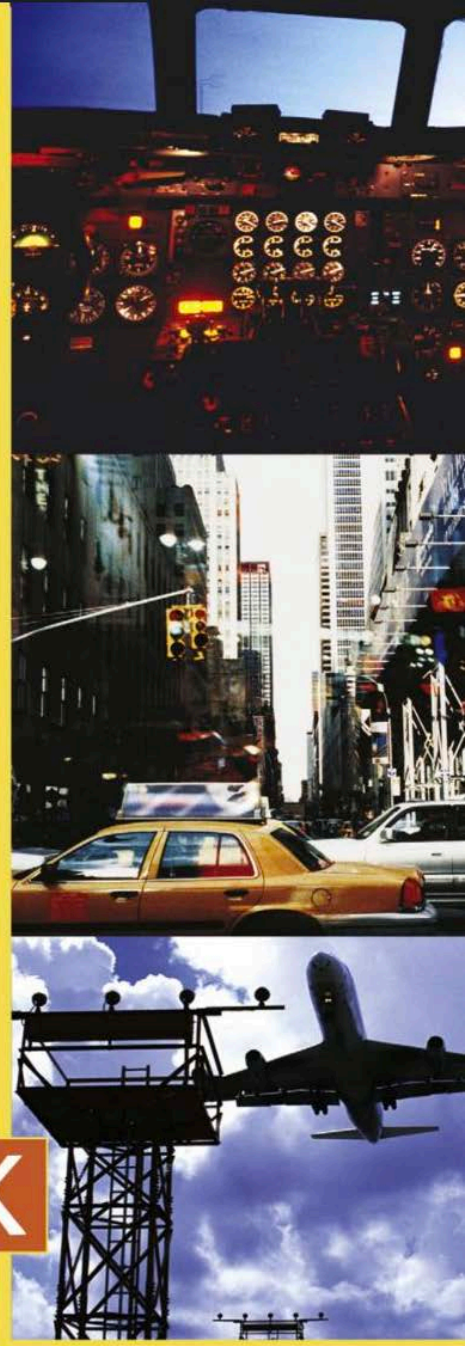


Sensor Technology HANDBOOK

Edited by
JON S. WILSON

Companion website contains design tools
and related information on sensors and
instrumentation techniques



Sensor Technology Handbook

Editor-in-Chief
Jon S. Wilson



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Types of Position Sensors

Every commonly applied position sensing technology has its own characteristic benefits and limitations. Obviously, some of these technologies provide a better fit than others in different applications. The goal is to find the most cost-effective solution for the performance parameters that are important in your specific application and environment. The types of position sensors covered here include:

- Contact devices
 - Limit switches
 - Resistive position transducers
- Non-contact devices
 - Magnetic sensors, including Hall effect and magneto-resistive sensors
 - Ultrasonic sensors
 - Proximity sensors
 - Photoelectric sensors

Limit Switches

Limit switches are electromechanical contact devices. Easy to understand and apply, they are the cost-effective switches of choice for detecting objects that can be touched. These rugged, dependable switches are offered in a variety of sizes with different seals, enclosures, actuators, circuitries and electrical ratings.

Limit switches contain a set of contacts. When a target object comes into contact with a limit switch's actuator on the conveyor in Figure 15.1.1, the switch operates.

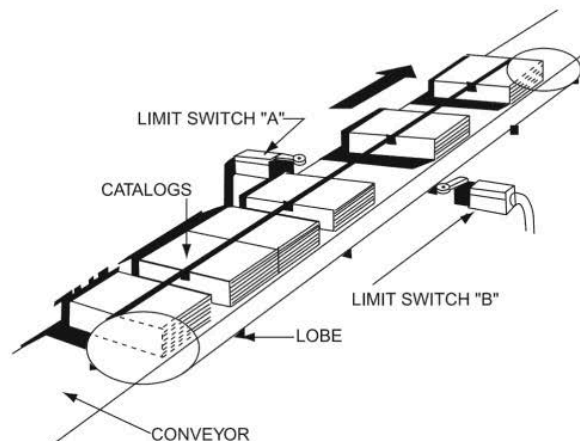


Figure 15.1.1: Limit switches on a conveyor.

One-shot (pulsed) logic gives a single fixed pulse in response to a change at the sensor. This is often used as a leading edge detector for moving parts, where the first indication of presence requires a single operation to take place, but where the continued presence will not cause recycling to occur.

Maintained (latching) logic might be used to detect parts for manual reject. The output is continuous until the operator resets. After resets, the output will not trigger if the original target is still in front of the sensor.

ON delay does not trigger immediately with a change at the sensor, but will trigger only if the input signal exceeds a preset time delay. For example, it can provide jam-up detection on a conveyor for parts feeding at specific intervals. A slow down or stoppage downstream will cause a slower rate of passage, recognized as overloading or jam-up, and will cause an output to give warning or shut down the equipment until the cause is eliminated. A similar type provides an output which stays ON even when the cause is corrected, until manually reset by the operator.

ON/OFF delay is used especially for jam-up detection on vibration feeders and conveyors. The ON delay detects a jam-up, and the OFF delay allows the needed time for the jam to clear the sensing area.

Zero-speed detection provides shutdown for universal jam-up detection where the product may end up in front of the sensor for too long an interval, depending on whether the jam is upstream or downstream. If the interval exceeds a preset time, the output turns OFF or shuts down the equipment.

Photoelectric Sensors

Photoelectric sensors respond to the presence of all types of objects, be it large or small, transparent or opaque, shiny or dull, static or in motion. They can sense targets from distances of a few millimeters up to 100 meters. Photoelectric sensors use an emitter unit to produce a beam of light that is detected by a receiver. When the beam is broken, a “presence is detected.

The emitter light source is a modulated, vibration-resistant LED. This beam, which may be infrared, visible red or green, is switched at high currents for short time intervals so as to generate a high-energy pulse to provide long scanning distances or penetration in severe environments. Pulsing also means low power consumption.

The receiver contains a phototransistor that produces a signal when light falls upon it. A phototransistor is used because it has the best spectral match to the LED, a fast response, and is temperature stable. By tuning the receiver circuitry to respond to a narrow band around the LED pulsing frequency, very high ambient light and noise

rejection can be achieved. Tuning the receiver to respond only to a specific phase of the pulsed beam can further enhance this effect.

The availability of various fiber optic cables with sensing elements permits photoelectric sensors to be used in many applications where space is limited or where there is a hazardous environment. These sensors also are capable of sensing objects traveling at high speeds with the option of detection at up to 8 kHz if necessary.

Selecting and Specifying Photoelectric Sensors

There are different scanning techniques available for photoelectric controls.

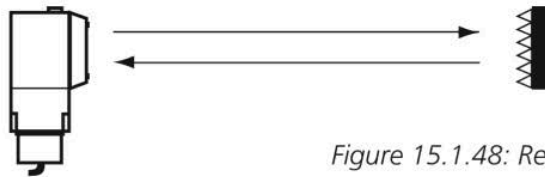


Figure 15.1.48: Retroreflective scanning.

Retroreflective scanning uses an emitter and receiver housed in the same unit with the beam reaching the receiver via a reflector (Figure 15.1.48). Advantages are single side mounting, easy alignment and the ability to mount a reflector in spaces too small for a receiver unit. Reflectors are either acrylic discs or panels, or reflective tape cut to a convenient size. The larger the reflector, the more light reaches the receiver, giving longer scanning distances.

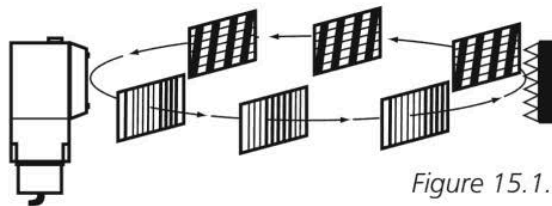


Figure 15.1.49: Polarized scanning.

Polarized scanning involves all the features of retroreflective scanning with the addition of a polarized lens (Figure 15.1.49). When the light wave hits the prismatic reflector, it is turned 90 degrees and, on return, allowed to pass through the receiving lens. This prevents false reflections when detecting shiny surfaces.

To reliably activate retroreflective and polarized scanning techniques, approximately 80 percent of the effective beam needs to be blocked. (See Figure 15.1.50.) The diameter of the effective beam is the same as the reflector on one end and the lens of the photoelectric.