safe detection of a metal object.

In this whitepaper we are analyzing two of the most common applications:

- Detection of the correct and safe position of a rotary table in an assembly machine
- Safety control of the position and stroke of a bin tipper

Inductive safety sensors are certified according to the following standards:

EN 60947-5-3 " Low-voltage switchgear and controlgear - Part 5-3: Control circuit devices and switching elements - Requirements for proximity devices with defined behaviour under fault conditions"

IEC 61508 " Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems"

ISO 13849 "Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design".

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PI-SAFE SENSORS RANGE

Key characteristics, common to the whole range of PI-Safe sensors are:

- Protection rate: IP65 and IP67
- Operative temperature: -25 ... 70 °C
- LED signalling: Green LED (operation); Yellow LED (signal)
- Protection class: III
- Safety output: 2 x OSSD
- Voltage type and electrical design: DC PNP
- Connection: M12 4-pole connector

Cylindrical with metal thread

	PI M12 NF	PI M18 NF	PI M30 NF	PI M30 NF K	PI M18 F	PI M18 FR	PI M30 F
Safety Level	PL d / SIL 2			PL e / SIL 3	PL d / SIL 2		
Mounting	Non-flush mountable				Flush mountable		
Dimensions (mm)	M12 x 1 L = 70	M18 x 1 L = 70,5	M30 x 1,5 L = 70	M30 x 1,5 L = 80	M18 x 1 L = 70	M18 x 1 L = 86,5	M30 x 1,5 L = 70
Enable zone (mm)	0,5 ... 4	1 ... 8	1 ... 15	6 ... 12	1 ... 5	> 10	6 ... 12
Ordering code	1293000	1293001	1293004	1293006	1293002	1293003	1293005

Rectangular

	PI SQ F-NF	PI SQ NF
Safety Level	PL e / SIL 3	
Mounting	Non-flush or flush mountable	Non-flush mountable
Dimensions (mm)	40x40x66	40x40x66
Enable zone (mm)	10 ... 15	4 ... 20
Ordering code	1293007	1293008

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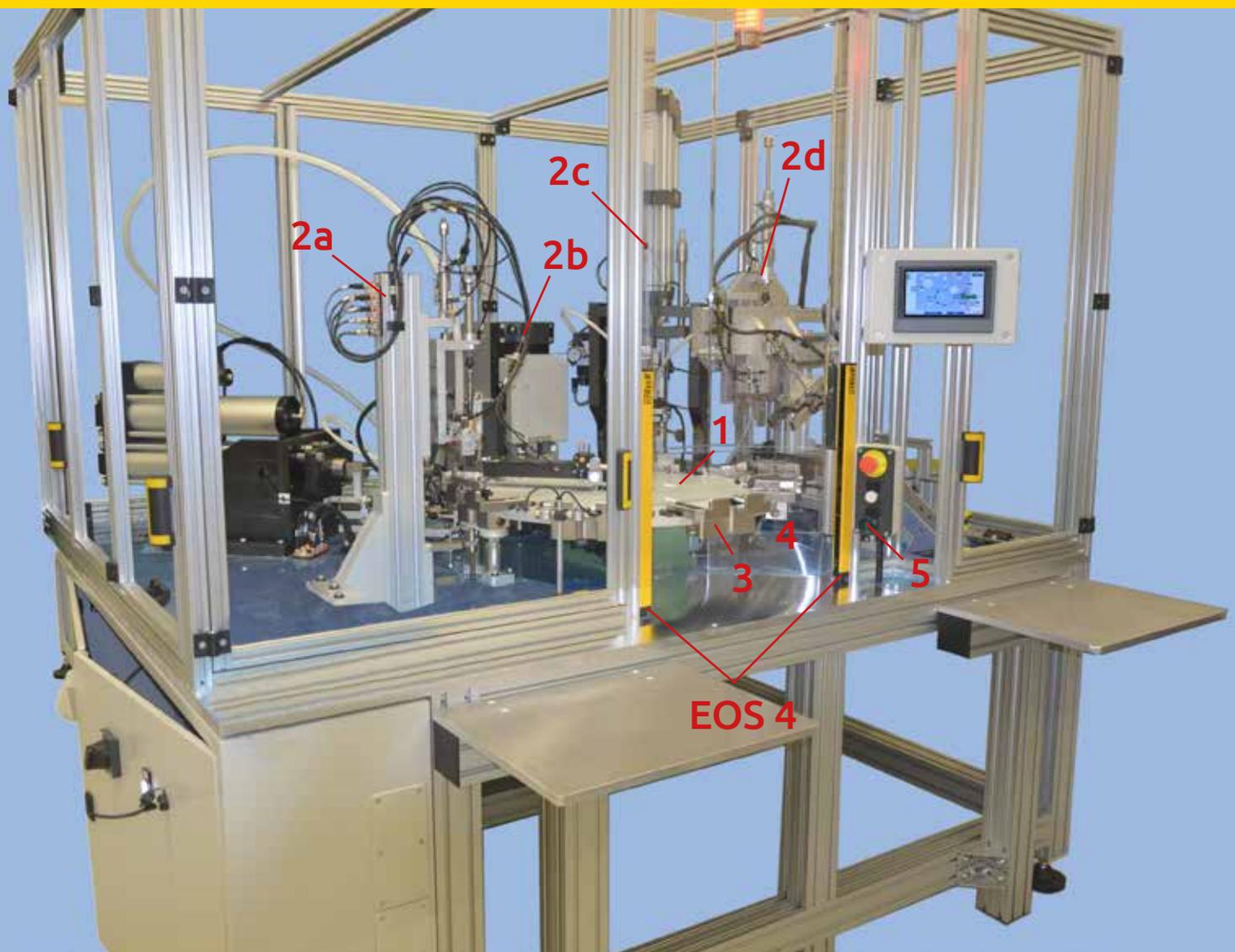
1. ROTARY TABLE
2. WORKSTATION (a, b, c, d)
3. WORK PIECE FEEDER
4. PROTECTIVE SCREEN (plexiglass)
5. START BUTTON

Assembly machine with rotary table

The machine consists of a rotary table [1], moving work pieces in sequence from one working station [2a, 2b, 2c, 2d] to the next, until the final product is manufactured. Operator safety is guaranteed by a mechanical protection (plexiglass protective screen) [4] as well as a set of ReeR EOS4 safety light curtains.

Operator and machine interaction only occur when workpieces are loaded into the rotary table feeder [3], after each sequence operation has been completed. When the working stations are operating, the rotary table is locked, the protective screen closed and the safety light curtain disabled.

During this phase the operator can load a new workpiece in the rotary table feeder. When all working stations complete their operations, the machine PLC will enable the start button [5]. Pressing the start button activates the rotation of the table and the protective screen to rise; during this phase, operator safety is secured by the EOS4 safety light curtain.

Looking at the operation of the machine, we note that the safety problems to be solved are:

1. Safe controls of the position of the protective screen
2. The rotary table movement monitoring, enabling/disabling the safety light curtain

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The position monitoring of the protection screen and rotary table are carried out by means of inductive safety sensors PI-Safe M12.

Two PI-Safe sensors control the position of the protective screen detecting the proximity of the metal blocks placed on the side of the screen (One PI-Safe monitors the open position, a second PI-Safe monitors the close position of the screen).

Protective screen closed
Rotary table stopped
Light curtain disabled

Protective screen open
Rotary table activated
Light curtain enabled
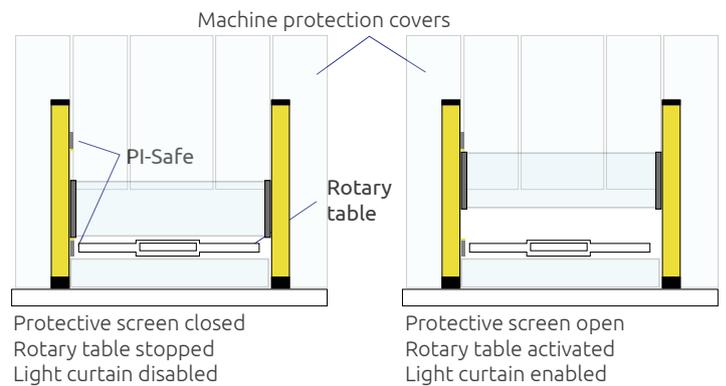
A PI-Safe sensor controls the position of the rotating table detecting, at each rotation of the table, the position of a metal block placed on the axis as indicated in the figure.
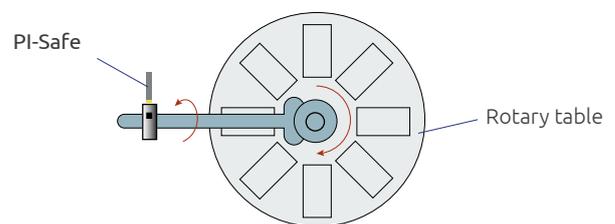
The safety of the machine is completed by a series of Magnus RFID sensors monitoring the side doors of the machine. If one of these doors should be opened during operations, the machine would stop.

All PI-Safe and Magnus RFID sensors are managed by a ReeR Mosaic Safety Controller that also controls the light curtain enable / disable logic.

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Position control of a bin tipper

In this application the PI-Safe inductive safety sensors are used to detect the position of a bin tipper.

The tipper is placed inside a fence-protected area, accessible by opening an interlocked safety lock controlled gate.

The release of the safety lock, allowing the operator to enter in the protected area, can only take place when the bin tipper is in a safe position

We have two safety positions of the bin tipper to be monitored:

1. Bin raised from the ground for unloading / loading operations. In this position, to prevent accidental movement, a mechanical locking lever [A] is used (as shown in the picture)
2. Bin on the ground during normal operations

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A total of three PI-Safe sensors are used to achieve system safety.

Two PI-Safe sensors are installed on the mechanical blocking lever to ensure the engagement and lock the bin tipper before people can enter the hazardous area when the bin is raised. One sensor detects the "inserted" position of the blocking lever, the other one the "removed" position.

A third PI-Safe is installed on the floor to ensure the bin has been lowered before people can enter the hazardous area.

The three PI-Safe sensors, as well as the interlocked safety lock, are managed by a ReeR Mosaic Safety Controller.

The performance level PLr obtained for this system is:

Cat 3 - PLd.

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More than 60 years of quality and innovation

Founded in Turin (Italy) in 1959, ReeR distinguished itself for its strong commitment to innovation and technology.

A steady growth throughout the years allowed ReeR to become a point of reference in the safety automation industry at a worldwide level.

The Safety Division is in fact today a world leader in the development and manufacturing of safety optoelectronic sensors and controllers.

ReeR is ISO 9001, ISO 14001 and ISO 45001 certified.

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Product	Inductive safety sensors
Data	20-04-2020
Application	Position detection
Object	Safe position control via PI-Safe safety inductive sensors