Sensor solutions for the automotive industry

The Sensor People
Creating transformation
Yesterday. Today. Tomorrow.

With curiosity and determination, we – the Sensor People – have been partners for technological milestones in industrial automation for 60 years. The success of our customers is what drives us. Yesterday. Today. Tomorrow.
Designing future-proof and efficient systems

Through innovative technologies, such as OPC UA, process and diagnostic data can be evaluated with a new level of quality. Processes can thereby be systematically optimized, machines constantly monitored and devices centrally and easily managed.

Intelligent sensors are a fundamental element here: with the help of new communication technologies, the data from these sensors can be collected and evaluated across all levels of a production system.

With our 1D- and 2D-sensors, we already have OPC-UA-certified sensors that are ideally suited for, among other things, track & trace applications. We are constantly expanding our line of OPC-UA-capable sensors. Because your ability to design plants that are both fit for the future as well as efficient is important to us.
Standardized communication enables analyses on the level of the individual device or of a local system. Moreover, through cloud communication, data can also be aggregated over multiple locations worldwide. Additional knowledge can thereby be gained and uniform analysis data made available securely.
Prepared for the car of the future

The market for alternative drives is growing rapidly. An increasing number of models and equipment options require even more flexible production and an extensive quality management system. Our goal, as a partner for our customers, is to ensure your success in an industry that is ever evolving. The automotive industry in particular currently faces great challenges.

Based on years of industry knowledge, we orient our product range toward current and future application solutions. Predictive maintenance and diagnostic possibilities for Industry 4.0 are as much in focus as high system availability and smooth production processes.
Flexible manufacturing and e-mobility
The production processes in the press shop, paint shop and final assembly are becoming increasingly flexible. Different vehicle models and equipment options need to be taken into account in the process. Scalable manufacturing concepts that can be adapted to production capacities are called for here. The trend towards emission-free vehicles is also changing manufacturing processes. The complexity and the number of components in the powertrain is decreasing, and the production of batteries and battery packs is growing.

Maximum system availability and certified quality standards
Our sensors support you in all areas of automation, quality assurance, traceability and machine safety. They are characterized by easy handling during commissioning and exchange. With sophisticated functions, intelligent devices ensure smooth production and material provision. Long-term quality as well as the availability of sensors are guaranteed here. Our products thereby help to ensure and maintain the high availability of the system.

Safety without compromise
The advance of automation gives rise to new requirements with regard to the safety of persons and machines. Through our specific application know-how and more than 30 years of experience in the area of machine safety, we offer unique insight into safety-related applications. With our safety product range consisting of high-quality products, intelligent systems as well as competent technical services, we provide you with targeted answers.
The press shop

Various body parts for the subsequent finished vehicles are produced from massive steel rolls, so-called coils.

Whether for cutting the coils or punching, pressing and shaping the blanks: sensors accompany and safeguard all manufacturing steps, even under harsh environmental conditions.

The applications are as diverse as our product range, which is tailored to these applications. Inductive and optical sensors check and monitor the presence and position of parts. Identification systems record data for the traceability of those parts. At the cutting systems, our sensors supply measurement values for loop control and edge control.
1 Code reading on the steel coil
2 Area guarding of the feeder
3 Measuring the coil diameter
4 Loop control
5 Edge control
6 Anteroom guarding on press lines
7 Access guarding on press lines
8 Presence control of the tool
9 Position control of the pallet
10 Monitoring of the stack height
11 Error-free acceptance of the blanks
12 Presence control for controlling the gripper robot
13 Code reading on the rack
The press shop

Code reading on the steel coil

**Requirement:** The relevant technical data, such as material and material thickness, are encoded onto the coil. After removing the coils from the warehouse and before they are accepted into the cutting machine, this data must be recorded in order to ensure traceability over the entire process chain.

**Solution:** The DCR 200i camera-based code readers read all common 1D- and 2D-codes, are easy to configure, and, thanks to the various optics, are simple to install. In cases where the position of the 1D-code on the coil can vary, the oscillating mirror model of the BCL 300i bar code reader is used.

Area guarding of the feeder

**Requirement:** The extremely heavy coils are fed into the cutting system by means of forklift trucks or AGVs. Access to the area near the feeder of the cutting machine must be safeguarded.

**Solution:** The ELC 100 and MLC 500 safety light curtains offer high resolutions for short safety distances and a compact system design. If there is sufficient space, the MLD 500 multiple light beam safety devices are used. These are optionally available with integrated muting functions.

Measuring the coil diameter

**Requirement:** To enable an automatic coil change before the material runs out, the diameter of the coil must be constantly monitored. Cost-intensive downtime can thereby be minimized.

**Solution:** The measuring ultrasonic sensors of the DMU 300/400 series offer an especially large measurement range of up to 6,000 mm. The robust devices in plastic and full-metal versions are characterized by short response times and high resolutions. They are available with analog current or voltage output and IO-Link interface.
**Loop control**

**Requirement:** In the cutting system, the cutting process must be decoupled from the belt transport. The sag of the loop is to be determined contact-free to communicate the necessary measurement values to the control for determining the haul-off speed.

**Solution:** The sensors of the ODS10 / 110 and ODSL 96 series, which operate according to the time-of-flight measurement principle (TOF), offer measurement ranges of several meters. They feature a high resolution and a high level of reproducibility. The devices can be flexibly integrated via analog output, serial interface and IO-Link.

**Edge control**

**Requirement:** The blank cutting system cuts the material that is unwound from the endless band into so-called plates or blanks. To ensure that they are identical in shape and dimensions and within tolerance, the edge must be precisely controlled.

**Solution:** With their high level of reproducibility of ± 0.03 mm, the GS 754B CCD fork photoelectric sensors ensure precise determination of the web edge. The devices can be flexibly integrated via analog output, serial interface or IO-Link.
The press shop

Anteroom guarding on press lines

**Requirement:** Before the carriages move into the press, a check must be performed to ensure that no persons are in front of the gates. During entry, the area to the side of the carriages is to be secured to prevent persons from entering the press line alongside a carriage.

**Solution:** With its configurable and switchable protective fields, the RSL 400 safety laser scanner secures the area in front of the respective door. With its large operating range of 8.25 m and two parallel protective functions, two entrance areas can be simultaneously monitored independent of one another with just one device.

Access guarding on press lines

**Requirement:** The press tools are brought to the press anteroom with gantry cranes and positioned in the press during a tool change. During this process, the entire anteroom is a safety-critical area. The access of persons must be monitored.

**Solution:** The multiple light beam safety devices of the MLD 500 series offer economical access guarding for large areas. As transmitter-receiver systems with operating ranges of 70 m, they are used together with mirror columns and thereby safeguard the entire press anteroom.

Presence control of the tool

**Requirement:** The fitting tool is positioned on the shuttle carriage by means of a crane. In doing so, the proper seating is to be checked so that automatic locking can occur.

**Solution:** The IS/ISS 244 models with cubic design are the best suited from our wide range of inductive switches. The compact sensors can be installed quickly and in a space-saving manner. Status indicators that are easily visible from the side simplify commissioning and visualize states.
**Position control of the pallet**

**Requirement:** The cut, in some cases, already stamped blanks are fed for further processing by means of forklift trucks or automated guided vehicles. Before the parts can be accepted, a check must be performed to ensure that the pallet or load carrier has reached the transfer position. This is to occur contactlessly.

**Solution:** The inductive switches of the IS 200 / 244 series offer high performance and large function reserve. Depending on the installation location and the required operating range, both cylindrical designs with triple switching distance from the IS 200 series as well as the IS / ISS 244 cubic versions are available.

**Monitoring of the stack height**

**Requirement:** During operation, a continuous material infeed must be ensured. If the last blank is gripped by the robot or the filling level of the blank stack drops below a defined level, resupply is to be triggered automatically. To do this, the stack height of the blanks is to be monitored.

**Solution:** Devices with time-of-flight measurement (TOF) from our wide range of switching and measuring distance sensors are especially well suited for larger operating ranges. These include the HT 10 switching sensors, which monitor a defined stack height to ensure that it does not drop below a defined level, and the ODS 10 measuring sensors, which determine the height of the stack.

**Error-free acceptance of the blanks**

**Requirement:** The vacuum gripper on the robot arm automatically removes the top-most part from the stacked blanks and places it on the conveyor system of the press line. To avoid errors in the process, the length of the blank must be used to determine whether the part located underneath is lifted up as well – e.g., through adhesion.

**Solution:** The CSL 700 switching light barriers monitor the entire surface of the blank. Depending on requirements, the devices are available in various lengths and resolutions. The combination of integrated IO-Link interface and freely programmable switching outputs ensures simple integration in the system.
The press shop

**Presence control for controlling the gripper robot**

**Requirement:** At the end of the press line, the finished molded sheet metal parts are automatically removed and loaded on transport vehicles for further processing. To control the gripper robot, the presence of the parts on the belt conveyor must be checked.

**Solution:** From our wide product range of switching sensors, the HT 25C series combines above-average function reserve with compact size. Parts with glossy and even dark or structured surface are reliably detected. The devices are available as red light and infrared versions.

**Code reading on the rack**

**Requirement:** The finished sheet metal parts are stored on movable racks that can be transported, e.g., by automatic tugger trains or AGVs, to the further processing in the body shop. To ensure that the rack is used correctly, the identification code attached to the rack that is to be read.

**Solution:** Depending on the attachment of the code and the reading distance, a BCL 300i decodes the code as a raster scanner and transfers the data to the PLC or to the material flow computer. If the label has large position tolerances, device models with integrated oscillating mirror are used.
Vehicle body construction is the most automated part of automobile manufacturing. Welding, flanging and lasering as well as riveting and screwing and – increasingly – gluing are typical work processes. Robot cells, collaborative robots and conveyor systems such as skids and electrical monorail systems determine the processes.

The factory of the future is characterized by even more flexible manufacturing concepts. A large variety, just-in-time material provision and the cushioning of peak demand are required. Storage areas and production are separated. Assembly occurs in flexible cell structures. In between, automated guided vehicles (AGV) transport materials.

Our sensors are used for a wide range of applications in the body shop. Safety laser scanners safeguard AGVs and supply data for their navigation. Sensors for presence and position control ensure smooth processes and our safety sensors guarantee the necessary machine safety.
1 Guarding and navigation of automated guided vehicles (AGVs)
2 Optical guidance of automated guided vehicles (AGVs)
3 Access guarding of parts warehouse
4 Inventory monitoring in parts warehouse
5 Code reading on the SKID
6 Presence control of components
7 Presence control for type testing
8 Monitoring of doors, with locking device
9 Area guarding of the transfer station
10 Presence and position monitoring of the vehicle body
11 Positioning of the lifter and optical data transmission
12 Presence control of the SKID in the lifter
13 Compartment occupation check in the body warehouse
The body shop

Guarding and navigation of automated guided vehicles (AGVs)

**Requirement:** The transportation path of the AGV must be guarded by means of safety sensors. The protective fields are to be flexibly adapted to the movement and loading situation. If the principle of natural navigation is used, the device is at the same time to provide the measurement data for the navigation software.

**Solution:** The RSL 400 safety laser scanners merge safety technology and high-quality measurement value output in a single device. They have a scanning range of 270° and 100 reversible field pairs. Two scanners therefore provide optimum guarding of the AGV. The measurement data has a high angular resolution of 0.1° and a low measurement error.

Optical guidance of automated guided vehicles (AGVs)

**Requirement:** An AGV must move safely and efficiently through its surroundings. Often, however, expansive production and storage areas pose a challenge. Moreover, many sensors are unsuitable for integration in flat vehicles due to their dimensions.

**Solution:** A high-contrast track on the floor defines the route for the AGV. The OGS 600 optical guidance sensor uses edge detection to detect the line and sends control signals to the vehicle’s drive. Its minimum distance from the floor is just 10 mm.

Access guarding of parts warehouse

**Requirement:** Access to the storage area is to be safeguarded by optoelectronic safety sensors without hindering free movement within the working range.

**Solution:** The RSL 400 safety laser scanner is installed above the access area and the protective field is aligned vertically. By means of two independent protective functions, an RSL 400 can simultaneously monitor two access points. Network integration is performed via PROFINET/PROFIsafe interfaces.
Inventory monitoring in parts warehouse

**Requirement:** The material supply must be ensured at all times during operation. If a part in the warehouse runs out, parts are then removed from a nearby location and replenishing is requested. The fill level of the warehouse is to be monitored continuously, and the sensor system must work reliably in the present mechanical/spatial conditions over longer distances.

**Solution:** The ODS 10 or – for higher resolutions – the ODKL 96 measuring sensors and the switching sensors of the HT 10 series provide stable results even over several meters. Glossy and reflective surfaces are reliably detected as well.

**Code reading on the SKID**

**Requirement:** Encoded information on the SKID must be detected contact-free in order to track the production process. Sufficient distance between the sensor and SKID/AGV must be ensured to avoid impeding the path of the AGV.

**Solution:** Bar code and RFID technology are suitable for reading encoded information. Bar code technology directs the read data to a central database. Decentral automation does, however, also require the writing of data. RFID technology is used here: the RFM 32 RFID read/write systems or, for larger operating ranges, the RFM 62.
The body shop

**Presence control of components**

**Requirement:** The presence of components as well as shapes, holes and openings or other special features is to be detected prior to joining and processing. The detection must often be performed from a safe distance.

**Solution:** The HT 3 diffuse reflection sensors with background suppression for shorter operating ranges and HT 46C for longer operating ranges ensure reliable presence control. Models with various light-spot geometries offer optimum adaptation to the application. Flexible mounting brackets, cables and IO-Link models are available.

**Presence control for type testing**

**Requirement:** A type test is necessary for the respective work step. This is performed by detecting structural elements in various models. Because the tests are to take place during the running work process, the sensors must be installed outside of the robot work areas.

**Solution:** The compact ODS 110/HT 110 measuring and switching TOF sensors are suitable for restricted installation locations. They offer an operating range of up to 5 m. For larger operating ranges, the ODS 10/HT 10 devices are used.

**Monitoring of doors, with locking device**

**Requirement:** Areas with hazardous movements can be entered via safety doors to allow maintenance. If the movement does not stop immediately after the door is opened, the door is to be guarded by a safety switch with locking device. Work and safety conditions are to be signaled.

**Solution:** The robust safety switches with locking device of the L series lock safety doors until they are released by means of an electrical signal. In addition to the standard models, there are devices with integrated control buttons and emergency stop as well as devices with RFID-coded actuator. Optical and acoustic signalers of the A7 series complement the integrated LED status displays.
Area guarding of the transfer station

**Requirement:** The danger zone of the robot and the working range of the transfer station should be safeguarded against entry by persons during the entire process. The vehicle should be able to enter and exit the work area fully automatically.

**Solution:** The safety solution for robots/AGV transfer stations secures the entire area around the transfer station through safety laser scanners. As the vehicle passes through, the protective field dynamically adapts to the position of the vehicle by blanking the outline of the AGV from the protective field.

Presence and position monitoring of the vehicle body

**Requirement:** Before the AGV can begin travel to the next workplace, the presence and correct positioning of the body on the AGV must be checked. This is to be performed by detecting a prominent body part at a precisely defined distance.

**Solution:** The economical, diffuse reflection sensors with background suppression of the HT 25C series impress even with glossy materials thanks to their high detection reliability. Models with red light, infrared and laser of protection class 1 as well as various light spot sizes enable optimum adaptation to the requirements.
The body shop

Positioning of the lifter and optical data transmission

**Requirement:** The stacker crane or lifter must be positioned in the x-direction (travel axis) and y-direction (lifting axis) appropriately for the pallet that is to be moved to. Travel commands and positioning data are to be optically transferred to the control to ensure high availability of the system.

**Solution:** The AMS 300i laser distance measurement devices or BPS 300i barcode positioning systems are used for the exact positioning. The DDLS 500i data transmission photoelectric sensors function fault-free without offset directly next to the AMS 300i devices. Selectable operating ranges, interfaces and protocols ensure optimum solutions.

Presence control of the SKID in the lifter

**Requirement:** To check whether the lifter exit is clear, the presence of the SKID or body on the lifter is to be checked.

**Solution:** Inductive switches are suitable here. Because SKID and lifter tolerances are to be compensated for, sensors with a large scanning distance are recommended, e.g., IS / ISS 244 cubic designs or cylindrical designs with triple switching distance from the IS 200 series.

Compartment occupation check in the body warehouse

**Requirement:** Before a body can be moved from the lifter to a free compartment, a check must be performed to determine whether the compartment is free or occupied. To be able to store different bodies, the SKID is to be used for detection.

**Solution:** The HRT 25 LR compact diffuse sensors are used for operating ranges up to 2.5 m. If larger operating ranges are required, the ODS 10 measuring distance sensors or HT 10 switching diffuse sensors are suitable.
The paint shop

Before paint comes into play, several pretreatment processes are performed. Following cleaning come the phosphating and cathodic dip painting process, the drying and then the actual painting of the bodies. The final quality control guarantees a perfect result.

With the new design of paint shops, flexible manufacturing processes are often called for. The classic, serial sequence is replaced, e.g., with concepts that can be scaled to the production capacities.

Depending on the selected concept and the used conveyor system, sensors for position and contour detection are needed in addition to sensors for machine safety and identification. Within paint booths or the area around CDC baths, sensors must have an ex marking for use in potentially explosive areas as well as a high degree of protection.
1 Products with ex marking
2 Position control of the SKID
3 Contour monitoring for type detection
4 Access guarding in the paint booth
5 Position control of the body
6 Guarding and navigation of automated guided vehicles (AGVs)
7 Identification of SKID and body
8 Code reading on attachment parts
9 Applications in the body warehouse
The paint shop

Products with ex marking

Requirement: If sensors are used within paint booths or the CDC bath’s environment, not only are robust construction and high IP degree of protection required, but they must also have an ex marking for use in potentially explosive areas.

Solution: We offer devices with ex marking for different areas of application:
- CML 700 measuring light barriers
- MLC 500 safety light curtains
- Measuring sensors of the ODS series
- Switching sensors of the 46 series
- RFM 32 RFID solutions

Position control of the SKID

Requirement: The position of the SKID must be determined exactly so that the subsequent work steps can be coordinated and synchronized.

Solution: Depending on the installation situation, inductive switches with cylindrical or cubic design are suitable. The robust devices of the IS 230 and IS / ISS 244 series are characterized by increased operating ranges and LED status indicators.

Contour monitoring for type detection

Requirement: For positioning and synchronization of the painting robot, the body model must be detected. The bodies differ, e.g., near the A- and B-pillars with respect to design and dimensions. These features are to be used for detection.

Solution: The CML 700i measuring light curtains determine, e.g., the distances between the A- and B-pillars or the different widths of the window openings. The results of these measurements are used to determine the body types and, thus, to control and synchronize the painting robots.
Access guarding in the paint booth

**Requirement:** Access to the paint booth or to the CDC bath is to be guarded. At the same time, the safety sensor technology should allow the vehicle bodies to be transported into these areas and also function reliably if body formats are changed. In addition, the closed state of the pendulum flaps is to be monitored.

**Solution:** The MLC 530 SPG safety light curtains with Smart Process Gating require no additional muting sensors for bridging for the transported goods. The space-saving solution guarantees high availability and high protection against manipulation. The partial gating simultaneously uses the upper beams of the safety light curtain to also monitor the pendulum flaps.

Position control of the body

**Requirement:** If different bodies are transported on a SKID and the work process requires the exact starting point of the body for purposes of synchronization, this must be detected contact-free.

**Solution:** Our ODS 10/HT 10 distance sensors in measuring or switching versions are ideal. They operate according to the principle of time-of-flight measurement (TOF) and, with an operating range of 8 m, are very well suited for applications over larger distances.

Guarding and navigation of automated guided vehicles (AGVs)

**Requirement:** The transportation path of the AGV must be guarded by means of safety sensors. The protective fields are to be flexibly adapted to the movement and loading situation. If the principle of natural navigation is used, the device is at the same time to provide the measurement data for the navigation software.

**Solution:** The RSL 400 safety laser scanners merge safety technology and high-quality measurement value output in a single device. They have a scanning range of 270° and 100 reversible field pairs. Two scanners therefore provide optimum guarding of the AGV. The measurement data has a high angular resolution of 0.1° and a low measurement error.
Applications – The paint shop

The paint shop

Identification of SKID and body

Requirement: The SKID or the body must be identified so that process parameters, such as paint application in the paint booth, can be correctly set. The data carrier must withstand temperatures of 200°C here.

Solution: The RFID systems of the RFM series operate in the 13.56 MHz frequency band and are available with various antennas depending on the required operating range. Transponders with different geometries and special, paint-compatible, high-temperature transporters are available for temperatures up to 250°C that match the frequency band.

Code reading on attachment parts

Requirement: If accessory parts and attachment parts did not pass through the painting process together, they must be identified for proper assignment.

Solution: The DCR 200i camera-based code readers can be flexibly integrated thanks to their compact housing. For especially large reading distances with the same high depth of field, the BCL 500i bar code readers are used.

Applications in the body warehouse

Requirement: Automated buffer storage in the painting area have requirements on the sensor system that are similar to those in the body shop. Examples are the determination of position data in the travel/lifting area and the optical transmission of this data. Compartment occupation checks and presence control of the skid in the lifter are typical applications.

Solution: Positioning of the x/y axis is realized with the AMS 300i laser distance measurement system. The DDLS 500i data transmission photoelectric sensors are available for optical data transmission of up to 100 Mbit and distances of up to 200 m; sensors of the 10 series are available for compartment occupation checks. Inductive switches perform the presence testing.
Powertrain –
The combustion engine

Engine blocks coming from the foundry form the basis for the combustion engine. Together with a large number of parts, modern and efficient drive units are created in engine production.

The work and process steps are accordingly diverse. The processing of the engine blocks in the processing centers must be consistent and must permanently meet the high quality standards. Parts must be precisely mounted on and perfectly matched to the respective engine model. Through process-related tests, the traceability to the completed engines is ensured.

Sensors are essential for ensuring efficient processes and for adhering to the quality standards. Typical areas of use for our devices include type testing, object detection, code reading and identification as well as applications for safety at work and machine safety.
1 Visual monitoring of hidden areas
2 Presence control of tools
3 Presence control
4 Point of operation guarding at the machine tools
5 Machine room monitoring
6 Area guarding
7 Stationary code reading for traceability
8 Mobile code reading for traceability
9 Transport control of the conveyor line
10 Access guarding on linked systems
11 Code reading on the transport carrier
Visual monitoring of hidden areas

**Requirement:** The machine room is to be visually monitored. This also applies for areas that cannot be viewed from the outside. Due to the special environmental conditions, an industrial camera with high degree of protection is required.

**Solution:** The LCAM 408i color camera is optimized for use in harsh, industrial environments. 5-megapixel image resolution and Gigabit Ethernet interface ensure high image quality and fast, live-image transfer. The metal housing with degree of protection IP 67 and models with compressed air connection guarantee reliable operation.

Presence control of tools

**Requirement:** Processing centers are to operate automatically and with a high degree of utilization. To avoid downtime, the presence of the tools is to be checked during a tool change.

**Solution:** Our product range of inductive switches includes cubic and cylindrical designs with operating ranges up to 40 mm. In constrained spaces, the IS 204 and IS 205 devices with miniature construction are used. Robust, full-metal versions are suitable, e.g., for environments with aggressive lubricants.

Presence control

**Requirement:** During the automatic loading of the processing center, an industrial robot performs numerous swivel and gripping movements in a very short period of time. During the gripping movement, sensors should check and monitor the presence and position of work pieces and parts.

**Solution:** Due to the constrained space, the fiber optic sensors such as the LV / KF series are ideally suited for this application. Depending on the contour of the part / work piece, various beam exits are available. The fiber-optic product range is rounded out by the dual display of the amplifier for convenient commissioning.
Point of operation guarding at the machine tools

**Requirement:** The point of operation that arises from opening the safety doors must be safeguarded. Ideally, the optical protective device can easily be integrated in the machine in a space-saving manner.

**Solution:** The MLC 520-S safety light curtains have an especially narrow design. Together with the finely graduated length selection in increments of 30 mm and the design without dead zones, the devices can be perfectly integrated in the machine assembly.

Machine interior monitoring

**Requirement:** During the fully automatic loading of processing centers by means of AGVs, it must be ensured that no persons are located in the interior before the process is allowed to restart.

This also applies for areas of large processing centers that are difficult to see.

**Solution:** The LBK 3D safety radar system detects persons in the monitored area and operates reliably even under harsh ambient conditions. Furthermore, the radar technology allows the presence of static objects in the monitored area.

Area guarding

**Requirement:** The hazardous working range of the robot is to be guarded against entry by and the presence of persons. The interaction of man and machine requires efficient structuring of the processes.

**Solution:** The RSL 400 safety laser scanners monitor the working range of the robot and enable simple access to the machine. Because the presence of persons is also monitored, an automatic start-up of the robot can be integrated in the processes.
Stationary code reading for traceability

**Requirement:** The traceability of the process steps is also important in linked systems. The directly marked, laser-etched code on the engine block must be read and stored prior to every processing step.

**Solution:** The DCR 200i 2D-code readers decode the laser-etched DPM codes (direct part mark). They combine a compact design with large reading range and high depth of field, making them easy to integrate. They are equipped with interfaces for fieldbus integration and simple configuration tools for fast commissioning.

Mobile code reading for traceability

**Requirement:** Before a combustion engine is complete, many components must be mounted. For the traceability of relevant parts, the DPM (direct part mark) codes are to be detected in each process step. The codes must be read quickly and reliably, even on surfaces with oily residues.

**Solution:** The robust IT 1920i and HS 66x8 hand-held scanners decode 2D-DPM codes and can withstand impacts or falling onto the floor. They are easily incorporated in the respective control concept via the integrated USB and RS 232 interface or – for common fieldbus / Ethernet interfaces – using the MA 200i modular connection unit.

Transport control of the conveyor line

**Requirement:** The engines may only be fed into the processing centers and workplaces if these are free. For the corresponding control of the conveyor line, the presence of the transported goods is to be checked at defined points.

**Solution:** The retro-reflective photoelectric sensors of the 15 series are simple and the most economical solutions. They offer a high system availability thanks to high function reserves and are easy to adjust. An extensive selection of mounting accessories and suitable reflectors simplify the setup.
Access guarding on linked systems

**Requirement:** In engine assembly, automatic processing centers and manual workplaces are often linked to one another via conveyor systems. The entrances and exits to the processing centers must be secured against access.

**Solution:** The multiple light beam safety devices of the MLD 500 series safeguard the access point to the conveyor lines. Models with integrated muting function simplify the setup. Device configuration is performed without a PC directly via the pin assignment. The integrated, multi-colored indicator light optionally indicates the device status and reset requirements.

Code reading on the transport carrier

**Requirement:** The finished engines are transported on transport carriers directly to installation in the powertrain or delivered to various plants. The bar code on the transport carriers is to be read. It is linked to the engine in the database so that the delivery as well as the subsequent use can be clearly tracked.

**Solution:** The BCL 300i bar code readers operate with an operating range of 700 mm. The modular series includes line and raster scanners, models with oscillating mirror, M12 or PG threaded connections as well as industrial Ethernet and fieldbus interfaces. The BCL 500i series is suitable for larger operating ranges and offers similar configurations.
The complexity and the number of components in the powertrain is decreasing with purely battery-operated vehicles. In addition to this, however, is the production of batteries systems and battery packs, which are required in ever increasing quantities and make up a large portion the vehicle’s value. The production is largely automated. The “tracking and tracing” of the components, transport- and logistics solutions for material supply of the assembly cells and the safety of the work stations determine the requirements on the sensors.

Our components guarantee smooth processes and ensure machine safety. Typical areas of use are code reading and identification for the traceability, object detection for automation as well as access guarding at the assembly cells.
1 Code reading for the traceability of the batch
2 Code reading for the traceability of the cells
3 Monitoring of doors and flaps
4 Belt positioning for the picking up of parts by the robots
5 Access guarding of the work systems
6 Access guarding with short safety distances
7 Transport control of the conveyor line
8 Guarding and navigation of automated guided vehicles (AGVs)
Powertrain – The electric drive

**Code reading for the traceability of the batch**

**Requirement:** The order and the batch are to be detected at the start of battery production and stored for the further course of action. To do this, the processing steps and all relevant components are to be identified using a bar code.

**Solution:** Mobile code readers are well suited for detecting the orders and the batches. Wireless models like the IT 1990i make operation easy and comfortable. Depending on the control concept, they are connected directly to a PC or – for integration via common fieldbus and Ethernet interfaces – to the MA 200i modular connection unit.

**Code reading for the traceability of the cells**

**Requirement:** The “track and trace” concept also includes the traceability of each individual battery cell that is in the work system for processing. Depending on the used system, the 1D- or 2D-code affixed to the cell is to be captured.

**Solution:** The DCR 200i code readers reliably identify 1D- and 2D-codes. The devices are characterized by their compact design and simple commissioning. They feature multiple interfaces for fieldbus integration. To enable adaptation of the reading range, various optics models are available.

**Monitoring of doors and flaps**

**Requirement:** Moving protective devices such as doors and flaps protect the operator from hazards. The closed state of the protective devices must be monitored.

**Solution:** The RD 800 contactless safety transponders with RFID coding offer maximum protection against manipulation. Special installation measures are not necessary. With their OSSD outputs, they are also easy to integrate. The robust safety switches with mechanical tongue actuators of the S20 / 200 series can be used universally.
Belt positioning for the picking up of parts by the robots

**Requirement:** For acceptance by a robot and for further processing in the work cell, the battery cells on the conveyor system must be stopped and positioned precisely. The assembly workstations usually have a compact design – the sensor systems must therefore be compact as well.

**Solution:** The PRK 318B retro-reflective photoelectric sensors with cylindrical housing and 90° angular optics are especially well suited for applications with low space requirements. With their small dimensions, the cubic models of the 3 series offer an alternative. The high switching frequencies of the devices enable exact positioning of the conveyor system.

Access guarding of the work systems

**Requirement:** The battery components are moved from one robot assembly cell to the next via the conveyor system. The entrances and exits to the robot cells must be secured against access.

**Solution:** The MLD 500 multiple light beam safety devices safeguard the access point to the conveyor lines. Depending on requirements, e.g., installation situation and size of the transport material, models are available with and without muting function. Configuration is easily performed via the pin assignment. With the integrated muting function, no additional devices are necessary.

Access guarding with short safety distances

**Requirement:** Even on automatic operating systems, it can be necessary for the operating personnel to intervene. Because easy access is required in these cases, optical safety sensors are to be used. To keep the designs of the system as compact as possible, the sensors should enable short safety distances.

**Solution:** The ELC 100 and MLC 500 safety light curtains offer high resolutions for short safety distances and a compact system design. For European requirements, the devices feature AIDA-compliant pin assignment.
Powertrain – The electric drive

Transport control of the conveyor line

**Requirement:** The production systems for battery production are linked by means of conveyor systems. The products are fed to the next process step either directly on these or in trays. To allow the products to be removed by the gripper robot or transferred to an AGV, the conveyor line must be controlled through detection of the products.

**Solution:** The universally usable PRK 15 and PRK 25C retro-reflective photoelectric sensors offer high function reserves for high system availability. With their bright light spot, they can be adjusted quickly and easily. Additional functions, such as warning output and activation input, increase process reliability.

Guarding and navigation of automated guided vehicles (AGVs)

**Requirement:** The transportation path of the AGV must be guarded by means of safety sensors. The protective fields are to be flexibly adapted to the movement and loading situation. If the principle of natural navigation is used, the device is at the same time to provide the measurement data for the navigation software.

**Solution:** The RSL 400 safety laser scanners merge safety technology and high-quality measurement value output in a single device. They have a scanning range of 270° and 100 reversible field pairs. Two scanners therefore provide optimum guarding of the AGV. The measurement data has a high angular resolution of 0.1° and a low measurement error.
The final assembly

Before the wedding is celebrated in automobile production, countless individual parts and elements must be assembled and processed to create partial and final products.

Assembly of the door modules with all of their attachment parts takes place on the door line. In the interior construction, arm-thick cables are laid, carpeting glued and the cockpit installed. Parallel to this, engine and transmission are joined to the chassis. And finally the wedding: The entire powertrain and the vehicle body are united forever. Further assembly steps for wheels, windows, seats and headlights follow. After filling with oil, fuel and water, it’s on to the final inspection – the last station in the manufacturing process.

Position control is among the most important application areas for sensors in final assembly. Our wide range of optical distance sensors and bar code positioning systems supports the many different assembly steps. Our code readers for part identification and numerous solutions for type testing ensure the correct assignment of the assemblies to the vehicle.
1 Collision protection on electrical monorail systems
2 Code reading for the assignment of the doors
3 Area guarding on skillets
4 Distance measurement for cockpit positioning
5 Positioning of electrical monorail systems
6 Distance measurement for the lowering of the body
7 Code reading for the assignment of the wheels
8 Contour monitoring for model monitoring
9 Detection of the open engine hood
10 Access guarding of the filling station
The final assembly

Collision protection on electrical monorail systems

**Requirement:** Assembly of the vehicles actually begins with the removal of the doors. The doors, which would interfere in the subsequent steps, are removed and processed separately on the door line. During transport with electrical monorail systems, the suspension gear is to be protected against collision through distance measurement.

**Solution:** The ODS 10 / HT10 and ODSL 96 optical distance sensors check the distance between the suspension gears. Devices of the 10 series measure on the object or – with an operating range of up to 8 m – on a cooperative reflector. Configuration is performed via the display or IO-Link. The ODSL 96 series is suitable for larger operating ranges.

Code reading for the assignment of the doors

**Requirement:** The separated doors are to be completed according to their specified equipment and reassigned to their respective vehicle at the end of the process. A paper label with bar code identifies the individual door and helps track it through the production process. For the identification of the doors, the attached code is to be read.

**Solution:** The BCL 300i bar code readers detect codes at a distance of up to 700 mm. The BCL 500i bar code readers are used for longer reading distances of up to 2,400 mm. Depending on the arrangement of the codes and the connection to the control, suitable passive optics models and interfaces are available.

Area guarding on skillets

**Requirement:** Skillets are often used in the final assembly. The working areas and danger zones are to be safeguarded at the individual stations.

**Solution:** Through the parallel monitoring of up to four protective fields, the RSL 400 safety laser scanners are suitable for area guarding in automated production systems and in human-robot collaborations. Their PROFIsafe interface makes it easy to integrate the unit in industrial networks and offers extensive diagnosis options.
Distance measurement for cockpit positioning

**Requirement:** The cockpit is guided into the vehicle with the assistance of cobots or installation aids and must be moved into position with the tightest tolerances. To do this, distances and spacings are to be determined that provide the manipulator with important position information.

**Solution:** The ODS 9 optical distance sensors set standards in precision and operating comfort. They deliver exact measurement values even under difficult conditions, e.g., with glossy objects. These values can be read on the integrated display. The supported IO-Link Smart Sensor profile enables a fast and fail-safe device exchange.

Positioning of electrical monorail systems

**Requirement:** Electrical monorail systems transport not only the vehicles. By rotating, lowering or lifting, these also allow the bodies to be oriented so as to provide the assembly workers with optimum work positions. To do this, the position of the transport unit on the carrier must be determined continuously and exactly.

**Solution:** The BPS 300i compact bar code positioning systems enable the exact positioning over a length of up to 10,000 m. Interfaces for fieldbuses, industrial Ethernet as well as SSI or serial connections make integration in the control simple and flexible. The configuration and diagnosis of the devices are just as easy.
The final assembly

Distance measurement for the lowering of the body

**Requirement:** During the automotive wedding celebration, the body is joined with the power train. To do this, the powertrain is moved under the body and then permanently bolted to the body. When lifting or lowering the parts, the distances between the components with respect to one another are to be determined.

**Solution:** The ODS 9 laser triangulation sensors are installed on the assembly device and monitor the distance to the body to allow it to be precisely moved into place. They offer an optimum combination of operating range, resolution and reproducibility. Various outputs as well as IO-Link enable optimum integration of the devices.

Code reading for the assignment of the wheels

**Requirement:** The complete wheels – consisting of tires and rims – are transported to the assembly line according to the order. The bar code on the label is to be read for the correct assignment of the wheels to the vehicle. The label can be located at any point along the circumference of the wheel.

**Solution:** To cover the entire tire, several BCL 500i oder BCL 600i bar code readers are used. The devices are characterized by a large reading range and depth of field. Code identification is supported by code reconstruction technology, which assembles the partial results into a global result.

Contour control for model monitoring

**Requirement:** Depending on the number of models and on the different equipment details of the doors, it must be ensured before the doors are remounted that no mistakes are made with respect to the door assignments. For this purpose, the contour of the doors is to be checked.

**Solution:** With measurement field lengths of up to 2,960 mm, various resolutions and very short cycle times, the CML 700i measuring light curtains provide the ideal basis for reliably meeting a range of requirements. Sophisticated mounting solutions and a variety of integrated interfaces simplify installation and integration of the devices.
Detection of the open engine hood

**Requirement:** For the vehicle to be able to dock at the filling station, it must be ensured that the engine hood is open. This is to be detected by means of a suitable sensor.

**Solution:** The ODS 110 / HT 110 measuring and switching distance sensors operate according to the time-of-flight principle (TOF) and offer reliable results over distances of up to 5 m. Configuration is performed easily via a teach button or IO-Link. Thanks to the compact dimensions, the devices can be flexibly integrated in the system.

Access guarding of the filling station

**Requirement:** The vehicles are automatically filled in the station. Because no persons may be located within the system during the filling process, access to the station is to be safeguarded. At the same time, the safety sensor technology is to allow the vehicles to be transported into the station. In addition, the closed state of the pendulum flaps is to be monitored.

**Solution:** The MLC 530 SPG safety light curtains with Smart Process Gating require no additional muting sensors for bridging for vehicle transport and guarantee high availability and high protection against manipulation. The partial gating simultaneously uses the upper beams of the safety light curtain to also monitor the pendulum flaps.
The battery cell production

Battery cells are manufactured in what are known as “gigafactories”. From individual machines to networked production systems, the production steps are optimized to ensure process efficiency. The most stringent requirements relate to the stability of the processes and the quality of the manufactured products. As a result, the sensors used must also meet certain requirements, which are determined by the tracking and tracing of battery cells, the production logistics and the safety and reliability of the machines.

Our sensor solutions guarantee smooth processes and ensure machine safety. Typical areas of application are code reading for traceability, object detection for automation, and access guarding on machines and systems.
1 Access guarding on a coating system
2 Fine alignment of load receptacle of the AGV
3 Determination of roll diameter
4 Determination of the position of the film edge
5 Differentiation between electrode coating and carrier film
6 Monitoring of doors, with locking device
7 Presence control of battery cells on the transport carrier
8 2D-code reading on the cover of the battery cell
9 Presence control of battery cells
10 Presence control of battery cells in the filling station
11 Monitoring of the fill level in the electrolyte container
12 2D-code reading for traceability

A Our solutions for applications in continuous conveyors, high-bay warehouses and automated guided vehicles can be found in our “Sensor solutions for intralogistics” brochure.
The battery cell production

Access guarding on a coating system

**Requirement:** On the coating system, access to the danger zone must be guarded. To ensure that material can enter and exit easily, optoelectronic safety sensors are to be used.

**Solution:** The ELC 100 and MLC 500 safety light curtains offer high resolutions for short safety distances, thereby enabling a compact system design. If there is sufficient space, the MLD 500 multiple light beam safety devices are used. These are optionally available with integrated muting function.

Fine alignment of load receptacle of the AGV

**Requirement:** The AGV transports the roll into the transfer station. There, it is pulled in by the coating system. To ensure that the transfer is performed reliably, the lifting device of the AGV must be positioned exactly in the Y-direction (lifting axis).

**Solution:** The IPS 200i smart camera determines its position in relation to a marker (hole or reflector) with an accuracy of up to 0.1 mm. The distance can be up to 600 mm. The results are output via an Ethernet TCP/IP, PROFINET or Ethernet/IP interface.

Determination of roll diameter

**Requirement:** While the film is being wound and unwound, the diameter of the roll must be continuously determined.

**Solution:** The ODS 9 optical distance sensors provide exact measurement values even under difficult conditions and set standards in precision and operating comfort. The measurement values can also be read off the integrated display.
Applications – The battery cell production

**Determination of the position of the film edge**

**Requirement:** Various process steps in battery cell production require accurate positioning of the electrode film. While the film is being fed into the winding or cutting process, the position of its edge must be determined exactly.

**Solution:** The measuring GS 754B CCD fork photoelectric sensor detects the edge of the electrode film with a resolution of up to 0.014 mm and a minimum reaction time of 2.5 ms. The devices transfer the measurement values to the control via analog means or an RS 232/422 interface.

**Differentiation between electrode coating and carrier film**

**Requirement:** The electrode coating is interrupted periodically. As a result, the copper or aluminum carrier film is visible in these places. The interruptions act as “markings” for the process control – for example, for the cutting process – and are to be detected by sensors.

**Solution:** The robust L series safety switches with locking device keep safety doors securely locked until access is released by an electric signal. The series includes standard designs and a device with an RFID-coded actuator for optimal protection against tampering.

**Monitoring of doors, with locking device**

**Requirement:** Areas with hazardous movements can be entered via safety doors to allow maintenance. If the movement does not stop immediately after the door is opened, the door is to be guarded by a safety switch with locking device.

**Solution:** The KRT 3B contrast sensor differentiates reliably between the copper/aluminum film and the electrode coating, and thereby detects the markings. The one-button teach function can also be activated from the control. The large operating range of 60 mm ± 20 mm enables the sensors to be flexibly integrated into the machine.
The battery cell production

Presence control of battery cells on the transport carrier

**Requirement:** The presence and position of the battery cells on the transport carrier must be checked before the next processing step. To ensure that the system set-up is compact, the sensors must not take up much space.

**Solution:** The optical sensors of the 5B series require little installation space. Thanks to the optimized beam geometry, the devices are able to detect even flat battery cells reliably, thus ensuring the high availability of the machine.

2D-code reading on the cover of the battery cell

**Requirement:** The “track & trace” concept also includes the traceability of each individual battery cell that is in the work system. To make this possible, the laser-etched 2D-code (DPM code) on the cover must be read.

**Solution:** The DCR 200i 2D-code readers reliably read DPM codes on metallic surfaces – even if the objects are moving quickly. To enable adaptation of the reading range to the application, various optics models are available. The devices can be flexibly integrated via PROFINET IO/RT, Ethernet TCP/IP, UDP, RS 232 and RS 422 interfaces.

Presence control of battery cells

**Requirement:** Before the liquid is injected at the filling station, it is necessary to check that the battery cells are in the correct positions. This is also required to ensure that the battery cells are gripped reliably.

**Solution:** The optical sensors of the 3C series use their laser light source to detect the battery cells reliably, even in confined spaces. In addition, thanks to their active ambient light suppression, the sensors are unaffected by direct light from LED hall lighting. This prevents erroneous switching.
Presence control of battery cells in the filling station

Requirement: Before they are filled with liquid at the filling station, the presence of the battery cells must be checked. The sensor must reliably detect the reflective aluminum material of the cell cover.

Solution: The PRK 5B retro-reflective photoelectric sensors detect even reflective objects reliably. Thanks to the homogeneous light spot, the devices have safe switching behavior and can be aligned easily.

Monitoring of the fill level in the electrolyte container

Requirement: The fill level of the electrolyte in the container must be monitored from outside the container in a contactless manner.

Solution: The LCS-1 capacitive sensors detect the fill level in the container, even with many different container wall materials. To ensure easy handling and integration, models with a teach button and IO-Link are available.

2D-code reading for traceability

Requirement: Before the battery cell is placed into storage, it must be coated. The relevant information is coded and printed on the battery cell. Before the cell enters the coating machine, this information (data) must be detected to ensure traceability along the entire process chain.

Solution: Thanks to their high scanning rate, the DCR 200i 2D-code readers enable the reading of codes on quickly moving objects. To enable adaptation of the reading range, various optics models are available. Diverse interfaces can be used to integrate the devices easily into fieldbuses and commission them quickly with simple configuration tools.
Switching sensors

### Specifications

<table>
<thead>
<tr>
<th></th>
<th>3C series</th>
<th>5 series</th>
<th>15 series</th>
<th>25C series</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions excl. connector, W × D × H</strong></td>
<td>11 × 32 × 17 mm</td>
<td>14 × 32.5 × 20.2 mm</td>
<td>15 × 43 × 30 mm</td>
<td>15 × 43 × 30 mm</td>
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<tr>
<td><strong>Operating voltage</strong></td>
<td>10–30 V DC</td>
<td>10–30 V DC</td>
<td>10–30 V DC</td>
<td>10–30 V DC</td>
</tr>
<tr>
<td><strong>Switching outputs</strong></td>
<td>Push-pull, PNP, NPN, IO-Link</td>
<td>PNP, NPN</td>
<td>PNP, NPN</td>
<td>PNP, NPN, push-pull, IO-Link</td>
</tr>
<tr>
<td><strong>Connection type</strong></td>
<td>M8, cable, cable+M8/M12</td>
<td>M8, cable, cable+M8/M12</td>
<td>M12, cable, cable+M12</td>
<td>M8/M8+snap/M12, cable, cable+M8/M12</td>
</tr>
<tr>
<td><strong>Degree of protection</strong></td>
<td>IP 67, IP 69K</td>
<td>IP 67</td>
<td>IP 66, IP 67</td>
<td>IP 67, IP 69K</td>
</tr>
<tr>
<td><strong>Certifications</strong></td>
<td>CDRH C US</td>
<td>C US</td>
<td>C US</td>
<td>CDRH C US</td>
</tr>
<tr>
<td><strong>Housing</strong></td>
<td>Plastic</td>
<td>Plastic</td>
<td>Plastic</td>
<td>Plastic</td>
</tr>
<tr>
<td><strong>Operating range</strong></td>
<td>0–10 m</td>
<td>0–15 m</td>
<td>0–30 m</td>
<td>0–30 m</td>
</tr>
<tr>
<td><strong>Light source</strong></td>
<td>Laser</td>
<td>Red light, infrared</td>
<td>Red light</td>
<td>Red light</td>
</tr>
<tr>
<td><strong>Switching</strong></td>
<td>Light, dark, antivalent</td>
<td>Antivalent</td>
<td>Light, dark</td>
<td>Light, dark</td>
</tr>
<tr>
<td><strong>Switching frequency</strong></td>
<td>1,000 / 3,000 Hz</td>
<td>500 Hz</td>
<td>500 Hz</td>
<td>1,500 Hz</td>
</tr>
<tr>
<td><strong>Operating range</strong></td>
<td>0–7 / 0.02–5.5 / 0–3 m</td>
<td>0.02–6 m</td>
<td>0–8 / 0–10 m</td>
<td>0–10 / 0–12 / 0–25 m</td>
</tr>
<tr>
<td><strong>Light source</strong></td>
<td>Red light/infrared / laser (class 1)</td>
<td>Red light</td>
<td>Red light</td>
<td>Red light / laser</td>
</tr>
<tr>
<td><strong>Switching</strong></td>
<td>Light, dark, antivalent</td>
<td>Antivalent</td>
<td>Light, dark</td>
<td>Light, dark, antivalent</td>
</tr>
<tr>
<td><strong>Switching frequency</strong></td>
<td>1,000 / 1,500 / 3,000 Hz</td>
<td>500 Hz</td>
<td>500 Hz</td>
<td>1,500 / 2,500 Hz</td>
</tr>
<tr>
<td><strong>Operating range</strong></td>
<td>0–1 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Light source</strong></td>
<td>Red light / infrared</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Switching</strong></td>
<td>Antivalent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Switching frequency</strong></td>
<td>500 Hz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Operating range</strong></td>
<td>5–600 mm</td>
<td>0–400 mm</td>
<td>0–1,000 mm</td>
<td>0–1,200 mm / 0–1,300 mm</td>
</tr>
<tr>
<td><strong>Light source</strong></td>
<td>Red light / laser (class 1)</td>
<td>Red light</td>
<td>Red light / infrared</td>
<td>Red light / infrared</td>
</tr>
<tr>
<td><strong>Switching</strong></td>
<td>Light, dark, antivalent</td>
<td>Light, dark</td>
<td>Light, dark</td>
<td>Light, dark, antivalent</td>
</tr>
<tr>
<td><strong>Switching frequency</strong></td>
<td>1,000 / 3,000 Hz</td>
<td>1,000 Hz</td>
<td>500 Hz</td>
<td>1,000 Hz / 2,500 Hz</td>
</tr>
<tr>
<td><strong>Transparent media</strong></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Warning output</strong></td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td><strong>Activation input</strong></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td><strong>Deactivation input</strong></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Active ambient light suppression A/LS</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Properties</strong></td>
<td>ECOLAB</td>
<td>2 housings: through holes with metal sleeves or threaded sleeves</td>
<td>Sensor with different light-spot geometry and V-configuration</td>
<td>Laser variants Teach-in Bottle detection Contrast sensors Detection of labels on bottles Devices with IO-Link communication interface</td>
</tr>
</tbody>
</table>

* Typical operating range limit
### Technical data – Switching sensors

#### Photoel. sensors / diffuse sensors, cubic housing

**46C series**
- Universal, long range
- 20.5 × 76.3 × 44 mm
- 10–30 V DC
- PNP, NPN, push-pull
- M12, cable, cable+M12
- IP 67, IP 69K
- Plastic
- 0–150 m
- Red light, light, antivalent
- 100 / 500 Hz
- 0.05–30 m
- Red light
- Light, dark, antivalent
- 25 / 150 / 500 Hz
- Retro-refl. reflective photoelectric sensor with light-band for objects with openings / irregular shape
- Can be used as muting sensor | Roller conveyor sensor | Models for dusty environments | Optimized for parallel operation | Extreme background suppression | Devices with IO-Link interface

**318(B) series, 328 series**
- M18, cylindrical
- M18 × 46 mm, M18 × 60 mm
- 10–30 V DC
- PNP, NPN, push-pull
- M12, cable
- IP 67
- Plastic Full metal, stainless steel, plastic
- 0–150 m
- Red light / infrared
- 100 / 500 Hz
- 0.05–30 m
- Red light
- Light, dark, antivalent
- 25 / 150 / 500 Hz
- Retro-refl. reflective photoelectric sensor with light-band for objects with openings / irregular shape
- Can be used as muting sensor | Roller conveyor sensor | Models for dusty environments | Optimized for parallel operation | Extreme background suppression | Devices with IO-Link interface

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- M18 × 46 mm, M18 × 60 mm
- 10–30 V DC
- PNP, NPN, push-pull
- M12, cable
- IP 67
- Plastic
- 0–150 m
- Red light / infrared
- 100 / 500 Hz
- 0.05–30 m
- Red light
- Light, dark, antivalent
- 25 / 150 / 500 Hz
- Retro-refl. reflective photoelectric sensor with light-band for objects with openings / irregular shape
- Can be used as muting sensor | Roller conveyor sensor | Models for dusty environments | Optimized for parallel operation | Extreme background suppression | Devices with IO-Link interface

#### Special sensors

**KRT 3B**
- Contrast sensors
- Function Contrast distinction
- Dimensions excl. connector, W × D × H 11 × 32 × 17 mm
- Operating voltage 10–30 V DC
- Outputs Push-pull, IO-Link
- Connection type M8, cable, cable+M12
- Degree of protection IP 67
- Certifications CDRH C US
- Operating range* 0.0125 … 0.08 mm
- Light source LED, laser (class 1)
- Switching frequency 4,000–10,000 Hz
- Transmitter color RGB / white / red laser
- Light beam gate Front
- Light spot shape Rectangular or round
- Light spot orientation Lengthwise / sideways
- Operation Teach button, cable, IO-Link,
- Additional functions easy-Tune for manual adaptation of the switching threshold

### Specifications

**46C series**
- Function Contrast distinction
- Dimensions excl. connector, W × D × H 11 × 32 × 17 mm
- Operating voltage 10–30 V DC
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- Light spot orientation Lengthwise / sideways
- Operation Teach button, cable, IO-Link,
- Additional functions easy-Tune for manual adaptation of the switching threshold

### Additional notes

- Bracket versions | Simple alignment with omni-mount | Embedded mounting option | Models with M18 stainless steel sleeve and full-metal version | Variant available with preset range and as label sensor

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# Switching sensors

## Long-range sensors

<table>
<thead>
<tr>
<th>25 LR series</th>
<th>110 series</th>
<th>10 series</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions excl. connector, W × D × H</strong></td>
<td>15 × 38.9 × 28.7 mm</td>
<td>50 × 23 × 50 mm</td>
</tr>
<tr>
<td><strong>Operating voltage</strong></td>
<td>10–30 V DC</td>
<td>18–30 V DC</td>
</tr>
<tr>
<td><strong>Switching outputs</strong></td>
<td>PNP, NPN, push-pull, IO-Link</td>
<td>Push-pull</td>
</tr>
<tr>
<td><strong>Connection type</strong></td>
<td>Cable+M12</td>
<td>Turnable M12 connector</td>
</tr>
<tr>
<td><strong>Degree of protection</strong></td>
<td>IP 67</td>
<td>IP 67, IP 69K</td>
</tr>
<tr>
<td><strong>Certifications</strong></td>
<td>CDRH US</td>
<td>CDRH US</td>
</tr>
<tr>
<td><strong>Housing</strong></td>
<td>Plastic</td>
<td>Plastic</td>
</tr>
</tbody>
</table>

### Diffuse sensors with background suppression

| **Operating range** | 50–3,000 mm | 100–5,000 mm (WH) / 3,000 mm (BK) | 50–8,000 mm / 25,000 mm |
| **Light source** | Infrared | Red light laser (class 1) | Red light laser (class 1) |
| **Switching** | Light, dark | Light | Light |
| **Switching frequency** | 40 / 75 Hz | 250 Hz | 40 Hz |

### Additional functions

- **Transparent media**
- **Protective sensors category 2/4**
- **Warning output**
- **Activation input**
- **Active ambient light suppression ALS**

### Properties

- Detection of objects with low diffuse reflection > 2%
- 2 teachable switching points (TOF)
- Line teach and deactivation
- All devices with IO-Link interface for configuration (including adaptation to the application) and process data transfer
- Very good fading
- Operating range adjustment via IO-Link
- All devices with IO-Link interface
- Turnable M12 connector
- 2 switching points
- Small black-white error
- High repeatability
- Adjustment via teach buttons
- Propagation time of the radiated light (TOF)
- Turnable M12 connector
- All devices with IO-Link interface
- Light/dark switching via teach button
- Window function
- Adaptation to the application by means of configurable filters and gain values
- Propagation time of the radiated light (TOF)
<table>
<thead>
<tr>
<th>Specifications</th>
<th>Inductive switches</th>
<th>Capacitive sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS 203, 204, 205, 206</td>
<td>IS 208, 212, 218, 230</td>
<td>IS 240, 244 / ISS 244</td>
</tr>
<tr>
<td>Dimensions incl. connector, W × D × H</td>
<td>M8: 22 – 45 mm</td>
<td>LCS-2</td>
</tr>
<tr>
<td>Ø 3.0: 22 mm</td>
<td>M12: 35 – 60 mm</td>
<td>Capacitive sensors, cylindrical</td>
</tr>
<tr>
<td>Ø 4.0: 25 mm</td>
<td>M18: 35 – 64 mm</td>
<td></td>
</tr>
<tr>
<td>M5: 25 – 38 mm</td>
<td>M30: 40.6 – 73.5 mm</td>
<td></td>
</tr>
<tr>
<td>Ø 6.5: 35 – 65 mm</td>
<td>12 × 40 × 26 mm</td>
<td></td>
</tr>
<tr>
<td>Type of installation</td>
<td>Embedded / non-embedded</td>
<td>Embedded / non-embedded</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>10 – 30 V DC</td>
<td>Embedded / non-embedded</td>
</tr>
<tr>
<td>Operating range</td>
<td>1 – 3 mm</td>
<td>10 – 30 V DC</td>
</tr>
<tr>
<td>Switching outputs</td>
<td>PNP</td>
<td>10 – 30 V DC</td>
</tr>
<tr>
<td>Switching principle</td>
<td>NO, NC</td>
<td>10 – 30 V DC</td>
</tr>
<tr>
<td>Switching frequency</td>
<td>Up to 5,000 Hz</td>
<td>10 – 30 V DC</td>
</tr>
<tr>
<td>Connection type</td>
<td>M8, cable + M8, cable</td>
<td>10 – 30 V DC</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP 67</td>
<td>10 – 30 V DC</td>
</tr>
<tr>
<td>Certifications</td>
<td>CE</td>
<td>CE</td>
</tr>
<tr>
<td>Housing</td>
<td>Stainless steel (V2A)</td>
<td>CE</td>
</tr>
<tr>
<td>Properties</td>
<td>Cylindrical miniature housing</td>
<td>Metal</td>
</tr>
<tr>
<td>IS 203, 204, 205, 206</td>
<td>IS 208, 212, 218, 230</td>
<td>Plastic</td>
</tr>
<tr>
<td>Different versions available:</td>
<td>M8, cable + M8, cable</td>
<td>Metal / plastic</td>
</tr>
<tr>
<td>IS 203, 204, 205, 206</td>
<td>IS 208, 212, 218, 230</td>
<td></td>
</tr>
</tbody>
</table>
# Measuring sensors

## Specifications

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<th>ODS 9</th>
<th>ODS 10</th>
<th>ODS 110</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Function</strong></td>
<td>Distance measurement, optical</td>
<td>Distance measurement, optical</td>
<td>Distance measurement, optical</td>
</tr>
<tr>
<td><strong>Dimensions excl. connector, W × D × H</strong></td>
<td>21 × 50 × 50 mm</td>
<td>25 × 65 × 55 mm</td>
<td>50 × 23 × 50 mm</td>
</tr>
<tr>
<td><strong>Operating voltage</strong></td>
<td>18–30 V DC (analog, IO-Link)</td>
<td>18–30 V DC</td>
<td>18–30 V DC</td>
</tr>
<tr>
<td><strong>Connection type</strong></td>
<td>M12</td>
<td>M12</td>
<td>M12</td>
</tr>
<tr>
<td><strong>Degree of protection</strong></td>
<td>IP 67</td>
<td>IP 67</td>
<td>IP 67</td>
</tr>
<tr>
<td><strong>Certifications</strong></td>
<td>CDRH, CUS</td>
<td>CDRH, CUS</td>
<td>CDRH, CUS</td>
</tr>
<tr>
<td><strong>Measurement range</strong></td>
<td>50–650 mm</td>
<td>50–3,500 mm (90% diffuse reflection)</td>
<td>100–3,000 mm</td>
</tr>
<tr>
<td><strong>Measurement principle</strong></td>
<td>Optical / laser (class 1, 2)</td>
<td>Optical / laser (class 1)</td>
<td>Optical / laser (class 1)</td>
</tr>
<tr>
<td><strong>Measurement time</strong></td>
<td>1 ms</td>
<td>3,4–1,020 ms (adjustable)</td>
<td>4 ms</td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
<td>0.01–0.5 mm</td>
<td>1 mm</td>
<td>1 mm</td>
</tr>
<tr>
<td><strong>Mouth width</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mouth depth</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number of inspection tasks</strong></td>
<td>Teach-in</td>
<td>Control buttons on foil display or Sensor Studio</td>
<td>Teach-in or Sensor Studio</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td>Display for measured value display and configuration</td>
<td>Display for measured value display and configuration</td>
<td>All devices with IO-Link interface</td>
</tr>
</tbody>
</table>

## Properties

- Display for measured value display and configuration
- Turnable M12 connector
- Triangulation measurement
- Supports the IO-Link smart sensor profile
- All devices with IO-Link interface
- Turnable M12 connector
- Adjustment via teach button
- Propagation time measurement (TOF)
Technical data – Measuring sensors

**ODSL 96**
Optical distance sensors

**300, 400 series**
Measuring ultrasonic sensors

**GS 754B**
CCD fork sensors

<table>
<thead>
<tr>
<th>Distance measurement, optical</th>
<th>Distance measurement, ultrasonics</th>
<th>Edge/diameter measurement, optical</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 × 90 × 70 mm</td>
<td>M18 × 46.3 / 51.8 / 74.3 / 75 / 77.6 / 82.8 mm</td>
<td>19.4 × 81.5 × 91 mm</td>
</tr>
<tr>
<td></td>
<td>M30 × 75 / 88.8 / 142.5 mm</td>
<td>20 × 155 × 91.5 mm</td>
</tr>
</tbody>
</table>

| 10–30 V DC                    | 10–30 V DC (digital)               |
| 18–30 V DC (analog, IO-Link)  | 18–30 V DC (analog)               |
| 4–20 mA                       | 2 × 4–20 mA                       |
| 1–10 V / 0–10 V               | 2 × 0–10 V                        |
| RS 232 / RS 485               | RS 232 / RS 422 / RS 485         |
| Push-pull IO-Link             | 1 × PNP; 2 × PNP                  |

| M12, cable                    | M12                                |
| IP 67, IP 69K                 | IP 67                              |

**Ultrasonic sensors**

<table>
<thead>
<tr>
<th>Optical / LED / laser (class 1, 2)</th>
<th>Ultrasonics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–100 ms</td>
<td>0.1–1 s</td>
</tr>
<tr>
<td></td>
<td>Min. 2.5 ms</td>
</tr>
</tbody>
</table>

| 25–400 / 50–400 / 80–1,200 / 150–1,300 / 250–3,500 / 300–3,000 / 350–6,000 / 600–6,000 mm |

60–25,000 mm

**Fork sensors**

<table>
<thead>
<tr>
<th>Detection of transparent media</th>
</tr>
</thead>
</table>

| 3/5 operating modes | Temperature-compensated | Metal/plastic housing | Small dead zone |

**Teach-in**

<table>
<thead>
<tr>
<th>Terminal program via RS232 interface</th>
</tr>
</thead>
</table>

**Configuration software**

| Foil detection > 0.1 mm |
| KnowLEDGE |

**Display**

<table>
<thead>
<tr>
<th>Triangulation measurement</th>
</tr>
</thead>
</table>

**Propagation time measurement (TOP)**

<table>
<thead>
<tr>
<th>Turnable M12 connector</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Wide-ranging evaluation functions</th>
</tr>
</thead>
</table>

**Robust metal housing**

| Perfect for thread and fiber measurement |

| M12 connector |

**Ex devices are also available**

| Small dead zone |

| Wide-ranging evaluation functions |

**Triangulation measurement**

| Small dead zone |

**Detection of transparent media**

| Foil detection > 0.1 mm |

| Turnable M12 connector |

**Foil detection > 0.1 mm**

| Turnable M12 connector |

**Wide-ranging evaluation functions**

| Perfect for thread and fiber measurement |

**Small dead zone**

| Perfect for thread and fiber measurement |

**Foil detection > 0.1 mm**

| Turnable M12 connector |

**Wide-ranging evaluation functions**

| Perfect for thread and fiber measurement |

**Robust metal housing**

| Perfect for thread and fiber measurement |

**Foil detection > 0.1 mm**

| Turnable M12 connector |

**Wide-ranging evaluation functions**

| Perfect for thread and fiber measurement |

**Small dead zone**

| Perfect for thread and fiber measurement |

**Turnable M12 connector**

| Perfect for thread and fiber measurement |

**Wide-ranging evaluation functions**

| Perfect for thread and fiber measurement |

**Small dead zone**

| Perfect for thread and fiber measurement |

**Turnable M12 connector**

| Perfect for thread and fiber measurement |

**Wide-ranging evaluation functions**

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| Perfect for thread and fiber measurement |

**Wide-ranging evaluation functions**

| Perfect for thread and fiber measurement |

**Small dead zone**

| Perfect for thread and fiber measurement |

**Turnable M12 connector**

| Perfect for thread and fiber measurement |

**Wide-ranging evaluation functions**

| Perfect for thread and fiber measurement |
# Measuring sensors

## Sensors for positioning

<table>
<thead>
<tr>
<th>AMS 300i</th>
<th>BPS 8</th>
<th>BPS 300i</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Function</strong></td>
<td>Distance measurement, optical</td>
<td>Position detection, optical</td>
</tr>
<tr>
<td><strong>Operating range</strong></td>
<td>40 / 120 / 200 / 300 m</td>
<td>10,000 m</td>
</tr>
<tr>
<td><strong>Reading distance</strong></td>
<td>60 … 140 mm</td>
<td>50 … 170 mm</td>
</tr>
<tr>
<td><strong>Interfaces</strong></td>
<td>Integrated: PROFIBUS and SSI</td>
<td>Integrated: PROFIBUS</td>
</tr>
<tr>
<td></td>
<td>PROFINET</td>
<td>PROFINET</td>
</tr>
<tr>
<td></td>
<td>PROFINET and SSI</td>
<td>EtherCAT</td>
</tr>
<tr>
<td></td>
<td>DeviceNet</td>
<td>PROFINET</td>
</tr>
<tr>
<td></td>
<td>EtherCAT</td>
<td>EtherNet/IP</td>
</tr>
<tr>
<td></td>
<td>EtherNet/IP, UDP</td>
<td>Ethernet TCP/IP, UDP</td>
</tr>
<tr>
<td></td>
<td>Interbus-S</td>
<td>RS 422, RS 485</td>
</tr>
<tr>
<td></td>
<td>RS 232, RS 422, RS 485 SSI</td>
<td></td>
</tr>
<tr>
<td><strong>Connectivity</strong></td>
<td>Via the interfaces mentioned above</td>
<td>With MA 200i connection unit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PROFINET IO/RT, PROFIBUS,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ethernet TCP/IP, UDP, IP,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EtherCAT, DeviceNet, CANopen</td>
</tr>
<tr>
<td><strong>Position calculation through</strong></td>
<td>Reflector</td>
<td>Bar code tape</td>
</tr>
<tr>
<td><strong>Measurement value output</strong></td>
<td>1.7 ms</td>
<td>3.3 ms</td>
</tr>
<tr>
<td><strong>Reproducibility</strong></td>
<td>±0.9 / 1.5 / 2.1 / 3 mm (3 sigma)</td>
<td>±1 mm (3 sigma)</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>±2 / 2 / 3 / 5 mm</td>
<td></td>
</tr>
<tr>
<td><strong>Degree of protection</strong></td>
<td>IP 65</td>
<td>IP 67</td>
</tr>
<tr>
<td><strong>Light source</strong></td>
<td>Red light laser (class 2)</td>
<td>Red light laser (class 2)</td>
</tr>
<tr>
<td><strong>Supply voltage</strong></td>
<td>18 – 30 V DC</td>
<td>5 V DC (24 V DC via MA 8-01)</td>
</tr>
<tr>
<td><strong>Operating temperature</strong></td>
<td>−5 °C … +50 °C (−30 °C … +50 °C with heating)</td>
<td>0 °C … +40 °C (−35 °C … +50 °C with heating)</td>
</tr>
<tr>
<td><strong>Options</strong></td>
<td>Speed measurement and monitoring</td>
<td>Customer-specific configuration facility</td>
</tr>
<tr>
<td><strong>Certifications</strong></td>
<td>C</td>
<td>C</td>
</tr>
</tbody>
</table>

## Properties

- Absolute measurement system with very high accuracy, tested by the Physikalisch Technische Bundesanstalt (German Metrology Institute) | Distance measurements of up to 10,000 m, also for curves, gradients and track switches | Positioning on curves, gradients and track switches | Curve-going, horizontally and vertically |
- Simultaneous use of the PROFIBUS and SSI; alternatively, PROFINET and SSI interface | Compact metal housing | Metal housing | 3 selectable connection systems |
- Easy programming via extensive configuration file | Turnable M12 connector | Fast, secure and position-neutral installation | Using special mounting device |
- Optionally with heating | Large selection of different protocols via external MA 200i connection units | Extensive diagnostic options | |
- Heatable reflectors available as accessories | Comfortable programming via GSDML/GSD or ESI files | Optionally with heating or display |
## Technical data – Measuring sensors

### Specifications

<table>
<thead>
<tr>
<th>Function</th>
<th>CML 700i Measuring</th>
<th>CSL 505 Switching</th>
<th>CSL 710 Switching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size / contour detection, optical</td>
<td>Throughbeam principle</td>
<td>Throughbeam principle</td>
<td></td>
</tr>
<tr>
<td>Dimensions excl. connector, $W \times D \times H$</td>
<td>$29 \times 35 \times 168 \ldots 2,968 \text{ mm}$</td>
<td>$10 \times 27 \times 150 \ldots 3,180 \text{ mm}$</td>
<td>$29 \times 35 \times 168 \ldots 2,968 \text{ mm}$</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>$18 \ldots 30 \text{ V DC}$</td>
<td>$24 \text{ V DC}$</td>
<td>$18 \ldots 30 \text{ V DC}$</td>
</tr>
<tr>
<td>Outputs</td>
<td>Analog, CANopen, IO-Link, PROFIBUS, PROFINET, RS 485 (MODBUS)</td>
<td>2x outputs / push-pull</td>
<td>4 I/Os (configurable) + IO-Link</td>
</tr>
<tr>
<td>Connection type</td>
<td>M12</td>
<td>M8</td>
<td>M12</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP 65</td>
<td>IP 65</td>
<td>IP 65</td>
</tr>
<tr>
<td>Operating range*</td>
<td>4.5 ... 9.5 m</td>
<td>Up to 5 m</td>
<td>Up to 3.5 ... 7 m</td>
</tr>
<tr>
<td>Light source / Measurement principle</td>
<td>Infrared</td>
<td>Infrared</td>
<td>Infrared</td>
</tr>
<tr>
<td>Cycle time / measurement time</td>
<td>10...30 μs per beam + 0.4 ms</td>
<td>1 ms per beam</td>
<td>30 μs per beam</td>
</tr>
<tr>
<td>Measurement field length / scanning angle</td>
<td>160...2,960 mm</td>
<td>35...3,100 mm</td>
<td>160...2,960 mm</td>
</tr>
<tr>
<td>Resolution</td>
<td>5, 10, 20, 40 mm</td>
<td>5**, 12.5, 25, 50, 100 mm</td>
<td>5, 10, 20, 40 mm</td>
</tr>
<tr>
<td>Number of beams</td>
<td>Max. 592</td>
<td>Max. 160</td>
<td>Max. 592</td>
</tr>
<tr>
<td>Operation</td>
<td>Control buttons on foil display, 5 languages, configuration software</td>
<td>Autocalibration, configuration software, configuration by means of pin assignment</td>
<td>Control buttons on foil display, 5 languages, configuration software</td>
</tr>
</tbody>
</table>

### Properties

<table>
<thead>
<tr>
<th>Cycle time CML 730: 10 μs x number of beams + 0.4 ms</th>
<th>Cycle time CML 720: 30 μs x number of beams + 0.4 ms</th>
<th>Detection of transparent media</th>
<th>Display for diagnosis and alignment</th>
<th>Standard profile for simple mounting</th>
<th>Robust metal housing</th>
<th>Suitable for low-temperature applications down to −30 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 switching ranges</td>
<td>Narrow profile</td>
<td>Through holes</td>
<td>Suitable for low-temperature applications down to −30 °C</td>
<td>8 switching ranges</td>
<td>Simple area splitting</td>
<td>4 switching outputs + 1 IO-Link</td>
</tr>
</tbody>
</table>

* Guaranteed operating range
** 5 mm resolution only with 58 mm housing depth
### General

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protective field range</strong> (at 10% diffuse reflection)</td>
<td>3,0 / 4,5 / 6,25 / 8,25 m</td>
<td>3,0 / 4,5 / 6,25 / 8,25 m</td>
<td>3,0 / 4,5 / 6,25 / 8,25 m</td>
</tr>
<tr>
<td><strong>Scanning angle</strong></td>
<td>270°</td>
<td>270°</td>
<td>270°</td>
</tr>
<tr>
<td><strong>Angular resolution</strong></td>
<td>0.1°</td>
<td>0.1°</td>
<td>0.1°</td>
</tr>
<tr>
<td><strong>Warning field range</strong></td>
<td>20 m</td>
<td>20 m</td>
<td>20 m</td>
</tr>
<tr>
<td><strong>Resolution, selectable</strong></td>
<td>30 / 40 / 50 / 60 / 70 / 150 mm</td>
<td>30 / 40 / 50 / 60 / 70 / 150 mm</td>
<td>30 / 40 / 50 / 60 / 70 / 150 mm</td>
</tr>
<tr>
<td><strong>Response time</strong></td>
<td>≥ 80 ms</td>
<td>≥ 80 ms</td>
<td>≥ 120 ms</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td>Type 2, SIL 3, PL d</td>
<td>Type 2, SIL 3, PL d</td>
<td>Type 2, SIL 3, PL d</td>
</tr>
<tr>
<td><strong>Dimensions, incl. connection unit (W × H × D)</strong></td>
<td>140 × 149 × 140 mm</td>
<td>140 × 149 × 140 mm</td>
<td>140 × 169 × 140 mm</td>
</tr>
<tr>
<td><strong>Temperature range</strong></td>
<td>0 … +50°</td>
<td>0 … +50°</td>
<td>0 … +50°</td>
</tr>
<tr>
<td><strong>Certifications</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Functions

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Safety-related switching outputs</strong></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Number of field pairs (1 protective field + 1 warning field)</strong></td>
<td>RSL 410: 1</td>
<td>RSL 430: 10</td>
</tr>
<tr>
<td>RSL 420: 10</td>
<td>RSL 440, 445: 100</td>
<td>RSL 450P, 455P: 100</td>
</tr>
<tr>
<td><strong>Number of 4-field sets (1 protective field + 3 warning fields)</strong></td>
<td>RSL 410: 1</td>
<td>RSL 440, 445: 50</td>
</tr>
<tr>
<td>RSL 420: 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number of 4-field sets (2 protective fields + 2 warning fields)</strong></td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Number of independent sensor configurations</strong></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Plain-text display, integrated electronic spirit level</strong></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Configurable signal outputs</strong></td>
<td>RSL 410: 3</td>
<td>RSL 420: 4</td>
</tr>
<tr>
<td><strong>UDP data output optimized for AGV navigation, configurable, 50 m operating range</strong></td>
<td>RSL 425</td>
<td>RSL 445</td>
</tr>
<tr>
<td><strong>Connection unit (removable, with integrated configuration memory)</strong></td>
<td>RSL 410: M12 connector, RSL 420, 425: cable or connector, 16-pin</td>
<td>Cable or connector, 29-pin</td>
</tr>
<tr>
<td><strong>Interfaces for configuration and diagnosis</strong></td>
<td>Ethernet TCP/IP, Bluetooth RSL 420, 425: USB</td>
<td>Ethernet TCP/IP, USB, Bluetooth</td>
</tr>
<tr>
<td><strong>PROFINET</strong></td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Further features</strong></td>
<td>Technology for robust operation</td>
<td>Technology for robust operation</td>
</tr>
<tr>
<td>Start/restart interlock (RES)</td>
<td>Start/restart interlock (RES)</td>
<td>Vertical access guarding with reference boundary monitoring</td>
</tr>
<tr>
<td>Vertical access guarding with reference boundary monitoring</td>
<td>Start/restart interlock (RES)</td>
<td>Vertical access guarding with reference boundary monitoring</td>
</tr>
<tr>
<td>Parking function (protective field switch-over, RSL 420 and RSL 425)</td>
<td>Parking function (protective field switch-off)</td>
<td>Parking function (protective field switch-off)</td>
</tr>
</tbody>
</table>
### General

<table>
<thead>
<tr>
<th>Specification</th>
<th>LBK-S01 with LBK-ISC controller</th>
<th>LBK-SBV-01 with LBK-ISC controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIL in accordance with EN IEC 62061 (SIL)</td>
<td>SIL 2</td>
<td>SIL 2</td>
</tr>
<tr>
<td>Performance Level (PL) in accordance with EN ISO 13849-1</td>
<td>PL d</td>
<td>PL d</td>
</tr>
<tr>
<td>Category in accordance with EN ISO 13849-1</td>
<td>Category 2</td>
<td>Category 3</td>
</tr>
<tr>
<td>Operating principle</td>
<td>FMCW (frequency modulated continuous wave) for movement detection</td>
<td>FMCW (frequency modulated continuous wave) for movement detection</td>
</tr>
<tr>
<td>Response time</td>
<td>100 ms</td>
<td>100 ms</td>
</tr>
<tr>
<td>Temperature range</td>
<td>–30 … +60°C</td>
<td>–30 … +60°C</td>
</tr>
<tr>
<td>Certifications</td>
<td></td>
<td></td>
</tr>
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</table>

### Sensor

<table>
<thead>
<tr>
<th>Specification</th>
<th>LBK-S01 with LBK-ISC controller</th>
<th>LBK-SBV-01 with LBK-ISC controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating range</td>
<td>1 … 4 m</td>
<td>1 … 5 m</td>
</tr>
<tr>
<td>Angle of radiation (Wide)</td>
<td>110° (horizontal plane)</td>
<td>30° (vertical plane)</td>
</tr>
<tr>
<td></td>
<td>50° (horizontal plane)</td>
<td>15° (vertical plane)</td>
</tr>
<tr>
<td>Restart time</td>
<td>10 s</td>
<td>4 s</td>
</tr>
<tr>
<td>Frequency range</td>
<td>24.0 … 24.5 GHz</td>
<td>60.6 … 62.8 GHz</td>
</tr>
<tr>
<td>Emitted power</td>
<td>≤ 13 dBm</td>
<td>≤ 16 dBm</td>
</tr>
<tr>
<td>Dimensions (W × H × D)</td>
<td>165 × 125 × 53 mm</td>
<td>158 × 132 × 71 mm</td>
</tr>
<tr>
<td>Connection</td>
<td>M12, 5-pin</td>
<td>M12, 5-pin</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>Via controller</td>
<td>Via controller</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP 67</td>
<td>IP 67</td>
</tr>
</tbody>
</table>

### Controller

<table>
<thead>
<tr>
<th>Specification</th>
<th>LBK-S01 with LBK-ISC controller</th>
<th>LBK-SBV-01 with LBK-ISC controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety-related switching outputs</td>
<td>ISC-02/03: 2 x 2 PNP transistor outputs (OSSDs)</td>
<td>ISC-02/03: 2 x 2 PNP transistor outputs (OSSDs)</td>
</tr>
<tr>
<td></td>
<td>ISC Bus PS: PROFIsafe in addition</td>
<td>ISC Bus PS: PROFIsafe in addition</td>
</tr>
<tr>
<td>Signal outputs</td>
<td>The PNP transistor outputs can be configured as signal outputs</td>
<td>The PNP transistor outputs can be configured as signal outputs</td>
</tr>
<tr>
<td>Inputs</td>
<td>2 (2-channel)</td>
<td>2 (2-channel)</td>
</tr>
<tr>
<td>Number of sensors in a system</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Number of configurable groups (1 to 6 sensors)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Deactivation of individual groups</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Switchable configurations</td>
<td>ISC-02/03: 4, ISC Bus PS: 32</td>
<td>ISC-02/03: 4, ISC Bus PS: 32</td>
</tr>
<tr>
<td>Start / restart interlock (RES)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Dimensions (W × H × D)</td>
<td>105 × 58 × 103 mm</td>
<td>105 × 58 × 103 mm</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP 20</td>
<td>IP 20</td>
</tr>
<tr>
<td>Interfaces for configuration and diagnosis</td>
<td>ISC-02, ISC BUS PS: Ethernet TCP/IP</td>
<td>ISC-02, ISC BUS PS: Ethernet TCP/IP</td>
</tr>
<tr>
<td></td>
<td>ISC-02/03, ISC BUS PS: Micro-USB</td>
<td>ISC-02/03, ISC BUS PS: Micro-USB</td>
</tr>
</tbody>
</table>
## Safety

### Technical data – Safety

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<tr>
<th>Feature</th>
<th>ELC 100</th>
<th>MLC 310</th>
<th>MLC 510</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type in accordance with EN IEC 61496</td>
<td>Type 4</td>
<td>MLC 300: type 2</td>
<td>MLC 500: type 4</td>
</tr>
<tr>
<td>SIL in accordance with IEC 61508 and EN IEC 62061 (SILCL)</td>
<td>SIL 3</td>
<td>MLC 300: SIL 1</td>
<td>MLC 500: SIL 3</td>
</tr>
<tr>
<td>Performance Level (PL) in accordance with EN ISO 13849-1</td>
<td>PL e</td>
<td>MLC 300: PL c</td>
<td>MLC 500: PL e</td>
</tr>
<tr>
<td>Resolution</td>
<td>17 / 30 mm</td>
<td>14 / 20 / 30 / 40 / 90 mm</td>
<td></td>
</tr>
<tr>
<td>Operating range</td>
<td>3 / 6 m</td>
<td>6 / 15 / 10 / 20 / 20 m</td>
<td></td>
</tr>
<tr>
<td>Protective field height</td>
<td>300 ... 1,500 mm</td>
<td>150 ... 3,000 mm</td>
<td></td>
</tr>
<tr>
<td>Response time</td>
<td>4.5 – 21 ms</td>
<td>MLC 300: 3 – 51 ms</td>
<td>MLC 500: 3 – 64 ms</td>
</tr>
<tr>
<td>Profile cross section</td>
<td>34.7 mm × 39.3 mm</td>
<td>29 × 35 mm</td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>0 ... +55°C</td>
<td>MLC 300: 0 ... +55°C</td>
<td>MLC 500: –30 ... +55°C</td>
</tr>
<tr>
<td>Safety-related switching outputs (OSSDs)</td>
<td>2 PNP transistor outputs</td>
<td>2 PNP transistor outputs</td>
<td></td>
</tr>
<tr>
<td>Connection type</td>
<td>300 mm cable with M12 connector</td>
<td>M12 connector</td>
<td></td>
</tr>
<tr>
<td>Certifications</td>
<td></td>
<td></td>
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</table>

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<th>ELC 100</th>
<th>MLC 310</th>
<th>MLC 510</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range reduction on the transmitter</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switchable transmission channels</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED indicator</td>
<td>X (additional alignment indicator)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>7-segment display</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Configuration by means of wiring</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automatic start/restart</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Start/restart interlock (RES)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contactor monitoring (EDM)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beam blanking, fixed or movable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muting function, integrated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linkage of safety output, multiscan</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Application or special

<table>
<thead>
<tr>
<th>Feature</th>
<th>ELC 100</th>
<th>MLC 310</th>
<th>MLC 510</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely slim design</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Cascadable (triple)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AIDA version</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS-i Safety interface</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ex marking acc. to EN 60079</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degrees of protection IP 67 / IP 69K, mounted in protective tube</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Extra shock/vibration resistant</td>
<td>X (standard for all devices)</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
### Technical Data – Safety

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>SIL</th>
<th>PL</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLC 300: type 2</td>
<td>Type 4</td>
<td>SIL 3</td>
<td>PL c</td>
</tr>
<tr>
<td>MLC 500: type 4</td>
<td>Type 4</td>
<td>SIL 3</td>
<td>PL e</td>
</tr>
<tr>
<td>MLC 300: type 1</td>
<td>SIL 3</td>
<td>SIL 3</td>
<td>PL e</td>
</tr>
<tr>
<td>MLC 500: type 3</td>
<td>SIL 3</td>
<td>SIL 3</td>
<td>PL e</td>
</tr>
<tr>
<td>MLC 300: PL c</td>
<td>PL e</td>
<td>SIL 3</td>
<td>PL e</td>
</tr>
<tr>
<td>MLC 500: type 4</td>
<td>Type 4</td>
<td>SIL 3</td>
<td>PL e</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MLC 300: 14/20/30/40/90 mm</th>
<th>MLC 500: 14/20/30/40/90 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>14/24 mm</td>
<td>14/20/30/40/90 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MLC 300: 6/15/10/20/20 m</th>
<th>MLC 500: 6/15/10/20/20 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 m</td>
<td>10/20/20 m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MLC 300: 150 ... 3,000 mm</th>
<th>MLC 500: 150 ... 3,000 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 ... 1,200 mm</td>
<td>150 ... 3,000 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MLC 300: 14 – 51 ms</th>
<th>MLC 500: 3 – 64 ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 – 17 ms</td>
<td>3 – 64 ms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MLC 300: 15.4 × 32.6 mm</th>
<th>MLC 500: 29 × 35 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>29 x 35 mm</td>
<td>29 x 35 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MLC 300: 0 °C ... +55°C</th>
<th>MLC 500: –30 °C ... +55°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>–10 °C ... +55°C</td>
<td>–30 °C ... +55°C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2 PNP Transistor Outputs</th>
<th>2 PNP Transistor Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 PNP Transistor Outputs</td>
<td>2 PNP Transistor Outputs</td>
</tr>
</tbody>
</table>

M12 connector options:

- 160 mm cable with M12 connector
- M12 connector
- M12 connector

Certifications:

- CE
- UL
- CSA
- NRTL
- TUV
- VDE
- KEMA
- SABS

.functions

- Range Reduction on the Transmitter (X)
- Switchable Transmission Channels (X)
- LED Indicator (X) (Additional Alignment Indicator)
- 7-Segment Display (X)
- Configuration by Means of Wiring (X)
- Automatic Start / Restart (X)
- Start / Restart Interlock (RES) (X)
- Contactor Monitoring (EDM) (X)
- Beam Blanking, Fixed or Movable (X)
- Muting Function, Integrated (X) (2-sensor Timing Controlled)
- Linkage of Safety Output, Multiscan (X)

Versions for Special Applications:

- Extremely Slim Design (X)
- Cascadable (triple) (X)
- AIDA Version (X)
- AS-i Safety Interface (X)
- Ex Marking acc. to EN 60079 (group II, cat 3D and 3G)
- Degrees of Protection IP 67 / IP 69K, Mounted in Protective Tube (X)
- Extra Shock / Vibration Resistant (X) (Standard for All Devices) (X) (X)

(group II, cat 3D and 3G)
### Safety

#### Multiple light beam safety devices

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<tr>
<th></th>
<th>MLD 310, 320</th>
<th>MLD 510, 520</th>
<th>MLD 330, 335</th>
<th>MLD 530, 535</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type in accordance with EN IEC 61496</td>
<td>MLD 300: type 2</td>
<td>MLD 300: type 2</td>
<td>MLD 300: type 2</td>
<td>MLD 300: type 2</td>
</tr>
<tr>
<td></td>
<td>MLD 500: type 4</td>
<td>MLD 500: type 4</td>
<td>MLD 500: type 4</td>
<td>MLD 500: type 4</td>
</tr>
<tr>
<td>SIL in accordance with IEC 61508 and EN IEC 62061 (SILCL)</td>
<td>MLD 300: SIL 1</td>
<td>MLD 300: SIL 1</td>
<td>MLD 300: SIL 1</td>
<td>MLD 300: SIL 1</td>
</tr>
<tr>
<td></td>
<td>MLD 500: SIL 3</td>
<td>MLD 500: SIL 3</td>
<td>MLD 500: SIL 3</td>
<td>MLD 500: SIL 3</td>
</tr>
<tr>
<td>Performance Level (PL) in accordance with EN ISO 13849-1</td>
<td>MLD 300: PL c</td>
<td>MLD 300: PL c</td>
<td>MLD 300: PL c</td>
<td>MLD 300: PL c</td>
</tr>
<tr>
<td>Number of beams / beam distance</td>
<td>2 / 500 mm</td>
<td>3 / 400 mm</td>
<td>4 / 300 mm</td>
<td>2 / 500 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of beams / beam distance</td>
<td>3 / 400 mm</td>
<td>4 / 300 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of beams / beam distance</td>
<td>4 / 300 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating range</td>
<td>0.5 ... 50 m or 20 ... 70 m (transmitter-receiver systems)</td>
<td>0.5 ... 50 m or 20 ... 70 m (transmitter-receiver systems)</td>
<td>0.5 ... 6/8 m (transceiver systems)</td>
<td>0.5 ... 6/8 m (transceiver systems)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Dimensions</td>
<td>Profile cross section 52 × 65 mm</td>
<td>Profile cross section 52 × 65 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>–30 ... +55 °C</td>
<td>–30 ... +55 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety-related switching outputs</td>
<td>2 PNP transistor outputs (OSSDs)</td>
<td>2 PNP transistor outputs (OSSDs)</td>
<td></td>
<td></td>
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<tr>
<td>Connection type</td>
<td>M12 connector</td>
<td>M12 connector</td>
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<tr>
<td><strong>Certifications</strong></td>
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</tr>
<tr>
<td><strong>Functions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED indicator</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>7-segment display</td>
<td>MLD 320, 520</td>
<td>X</td>
<td>MLD 320, 520</td>
<td>X</td>
</tr>
<tr>
<td>Start / restart interlock (RES)</td>
<td>MLD 320, 520</td>
<td>X</td>
<td>MLD 320, 520</td>
<td>X</td>
</tr>
<tr>
<td>Contactor monitoring (EDM)</td>
<td>MLD 320, 520</td>
<td>X</td>
<td>MLD 320, 520</td>
<td>X</td>
</tr>
<tr>
<td>Configuration by means of wiring</td>
<td>MLD 320, 520</td>
<td>X</td>
<td>MLD 320, 520</td>
<td>X</td>
</tr>
<tr>
<td>Laser alignment aid (optional for transmitter-receiver systems)</td>
<td>X</td>
<td>X</td>
<td>MLD 330, 530</td>
<td>MLD 335, 535</td>
</tr>
<tr>
<td>2-sensor muting (timing and sequence controlled)</td>
<td>MLD 330, 530</td>
<td>MLD 335, 535</td>
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<tr>
<td>4-sensor muting (timing controlled)</td>
<td>MLD 335, 535</td>
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<td></td>
</tr>
<tr>
<td>Muting-timeout extension up to 100 hours</td>
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<td>X</td>
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<tr>
<td>Integrated status indicator (optional)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS-i Safety interface</td>
<td>MLD 510</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Technical data – Safety

#### MC 300, magnetically coded

- **Type** in accordance with EN ISO 14119: Type 4 interlock device without guard interlocking
- **Category** in accordance with EN ISO 13849-1: Up to 4 (depending on the number of sensors)
- **Performance Level (PL)** in accordance with EN ISO 13849-1: Up to PL e (depending on the number of sensors)
- **Dimensions (housing)**: 36 × 26 × 13 mm (MC 336), 88 × 25 × 13 mm (MC 388)
- **Assured operating distances (Seo, Sar)**: < 6 mm, > 14 mm (MC 330), < 3 mm, > 11 mm (MC 336), < 6 mm, > 30 mm (MC 388)
- **Switching tolerance**: ± 1 mm
- **Contact type**: 2 NC or 1 NC + 1 NO
- **Code type**: Actuator with low coding level in accordance with EN ISO 14119
- **Connection type**: M8, M12, cable, cable+M12
- **Min. approach speed of actuator towards sensor**: 50 mm/s
- **Response time**: 3 ms
- **Degree of protection**: IP 67
- **Certifications**:
  - CE
  - CUL

#### RD 800, RFID-coded

- **Type** in accordance with EN ISO 14119: Type 4 interlock device without guard interlocking
- **Category** in accordance with EN ISO 13849-1: 4
- **Performance Level (PL)** in accordance with EN ISO 13849-1: PL e with a single device
- **Dimensions (housing)**: 87.5 × 25 × 18 mm (sensor), 45 × 25 × 18 mm (actuator)
- **Assured operating distances (Seo, Sar)**: 12 mm, 10 mm
- **Switching tolerance**: ± 1 mm
- **Contact type**: OSSD safety outputs
- **Code type**: Actuator with low and high coding level in accordance with EN ISO 14119
- **Connection type**: M12, cable
- **Min. approach speed of actuator towards sensor**: 50 mm/s
- **Response time**: 7 ms (typical), 12 ms (max.)
- **Degree of protection**: IP 67 / IP 69K
- **Certifications**:
  - CE
  - CUL

### Functions

- **Encoding**: Magnetically coded
- **Status indicator**: LED
- **Signal contact**: X
- **Programming input**: For teaching-in actuators

### Properties

- **Contactless actuation without mechanical contacts**
- **Long life expectancy**
- **Not sensitive to soiling**

- **Contactless actuation without mechanical contacts**
- **Long life expectancy**
- **Not sensitive to soiling**
- **Series connection possible**
## Safety

### Type in accordance with EN ISO 14119

**S20, S200**, L100, L200, L250, L300

<table>
<thead>
<tr>
<th>General</th>
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<th>Housing/ Degree of protection</th>
<th>Actuators</th>
<th>Locking type, locking force acc. to ISO 14119</th>
<th>Connection type</th>
<th>Certifications</th>
<th>Function</th>
<th>Integration in safety circuit</th>
<th>Actuators</th>
<th>Status indicator</th>
<th>Escape release</th>
<th>Special functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 2 interlock device without guard interlocking</td>
<td>For safety applications with performance level up to PL e/SIL 3</td>
<td>Technopolymer (S20) or metal (S200) / both IP 67</td>
<td>Mechanical tongue, with low coding level in accordance with EN ISO 14119</td>
<td>With either quiescent current principle or open circuit current principle</td>
<td>Cable entry M20 x 1.5 (S20: optional 3-way), M12 connector</td>
<td>C US C US C US</td>
<td>Safety switches with separate actuator</td>
<td>Positive-opening contacts for integration in a safety circuit</td>
<td>Up to 8 different actuators</td>
<td>LED status display (L200)</td>
<td>Models with escape unlocking (L200)</td>
<td>Models with up to three integrated operational controls</td>
</tr>
<tr>
<td>Type 2 interlock device with guard interlocking</td>
<td>For safety applications with performance level up to PL e/SIL 3</td>
<td>Technopolymer or metal, both IP67</td>
<td>Mechanical tongue, with low coding level in accordance with EN ISO 14119</td>
<td>With either quiescent current principle or open circuit current principle, Fₚₘₐₓ 1,100 N</td>
<td>Cable entry M20 x 1.5 (3-way)</td>
<td>C US C US</td>
<td>Safety switches with locking device</td>
<td>Positive-opening contacts for integration in the safety circuit</td>
<td>Multiple heavy-duty actuators</td>
<td>LED status display</td>
<td>Models with escape unlocking</td>
<td></td>
</tr>
<tr>
<td>Type 4 interlock device with guard interlocking</td>
<td>Performance Level PL e/SIL 3 with a single device</td>
<td>Technopolymer, IP 67 / IP 69K</td>
<td>Mechanical tongue with RFID-encoded actuator in accordance with EN ISO 14119; AC-L250-SCA: low AC-L250-UCA: high</td>
<td>With either quiescent current principle or open circuit current principle, Fₚₘₐₓ 2,100 N</td>
<td>M12 connector, various outgoing lines</td>
<td>C US C US C US</td>
<td>Safety switches with locking device</td>
<td>OSSD safety-related switching outputs</td>
<td>Contactless actuation through RFID technology</td>
<td>LED status display</td>
<td>Models with escape unlocking</td>
<td></td>
</tr>
<tr>
<td>Type 4 interlock device with guard interlocking</td>
<td>Performance Level PL e/SIL 3 with a single device</td>
<td>Metal, IP 67 / IP 69K, IP 65 for integrated operational controls</td>
<td>Mechanical tongue with RFID-encoded actuator in accordance with EN ISO 14119; AC-L300-SCA: low AC-L300-UCA: high</td>
<td>With either quiescent current principle or open circuit current principle, Fₚₘₐₓ 9,750 N</td>
<td>Cable entry M20 x 1.5 (3-way), M12 (8- or 12-pin), M23 (19-pin)</td>
<td>C US C US</td>
<td>Safety switches with locking device</td>
<td>OSSD safety-related switching outputs</td>
<td>Contactless actuation through RFID technology</td>
<td>LED status display</td>
<td>Models with escape unlocking</td>
<td></td>
</tr>
</tbody>
</table>

### Technical data – Safety

- **Housing/ Degree of protection:**
  - Technopolymer (S20) or metal (S200) / both IP 67
  - Technopolymer or metal, both IP67
  - Technopolymer, IP 67 / IP 69K
  - Technopolymer
  - Metal, IP 67 / IP 69K, IP 65 for integrated operational controls

- **Actuators:**
  - Mechanical tongue, with low coding level in accordance with EN ISO 14119
  - Mechanical tongue, with low coding level in accordance with EN ISO 14119
  - Mechanical tongue with RFID-encoded actuator in accordance with EN ISO 14119; AC-L250-SCA: low AC-L250-UCA: high
  - Mechanical tongue with RFID-encoded actuator in accordance with EN ISO 14119; AC-L300-SCA: low AC-L300-UCA: high

- **Locking type, locking force acc. to ISO 14119:**
  - L100: Fₚₘₐₓ 1,100 N
  - L200: Fₚₘₐₓ 2,800 N
  - With either quiescent current principle or open circuit current principle, Fₚₘₐₓ 2,100 N
  - With either quiescent current principle or open circuit current principle, Fₚₘₐₓ 9,750 N

- **Connection type:**
  - Cable entry M20 x 1.5 (S20: optional 3-way), M12 connector
  - Cable entry M20 x 1.5 (3-way)
  - M12 connector, various outgoing lines
  - Cable entry M20 x 1.5 (3-way), M12 (8- or 12-pin), M23 (19-pin)

- **Function:**
  - Safety switches with separate actuator
  - Safety switches with locking device
  - Safety switches with locking device
  - Safety switches with locking device

- **Integration in safety circuit:**
  - Positive-opening contacts for integration in a safety circuit
  - Positive-opening contacts for integration in the safety circuit
  - OSSD safety-related switching outputs
  - OSSD safety-related switching outputs

- **Actuators:**
  - Up to 8 different actuators
  - Multiple heavy-duty actuators
  - Contactless actuation through RFID technology
  - Contactless actuation through RFID technology

- **Status indicator:**
  - LED status display (L200)
  - LED status display
  - LED status display

- **Escape release:**
  - Models with escape unlocking (L200)
  - Models with escape unlocking
  - Models with escape unlocking

- **Special functions:**
  - Models with up to three integrated operational controls

### Properties

- Universal use with 5 actuator approach directions
- Universal use with 5 actuator approach directions
- Large center opening for actuator shaft
- Large center opening for actuator shaft
- Easy mounting with standard construction
- Robust design for big machinery and systems in harsh ambient conditions (L200)
- Flexibly mounted actuator enables secure closing even with warped doors
- Flexibly mounted actuator enables secure closing even with warped doors
- High-quality silver contacts for long life expectancy
- Variable installation options: Front and side mounting with just two screws
- Variable installation options: Flexible and independent alignment of device head and escape unlocking
- Flexible and independent alignment of connection unit and escape unlocking
- Door handle for simple mounting of switches and actuators
- Various contact blocks
- Flexible and independent alignment of connection unit and escape unlocking
- Lock-out/tag-out functionality
- Various contact blocks
- Flexible and independent alignment of connection unit and escape unlocking
- Lock-out/tag-out functionality
Technical data – Data transmission

## Data transmission

### Optical data transmission

### DDLS 500

<table>
<thead>
<tr>
<th>Specifications</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating range</td>
<td>40, 120, 200 m</td>
</tr>
<tr>
<td>Light source</td>
<td>Infrared laser (laser class 1)</td>
</tr>
<tr>
<td>Transmission rate</td>
<td>100 Mbit/s</td>
</tr>
<tr>
<td>Interfaces</td>
<td>PROFINET, EtherNet IP, EtherNet TCP/IP, EtherCAT, UDP</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP 65</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>18–30 V DC</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-5°C...+50°C (-35°C...+50°C with heating)</td>
</tr>
<tr>
<td>Certifications</td>
<td>CDRH, C, US</td>
</tr>
</tbody>
</table>

### Properties

- Transparent, real-time transmission of all TCP/IP- and UDP-based protocols
- Very simple diagnosis of the transmission technology
- Pre-mounted and complete delivery of all mounting and alignment elements
- Integrated laser pointer for fast installation (available optionally)
- Simple remote diagnosis via web browser-based user interface (available optionally)
- Device models as PROFINET network participants
# Technical data – Identification

## Stationary bar code readers

### BCL 200i
- **Reading distance** (dependent on version): 40 – 255 mm
- **Smallest resolution**: 0.2 mm
- **Scanning rate**: 1,000 scans/s
- **Optics models**: M, N, F, L, J
- **Reading method**: Single line scanner
- **Code reconstruction technology**: Single line scanner
- **Inputs/outputs**: 1 / 1
- **Interfaces**: Integrated: PROFINET IO/RT Ethernet TCP/IP
- **Connectivity**: With MA 200i connection unit DeviceNet, CANopen
- **Supply voltage**: 18 – 30 V DC
- **Degree of protection**: IP 65
- **Network master**: MA 31
- **Certifications**: C, CDRH
- **Mounting devices**: BT 56, BT 300W, BT 300-1

### BCL 300i
- **Reading distance**: 20 – 700 mm
- **Smallest resolution**: 0.127 mm
- **Scanning rate**: 1,000 scans/s
- **Optics models**: N, M, F, L
- **Reading method**: Raster scanner
- **Code reconstruction technology**: Raster scanner
- **Inputs/outputs**: 1 / 1
- **Interfaces**: Integrated: PROFINET IO/RT, Ethernet TCP/IP
- **Connectivity**: MA 200i connection unit DeviceNet, CANopen
- **Supply voltage**: 18 – 30 V DC
- **Degree of protection**: IP 65
- **Network master**: Integrated
- **Certifications**: C, CDRH
- **Mounting devices**: BT 56, BT 300W, BT 300

### BCL 500i
- **Reading distance**: 200 – 2,400 mm
- **Smallest resolution**: 0.2 mm
- **Scanning rate**: 1,000 scans/s
- **Optics models**: N, M, F, L
- **Reading method**: Deflecting mirror
- **Code reconstruction technology**: Oscillating mirror
- **Inputs/outputs**: 2 / 2
- **Interfaces**: Integrated: PROFINET IO/RT, Ethernet TCP/IP, UDP
- **Connectivity**: With MA 200i connection unit EthernetCAT, DeviceNet, CANopen
- **Supply voltage**: 10 – 30 V DC
- **Degree of protection**: IP 65
- **Network master**: Integrated
- **Certifications**: C, CDRH
- **Mounting devices**: BT 56, BT 300

### BCL 600i
- **Reading distance**: 300 – 1,500 mm
- **Smallest resolution**: 0.25 mm
- **Scanning rate**: 800 – 1,000 scans/s
- **Optics models**: M, F
- **Reading method**: Oscillating mirror
- **Code reconstruction technology**: Oscillating mirror
- **Inputs/outputs**: 2 / 2
- **Interfaces**: Integrated: PROFINET IO/RT, Ethernet TCP/IP, UDP
- **Connectivity**: With MA 200i connection unit EthernetCAT, DeviceNet, CANopen
- **Supply voltage**: 10 – 30 V DC
- **Degree of protection**: IP 65
- **Network master**: Integrated
- **Certifications**: C, CDRH
- **Mounting devices**: BT 56, BT 59

### Properties
- **Optimized for constrained spaces between the conveyor lines**: Integrated fieldbus connectivity | Code reconstruction technology (CRT) | Simple configuration without additional software or GSDML file | Connection type: cable tail with connector
- **“webConfig” software integrated in the device permits configuration via USB interface without additional software**: Connected fieldbus connectivity for convenient fieldbus link, networking and configuration via the GSD/GSDML file | Code reconstruction technology (CRT) for reliable identification of damaged codes | Optional heating models to –35 °C

### Accessories
- **“webConfig” software integrated in the device permits configuration via USB interface without additional software**: “webConfig” software integrated in the device permits configuration via USB interface without additional software | Multiple language menu-driven display | M12 connection type | Integrated fieldbus connectivity for convenient fieldbus link and networking | Code reconstruction technology (CRT) for reliable identification of damaged codes | Optimized for modules from 0.25 to 0.5 mm
### Stationary 2D-code readers

<table>
<thead>
<tr>
<th>Code reading</th>
<th>Data Matrix, bar code, QR-Code, Pharmacode, Aztec, GS1 Databar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor / cameras</td>
<td>CMOS (Global Shutter)</td>
</tr>
<tr>
<td>Resolution (pixel)</td>
<td>1,280 × 960</td>
</tr>
</tbody>
</table>
| Focal point           | U optics: 50 mm  
                        | N optics: 70 mm  
                        | M optics: 105 mm  
                        | F optics: 185 mm  
                        | L optics: 285 mm  |
| Interfaces            | Integrated:  
                        | Ethernet TCP/IP, UDP  
                        | PROFINET IO/RT  
                        | RS 232  
                        | RS 422  |
| Connectivity          | With MA 200i connection unit  
                        | PROFIBUS  
                        | Ethernet TCP/IP, UDP  
                        | EtherCAT  
                        | DeviceNet  
                        | EtherNet/IP  
                        | CANopen  |
| Digital inputs / outputs | 2 / 2                                                        |
| Number of test routines | Memory capacity for 1 parameter set in the camera            |
| Configuration / Operating system | Configuration via configuration codes or via PC using standard web browser without software to be installed additionally (webConfi g tool) |
| Options               | Optional: connection cables  
                        | Optical filters  
                        | Housing hoods  
                        | External illumination  
                        | Mounting devices:  
                        | BTU 320M-D12, BT 320M  
                        | MA 150 modular connection unit  |
| Dimensions, W × H × D | 43 × 61 × 44 mm                                                |
| Certifications        | ?? ?? ?? US                                                   |

### RFID systems

#### RFI 32

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Working frequency</th>
<th>Max. RFID reading distance</th>
<th>Max. speed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>125 kHz</td>
<td>80 mm</td>
<td>6.0 m/s</td>
</tr>
<tr>
<td></td>
<td>13.56 MHz</td>
<td>400 mm</td>
<td>6.0 m/s</td>
</tr>
<tr>
<td>Interfaces</td>
<td>Integrated:</td>
<td>RS 232</td>
<td>RS 232</td>
</tr>
<tr>
<td>Connectivity</td>
<td>With MA 21 connection unit</td>
<td>multiNet</td>
<td>multiNet</td>
</tr>
<tr>
<td></td>
<td>PROFIBUS</td>
<td>Ethernet TCP/IP, UDP</td>
<td>EtherCAT</td>
</tr>
<tr>
<td></td>
<td>DeviceNet</td>
<td>EtherNet/IP</td>
<td>CANopen</td>
</tr>
<tr>
<td>Function</td>
<td>RFID reading</td>
<td>RFID reading / writing</td>
<td></td>
</tr>
</tbody>
</table>
| Possible transponder types | – Disc  
                        | – High temperature proof up to 200 °C |
| Supply voltage       | 12 – 30 V DC      | 12 – 30 V DC              |
| Degree of protection | IP 65             | IP 65 / IP 67             |
| Certifications       | ?? ?? ?? US       | ?? ?? ?? US               |

#### RFM 32, 62

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Working frequency</th>
<th>Max. RFID reading distance</th>
<th>Max. speed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13.56 MHz</td>
<td>400 mm</td>
<td>6.0 m/s</td>
</tr>
<tr>
<td></td>
<td>13.56 MHz</td>
<td>400 mm</td>
<td>6.0 m/s</td>
</tr>
<tr>
<td>Interfaces</td>
<td>Integrated:</td>
<td>RS 232</td>
<td>RS 232</td>
</tr>
<tr>
<td>Connectivity</td>
<td>With MA 21 connection unit</td>
<td>multiNet</td>
<td>multiNet</td>
</tr>
<tr>
<td></td>
<td>PROFIBUS</td>
<td>Ethernet TCP/IP, UDP</td>
<td>EtherCAT</td>
</tr>
<tr>
<td></td>
<td>DeviceNet</td>
<td>EtherNet/IP</td>
<td>CANopen</td>
</tr>
<tr>
<td>Function</td>
<td>RFID reading</td>
<td>RFID reading / writing</td>
<td></td>
</tr>
</tbody>
</table>
| Possible transponder types | – Disc  
                        | – High temperature proof up to 250 °C  
                        | – Smart label |
| Supply voltage       | 12 – 30 V DC      | 12 – 30 V DC              |
| Degree of protection | IP 65             | IP 65 / IP 67             |
| Certifications       | ?? ?? ?? US       | ?? ?? ?? US               |

### Properties

- Camera system for omni-directional reading of bar codes, stacked codes and 2D-codes
- Integrated illumination (type-dependent: red or IR)
- High object speed of up to 7 m/s
- Integrated teach functions for simple adjustments via buttons
- Optional robust stainless steel housing
- Optional with NPN switching inputs/outputs
- Optional with integrated heating for use to –30 °C

---

**Note:** The above text is a natural language representation of the technical data and specifications provided in the original document. It has been crafted to maintain clarity and coherence while adhering to the guidelines for natural text generation.
## Mobile code readers

<table>
<thead>
<tr>
<th></th>
<th>IT 1980i, 1981i</th>
<th>IT 1990i, 1991i</th>
<th>HS 6608, 6678</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reading method</strong></td>
<td>Area imager</td>
<td>Area imager</td>
<td>Area imager</td>
</tr>
<tr>
<td><strong>Reading distance</strong></td>
<td>0 – 16,000 mm</td>
<td>0 – 170 mm</td>
<td>0 – 147 mm</td>
</tr>
<tr>
<td><strong>Interfaces</strong></td>
<td><strong>Integrated:</strong> RS 232 / USB, Keyboard Wedge PS 2</td>
<td><strong>Integrated:</strong> RS 232 / USB, Keyboard Wedge PS 2</td>
<td><strong>Integrated:</strong> RS 232 / USB</td>
</tr>
<tr>
<td><strong>Connectivity</strong></td>
<td><strong>With MA 21 connection unit</strong> multiNet</td>
<td><strong>With MA 200i connection unit</strong> PROFINET IO/RT, PROFIBUS, Ethernet TCP/IP, UDP, EtherCAT, DeviceNet, CANopen</td>
<td><strong>With MA 200i connection unit</strong> PROFINET IO/RT, PROFIBUS, Ethernet TCP/IP, UDP, EtherCAT, DeviceNet, CANopen</td>
</tr>
<tr>
<td><strong>Accessories</strong></td>
<td>Cable for: RS 232, USB, Keyboard-Wedge; holder, power supply unit, base station</td>
<td>Cable for: RS 232, USB; power supply unit, mounting bracket</td>
<td>Cable for: RS 232, USB, Keyboard-Wedge; holder, power supply unit, base station</td>
</tr>
<tr>
<td><strong>Supply voltage</strong></td>
<td>4.5 – 5.5 V DC</td>
<td>4.5 – 5.5 V DC</td>
<td>4.5 – 5.5 V DC</td>
</tr>
<tr>
<td><strong>Area of application</strong></td>
<td>Tough industrial use</td>
<td>Reading of directly marked codes (laser or matrix printed) with low contrast</td>
<td>Tough industrial use</td>
</tr>
<tr>
<td><strong>Code types</strong></td>
<td>Bar codes and 2D-codes</td>
<td>Bar codes and directly marked 2D-codes</td>
<td>Bar codes and directly marked 2D-codes</td>
</tr>
<tr>
<td><strong>Certifications</strong></td>
<td>CE</td>
<td>CE</td>
<td>CE</td>
</tr>
</tbody>
</table>

### Properties

<table>
<thead>
<tr>
<th></th>
<th>IT 1980i, 1981i</th>
<th>IT 1990i, 1991i</th>
<th>HS 6608, 6678</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Large reading field for detection of high-contrast codes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Ergonomic and very robust housing for rough applications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Operating temperature from –30°C…+50°C</strong> (IT 1990i, IT 1980i), –20°C…+50°C (IT 1991i, IT 1981i)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>High resolution for directly marked parts (laser or matrix printed) and labels</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Ergonomic and robust housing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Operating temperature 30°C…+50°C</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>High resolution for directly marked codes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Display for successful reading with LED, signal tone and vibration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Ergonomic and robust housing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Operating temperature –30°C…+50°C (HS 6608), –20°C…+50°C (HS 6678)</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Industrial IP cameras

<table>
<thead>
<tr>
<th>Specifications</th>
<th>LCAM 308</th>
<th>LCAM 408i</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring camera</td>
<td>Live-image transfer, image transfer recording</td>
<td>Live-image transfer</td>
</tr>
<tr>
<td>Sensor / cameras</td>
<td>Color CMOS</td>
<td>Color CMOS</td>
</tr>
<tr>
<td>Resolution (pixel)</td>
<td>1,280 × 720</td>
<td>2,592 × 1,944</td>
</tr>
<tr>
<td>Focal point</td>
<td>500 mm ... ∞</td>
<td>500 mm ... ∞</td>
</tr>
<tr>
<td>Interface</td>
<td>Ethernet</td>
<td>Ethernet</td>
</tr>
<tr>
<td>Digital inputs/outputs</td>
<td>1x IN</td>
<td>–</td>
</tr>
<tr>
<td>Transmission rate</td>
<td>10/100 Mbit/s</td>
<td>10/100 Mbit/s, 1 Gbit/s</td>
</tr>
<tr>
<td>Options</td>
<td>Trigger input, integrated memory, heating</td>
<td></td>
</tr>
<tr>
<td>Optional</td>
<td>Cables, mounting devices, network switch</td>
<td>Cables, mounting devices, air blower</td>
</tr>
<tr>
<td>Configuration / Operating system</td>
<td>Configuration via PC using standard Web browser (webConfig tool)</td>
<td>Configuration via PC using standard Web browser (webConfig tool)</td>
</tr>
<tr>
<td>Dimensions, W × H × D</td>
<td>85 × 114 × 35 mm</td>
<td>75 × 113 × 55 mm / 76.5 × 66 × 126 mm</td>
</tr>
</tbody>
</table>

## Properties

- Very well suited for industrial use through glass window and metal housing
- Degree of protection IP 65
- Megapixel color camera chip for live-image transfer in MJPEG format
- Operating temperature −30 ... 50 °C
Safety Solutions
Efficient material flow and complete safety

The increasing automation of processes places growing demands on safety concepts. Classic concepts such as muting are often pushed to their limits here, e.g. at transfer stations and material locks. Our innovative safety solutions guarantee gapless safety, efficient material flow and high availability of your system, even with automatic processes.

Advantages for you

— Save time and money with our pre-developed safety solutions
— All safety solutions are CE-certified and compliant with standards. This gives you legal security.
— The intelligent and innovative safety concepts ensure smooth processes and seamless safety – even where classic concepts are pushed to their limits
— Each safety solution is individually adapted to your system layout
— Our teams of certified safety experts accompany you throughout the entire project

Use our experience

Innovative ideas are based on experience and know-how. For more than 30 years, we have been supporting safety-related applications in different industries by offering a broad range of products. Our safety experts have comprehensive knowledge of the latest norms and standards and extensive experience in designing safety concepts. This allows us to develop efficient safety solutions for use in automated environments.

— Global network of certified experts for the creation of safety concepts and the validation of the solutions on-site
— In-house Solutions Engineering Center
— Development and design according to the V-model in accordance with EN ISO 13849-1
— Extensive selection of in-house safety products
Complete solutions for your plants

Our solutions are based on qualified safety concepts, which can also be expanded or newly created if required. We take care of all the necessary process steps, from standards research to commissioning support. And in the project, each solution is individually adapted to your system layout.

Concept and design

The conception and design of the safety solutions is carried out entirely by our Solutions Engineering Center. This includes:

— Research of guidelines and standards
— Design of the safety concept and the system architecture
— Software development and validation
— Comprehensive documentation, including CE declaration of conformity

Services – Tailored to your project

Each safety solution is individually adapted to your system and supported by us within the project until the handover:

— Engineering services with configuration and parameterization according to project requirements
— Commissioning support
— Final acceptance

Hardware and software components

Our safety solutions include all necessary hardware and software components for integration into your system:

— Safety sensors
— Safety control
— Leuze safety program
— Compact control cabinet, as required
— Cabling

The path to your solution

Gather requirements

— Examine layout and danger zones, clarify processes
— Check risk assessment, define protective goals
— Clarify timing

Selection of the safety concept

— Evaluation of the requirements by our safety experts
— Selection of the appropriate safety concept and the required components

Installation & commissioning

— Provision of the mounting and installation instructions
— Mounting and installation of the system components
— Support during commissioning and the integration in the control

Configuration & parameterization

— Configuration of the safety system
— Programming and parameterization according to requirements
— Project-specific documentation

Safety inspection & acceptance

— Validation of the safety function
— Initial inspection of the safety devices
— Creation of the acceptance documentation
Machine Safety Services

Sustainable machine safety begins with professional planning of the safety systems and spans the entire lifecycle of a machine. Our teams of experienced and certified experts offer the appropriate support here.

Stages of a machine life cycle

When designing and constructing machines, we create the safety-related concept together with you and support you in its realization. During operation, we regularly perform tests to ensure the permanent function of the safety systems. If changes are made to existing machines, we provide you with support on everything from the safety-related planning to renewed commissioning.

Through our services, you benefit from our many years of experience in the area of machine safety and our extensive industry and application knowledge. Efficient safety-related solutions for every phase of a machine’s life cycle are thereby created together.
Our service offerings

Status check “safety technology on machines and systems”
— Our experts analyze the safety-related condition of your machinery and check whether the current safety-related requirements are satisfied in accordance with the current state of the art.
— In the event of deviations, we provide recommendations on what corrections can be performed so as to comply with legal requirements.

Risk assessment and hazard assessment
In accordance with applicable directives, the manufacturer of a machine is required to perform a risk assessment. This also applies in the case of significant modifications or extensions of machines.
The national regulations for the operation of machines require employers to conduct a hazard assessment before using work equipment and to update this assessment at regular intervals according to the current state of the art.
— Our experts support you in identifying the dangers, in assessing and evaluating the risks as well as in defining the risk-reducing measures.

Inspection of protective devices
— Within the scope of the initial or regular inspection, we check the condition, mounting and correct function of the protective device as well as the correct integration in the safe part of the machine control
— We summarize the results of the tests in a detailed report.
If necessary, this includes practically oriented suggestions on how deviations can be corrected.

Stopping time measurement
For the correct placement of the protective device, the required minimum distance between protective device and dangerous movements is to be calculated. To do this, the stopping time of the machine must be known. With the stopping time measurement, we determine this value reliably.
— By measuring the stopping time within the scope of regular inspections, any wear, such in brake components, can be detected in good time.

Status check “CE marking of machines”
During the development of machines, the specifications from the machinery directive must be adhered to and documented by the manufacturer. This is confirmed with the Declaration of Conformity and the CE marking.
— We check the documentation for completeness and give recommendations of how any deviations can be corrected.

Conformity assessment in accordance with the European machinery directive
The machinery directive defines the procedure for the design and construction of machines for satisfying the applicable safety and health protection requirements. This is a prerequisite for the Declaration of Conformity and the CE marking.
— We help you comply with and implement the legal requirements of the machinery directive.

Safety concept and safety design
The measures necessary for risk minimization are known from the risk analysis.
The safety concept and the safety functions are developed on the basis of these requirements.
— With our extensive industry knowledge and our many years of safety-related experience, we create practically oriented concept proposals for you and support you during their implementation.

Verification and validation
To avoid errors during the implementation of safety functions, both the hardware as well as the software must be checked to determine whether the requirements of the functional specification were met completely and correctly. The function test of all safety functions is to be performed according to the validation plan.
— We support you during the planning, development and execution of the function tests as well as with the creation of the required documentation.
Efficient work requires more than just a sensor. Almost as important are the appropriate accessories, which allow the sensor to utilize its full functionality. No matter if you need easy mounting, uncomplicated connection or reliable signaling, you can easily find the right accessories for your application in our extensive product range.

You can find our complete accessories range on our website at www.leuze.com/accessories
Mounting systems
We place great emphasis on our products being easy to mount and simple to align. For this reason, you will find specially-attuned mounting systems in our product range such as mounting brackets, rod holders or device columns.

Reflectors
Just how reliably retro-reflective photoelectric sensors can detect depends upon the selected reflector, among other things. That is why we offer various matching solutions made of plastic, film, and glass for all conceivable conditions.

Mounting brackets and device and mirror columns
The mounting brackets designed for our safety sensors ensure simple mounting and alignment of the devices. Device columns for free-standing floor assembly and mirror columns for multi-sided safeguarding simplify the installations.

Cables
To facilitate the integration of our sensors, we offer a large variety of connection and interconnection cables with M8, M12, and M23 connectors – straight or angled, and with or without LED.

Connection units
Today, sensors, safety switches and cameras are linked together via active or passive sensor distribution boxes with fieldbus interfaces from our product range to ensure more flexibility and transparency during installation.

Signaling devices
For signaling in automated systems, we offer an extensive product range of single- and multi-colored as well as acoustic transducers in order to ensure productivity and efficiency.
In a constantly changing industrial world, we work together with our customers to find the best solution for their sensor applications: innovatively, precisely and efficiently.

Our company
Everything at a glance

In a constantly changing industrial world, we work together with our customers to find the best solution for their sensor applications: innovatively, precisely and efficiently.

**Key figures**

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**Product range**

- Switching sensors
- Measuring sensors
- Safety
- Identification
- Data transmission
- Network and connection technology
- Industrial image processing
- Accessories and supplementary products

**Focus industries**

- Intralogistics
- Packaging industry
- Machine tools
- Automotive industry
- Laboratory automation

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Your success is our motivation. We therefore place great value on always being personally, quickly, and easily accessible to you. We produce on four continents, allowing us to offer you reliable product availability.

Our Locations
At work for you around the world

Technological competence centers
- Owen, Germany
- New Hudson/Detroit, USA
- Singapore

Production locations
- Owen, Germany
- Unterstadion, Germany
- New Hudson/Detroit, USA
- Shenzhen, China
- São Paulo, Brazil
- Malacca, Malaysia

Subsidiaries
- Australia/New Zealand
- Belgium
- Brazil
- China
- Denmark/Sweden
- Germany – headquarters
- Germany – distribution company
- France
- Great Britain
- Hong Kong
- India
- Italy
- Mexico
- Poland
- Singapore
- South Korea
- Spain
- Switzerland
- The Netherlands
- Turkey
- USA/Canada
Our product range at a glance

Switching sensors
- Optical Sensors
- Inductive switches
- Capacitive sensors
- Ultrasonic sensors
- Fiber optic sensors
- Fork sensors
- Light Curtains
- Special Sensors

Measuring sensors
- Distance Sensors
- Sensors for Positioning
- 3D sensors
- Light curtains
- Bar Code Positioning Systems
- Fork Sensors

Identification
- Bar Code Identification
- 2D-Code Identification
- RF Identification

Data transmission
- Optical Data Transmission Systems

Network and Connection Technology
- Connection Technology
- Modular Connection Units

Industrial Image Processing
- Light Section Sensors
- Smart Camera

Safety
- Safety Solutions
- Safety Laser Scanners
- Safety Light Curtains
- Single and Multiple Light Beam Safety Devices
- Safety Radar Sensors
- Safe Locking Devices, Switches and Proximity Sensors
- Safety PLCs and Relays
- Machine Safety Services

Accessories and supplementary products
- Signaling Devices
- Mounting Systems
- Reflectors

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