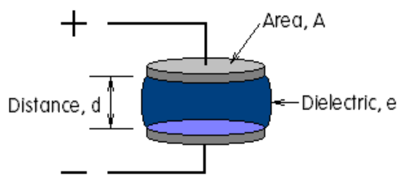
How they work

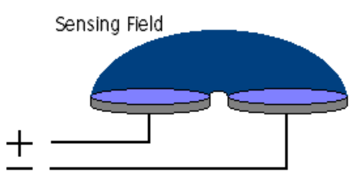
A capacitor is a two terminal device that consists of two conducting bodies separated by a non conducting (dielectric) material. A simple capacitor consisting of two plates is shown below. A simplified expression for the capacitance of this arrangement is:

Capacitance, C = (A * e) / d



Capacitance, C = (A * e) / d

To create a more usable geometry for sensors the plates (or electrodes) can be arrayed in a variety of ways. Though this complicates the above expression for capacitance, the overall relationship between the variables remains the same. Shown below, the electrodes are arrayed on the same plane. This can be accomplished in numerous ways. The electric field is projected away from the electrodes.



If the dielectric remains constant, the capacitance also remains constant. If the dielectric changes, the capacitance naturally also changes.

In capacitive proximity sensors, these two electrodes are coupled together, and integrated in a high frequency oscillator. In the "no target" state the oscillator is tuned to be resting. As a target enters the electric field, increasing the capacitance, oscillation begins. When the amplitude reaches a high enough level, a change in signal state is triggered.

Two main families of electrode configurations are utilized for standard applications:

Dielectric Type (D-Type) capacitive proximity sensors are configured as shown previously, with two sensing electrodes integrated in the oscillator. The sensing field projects away from the sensor face and entrance of any object into the sensing field will increase the capacitance, resulting in oscillation. Such sensors will detect all materials, insulative or conductive. These sensors are often called "shielded" and they may be flush mounted.

Conductive Type (L-Type) capacitive proximity sensors are configured with only one sensing electrode integrated with the oscillator. Entrance of a conductive material into the field provides the second coupling electrode which then causes oscillation. Such sensors are excellent for "looking through" an insulative material such as rubber, glass or paper in order to detect a conductive material such as water, or metal. These sensors are often called "unshielded" and they may not be flush mounted.

In addition to the sensing electrodes, Stedham Electronics also incorporates a compensation electrode in all capacitive prox products. This electrode is integrated into the oscillator and is designed to detect contaminating elements only. Once a build-up of contaminants is detected, the effect is compensated to avoid false triggering.

The ability of any electrode configuration to sense great distances is a function of the material being sensed. Sensing conductive materials results in the maximum sensing distance capabilities of any capacitive proximity sensor.

The sensing capabilities for dielectric materials is a function of the dielectric constant of the material and the mass of material within the sensing field. A sensing distance reduction factor needs to be applied to such materials.

Selection

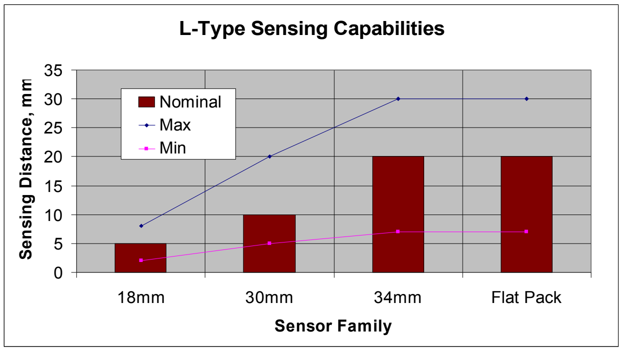
Generally, selection of the proper capacitive proximity sensor is controlled by the following: the target material, the desired sensing distance, and/or the available space in which to insert the sensor.

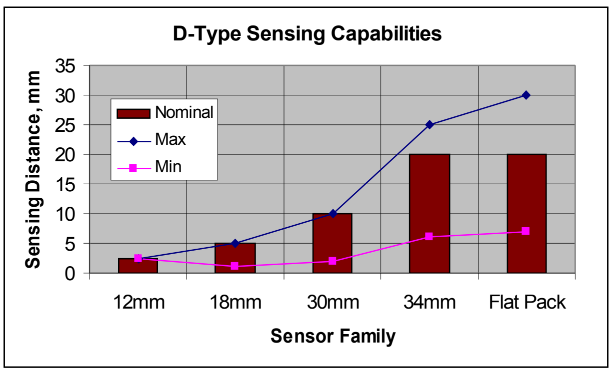
- For conductive targets, including "look through" applications, the best sensor choice is generally a plastic, L-Type sensor.
- For targets which are not conductive, D-Type sensors should be used.

The below graphs indicate the sensing distance capabilities of Stedham Electronics capacitive proximity sensors. The nominal sensing distance is defined by using a square 1mm thick earth grounded steel target measuring dia x dia for cylindrical sensors, and equivalent to the size of the electrode for FlatPack versions. Though the sensors will generally function at distances greater that the indicated maximum, performance can not be assured.

The sensing capability of all capacitive proximity sensors is maximized with conductive, grounded targets (metal, water, etc). Other non-conductive (dielectric) targets (plastics, dry wood and paper, glass, etc) are sensed at reduced distances. Determination of the proper correction factor is required to assure that the sensor size needed can supply the required sensing distance. On-site testing is the best method, once it is established that a certain product will probably yield the desired results.

The customary decisions regarding whether AC or DC sensors, and which output combination is to be used, apply to this product family. Should you have questions concerning this, please contact us and a friendly engineer will help you select the right sensor.





Installation

Stedham Electronics has all mounting brackets and accessories required for standard installations (See Accessories). Should you have special requirements we will be happy to provide custom solutions and application help.

D-Type sensors with metal housings may be flush mounted. These sensors may be mounted side-by-side.

Sensors with plastic housings require an area of free space around the sensing face. The face of the sensor should be positioned from the mounting surface a distance equivalent to the diameter of the sensor (see Figure 1). Such sensors may be mounted as close as two diameters (on center) to one another to prevent "cross-talk" interference.

When sensors are facing each other, they should be no closer than 8 times the sensing distance (See Figure 2).

On cable versions, Stedham Electronics provides tinned wire ends. If you need to trim the cable, please tin the wire ends to assure proper connection.

Care should be taken to assure that the target does not strike the sensor. Care should also be taken to assure that excessive dust, shavings, chips, liquids, etc. can not collect directly on the sensor face or in the sensing field.

Connecting cables may be run in conduit with other control wiring. **Never run DC connecting cables in conduit containing AC power wiring!**

Figure 1

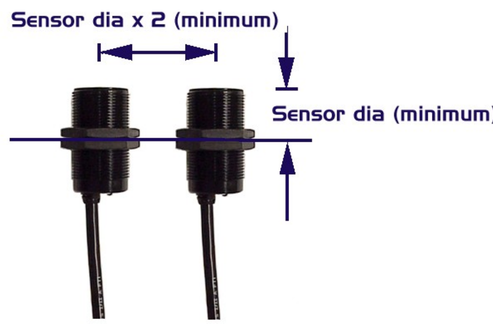


Figure 2

Adjustment

Most of Stedham Electronics capacitive proximity sensors are equipped with an adjustment potentiometer located near the cable entrance. By rotating the potentiometer in the **clockwise direction** the sensing distance is **increased**. For convenience, each sensor so equipped is provided with a small screw driver for this purpose.

Apply power to the sensor and place the target at the desired detection point. If the sensor is detecting the target, reduce the sensitivity until it no longer detects it. Then adjust the potentiometer until is just detects the target. Then add an appropriate safety factor (see note) by rotating the potentiometer more in the clockwise direction.

Achieving usable sensing distances up to 1.25*S_n may be possible, however, degradation of the performance specifications (hysteresis and repeatability) may occur .

The nominal sensing distance (S_n) is defined by using a square 1mm thick earth grounded steel test-target measuring dia x dia for cylindrical sensors. After setting the sensor for your application and target material, you should check the sensor using such a target. If the steel test-target is detected at a distance greater than 1.25 x S_n the sensor should be mounted closer to the actual target if possible, and the sensing distance readjusted.

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Note:
The safety factor varies for each application and is a function of several variables such as: target material, desired sensing distance, environmental conditions and variability, etc. By increasing the sensitivity past the point where the sensor just detects the target, the above factors are eliminated from causing false triggers. However, the sensitivity can inadvertently be increased so much that the sensor detects the target too early or is unintentionally influenced by nearby objects. Determination of the safety factor is therefore best carried out on site.

Please call us if you need further help setting up your sensor.

Contact us if you have any difficulties. A friendly engineer is standing by to assist you! Thanks for buying our products!