

# Glossary

## Adjustable focus

This is the area within which the focal position can be set, i.e. the area between minimum and maximum distance between the workpiece and the camera lens.

## Ambient light

Apart from the light emitted by the transmitter, light from other sources can hit the receiver. This must not be permitted to lead to spurious switching.

## Analogue output

The output of an analogue sensor, whereby the current or voltage signal provides the location information.

## Analogue sensors

These provide a distance-proportional current or voltage signal as an output signal. The location of an object within the detection range is converted to a current or voltage value between 4 and 20 mA or 0 and 10 V.

## Antivalent

In sensors with an antivalent output, the normally closed (N.C.) and normally open (N.O.) function are simultaneously provided at the corresponding connections. A 4-wire connection cable is required for this.

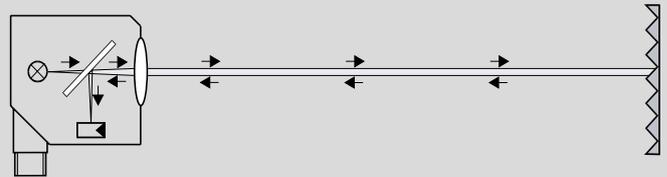
## Auto-detect

Auto-detect combines a real PNP and a real NPN switching function in one sensor. On the basis of the load present, the sensor detects whether switching is necessary as a NPN or PNP output. Adaptation of the switching function takes place automatically.

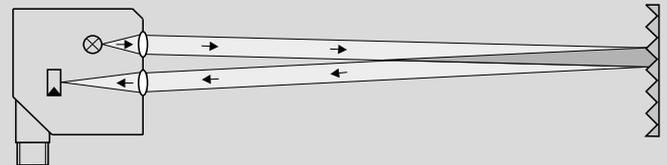
## Autocollimation principle

With photoelectric retro-reflective sensors one speaks of the autocollimation principle when the light reflected from the reflector travels parallel to itself (i.e. within itself). Unlike the double-lens system, a photoelectric retro-reflective sensor using the autocollimation principle has a very homogeneous and narrow optical path. Its switching point is largely independent of the entry direction of the target object.

*The autocollimation principle*



*The double-lens system*



## Background suppression

Background suppression in photoelectric proximity sensors is a special process for detecting objects with differing surfaces and colors regardless of the background.

## Bar codes

Bar codes consist of several bars and spaces that represent optoelectronically legible script. They are illuminated so that a light-sensitive sensor can detect the light beams (wavelengths) of the emitting element. The sensor receives the light reflected from the substrate. The data are thus read automatically and further processed electronically. The most familiar bar codes are 1- and 2-dimensional, whereby 2D codes can contain considerably more information.

<b>Black/white- and grey/white-shift</b>
<p>The black/white-shift defines the difference in switching distance with measurement plates of differing reflectivity (reflectivity: white = 90 %, black = 6 %). The formula for the calculation used by SensoPart is: black/white-shift = <math>[(\text{switch-off point white} - \text{switch-on point black}) / \text{switch-on point black}] \times 100 \%</math>.</p> <p>The grey/white-shift defines the difference in switching distance with measurement plates of differing reflectivity (reflectivity: white = 90 %, grey = 18 %). The formula for the calculation used by SensoPart is: grey/white-shift = <math>[(\text{switch-off point white} - \text{switch-on point grey}) / \text{switch-on point grey}] \times 100 \%</math>.</p>
<b>Blind zone</b>
<p>The area directly in front of the sensor within which no objects can be detected.</p>
<b>Calibration</b>
<p>The function „Calibration“ transforms the image coordinates (pixel) into world coordinates (e.g. millimeter). When activated all position and distance data is calculated in the selected unit.</p>
<b>CCD</b>
<p>CCDs, Charge-Coupled Devices, are light-sensitive electronic components for transporting electrical charge. A CCD cell passes on its stored electrical charge to the neighbouring cell. The content of the storage cell is passed on to the next cell, as with an analogue shift register.</p>
<b>CMOS</b>
<p>A CMOS, a Complementary Metal Oxide Semiconductor, is an image sensor and light-sensitive component. It converts light falling onto it into a voltage.</p>

<b>Codabar</b>
<p>The Codabar is increasingly being replaced by new codes because of its high error rate. This code is a numerical code and is mainly used in libraries and health care.</p>
<b>Code 39</b>
<p>Code 39 is an alphanumeric, discrete and self-checking bar code and is used where an alphanumeric type of code is required.</p>
<b>Code 93</b>
<p>Code 93 is a continuous code and has a greater density of information than Code 39. The code's character set is identical to that of Code 39 and it is used when a higher information density and reliability is required.</p>
<b>Code 128</b>
<p>This code is based on the 128 representable characters of the ASCII code. Each character consists of 3 bars and 3 spaces of four different widths, with a total width of 11 modules. Apart from its high information density, Code 128 has been able to achieve a wide user community through its ability to represent the complete ASCII code.</p>
<b>Color</b>
<p>Colored CCD or CMOS imaging chips provide brightness values for the pixels of each color channel, generally from 0 to 255. 0 means no light incidence, 255 means maximum light incidence. Colored pictures are possible.</p>
<b>Color sensors</b>
<p>These analyse the light reflected from an object according to its spectral composition, and can thus detect colored objects and differentiate between them.</p>

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## Correction factor

Refers to inductive sensors and is the reduction in the switching distance for damping materials that deviate from Fe 360 (ISO 630).

## Cycle time

This is the time required by a vision sensor to carry out the inspection task once.

## Dark-switching

The switching output of a photoelectric sensor or a scanner is activated when no light hits the receiver. In this case, the downstream amplifier is activated and connected devices are switched on.

Receiver	Amplifier	Output (PNP)
Unilluminated	Activated	High
Illuminated	Not activated	Low

## Datacode

Two-dimensional bar code.

## DELTA function

See switching threshold adjustment.

## Depth of field

The depth of field is the area in which an object in the object space of an imaging optical system can be sharply focused. Example: in the case of a contrast sensor with a scanning distance of 12 mm (focus) and a depth of field of  $\pm 3$  mm the sensor operates reliably in a zone between 9 and 15 mm.

## Detector

A single inspection task in the VISOR®. Detectors are always part of the user settings for the VISOR® and are stored in a job.

## Diffuse (energetic) sensor

A sensor with the transmitter and receiver accommodated in a single housing that can detect light diffusely reflected from the object. Whereby only the intensity of the reflected light is evaluated. Diffuse sensors can therefore only be used for object detection if no background is present or if it is necessary to differentiate between light and dark objects.

## Diffuse reflection

Light hitting rough and uneven surfaces, in particular, is reflected in all directions.



## Drag & drop

Drag & drop is a technique in graphic user interfaces with which graphic elements are picked up and moved (dragged) with the help of a pointer device and released (dropped) in the desired location.

## EAN

EAN stands for European Article Number and is a 13-digit or 8-digit sequence of numbers. This international article number provides information about the article, e.g. the producer and the producing country.

### ECC200

ECC200 is also called DataMatrix code and is a two-dimensional code. Compared to the linear bar code, considerably more information can be shown in a smaller space. The size of the code increases proportionately with the content. ECC200 codes can also be printed in a non-square shape.

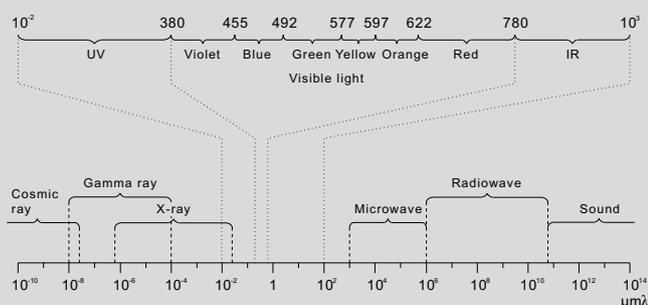
### ECC200 GS1

ECC200 GS1 is a special form of the ECC200 data matrix code; main field of application are data matrix codes on pharmaceutical packages.

### Electromagnetic radiation spectrum

Only a very small part of the spectrum of all electromagnetic waves is visible to the human eye. The visible range begins at about 380 nm and stops at roughly 780 nm. The colors we perceive can be assigned to individual wavelengths.

Red light and infrared sensors are principally used as optical sensors. Red light offers the advantage that it is visible and thus simplifies the adjustment of sensors. Longer ranges, however, can be achieved with infrared light.



### EN 60947-5-2

This is the European standard for optical sensors. It defines the limit values that sensors must maintain, e.g. regarding electromagnetic compatibility (EMC).

### Enclosure rating (IP = ingress protection)

Uses a two-digit number to define the tightness of the sensor towards particles and dampness. The first digit stands for mechanical particles such as dust, the second digit stands for moisture particles, e.g. drops of water. The numbers mean differing values according to the following table.

First digit	Protection against contact	Second digit	Protection against water
0	Unprotected	0	Unprotected
1	Protection against foreign bodies > 50 mm	1	Protection against dripping water
2	Protection against foreign bodies > 12 mm	2	Protection against dripping water below 15°
3	Protection against foreign bodies > 2.5 mm	3	Protection against water spray
4	Protection against foreign bodies > 1 mm	4	Protection against water spray
5	Dust protection	5	Protection against water jets
6	Dust-proof	6	Protection against heavy seas
		7	Protection against immersion
		8	Protection against submersion (... m)
		9	High-pressure / steam jet cleaning

IP enclosure ratings, DIN 40 050, Part 9

## Encoder input

Sensors for determining changes in length (linear) or in angle (rotating) that can detect the path and path direction or angular changes and the direction of rotations are described as encoders or incremental encoders. Such a device can be directly connected to the vision sensor via the encoder input. The vision sensor can delay the output signals in dependence on the position and thus, for example, control an ejector that is not located directly alongside the vision sensor.

## Ensured switching distance (operating distance, Sa)

The ensured switching distance takes into account all external influences and sample variances. It is roughly  $\leq 80\%$  of the nominal switching distance. The sensor switches reliably within this range.

## Ethernet (LAN)

This widespread producer-neutral technology allows data to be transferred to a Local Area Network (LAN).

## EtherNet/IP (EIP)

EIP, also called Ethernet Industrial Protocol, is based on the TCP/IP and UDP/IP transport protocols and is an internationally accepted communication network using the Ethernet. In industry, the EIP thus forms a broad basis for effective data communication.

## Exposure time

The illumination duration of, for example, a line sensor. It defines how long the detection line is illuminated. Increasing the exposure time can raise sensitivity (with a simultaneous reduction in switching frequency).

## Fibre-optic sensors

The transmitter and receiver are accommodated in a single housing. The light emitted by the transmitter is reflected by the target object and evaluated by the receiver. The advantage is that the transmitted and received light is transported to and from the object directly via a fibre-optic cable – even when space is very limited.

## Field of view

The field of view is the area within which objects can be detected.

## Focal length

The focal length is the distance from the focus to the lens, also called the focal point. It is measured in millimetres. The greater the focal length of a lens, the smaller the field of view, and the larger and nearer the image appears.

## Focus position

This is the location of the focal point in relation to the workpiece surface.

## Fork width

The fork width is the distance between the transmitter and receiver of a fork photoelectric sensor.

## GS1

The GS1 is a special form of Code 128. It is used in both commerce and industry. The length of the code is variable, but should not exceed the maximum length of 165 mm. A maximum of 48 useful characters can be coded. Because several pieces of data can be coded simultaneously it is also possible to record weight information and the sell-by date on, for example, the bar code of a food pallet.

<b>Hysteresis</b>
The difference between the sensor's switch-on point and switch-off point. It is measured in per cent (related to the switch-on point).
<b>2/5 Industrial</b>
The 2/5 Industrial code is a very simple, self-testing code with a high tolerance. Because of its simplicity it has a low information density, resulting in a relatively high space requirement. It is used, for example, in warehouses and on flight tickets.
<b>2/5 Interleaved</b>
The Interleaved 2 out of 5 code is a numerical, sequential and self-testing code. It is used wherever bar codes are to be attached in compact form. This would be, for example, with difficult surfaces such as outer wrapping made of corrugated cardboard or when the bar code is to be read from a long distance.
<b>Infrared light</b>
Light with wavelengths above that of visible light. The wavelength range of infrared light starts at about 780 nm.
<b>Inspection programme</b>
An inspection programme is a sequence of instructions in Eyesight.
<b>IO-Link</b>
IO-Link is the first standardised IO technology worldwide (IEC 61131-9) for the communication with sensors and actuators. The point-to-point communication is established via an un-screened cable connection. IO-Link is no fieldbus but the further development of a tried-and-tested connection technology.

<b>Jitter (electrical)</b>
Jitter is a measure of the accuracy of the response time. For example: with a max. response time of 20 µs and a jitter of 5 µs, the actual response time is 15 - 20 µs.
<b>Job</b>
Contains all the user settings necessary for operating the VISOR®. These are the basic settings such as resolution, exposure time, interfaces as well as the detectors with their settings.
<b>Laser Protection Class</b>
All devices that contain a laser light source must be assigned to one of the four laser Protection Classes with their corresponding sub-classes (Class 1, 1M, 2, 2M, 3R, 3B and 4). The laser Protection Classes are specified in the DIN EN 60825-1/2001-11 standard. All current sensors from SensoPart are either in Classes 1 or 2 (not 1M or 2M – see data sheets). The relevant text in the standard is paraphrased below:
<p><b>Class 1</b> Lasers that are safe under reasonably predictable operating conditions; whereby the use of optical instruments for the direct observation of the beam is included.</p> <p><b>Class 2</b> Lasers that emit visible radiation at a wavelength between 400 nm to 700 nm; whereby the eyes are usually protected by aversion responses including the eyelid closing reflex. One can expect that this reaction offers appropriate protection under reasonably predictable operating conditions; whereby the use of optical instruments for the direct observation of the beam is included.</p>

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## Light-switching

The switching output of a photoelectric sensor or scanner is activated when light hits the receiver. In this case, the downstream amplifier is activated and connected devices are switched on.

Receiver	Amplifier	Output (PNP)
Unilluminated	Activated	High
Illuminated	Not activated	Low

## Limit frequency

The frequency at which the amplitude of an analogue signal has fallen to about 70% (3 dB).

## Linearity

A measure of the quality of the characteristic output curve. The sensor's electrical signal is processed and linearised. The characteristic curve thus obtained shows slight deviations from an exactly straight course, defined in per cent as linearity or linearity deviation.

## Max. output current

The maximum current with which a load at the switching output can be operated.

## Monochrome

Monochrome CCD or CMOS image chips provide a grey value for every pixel. From 0 to 255 with 8 bits. 0 means no light incidence (black), 255 means maximum light incidence (white).

## Multi-color RGB evaluation

During teach-in, contrast sensors with RGB illumination (red, green, blue) select the transmission color that provides the largest contrast difference between the mark and the background. In operation, the sensor will then only work with this transmission color.

## Multishot

With the multishot function, four images are captured one after the other, each illuminated from another direction. By combining the four images in one single image, a pseudo height image can be created. This method is particularly suitable for the detection of indentations and bumps on even surfaces, e.g. stamped fonts, codes or surface defects.

## No-load current

The current consumed by the sensor itself.

## NPN output

The NPN output switches a load connected to the positive pole through to the negative pole.

## Operating voltage

The voltage range that the sensors need for operation. This is generally 10 ... 30 V DC for optical sensors.

## PDF 417

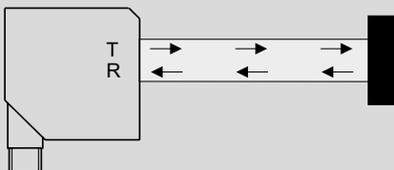
This is a 2D code and is based on stacked bar codes. The characters used are encoded in code words. A code word consists of 17 modules, each made up of 4 bars and 4 spaces.

### Pharmacode

This code is the standard bar code for the pharmaceutical industry, e.g. for checking the presence of package inserts. The information is coded in the bars. The code value is calculated by adding up the individual bar values. There are narrow and wide bars. This code offers extremely rapid readability and is not sensitive towards print tolerances.

### Photoelectric proximity sensor

A sensor in which the transmitter and receiver are accommodated in a single housing and which detects the diffuse light reflected from the object. Whereby it is not the intensity of the reflected light that is evaluated. Diffuse scanners can therefore only be used for object detection if there is no background or when it is necessary to differentiate between light and dark objects.



### Pixel

Also called picture element, it is the smallest image unit in digital projection systems. These are the individual grey or color values in a digital raster graphic as well as the surface elements of an image sensor for representing a grey or color value.

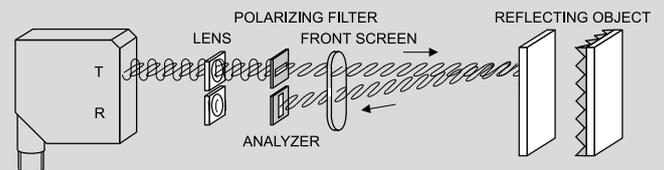
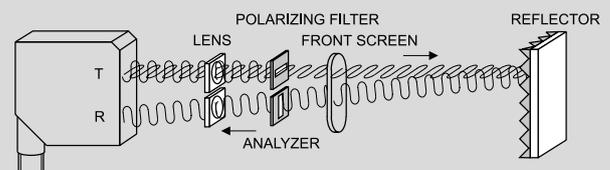
### PNP output

The PNP output switches a load connected to the negative pole through to the positive pole.

### Polarisation filters

Polarisation filters are optical filters that can be compared with a grid of lines. Incidental light that oscillates in all directions is filtered and only light that is oscillating parallel to the lattice plane is let through.

Highly reflective objects can be reliably detected by using a polarisation filter in combination with a photoelectric retro-reflective sensor and a prismatic reflector.



### Polarised light

Light that only oscillates on one plane.

### Prismatic reflectors

A prismatic reflector consists of densely packed pyramidal individual reflectors. As a result of its structure it reflects the incidental light back into itself. In addition, the polarisation plane of the light is rotated by 90°.

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## Push-pull

With push-pull a complementary pair of transistors (N-channel and P-channel) is used as the output stage. The sensor can therefore be operated as both a PNP and NPN device.

## QR code

A quick-response code is a two-dimensional binary code that represents computer-legible text. It appears, for example, in newspapers, and can contain information such as text or Internet addresses.

## Range/scanning distance or detection range

The area within which the sensor reliably detects objects.

## Red light

In certain applications it can be helpful to change the color of the light of the vision sensor. Red light generally achieves a better contrast on grey metal surfaces, in particular.

## Reference material

A standardised reference material that is used for specifying sensors. A typical reference material would be Kodak paper with varying reflectivity levels (e.g. 90% white, 18% grey, 6% black).

## Reflection

When a light beam hits a reflective object it is reflected as a result of the object's surface properties. The structure of the surface influences the type of reflection.

## Reflection loss

As a result of the surface structure there is always reflection loss when reflectors are used. The imprecision of the surface is responsible for the level of loss. Highly reflective, polished mirrors have, for example, only low losses. The reflection loss also leads to the defined range being reduced when deflector mirrors are used.

## Reflectivity

Reflectivity is the reflection of light by non-transparent surfaces. In the case of proximity sensors, the scanning distance is often defined in relation to the level of surface reflectivity. Black surfaces have a low level of reflectivity. White surfaces have a very high level of reflectivity. As a result of this property, the scanning distance of diffuse scanners is heavily dependent on the surface characteristics and color of the target object.

## Repeatability

This is the measure of the conformity of repeat measurements under the same conditions.

## Resolution

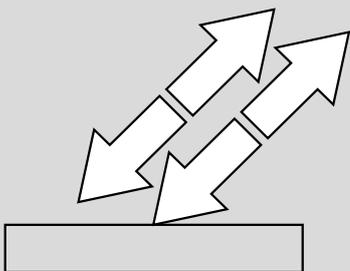
The number of horizontal and vertical picture elements (pixels). The higher the number of pixels, the smaller the details that can be detected within the search area.

## Response time

The time the sensor requires to show a detected object at the switching output is the maximum response time.

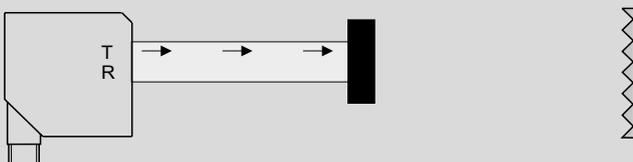
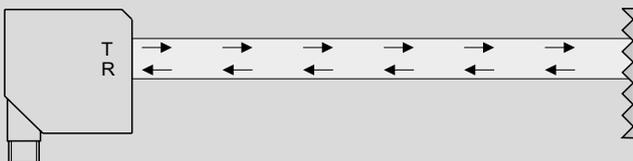
### Retroreflection

As a result of the special design of the surface of reflectors it is possible to reflect the light beam in the same direction as it hits the reflector. Photoelectric retro-reflective sensors can use this special construction of the reflector optimally because the light hitting the reflector is largely reflected back to the sensor.



### Photoelectric retro-reflective sensor

In a photoelectric retro-reflective sensor the transmitter and receiver are accommodated in a single housing. The light emitted by the transmitter hits a reflector and is reflected back. The receiver evaluates the returning light. The advantage lies in the small size of the reflector. It is also easy to install because it is a passive element, i.e. requires no connections.



### Reverse-polarity protection

This means that a sensor is protected against transposition of the positive and negative poles of the operating voltage.

### Ripple

The maximum permissible fluctuation of the operating voltage for trouble-free operation. It is defined in per cent of the operating voltage.

### RS422

The RS422 interface was developed for serial high-speed data transfer over long distances. The serial data are transferred without reference to Ground as a voltage difference between two corresponding cables.

### Scanners with background suppression

These evaluate the location of an object and not the light intensity. They can therefore also detect, for example, dark objects against bright backgrounds, because they work (almost) independently of the intensity.

### Short-circuit protection

The semiconductor outputs of sensors can be protected from short-circuits by taking special electronic measures. Whereby the electronics in the sensor constantly measures the output current. The output is switched off if it exceeds a certain value. The sensor returns to its normal operating state when normal conditions are restored.

### SmartPlug

A multifunctional device for use with sensors, available as a timing element, counter, frequency monitor and inverter. All SmartPlugs work as switching current amplifiers to a maximum output current of 400 mA at a switching frequency of 10 kHz.

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## Standby time / readiness delay

The time the sensor needs to be ready for operation after the operating voltage has been applied.

## Switching distance (nominal switching distance, $S_n$ )

The switching distance is the distance between an object and the active surface of a sensor at which a switching process is triggered. The switching distance does not take any external factors, such as temperature, supply voltage or sample variances, into account.

## Switching frequency

The maximum frequency with which events can be detected. The reciprocal value of the switching frequency is the minimum time that an object must be in the detection zone in order to be detected.

## Switching threshold adjustment (DELTA function)

DELTA – Dynamic Evaluation of Light for Threshold Adaption – describes the automatic adaptation of the switching threshold to changing environmental conditions (e.g. the gradual contamination of a reflector).

## Teach-in

A process for setting optical sensors, whereby the sensor is adjusted for the process at the press of a button. The button is pressed when the object is in the detection zone of the sensor (with a time lock of 3 seconds to prevent unintentional adjustment). The sensor shows detection of the object by means of simultaneous blinking of the LEDs. The object is removed after releasing the button, and the button is pressed again for one second in order to store the signal value without the object.

## Temperature drift

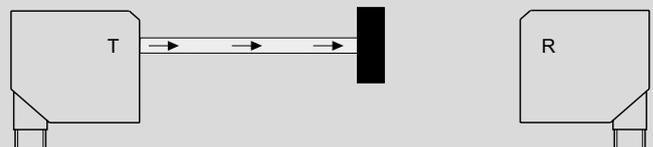
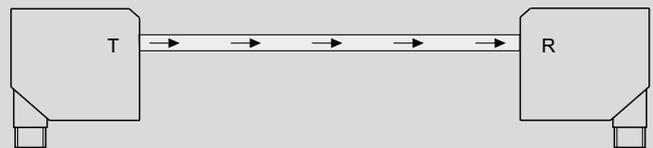
Temperature drift is the change of a physical value in response to a change in the (ambient) temperature.

## Test input

Input with which the function of a photoelectric through-beam sensors can be checked. The laying down of a signal at the test input causes the transmitter to switch off, resulting in a change in the switching state of the receiver if the sensor is functioning properly.

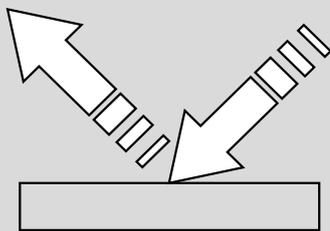
## Photoelectric through-beam sensors

Transmitter and receiver are physically separated and each requires its own power supply. Long ranges can be achieved with this system.



### Total reflection

Total reflection occurs, for example, with highly reflective mirrors. Whereby the angle of light incidence is equal to the angle of reflection. In optimum cases reflection losses are insignificantly small.

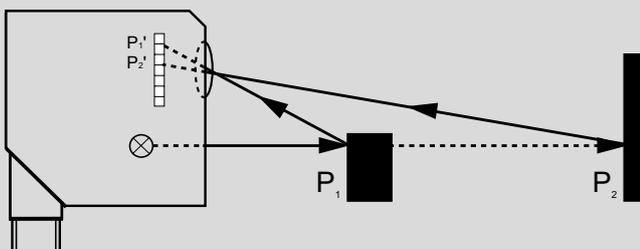


### Transmission

The penetration of a medium by radiation (e.g. light through transparent objects).

### Triangulation

The light beam hits an object or the background at a right angle. Depending on the distance between sensor and object/background, the angle of incidence of the reflected light beam and thus its position on the receiver changes. As a result, the distance to the object is decisive for the switching point of the sensor. When the target object is taught-in, everything located behind this object is optically suppressed.



### Trigger input

An input with which the sensor can, for example, be timed. If, for example, the sensor should only detect objects at a particular point in time, a signal is provided to the trigger input within this time period and during the rest of the time the input remains signal-free and the sensor thus function-free.

### Types of reflections

- Direct reflection
- Retroreflection
- Diffuse reflection
- Total reflection

### UPC

UPC, Universal Product Code, is the forerunner of EAN and is still used in the USA.

### Vibration and impact resistance

The stresses caused by vibrations or sudden loads to which a sensor may be exposed without function being impaired. The limit values for optical sensors are defined in the EN 60947-5-2 sensor standard.

### Vision sensor

A vision sensor is an image-processing system that records pictures, evaluates them and then triggers a reaction. The sensor is optimised for a particular use or field of use. A vision sensor is characterised, above all, by the software interface and operation being designed in such a way that even users with little or no image-processing knowledge can operate it. After commissioning, a vision sensor carries out its inspection task autonomously – without an external PC.

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## Vision systems

A vision system consists of a camera and software, generally with a larger scope of function than a vision sensor. A vision system is thus considerably more powerful, but far more demanding in terms of operation. After commissioning, a vision system carries out its inspection task autonomously – without an external PC.

## White light

White light is used as a light source for color sensors, contrast sensors, vision sensors and systems because it is a homogeneous spectrum and no mixture of different colors is required.

## Window size

The area within which the transmitter and receiver elements of a frame light sensor are located is defined as the window size.

