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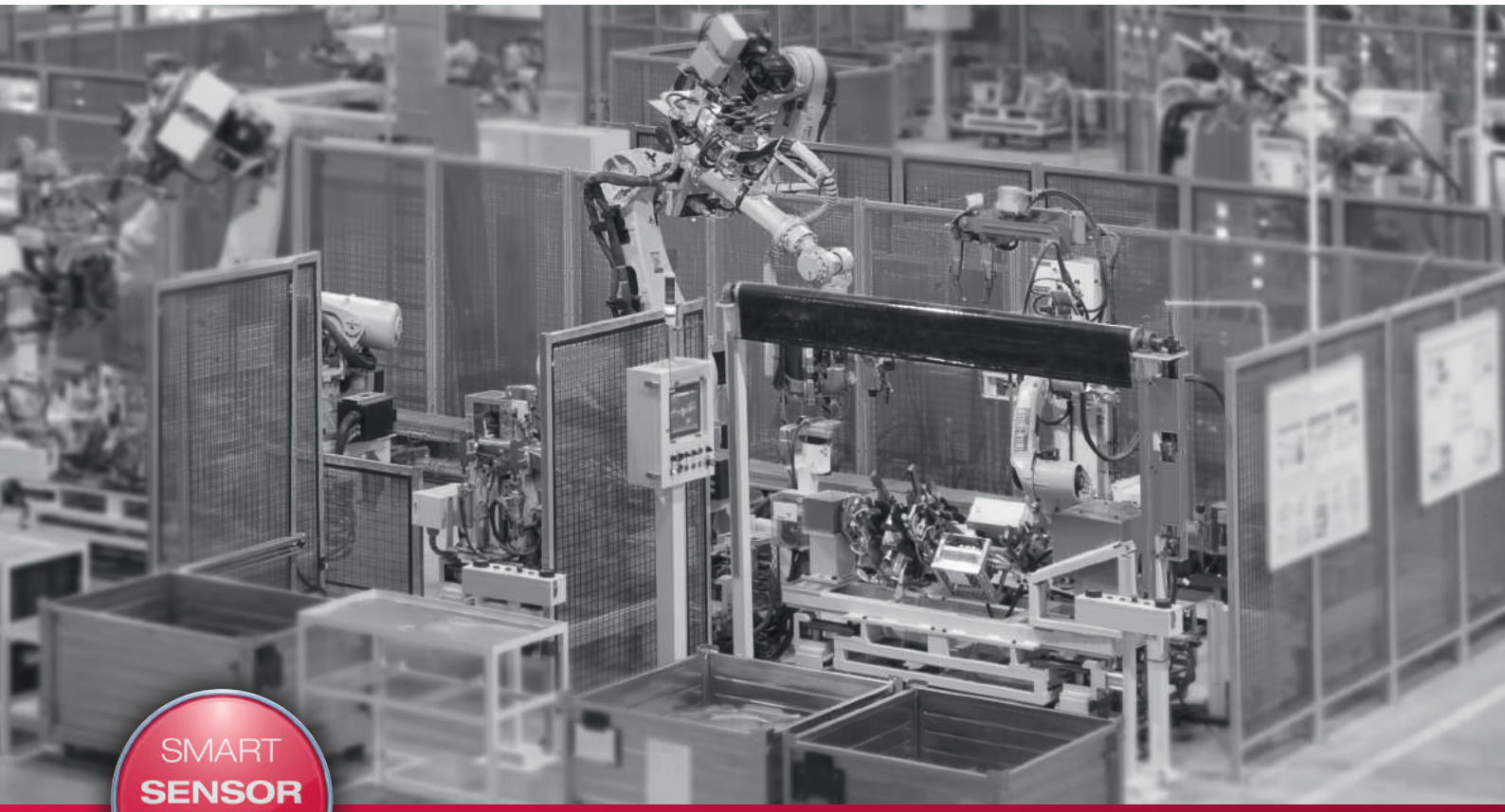

SMART
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SMART PROCESS GATING

White Paper

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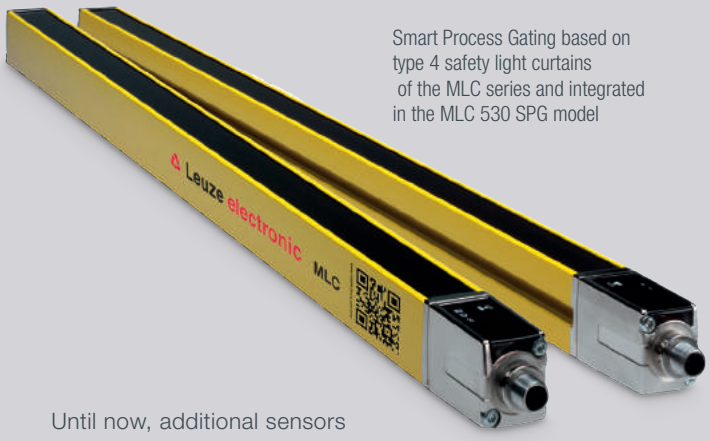
White Paper

SMART PROCESS GATING

Smart Process Gating enables protective field bridging without additional muting sensors.

Handling and mounting systems often contain danger zones which must be protected against unauthorized access. However, material transport must be able to enter and exit the danger zone at the same time. Examples of systems such as this can be found in intralogistics, the automobile industry and the packaging industry.

In practice, these requirements are met using optoelectronic protective devices which are installed at the channeling and diverter stations. These protective devices must be designed so that they detect the approach of the transport material at the protective field, and then temporarily bridge the protective field. Fault-free passage of the transport material is therefore guaranteed. The protective field may only be bridged when transport material is approaching – access by persons must be prevented.



Smart Process Gating based on type 4 safety light curtains of the MLC series and integrated in the MLC 530 SPG model

Until now, additional sensors were required for detecting the transport material – and therefore also for distinguishing between transport material and persons. These are also referred to as 'muting sensors'. The "Smart Process Gating" process meets the above-mentioned requirements *without* the need for additional sensors.

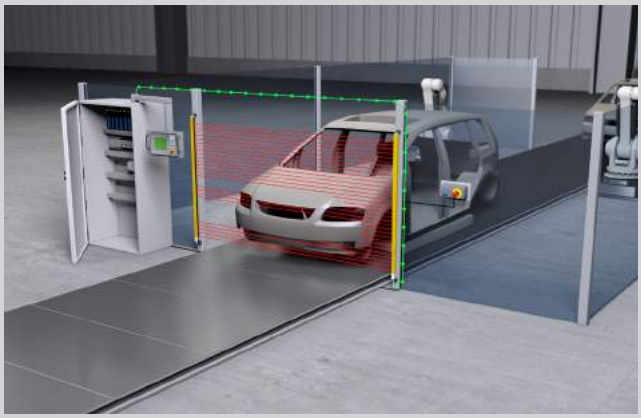


Figure 1: Process-controlled access guarding with Smart Process Gating (SPG)

Figure 2: SPG allows for a very compact system arrangement with material locks, even in deep-freeze areas as low as –30 °C ❄

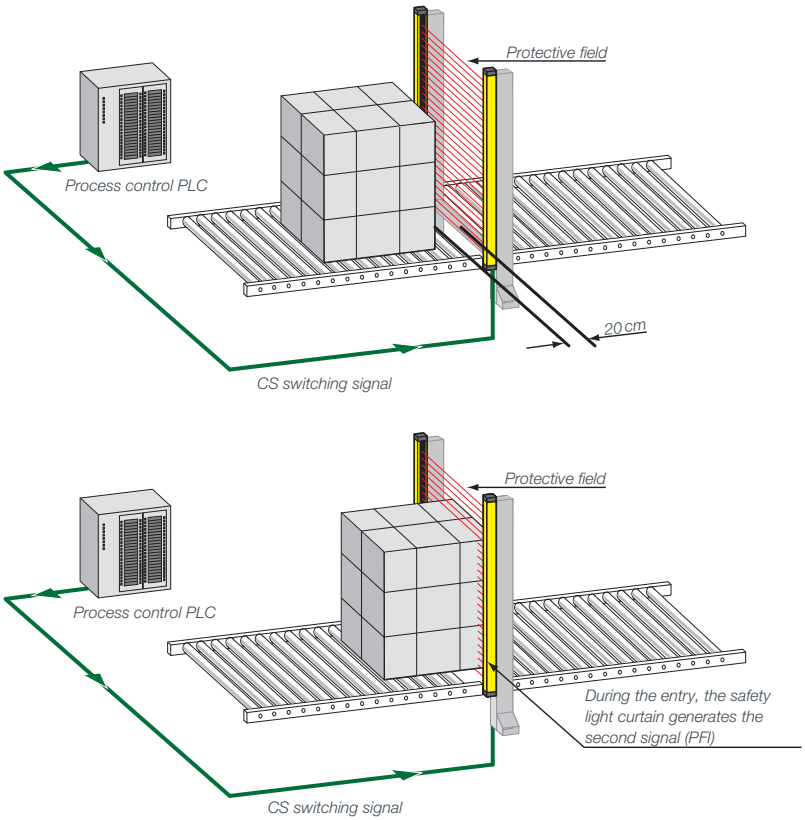


Figure 3: Overview of the operating principle

SMART PROCESS GATING – THE OPERATING PRINCIPLE

The Smart Process Gating (SPG) process is based on type 4 safety light curtains of the Leuze electronic MLC 500 series. It is implemented in the MLC 530 SPG variant.
In the basic principle, the SPG process uses two control signals (figure 3):

- The first signal (CS Control Signal) is provided by the system control (PLC)
- The second signal (PFI, Protective Field Interruption) is generated by the safety light curtain itself when the protective field is interrupted.

In order to bridge the protective field of the safety light curtain to allow transport material to pass through, with Smart Process Gating the first switching signal (CS) is sent from the process control (PLC) to the safety light curtain shortly before entry into the protective field. The point in time must be set such that the transport material is within 200 mm of the protective field. This is necessary to prevent persons from slipping through. The SPG process therefore requires knowledge of the position of the transported goods so that the necessary PLC control signals are within the correct time window at the safety light curtain. The safety light curtain generates the second signal in the protective field (PFI). This starts the bridging of the protective field. Bridging ends after a fixed time t after the transport material has exited the protective field again.

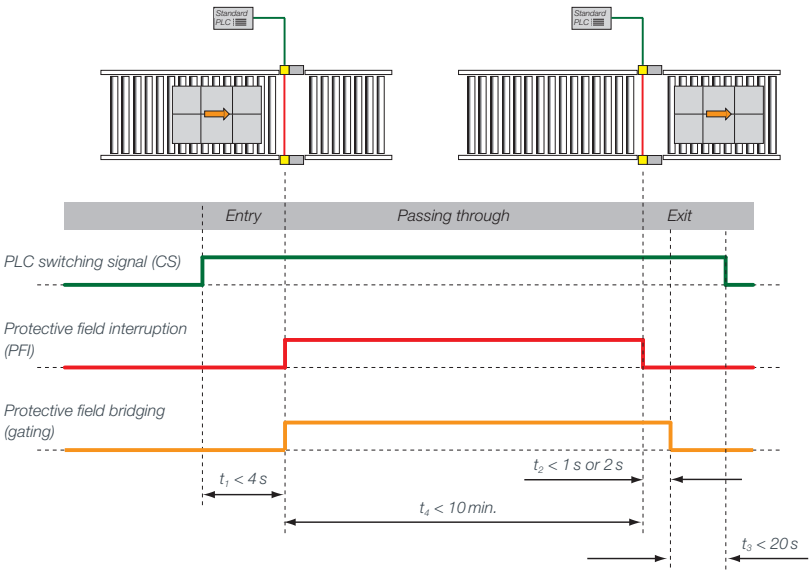


Figure 4: Signal progress whilst transport material is passing through the protective field

SIGNAL RESPONSE IN DETAIL

Once the system control (PLC) has sent the switching signal (CS) to the safety light curtain, the transport material must enter the protective field within 4 s (t1) (figure 4). During entry, the safety light curtain generates the second signal (PFI) and, thus, starts the bridging of the protective field (gating). With the basic setting, the transport material must pass through within 10 min (t4) – otherwise the receiver of the safety light curtain goes into interlock state. Alternatively, a timeout extension of up to 100 hours can be activated, if necessary, in order to permit downtimes during a shift change or over a weekend, without blocking the processes.

When the transport material exits the protective field, the safety light curtain resets the signal that it generated (PFI) as soon as the transport material leaves the protective field. Depending on the operating mode selected, the protective field is then switched on again after 1 or 2 s (t2) by the safety light curtain and access guarding is re-activated.

APPLICATION-OPTIMIZED OPERATING MODES

The SPG process works in two operating modes in order to adapt to different areas of application. These are implemented in the MLC 530 SPG safety light curtain (table 1).

	Operating mode A	Operating mode B
Max. conveyor speed	0.2 m/s	0.6 m/s
Typical area of application	Automotive industry	Intralogistics and packaging industry
Special functions	Controlled stop/ restart	Interruption of the gating sequence by the PLC
Control (PLC) requirement	Safety PLC, two switching signals with antivalent signal edges	Standard PLC, one switching signal

Table 1: Overview of the operating modes

The first operating mode is designed for a maximum speed of up to 0.6 m/s, and is mainly used for applications in the intralogistics area. The integrated filter time of 1 s means that the light beams of the light curtain must have an unobstructed view for a time window of up to 1 s, i.e., they may not be interrupted by the transport material. This means that gaps are also permitted in the transport material, such as those that occur when a pallet is being loaded, without the Gating process being terminated. Once the transport material has left the protective field, the protective function is re-activated after 1 s.

It must also be ensured that the gap between the transport material and protective field is no more than 200 mm when the transport material is exiting from the protective field (to prevent persons from entering). If the transport material moves more than 200 mm from the protective field within the re-activation time of 1 s, the gating can be terminated prematurely using the “Interrupt by control” function. This is done by resetting the CS signal. Gating is terminated within 0.1 s (t2) of resetting the CS signal and the protective function is re-activated (figure 5). This operating mode can be used with a standard PLC or a safety PLC. The timeout extension to 100 hours is supported.

The second operating mode is optimized at slower conveyor speeds of up to 0.2 m/s, such as those which occur in the automotive environment. At slow

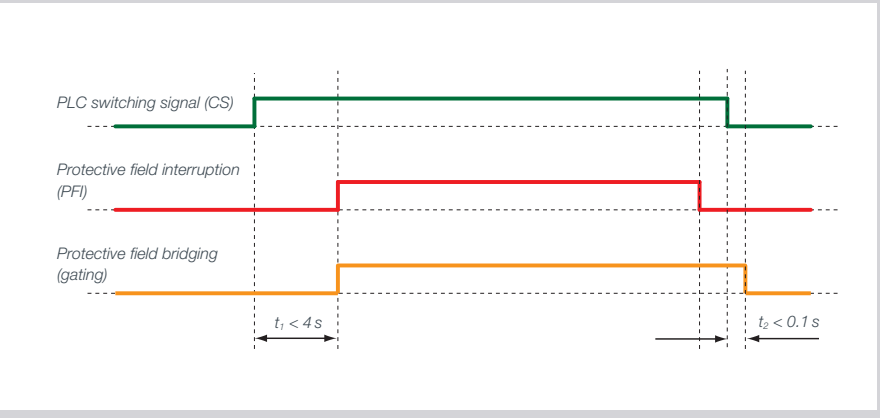
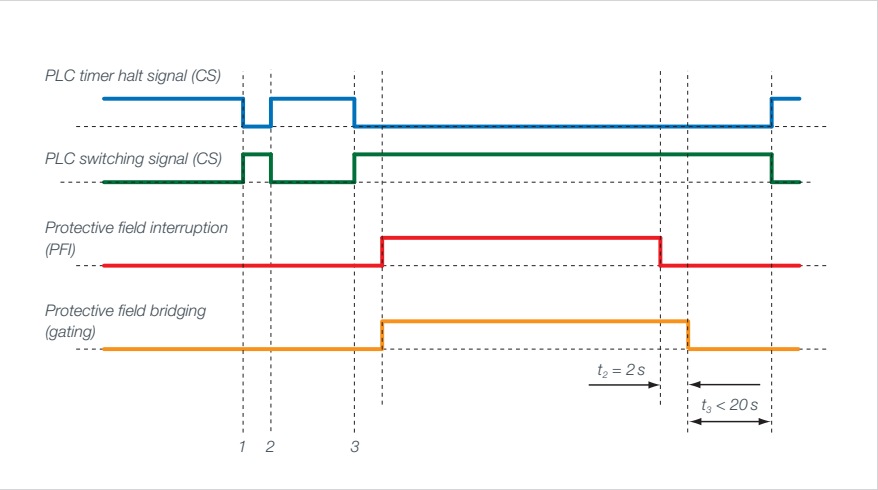


Figure 5: Signal response with “Interrupt by control” function

Figure 6: Example of an application for operating mode with a conveyor speed of up to 0.6 m/s



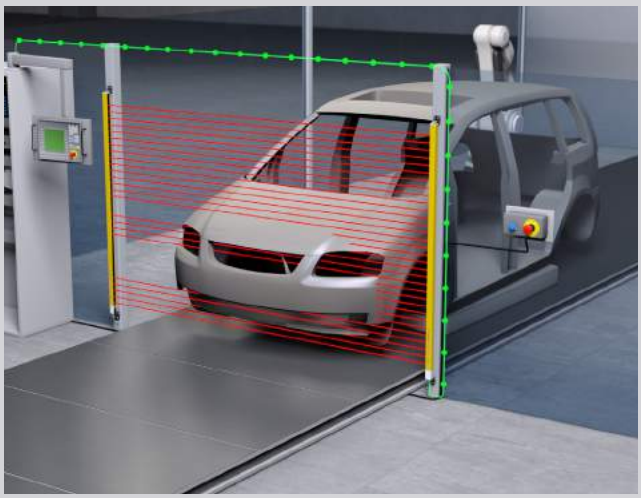


Figure 8: Example of an application for operating mode with a conveyor speed of up to 0.2 m/s

speeds, the conveyor process can stop extremely quickly. Since the SPG process expects the protective field to be interrupted no more than 4 s after activation by the control signal (CS), this operating mode has the additional function “Qualified stop / restart”. This allows an initiated SPG sequence to be interrupted within the 4 s (qualified stop) and then restarted. The process can therefore continue operating without interference, even in the event of a quick stop.

In this operating mode, two control signals (CS and TH) with antivalent signal edges are used by the PLC (figure 7), which initiate the PLC gating sequence and also control the qualified stop and restart.
The timer halt signal (TH) must be replaced with the PLC switching signal (CS) within 0.5 s. This operating mode requires a safety PLC. The timeout extension to 100 hours is supported.

REQUIREMENTS FOR A SAFE SOLUTION

The integration of an SPG application into a system is considered to be a system solution as far as safety technology is concerned. This results from the interaction of the safety light curtain, the system control and, if necessary, mechanical elements. In order to do this, the system manufacturer requires experience in safety design, since the manufacturer programs the gating sequence into the PLC and creates the safety system solution. The manufacturer therefore takes responsibility for implementing the overall system. It is therefore important to take the necessary safety-related requirements into consideration with an SPG installation. These are described in the corresponding operating instructions. An important requirement is for the system control (PLC) to be aware of the current position of the transport material. The PLC must know when the protective field has been reached and exited by the transport material in order to transmit the necessary control signals to the safety light curtain at the correct time. This is necessary because the protective field has to be interrupted within 4 s of the arrival of the PLC control signal. A maximum distance of 200 mm between the transport material and light curtain is also to be maintained between entry and exit, provided that a gating is active. Knowledge of the position can be acquired with active conveyors.

For safety-related integration, the system must be operated with a start/restart interlock which is integrated into the MLC 530 SPG accordingly. A synchronization beam (uppermost or lowermost beam of the safety light curtain) must also remain free to safeguard the gating function during the entire protective field bridging procedure.

The achievable performance level of the solution is attained in conjunction with the system control that is used. Performance Level d is achieved if a standard controller is used, and Performance Level e is achieved with a safety PLC.

OPTIMIZATION FOR TALL TRANSPORT MATERIALS

As described, with the Smart Processing Gate, a synchronization beam (uppermost or lowermost safety light curtain beam) must remain connected during the entire process. This can be implemented in two ways:

- The entire protective field is arranged above the conveyor line. The uppermost beam of the protective field acts as the synchronization beam. It runs above the highest point of the transport material (figure 9 left).
- The protective field is arranged so that the lowermost beam of the protective field acts as the synchronization beam and this runs underneath the conveyor line (figure 9 on the right). By doing this, the beams of the safety light curtain are partially interrupted by the conveyor line. The beams that are interrupted by the conveyor line must therefore be blanked out using the “Fixed beam blanking with 1 beam tolerance” function. Thus, with very tall transport materials, it is possible to use light curtains that do not cover the entire height of the transport material, thereby resulting in a corresponding cost advantage for the light curtain. The “beam blanking” function can be configured in both operating modes.

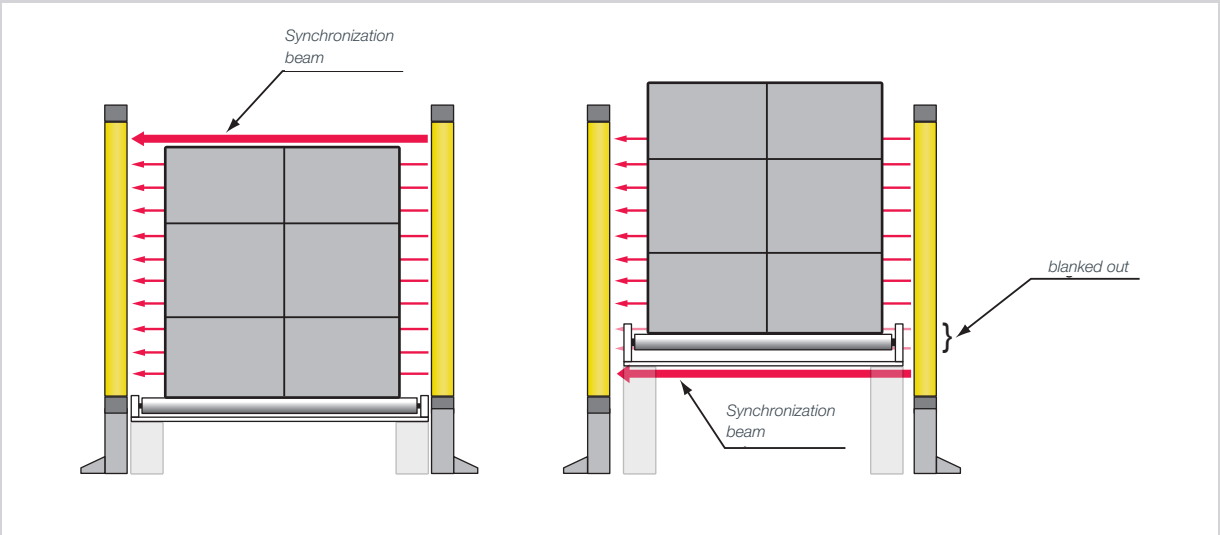


Figure 9: Use of the top or bottom beam as synchronization beam

STANDARDS AND SPECIFICATIONS

The MLC 530 SPG safety light curtain specification is designed in accordance with the safety-relevant, international standards. The data of the sensor is type 4 (IEC/EN 61496), performance level PL e/ category 4 (EN ISO 13849-1) and SIL 3 (IEC 61508). The sensors and the associated documentation concerning the integration of the solution are independently certified. All aspects that need to be noted in order to use the system are described in the operating instructions.

ADVANTAGES OF SMART PROCESS GATING

- Extremely compact, space-saving system design, since there is no need to make space for muting sensors in front/behind the light curtain
- Outstanding reliability and availability of the safety device and low installation and service costs at the same time (no set-up/alignment/ realignment of muting sensors)
- Reduced risk of tampering by operating personnel
- Even interrupted parts and pallets with gaps between loading are reliably transported