CAPACITIVE PROXIMITY SENSORS

Capacitive Sensors are very similar to inductive proximity sensors in shape and function. The difference is that the capacitive sensor can sense not only conductors/metallic but also non-conductors. Capacitive sensors are sensitive to all materials. Just like an ultrasonic sensors that is used as a limit switch, it can sense any substance, metallic or non-metallic close by. The sensing distance is dependent on the material but, at best it should not be expected to be more than 20 cm.

Description:

Capacitive proximity sensor is non-contact sensing solution to metallic as well as non-metallic objects. With adjustable sensitivity almost any medium can be detected with desired reliability.

Design and Principal:

The primary functional element of capacitive proximity switch is high frequency oscillator with floating electrode in the transistor base circuit. In non-activated state, noise field exists in region of base electrode which represents active area of proximity switch. When medium appears in active area, oscillations begin. The switching stage rectifies and switches high frequency oscillations, resulting DC signal triggers output stage. Switching stage includes signal feedback system, level of which can be adjusted by potentiometer, thus providing presentable response sensitivity of switch.
Proximity Sensor Selection Guide

SENSING DISTANCE

<table>
<thead>
<tr>
<th>More than a meter</th>
<th>Less than a meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment Dust</td>
<td>Target Object Metal</td>
</tr>
<tr>
<td>Use ultrasonic proximity sensor</td>
<td>Use the inductive proximity Sensor</td>
</tr>
<tr>
<td>Target Object Metal (High Speed)</td>
<td></td>
</tr>
<tr>
<td>Use MR (Magneto restrictive)</td>
<td></td>
</tr>
<tr>
<td>Hall Sensor. Application like Gear Teeth.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distance very large</th>
<th>Target non-conductor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use through the beam optical type</td>
<td>Use capacitive sensor</td>
</tr>
<tr>
<td>Hazardous environment</td>
<td>Distance very small</td>
</tr>
<tr>
<td>Both ultrasonic and optical suitable</td>
<td>Use optical proximity sensor</td>
</tr>
</tbody>
</table>

The principle of operation for the capacitive sensor is sensing the change of dielectric constant of the capacitor. Just like the inductivity proximity sensor, this sensor also has a sinusoidal AC voltage source driving a capacitor. Any substance close by will change the dielectric constant of the capacitor which in turn will cause the capacitance to change. Changing capacitance gives the indication of target material in the vicinity. Capacitive sensors are widely used in industry for sensing non-conductive materials like cardboard boxes, wrapped packages, or granules of different materials. We have developed a range of application/need based capacitive sensors in Standard Barrel types and AC/DC types.
INDUCTIVE PROXIMITY SENSORS

Description:

Inductive proximity switches are ideally suitable for no contact sensing of metallic objects. As inductive sensors work on electromagnetic principle, they are inherently resistant to dust, humidity and oil in industrial environment. Besides Proximity detection, continuous development in the field has led to new applications such as distance measurement with Analogue Types. Low power consumption, availability in wide range of packages and low unit price has made them very popular in industry.

Standard Barrel Types

Housings of standard inductive ranges are made of Nickel coated brass barrels. They are widely used in non-corrosive atmospheres.

Limit Switch Style Blocks.

With housings moulded in engineering plastic material these switches replace mechanical limit switches. KATLAX offers Models with multi-axes sensing to adopt design flexibility.
Flat Types.

These models in engineering plastic are best fit for conveyor belt applications to overcome z-axis limitations. They virtually substitute mechanical micro switches.

Slotted Types.

Designed for RPM measurement and zero speed detection these slotted versions are also available in engineering plastic housings.

Design And Principle

KATLAX Inductive Sensors are no contact type electronic sensors comprising of three components oscillator, comparator and output stage. Catalogue specifies sensing distance for Fe ST-37 grade steel plate and necessary Correction Factor must be considered for different metals. ( refer table 1 ).
Operation

The oscillator creates high frequency electromagnetic field which radiates from sensing face of the sensor. When damped with metallic object, eddy currents are induced in metal causing change in amplitude of oscillations. This signal is conditioned to change Schmitt trigger output and state of output amplifier. Analogue DC output voltage and current are available in addition to standard PNP/NPN switching outputs.

Definitions....

**Sensing distance (Sn)** :

Distance at which output signal is triggered when standard target is moved towards sensing face.

**Standard target**:

Square plate st-37 /Fe length of the side equal to sensing face diameter.

**Correction factor (C.F.)** :

If target differs from standard test target, then the applicable published sensing distance must be multiplied by appropriate correction factor.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>C.F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild Steel</td>
<td>1.00</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>0.70</td>
</tr>
<tr>
<td>Brass</td>
<td>0.45</td>
</tr>
<tr>
<td>Aluminum</td>
<td>0.35</td>
</tr>
<tr>
<td>Copper</td>
<td>0.25</td>
</tr>
</tbody>
</table>

**Hysteresis (H)**:

Difference in distance between operate and release points given in terms of percentage of sensing distance. KATLAX switches are designed for 3% to 15% over its range of operating conditions.

**Repeatability (R):**
The repeatability of actual switching point of two successive switching within 8 hours.

**Temperature:**

The normal temperature range between 0 to 70 Deg.C.

**Switching Frequency (F):**

Highest frequency at which proximity sensor can be switched.

**Mounting Instructions:**

**For Cylindrical Forms:**

**Shielded:** Sensor can be mounted flush in the metal.

**Unshielded:** There must be space equal to diameter of sensing head with no metal interference.
For Limit Switch Styles:

40Block type switches: Mounting should be done as shown.

**Electrical and Mechanical Specifications:**

**Supply Voltage (Vb):**
Maximum ripple of 10% of supply voltage should not be exceeded.

**Voltage Drop (Vd):**
Maximum voltage drop measured across conducting output.

**Current Consumption (Ia):**
Maximum current drawn by switch.

**Output Load Current (IL):**
Maximum current switch can sink or source should not be exceeded.

**Output Protection:**
KATLAX switches are protected against
BACK EMF,
REVERSE POLARITY,
& INDEFINITE OUTPUT SHORT- CIRCUIT.

**Magnetic Fields:**
Strong Magnetic Fields may push proximity switch into latching condition. e.g. Induction Furnaces. Protective screening is recommended in such cases.

**Cable Length:**
KATLAX standard proximity switches are furnished with 3m Cable. Longer lengths add capacitive coupling on output leading to switching limitations and /or noise problems.

**Status:**
KATLAX switches are provided with LED indication.

**Protection Class:**
KATLAX Proximity Switches are approved for IP67 class of protection against ingress of water at specified pressure and time conditions.

**Electrical Configurations:**

**NAMUR SENSORS:**
These low current two wire sensors developed at KATLAX are approved by CMRI., Dhanbad for INTRINSICALLY SAFE AREA APPLICATIONS as per IS 5780-1980 and can be operated in EX-PROOF areas Gr I,IIA,IIB,IIIC.

**DC/AC SWITCHING SENSORS**
These high output current driving capacity sensors are manufactured to operate over wide range of supply conditions 10 to 30 Vdc / 40 to 250Vac.

**ANALOGUE SENSORS**
These are available in standard process control protocol viz. 4-20 mA. /0-10V output proportional to target distance.

- Metallic or Plastic with Cylindrical, Flat, Slot or Customized Mounting, Certified for IP 67, Short Circuit, Overload, Polarity reversal Protection.
- Reflex, Retro-reflective, Through Beam, Colour Mark.

Inductive Proximity Sensors are devices which can sense the existence of conductive objects that are situated close by. The sensing distance for the sensor is adjustable by adjusting the controls on the sensor but, it cannot be more than 10 cm. The sensing distance for the sensor is adjustable by adjusting the controls on the sensor but it cannot be more than 10 cm. The sensing distance also depends on the type of the target material. Different metals have different sensing distances.

The principle of operation of the inductive proximity sensor is sensing the eddy current loss induced in a conductor. Inside the sensor there is a coil which is continuously driven by sinusoidal AC signal. Any time there is a conductor around the emitting coil, eddy current will be generated inside the conductor. (Eddy currents are considered losses and one tries to reduce them normally)
The eddy current losses will cause loading in the coil and the current drawn from the AC voltage source will increase by monitoring the current by the coil existence of the conductive substances around the sensor can be sensed.

We have developed a range of inductive proximity sensors to cater to operational needs of a wide range of machines used in different industry. Inductive proximity sensors are available in M8, M12, M14, M18, M30, M36 Barrel type, Block type, Limit Switch Style, Slotted type, Namur sensors, 2 wire AC/DC, 3 wire AC/DC, 4 wire DC, Analogue/Digital Sensors, Single I/P-SingleO/P type, Single IP-Scaled O/P type.

In addition to what has been covered in the current catalogue and the website, we have capability to produce Inductive Proximity Sensors to specific customer needs, provided the quantity requirement is large enough.

**PHOTOELECTRIC SENSORS**

Description:

Photoelectric Sensors are indispensable components of modern automated production processes. KATLAX combines precision optics with electronics and rugged housing to provide versatile REFLEX and THROUGH BEAM SENSORS. These sensors are designed for applications involving Non-contact detection for measuring, counting and positioning.

Types:

Through Beam Types:
These switches offer sensing range up to 5M. Emitter and Receiver are in separate housings facing each other with their optical axes matched. Sensor switches whenever light beam is interrupted.

**Features:**

Switching point independent of surface nature. Narrow effective beam results in better repeatability. Largest sensing ranges.

**Applications:**

Monitoring doors and gates. Counting and monitoring objects over large distances.

**Reflex types:**

These are available in two types.

(a) **Diffused Beam REFLEX Sensor:**

Emitter and Receiver are in same housing. Sensing range up to 0.2m is provided. Emitter sends beam of pulsed infrared light. Only small portion of light diffused by object in all directions is sensed, which switches the sensor.

**Features:**

Sensing range depends largely on reflective properties of target. Suitable for distinguishing between black and white targets. Positioning and monitoring with only one active sensor.

**Applications:**

Distinguishing and sorting of objects according to their volumes and degree of reflection.

(b) **Retro reflective Reflex Sensor:**

With Emitter and Receiver in same housing, light reflected by triple prism reflector or reflecting Tape opposite to sensor is sensed. Sensor switches when light beam is interrupted.

**Features:**
Large sensing range. Mat finished surfaces are sensed independent of surface properties.

Applications:
Height detection of stacked objects. Control of randomly positioned objects on conveyor.

- Metallic or Plastic with Cylindrical, Flat, Slot or Customized Mounting, Certified for IP 67, Short Circuit, Overload, Polarity reversal Protection.
- Reflex, Retro-reflective, Through Beam, Color Mark

An industrial photoelectric sensor is a device composed of a light transmitter and light receiver. Light is directed towards the object by the transmitter. The receiver is pointed towards the same object and detects the presence or absence of reflected light originating from the transmitter. Detection of light generates and output signal for use by an actuator, controller or computer. The output signal can be analogue or digital and is often internally modified by timing logic, scaling or offset adjustments prior to output.

The control unit also controls the output device in self contained photoelectric controls; the control unit and sensor are built into an integral unit. Controls can be configured to operate as light activated devices. The output is triggered when the detector sees light. They can also be dark-actuated devices where the output is triggered when the detector does not see light. In order to successfully automate a process it is necessary to obtain information about its status.

The sensors are the part of control system which is responsible for collecting and preparing process status data and for passing it onto a processor. Photoelectric controls use light to detect the presence or absence of an object. All photoelectric controls consist of a sensor, a control unit and an output device. A logic module or other accessories can be added to the basic control to add versatility.

The sensor consists of a source and a detector. The source is a light emitting diode (LED) that emits a powerful beam of light either on the infrared or visible light spectrum. The detector is typically a photodiode that senses the presence or absence of light. The detection amplifier in all photoelectric controls is designed so that it responds to the light emitted by the source ambient light, including sunlight up to 3100 meter candles does not affect operation. The source and detector may be separated or may be mounted in the same sensor head, depending on the particular series and application. The control unit modulates and demodulates the light sent and received by the source and detector. This assures that the photoelectric control responds only to its light source. Output devices may include relays such as double pole, double throw (DPDT) and single pole, double throw (SPDT). Output devices may also include a triac or other high current device and may be programmable-controller-compatible. Logic modules are optional devices that allow addition of logic functions to a photoelectric control. For example instead of providing a simple ON/OFF signal, a photoelectric control can (with a logic module) provide time-delay, one-shot, retiggerable on-shot, motion-detection and counting function. The effective employment of
photoelectric sensors can lead to successful integration of data in manufacturing operations to maintain an error-free environment and assist in obtaining instantaneous information for dynamic interaction. A photoelectric sensor is a semiconductor component that reacts to light or emits light. The light may be either in the visible range or the invisible infrared range.

These characteristics of photoelectric components have led to the development of a wide range of photoelectric sensors.

**SENSORS CONNECTORS AND CABLE ASSEMBLIES**

![Photoelectric Sensors](image)

**Interface Products Group (IPG)**

In an automation system interface products that connect various elements play a very important part. Interface products in automation play the same role that is played by infrastructure in development of a nation.

Interface Products Group (IPG) manufactures various connectors, connectors with cables and such interface products which help in connecting various types of sensors to different types of cable trees or amplifier and controller units which make automation systems. Some of the common and standard products are available off the shelf and various others that need to be developed are also taken up to meet special needs.

With an in-house development cell which has Die design, machining and pilot extrusion machine for quick development this group caters to various demands of its clients with tailored quality products. The test facilities include micro ohm meter, insulation and high voltage tester as well as routine automatic tester for mass production needs. With an ERP system and programmable length cable cutting machine customized cable lengths which help in reducing waste can also be supplied by this group.
**Why Interface Products:**

Normally field devices are mounted in harsher environments near equipments but the central controls are located at central locations. The signal from field devices needs to be taken to controllers via cables. If there are environmental problems like fluctuating voltage, spikes, physical abuse or accidental breakages, the devices fails more often than the connecting path consisting of cable and interconnections. Earlier the devices used to have their own cables and one had to change device as well as cable. It means increased downtime and consequent production loss. With interface products, one need only replace the device and quickly restart the system. Various advantages of this system are given below.

- Time saving of reconnecting device at machine.
- No skilled electrician is needed to change a device. The device becomes as versatile as a PCB and can be replaced by anyone.
- With newer technologies one can substitute device and improve performance.
- One becomes free on choice of sensing device.
- The interconnection quality does not depend on electrician skill but is assured by interconnection system components.
- It is environment friendly and reduces carbon footprint by preventing scrapping of cables.
- It is automation friendly and can be better used for higher levels of control.
- After replacement the wiring does not become worse as it is not affected. In the old system, due to lack of proper dressing components wiring after such replacement becomes shabby and unreliable.

Katlatex Interface Product Group (IPG) has developed innovated and indigenously various types of connectors and cable assemblies for sensors.

- Screw type straight
- M-12 Plastic (M&F) Connector
- M-8 (M & F) Straight
- Quick Connect Series Connector
- M-8 Female Right Angle
- M-12 Female Right Angle
- M12 Female Straight
- M-12-5 Pin Male (up to 8 pin)
- M-12-4 in male connector

These connectors and cable assemblies have been accepted by United States & European market against international competition.

**Application:**
When Sensors are used in automation or any High efficient machine, Machine or process down time is critical when sensors are provided with molded cable, which is part of cable harness assembly. To avoid cable removal when sensor is defective, connector is solution with Plug forming part of sensor and socket with cable.

**Key Features:**
- Conductor color identifications comply with European Standards.
- KATLAX SENSORS, for all size, i.e. M8 to M36 or Box type, we use M12 connectors both Male & Female.
- Right angle cable socket, with integrally molded lead, self-securing lock nut.
- Screw locking, metal coupling nut and self-assembly
- Connector assembly also available without cable.
- All the combinations also available with shielded type cable.

These connectors can be supplied in mounting diameters of M8, M10 and M12 and Euro, M & F, F & F, 3 core and 4 core types to serve various applications. Likewise, the male and female contacts are available in 3 poles, 4 poles and 5 poles. Female connectors can be supplied with or without LED. The designs include hydraulics and pneumatics controls and I/p – O/p devices.

Sensor Connectors have been so designed that they are user friendly and facilitate the implementation of wiring jobs in the automation projects. The connectors’ I/O wires can all be crimped at once and hence, they simplify the wiring. The connector and cable assemblies provide substantial new application flexibility to production lines and associated OEM production machinery design. They reduce wiring to a great extent. Besides, as Actuator – Sensor (AS-i) interfaces they speeded up maintenance when required. They detect short circuits to prevent system from going down. They locate faults quickly. In short, they simplify the troubleshooting process. All these save precious time and money for the users and ensure maximum uptime.

The connectors allow for fast and easy replacement of sensors, switches and control components. They provide mechanical safeguard against vibrations. In conjunction with the sensors the use with Bus-Bars (CAN-bus, PROFI-bus, INTRA-bus) circular connection with extruded insulation cable cuts costs and work, substantially during the system installation.

Connectors come with nickel plated couplers and provide IP67/IP68 protection. They are mechanically keyed for miss-mating. Connectors consist of male and female plugs, straight and 90° configuration with polyurethane body and PVC jacketed cables. Teflon body and cables can also be offered for special applications.

Connector and Cable Assemblies are designed for international standards. Some of the products are tested and certified by CE compliance and UL (American) and cUL (Canadian) listed by Underwriters’ Laboratory. The Cables used are UL approved and are characterized by very high mechanical and chemical stability. The connectors are factory moulded to the cable for durability. The cables can be made available with varied lengths of wire or different cable material depending on user’s exact application needs.

Connectors can be offered without cable also, connector and cable assemblies can be used with sensors in conveyors, automated machinery, material handling equipments, packaging machinery, textile machinery, plastic moulding machinery, printing machinery, pharmaceutical machinery etc. They ensure better handling of automation and improve efficiency of diagnostics.

On request special type connectors with union nuts of high quality nickel chrome plating for food applications and the chemical industry are available.
SENSORS FOR IMPORTED TEXTILE (Spinning and Weaving) MACHINERY

These Sensors for Imported Textile Machinery have been accepted by United States & European market against international competition. These Sensors are for Imported & Indigenous Textile Machines. Sensors Developed for Picanol, Sulzer, Schlafhorst, Crossrol, Cherry, Hawa, IRO, Murata, Vouk etc. and Machines such as Air jet Loom, Auto Coner 138, 238 / Auto Coro, Carding, Drawing Frame, Pre Winder, Rapier Loom etc.

Katlax is accreditation by ANAB, UK, Tested for Intrinsically Safety (Ex) & Weather proof Construction (IP-67) by CMRI (Now CIMFR) Dhanbad, Tested for IEC standards by ERTL (W) Mumbai, Registered with BIS, DGFASLI & CCOE (Now PESO), Nagpur. Certified for CE, UL Listed, Product certified for UL (USA) & cUL (Canada), CE (Complying with European Countries/Standards)

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