

THE SELF-CONTAINED THRU-BEAM SENSOR

Perfect for hundreds of part positioning,
orientation, and error proofing applications

White Paper

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This white paper describes the main features and how to use self-contained thru-beam sensors. These sensors are fast becoming the “go-to” sensors for a variety of error proofing sensing tasks.

Information includes:

- Types of self-contained thru-beam sensors
- Main attributes
- How to use them

When they first arrived on the scene, photoelectric sensors debuted as thru-beam devices using bulky transmitters and receivers. Over the years, they’ve blossomed into full lines of standard and specialized designs, each excelling at a certain job. Today’s solutions typically consist of a relatively compact system of emitters and receivers, sometimes with associated fiber optic cabling and separate amplifier modules, as well as other accessory products such as reflectors and mounting brackets. Now, the self-contained thru-beam sensor (also called a “fork” or “slot” sensor) has established its place in the market. When working with production-oriented customers, we’ve found this sensor to be much more than just an addition to our photoelectric arsenal. It has emerged as a jack-of-all-trades, and master of a variety of applications.

Application Expertise is Driving Sensor Design

Until recently, sensor development has tended to concentrate on the electronic/electrical performance aspects of sensors. However, making sensors more accurate, more robust, and more reliable in extreme environments is no longer enough. Today, state-of-the-art sensor design is focusing on the mechanical side of the subject, considering issues such as decreasing the amount of setup time, decreasing production downtime, and helping overloaded production lines run at their peak. Rather than just improving the performance of a sensor, it’s important to make sensors easy to use and maintain. Helping customers in new production environments means looking at the whole picture and letting production and mechanical environments drive electronic sensor design. This is where the self-contained thru beam sensor comes in.

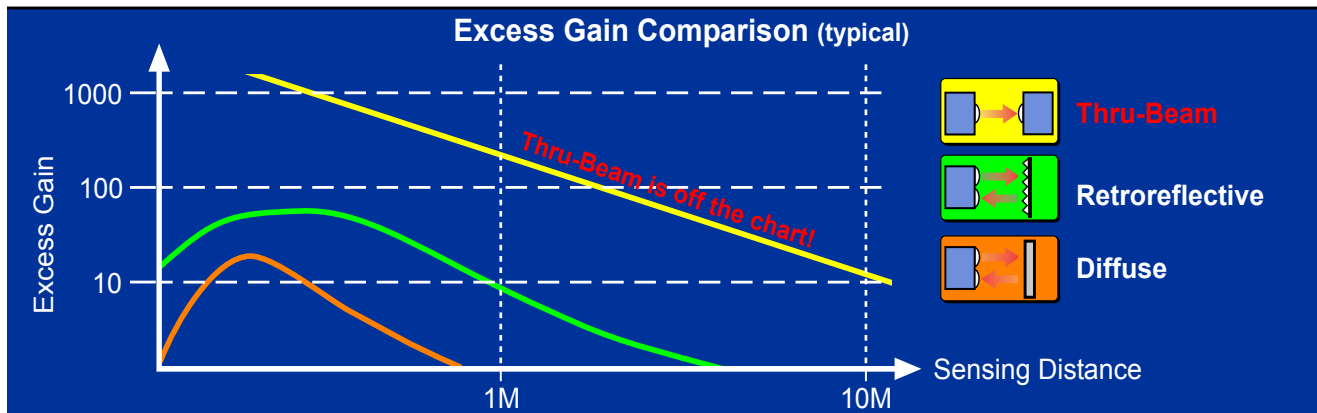
The Basics

This photoelectric sensor style, typically configured in a block letter “C” or “L” shape, sends a beam of visible red, laser red, or infrared light across from one arm of the sensor to the other. Configurations vary from narrow gap versions to sensors with gaps more than 8 inches wide. Originally developed for translucent or transparent contrast mark applications, thru-beam sensors offer high accuracy and operational flexibility. For example, laser versions are capable of resolutions down to 0.03 mm, and are often a better choice than conventional, multi-component thru-beam designs with their two cables, associated fiber-optic amplifier, and additional special mounting brackets.



The Advantages of Thru-beam Sensing

When it comes to reliability and accuracy, no optical sensing mode out performs self-contained thru-beam. Its reliability is a result of the high levels of excess gain inherent in the design. Excess gain is the ability to sense light energy above the level required for normal sensing. The more excess gain, the more tolerant the sensor is of dirt, moisture, and debris. Thru-beams also have a tightly controlled, small sensing area called the effective beam, which is defined by the size of the emitter and receiver lenses. The smaller the lens, the smaller the effective beam. Because the beam has such a small diameter, very small targets or variations of targets can break it. This combination of excess gain and small effective beam increases the utility and accuracy of thru-beam sensors. Moreover, these sensors are immune to variations in target color, reflectivity, or surface condition.



Self-contained laser thru-beam sensors have superior excess gain characteristics over such sensing modes as retroreflective and diffuse. Not only are laser thru-beams very accurate, their high excess gain enables them to maintain their accuracy in the type of harsh environments that would degrade that of most conventional sensors.

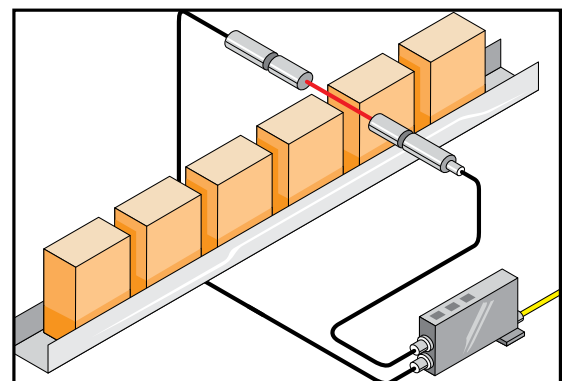
The Advantages of Self-Contained Thru-beams

There are two significant drawbacks to traditional thru-beams sensors: their two-piece architecture, and their need for accurate, stable alignment. A conventional thru-beam system requires a separate emitter and receiver. These systems may be difficult to install because of space or configuration requirements and the need for additional complex wiring. Beyond that, to achieve excess gain, the system must be properly aligned and stay in alignment over time regardless of vibration, incidental operator interaction, and random impacts.

By packaging the sensing elements and electronics into one housing, both drawbacks are solved. Short of bending the housing, sensor emitter and receiver are always aligned perfectly. As a result, self-contained thru-beam sensor designs are superior to traditional thru-beam and more complex fiber optic multipiece units. This class of sensor provides significant advantages to the production line. Because the sensors are always in alignment, setup time is vastly reduced. If they're dislodged during the production, they can be quickly repositioned. Because they're self-contained, they eliminate the need for additional wiring and fragile fiber optic cabling.

Self-contained thru-beam features include:

- Highly visible red emission for easy setup.
- Infrared emission for dirty environments.
- Single-piece housings with pre-aligned optics for quick installation.
- Rugged and rigid single-piece metal housings for stable, accurate readings over long periods of production time.
- High-resolution capability that can sense very small parts or very small part variation.
- High switching frequency capability to handle rapid production rates.



Traditional thru-beam sensor using fiber optics involves comparatively complex setup, including tricky calibration, multiple cables, and multiple components. This makes for longer setup time and a less robust overall configuration during heavy, vibration-prone production cycles.

Expanding the Application Envelope

Rather than treating this style of sensor as an additional photoelectric sensor design, its inherent advantages make it a good starting point when it comes to solving tough production installation problems. Here are just some of the applications where self-contained thru-beam sensors excel:

- Parts sensing on feed lines and conveyor belts (down to 0.3 mm in size with visible red; 0.03 mm using laser versions).
- Parts dimension verification (down to 0.2 mm repeatability with the visible red, 0.01 mm repeatability with the laser version).
- Parts counting on assembly lines.
- Tool breakage monitoring.
- Position verification.
- Feed verification on automatic assembly equipment.
- Press applications such as part ejection verification and double hit elimination.

L-Shaped Thru-beams

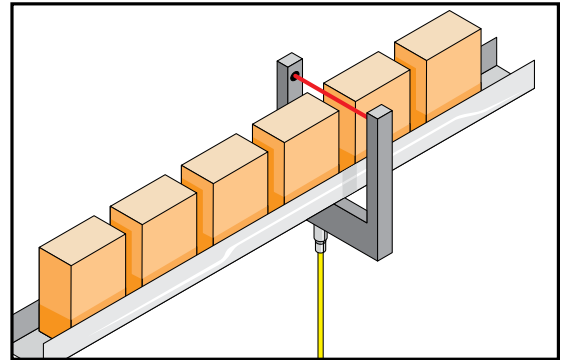
The latest example of this fast-expanding technology is the new L-shaped self-contained thru-beam sensor. Customers needed a sensor that can handle identification and quality verification duties while installed within impact-rich environments that would destroy conventional sensors or unacceptably degrade sensor output. The resulting L-shaped design can be used in a variety of applications where a fork style would be too large or inappropriately configured, or where the sensor would be exposed to sensor-destroying contact or products moving in multiple directions. Because of its angle design, this sensor can be tucked away out of danger and still get the job done. Its rugged housing, incorporating potted electronics, can withstand punishment that would destroy or misalign conventional sensors.

Laser Thru-beams

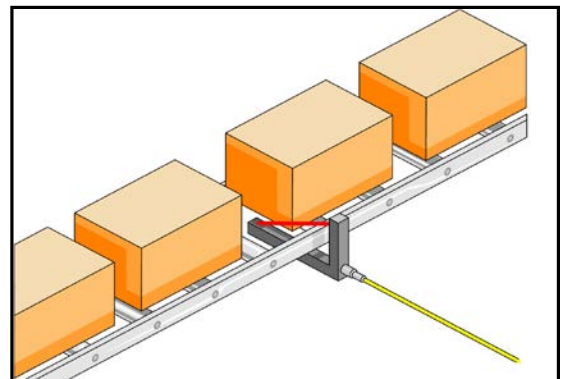
Another step forward is the self-contained laser thru-beam sensor. Laser emission is required for applications that demand higher resolution. Unlike thru-beams that use standard visible red emission, this style substitutes laser for the more diffuse visible red beam. (Visible red is the more economical version for most applications.) With laser versions, the resolution is consistent as the gap size increases. Not so with visible red. As a result, laser self-contained thru-beam designs are perfect for error proofing finished parts regardless of size or configuration in most production environments.

Dynamic Optical Windows – a specialized thru-beam sensor

Dynamic optical windows are closed thru-beam photoelectric sensors that detect an object's movement as it passes through its square or rectangular loop. The ability to detect movement makes these sensors perfect for counting small parts ejecting from dies or machines in a random pattern or attitude. Rather than simply interrupting a static beam as with self-contained thru-beam sensors, the entire part must enter and exit completely through the inner perimeter of the dynamic optical window for the sensor to recognize or count the part. The sensor will not detect motionless objects within its sensing field. For example, a motionless clear plastic transport tube will be ignored but parts passing through it will be detected.



The self-contained thru-beam shown is easy to install. The sensors's rigid construction means that its emitter and receiver are always in alignment and it needs only one cable and no auxiliary electronics. If it's a laser version, it can see through dirty environments, and the one-piece housing conserves space.



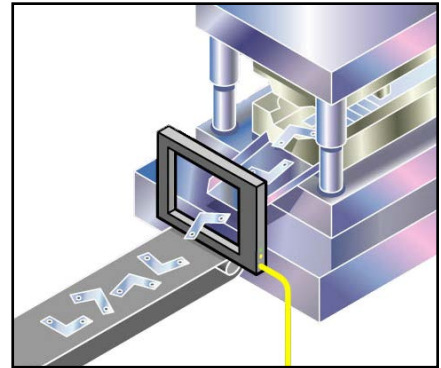
L-shaped sensors are ideal for detecting cases or other square objects on a conveying system. It can be used to see the leading edge of a case or package to initiate glue control, open flap detection, or other gating operations for package inspection.



Self-Contained Thru-Beams – the bottom line

Manufacturer can allow less than 100% in-spec parts to come off the assembly line. The control product with the highest leverage on product quality is the sensor. Almost any sensor can be used for error proofing, given a high level of application expertise on the factory floor. But in general, for most assembly and manufacturing operations, self-contained thru-beam sensors are best suited to provide the flexibility, low maintenance reliability, and performance characteristics necessary to deliver bullet-proof error proofing, increased productivity, and profitability all day, every day. If your operation is not employing this type of sensor, you may be doing things the hard way.

For more information on these sensors, go to www.balluff.com/thrubeam.



In this example, a dynamic optical window error proofs a progressive die program by making sure each finished part exits the die correctly. This also simultaneously protects the die from double hits by making sure each part is off the die and the press before the next hit.

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