

Transparency? No problem!

Extremely reliable recognition of even the thinnest materials

Sensor technologies for detecting transparent objects in a wide range of different applications are well known. However, such solutions sometimes have some disadvantages in practical applications and therefore present users with challenges time and again. However, an optical sensor system that works with UV light could change this.

For the recognition of transparent objects, either optical sensors that work with red or infrared light (retro-reflective sensors) or ultrasonic sensors are usually used. Both methods have proven their worth, but also have their pitfalls. Conventional optical sensors are taught using the 2-point method. Here, the devices are first taught without an object between the reflector and sensor and then with an object to be detected in the light barrier. The sensor then automatically determines a switching threshold from the resulting limit values.

Degree of transmission makes recognition difficult

In practice, however, the use of such solutions is made more difficult by the so-called transmittance of transparent objects for visible radiation. Glass, for example, has a high transmittance and therefore a high optical transmittance for light in the visible range. As red light or infrared light can also penetrate a transparent object, up to almost 100 percent depending on the transmittance of the material, a transparent object produces almost no optical damping of the sensor.

The result: the switching threshold of a conventional optical sensor is extremely low in such a case, so that its response sensitivity is close to the range at which there is no object within the light barrier.

High sensitivity to soiling

For this reason, optical sensors with a very high sensitivity are generally used to detect transparent objects, as they react to the slightest damping of the optical system. What is desirable on the one hand can be a disadvantage on the other, as such devices are also very sensitive to soiling. Depending on the switching threshold determined, there is therefore the problem that an optical sensor is damped even with the slightest soiling, as is the case, for example, with a film of dust on the transmitter or reflector that is barely visible to the naked eye, and thus switches even though there is no object to be detected within the light barrier.

The operation of highly sensitive optical sensors for detecting transparent objects can therefore sometimes be complex under the environmental conditions described, as it is either associated with regular checks of the sensor optics or the reflector, or makes it necessary to clean the corresponding components if the system is obviously malfunctioning due to soiling.

The challenge of thin, transparent materials

Ultrasonic sensors, or more precisely ultrasonic barriers, do not have the disadvantages or problems described with regard to the switching threshold, as they are able to detect all objects that reflect sound. As a one-way barrier system, ultrasonic barriers consist of a transmitter and receiver. If the sound path between the transmitter and receiver is interrupted by a transparent object, the switching output in the receiver changes its signal. Ultrasonic barriers are also comparatively less sensitive to soiling than optical sensors. Nevertheless, when mounting the transmitter and receiver, installation positions that lead to heavy dirt deposits or water droplets on the sensor surface or the so-called sound transducer should be avoided.

Ultrasonic sensors typically have a switching frequency of 150Hz and are therefore suitable for applications with relatively fast-running processes, e.g. for detecting transparent glass or PET bottles in the beverage industry. However, if the objects to be detected move through the detection range at extremely high speeds, the switching frequency, which is already high for ultrasonic barriers, always has its limits. A very special problem can also occur with ultrasonic barriers in the recognition of very thin materials that have a certain degree of natural vibration. Transparent films are the best example, as it is essential to ensure that the material between the transmitter and receiver is sufficiently taut. Otherwise, there is a risk that the sound pulse from the transmitter via the air molecules will also cause the film to be detected to oscillate, which means that the signal path between the transmitter and receiver is not interrupted and the receiver therefore does not switch.

Reliable detection with extremely short-wave light

The previous versions should have made it clear that the reliable detection of transparent objects and materials in particular is no easy task for either conventional optical sensors or ultrasonic sensors and has therefore been associated with a host of challenges in practice. Until now, because a completely different sensor technology now offers a real alternative.

With the **OR270478** ipf electronic offers an optical sensor that works with extremely short-wave UV light (group 2). Just for comparison: while the visible red light or infrared light of conventional optical sensors has a wavelength of around 700nm or 880nm, the UV light of the **OR270478** has a wavelength of just 275nm, which does not penetrate even transparent materials that are otherwise difficult to detect.

For the sensor, such objects no longer have the property of transparency, but are instead detected as completely non-transparent objects. The transmittance of transparent objects for visible radiation described above and the associated challenges for conventional optical sensors are therefore of no relevance to the device.

Clear plus points in comparison

In contrast to the optical sensor systems available to date, the solution therefore does not require high sensitivity to determine a clear switching threshold. If there is a transparent object between the sensor and reflector, the signal stroke is correspondingly high compared to a free light barrier (no object in the detection range), which has the decisive advantage that the overall system is also very insensitive to soiling. Even extremely thin, transparent films are recognized by the **OR270478** even detects extremely thin, transparent films extremely reliably, whereby the problem already described in connection with ultrasonic barriers does not even arise when detecting such materials. As the sensor also has a very high switching frequency of $\leq 1\text{kHz}$, it outperforms ultrasonic sensors by a factor of almost 10 in terms of speed.



The new product from ipf electronic also promises easy integration thanks to its compact design - here in comparison with a match. (All pictures: ipf electronic)

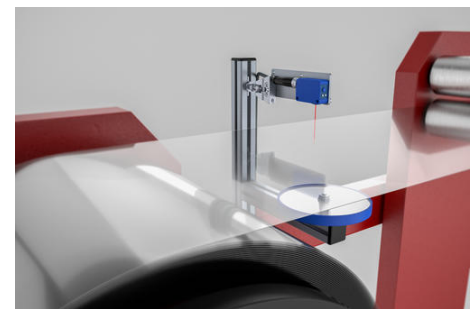


The **OR270478** can also score points with a switching frequency of $\leq 1\text{kHz}$.



Detection of transparent panes that are transported via a roller conveyor. The extremely high transmittance of visible and infrared radiation in glass does not cause any problems here, as the material is not susceptible to the UV radiation of the **OR270478** has no permeability.

Detecting transparent films is sometimes difficult. With ultrasonic barriers, if the voltage of the material between the transmitter and receiver is insufficient, the sound pulse from the transmitter may also cause the film to be detected to oscillate via the air molecules, which means that the signal path between the transmitter and receiver is not interrupted. With the sensor **OR270478** this problem does not even occur.



Simple Ethernet integration

At 37mm x 10mm x 20mm, the device is also very compact and should enable problem-free installation, especially in applications where space is extremely limited. Other technical features include an output current (max. load) of 100mA, a distance range of 40 to 1200mm from the reflector, a degree of protection of IP67 and an IO-Link interface for easy integration into Industrial Ethernet. As a side note, it should also be commented that the reflector of the system differs from previously known reflectors due to a protective cover on the front with a special coating that is resistant to the UV light of the **OR270478** UV light. Conventional reflectors could not be used with this sensor as they have a coverage that only allows visible light to pass through.

1-point or 2-point teach

In actual application, the user has to teach the **OR270478** the user has the choice between a fast or an extremely reliable solution. The sensor solution from ipf electronic achieves the best results with teaching using the 2-point method, whereby the teach button of the device is first pressed with a clear view of the reflector and then with a transparent object in the beam path. However, it should be noted that the short-wave UV light cannot be seen on the object. This method is particularly recommended if films are to be reliably detected and in environmental conditions where dirt or water can make detection more difficult. If you want to detect thicker transparent materials made of glass or plastic instead, e.g. bottles or containers, then pressing the teach button once with a clear view of the reflector is usually sufficient (1-point method).