

# *Study on various types of Proximity sensor, IR sensor & Pressure sensor which is used in the Industrial applications*

## **Proximity Sensor**

A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact. A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation and looks for changes in the field or return signal. The object being sensed is often referred to as the proximity sensor's target. Different proximity sensor targets demand different sensors.

Proximity sensors are sensors that are used in industrial automation and other applications. What distinguishes them from other sensors is that they can sense objects without having to touch them. Because they don't have to physically interact with the objects they detect, proximity sensors often have no moving parts.

## **Proximity Sensor Types**

### **Inductive Proximity Sensors**

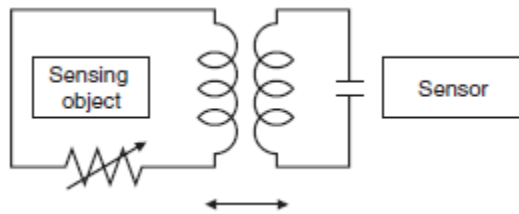
Inductive Proximity Sensors detect magnetic loss due to eddy currents that are generated on a conductive surface by an external magnetic field. An AC magnetic field is generated on the detection coil, and changes in the impedance due to eddy currents generated on a metallic object are detected.

Other methods include Aluminum-detecting Sensors, which detect the

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phase component of the frequency, and All-metal Sensors, which use a working coil to detect only the changed component of the impedance. There are also Pulse-response Sensors, which generate an eddy current in pulses and detect the time change in the eddy current with the voltage induced in the coil.

The sensing object and Sensor form what appears to be a transformer-like relationship.



The transformer-like coupling condition is replaced by impedance changes due to eddy-current losses.

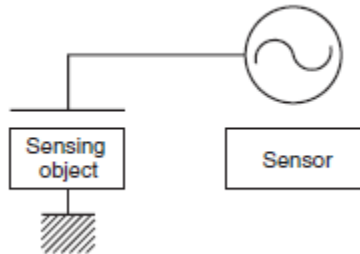
The impedance changes can be viewed as changes in the resistance that is inserted in series with the sensing object.

## **Application For Inductive Proximity Sensors**

inductive proximity sensors utilize electromagnetic fields, they can only detect metallic objects. Within the domain of metallic objects, inductive proximity sensors respond differently to different metals. As sensors in this family have evolved, you can now purchase sensors that respond more sensitively to ferrous metals (such as iron and steel), nonferrous metals (such as aluminum), or sensors that respond to a variety of metals approximately equally. The fact that inductive sensors only sense metal objects can be of benefit in many applications. As non-metallic contaminants will be less likely to trigger an inductive sensor, sensors of this type are tolerant of dirt and moisture build-up. For this reason, they're the go-to choice for

detection of metallic components.

## Capacitive Proximity Sensors



Capacitive Proximity Sensors detect changes in the capacitance between the sensing object and the Sensor. The amount of capacitance varies depending on the size and distance of the sensing object. An ordinary Capacitive Proximity Sensor is similar to a capacitor with two parallel plates, where the capacity of the two plates is detected. One of the plates is the object being measured (with an imaginary ground), and the other is the Sensor's sensing surface. The changes in the capacity generated between these two poles are detected. The objects that can be detected depend on their dielectric constant, but they include resin and water in addition to metals.

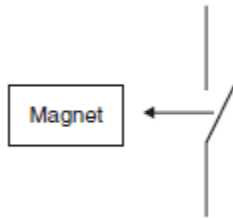
## Application For Capacitive Proximity Sensors

Capacitive sensors are an interesting type of proximity sensor used in manufacturing. Because capacitive sensors detect changes in the capacitance of the field they generate, they have the special property of being able to detect *non-conductive* materials. Due to this attribute, capacitive proxies can detect plastic, glass, water or other liquids, biological materials, and more.

In fact, capacitive proxies are often used as liquid or solid level detection sensors. Because the sensitivity of many capacitive proxies is

adjustable, these sensors can be set up to read the presence or absence of a material through the material's container.

## **Magnetic Proximity Sensors**



The reed end of the switch is operated by a magnet. When the reed switch is turned ON, the Sensor is turned ON.

## **Application For Magnetic Proximity Sensors**

There is a application in which you might find this type of proximity sensor used in industrial automation. In certain situations that are difficult for inductive sensors, magnetic proximity sensors can thrive. The sensing range for inductive sensors is dependent on the size of the sensor. The smaller the face of the inductive proximity sensor, the smaller its sensing range. With small inductive proxes, sensing ranges are in the single digit millimetre and sub-millimetre distances.

Another application is cylinder indication. Pneumatic cylinders are a common means of linear actuation. A linear actuator is a device that moves something from one position to another in a straight line. Pneumatic cylinders that are designed to be used with magnetic sensors have pistons with ring magnets. When the piston moves within sensing range, the ring magnet's magnetic field triggers the sensor. This provides indication back to the controller as to whether your requested actuation actually occurred.

# IR Sensor

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion.

## Infrared Radiation Theory

Infrared waves are not visible to the human eye. In the electromagnetic spectrum, infrared radiation can be found between the visible and microwave regions. The infrared waves typically have wavelengths between  $0.75$  and  $1000\mu\text{m}$ .

The infrared spectrum can be split into near IR, mid IR and far IR.

The wavelength region from  $0.75$  to  $3\mu\text{m}$  is known as the near infrared region. The region between  $3$  and  $6\mu\text{m}$  is known as the mid-infrared region, and infrared radiation which has a wavelength greater higher than  $6\mu\text{m}$  is known as far infrared.

## The Working Principle of Infrared Sensors

The physics behind infrared sensors is governed by three laws:

1. **Planck's radiation law:** Every object at a temperature  $T$  not equal to  $0\text{ K}$  emits radiation
2. **Stephan Boltzmann Law:** The total energy emitted at all wavelengths by a black body is related to the absolute temperature

3. **Wein's Displacement Law:** Objects of different temperature emit spectra that peak at different wavelengths

## **The Types of Infrared Sensors**

Infrared sensors can be active or passive and they can be split into two main types:

- **Thermal infrared sensors** – use infrared energy as heat. Their photosensitivity is independent of the wavelength being detected. Thermal detectors do not require cooling but do have slow response times and low detection capabilities
- **Quantum infrared sensors** – provide higher detection performance and faster response speed. Their photosensitivity is dependent on wavelength. Quantum detectors have to be cooled in order to obtain accurate measurements

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## **Applications of Infrared Technology**

### **Night Vision Devices**

Infrared technology is implemented in night vision equipment if there is not enough visible light available to see unaided. Night vision devices convert ambient photons of light into electrons and then amplify them using a chemical and electrical process before finally converting them back into visible light.

### **Infrared Astronomy**

Infrared astronomy is a field of astronomy that studies astronomical objects that are visible in infrared radiation. By using telescopes and solid-state detectors, astronomers are able to observe objects in the universe which are impossible to detect using light in the visible range of the electromagnetic spectrum.

## **Infrared Tracking**

Infrared tracking, also known as infrared homing, is a missile guidance system that operates using the infrared electromagnetic radiation emitted from a target to track it. These missile systems are often known as 'heat-seekers' as infrared is radiated strongly by hot bodies such as people, vehicles, and aircraft.

## **Pressure Sensor Types**

A **pressure sensor** is a device for pressure measurement of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical.

Pressure sensors are used for control and monitoring in thousands of everyday applications. Pressure sensors can also be used to indirectly measure other variables such as fluid/gas flow, speed, water level, and altitude.

## **Types of Pressure Sensors**

### **Strain Gauge- Chemical Vapor Deposition Pressure Sensor**

Chemical Vapor Deposition (CVD) is a process utilized to manufacture very stable strain gauge pressure transducers. The CVD process provides a reliable option where so many other low-cost pressure sensors fail. Inside each of these transducers, resides an

ASIC chip, which offers higher levels of linearity correction. CVDs pressure sensors are great for applications such as off-highway, HVAC, and semiconductor processing. In addition, the CVD pressure transducers offer a thicker diaphragm which makes it capable of handling intense pulsating pressures.

### **Strain Gauge - Sputtered Thin Film Pressure Sensors**

Of all the various types of pressure sensors, Sputtered Thin Film strain gauges are some of the most dependable, known for their long-term durability and pinpoint accuracy even under extremely harsh conditions. Depending on its job, these types of sensors can be ordered in ranges from 0-100 through 0-30,000 PSI. The product offers unmatched performance in volatile environmental scenarios such as high temperatures, intense shock and vibration, or massive pressure spikes. Sputtered Thin Film sensors are an ideal fit for applications such as off highway, fire protection, refrigeration, and alternative fuel.

### **Variable Capacitance Pressure Sensors**

When you need a tough, dependable way to measure low pressure, capacitive transducers are the way to go. These sensors can be ordered in ranges from 0-2 PSI through 0-15 PSI to accommodate a range of applications including marine tank level indication. They boast a sturdy, physical configuration, stainless steel and ceramic wetted parts, and variable capacitor technology. Capacitive pressure sensors can also be used for high pressure in applications from industrial engines to hydraulic systems, process control to natural gas pipelines.

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## **Solid-State Pressure Sensors**

If your application's needs deal with elements of high shock and vibration, Solid-State pressure switches are an excellent choice. These switches are built with a hermetic all stainless-steel diaphragm and provide high accuracy measurements where tight system controls are necessary. They also offer an advantage over electromechanical pressure switches in cases where actuations exceed 50 cycles per minute. Applications for Solid-State Switches include off-highway, medical gas, compressors, and other demanding general industrial applications.

## **MMS Pressure Sensors**

Micromachined silicon (MMS) strain gauge sensors offer very cost-effective solution for low pressures in both absolute, compound, and gauge references. MMS pressure sensors offer 316L stainless steel wetted parts and an all-welded construction makes for a compact unit that is highly compatible to harsh chemicals and environments. Applications appropriate for MMS include air conditioning refrigerant recovery, gas analysis instrumentation, and medical sterilizers.

## **The Applications of pressure sensors**

### **Automotive applications**

In automobiles, hydraulic brakes are a crucial component in passenger safety. The ability to control a vehicle using brakes is down to a complex blend of components, including pressure sensors. These can be used to monitor pressure within the chambers of the braking

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system, alerting drivers and engine management systems alike if pressures are too low to be effective. If pressure inside chambers is not measured, systems can fail without the driver knowing and lead to a sudden loss of braking efficacy and accidents.

Until recently, airbags were solely designed to inflate inside of vehicles for the front two passenger seats in the event of a collision. Now, car manufacturers have created airbag innovations inside and outside of vehicles that release faster, resulting in safer outcomes for passengers in any seat and pedestrians too. They have also found ways of making the driving experience safer for the planet; bringing down engine emissions, by re-circulating exhaust gases.

### **Life-saving medical applications**

Raising the air pressure in a sealed chamber containing a patient is known as hyperbaric therapy. It can be effective for treating a number of medical conditions, from skin grafts, burn injuries, and carbon monoxide poisoning to decompression sickness experienced by divers. Measuring blood pressure correctly is crucial to patient care, as errors in readings can lead to a misdiagnosis. Thanks to recent innovations, tiny pressure sensors can even be implanted into the body, known as In Vivo Blood Pressure Sensing for more accurate monitoring.

### **Industrial applications**

Submersible pressure sensors can be used to measure liquid pressures (up to 30 PSI) with either a voltage or current (4-20mA) output in liquid tanks. By positioning these sensors at the bottom of a tank, you can get an accurate reading of the contents in order to alert workers or the process control system when levels in the tank fall below safe limits