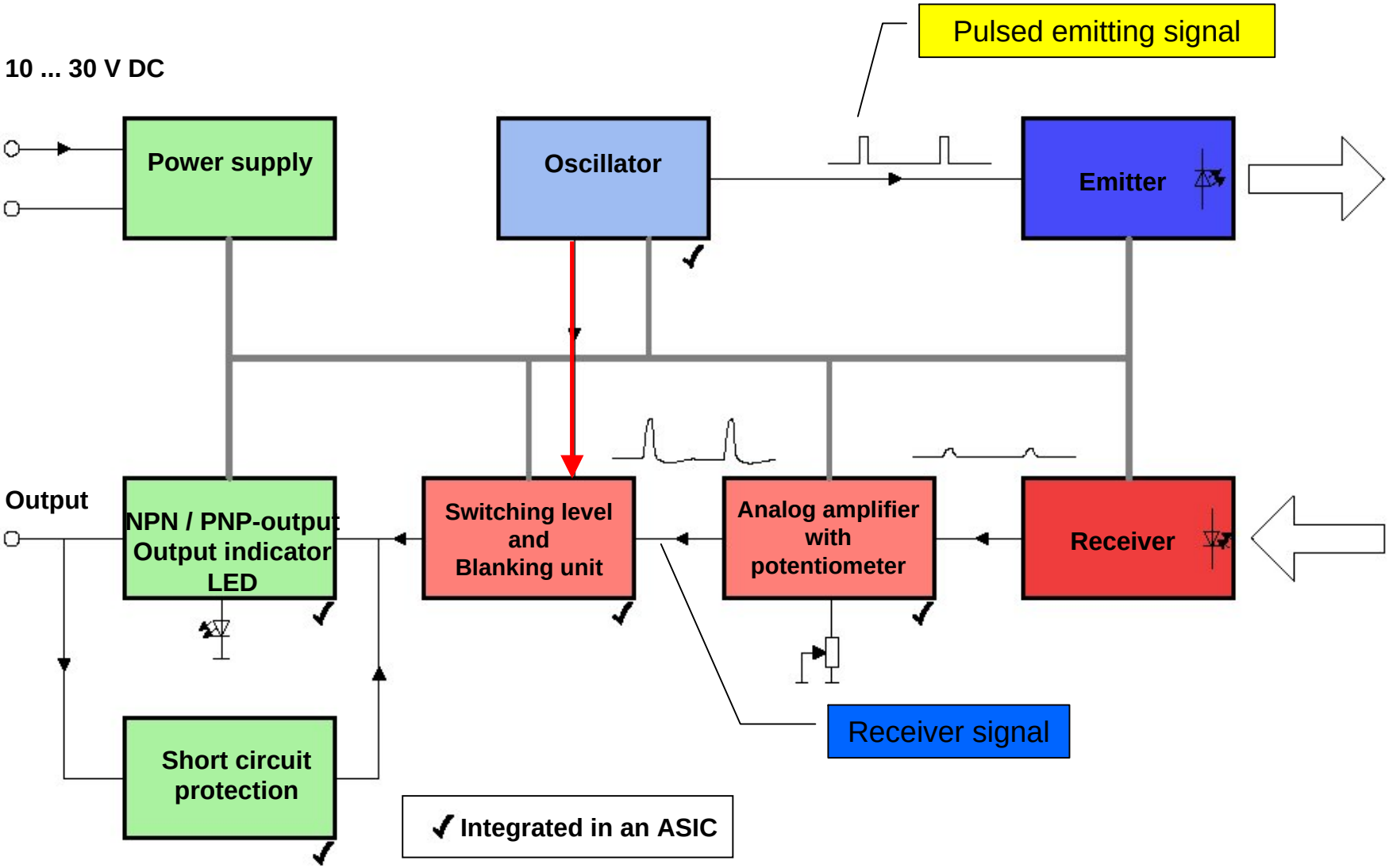
Photoelectric sensors basics

Block diagram

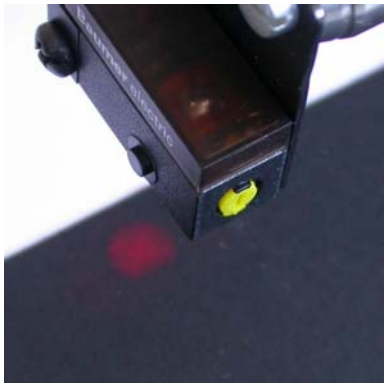


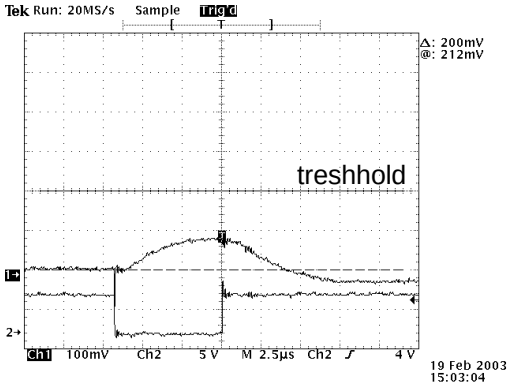
Diffuse sensor (Intensity difference)

The light will be reflected by the object. A small part of the light will be received by the receiver. The kind of reflection depend on the color, the surface and the brightness of the object and so the sensing distance differ very strong. The sensing range can be adjusted with a potentiometer.

Diffuse sensor (Intensity difference)

Receiving signal

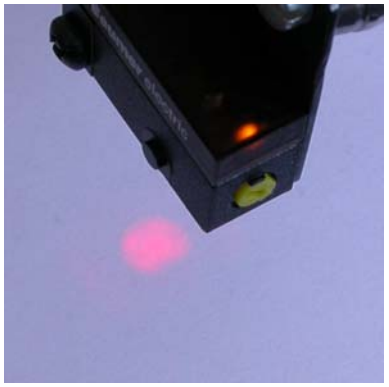


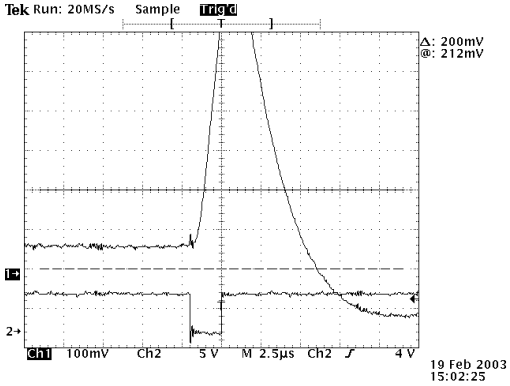


Dark objects reflect less light.

The input signal is under the switching level.

The sensor switches off (OFF-status).





Bright objects reflect more light.

The input signal is over the switching level.

The sensor switches on (ON-status).

Remark:

The application is reliable if the signal difference is big enough between ON- and OFF-status.

Diffuse sensor (Intensity difference)

Summary

strength

- Suitable to distinguish between black and white objects / marks
- The solution with the best price-performance ratio

⇨ Fiber optic sensors are available with the the operating principle of diffuse sensors

weakness

- Object detection dependent on color and object's surface
- Be careful with background especially with bright backgrounds

Typical applications

- To detect and count objects with the same color and same distance
- To detect black marks on white paper
- To detect objects without background

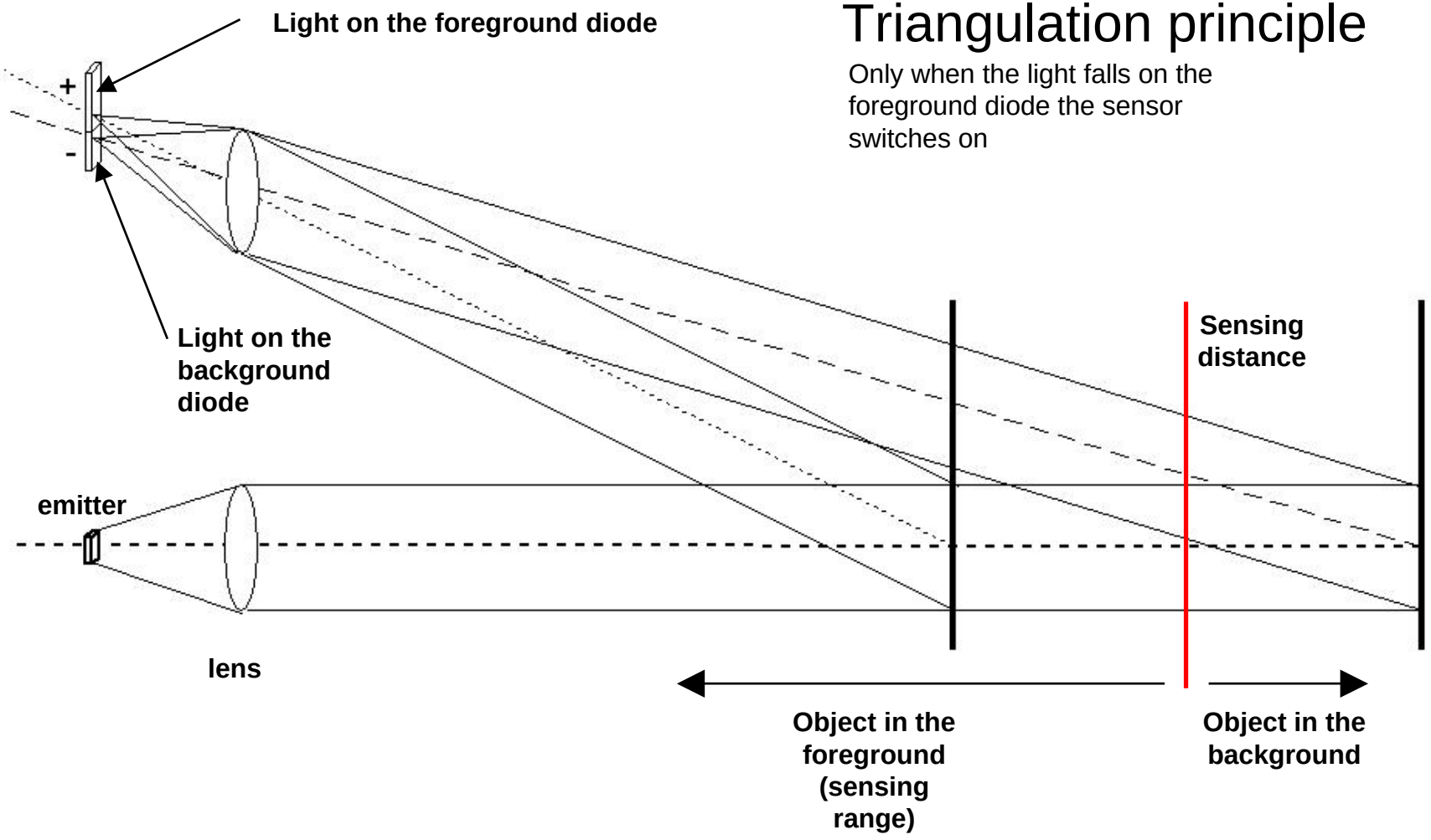
Diffuse sensor with background suppression

Diffuse sensors with background suppression (with triangulation principle) do not only sense the light reflected from the target, but also sense the distance of the object to the sensor.
Within the fully adjustable distance, objects are recognized independently of color and surface properties.

Diffuse sensor with background suppression

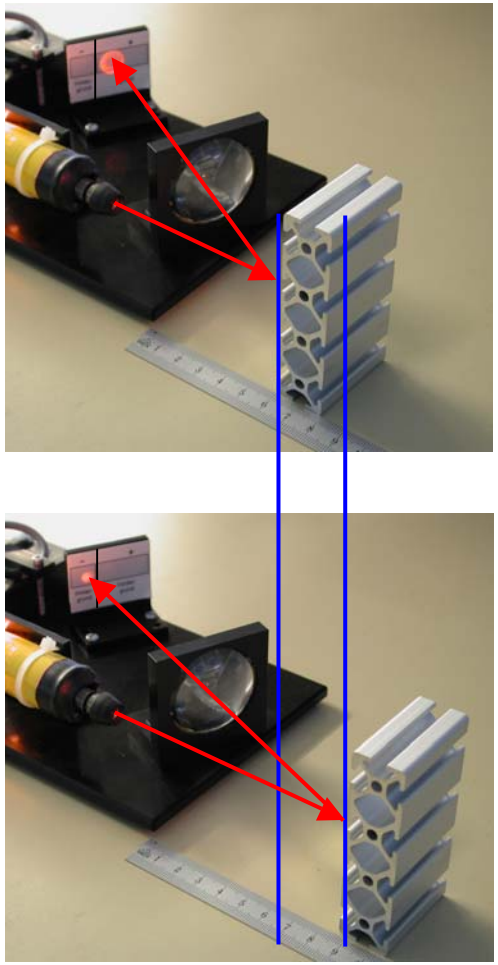
Triangulation principle

Only when the light falls on the foreground diode the sensor switches on



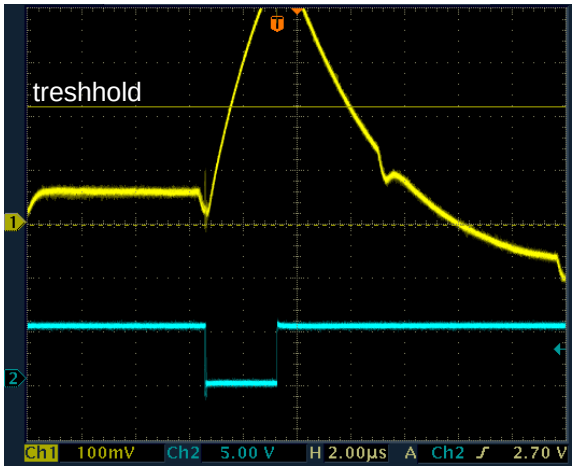
Photoelectric sensors basics

Diffuse sensor with background suppression



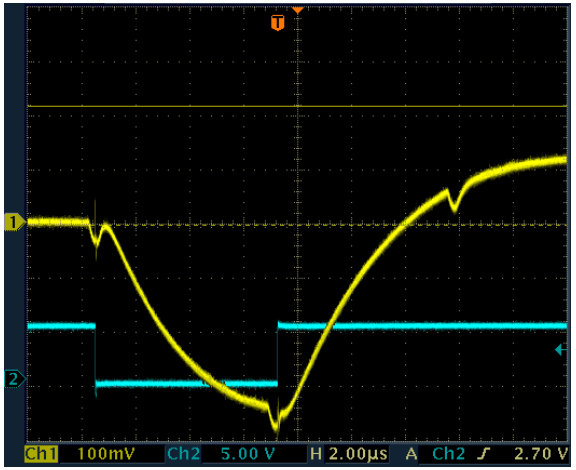
Object in the foreground:

- Light falls on the foreground diode
- The receiving signal is over the switching level



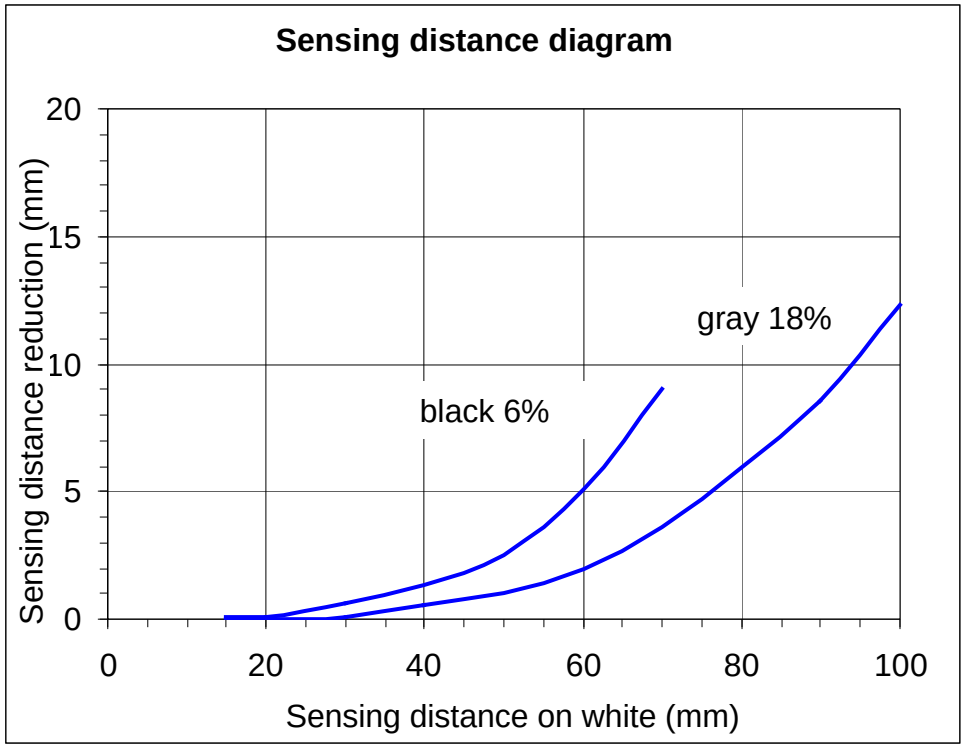
Object in the background:

- Light falls on the background diode
- The receiving signal is under the switching level



Sensing distance reduction

In the real the sensing distance of a diffuse sensor with background suppression differ a little bit with the color.



Example:

Is it possible to detect a black object 8 mm in front of a white background? The distance to the white background is 60 mm. Where should be the sensing distance?

Solution

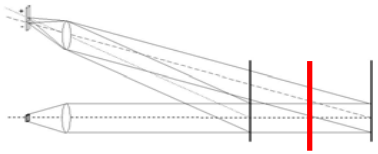
yes

The reduction for black is about 5 mm. That means black object would be detected up to 55 mm.

But the sensing distance has to be 1 – 2 mm in front of the white background. So the real max. distance is about 53 mm.

Diffuse sensor with background suppression

Summary

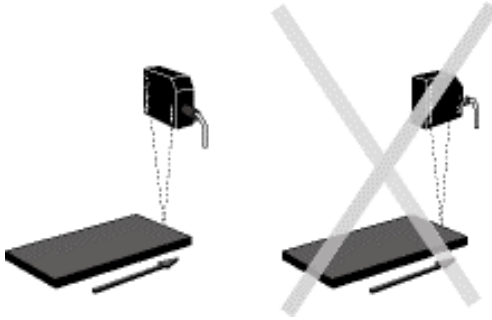


Strength

- Object detection independent on color and surface
- Reliable object detection with changing background

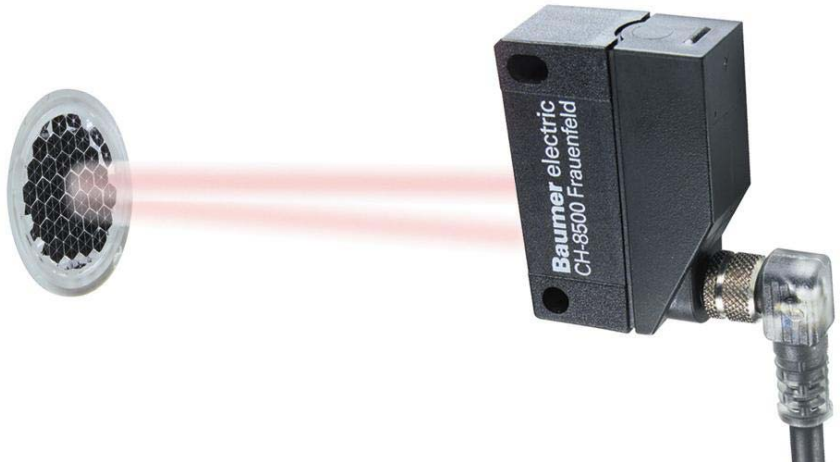
Weakness

- Caution with mirroring objects and mirroring backgrounds
- Caution with Black-white displacement
- For a reliable application adjust the sensing distance into the middle between object and background
- The object has to approach the light beam laterally

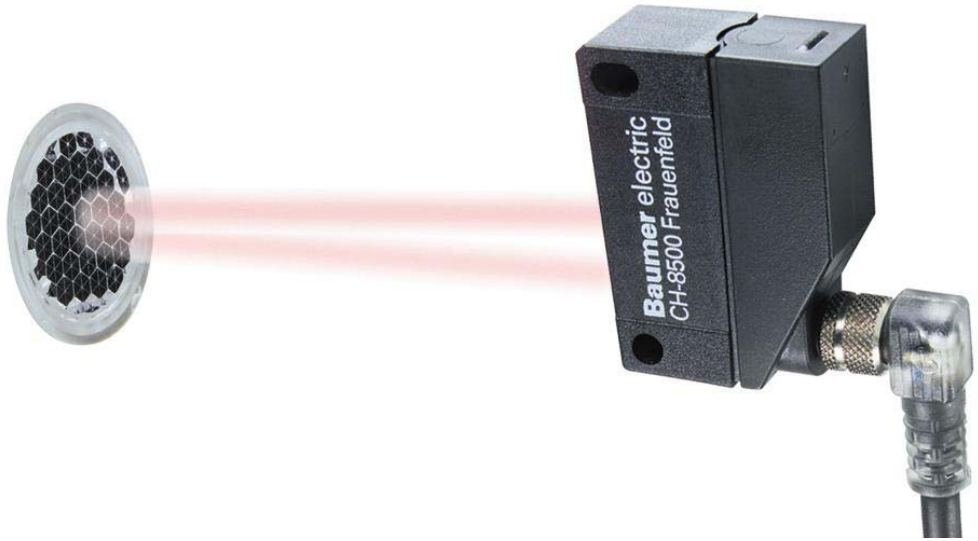


Typical applications

- To detect and count objects with different colors in front of a background
- To detect and count objects in front of a background



Retro reflective sensor with polarization filter

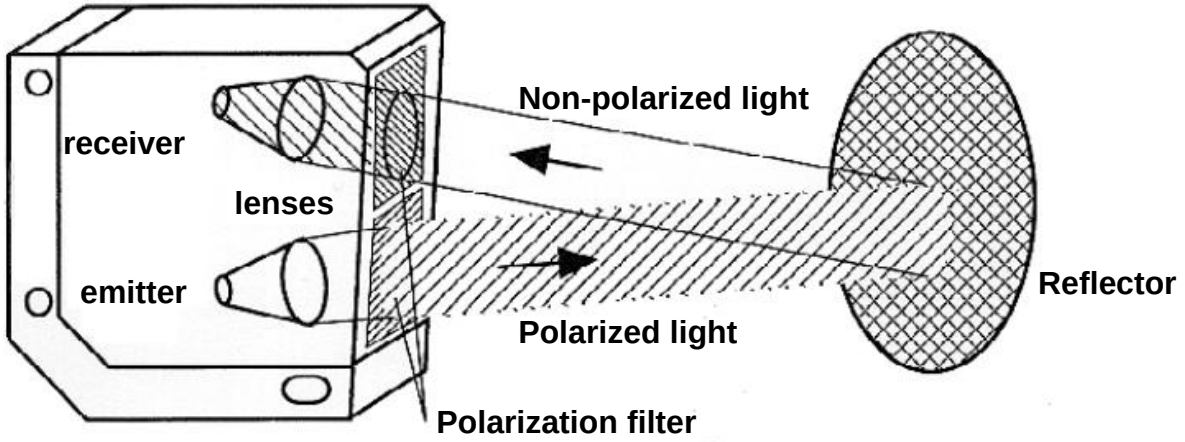


Another method for an optical detection of objects is the so-called retro-reflective sensor. The principle is similar to the through beam sensor but transmitter and receiver are incorporated into one single housing. The transmitted beam is reflected by means of a reflector so that it strikes the receiver. This principle is also based on the interruption of the light beam to the receiver being evaluated.

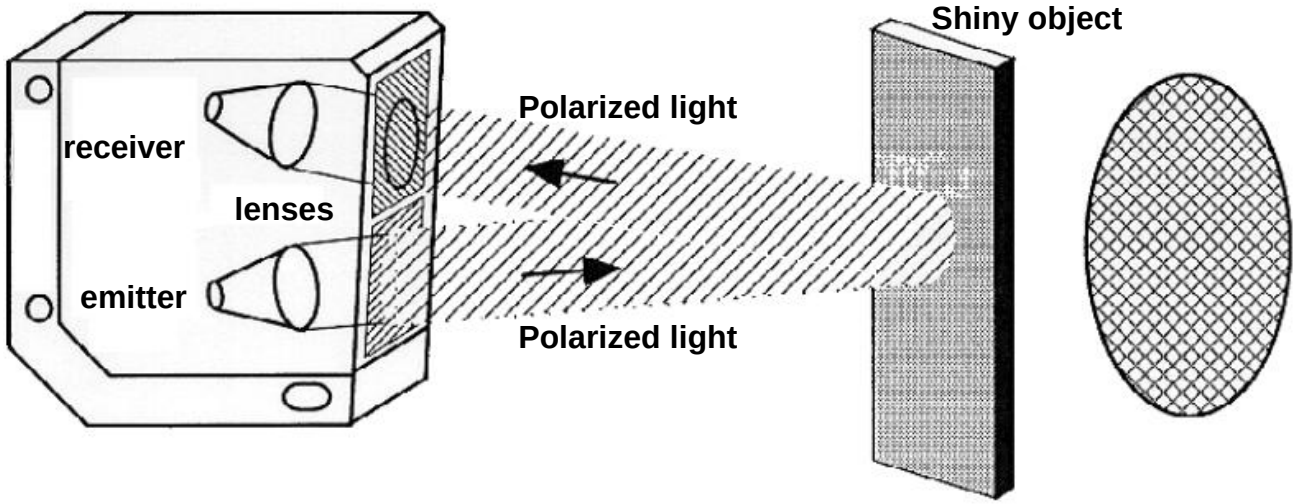
Photoelectric sensors basics

Retro reflective sensor with polarization filter

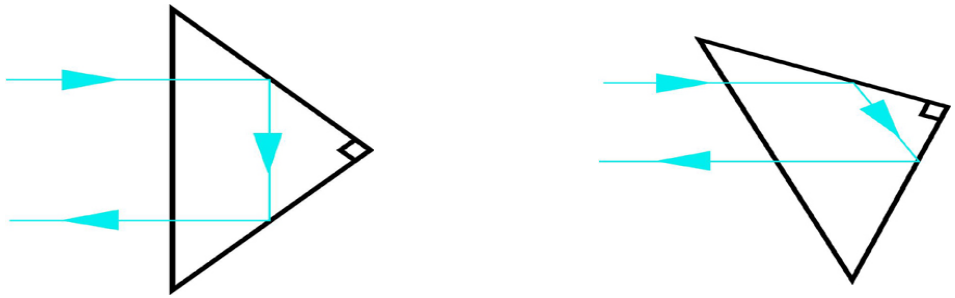
Only one orientation of the light passes through the polarization filter. The reflector rotated and depolarized the light. A part of this light pass through the second polarization filter in front of the receiver.



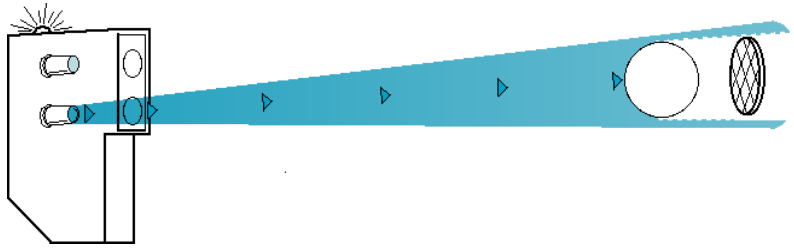
When a shiny target breaks the beam, is reflects the light without changing the plane of polarization and the light is not seen by the receiver.



Reflectors



Tilting the reflector by ±15°does not affect the direction of reflection



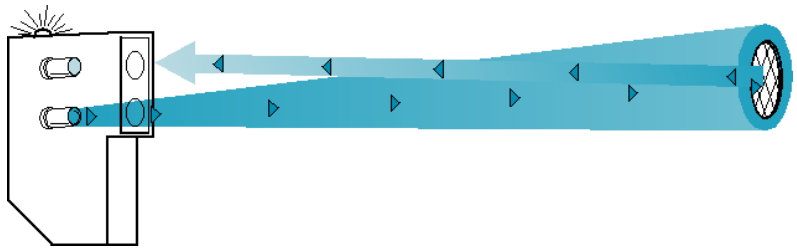
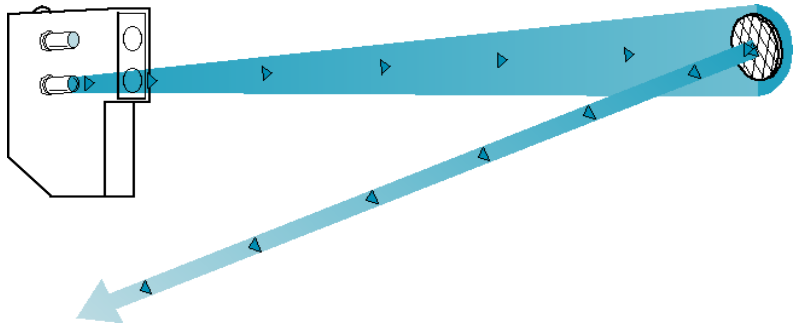
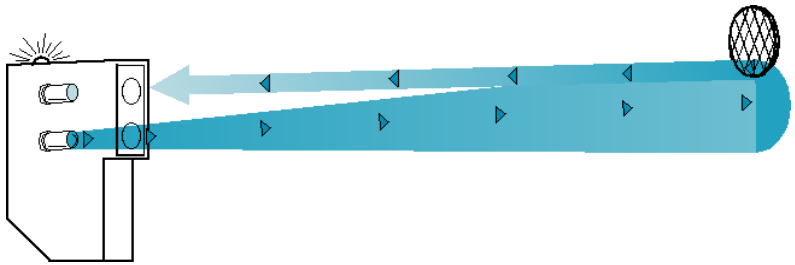
right

The reflector should be smaller than the object

wrong

The reflector is too big

Positioning of reflectors

	**right** -The reflector is aligned and centered
	**wrong** -The reflector is tilted more than 15°
	**wrong** -The reflector is not centered

Retro reflective sensor with polarization filter

Summary

Strength

- Large sensing distances are possible
- Object detection independent of color and surface properties
- No problem with mirroring and bright objects

Weakness

- Caution with transparent objects – special sensors for foil-detection are available
- Sensor has to be align to the reflector

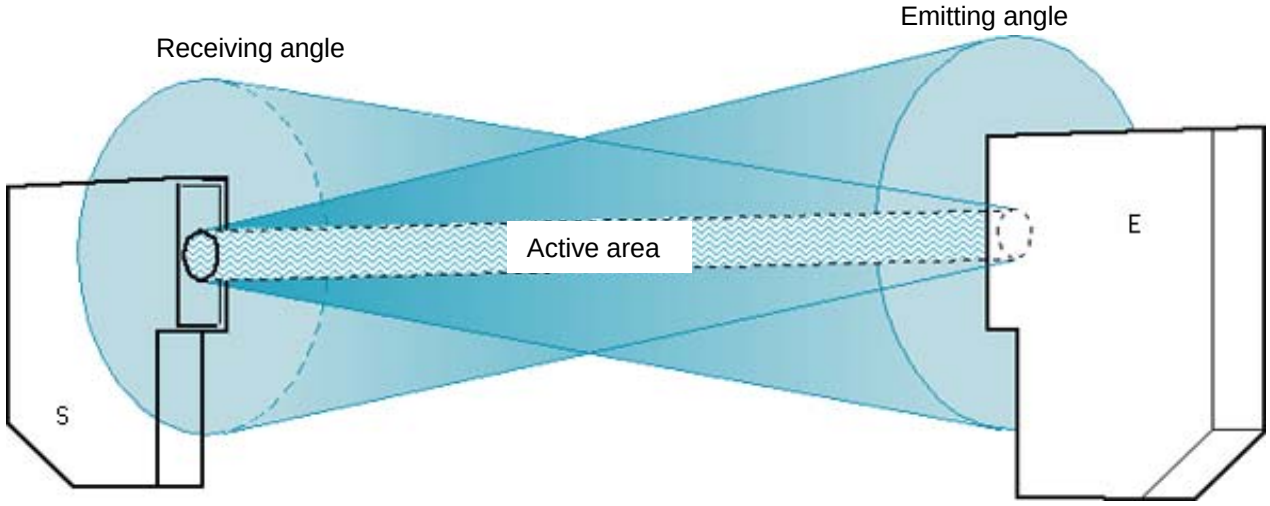
Typical applications

- To detect and count objects with different color and surface properties and mirroring and bright objects

Through beam sensor

A through beam sensor consists of transmitter and receiver mounted opposite each other. Each time an object interrupts the direct path between transmitter and receiver the electrical response of the receiver transistor or the receiver diode changes. This change can be used to detect the presence of an object by means of the electronics and can be signaled via an output stage.

Active area



The active area of a through beam sensor is equivalent to the lens size of the emitter and receiver.

For laser sensor the active area matches with the beam diameter as long as the beam diameter is smaller than the lens diameter.

Summary

Strength

- Due to the narrow effective beam, through beam sensors have excellent repeatability
- Large sensing distances are possible

Fiber optic sensors are available with the the operating principle of through beam sensors

Weakness

- Caution with transparent objects
- Caution with bright surfaces which are parallel to the light beam
- Two housings

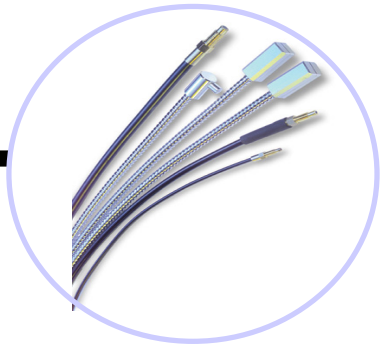
Typical applications

- To detect and count objects with different color and surface properties and mirroring and bright objects

What's the difference?

What's the difference between fiber optics and a standard sensor?

+



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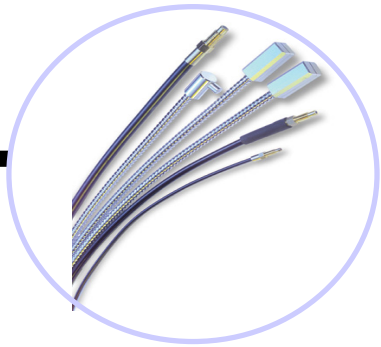

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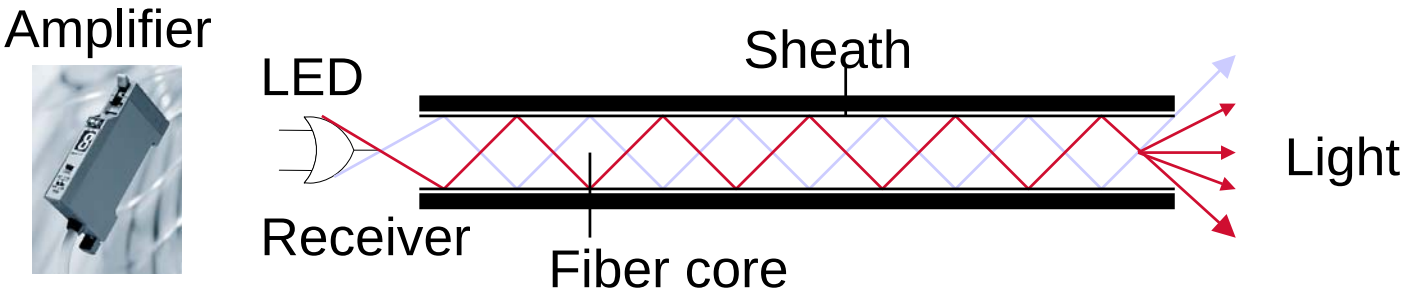
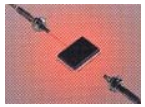
→ **The fiber cable!**

The fiber cable:



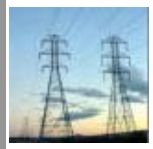
The light away line within the fiber optic takes place according to the principle of the total reflection. The light spreads thus Zigzag forming in the fiber-optic cable. The core material (plastic or glass) is high-breaking, the coat material is low-breaking.

Narrow space! → small sensing heads & highly flexible cable



High/low temperature areas from –60 up to +350°C

Chemical environment, thanks to Teflon PFA material



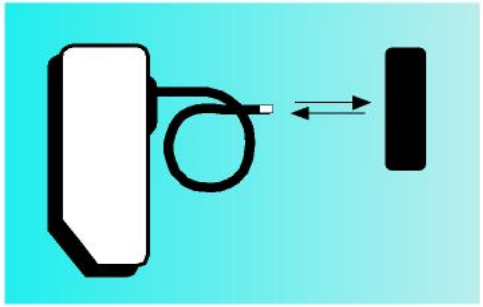
Intensive electromagnetic fields (only light is transmitted!)

No danger to cause an explosion in hazardous areas.

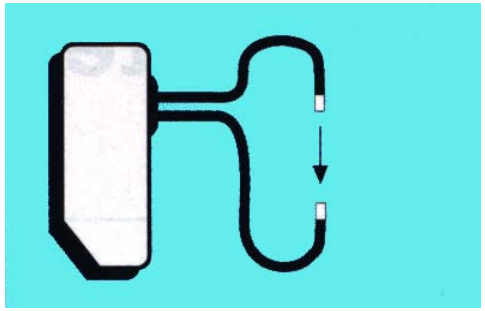
Vacuum environment

Detection of very small objects using precise sensing heads

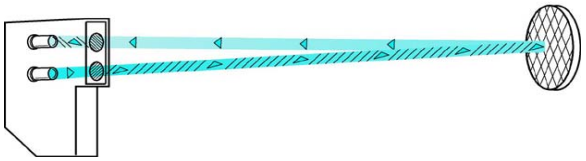
Fine light curtains, detecting/measuring objects in an area



By reflex types is one half of the glass fibers for the emitter, the other half for the receiver. By plastic fiber cables, one has divided into two parts a line



Fiber optic cables may be applied using the same guidelines as through beam sensors.



The retro-reflective principle could be the solution if the customer can’t mount both, the emitter and the receiver. The light passes the object two times. (transparent objects!)

Photoelectric Sensors.

1. Photo Micro Sensor (BS5 Series).
2. DC Long Distance Diffuse Type (BA2M Series).
3. DC Miniature Through Beam Type (BY Series).
4. DC Background Suppression Type (BYD Series).
5. DC Through Beam, IP67 Housing Type (BPS Series).
6. DC Small Size, Horizontal Mounting Type (BM Series).
7. DC Small Size, Vertical Mounting Type (BMS Series).
8. AC/DC Middle Size Housing & Long Distance Type (BX Series).
9. DC Cylindrical Housing Type (BR Series).
10. DC U - Housing Type (BUD Series).

Fiber Optic Sensors.

1. Auto Tuning Setting Type (BF4R Series).
2. Manual Setting Type (BF3RX Series).
3. Diffuse Beam Fiber Cable (FD Series).
4. Through Beam Fiber Cable (FT Series).

Motion Detector.

- Auto Door Sensor (ADS-A Series).

1. Door Side Sensor (ADS-S Series).
2. Area Sensor (BW Series).

1.
The door of this lift shall not close if a person stand between the doors.

Diffuse sensor
Diffuse sensor with background suppression
retro reflective sensor with polarization filter
through beam sensor

2.
The sensor shall stop the conveyer if the food will reach the end of the conveyer. The smallest objects has a high of only 5mm.

Diffuse sensor
Diffuse sensor with background suppression
Retro reflective sensor with polarization filter
Through beam sensor

3.

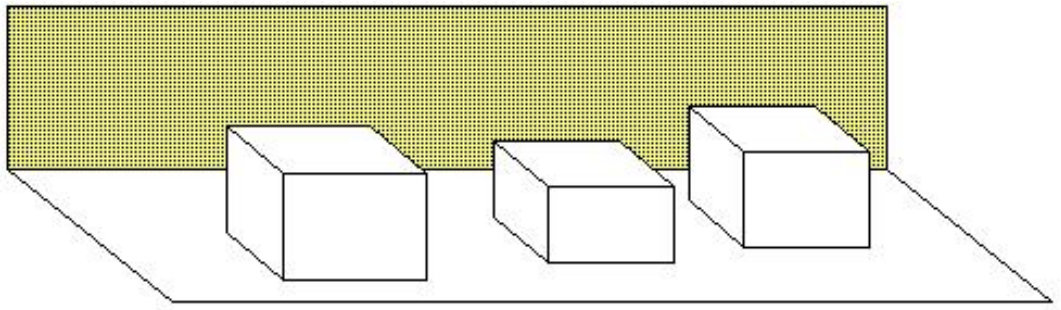
A cheap sensor shall detect white boxes on a conveyer. No disturbing background.

Diffuse sensor

Diffuse sensor with background suppression

retro reflective sensor with polarization filter

through beam sensor



4.
The bottle (different colors) shall be detected.

Diffuse sensor
Diffuse sensor with background suppression
retro reflective sensor with polarization filter
through beam sensor

5.

On a white foil black marks shall be detected.

Diffuse sensor
Diffuse sensor with background suppression
retro reflective sensor with polarization filter
through beam sensor