

## Muting and Personnel Protection

### SAFETY TECHNOLOGY

**Sophisticated sensors - combined with a diverse range of redundant safety technology - can differentiate without contact between movements of persons and production-relevant goods.**

Applications with safety technology must be reliable in order to guarantee safe operation. This for example includes the self-monitoring function. This means that a system has a safe and redundant design by multiple use of components. The ultimate in such systems is used in the field of personnel protection.

The effort involved should be demonstrated on the example of a safety lightscreen which initiates the shutdown of the dangerous machine when persons are detected who are too close to the vicinity of the danger area.

The hardware and firmware of the control unit is subject to a very rigorous "failure mode and effect analysis (FMEA) test, in order to ensure that a dangerous state cannot occur due to the failure of an individual system component. This is only possible when two processors of different designs with different firmware versions mutually test each other on a cyclic basis. Accordingly, a random failure of the same type of component to the same fault is thus eliminated. Systems of this type also provide very good diagnostics features resulting from their capability to perform self tests.

This can on the one hand result in the output of the error code, which is in turn described at a suitable location, e.g. in the operating manual or on the actual device. On the other hand the visualisation is performed via the connection to a PC. The controlled blanking out of the safety function appears to oppose this rigorous concept, it is however particularly useful with special tasks, e.g. with the transport of manufactured parts in a processing cell. It is important to ensure that the objects being transported through the lightscreen can on the one hand be differentiated from persons, and on the other hand to ensure that it is still not possible for persons to enter the danger zone.

### Muting for the safety check

Exactly this trick is possible using the muting function, i.e. the controlled suppression of the safety switching output when manufactured parts pass through the endangered and secured area of a machine. For this purpose the switching output of the safety device is uniquely combined with further input factors which prevent the machine from stopping, even though a stop command has been issued.

The European machine directive allows the use of further sensor pairs for this purpose, which deliver a signal within a time envelope not exceeding 3 s, and operate ensuring that random or accidental actuation by a person is not possible.

Only the flow of materials should be in a position to perform actuation at a location where it is impossible for people to access, or where the physical dimensions make them impossible to actuate simultaneously, as the design dimensioning ensures that it is impossible for persons to actuate. The objective is the prevention of a random activation of a muting cycle if a person enters the danger area without the machine safety system stopping the machine in the time which is needed to access the danger area.

Diversity is also important in the selection of muting sensors. These devices must not necessarily feature a special safety approval: well-proven technology is sufficient. Diversity can be implemented for example using the same operating modes with different switching outputs such as PNP and NPN. The big advantage of muting initiators is the time-relevant independence of the material flow.

The flow of material need not remain constant in contrast to a permanently blanked out area – fixed blanking – where the blanked out area is continuously interrupted by the material or objects to prevent activation of the safety switching output. The muting function is the best option particularly with random pauses and gaps, which occur for example in the manufacture of body shells and chassis in the automobile industry.

If spacing considerations allow for a horizontal monitoring in addition to vertical monitoring, the detection and evaluation by the safety system of constant distances between blanked areas – which also cannot be caused by the physical dimensions of a person – but only by the transport system and which ensure a safe area. This is referred to as the entry-exit application and does not require separate muting sensors.



The muting status must be visible for persons who are present and is usually indicated by an illuminated display which lights up when muting is initiated. This function is also implemented via a test function or via monitoring of the electrical energy which is necessary. A maximum time window in which muting is allowed can be defined via a timer.

This function prevents the intentional bypassing of a muting device for the purpose of triggering inappropriate muting. It is also useful for the recognition of a common-mode fault, which would affect all muting devices in the application. The override function can be used for a brief intervention without having to switch off the lightscreen if a material jam occurs in the safety lightscreen zone. This is implemented by connecting a switch which extends the muting time window when it is pressed.

**Application of muting**

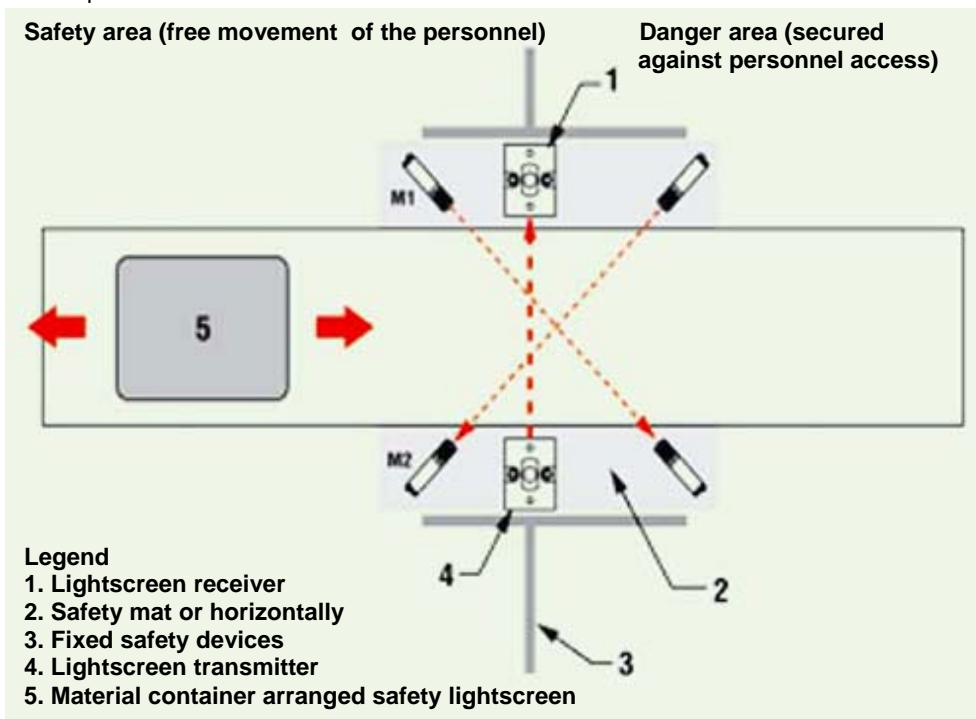
Depending on the application it is initially possible to choose between one-way and double-way muting. With one-way muting the direction of material movement is only defined for a single direction. For example, a machine or robotic station is only supplied with material from a single direction and after processing it is removed on the opposite side.

Usually a muting sensor pair before and after the safety lightscreen are generally sufficient and are activated under certain conditions in a defined time window, which for example can depend on the material geometry. The activation sequence can be defined via the setting on the muting module, in order to allow reverse direction of motion – known as double-way muting. The crossover of two lightscreens in the danger area is also a possibility.

**Safe with responsibility**

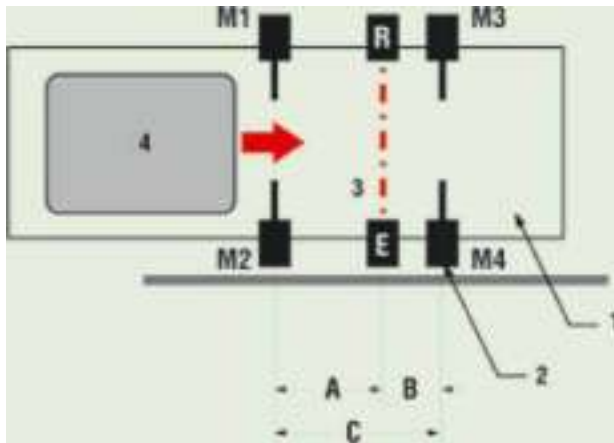
A very important closing point must still be mentioned for all the possibilities described here, and that is the responsibility of the operators of a machine to ensure its safety. The supplier or manufacturer of safety components can never have knowledge of the entire range of possibilities of a machine to match the machine manufacturer or machine operator. It is only possible for the safety component manufacturer to pass on know-how in a consultative capacity.

For this reason the responsibility for safe operation of the machine and a detailed risk analysis before operation of the machine is the sole responsibility of the operator. The state-of-the-art technology allows the operators to perform their own cyclic inspections of the safety components which are used. A named person authorized by the operator, who possesses suitable qualifications can perform these tests.



**Legend**

1. Transfer belt
2. Whisker/limit value switch
3. Lightscreen
4. Material container
5. Fixed protection devices



- A  $\geq$  (performance speed m/s) x 0.1 s
- B = 76 mm (in the suggested position a person must not be able to immediately follow the object in the muting state)
- C  $\leq$  length of the material container

The following criteria are valid:

- Danger due to feed-in must be avoided and distance considerations must be observed
- The trigger switches may not be dimensioned so that a single person can initiate the muting state.
- Retro-reflective sensors with polarisation filter (mounted with objects on supports) and inductive proximity switches can be used in a similar fashion, assuming that it is not possible for a person to enter the danger zone.

One-way muting (directional) can be used with output applications, in order to reduce the possibility of intentional bypassing.

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