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ULTRASONIC SENSORS WITH IO-LINK

And there's more!

IPF ELECTRONIC

High-End *in High-Tech.*

UNBELIEVABLY VERSATILE: ULTRASONIC SENSORS

Fast, precise, robust, reliable, wear-free, compact, … These are just some of the convincing features of our ultrasonic sensors, which can be used nearly universally.

Universally? Exactly, because the devices with analog/switching output contactlessly detect a variety of objects and materials, no matter whether liquid, powder or solid and do so completely independent of shape, color or transparency.

Typical conditions for harsh industrial environments such as moisture, dust or smoke don't bother our ultrasonic sensors in the least. So it's no surprise that they prove themselves time and again in outdoor applications as well.

YOU WANT MORE?

With IO-Link, our ultrasonic sensors are provided with additional intelligence and become even more versatile, e.g. by simply changing over from scanner operation to retro-reflective mode. The IO-Link interface also offers access to many other useful functions. Moreover, all sensors with switching output integrate various teach modes, thereby making initial setup even simpler.

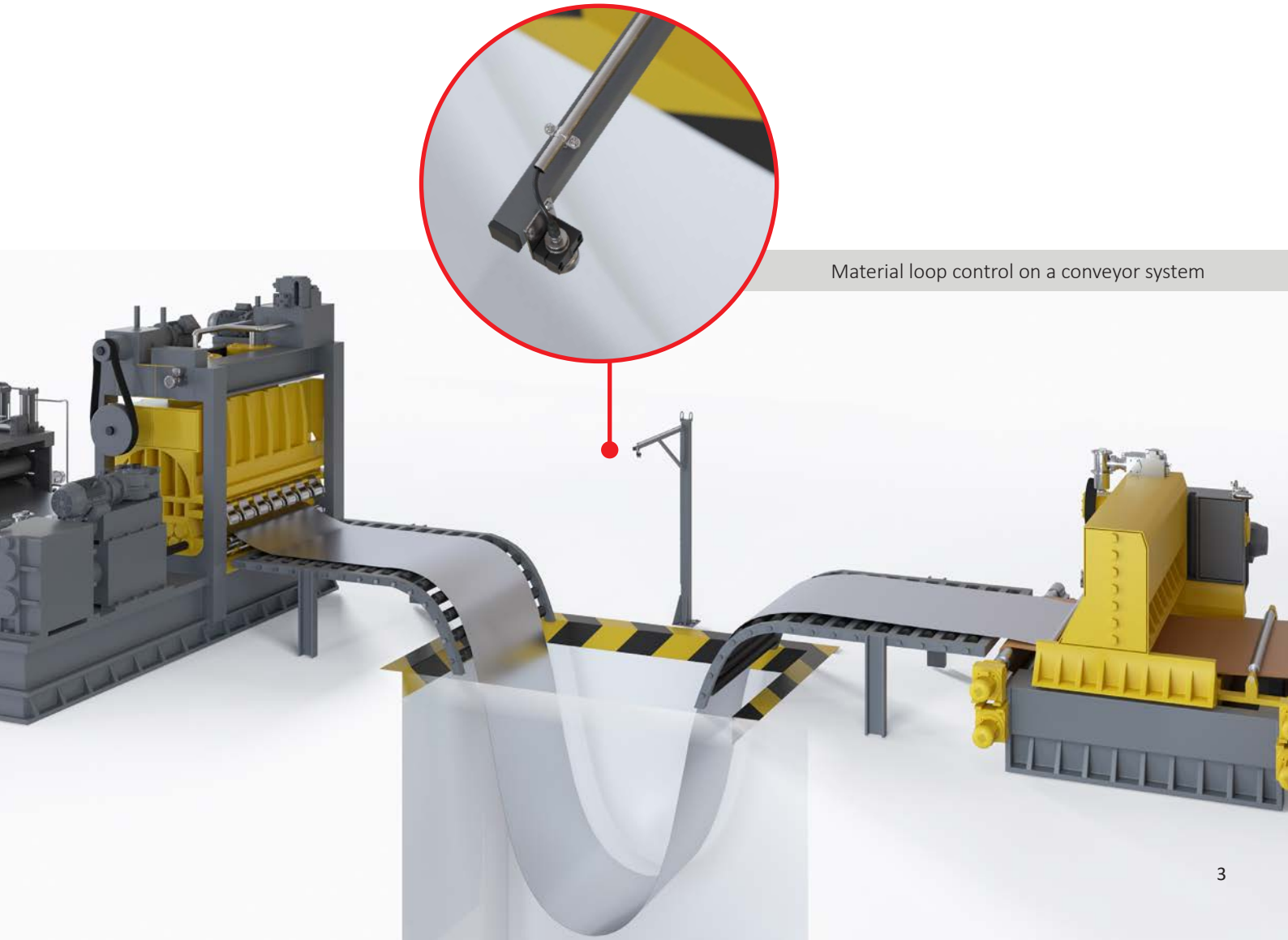
We even considered extremely specific requirements: our compact sensor with beam columnator is especially well suited for pinpoint measurements and therefore for very precise queries, e.g. for filling level checks through the smallest openings.

YOU WANT EVEN MORE?

Then take a closer look at the extremely versatile functions of our ultrasonic sensors with analog output starting on page 10.

When speaking of our ultrasonic sensors, it's not without reason that we talk about universal solutions for countless industries with an equally broad range of uses.

Have we sparked your interest? Let us show you some additional details.



Material loop control on a conveyor system

ULTRASONIC SENSORS WITH SWITCHING OUTPUT

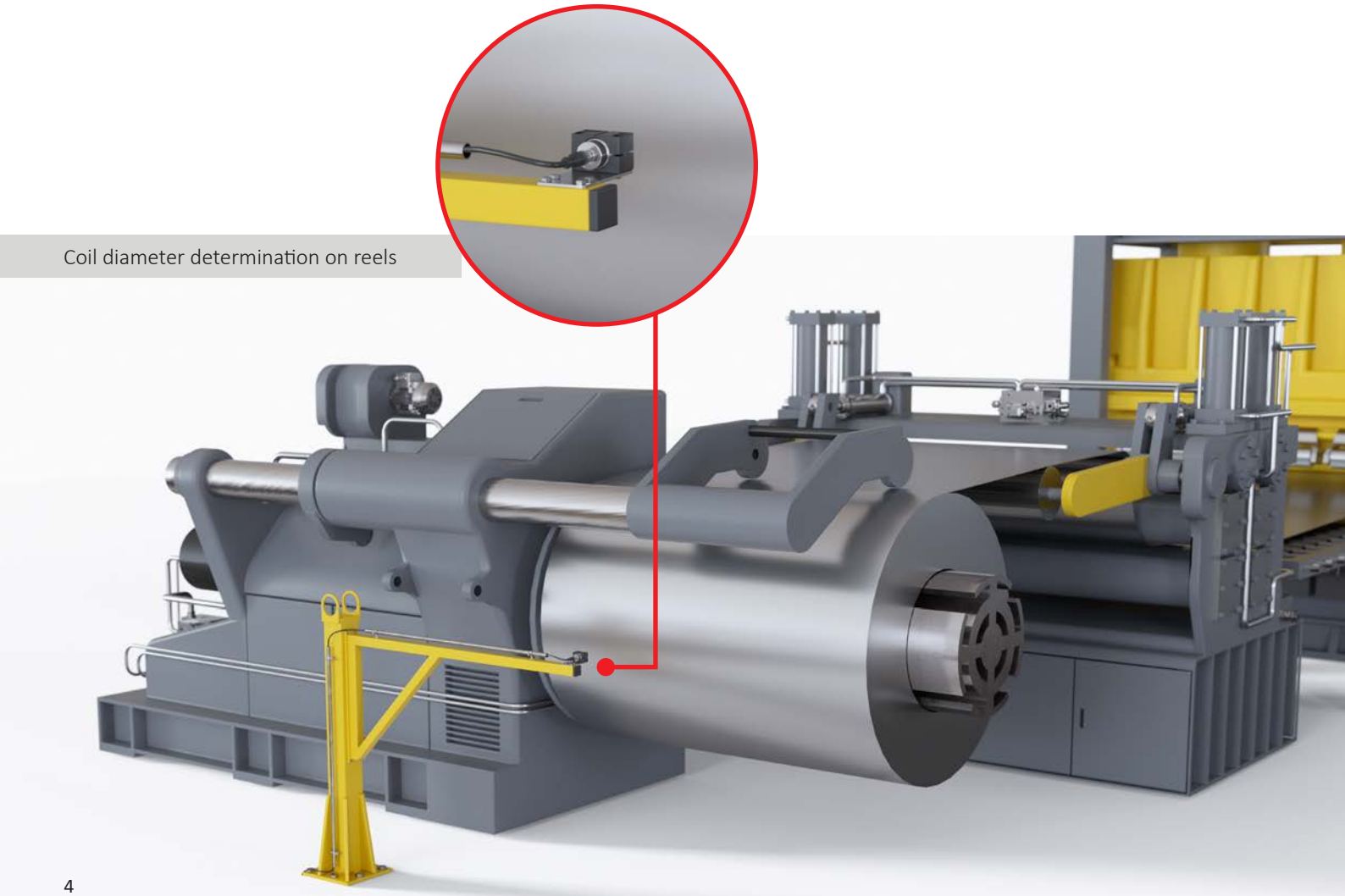
EITHER OR? – HOW ABOUT "AND"!

Our ultrasonic sensors can function as diffuse reflection sensors and as retro-reflective sensors. With just one device, you thus have freedom of choice and, as a result, even more advantages.

SCANNER OPERATION

Ultrasonic sensors operate according to the echo propagation time process, or the principle of time-of-flight measurement. For this purpose, the devices integrate a sound transducer that functions cyclically as either transmitter or receiver. This transformer emits a certain number of sound waves that are reflected by an object that is to be detected. The transformer then switches to receive mode and captures the signal echo. The time that elapses from the transmission to the reception of the signals is proportional to the distance between sensor and object.

While the sound transducer is functioning as a transmitter, it cannot receive any signals. Objects near the sensor are, therefore, either not detected at all or are detected only unreliably. In the blind range or dead zone, neither validatable measurements nor reliable object detections are possible.



Coil diameter determination on reels

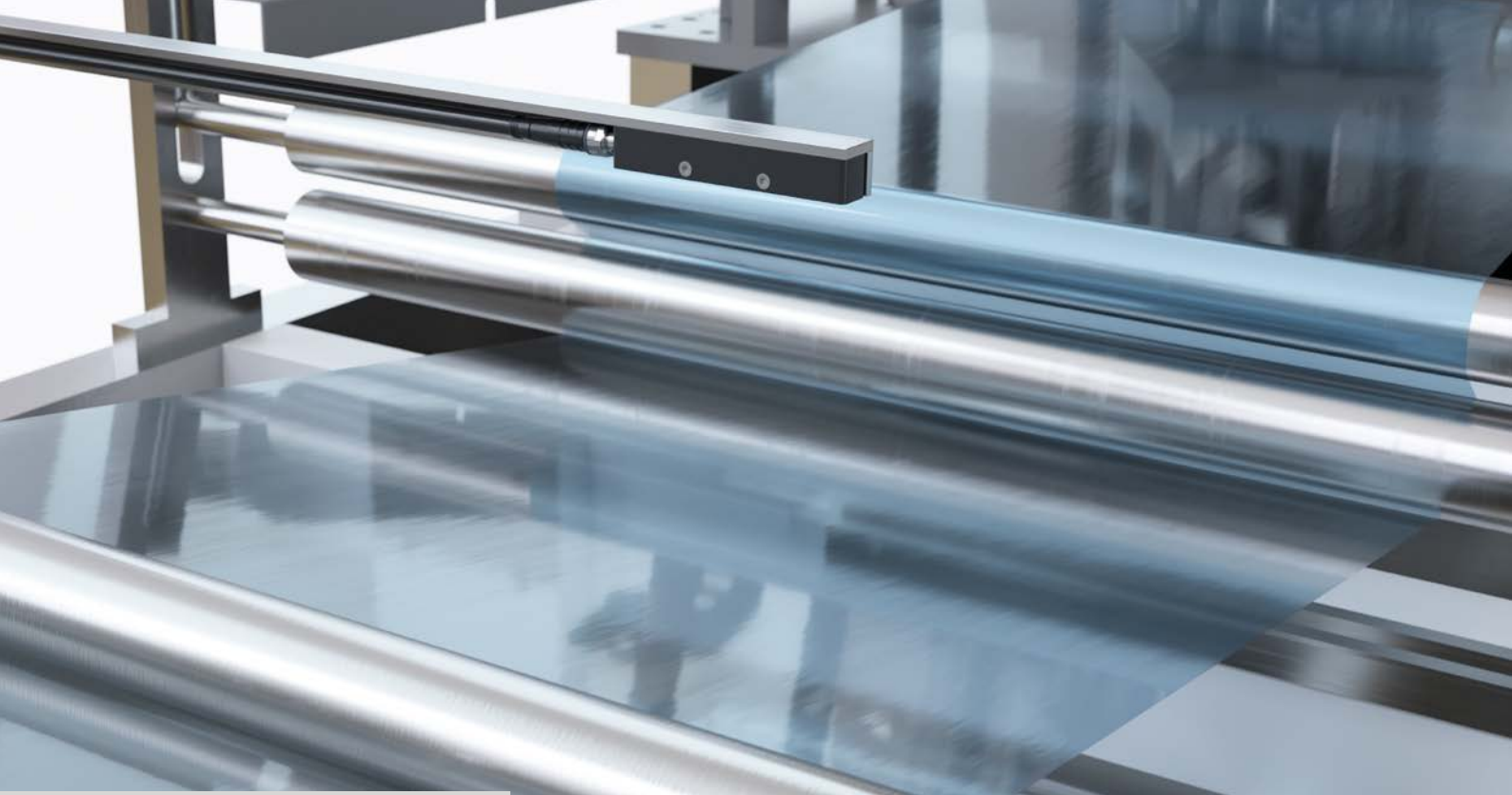
Packet detection on a conveyor system

RETRO-REFLECTIVE MODE

For ultrasonic sensors, the law of reflection applies, i.e. "angle of incidence = angle of reflection". When using ultrasonic sensors, irregular, structured, round or oblique object surfaces can, therefore, deflect the signal echo in such a way that the signal does not reach the receiver. With our solutions, these problems are a thing of the past, as our sensors can easily be switched from diffuse reflection sensor to retro-reflective sensor via IO-Link. This presents various possibilities for adapting the ultrasonic sensor to a background (e.g. machine part, metal sheet, etc.) instead of to an object that is to be detected. Consequently, all deviations from the background (object in the detection area) are reliably detected and result in a signal change at the switching output.

The advantages: Reliable detection of objects, completely independent of the object surface and significantly simpler and more stable processes. A dead zone like in scanner operation does not exist in this operational mode.

Bottle detection in a cleaning system



Tear detection with transparent film

A SINGLE SOLUTION – MANY USEFUL FUNCTIONS

Our product line of ultrasonic sensors comprises four different round designs and one cuboid device version. All solutions have one thing in common:
They integrate a number of practically oriented functions and adjustment options.

MORE FLEXIBILITY WHEN TEACHING

Regardless of your task, we make the setup of our ultrasonic sensors with switching output extremely easy for you. To this end, our sensors have, for example, three different operational modes.

- Window mode
- 2-point mode
- Auto-teach mode

AREA MONITORING (WINDOW MODE)

Window mode allows two limit values to be defined in the detection range of the ultrasonic sensor. These limit values define the area that is checked for the presence of an object.

STATIC TEACHING (2-POINT MODE)

Using the 2-point mode, the states "object present" and "object not present" are taught on the sensor. The device then automatically sets the correct switching point for the query.

DYNAMIC TEACHING (AUTO-TEACH MODE)

Dynamic teaching was developed for the sensor setting for moving objects. After activation, the device automatically detects the states "object present" and "object not present" and uses this information to generate a switching threshold.

Auto-teach mode

2-point mode

IO-LINK: EVEN MORE VERSATILE PLUS VALUABLE INFORMATION

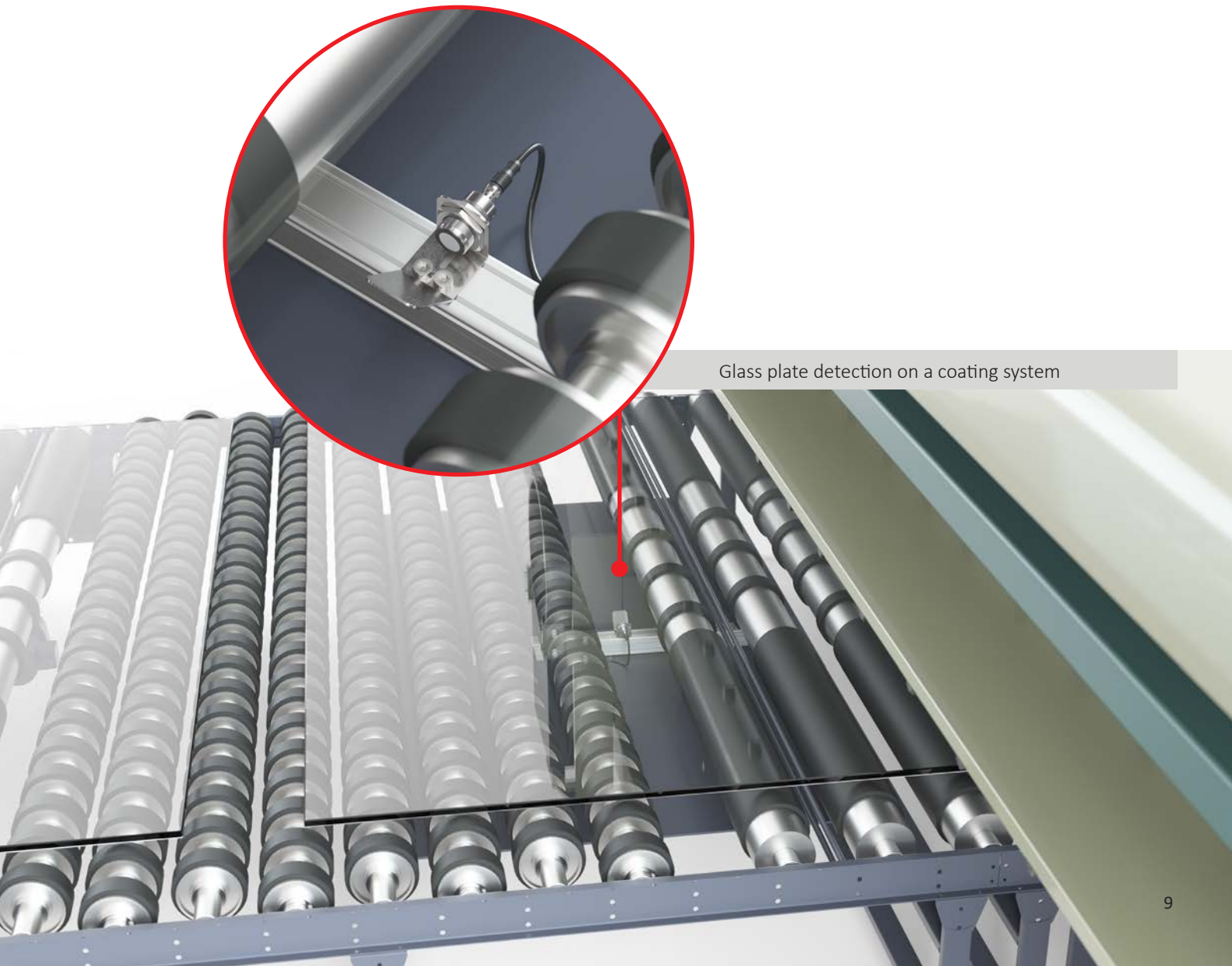
With the IO-Link interface, each sensor is – in spite of its compact design – provided with a number of intelligent additional functions. In addition to the simple switching between scanning operation and retro-reflective mode, this includes e.g. temperature compensation that can be activated as needed as a guarantee for consistent measuring accuracy.

In addition, IO-Link allows you to benefit from further options that not only supply valuable information but also enable individual settings, e.g. starting processes, operating hour counter, time functions, switching operation counters, detection of the current and maximum device temperature, minimum and maximum object distance and hysteresis setting.

A RANGE OF OPTIONS THROUGH SIGNAL DEFLECTION

It is generally possible to deflect the ultrasonic signal on devices with switching output or analog output. Prerequisite for this is: The surfaces on which the sound is incident are solid and flat. This makes installation of the devices even more flexible, especially in constrained installation conditions, as the sound transducer does not absolutely need to be aligned with the object. Instead, the ultrasonic signal is, for example, deflected by means of a metal plate.

Additional advantages: Due to the signal deflection, the potential soiling of the sound transducer can be reduced and, moreover, the installation situation optimized with respect to the dead zone during scanner operation.



Glass plate detection on a coating system

ULTRASONIC SENSORS WITH ANALOG OUTPUT

MAXIMUM POSSIBILITIES!

More is almost impossible. With the IO-Link interface, our ultrasonic sensors with analog output are equipped with maximum flexibility. That means even more freedom – also for the individual requirements of your application.

ONE OUTPUT, THREE MEASUREMENT SIGNAL RANGES

In the default setting, the analog output delivers a measurement signal that is proportional to distance in the range from 4-20mA. Thanks to IO-Link, the signal can be switched to 0-20mA or 0-10V. As a result, you can freely select the best measurement signals for your application.

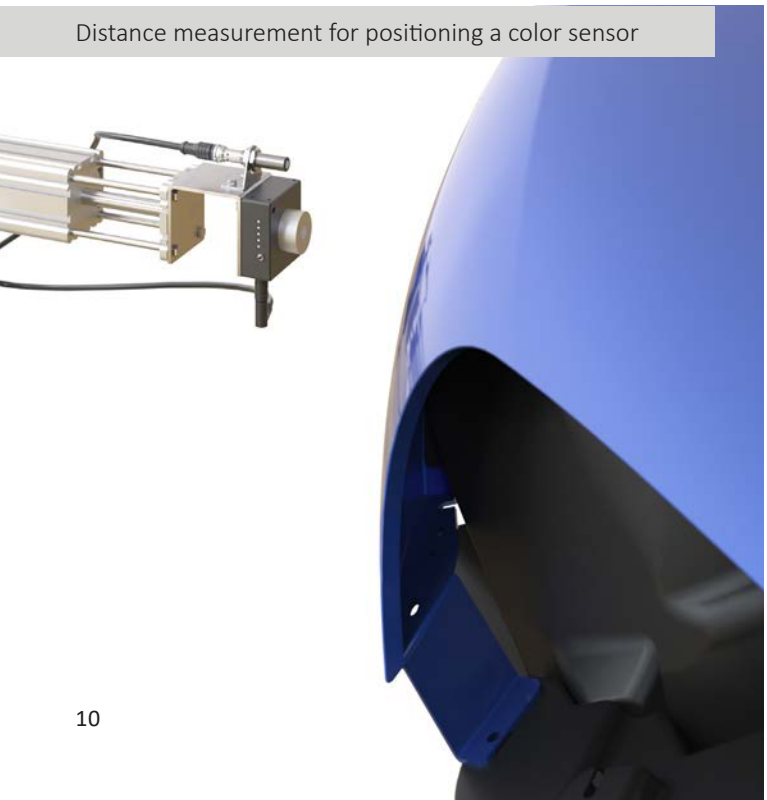
ONE TEACH INPUT – A WIDE VARIETY OF OPTIONS

In addition to the analog output, the sensors integrate a teach input that can perform many more tasks than just define the start and end point of a measuring range. What makes it special: Via IO-Link, multiple functions can be assigned to the teach input.

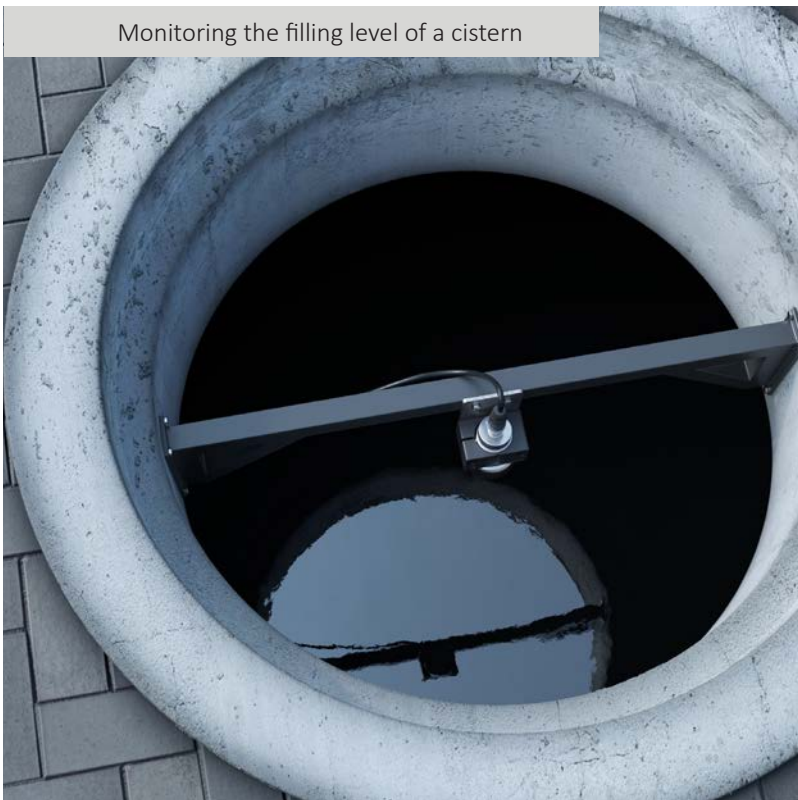
YOU DECIDE:

- Switching output
- Synchronization input
- Multiplex input

Distance measurement for positioning a color sensor



Monitoring the filling level of a cistern



Filling level monitoring at a filling station

TEACH INPUT AS SWITCHING OUTPUT

Via IO-Link, the teach input becomes a switching output. You can now use all functions and adjustment options that are available on sensors with switching output. Further advantage: In addition, the analog output is also available for measurement signals.

SIMULTANEOUS OPERATION OF MULTIPLE SENSORS

Because the sound transducer of an ultrasonic sensor serves as transmitter and receiver, it is not able to simultaneously transmit an acoustic pulse and receive the echo. If multiple sensors are operated next to one another, the acoustic pulse of one sensor may interfere with the sound transducer of the adjacent sensor if this is currently switched to receive. Our ultrasonic sensors therefore offer the option of activating the teach input either as a synchronization input or as a multiplex input via IO-Link.

TEACH INPUT AS SYNCHRONIZATION INPUT

With the teach input as synchronization input, all sensors generate an acoustic pulse at the same time and then switch to receive. All devices thus work in perfect harmony with one another.

TEACH INPUT AS MULTIPLEX INPUT

In multiplex mode, only a single sensor generates an acoustic pulse and then switches to receive to evaluate the echo before the next sensor is activated. In this mode, only one sensor is in operation at a time if multiple devices arranged next to one another are being used simultaneously.

"THE TINY SENSOR" FOR SPECIAL TASKS

PRECISE FILLING LEVEL MONITORING THROUGH THE SMALLEST OF OPENINGS

In automated filling or dosing processes, a reliable check of filling levels is usually necessary. Both the medium to be monitored and the container itself often present the user with challenges. These can, however, be overcome with special solutions.

A chemical company fills products in small glass bottles at an automatic dosing station. For this purpose, the bottles with openings the size of a test tube are transported to a dosing unit by a transport unit and filled there with a precise quantity of a clear, transparent liquid. The quantity of product filled in each bottle must be absolutely identical. Therefore, each container should be inspected for the proper filling level prior to sealing.

SEEMS OBVIOUS, BUT NOT A SOLUTION

For this task, the company first tested a light barrier (transmitter/receiver system) with linear light beam that operates based on the proportion of coverage. This was intended to detect the filling level on the side of the glass wall of the bottles. The transparent liquid in the bottles did not, however, enable sufficient damping and, as a result, did not provide a clear signal. Light refraction further encumbered a reliable filling level check.

FILLING LEVEL CHECK INDEPENDENT OF MEDIA PROPERTIES

Due to the various challenges, the chemical company next opted for an ultrasonic sensor. The advantage of such devices: With ultrasound, it is possible to detect, among other things, filling levels in containers almost completely irrespective of the specific media properties. To monitor the filling level, it is necessary to position the sensor above the bottle opening which, in this case, has a diameter of just 10mm.

But this solution did not yield the desired result. The reason: An ultrasonic transmitter cyclically emits a short, high-frequency acoustic pulse. If this is incident on an object, the pulse is reflected by the object's surface as an echo in the direction of the diffuse reflection sensor. The sound transducer integrated in the device simultaneously performs the function of the transmitter and receiver. After the acoustic pulse is generated, the sound transducer thus functions as a receiver for only a short period of time. Because the propagation velocity of sound in air is known, the distance from an object surface to the sensor can be determined using the time-of-flight measurement of the pulse from the time it was sent to the time it is received. Here, it is always the first echo signal that is evaluated, i.e. the signal of the reflection surface closest to the sensor, independent of whether any other reflection signals from more distant surfaces are received.

Decisive in the context of the described practical example are the surface of the sound transducer and the angle of beam spread of the emitted sound cone. Because standard ultrasonic sensors have sound transducers with a relatively large surface area depending on the size of the sensor, the large angle of beam spread of the resulting sound cone from the used sensor meant that the sound cone also included the edge of the small bottle openings. As a result, the echo signal produced by the edge of the bottle was the first received signal and was used for distance determination. The result: The ultrasonic sensor only detected the distance from the sensor to the edge of the bottle.

Filling level check and position detection at a dosing station

PRECISE CONTROL THROUGH SMALL OPENINGS

Even though the attempts using the standard device failed, the choice of technology was nevertheless correct. Ultimately, an ultrasonic sensor of the **UT12** series was used. This had a diameter of just 12mm. The series offers solutions with switching output for position sensing (**UT129520**) and versions with analog output for measurements that are proportional to distance (e.g. with filling level checks) such as the **UT129021**.

ONE SERIES FOR MANY TASKS

In the filling system of the chemical company, the **UT129021** was mounted directly behind the dosing unit to enable the filling level to be detected. What makes this device special is the so-called beam columnator attached to the sensor head. The beam columnator focuses the ultrasound, producing an almost linear sound cone. This further reduces the exit angle and the angle of beam spread of the sound compared to a device without beam columnator. In this way, it is possible to check the filling levels in containers with very small openings. The resulting analog signal from the sensor, which is proportional to the filling level, is evaluated by the primary control unit. The advantage: The reference value and the permissible tolerances for the filling level can be used flexibly in the control unit, allowing various batches with different filling levels to be produced. Bottles with a filling level that is too high or too low are ejected from production by the system control.

Moreover, a **UT129520** with digital switching output for presence checking is installed at the dosing unit itself to ensure that a bottle is actually located at the desired position prior to the filling process.

ULTRASONIC SENSOR VARIANTS

M8 DESIGN

- operating range 20 to 100mm
- switching output

M12 DESIGN BEAM COLUMNATOR

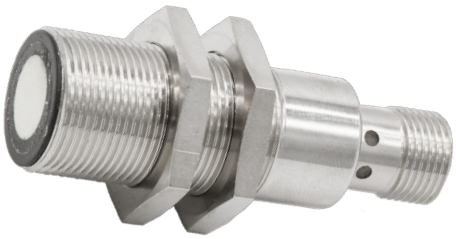
- operating range 0 to 150mm
- switching or analog output

M12 DESIGN

- operating range 20 to 200mm or 40 to 400mm
- switching or analog output

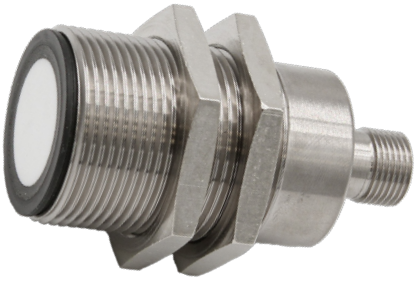
M18 DESIGN

- operating range 80 to 800mm or 150 to 1500mm
- switching or analog output



CUBOID DESIGN

- operating range 20 to 200mm or 40 to 400mm
- switching or analog output



M30 DESIGN

- operating range 300 to 3000mm or 600 to 6000mm
- switching or analog output

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