Sensor solutions in feeder technology

Sensor solutions in feeder technology

Maximum system availability with application stability and flexible sensor solutions.

Baumer
Passion for Sensors

Maximum system availability with application stability and flexible sensor solutions.

The automation of assembly processes begins by feeding the individual parts or work pieces. Whether connecting elements, washers, O-rings or plastic parts: the diversity of the elements is as great as their field of application in a wide variety of industries, ranging from automotive through pharmaceutical / medical technology to consumer goods, electronics, food and packaging.

Regardless of the application in question, the task of feeding systems is always to sort the parts as gently as possible and to make them available singly in a defined position for the subsequent process steps. In addition, integrated test stations can ensure that bad parts are ejected from the value stream at an early stage in order to guarantee the best possible material flow.

With over 60 years of experience in assembly automation, Baumer offers the best sensor solutions to achieve maximum process quality and reliability using controlled feeding systems.

Allow the following pages to inspire you, and discover the right solution for your sensor applications when it is a question of feeding work pieces.

Contents.

Your benefits at a glance.

Feeding a wide range of components in the right position requires feeder systems that offer a high degree of flexibility and process reliability. With over 60 years of experience in assembly automation, Baumer offers a comprehensive portfolio of proven sensor solutions. The choice of the right sensor, tailored to your application and taking account of ambient conditions, is a critical factor in the maximization of system availability as well as the minimization of costs for service and maintenance.

Reliable and efficient processes

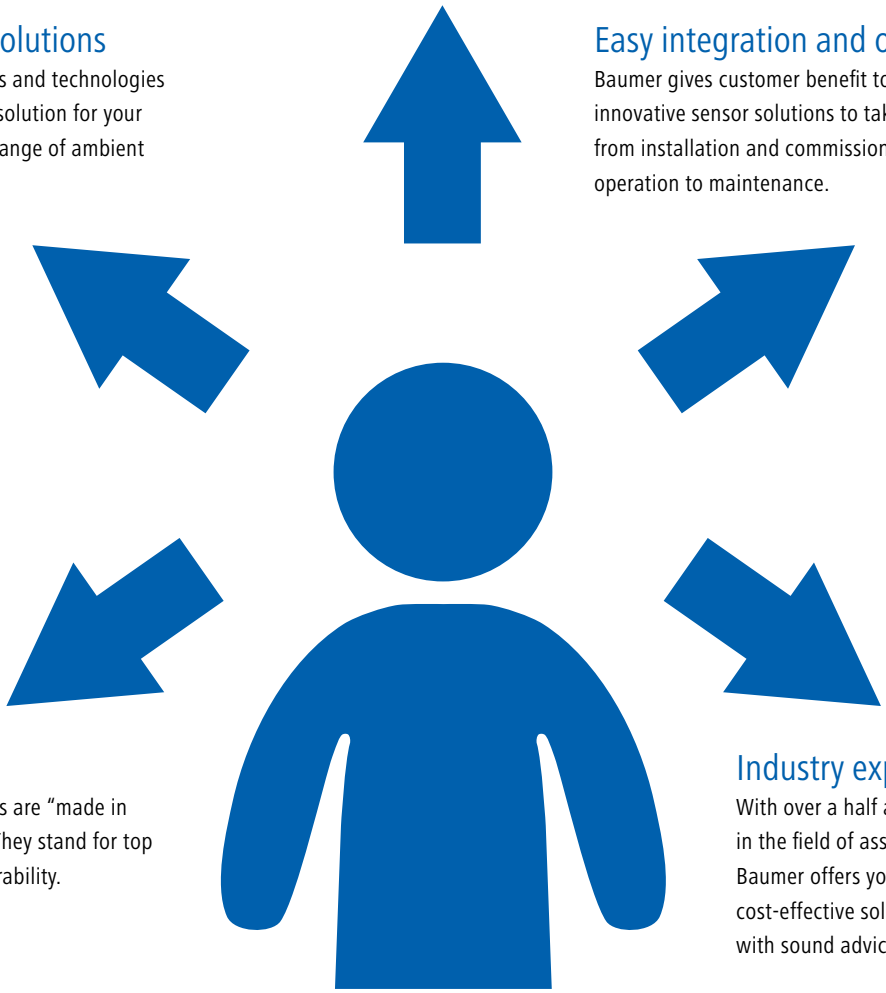
Robust product design, high performance reserves and intelligent signal conditioning guarantee process reliability and maximum system availability even in critical areas.

Flexible sensor solutions

A wide range of products and technologies offers you the optimum solution for your requirements in a wide range of ambient conditions.

Easy integration and operation

Baumer gives customer benefit top priority, and develops innovative sensor solutions to take account of all aspects, from installation and commissioning through day-to-day operation to maintenance.



Quality

Baumer sensors are “made in Switzerland”. They stand for top quality and durability.

Industry expertise

With over a half a century of experience in the field of assembly automation, Baumer offers you industry-proven and cost-effective solutions in conjunction with sound advice.

Product portfolio – sensor solutions in feeder technology.

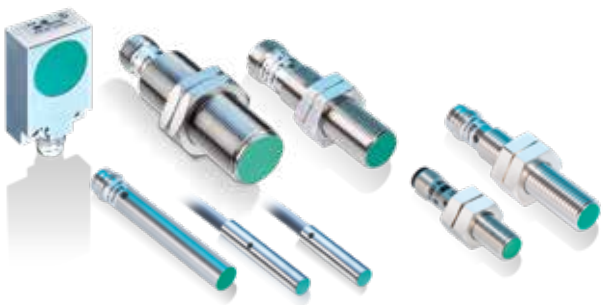
Light barriers and light scanners

Ultrasonic sensors

Light conductors and light amplifiers

Forked light barriers

Inductive proximity switches



Inductive distance sensors *AlphaProx*

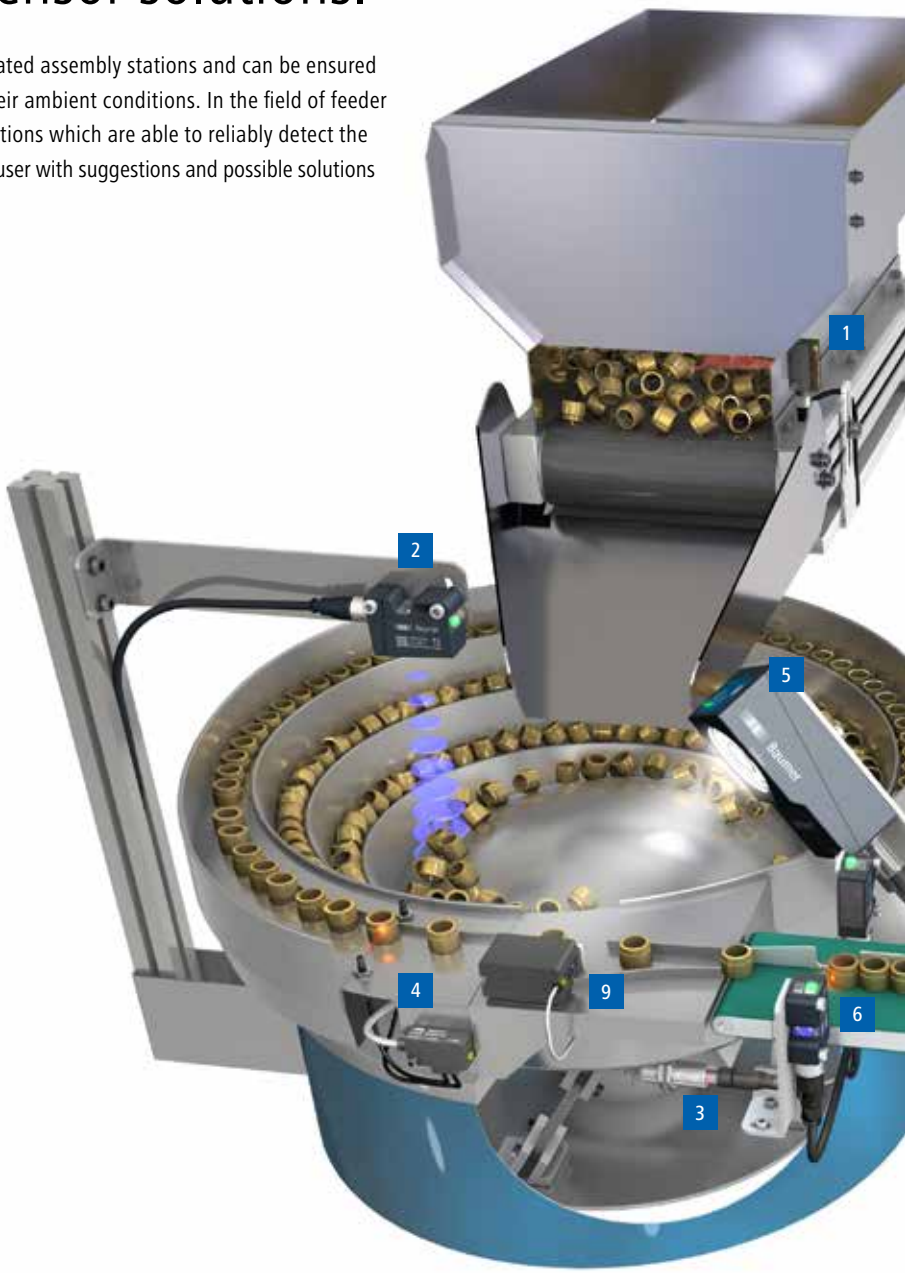
VeriSens® Vision sensors

Incremental rotary encoders

Cylinder sensors

Application-optimized sensor solutions.

Maximized system availability is of utmost importance in automated assembly stations and can be ensured by using components which are stable in use and resistant to their ambient conditions. In the field of feeder technology the focus also lies on particularly flexible sensor solutions which are able to reliably detect the whole range of various components. These guidelines provide the user with suggestions and possible solutions utilizing sensors within classical feeder systems.



1

Filling level monitoring in the parts hopper
To avoid downtimes, you need reliable sensors which are not influenced by ambient conditions such as ambient light, reflections, and dirt. Here, Baumer offers you the right sensors for your range of parts and for different assembly situations.

Find out more about sensor solutions from Page 8

2 3

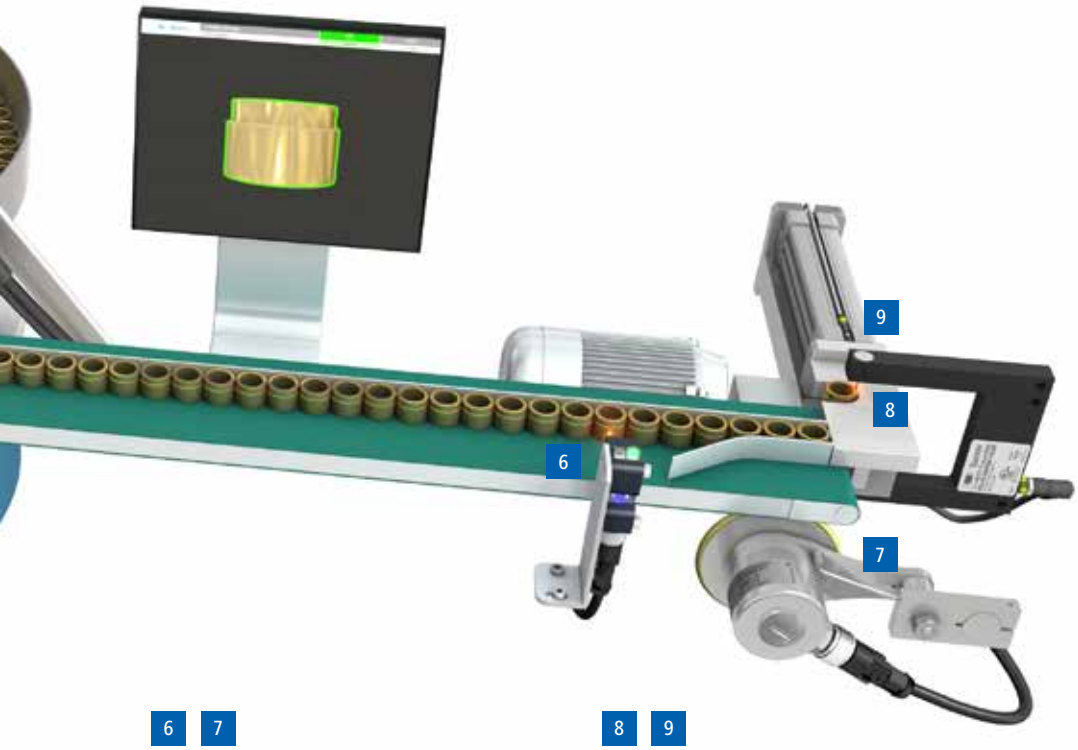
Vibrating spiral feeder: Filling level monitoring and drive control
In order to guarantee the flow of material, a particularly position-tolerant, shape, size and color-independent part identification system is required. Sensory control of the drive allows gentle operation at the optimum working point, thus reducing energy consumption and noise emissions.

Find out more about sensor solutions from Page 10

4 5

Checking position and presence at the outlet of the vibrating spiral feeder
A prerequisite for trouble-free feeding is the exact orientation of the part. With Baumer *VeriSens*® vision sensors, not only part orientation but also numerous other test criteria can be checked. Bad parts are thus detected at an early stage and ejected from the value stream.

Find out more about sensor solutions from Page 14



6 7

Buffer zone monitoring

To avoid downtimes, the presence of parts is detected at several points in the buffer zone and the conveyor speed adjusted accordingly. A large number of parts of different size, shape and material can be detected by the same sensor. Baumer *SmartReflect*® light barriers allow easy installation without a reflector.

Find out more about sensor solutions from Page 16

8 9

Separation

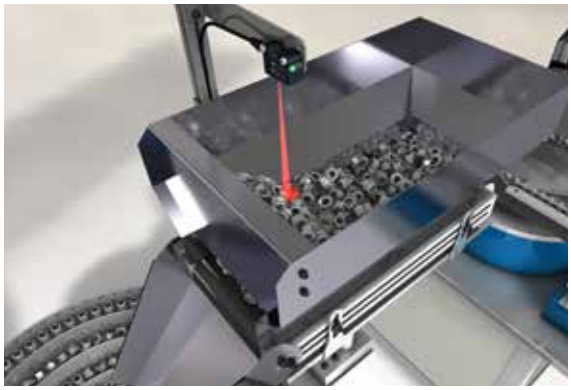
At the end of the buffer zone, the presence of parts in the nest is checked. Magnetic cylinder sensors monitor the position of the pneumatic actuators.

Find out more about sensor solutions from Page 21

Filling level monitoring in the parts hopper.

Light barriers and light sensors

Baumer optical sensors offer high performance reserves in a compact design, and allow flexible installation.



High performance reserves thanks to powerful processors

- Trigger safety even with highly reflective parts
- Enormous resistance to dirt

Flexibility in machine design

- Installation solutions from the side or from above
- Miniaturized sensors for minimal interference contours

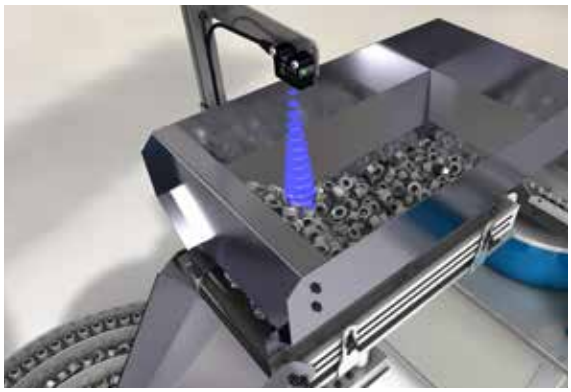
Easy installation and start-up

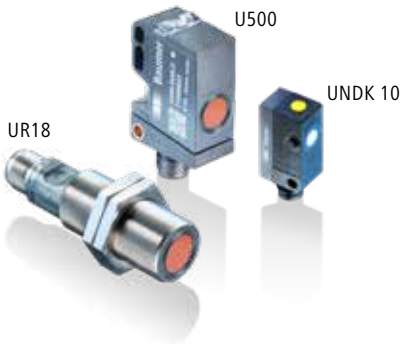
- Automated parameterization with IO-Link
- Simple and well-guided *qTeach*® teach-in method allows rapid training, saves time and improves protection against manipulation
- Universal push/pull sensor with selectable mode (NO/NC) reduces the number of different parts in stock

Solution portfolio of light barriers and light sensors, page 24

Ultrasonic sensors

Ultrasonic sensors detect the parts in the hopper, regardless of their color and transparency properties. The characteristic of the sonic cone allows reliable level detection even in the case of cluster-forming parts, such as longer pins or rivets. Variants with one or two independent switching signals as well as an analog measuring signal are available.





High process reliability with a large range of parts
- Independent of object color, gloss, or transparency
- Unsusceptible to dust, dirt and moisture
- U500 and UR18 are uniquely resistant to chemical and mechanical influences, thanks to the hermetically sealed sensor element
- Sensor adjustment to the properties of the object, thanks to parameterization with IO-Link

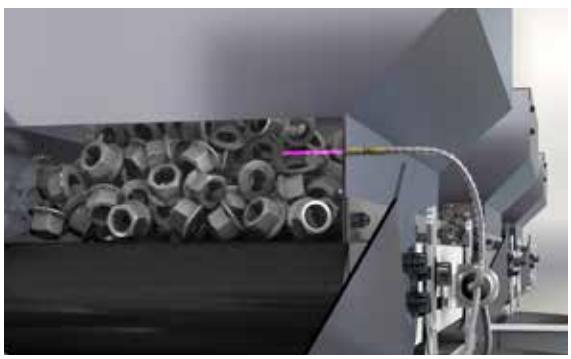
Flexibility in machine design
- Cylindrical or rectangular design allows installation in practically any installation situation
- Miniaturized sensors for minimal interference contours
- Short blind regions allow measuring almost up to the sensor surface

Easy installation and start-up
- Automated parameterization with IO-Link
- Simple and well-guided *qTeach*® teach-in method allows rapid training, saves time and improves protection against manipulation
- Universal push/pull sensor with selectable mode (NO / NC) reduces the number of different parts in stock

Ultrasound sensor solution portfolio, page 24

Optical fibers and amplifiers

Baumer optical fibers and amplifiers are characterized by their robustness and easy handling.



Vibration-resistant optical fibers
- Robust sheaths made of plastic or metal

Flexibility in machine design
- Large selection of sensing heads
- Cylindrical or rectangular optical fiber amplifier allows installation in practically any installation situation

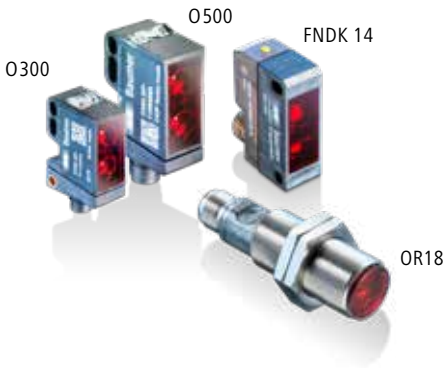
Easy installation and start-up
- Minimal installation effort for optical fiber
- Amplifier also available in 18mm metal housing for the use of standard mounting elements
- Fast adjustment through teach-in function or potentiometer

Fiber optic sensor solution portfolio, page 28

Filling level monitoring in the vibrating spiral feeder.

SmartReflect® light barriers

SmartReflect® optical sensors by Baumer are suitable for reliable level control in the vibrating spiral feeder. Thanks to their design and intelligent signal processing, they detect objects reliably and without contact, regardless of their color or shape.



High performance reserves thanks to powerful processors

- Trigger safely even with highly reflective parts
- Extremely dirt-resistant

Easy installation and start-up

- Teach-in takes place on the bottom of the container. When the light beam is interrupted by parts, the switching output is activated
- Automated parameterization with IO-Link
- Simple and well-guided *qTeach*® teach-in method allows rapid training, saves time and improves protection against manipulation, or by potentiometer
- Universal push/pull sensor with selectable mode (NO / NC) reduces the number of different parts in stock

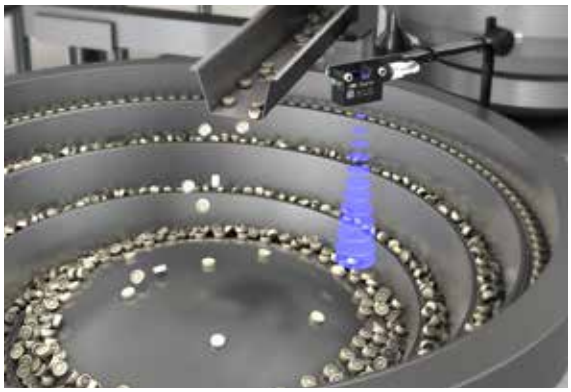
Flexibility in machine design

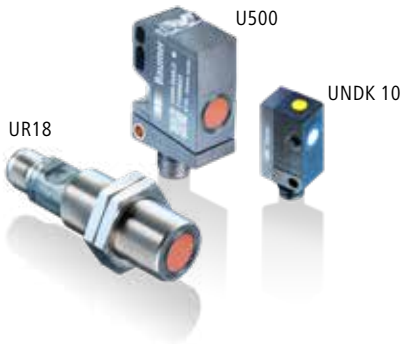
- The Baumer *OneBox Design* allows for easy exchange between optical and ultrasonic sensors of the U500 and O500 series thanks to an identical housing

SmartReflect® light barrier solution portfolio, page 24

Ultrasonic sensors

Ultrasonic sensors detect the parts in the hopper, regardless of their color or transparency properties. The characteristic of the sonic cone allows reliable level detection even in the case of cluster-forming parts, such as longer pins or rivets. Variants with one or two independent switching signals as well as an analog measuring signal are available.





High process reliability with a large range of parts

- Independent of object color, gloss, or transparency
- Unsusceptible or highly resistant to dust, dirt and moisture
- U500 and UR18 are uniquely resistant to chemical and mechanical influences, thanks to the hermetically sealed sensor element
- Sensor adjustment to the properties of the object, thanks to parameterization with IO-Link

Flexibility in machine design

- Cylindrical or rectangular design allows installation in practically any installation situation
- Miniaturized sensors for minimal interference contours
- Short blind regions allow measuring almost up to the sensor surface

Easy installation and start-up

- Automated parameterization with IO-Link
- Simple and well-guided *qTeach*® teach-in method allows rapid training, saves time and improves protection against manipulation
- Universal push/pull sensor with selectable mode (NO / NC) reduces the number of different parts in stock

Ultrasound sensor solution portfolio, page 24

Inductive proximity switches

To use in conjunction with the sensor arm on your level control device. Baumer offers a very wide range of inductive proximity switches. With their robust metal housing and fully encapsulated electronics, inductive sensors guarantee robustness and process reliability, even in applications exposed to vibrations.

High process reliability even in demanding environments

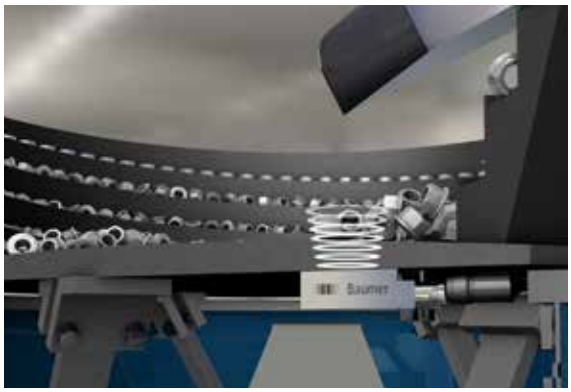
- High repeat accuracy and precise switching point
- Vibration resistant encapsulated electronics
- Robust metal housing
- Independent of object color
- High degree of temperature stability and very good EMC properties

Flexibility in machine design

- Large selection of sizes and shapes allow installation in practically any installation situation

Inductive proximity switch solution portfolio, page 34

The IFFM20 inductive sensor with a particularly large sensing distance is ideal for detecting the level of metallic parts in vibrating spiral feeders made of plastic.



IFFM 20

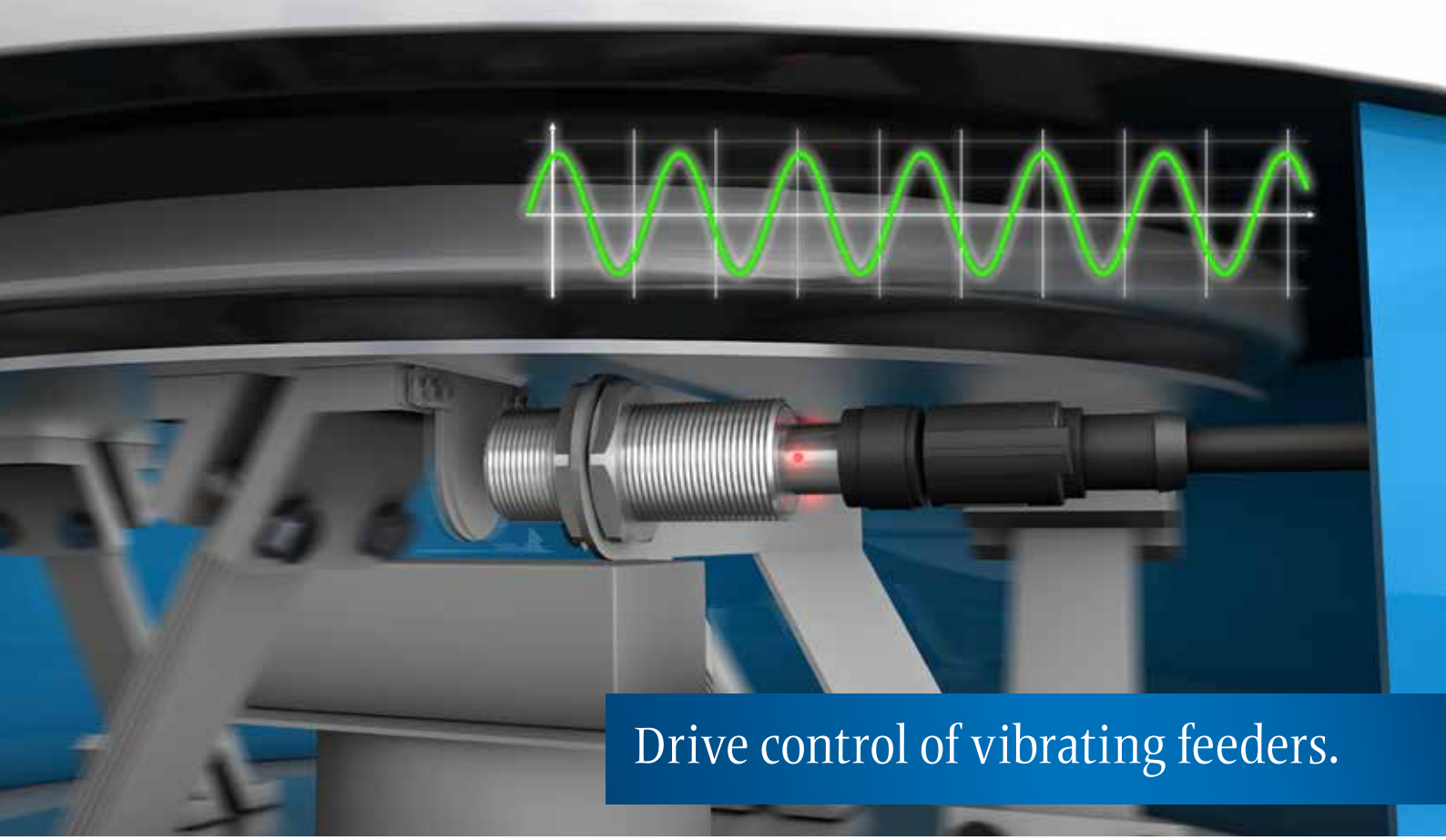
Discrete assembly from below

- Gentle, non-contact detection
- Free access from above without wiring getting in the way
- Very small footprint thanks to flat and compact design

High process reliability

- Reliable detection of metal parts such as washers or nuts through the plastic floor thanks to the extra large sensing distance of up to 8 mm
- Metal housing with encapsulated electronics for maximum robustness, particularly in applications exposed to vibrations
- High repeat accuracy and precise switching point
- High degree of temperature stability and very good EMC properties

Inductive proximity switch solution portfolio, page 36



Drive control of vibrating feeders.

AlphaProx inductive distance sensors

The detection of the current vibration frequency and amplitude means that the system always operates at the optimum working point. *AlphaProx* inductive distance sensors offer many advantages compared to current-controlled systems.

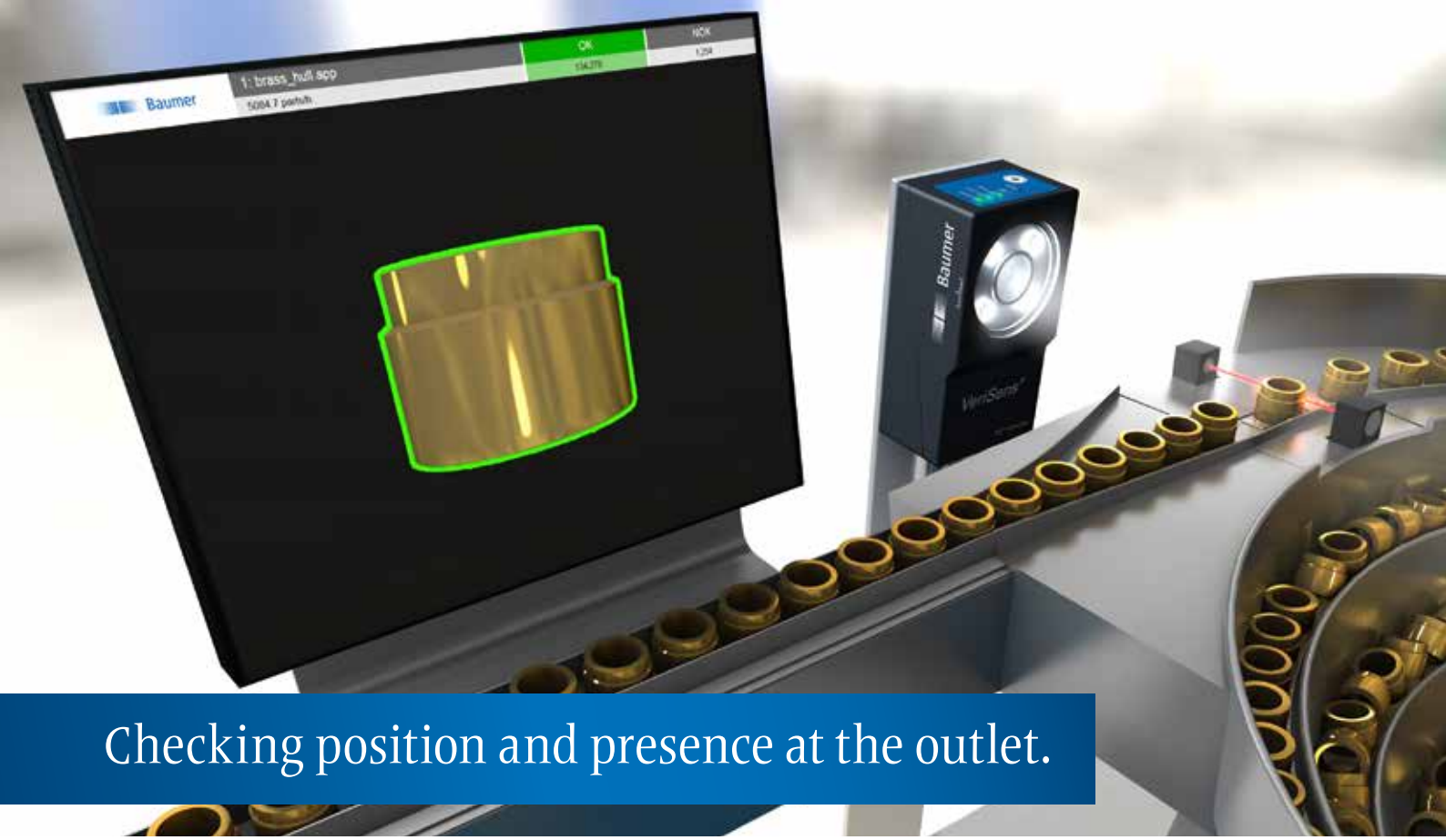
Demand-driven, intelligent drive control

- Accurately adjustable material flow thanks to high resolution
- Fast response times from 1 ms
- High repeat accuracy
- Reduction of noise emissions
- Maximum energy efficiency

Easy installation and handling

- Fully integrated electronics without external amplifier
- Discrete wiring below the spiral feeder
- IO-Link for easy sensor adjustment and the use of additional measurement functions and analysis data

Inductive distance sensor solution portfolio, page 40



Checking position and presence at the outlet.

VeriSens® vision sensors

The parts are checked for position and orientation at the outlet of the vibrating feeder. The *VeriSens*® vision sensor ejects parts with the wrong orientation at an early stage, so that a reliable process flow is guaranteed and downtimes avoided.

Maximum process reliability

- *FEX*® image processor calculates contours in real time
- *FEXLoc*® automatic part location for variable object positions and reliable detection of vibrating parts
- Up to 144 feature checks per second

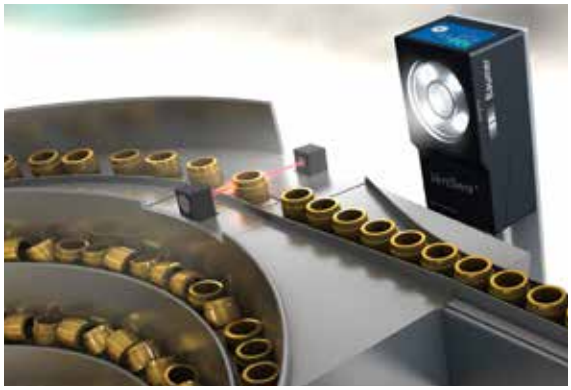
Cost-effectiveness

- *VeriSens*® *Application Suite* – Simple, user-friendly and time-saving parameterization of all *VeriSens*® vision sensors
- *VeriSens*® web interface – configurable user interface for fast adjustments during operation
- Flash Sync signal to synchronize illumination with flash controller
- Integrated lenses and illumination
- Digital I/O for the direct addressing of diverters

Long service life

- Robust metal housing in IP 67
- Stainless steel housing with IP 69K available for medical pharmaceutical or food and beverage applications

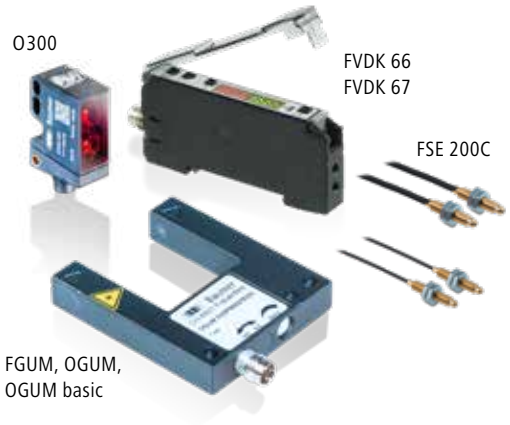
VeriSens® vision sensor solution portfolio, page 40



Setting the trigger for the vision sensor

To set a trigger for the *VeriSens*® vision sensor, reliable object detection at the outlet of the vibrating spiral feeder is essential. Baumer offers an extensive portfolio of different technologies for this – suitable for each installation situation and ambient conditions.

Solution portfolio for light barriers and sensors, optical fibers and amplifiers and fork sensors from page 24



Recommended sensor solution

VeriSens® vision sensors – position and quality control with one sensor

VeriSens® vision sensors offer the opportunity to check quality criteria at the outlet of the vibrating spiral feeder. In addition to the early ejection of parts on account of incorrect orientation, bad parts can also be detected prematurely and ejected from the value stream. The vision sensors of the *VeriSens*® family can check up to 32 characteristics: their range of features includes contours, colors as well as code reading.

Buffer zone monitoring.

SmartReflect® light barriers without reflectors

Baumer *SmartReflect*® light barriers offer the reliability of through beam sensors with half the time and expense needed for installation: The reflector, potentially subject to wear and tear, is eliminated, as a part of the machine is used as the background. Transparent and highly reflective objects of any shape or structure are reliably detected.

High performance reserves thanks to powerful processors

- Trigger safety even with highly reflective parts
- Extremely dirt resistant
- Detection of very small parts with up to 0.1 mm fine laser beam

Easy installation and start-up

- Simple and well-guided *qTeach*® teach-in method allows rapid training, saves time and improves protection against manipulation
- Automated parameterization with IO-Link
- Installation is also possible from above
- Universal push/pull sensor with selectable mode (NO / NC) reduces the number of different parts in stock

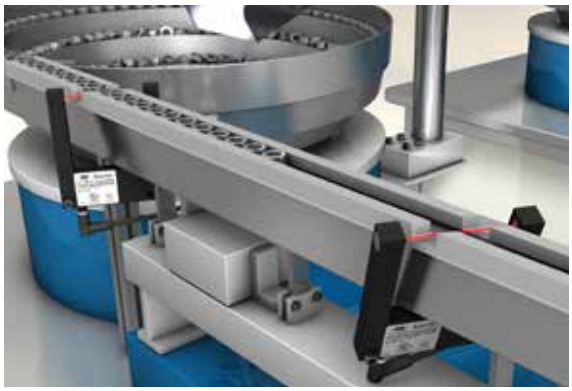
Low running costs

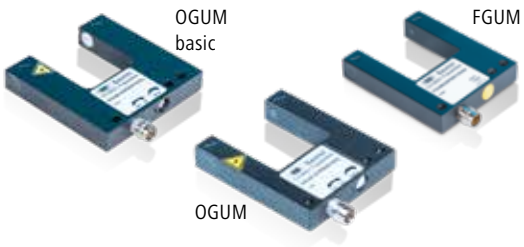
- Installation time can be cut by 50% since no reflector is required
- Replacement of the reflector due to wear and tear is no longer necessary

Light barrier solution portfolio, page 24

Fork sensors

Baumer fork sensors can be installed quickly and easily. Different fork widths up to 120 mm are available, as well as several light sources.





Quick and easy initial start-up
- No alignment of transmitter and receiver necessary

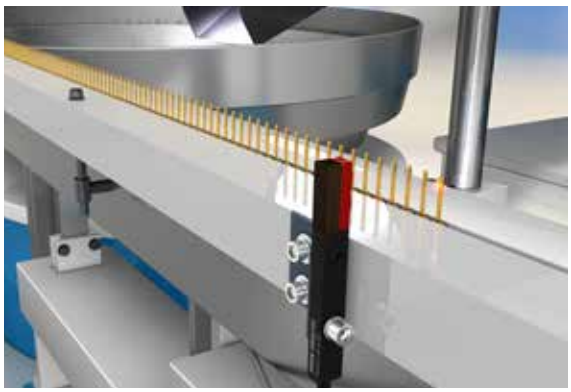
Reliable object detection even under difficult conditions
- Object recognition regardless of color or surface
- Laser versions for very small parts in the 1/100 mm range
- High ambient light immunity
- Robust metal housing and encapsulated electronics for continuous use in environments subject to vibrations

High system efficiency
- Detection of fast-moving parts thanks to short response times of up to 0.125 ms
- High repeat accuracy

Fork sensor solution portfolio, page 28

Miniature diffuse sensors with background suppression

Our miniature models are ideal for installation in tight spaces. Even our smallest sensors feature integrated evaluation electronics for top performance.



Reliable and stable detection of complicated parts such as springs, spirally wound filaments
- Narrow line spot (LED: 3.5 mm, laser: 0.2 mm)

Space saving in spatially critical conditions
- Housing in miniature design

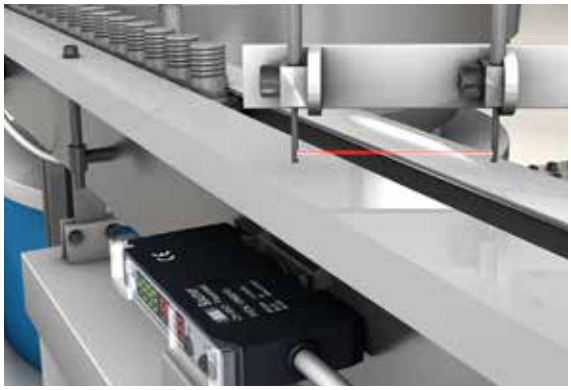
Stable processes
- High repeat accuracy of < 0.2 mm

Fast start-up and adjustment
- Classical mechanical adjustment with potentiometer

Miniature light sensor solution portfolio, page 26

Optical fibers and amplifiers

Optical fiber sensors are suitable for particularly narrow and tight installation conditions.



Use in very tight or inaccessible spaces
- Compact sensing heads with cylindrical and rectangular shapes with straight or right-angle light emission
- Small light spots of 0.1 mm

Robustness
- PTFE-coated for protection against aggressive media
- Robust sheaths made of plastic or metal

Easy installation and start-up
- Fast adjustment through auto-teach-in function or potentiometer

Fiber optic sensor solution portfolio, page 28

Inductive proximity switches with factor 1

Factor 1 means identical sensing distance with all metals. This means that only one sensor is required for the detection of different parts made of stainless steel, aluminum or non-ferrous metal.

Flexibility in design and installation
- Same sensing distance for all metals
- Little customization required for faster installation
- Choice of four cylindrical sizes

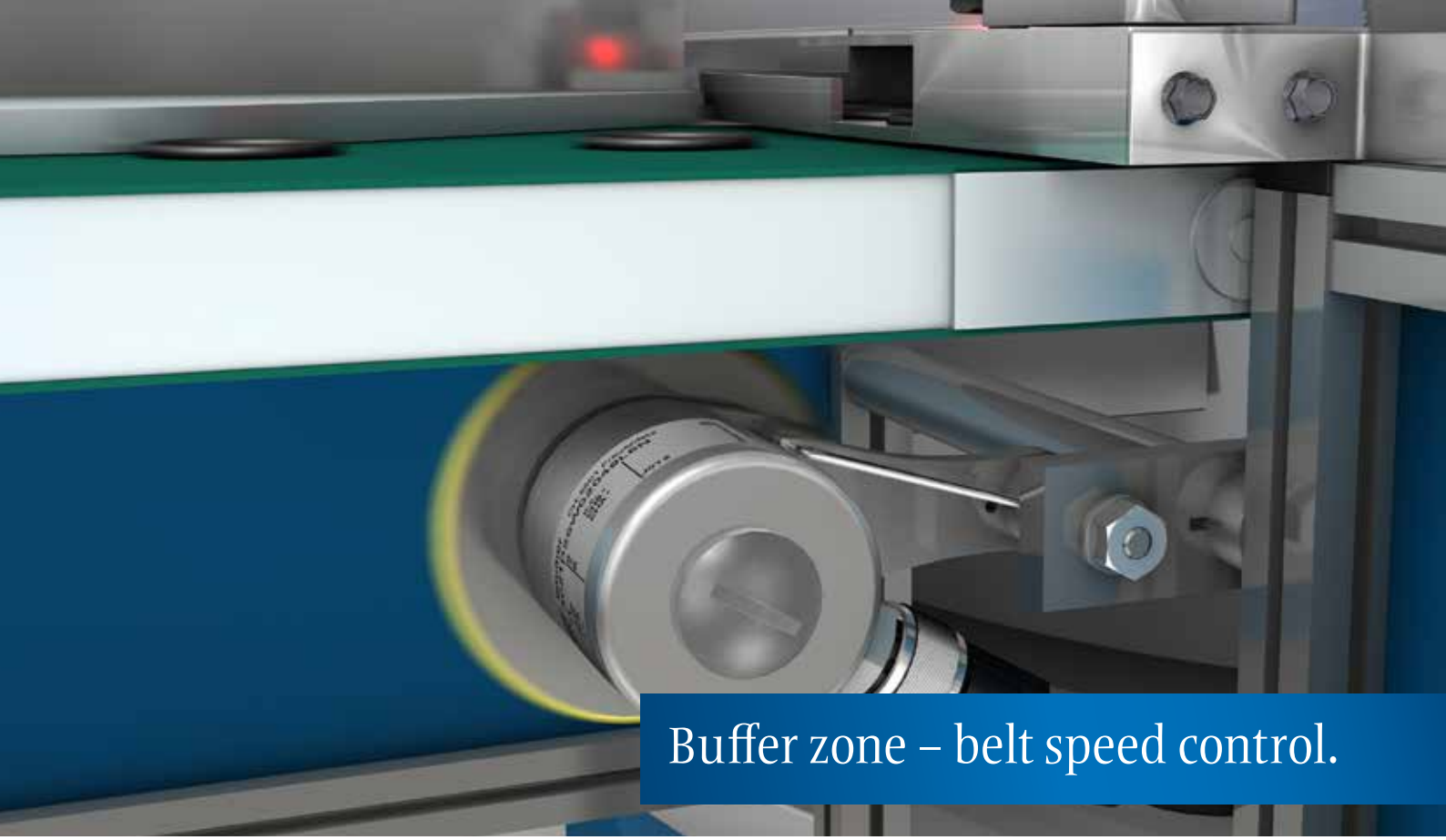
Maximum operational reliability
- Switching frequencies of up to 3 kHz allow high conveyor speeds
- Resistant even to vibrating parts
- High EMC resistance
- Wide temperature range, also suitable for changing ambient conditions

Solution portfolio for inductive proximity switches with Factor 1, page 34

Recommended sensor solution

Light barriers without reflector – *SmartReflect*®

The intelligent Baumer *SmartReflect*® technology combines process safety of through-beam light barriers with the simplicity of reflected light barriers. No separate reflector is needed however – as any part of the machine can function as such. Objects are reliably detected; regardless of their color or degree of reflection.



Buffer zone – belt speed control.

Incremental encoders

For the use of conveyor belts, for example in conjunction with Pick & Place applications, the actual belt speed for control processes is required.

MA20

Long service life even in harsh environments
- Heavy duty version – vibration and shock-tested (DIN EN 60068)

Quick and easy initial start-up
- Resolution setting by means of switch
- Reduced installation costs thanks to the availability of 16 factory presets

Maximum flexibility and reduced number of variants in stock
- Setting range from 100 ... 25000

Perfect adaptation to the conveyor belt
- Adjustable spring pressure

Space-saving solution, for retrofitting as well
- Compact size (40 mm housing)

Incremental encoder solution portfolio, page 42

EIL 580P-SC

Perfectly suited to your needs, reduction in stocks
- Modular product design

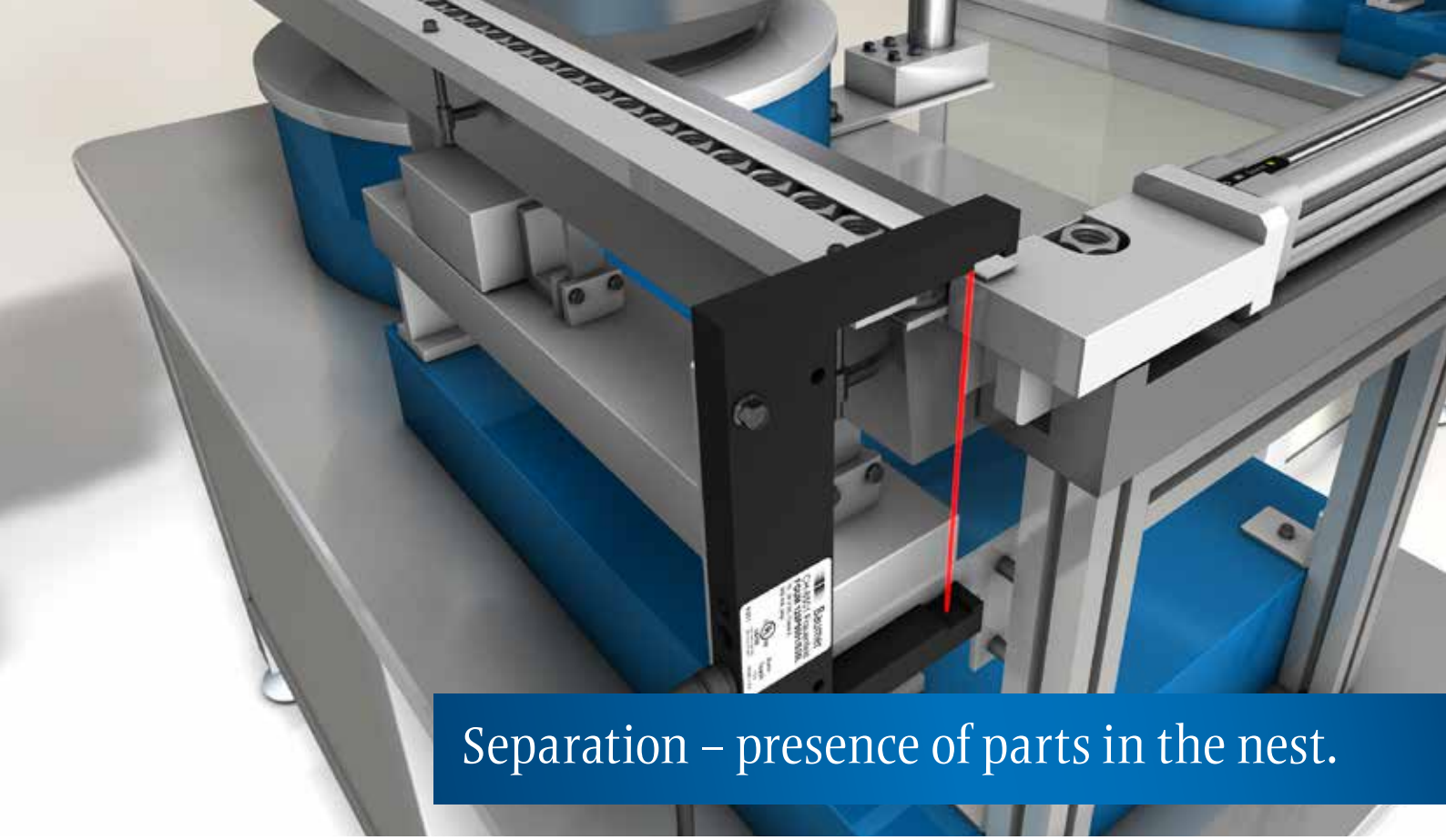
Reduced diversity of parts in stock
- Programmable version

Perfect adaptation to the application
- Large selection of accessories

Reliable even under harsh conditions
- Robust mechanical design

Outstanding signal quality
- High-precision optical measurement

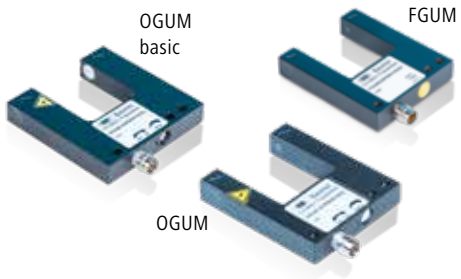
Incremental encoder solution portfolio, page 42



Separation – presence of parts in the nest.

Fork sensors

Different light sources with different-sized spots provide maximum detection reliability even for the smallest parts. Fork widths of 20 to 120 mm are available.



Quick and easy initial start-up

- No alignment of transmitter and receiver necessary

Reliable object detection even under difficult conditions

- Object recognition regardless of color or surface
- Laser versions for very small parts in the 1/100 mm range
- High ambient light immunity
- Robust metal housing and encapsulated electronics for continuous use in environments subject to vibrations

High system efficiency

- Detection of fast-moving parts thanks to short response times of up to 0.125 ms
- High repeat accuracy

Fork sensor solution portfolio, page 28

Optical fibers and amplifiers

Optical fiber sensors are suitable for particularly narrow and tight installation conditions.

Use in very tight or inaccessible spaces
- Small, light sensing heads in cylindrical and rectangular shapes
- Small light spots of 0.1 mm

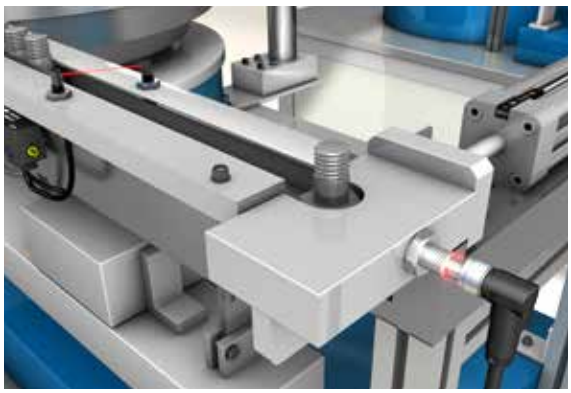
For particularly adverse environmental conditions – very robust sensors resistant to heat and chemicals
- PTFE-coated for protection against aggressive media
- Ambient temperatures of –60 ... +350 °C
- Robust sheaths made of plastic or metal

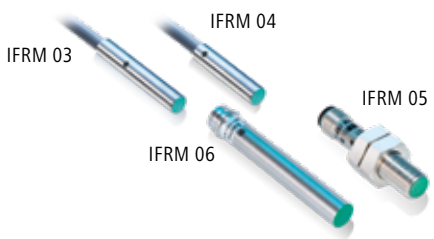
Easy installation and start-up
- Fast adjustment through teach-in function or potentiometer

Solution portfolio of light sensors and amplifiers, page 28

Inductive proximity switches

The wide Baumer range of inductive sensors is characterized by very small sensors with fully integrated evaluation electronics and large sensing distances. This ensures simple and precise integration.





Highly reliable part detection and easy integration
- Large sensing distance even with the smallest sensor housing

The ideal sensor solution for all applications
- Wide portfolio diversity

Reduced false trigger setting when mounted in the vicinity of drives
- High EMC resistance

Reliable signal even in unstable ambient conditions
- Wide temperature range

Long sensor service life
- High quality (Swiss made)
- Encapsulated electronics
- Low series deviation

Inductive proximity switch solution portfolio, page 34

Separation – the position of the pneumatic cylinder.

Cylinder sensors

Cylinder sensors in different styles and a wide range of mounting accessories ensure maximum flexibility. They are contactless and absolutely wear-free.

MZTK 06×1011
MZTK 06×1012
MZTK 06×1013

MZCK 03×1011
MZCK 03×1012

High process reliability and durability

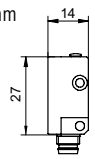
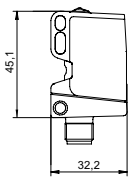
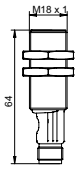
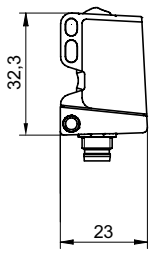
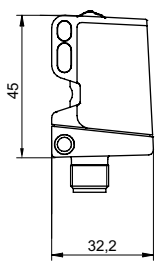
- Magneto-resistive technology
- Robust design and IP 67
- Resistant to harsh conditions such as moisture, dirt, vibrations

Flexibility in machine design

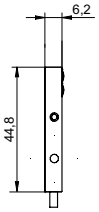
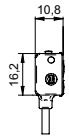
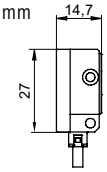
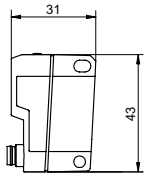
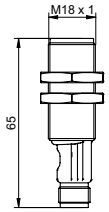
- Wide range of sensor types (for C or T-slot cylinders) and accessories
- Can be inserted into the slot from above

Cylinder sensor solution portfolio, page 38

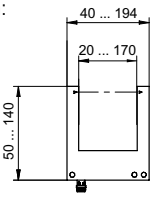
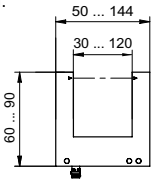
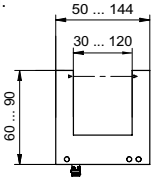
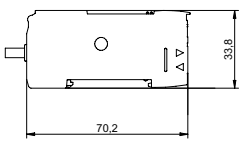
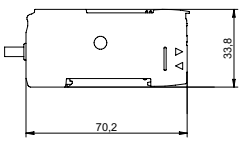
Overview sensor solutions.

	Size	Sensor principle: Proximity switch	Diffuse reflective sensor	Reflective barrier	Through-beam sensor	*SmartReflect*® light barrier without reflector	Reflective light sensor with background suppression	Detection area: 100 mm … 500 mm … 1000 mm … 1500 mm
Ultrasonic sensors								
UNDK 10 SONUS 	10.4 × 27 × 14 mm 	■		■				10 … 200 mm 0 … 200 mm
U500 	18 × 45.1 × 32.2 mm 	■		■				70 … 1000 mm 0 … 1000 mm
UR18 	M18 × 64 mm 	■		■				70 … 1000 mm 0 … 1000 mm
Light barriers and light sensors								
O300 	12.9 × 32.3 × 23 mm 				■	■	■	30 … 300 mm *SmartReflect*® light barrier without reflector (O300.SP) *SmartReflect*® transparent light barrier without reflector (O300.SP.T) 15 Through-beam light barrier (O300.TR and O300.ER) 30 … 300 mm Reflective light sensor with background suppression (O300GP)
O500 	18 × 45 × 32 mm 				■	■	■	60 … 600 mm *SmartReflect*® light barrier without reflector (O500.SP) *SmartReflect*® transparent light barrier without reflector (O500.SP.T) 40 Through-beam light barrier (O500.TR and O500.ER) 60 … 400 mm Reflective light sensor with background suppression (O500GP)

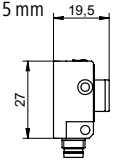
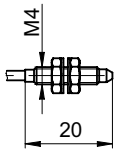
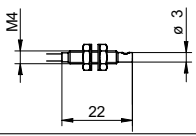
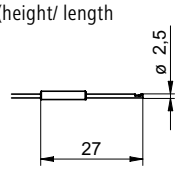
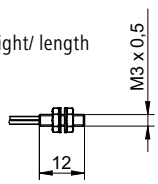
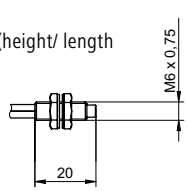
	Response time	Electric connection / interface points	IO link	Housing material	Protection class	Distinguishing features	Applications in feeder technology: Fill level controls in parts hoppers	Fill level controls in vibrating spiral feeders	Drive control of vibrating feeders	Checking position and parts presence at outlet of the vibrating spiral feeders	Buffer zone monitoring	Buffer zone belt speed control	Separation – parts presence in nest	Separation – position of pneumatic cylinder
	< 15 ms	Plug M8, 4-pole Cable 2 m, 4-pole		Plastic	IP 67	Smallest ultrasonic sensor Minimum weight 4 g Narrow sonic beam	■	■						
	< 40 ms	Plug M12, 5-pole	■	Plastic	IP 67	Uniquely robust thanks to hermetically-sealed sensor element Short blind range of 70 mm *qTarget*®: saves assembly time *qTeach*®: easy to use, safe and wear-free *OneBox Design*: allows flexible planning	■	■						
	< 40 ms	Plug M12, 5-pole	■	Stainless steel	IP 67	Uniquely robust thanks to hermetically-sealed sensor element Short blind range of 70 mm *qTeach*®: easy to use, safe and wear-free Short design	■	■						
	< 49 ms (SP, GP and TR) < 0.25 ms (SP.T)	Cable 2 m, 4-pole Plug M8, 4-pole Cable plug M8, 4-pole Cable plug M12, 4-pole	■	Plastic or stainless steel	Plastic: IP 67 Stainless steel: IP 68 / IP 69K *proTect+*	Versions for transparent objects Miniature sensors	■	■		■	■			
	< 49 ms (SP, GP and TR) < 0.25 ms (SP.T)	Cable 2 m, 4-pole Cable 2 m, 3-pole Plug M12, 4-pole Plug M12, 3-pole	■	Plastic or stainless steel	Plastic: IP 67 Stainless steel: IP 68 / IP 69K *proTect+*	Sensors for transparent objects Adjustable signal	■	■			■			

	Size	Sensor principle						Detection area
		Proximity switch	Diffuse reflective sensor	Reflective barrier	Through-beam sensor	*SmartReflect*® light barrier without reflector	Reflective light sensor with background suppression	100 mm … 500 mm … 1000 mm
FHDK04 	4 × 44.8 × 6.2 mm 						■	max. 50 mm
FHDK07 	8 × 16.2 × 10.8 mm 						■	10 … 60 mm
FHDK 10 / OHDK 10 (Laser) 	10.4 × 27 × 14 mm 						■	10 … 300 mm Reflective light barrier with background suppression (FHDK)
FxDK 14 	14.8 × 43 × 31 mm 					■	■	20 … 500 mm Reflective light barrier with background suppression (FHDK) 50 … 800 mm *SmartReflect*® light barrier without reflector and transparent (FNDK)
OR 18.SP 	M18 × 65 mm 					■		55 … 300 mm

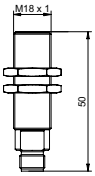
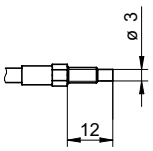
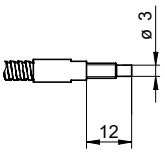
	Response time	Electric connection / interface points	IO link	Housing material	Pro-tection class	Distinguishing features	Applications in feeder technology							
							Fill level controls in parts hoppers	Fill level controls in vibrating spiral feeders	Drive control of vibrating feeders	Checking position and parts presence at outlet of the vibrating spiral feeders	Buffer zone monitoring	Buffer zone belt speed control	Separation – parts presence in nest	Separation – position of pneumatic cylinder
1500 mm														
	< 0.5 ms	Cable 2 m, 3-pole Cable plug M8, 4-pole		Plastic	IP 65	Sub-miniature Assembly in snap-on rail method Fixed scanning range					■			
	< 0.5 ms	Cable 2 m, 4-pole Cable plug M8, 4-pole		Plastic	IP 65	Worldwide, the smallest adjustable sensor family					■			
	< 0.5 ms < 0.05 ms (Laser)	Cable 4-pole, 2 m Plug M8 4-pole Cable plug M8 3-pole		Plastic	IP 65 / IP 67	Miniature					■		■	
	< 0.5 ms	Cable 4-pole, 2 m Plug M12, 4-pole Plug M8, 4-pole	■	Plastic (ASA, MABS)	IP 67	Versions for transparent objects	■							
	< 0.49 ms	Plug M12, 4-pole		Brass nickel-plated	IP 67	*qTeach*®: easy to use safe and wear-free	■	■			■			

	Size	Sensor principle						Detection area
		Proximity switch	Diffuse reflective sensor	Reflective barrier	Through-beam sensor	*SmartReflect*® light barrier without reflector	Reflective light sensor with background suppression	100 mm … 500 mm … 1000 mm … 1500 mm
Forked light barriers								
FGUM 	Fork width: 20 mm 30 mm 50 mm 80 mm 120 mm 170 mm 				■			
OGUM 	Fork width: 30 mm 50 mm 80 mm 120 mm 				■			
OGUM basic 	Fork width: 30 mm 50 mm 80 mm 120 mm 				■			
Light conductors and light amplifiers								
FVDK 66 	10 × 33.8 × 70.2 mm 			■	■			1.5 m (max Beam-through light conducto 130 mm (max.) Reflective light conducto
FVDK 67 	10 × 33.8 × 70.2 mm 				■	■		4 m (max Beam-through light conducto 550 mm (max.) Reflective light conducto

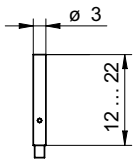
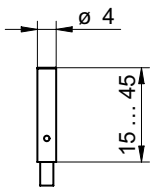
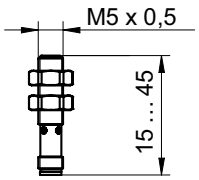
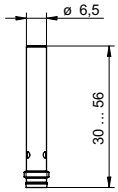
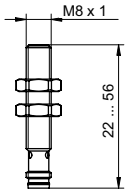
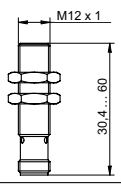
	Response time	Electric connection / interface points	IO link	Housing material	Protec-tion class	Distinguishing features	Applications in feeder technology							
							Fill level controls in parts hoppers	Fill level controls in vibrating spiral feeders	Drive control of vibrating feeders	Checking position and parts presence at outlet of the vibrating spiral feeders	Buffer zone monitoring	Buffer zone belt speed control	Separation – parts presence in nest	Separation – position of pneumatic cylinder
	< 0.125 ms	Plug M8, 3-pole		Die-cast zinc	IP 67	Potentiometer or Teach-in Version Narrow, almost parallel light beam Sensors can be assembled in series				■			■	
	< 0.166 ms	Plug M8, 3-pole		Aluminum	IP 67	Very high resolution Extremely narrow laser light beam Sensors can be assembled in series High repeat accuracy Sensors in laser class 1				■			■	
	< 50 ms	Plug M8, 3-pole		Aluminum	IP 67	High resolution Short response time Sensors can be assembled in series Sensors in laser class 1				■			■	
	0.25 … 1 ms	Cable 2 m, Plug M8, 4-pole		Plastic	IP 40	Adjustable sensitivity with Teach-in Minimized wiring work (Master- Slave) Timer functions	■			■	■		■	
	0.05 … 5 ms	Cable 2 m, Plug M8, 4-pole		Plastic	IP 40	Multi-functional instrument Adjustable sensitivity with Teach-in Minimized wiring work (Master- Slave) Timer functions	■			■	■		■	

	Size	Sensor principle						Detection area
		Proximity switch	Diffuse reflective sensor	Reflective barrier	Through-beam sensor	*SmartReflect*® light barrier without reflector	Reflective light sensor with background suppression	100 mm … 500 mm … 1000 mm … 1500 mm
FVDK 10 	10.4 × 27 × 19.5 mm 			■	■			600 mm (max.) Beam-through light conducto 70 mm (max.) Reflective light conducto
FSE 200C1002 	4 mm (width / diameter (head)) 20 mm (height/ length (head)) 				■			1200 mm (max.)
FSE 200C4002 	4 mm (width / diameter (head)) 22 mm (height/ length (head)) 				■			750 mm (max.)
FSE 200F4Y00 	2,5 mm (width / diameter (head)) 27 mm (height/ length (head)) 				■			52 mm (max.)
FCE 200D1Y01 	3 mm (width / diameter (head)) 12 mm (height/ length (head)) 		■					1 … 95 mm (max.)
FCE 200C1Y00 	6 mm (width / diameter (head)) 20 mm (height/ length (head)) 		■					1 … 400 mm (max.)

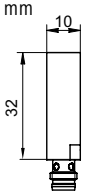
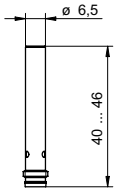
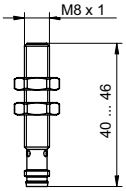
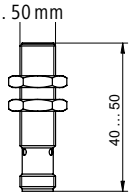
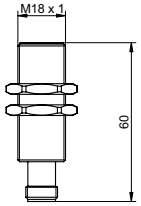
	Response time	Electric connection / interface points	IO link	Housing material	Protection class	Distinguishing features	Applications in feeder technology							
							Fill level controls in parts hoppers	Fill level controls in vibrating spiral feeders	Drive control of vibrating feeders	Checking position and parts presence at outlet of the vibrating spiral feeders	Buffer zone monitoring	Buffer zone belt speed control	Separation – parts presence in nest	Separation – position of pneumatic cylinder
	< 1 ms	Kabel 2 m Stecker M8, 4-Pol Kabelstecker M8, 4-Pol		Plastic	IP 40	Smallest light conductor instrument Sensitivity adjustable by means of potentiometer	■			■	■		■	
	0.05 … 5 ms			Material (light conductor): plastic Outer casing: PE Head: brass			■			■	■		■	
	0.05 … 5 ms			Material (light conductor): plastic Outer casing: PE Head: brass		Lateral light emission	■			■	■		■	
	0.05 … 5 ms			Material (light conductor): plastic Outer casing: PE Head: stainless steel		Lateral light emission Small sensing head	■			■	■		■	
	0.05 … 5 ms			Material (light conductor): plastic Outer casing: PE Head: stainless steel		Co-axial optics	■			■	■		■	
	0.05 … 5 ms			Material (light conductor): plastic Outer casing: PE Head: stainless steel		Co-axial optics	■			■	■		■	

	Size	Sensor principle						Detection area
		Proximity switch	Diffuse reflective sensor	Reflective barrier	Through-beam sensor	*SmartReflect*® light barrier without reflector	Reflective light sensor with background suppression	100 mm … 500 mm … 1000 mm … 1500 mm
FZAM 18 	M18 × 50 mm 			■	■			800 mm (max.) Through-beam light conductor 150 mm (max.) Reflective light conducto
FSE100A1003 	3 mm (width / diameter (head)) 12 mm (height / length (head)) 				■			1400 m (max.)
FSF100A1001 	3 mm (width / diameter (head)) 12 mm (height / length (head)) 				■			1400 m (max.)

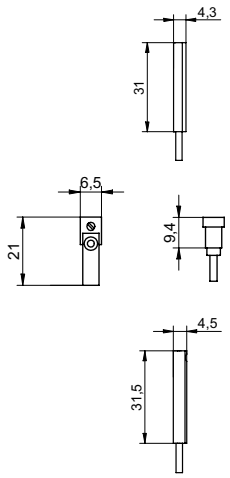
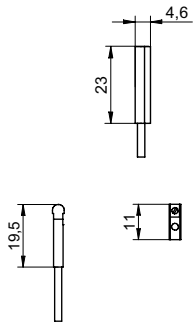
							Applications in feeder technology							
	Response time	Electric connection / interface points	IO link	Housing material	Protec-tion class	Distinguishing features	Fill level controls in parts hoppers	Fill level controls in vibrating spiral feeders	Drive control of vibrating feeders	Checking position and parts presence at outlet of the vibrating spiral feeders	Buffer zone monitoring	Buffer zone belt speed control	Separation – parts presence in nest	Separation – position of pneumatic cylinder
	< 1 ms < 0.5 ms	Cable 2 m, 3-pole Cable 2 m, 4-pole Plug M12, 4-pole		Brass nickel-plated / PC	IP 67	Adjustable sensitivity by means of Teach-In or potentiometer Robust metal housing	■							
				Outer casing: PVC			■			■	■		■	
				Outer casing: Brass chromium-plated			■			■	■		■	

	Size	Sensor principle						Detection area
		Proximity switch	Diffuse reflective sensor	Reflective barrier	Through-beam sensor	*SmartReflect*® light barrier without reflector	Reflective light sensor with background suppression	1 mm … 5 mm … 10 mm …
Inductive proximity switch								
IFRM 03 	3 mm × 12 … 22 mm 	■						max. 1 mm
IFRM 04 	4 mm × 15 … 45 mm 	■						max. 1,6 mm
IFRM 05 	5 mm × 15 … 45 mm 	■						max. 1,6 mm
IFRM 06 	6,5 mm × 30 … 56 mm 	■						max. 6 mm
IFRM 08 	8 mm × 22 … 56 mm 	■						max. 6 mm
IFRM 12 	12 mm × 30.4 … 60 mm 	■						max. 10 mm

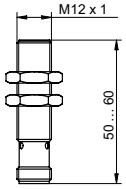
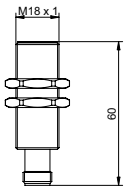
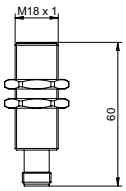
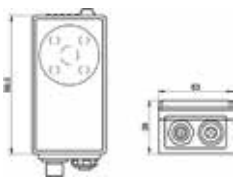
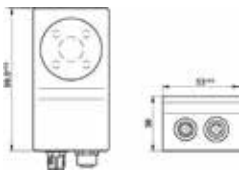
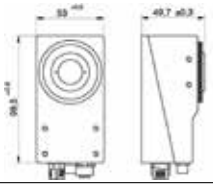
	Response time	Electric connection / interface points	IO link	Housing material	Protec-tion class	Distinguishing Features	Applications in feeder technology: Fill level controls in parts hoppers	Fill level controls in vibrating spiral feeders	Drive control of vibrating feeders	Checking position and parts presence at outlet of the vibrating spiral feeders	Buffer zone monitoring	Buffer zone belt speed control	Separation – parts presence in nest	Separation – position of pneumatic cylinder
	Up to 4 kHz	Cable, 2 m Cable plug M8, 3-pole Stranded wire		Stainless steel	IP 67	Sub-miniature Completely integrated electronics							■	
	Up to 5 kHz	Plug M5, 3 pole Plug M8, 3-pole Cable 2 m Cable plug M8, 3-pole Stranded wire 0.5 m		Stainless steel	IP 67	Sub-miniature Completely integrated electronics							■	
	Up to 5 kHz	Plug M5, 3 pole Plug M8, 3-pole Cable 2 m Cable plug M8, 3-pole Stranded wire 0.5 m		Stainless steel	IP 67	Sub-miniature Completely integrated electronics							■	
	Up to 5 kHz	Plug M8, 3-pole Cable 2 m Cable plug M8, 3-pole		Stainless steel	IP 67	Sub-miniature Completely integrated electronics							■	
	Up to 5 kHz	Cable 2 m Cable plug M8, 3-pole Plug 3-pole Plug M8, 3-pole		Stainless steel	IP 67	Miniature Completely integrated electronics Factor 1 Sensors (same switching distance on all metals) High temperature -proof sensors up to +180 °C Sensors in accordance with ATEX / NAMUR Short design from 22 mm		■						
	Up to 2 kHz	Cable 2 m Plug M8, 3-pole Plug M12, 3-pole Plug M12, 4-pole		Brass nickel-plated	IP 67	Factor 1 Sensors (same switching distance on all metals) High temperature-proof sensors up to +180 °C Sensors in accordance with ATEX / NAMUR High pressure-proof sensors up to 500 bar Weld-resistant- and magnetic field resistant sensors		■						

	Size	Sensor principle						Detection area
		Proximity switch	Diffuse reflective sensor	Reflective barrier	Through-beam sensor	*SmartReflect*® light barrier without reflector	Reflective light sensor with background suppression	1 mm … 5 mm … 10 mm … 15 mm
IFFM 20 	20 × 32 × 10 mm 	■						8 mm
IR06.P02F Factor 1 – All metal 	6.5 mm × 40 … 46 mm 	■						2 mm
IR08.P02F Factor 1 – All metal 	8 mm × 40 … 46 mm 	■						2 mm
IR12.P04F Factor 1 – All metal 	12 mm × 40 … 50 mm 	■						4 mm
IR18.P06F IR18.P08F Factor 1 – All metal 	18 mm × 50 mm 18 mm × 60 mm 	■						6 mm (IR18.O06F) 8 mm (IR18.P08F)

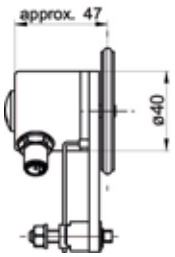
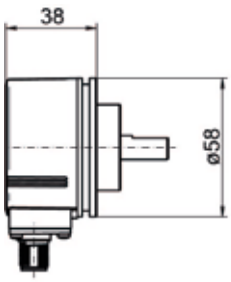
	Response time	Electric connection / interface points	IO link	Housing material	Protec-tion class	Distinguishing Features	Applications in feeder technology							
							Fill level controls in parts hoppers	Fill level controls in vibrating spiral feeders	Drive control of vibrating feeders	Checking position and parts presence at outlet of the vibrating spiral feeders	Buffer zone monitoring	Buffer zone belt speed control	Separation – parts presence in nest	Separation – position of pneumatic cylinder
15 mm														
	Up to 1 kHz	Plug M8, 3-pole		Brass nickel-plated	IP 67	Flat design, cuboid, lateral or vertical assembly		■						
	< 3 kHz	Plug M8, 3-pole Cable 2 m		Stainless steel	IP 67	Factor 1 Sensors (same switching distance on all metals) Miniature – Completely integrated elec-tronics					■			
	< 3 kHz	Plug M8, 3-pole Cable 2 m		Stainless steel	IP 67	Factor 1 Sensors (same switching distance on all metals) Miniature – Completely integrated elec-tronics					■			
	< 2 kHz	Plug M12, 3-pole Cable 2 m		Brass nickel-plated	IP 67	Factor 1 Sensors (same switching distance on all metals)					■			
	< 500 kHz	Plug M12, 3-pole Cable 2 m		Brass nickel-plated	IP 67	Factor 1 Sensors (same switching distance on all metals)					■			

	Size	Sensor principle						Nominal operating point / max. operating distance
		Proximity switch	Diffuse reflective sensor	Reflective barrier	Through-beam sensor	*SmartReflect*® light barrier without reflector	Reflective light sensor with background suppression	
Cylinder sensors								
MZTK 06×1011 MZTK 06×1012 MZTK 06×1013 	6.2 × 31 × 4.3 mm 6.5 × 21 × 9.4 mm 6.2 × 31.5 × 4.5 mm 	■						4 mT 2 mT (MZTK 06×1012)
MZCK 03×1011 MZCK 03×1012 	3.7 × 23 × 4.6 mm 3.7 × 11 × 19.5 mm 	■						4 mT

	Switch frequency	Electric connection / interface points	IO-Link	Housing material	Protec-tion class	Distinguishing Features	Applications in feeder technology							
							Fill level controls in parts hoppers	Fill level controls in vibrating spiral feeders	Drive control of vibrating feeders	Checking position and parts presence at outlet of the vibrating spiral feeders	Buffer zone monitoring	Buffer zone belt speed control	Separation – parts presence in nest	Separation – position of pneumatic cylinder
	< 200 kHz	Cable PUR 3 × 0.08, 2.5 m Cable PUR 3-pole, 5 m Cable plug PUR M8, L=300 mm		PA66	IP 67	For T-slot cylinders Detection of piston position Detection of magnets position								■
	< 200 kHz	Cable PUR 3 × 0.08, 2.5 m Cable PUR 3-pole, 5 m Cable plug PUR M8, L=300 mm		PA66	IP 67	For C-slot cylinders Detection of piston position Detection of magnets position								■

	Size	Sensor principle						Measuring distance
		Proximity switch	Diffuse reflective sensor	Reflective barrier	Through-beam sensor	*SmartReflect*® light barrier without reflector	Reflective light sensor with background suppression	
Inductive distance sensors								
IR12.D 	M12, 12 mm × 40 … 60 mm 	■						0 … 6 mm
IR18.D 	M18, 18 mm × 50 … 60 mm 	■						0 … 10 mm
IWRM 18 Outdoor design 	M18, 18 mm × 60 mm 							0 … 8 mm
VeriSens® **Vision sensors**								
VeriSens® XF series 	53 × 99.5 × 38 mm 							
VeriSens® CS series 	53 × 99.5 × 38 mm 							
VeriSens® XC series 	53 × 99.5 × 49.8 mm (without lens / tube) 							

	Response time / resolution	Electrical connections / interfaces Speed	IO link / Lighting	Housing material / Process interface	Protection class	Distinguishing Features	Applications in feeder technology: Fill level controls in parts hoppers	Fill level controls in vibrating spiral feeders	Drive control of vibrating feeders	Checking position and parts presence at outlet of the vibrating spiral feeders	Buffer zone monitoring	Buffer zone belt speed control	Separation – parts presence in nest	Separation – position of pneumatic cylinder
	1 ms	Plug M12 Cable 2m	■	Brass nickel-plated	IP 67	With analog or IO link output IO link for simple sensor adjustment and use of additional measuring functions and analyses data			■					
	2 ms	Plug M12 Cable 2m	■	Brass nickel-plated	IP 67	With analog or IO link output IO link for simple sensor adjustment and use of additional measuring functions and analyses data			■					
	2 ms	Plug M12, 4-pole		Brass nickel-plated		Outdoor design			■					
	752 × 480 px	Max. 100 Inspections / s	White / Infrared	PROFINET (CC-A) EtherNet/IP™ TCP/UDP (Ethernet)	IP 67	All available feature inspections (up to 20) Automatic object alignment Integrated lighting and optics interface: Industrial Ethernet, digital I/Os				■				
	752 × 480 px	Max. 50 Inspections / s	White / Infrared		IP 67	6 different features inspections for presence and dimensions Integrated lighting and optics interface: Industrial Ethernet, digital I/Os				■				
	640 × 480 px 1280 × 960 px 1600 × 1200 px	Max. 118 Inspections / s	*VeriFlash*® flash controller	PROFINET (CC-A) EtherNet/IP™ TCP/UDP (Ethernet)		FEX® image processor FEXLoc® 360° Position tracking *VeriFlash*® integrated flash controller				■				

	Size	Sensor principle						Detection area
		Proximity switch	Diffuse reflective sensor	Reflective barrier	Through-beam sensor	*SmartReflect*® light barrier without reflector	Reflective light sensor with background suppression	
Incremental encoders								
MA20 	ø40 mm (Encoder) 							
EIL 580P-SC 	ø58 mm 							

	Impulses per revolution	Output signals	Output frequency TTL / HTL	Wave type	Connection	Distinguishing Features	Applications in feeder technology							
							Fill level controls in parts hoppers	Fill level controls in vibrating spiral feeders	Drive control of vibrating feeders	Checking position and parts presence at outlet of the vibrating spiral feeders	Buffer zone monitoring	Buffer zone belt speed control	Separation – parts presence in nest	Separation – position of pneumatic cylinder
	100 … 25 000	A 90° B	≤ 300 kHz	Full wave ø6 mm	Flange socket M12, radial cable	Measuring wheel encoder consisting of encoder, measuring arm and measuring wheel						■		
	1 … 65 536	A 90° B, R + inverted	≤ 300 kHz (TTL) ≤ 160 kHz (HTL)	Full wave ø10 mm	Flange socket M23, radial / axial Cable radial / axial / tangential	Full wave with clamping flange up to ø10 mm or Servo flange up to ø6 mm						■		

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