



Sensing Liquids in Challenging Bottling Applications

Common Challenges in Liquid Detection

The bottling industry has found detecting liquid presence and verifying levels challenging, particularly in two specific applications: detecting clear water in clear bottles and detecting liquid in frosted, colored or decorated bottles. In the past, these applications have been inconvenient and expensive to solve.

When an optical sensor is used to detect water in a clear container, the low contrast will cause the sensor to see the bottle and water as the same item, yielding inconsistent, faulty sensing results. On the other hand, when liquid is contained within a bottle that is partially opaque, the contrast between the bottle and liquid is extremely high. However, many optical sensors cannot burn through dark plastics or colored bottles. High excess gain is required for such applications, and such high excess gain will also easily cut through the enclosed liquid, thereby delivering insufficient sensing results.

The Development of a New Solution

Banner Engineering created the WORLD-BEAM[®] QS30 opposed mode sensors several years ago, and this technology became a popular choice for car wash applications. The sensors' high excess gain allows them to cut through the fog and airborne debris in these settings to deliver reliable results, and their epoxy-encapsulated design allows them to withstand water for long-lasting operation.

When customers needed a sensing solution able to cut through decorated or colored bottles without cutting through the contained liquid, Banner took the QS30 technology and paired it with a 1450 nm infrared sensing beam—specially tuned to an absorption band of water. This combination offered customers a dual-purpose solution, enabling the technology—with a few modifications—to suit both bottling applications.

At 1450 nm, water absorbs 1,000 times the energy of alternative wavelengths, allowing the QS30H2O's emitted sensing beam to deliver accurate results in two ways. When the bottle is clear, the energy absorption of the water creates high contrast between the water and the bottle. The clear PET plastic bottle attenuates about 5% of the light emitted, while the water attenuates about 95% of the light, allowing for precise liquid detection. The beam is paired with high excess gain to “burn” or see through colored, decorated or frosted bottles while still detecting the liquid inside. This light-blocking technique delivers both accurate sensing and a cost-effective price.

Simple Operation in a Convenient Package

The emitted infrared light is 13 mm in diameter and designed to penetrate many types of plastic and glass containers without passing through water-based liquids. In addition, each emitter/receiver pair comes with three auxiliary apertures to shape the beam for reduced size and excess gain. By using apertures and/or mechanically aligning the sensors to achieve the desired results, the installed sensors maximize the optical contrast between the clear and blocked materials.

QS30H2O sensors with discrete output require no configuration, and each model has two bipolar outputs that switch simultaneously: one NPN (sinking) and one PNP (sourcing). Light Operate and Dark Operate models are available. Models with analog output are available for advanced applications, allowing the user to directly measure the amount of signal attenuation. The analog output value can be filtered and a switching threshold determined in a PLC or computer as required.

Multiple Options—A Multitude of Solutions

The QS30H2O offers one emitter model (EXH2O) and two receiver options, a low gain (RH2O) receiver with a 2 m sensing beam and a high gain (RXH2O) model with an extended 4 m range. Selecting the correct product for the application is key to its success.

The RXH2O provides the high excess gain necessary to see through thicker containers, such as colored glass or even HDPE brown plastic bottles and delivers accurate detection of water based liquids. The RH2O is used for applications such as challenging clear bottle/clear water sensing that require less excess gain.

Users also must consider the liquid contained when selecting the correct model. Distilled water attenuates the highest percentage of the emitted light and therefore requires only a low power receiver. When high contrast is created, either by the sensing design or naturally through a colored or partially opaque container, any water will be detected. Some mixed materials such as milk or carbonated beverages are more challenging to detect due to the sugar and minerals contained and will require the higher excess gain of the RXH2O.



Putting the Technology to Use

QS30H2O sensors were first used in place of traditional optical sensors to sense a water-based liquid at the neck of a frosted bottle for a German manufacturer. While the sensing pair cannot detect the quantity of liquid contained, QS30H2O sensors can be used in filling applications when the beam is positioned at the required fill level. This solution provided the high contrast needed to “burn” through the bottle and detect the liquid contained. The sensors can also be used in food packaging applications, seeing through a colored or decorated bag to sense the product inside.

When combined with one of several available apertures, QS30H2O sensors also provide a robust solution for pharmaceutical and medical applications. For example, the standard 13 mm beam can be narrowed to accurately sense liquid within a 13 mm test tube. The aperture further reduces excess gain for reliable results in a clear bottle/clear liquid application.

This specially designed emitter/receiver pair has been combined with a rugged IP67 housing for harsh environments and encapsulated electronics for challenging washdown applications. The sensors provide easy-to-read operating status indicators with excellent noise immunity and crosstalk avoidance, making them ideal for use on busy plant floors. Their compact design and mounting versatility make them simple to implement in a broad range of applications.



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