Background information

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Safe radar systems provide efficient protection for production

All-round flexible safeguarding

Ostfildern, May 2025 – **Protective devices are the preferred solution for area guarding, enabling barrier-free access when intervention in the process is required. Particularly when people require frequent access to the danger zone. Safe radar sensors also provide non-contact protection and, unlike other sensor types, can monitor volumes. But when is this special type of sensor used? When is it an advantage to use it?**

The general rule of thumb for using a safe radar system in automation is this: radar technology is the right choice wherever optoelectronic sensors reach their environmental limits. Compared with optoelectronic sensor technologies, a radar sensor is not only well able to tolerate rugged environments contaminated with dirt and dust, but is also an ideal protective measure in environments with extreme temperature fluctuations and weather conditions. Environmental conditions such as rain or extreme light, as well as flying sparks or vibration, present no problem to radar systems. Radar systems operate with electromagnetic waves in the two-digit gigahertz range and therefore react to movements.

The use of radar technology should also be considered when it is necessary to go beyond area monitoring and to detect objects in a 3-dimensional space.

Radar monitors two types of safety

A radar sensor handles two safety-related functions at once: area guarding and rear access protection. The former guarantees that

the machine is brought to a safe state when the danger zone is accessed. Rear access protection prevents the machine from restarting unintentionally when there is still somebody in the danger zone. Scalability – such as using multiple sensors to monitor the defined zone – and a modular structure – implementing a series connection for example – enable the safety system to be adjusted to the required extent and to be precisely dimensioned. A safe radar also detects micro-movements: in the case of rear access protection, the radar detects a person's heartbeat, for example. The radar is highly sensitive to barely perceptible movements, reliably recognising them.

Secure "large-scale" protection zones - even outdoors

The system's actual protection zone depends on the positioning, installation height and inclination of the sensors. The safe radar system PSENradar can monitor an area or zone of different sizes, depending on the type of radar selected. In addition to the radar sensor with a detection range of 0 to 5 metres, Pilz even covers a range of up to 9 metres with an additional safe radar sensor. This offers advantages particularly for mobile applications in outdoor areas, especially with very large machines such as gantry cranes. In this case, a radar that "sees far beyond the machine" performs better than conventional radar technology. A case study: If a gantry crane is to transport material ideally without stopping, the radar sensor can be mounted directly on the gantry crane and the sensor can “look far ahead beyond the crane” – to see if anyone is in the travel path, for example. The significantly extended detection zone of up to 9 metres enables there to be a sufficient protection zone around the machine, even on larger machinery.

Even complex applications are no challenge whatsoever for radar systems, particularly in rugged environments. Typical applications are found in heavy industry, such as in mineral and steel processing for example, where dust, chips, welding sparks or bright light are prevalent. As it monitors volume, radar technology can also be of benefit in the woodworking industry, on paint lines, in cold stores or in foundries. Outdoors, the radar sensor safeguards bulk cargo ports, for example, even in the event of fog, snow and moderately heavy rain.

Robot safely on (radar) screen

Whenever a robot cell is safeguarded, it is absolutely essential that rear access protection and a safe restart are guaranteed. For that, the robot application requires a high safety level: SIL 2 / PL d, Category 3. This is something radar technology can achieve. The use of a safe radar sensor brings significant advantages, and not only in terms of environmental monitoring. The radar technology reliably detects all environmental conditions and so safely monitors any type of movement within the defined (protection) zone. However, the focus of environmental monitoring is - quite classically - to monitor the standstill of a machine. Safe radar sensor solutions are also an economical alternative when it comes to robotics: instead of having to use safety light curtains for access guarding and safety laser scanners for rear access protection, the radar solution covers both functions equally. Because it implements access guarding and rear access protection via a single system.

Adaptable field of vision = higher productivity

Radar sensors with flexible, adaptable fields of vision enable users to implement the safety of their application more individually. This is particularly useful in cramped conditions, when machines are

located immediately next to one another, for example. With the Pilz system, in addition to the symmetrical viewing angle it is also possible to configure asymmetrical and corridor-like viewing angles. Users can define their individual field of vision using the corresponding software and simply transfer it to the radar sensor. Users have flexibility when applying the radar to the plant or machine. There are no restrictions on production operations.

If radar sensors can also monitor different geometries safely, further fields of vision are possible: with the radar sensors in the Pilz system, areas that feature smaller or larger angles are also possible in addition to narrow or wide straight lines. Radar sensors also monitor three-dimensional zones, i.e. volumes. In practice, a flexible, adaptable field of vision can be used to define (walk)ways more precisely, to optimise the use of space in production. With PSENradar, this is made possible by the significantly larger opening angle on the radar sensors. With these radar sensors, the field of vision is adjusted in 10° increments: the angle can be reduced on one or both sides, depending on the individual requirement.

FSoE provides faster radar safety

A safe radar solution can now use the open safety protocol Safety over EtherCAT FSoE, which significantly speeds up data transfer. For one thing, for more powerful diagnostics: not only do you get short reaction times to an event, but data is also transferred faster via a single-cable solution. As safety "kicks in faster" with short reaction times, the machine operator is also protected "more quickly" from the dangers posed by the machine. Thanks to the single-cable solution, the machine is ready for operation again more quickly. However, the radar's safety controller must be able to

analyse the sensor data - and act completely independently from a higher-level standard or machine controller.

Evaluate radar for maximum safety

In the Pilz system, the configurable small controller PNOZmulti 2 can achieve this, for example: As FSoE-MainInstance (FSoE Master), PNOZmulti 2 combines monitoring of all of a radar application’s safety functions in one device, and establishes connections to safe FSoE SubordinateInstances (FSoE Slaves) in the network. In other words, it evaluates the sensor data in the safe radar system PSENradar as part of the solution. In doing so, the radar system with FSoE functionality achieves the SIL 2 safety level required for robot applications. Radar sensors can be integrated so quickly because they are easier to incorporate into existing applications that run via the EtherCAT protocol.

A safe radar solution that includes products as well as services represents a comprehensive, complete solution for protection zone monitoring. Pilz, for example, offers the necessary conformity assessment for the machine as part of the package.

Simple zone configuration

If users select sensors precisely using a configurator, they can put their application into operation more quickly. Like the PSENradar Configurator from Pilz, for example. Using this configurator, the right protection zone can be defined for each sensor, depending on the size of the area to be monitored. This depends on the arrangement, installation height and inclination of the sensor. In addition to the protection zone, it is also possible to configure a warning zone. If a person violates the warning zone, this is signalled visually, by an

optical signal, for example. That way the operator can react more quickly.

Radar technology shows the way

Although radar technology is still a relatively new application in the industrial environment, it is already well accepted. It is used successfully in many applications. What's more, if the focus is on a holistic technology concept, this is beneficial to the application: automation tasks can also be covered using an access permission system - such as PITreader - a control instance such as the configurable small controller PNOZmulti 2 and an industrial PC such as the IndustrialPI as IIOT gateway. Developments – such as apps based on augmented reality – help customers visualise zone monitoring right from the start, even during the engineering phase. This makes implementation simpler.

In principle, area guarding of plant and machinery should be user-friendly. In practice, this means that devices for safe zone monitoring must be "out of the way" and must be capable of being used in any industrial environment. Because the robust radar technology measures three-dimensional spaces, users can also mount the sensors on the wall or ceiling. Flexible, integrable radar technology is ultimately a guarantee that the safety of a monitored zone is reliably ensured - as is its productivity.

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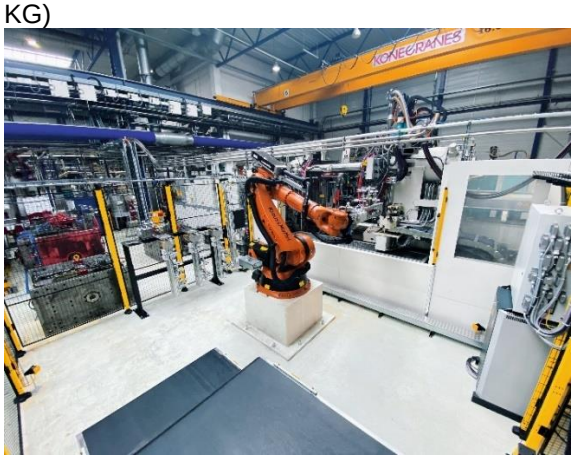
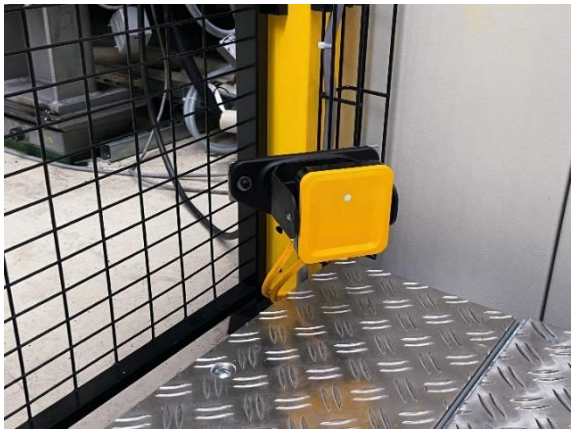
Illustrations for the main text

Fig. 1: F_Weidplas_Roboterzelle_IMG_7204_cold1 (© Pilz GmbH & Co. KG)



Caption: Safe within the protection zone with Pilz radar solution: robot at the injection moulding machine's removal area at Weidplas, with the conveyor in the foreground.

Fig. 2: F_Weidplas_PSENradar_IMG_7198_cold1 (© Pilz GmbH & Co. KG)



Caption: The safe radar solution PSENradar from Pilz at Weidplas: one of the three radar sensors pictured. With its three-dimensional area detection, it detects movements within the protection zone.

Fig. 3:
F_Press_Innovative_PSEN_rd1_2_sensor_6B000003_PNOZ_m_B0_772100_6997_B8_2_cold
(© Pilz GmbH & Co. KG)

Caption: PSENradar from Pilz provides sensors with a detection range of 0 to 5 metres, or from 0 to 9 metres. Efficient safeguarding of mobile applications is possible as a result.
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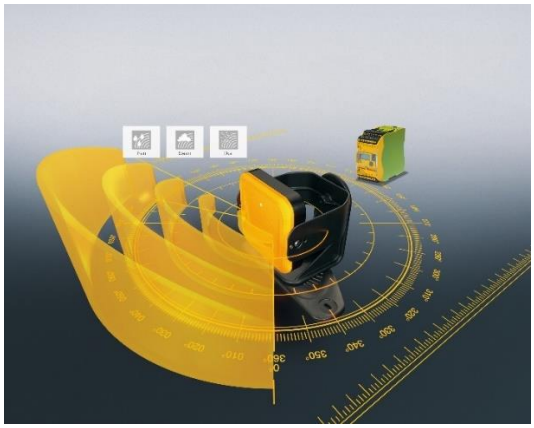
Fig. 4:
F_PSENradar_6B000003_Icons_Basis_P1_B8_2_cold_210mm (© Pilz GmbH & Co. KG)



Caption: The system's actual protection zone depends on the positioning, installation height and inclination of the sensors. The safe radar system PSENradar can monitor an area or zone of different sizes, depending on the type of radar selected.

Pilz Group

Pilz is a global supplier of products, systems and services for automation technology. As a pioneer of safe automation, Pilz creates safety for human, machine and environment. Founded in 1948, today the family business with its head office in Ostfildern is represented worldwide with 2500 employees in 42 subsidiaries and branches.

The technology leader offers complete automation solutions for Safety and Industrial Security on the machine. These include sensor, control and drive technology – as well as systems for industrial communication, diagnostics and visualisation. An international range of services with consulting, engineering and training completes the portfolio. Pilz solutions are used in many industries beyond mechanical engineering, such as intralogistics, packaging, railway technology, or the robotics sector for example.

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Press contact

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