

➤ **Photoelectric sensor**

A **photoelectric sensor**, or photo eye, is a device used to detect the distance, absence, or presence of an object by using a light transmitter. A **photoelectric sensor** consists of a receiver located within the line-of-sight of the transmitter. In this mode, an object is detected when the light beam is blocked from getting to the receiver from the transmitter.

A retroreflective arrangement places the transmitter and receiver at the same location and uses a reflector to bounce the light beam back from the transmitter to the receiver. An object is sensed when the beam is interrupted and fails to reach the receiver.

A proximity-sensing (diffused) arrangement is one in which the transmitted radiation must reflect off the object in order to reach the receiver. In this mode, an object is detected when the receiver sees the transmitted source rather than when it fails to see it.

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- The position of movable core determines the flux linkage between the primary and each of two secondary windings.

Let  $V_1$  = Output of secondary  $S_1$

$V_2$  = Output of secondary  $S_2$

Then  $V_o = V_1 - V_2$

**Case I : When the core is at centre :**

- With the core in the centre, the induced voltages  $V_1$  and  $V_2$  in the secondaries  $S_1$  and  $S_2$  are equal, since they oppose each other, the output will be zero volts. This is called as **Null or Reference position**.

**Case II : When the core is displaced :**

- When the core is displaced from the null position the induced voltage in the secondary towards which the core has moved increases while that in other secondary decreases.
- Input voltage  $V_i$  and output voltage  $V_o$  waveform for various core position is shown in the Fig. 2.21.
- The phase difference between the output and input voltage changes by  $180^\circ$  when the core moves through the null position. Therefore in actual measurement to determine position uniquely, this phase change over is measured with phase sensitive detector.

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**Advantages of LVDT****A) Mechanical**

1. Wide range of displacement :  $\pm 0.005$  to  $\pm 25$  inch.
2. Frictionless operation : No physical contact exists between the core and coil structure.
3. Ruggedness : Good mechanical life.
4. Insensitive to temperature changes.
5. Highly repeatable response (performance).

**B) Electrical**

1. Linearity : Better (Output voltage is a linear function of mechanical displacement).
2. High sensitivity.
3. Resolution : Infinite.
4. Electrical isolation is better.

**Disadvantages of LVDT**

1. Physical size is large and it is bulky.
2. Inertia of core limits the speed of response, therefore not suitable for dynamic measurements.
3. Phase sensitive circuit is required.
4. Susceptibility to stray magnetic field, it can be reduced by shielding.

➤ **Capacitive Sensors**

It is used for measuring displacement, velocity, force etc.

**Principle:**

It is passive type sensors in which equal and opposite charges are generated on the plates due to voltage applied across the plate which is separated by dielectric material.

**Formula :**

The capacitance 'C' of a parallel plate capacitor is given by

$$C = \frac{\epsilon_r \epsilon_0 A}{d}$$

where  $\epsilon_r$  = Permittivity of the dielectric between the plates [= 1 for air].

$\epsilon_0$  = Permittivity of free space [=  $8.854 \times 10^{-12}$  F/m for air]

A = Area of overlap between two plates in  $m^2$ .

d = Distance between two plates in m.

**By Changing the Distance between Two Plates:**