Background information

PSENradar, PSENscan and PSENopt II: Safe radar systems
and optoelectronic sensor technology for greater productivity

All-round protection for stationary and mobile applications

Safety, user friendliness and productivity should all be reconciled when it comes to area guarding of plant and machinery. When people require frequent access to the danger zone or when materials need to be fed in or out, optical safeguards are suitable for safeguarding protective devices. These include radar systems as well as optoelectronic sensors such as light curtains and laser scanners. Which sensor type is used and when depends largely on the application situation.

The following rule of thumb applies: scanners or light curtains are always a very good choice when it's possible to work well with optical methods and there is a clean machine environment. In contrast, not only is the radar sensor well able to tolerate rugged environments contaminated with dirt and dust, but it is also the ideal protective measure in environments with extreme temperature differences and weather conditions. The use of radar technology should also be considered when it is a question not just of monitoring areas but also of detecting objects in a 3-dimensional space. Light curtains/light barriers and scanners safeguard two-dimensional areas such as access points and floor areas. They can detect either static (light curtain) or dynamic obstacles (AGV). Monitoring of dynamic obstacles can also cover static application areas – the key phrase: access control or protection against encroachment behind. The radar sensor can do that too. That again illustrates that there are several criteria to apply when deciding which protection technology can or should be used on a case by case basis.

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Protection requirements and precision are part of the decision

If an intervention or access point to an application is to be monitored safely, with high resolution and short reaction times, then light curtains are the right choice. However, if entire areas with various protected fields are to be safeguarded, then scanner technology is suitable in this case, as it can also provide precise edge definition. Essentially, scanners record any type of object. In contrast, the radar sensor detects objects specifically by material – water, metal and movements, to which it reacts. So it is always beneficial when the environment requires a system to be highly robust and insensitive to environmental influences, whether that be dust, dirt, rain or similar rugged environments.

Safety light curtains: protection without barriers

Safety light curtains are mainly used when the implemented safety solutions need to be barrier-free. This is the case when processes do not run one hundred per cent automatically, i.e. there are open access or intervention points on the machine, where operators need to intervene in the process, as is the case when feeding or removing products or parts. Particular care is needed for the safety-related assessment of these processes. In the case of light curtains, an invisible infrared protected field protects against access or entry into hazardous machine areas: if a light beam is broken it will immediately trigger a safe shutdown command. Depending on the requirement, light curtains provide finger, hand and body protection in accordance with EN/IEC 61496-1/-2 "Safety of machinery – Electrosensitive protective equipment". These have short reaction times measured in milliseconds, meaning that the safety distance can be minimised and the precious space can be used for production tasks.

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Advanced functions on light curtains for more flexible production cycles

Advanced functions such as blanking, as well as muting or cascading, have been established to maintain detection mode while still allowing material to pass through the light curtain. Two types of blanking are available, depending on the requirement: either certain light curtain beams will be blanked because an object – a conveyor for example – permanently protrudes into the protection zone; this is called fixed blanking. Or the object protruding into the protection zone moves, such as a cable; in this case floating blanking is used. Applications that protect against encroachment into and behind the protected area can also be implemented using light curtains. This is possible thanks to the light curtains' cascading function, in which protected fields without dead zones can be connected together. In contrast, muting means that the light curtain beams are suspended temporarily during operation to allow material to pass through the detection zone. In other words, the muting sensors detect the material and the light barrier is automatically and temporarily interrupted in its machine cycle, under safety conditions. Pilz safety light curtains PSENopt II, for example, are directly compatible with the configurable small controller PNOZmulti 2. Its function blocks allow you to adapt the system individually to the required functions; there is a muting block that can be integrated within the small controller, for example.

Light curtains: practically indestructible, always close to the action

Another requirement that the light curtain can fulfil well is shock resistance. The current version of the standard EN/IEC 61496 defines two shock classes: class 3M4 defines acceleration values up to 15 g and class 3M7 accelerations up to 25 g. Shock resistance functionality is an absolute must where rugged environments are concerned, in which vibration or collisions prevail. This is the only way to guarantee higher plant availability. With short response times of up to 6 ms and an absolute absence of dead zones, Pilz light curtains also safeguard danger zones such as these. The mechanical load capacity and resulting high availability are what set the extremely shock resistant light curtains PSENopt II apart. They are the only products on the market equipped with a shock resistance of 50 g –

in other words, PSENopt II light curtains achieve acceleration of up to 50 g and so exceed even the highest class. That’s why these extremely robust light curtains are preferred on robot applications, packaging machines and presses.
While safety laser scanners and radar sensors tend to safeguard larger areas or zones, light curtains can also be used in a confined space. With light curtains, the specifications for physical positioning can be implemented freely and flexibly in accordance with the implementation requirements, without adversely affecting their functionality: coding is one solution here, so that even several light curtain pairs installed in close proximity will not interfere with each other. They are simply coded differently.
The light barriers PSENopt from Pilz can be used in all areas of industry in which a barrier-free safety concept is to be implemented. With their compact dimensions and simple installation, the light barriers enable an ergonomic work environment. In particular, special applications up to PL d of EN/IEC 61496-1/-2 can also be implemented using the world's first Type 3 light curtain PSENopt II from Pilz. In doing so the Pilz Type 3 light curtains comply with the updated 2020 standard, in which part 2 of the revised edition takes Type class 3 into account. The dimensions of the slimline light curtains PSENopt slim are 15.4 mm x 32.6 mm and so are suitable for space-critical applications. Their short reaction times enable a rapid shutdown, so the light curtains can be positioned close to the danger zone without adversely affecting safety. Slimline plant designs with a reduced space requirement are the result.

Safety laser scanners: safe area monitoring

Safety laser scanners are suitable for area guarding of static or mobile danger zones, as access control or for applications that protect against encroachment behind the protected area. For example, the safety laser scanner PSENscan from Pilz offers two-dimensional area monitoring with an opening angle of 275 degrees and a protected field range of up to 5.5 metres, even for vertical applications. The safety laser scanners also have master/slave mode, so that up to four scanners can be connected in series. Parameters can be set for the configuration sets, making the system flexible: up to 70 different sets can be defined, each consisting of several protection and

warning zones in different arrangements. The configurations can be implemented via digital inputs and outputs, which also include 17-pin versions and a master encoder version. Up to three separate safety zones can be monitored simultaneously. However, as with the light curtains, under certain pre-defined conditions, part of the plant or the goods themselves can be moved within the protected area, without causing the machine to stop. This is thanks to the dynamic muting function, or if necessary also the partial muting function available on the safety laser scanner. Partial dynamic muting guarantees greater availability on plants, as does beam coding, which ensures that two scanners do not interfere with each other. For example, dynamic muting is always an enormous benefit to users when feeding in material of various sizes.

Intralogistics: safety laser scanners for more productive manoeuvring

Laser scanners also lend themselves to automated guided vehicle (AGV) applications: in contrast to light curtains they can be used on mobile applications to safeguard the protection zone in front of an AGV. Laser scanners like those from Pilz, for which ROS (Robot Operating System) packages from the Open Source Framework ROS are available, can also be used for dynamic navigation of AGVs – using SLAM – Simultaneous Localisation and Mapping – for example.

This technology can be used for precise navigation to stations: as AGVs do not always travel at the same speed, the hazard due to changing speeds must be taken into consideration. Safety laser scanners like those from Pilz offer maximum safety because the protected fields can be adapted dynamically to the different speeds of the AGV. As such the AGV can go round obstacles with greater precision. With this protection technology the focus is on precise navigation and the ability to adapt to different speeds.

With functions such as standby mode and precise navigation for intralogistics, scanner technology provides more efficient monitoring of mobile applications. Including lower power consumption, which saves costs.

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In conclusion, laser scanners are a good choice when a high edge definition is required, when the protected field needs to be defined precisely and there is a “clean” machine environment: radar systems are used where classic optical sensors reach their limits due to environmental conditions such as reflection, dust, water, dirt or sparks.

Volumetric monitoring better via radar technology

Radar technologies achieve a somewhat lower resolution and edge definition on the border of the protected field and, with a response time of approx. 100 ms, react somewhat slower than the laser scanner; however they can penetrate all materials except metal and water. Environmental influences that can cause measurement errors on scanners are no problem for radar systems. That's because radar systems operate with reflected electromagnetic energy in the two-digit gigahertz range and react to movements. With the safe radar system PSENradar from Pilz it is possible to monitor a total area of 4 m x 15 m; the system’s actual protection zone depends on the positioning, installation height and inclination of the sensors. Depending on the application, this safe radar system solution comprises up to six radar sensors, a control unit and the configurable safe small controller PNOZmulti 2. Both the protection zone and system can be set up in modular fashion at the point of use: multiple sensors can be freely combined; each can be configured individually. A wide or narrow protection zone can be set up, depending on the properties of the area to be monitored.

The self-teaching background function is a special feature on PSENradar, for example, because it can be used to make changes within the warning and protection zone, which do not immediately require a new configuration. For example, with something straight forward such as depositing another tool box. That makes the protection more flexible to use and saves unnecessary extra work. As with the light curtains, here too integrated muting for the whole system or for individual sensors enables the radar sensor to be used in material flow applications, with benefits for the plant's output.

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Radar monitoring focuses on twofold safety

The scalability and modular structure of PSENradar, for example, enables the safety system to be adjusted to the extent necessary and to be precisely dimensioned. The radar sensor has two safety-related functions in its sights: area guarding and protection against encroachment behind the protected area. The former guarantees that the machine is brought to a safe state when the danger zone is accessed; protection against encroachment behind the protected area prevents the machine restarting unintentionally when there is still somebody in the danger zone. Complex applications, even in rugged environments, present no challenge to such radar systems; industrial plants work efficiently despite the environment, because their availability is reliable. So typical application areas can also be found in heavy industry, for example, where dust, swarf, welding sparks or bright light prevail. As volume is monitored, radar technology can also be of benefit in the woodworking industry, on paint lines, in cold stores or in foundries. On outdoor applications, the radar sensor safeguards cranes or bulk cargo ports and storage facilities, even in the event of fog, snow and moderately heavy rain.

All-encompassing service designed to be complementary

Whether it's light curtains, laser scanners or radar systems: one service that encompasses the entire purchasing and installation process saves further time and costs for planning and implementation. Projects that involve volumetric or area monitoring can be implemented more efficiently when experts such as those at Pilz are there to support the customer, from selection of the right components through to on-site commissioning at the customer's. The services portfolio should cover the whole machine lifecycle and include consulting, technical implementation, fault diagnostics and regular inspection, as is the case at Pilz.

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