Safety Product Training- Light Curtains & Safety Relays

November 2023

EVERY CONNECTION COUNTS

WHAT IS SAFETY?

Safety
Machine safety is the basis for safe operation between humans and machines. The use of safety automation protects staff from the hazards that originate from from plant operations and machinery. The use of safety automation provides a safe environment for workers and maximizes throughput.

Machine safety refers to the practices, measures, and standards put in place to ensure the well-being of individuals interacting with machines.

WHAT IS SAFETY?

Safety

Active protective measures are usually implemented by selecting and combining appropriate hardware components (such as sensors, switches, logic units, relays etc.) to create a Safety Related Control System.

A control system that provides an active protective measure carries out a **safety function** and the control system itself is called **Safety Related Control System.**

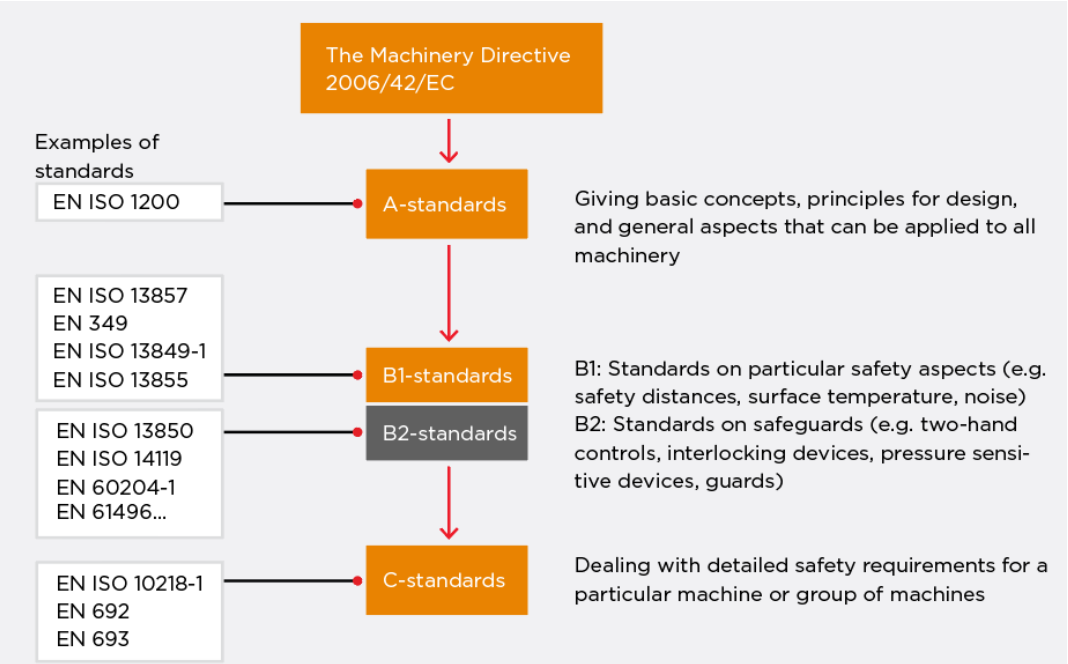
Safety function	Example of application
Safety –related stop function initiated by a safeguard	Stop a motor in response to tripping of a protective device
Manual reset function	Intended action to re-establishes the safeguard after its actuation. Acknowledgement that risk is no more present
Start/restart function	Start of a dangerous movement can take place only when an hazardous situation no more exists
Muting function	Automatic temporary suspension of a safety function
Hold-to-run function	Hazardous machine movements can be controlled from a position within the hazard zone, e.g., inching mode during setup
Prevention of unexpected start-up	Keeping a machine in a stopped condition while persons are present in danger zones
Operating mode selection	Activation of safety functions by an operating mode selector switch
Safe motion, safe position	Overspeed, overtravel control

WHAT IS SAFETY?

Main standards Europe

Fundamental Product European directives :
2006/42/EC: "Machine Directive" -> for machine manufacturers
2014/30/EU: "Electromagnetic Compatibility Directive" -> applies to electrical & electronic devices
2014/35/EU: "Low Voltage Directive" -> Applies to electrical material from 50 to 1500V

Umbrella Safety machinery standards
ISO 13849 "Safety of machinery"
IEC 61508 "Functional safety of electrical / electronic / programmable electronic safety related systems" which impacts safety of machinery especially through IEC 62061 "Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems"
IEC61496 "Safety of machinery - Electro sensitive protective equipment



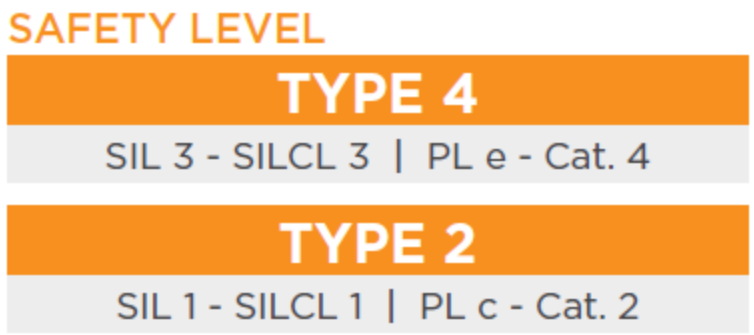
A type C Standard takes priority over type A and B Standards

Main standards North America

Health & Safety is governed by OSHA (Occupational Health and Safety Administration)
ANSI (American National Standard Institute) issue standards on the safety of machine tools and construction
Underwriters Laboratories inc (UL) or CSA are the bodies that issue certifications for safety equipment

WHAT IS SAFETY?

Safety levels



SIL (Safety Integrity Level) as per EN 62061
Can only be used for electrical, electronic or programmable safety solutions.

PL (Performance Level) as per EN ISO 13849-1
is a technology-neutral concept that can be used for electrical, mechanical, pneumatic and hydraulic safety solutions.

Category: refers to the machine itself and achievable protection level.
Goes from category B (basic) to category 4 (highest).
Ex: Category 4 allow to reach protection level (highest protection against higher risk)

Type 2 refers to the specific design of protection equipment like a safety light curtain or relay.

Type 4 device would be most likely to be used in a Category 4 application, and a Type 2 light curtain could probably only be used for a Category 2 application

SIL is particularly well-suited to large, complex facilities or factories with multiple machines, while **PL** is more suitable for individual machines.

WHAT IS SAFETY?

RISK EVALUATION : PLr (Protection Level required)

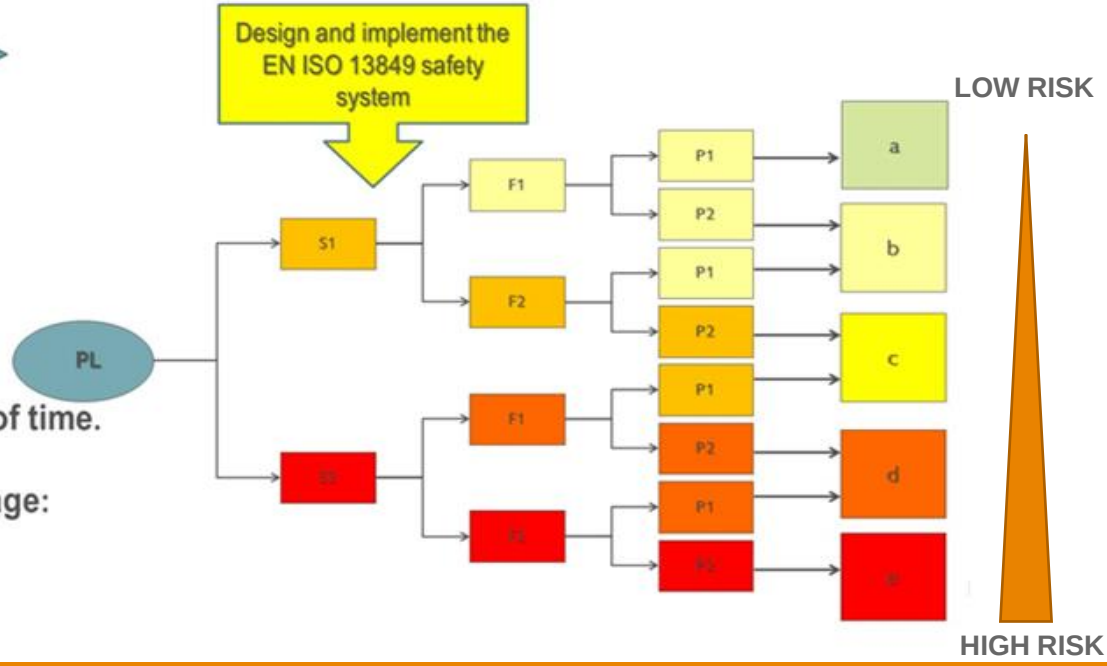
Machinery Directive - Overview of the steps to achieve the level of safety required by each application

▼ Objective: risk reduction applying defined control measures

Risk assessment EN ISO 12100 → Define risk reduction measures → Design and implement the EN ISO 13849 safety system

How to determine the required performance level – **PLr:**

- S = severity of the damage:
  - S1= light damage– reversible;
  - S2= serious damage– irreversible.
- F = frequency and/or danger exposition:
  - F1= rare and/or for a limited time;
  - F2= frequent/continuous and/or for an extended period of time.
- P = possibility of avoiding the danger or limiting the damage:
  - P1= possible within certain conditions;
  - P2= Highly Possible



PL r(e) provides the greatest contribution to risk reduction

PRODECT SCOPE

EVERY CONNECTION COUNTS

Product Portfolio

SAFETY LIGHT CURTAINS

SLC4 Range

SAFETY LEVEL

TYPE 4

SIL 3 - SILCL 3 | PL e - Cat. 4

SLC2 Range

SAFETY LEVEL

TYPE 2

SIL 1 - SILCL 1 | PL c - Cat. 2

SAFETY INTERFACES

SRS - SRK RANGE

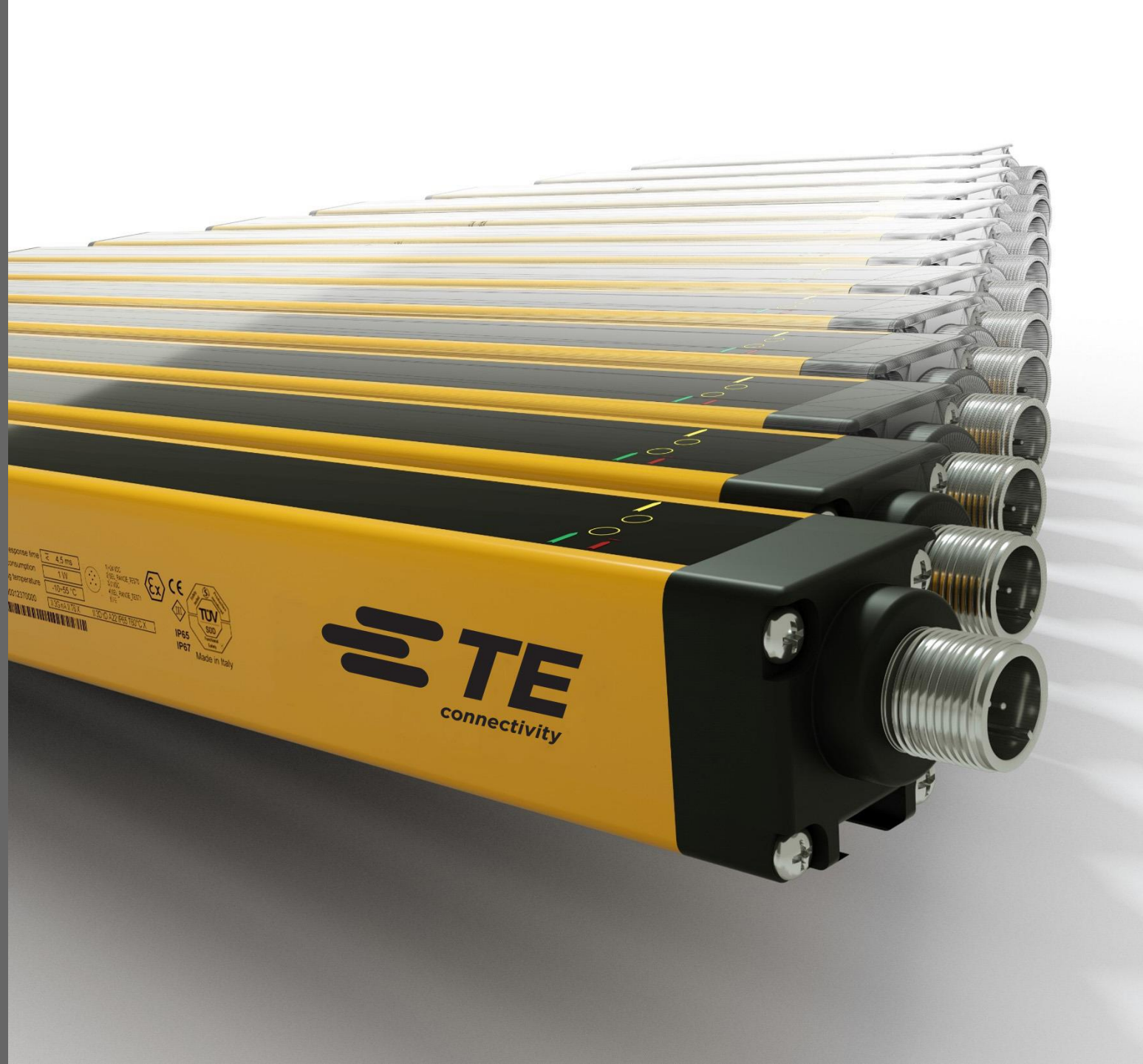
SINGLE & MULTI-FUNCTION SAFETY RELAYS

Type 4 SIL 3 - SILCL 3 | PL e - Cat. 4
OR
Type 2 SIL 1 - SILCL 1 | PL c - Cat. 2

SAFETY LIGHT CURTAINS

SLC Range

EVERY CONNECTION COUNTS

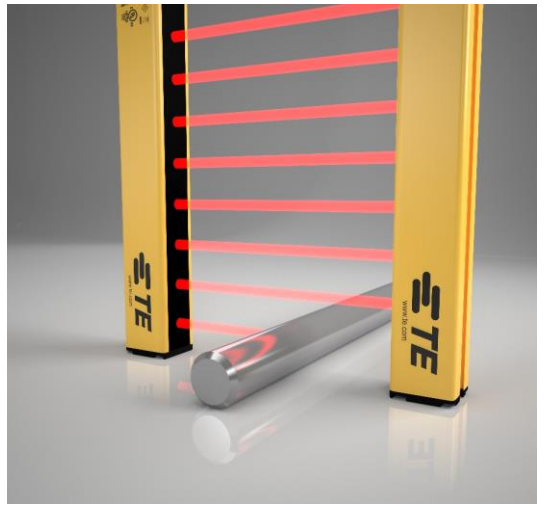


Safety Light Curtain : Principle of Operation

- The light curtain uses a combination of an emitter and a receiver. Multiple parallel beams are emitted with various resolutions (distance between beams).
- If no object or people are blocking the beam between the emitter and receiver, the machine is in a safe state and is allowed to operate.
- If any or all of the light beams are blocked by a human finger, hand or body, the machine determines the situation to be hazardous and turns off the output of the receiver to stop the machine.

Light curtains are considered **sensors**

Emitter Receiver



Safety Light Curtain: Advantages

- Effective protection in the event of fatigue or distraction of the operator.
- Increase in the productivity as the light curtain does not require the manual handling of physical guards or waiting for them to open.
- Higher throughput, faster machine loading/unloading operations.
- Elimination of the risk of tampering as intervention of the light curtain stops the machine.
- Simple and quick installation, components are easily positioned providing solution flexibility and allows for repurposing of the components as application changes.
- Components are configurable providing protection for a large area in a linear or perimeter orientation minimizing costs.
- Provides ease of access during machine maintenance without having to remove physical guards, such as grids, gates, etc.
- Improved appearance and ergonomics of the machine and work area.

Safety Light Curtain: Main Characteristics

SAFETY LEVEL

SAFETY LEVEL

TYPE 4

SIL 3 - SILCL 3
PL e - Cat. 4

SAFETY LEVEL

TYPE 2

SIL 1 - SILCL 1
PL c - Cat. 2

RESOLUTION

FINGER resolution

14 mm

HAND resolution

20-30-40 mm

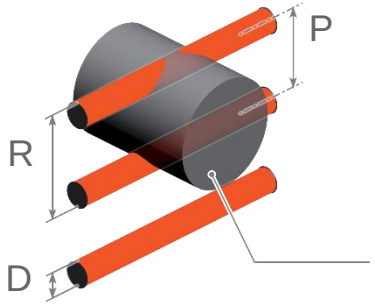
BODY resolution

50-90 mm

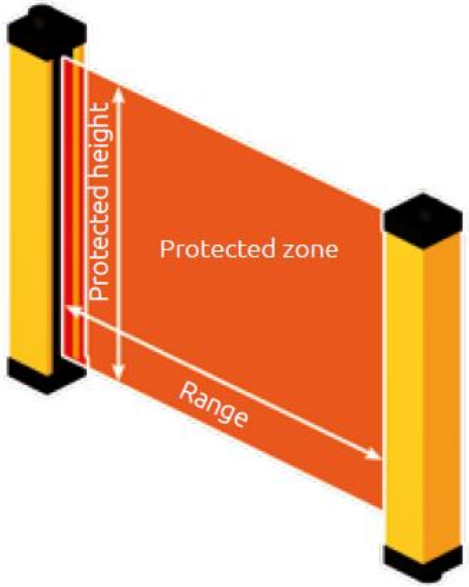
ACCESS CONTROL

2-3-4 beams

R= P+D



PROTECTED HEIGHT
RANGE
PROTECTED ZONE



RESPONSE TIME

STOP!

Safety Light Curtain : SLC4 & SLC4 L Type 4

Main features

SLC4…

4 types of detection

6 resolutions :

- **6m (19.6') range** 14mm (.55") for finger detection
- **12m (39.3') range** 20, 30, 40mm (.78" – 1.5") for hand detection
- **12m (39.3') range** 50mm (1.9"), 90mm (3.5") for detection of the body in a dangerous area
- **12m (39.3') range** 2-3-4 beams for body/access detection

Protected height range 160mm (6.3") to 2250mm (88.5")

SLC4…L

3 types of detection

resolutions :

- **20m (65.6') range** 20, 30, 40, 50, 90mm and 2-3-4 beams

Protected height range 160mm (6.3") to 2250mm (88.5")

Functions

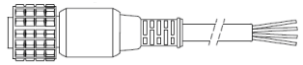
Selectable manual/automatic Start/Restart

2 safety outputs

Feedback input for external device monitoring

M12 5/8 poles connectors

Use of unshielded cables up to 100m (328')



SAFETY LEVEL

TYPE 4

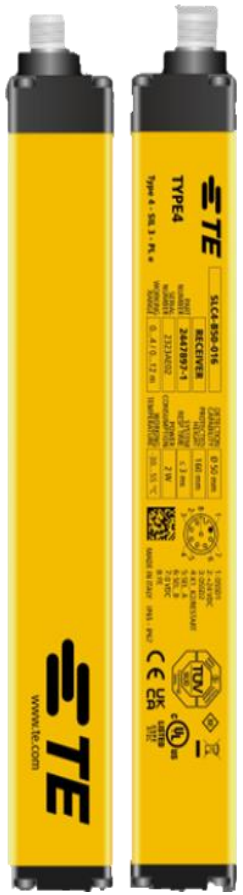
SIL 3 - SILCL 3
PL e - Cat. 4

APPROVALS

Type 4	IEC 61496-1-2
Category 4	ISO/EN 13849-1
PL e	ISO/EN 13849-1
SIL 3	IEC 61508
SIL CL 3	EN 62061

SLC2 Type 2 Safety Light Curtain

Manual/automatic Start/Restart



SLC2…

3 types of detection

4 Resolutions

- 30 – 40mm (1.1” – 1.5”) for hand detection
- 50 - 90mm (1.9” – 3.5”) for detection of the body in a dangerous area

Access control : 2-3-4 beams for body detection

Protected height range 160mm (6.3”) to 2250mm (88.5”)

Max range 12 m (39.3’) (20, 30, 40, 50, 90 mm and 2-3-4 beams)

Integrated manual or automatic Start/Restart

Feedback input for external relay monitoring

M12 5/8 poles connectors

Use of unshielded cables up to 100m (328’)

SAFETY LEVEL

TYPE 2

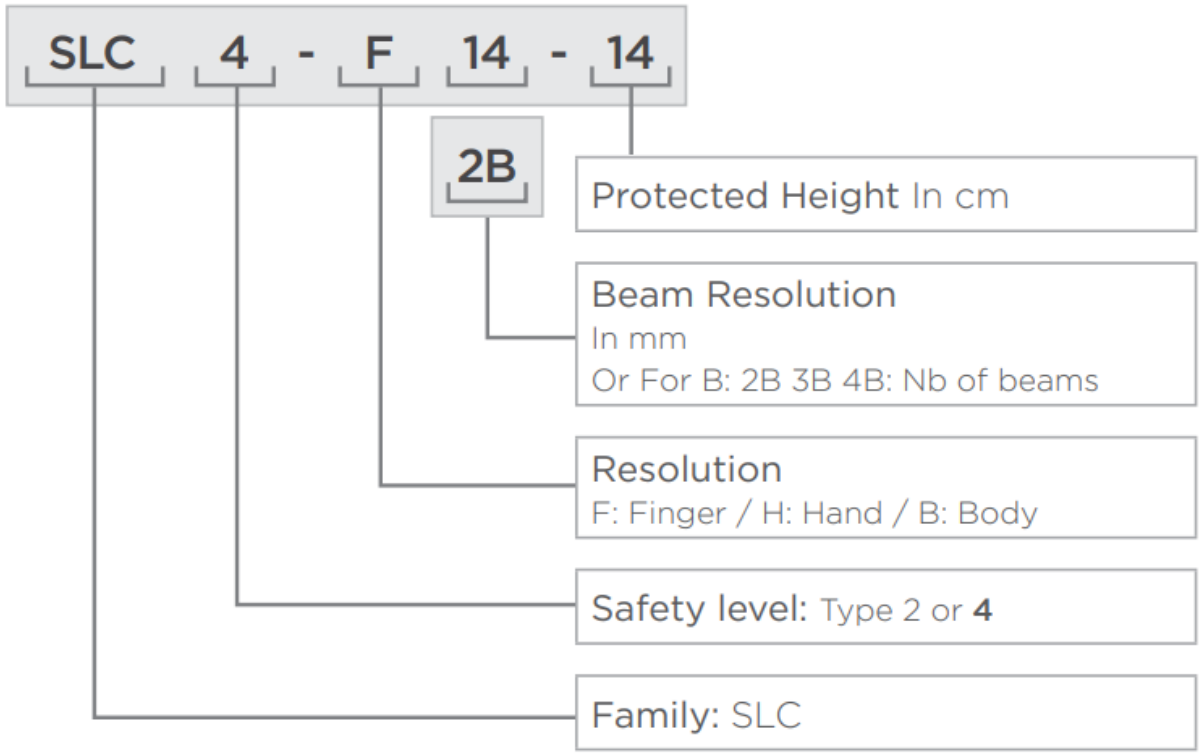
SIL 1 - SILCL 1
PL c - Cat. 2

Type 2	IEC 61496-1:2004 IEC 61496-2:2006
Category 2	ISO/EN 13849-1:2008
PL c	ISO/EN 13849-1:2008
SIL 1	IEC 61508-1:1998 IEC 61508-2:2000
SIL CL 1	EN 62061:2005

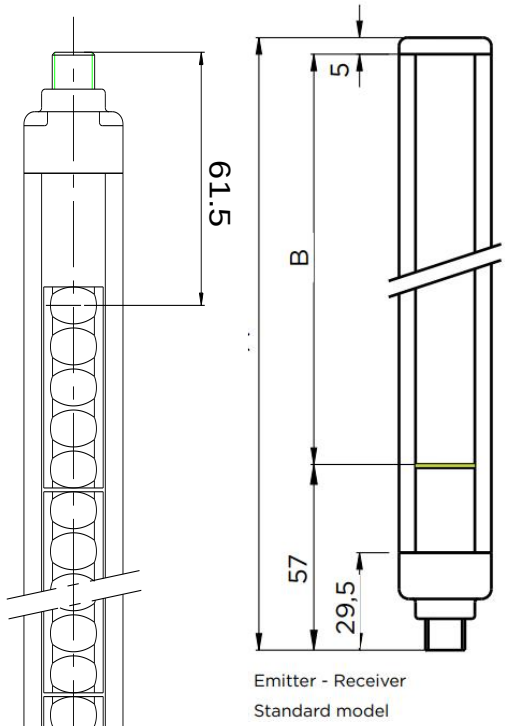
Safety Light Curtain : SLC range product scope

Type 2 and Type 4 safety light curtains

PART NUMBERING SYSTEM

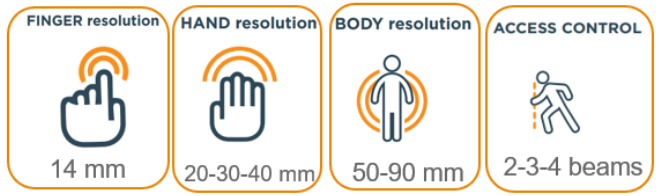


Dimensions



Emitter - Receiver
Standard model

Model	A (mm)	B (mm)	Mounting
2B	653	590	Set of 4 LE type brackets included
3B	953	890	
4B	1053	990	
150	213	150	Set of 4 LE type brackets included
250	313	250	
300	363	300	
450	513	450	
600	663	600	
750	813	750	
900	963	900	
1050	1113	1050	
1200	1263	1200	Set of 6 LE type brackets included
1350	1413	1350	
1500	1563	1500	
1650	1713	1650	
1800	1863	1800	
1950	2013	1950	
2100	2163	2100	
2250	2313	2250	



One simple product range to cover most of today's industrial applications

Reliable and compact

High ingress protection ratings

IP67 and IP65 offer high protection against dirt, dust, sand, water, and other liquids. High resistance to infiltration by dust and liquids in a highly compact footprint

Compact size

SLC is one of the smallest light curtains on the market (with all integrated safety functions.
With a minimal cross section: 28 x 30 mm (1.1” X 1.1”)

Robustness

The powder-coated aluminum casing SLC range can obtain high level of reliability. Ideal also in cold storage facilities with -30 to +55° C (-22 to +122° F) operating temperature

Safe and Smart

No blind area

Thanks to the position of the 1st beam on the connector side, the protected area extends until the light curtain end maintaining the resolution

Fast, simple installation

Plug and play solution using M12 connectors and the use of unshielded cables. No programming necessary Easy to install and replace.

User-friendly diagnostics via LEDs

Status indicating display that including alignment aids help the user to diagnosis the status

High level of productivity and safety

Highest Safety grades

Type 2 and Type 4 light curtains approved in accordance with;

- EN IEC 61496-1/-2
- ANSI / UL 1998

Finger, hand and body protection

From safety light barriers for body protection to the safety light curtains for finger and hand protection, the SLC4 and SLC2 product series cover a wide range of applications

A range updated to your needs

Integrated safety functions, including self-monitoring of static outputs, control of external contactors (EDM) and selectable automatic/manual restart help increase productivity and reduce downtime

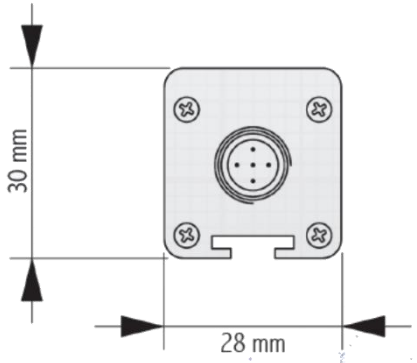
Reliable and compact

High ingress protection ratings - IP67 and IP65

- High degree of protection against dirt, dust, sand, water and other liquids
- High resistance to infiltration by dust and liquids in a highly compact footprint

Compact size

- He SLC has one of the smallest footprints in the market (with all integrated safety functions) with a cross section of 28 x 30 mm (1.1” X 1.1”)



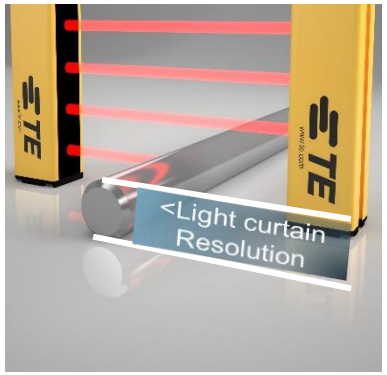
Robustness

- Thanks to powder-coated aluminum casings the SLC range provides a high level of mechanical reliability.
- Ideal for cold storage facilities with -30 to +55°C (-22 to +122° F) operating temperature

Safe and Smart

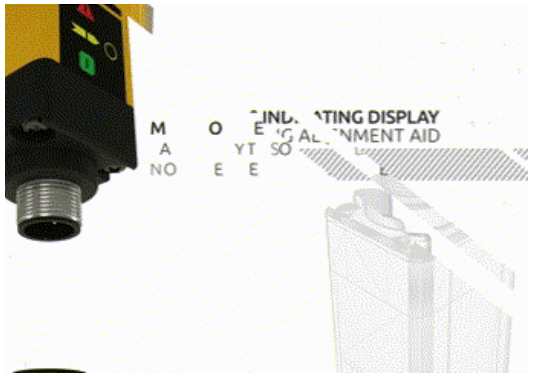
No blind area

Thanks to the position of the 1st beam on the connector side, the protected area extends to the end of the light curtain while maintaining the resolution



Fast, simple installation

The M12 connectors make the solution easy to install. The plug and play cables save installation time and allow for repositioning as needed.

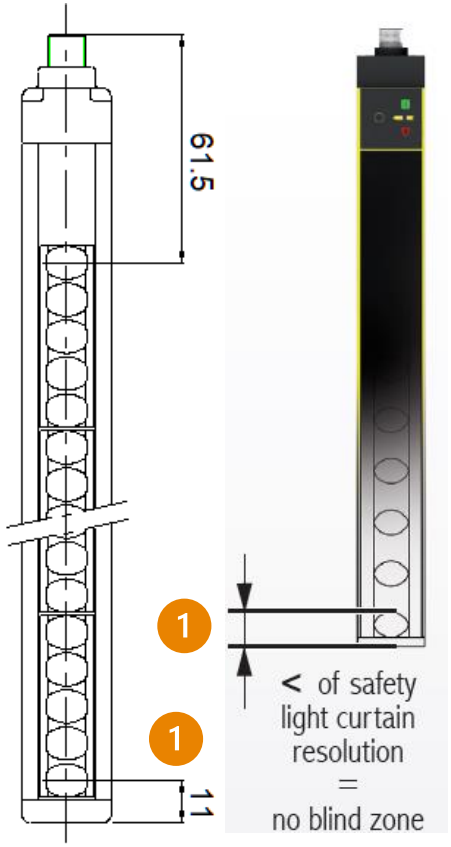


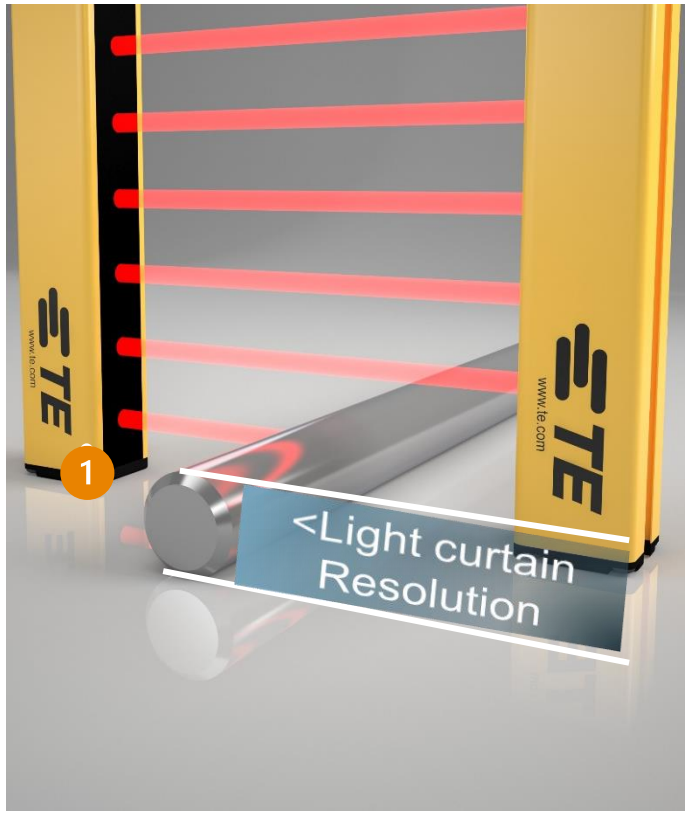
User-friendly diagnostics via LEDs

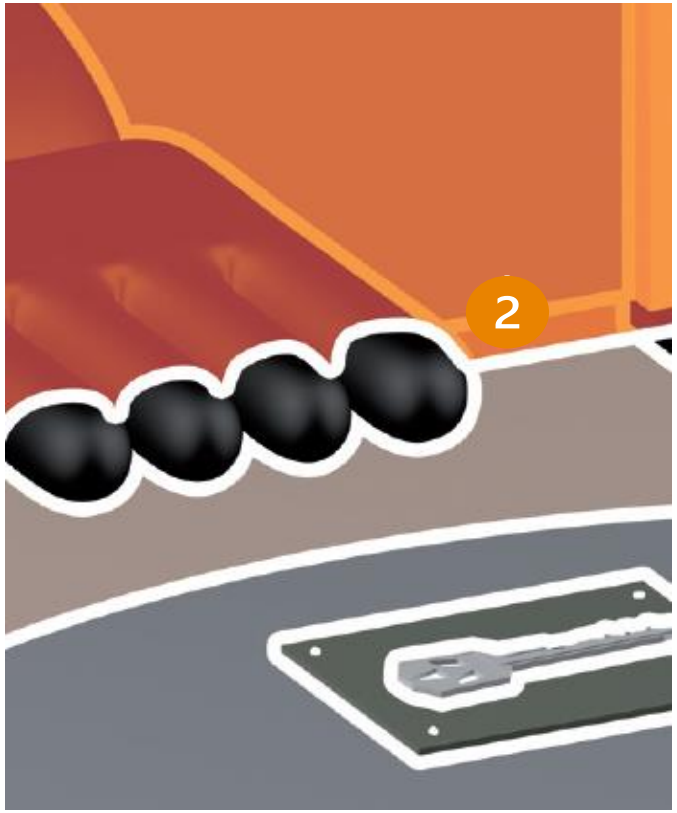
The status indicating display includes alignment aids that help the user to diagnosis the status of the system.

Safe and Smart : No blind area on one side

1. The position of the 1st beam on the protected area extends to end of the light curtain maintaining the resolution (14 mm/.55”)
2. Fingers and hands are always detected and protected over the entire height
3. 2 L-mounted light curtains maintain 40mm (1.5”) resolution (hand detection) in corners (models with resolution 30mm(1.1”) and 40mm (1.5”)

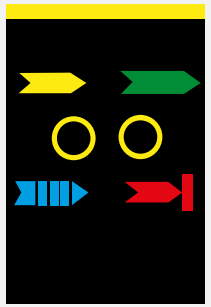






Safety Light Curtain : Safe and Smart
User-friendly diagnostics via LEDs

Display information



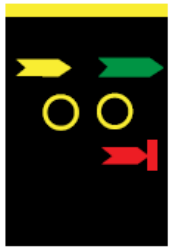
- On the receivers a blue LED indicates a weak signal intensity
- During alignment operations, checking the blue LED status can be helpful. During standard operation it must remain off.

Emitter - All models

Three colour LED	Meaning
●	System power-on - Initial TEST
● 2 blinks	System power-on - HIGH working range selected
● blinking	FAIL condition - The type of fault is identified by the number of flashes - See technical manual
●	TEST condition
●	Normal operating condition

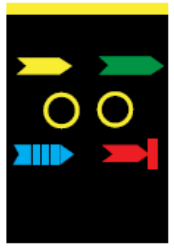
Receiver - All models except SLC4 14 mm and L (range 20 m) versions

1 - Yellow LED	2 - Two colour LED	Meaning
●	●	System power-on - Initial TEST
○	●	BREAK condition
●	○	CLEAR condition - SLC4 (with integrated control functions) only
● blinking	● blinking	BREAK_K condition - SLC4 (with integrated control functions) only
○	●	GUARD condition
○	● blinking	FAIL condition - The type of fault is identified by the number of flashes - See technical manual



Receiver - SLC4 14 mm and L (range 20 m) versions

1 - Two colour LED	2 - Two colour LED	Meaning
●	●	System power-on - Initial TEST
○	●	BREAK condition
●	○	CLEAR condition - SLC4 (with integrated control functions) only
● blinking	● blinking	BREAK_K condition - SLC4 (with integrated control functions) only
○	●	GUARD condition
○	● blinking	FAIL condition - The type of fault is identified by the number of flashes - See technical manual
● blinking	●	GUARD condition with weak signal
● ● alternating	○	CLEAR condition with weak signal
●	●	BREAK condition with weak signal
● ● alternating blinking	● blinking	BREAK_K condition with weak signal - SLC4 (with integrated control functions) only



Safety Light Curtain: Accessories for SLC range

Mountings Brackets:

Swivel brackets

180° swivel brackets

Flat brackets

Vibration dampers

Calibration

Test RODs

Lazer alignment device

Mounting Columns:

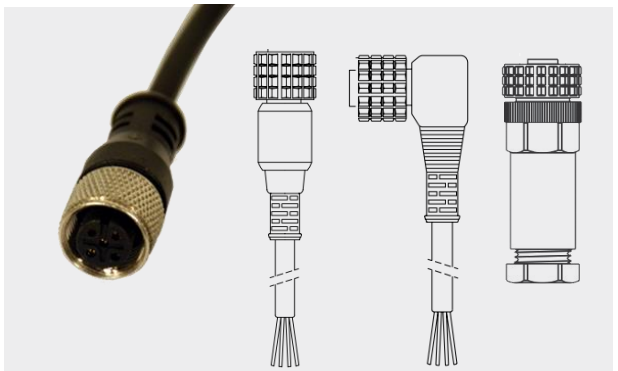
Floor support columns

Columns with deflecting mirror

Deflecting mirror

Cables & Connectors

Protective screens



5m (16.4’) to 50m (164’) – Straight & 90° angle

Connectors with cable glands

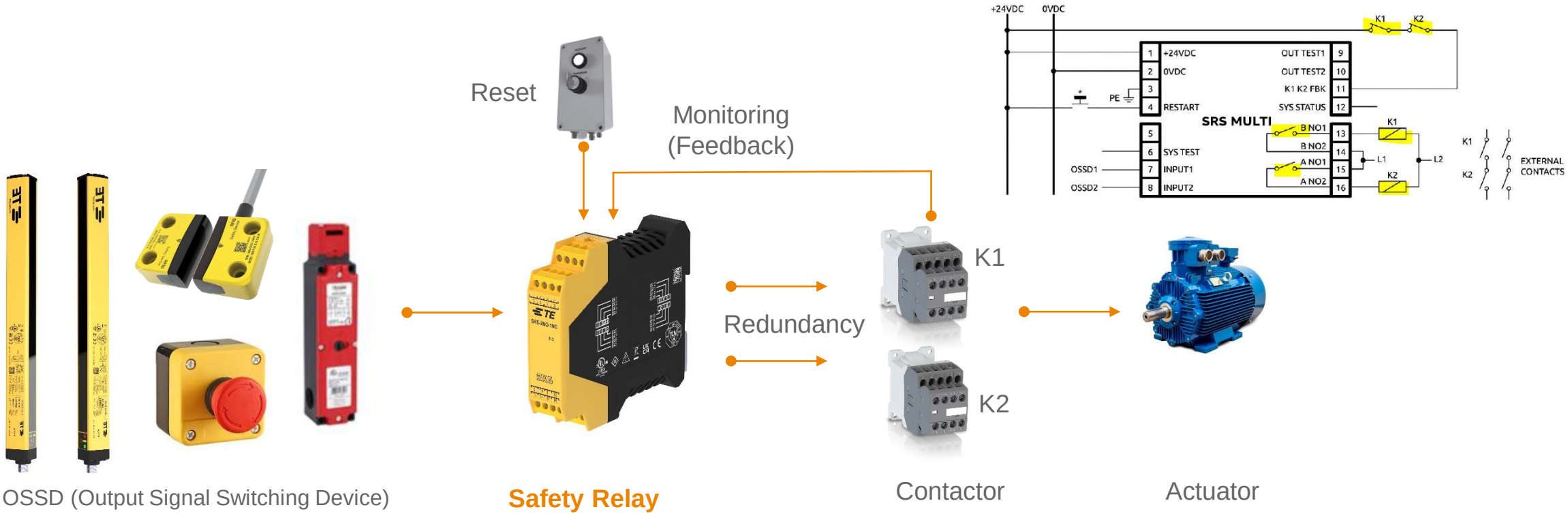
SAFETY RELAYS

SRS-SRK Range

EVERY CONNECTION COUNTS

How does it function?

Safety relays are used to **control the safety-related** part of control system. **Machine operation is only allowed when safety is confirmed**.
Safety is ensured by control signals coming from inputs such as emergency stops and locking switches. The contactors and other devices are connected to the relay outputs. The **safety relay module** plays a central role as the logic unit in the safety-related portion of the control system.

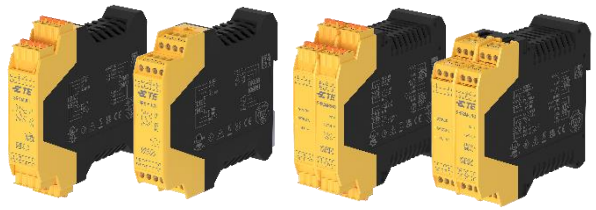


Safety Relays

Product scope

Single function interfaces

SRS (Screw) & SRK (Push-in)



- **For 2 Light curtains**
  - With or without muting function
  - With 2NO or 2NO+1NC contacts)
- **For 1 Light curtain** – 2NO contacts – 1 system status output
- **For 2 devices** : safety gates – Emergency stop buttons – Safety switches
- **For two-hand control**
- **For safety photocells** (up to 4)

Multi-Function interfaces

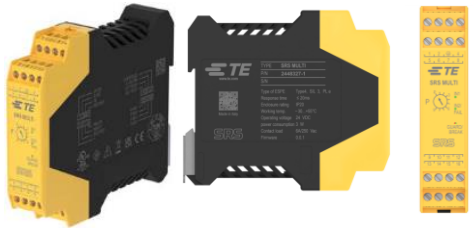
SRS Multi (Screw) & SRK Multi (Push-in)

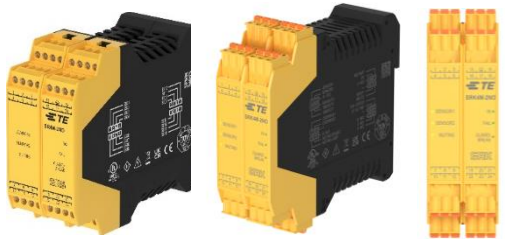
One product to connect :

- Safety light curtains
- Safety switches (solid state devices)
- Dual-channel emergency stops
- Two-hand controls
- For safety photocells

Safety Relays

The Safety Relays are a dedicated interface between safety light curtains, equipped with self-controlled safety static outputs, and control circuits of the machine or plant





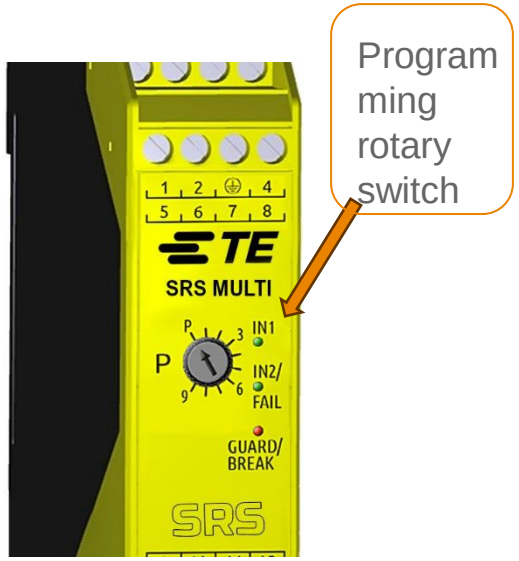
Type	SRS MULTI	SRK MULTI
Description	Multifunction safety interface	
Part number	2448327-1	2448327-2

Type	SRS-2NO-1NC	SRK-2NO-1NC	SRS-2NO	SRK-2NO	SRS4-2NO	SRK4-2NO
Description	Safety interface for 2 OSSD devices (like SL2C & SL4C safety light curtains) with integrated feedback input for EDM (with auxiliary contact).				Safety interface for 1 OSSD device (like SLC2 & SLC4 safety light curtains) and devices equipped with 2 solid state outputs. EDM feedback input for extra external contactors monitoring. One system status PNP output.	
Part number	2447934-1	2447934-2	2447934-3	2447934-4	2447935-1	2447935-2

Type	SRS4M-2NO	SRK4M-2NO	SRSE-2NO	SRKE-2NO	SRSE-MA-2NO	SRKE-MA-2NO
Description	Safety interface for 1 OSSD device (like SL2C & SL4C safety light curtains) and devices equipped with 2 solid state outputs. EDM feedback input for extra external contactors monitoring. With integrated muting functions.		Safety interface able to monitor 2 inputs from safety gates, emergency stop buttons and safety switches. With selectable automatic or manual start/restart command.		Safety interface able to monitor 2 inputs from safety gates, emergency stop buttons and safety switches. With selectable automatic or manual start/restart command. Manual mode with monitored restart.	
Part number	2447935-3	2447935-4	2447936-1	2447936-2	2447936-3	2447936-4

Type	SRS-THC-2NO	SRK-THC-2NO	SRS2-2NO	SRK2-2NO	SRS2M-2NO	SRK2M-2NO
Description	Safety interface for two-hand control type III C according to EN 574.		Safety interface for safety photocells. Connection from 1 to 4 photocells.		Safety interfaces for safety photocells. With integrated muting functions.	
Part number	2447937-1	2447937-2	2447938-1	2447938-2	2447938-3	2447938-4

SRS-SRK Multi

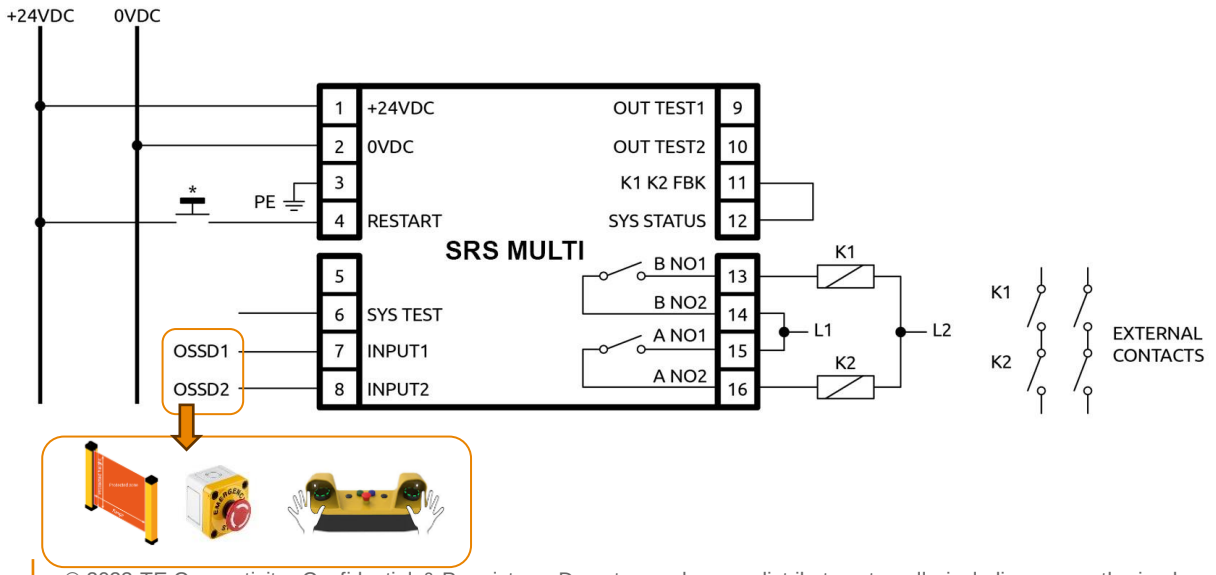


SRK Multi

Push-In connection
SRK Range

SRS Multi

Screw clamp connection
SRS Range



The SRS MULTI safety relay module main features are:

- **Different safety functions selectable via rotary switch**:

✓ Safety barrier with fail safe outputs

✓ Dual channel emergency stop button

✓ Two-hand control

✓ Type 2 safety photocells

✓ Gate monitoring applications

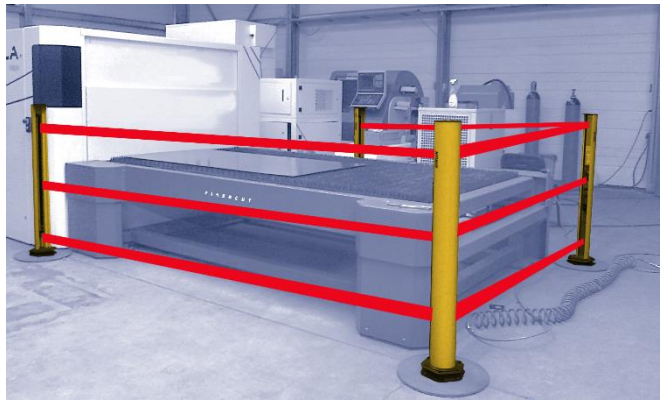
- Restart manual or automatic selectable
- 2 N.O. outputs with guided contact safety relays
- 1 system monitor PNP output
- 1 external contactors feedback input
- 1 System test input (for Type 2 light curtains)

Typical applications

- Robotics
- Food & beverage
- Packaging
- Pharmaceutics
- Paper
- Logistics
- Metalworking
- Woodworking
- Chemicals
- Injection moulding
- Printing

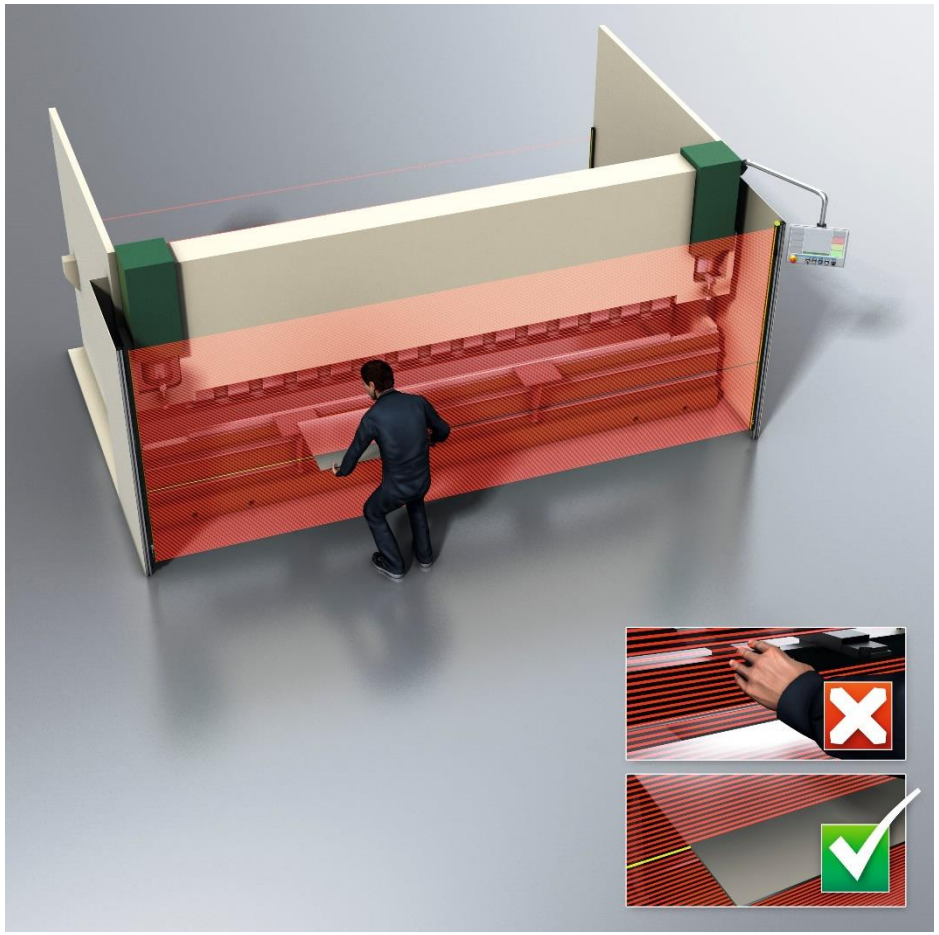
AFG- Robotics, Machinery, Control cabinet

Safety area with light curtains and mirrors



Safety area with light curtains for machinery

Safety solution for OEM machine builders



Safety systems for robots

Safe Robotics Area supports protection, safer access to cooperative robot applications for less downtime, enhanced work processes and higher productivity.

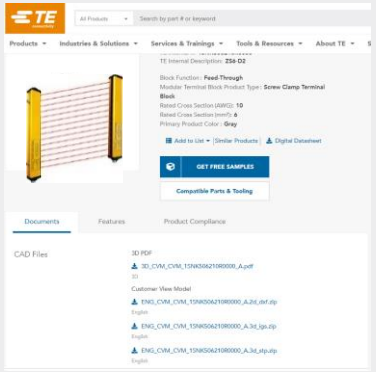
Marketing Materials

TE.COM

Safety light curtain page

Safety Interfaces page

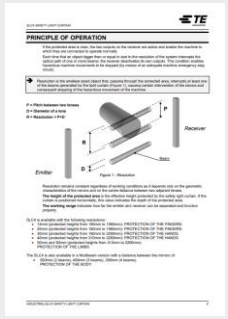
Product sheet

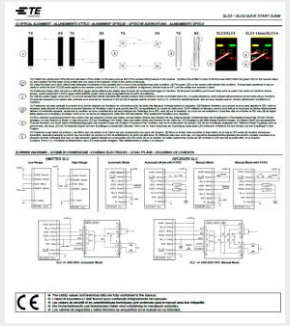


CVM

Technical guides

Manuals and Quick guides





Catalogues

Datasheets, Catalogue page

Demokit

Demo kits

Training Materials

1. Webinars
2. Training PPT
3. Customer PPT

CONNECT
LIKE THE WORLD
DEPENDS ON IT.
BECAUSE IT DOES.

EVERY CONNECTION COUNTS

TE connectivity