WORKING PRINCIPLES

Inductive sensors

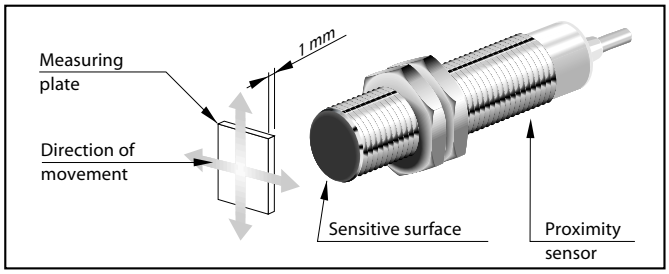
Voltage to the device creates an alternate inductive field through an oscillator coil before its active surface. If a metallic object (iron, alluminium, cooper, brass etc.) enters this field, it damps the oscillator and reverses the trigger threshold and causes a change in the output stage state.

Capacitive sensors

Capacitive sensors contain an oscillator by transistor in the frontal section.
The oscillating circuit R - C (Resistor - Capacitor) is influenced by variations in capacity, infact when any material, solid or liquid (water, wood, metal, caffee, ponders, etc) comes into contact with the active surface of the sensor the capacitance increases putting into action the oscillator up until the threshold of trigger inverts. By introducing a change in the condition of the final stage and therefore in the command of the external load a potentiometer makes fine adjustment to switching distance.

Nominal switching distance (Sn) According to EN 60947-5-2

It is the conventional distance at which the diffuse sensor switches when approching standard targets with axial movement. Such target (conform to the EN 500 10 regulation) shoud be of steel Fe37, square and 1mm thick. Targets should be the same as the sensor diameter.



Usable operating distance (Su) According to EN 60947-5-2

It is the assured operating distance during the specified voltage, functionning and temperature intervals it is included between 81% and 121% of the nominal switching distance Sn (0,81Sn ≤ Su ≤ 1,21Sn) for inductive sensors, and between 72% and 132% of the nominal switching distance (0,72Sn ≤ Su ≤ 1,32Sn) for capacitive sensors.

Assured operating distance (Sa) According to EN 60947-5-2

It is the distance at which the proximity sensor works safely in all the temperature and voltage intervals as specified for the same sensor. The assured operating distance is included between Ø and l'81% of Sn (Ø ≤ Sa ≤ 0,81Sn) for inductive sensors, and Ø and 72% of Sn (Ø ≤ Sa ≤ 0,72Sn) for capacitive sensors.

Reducing factors

When the element to be detected is different from Fe37, reduction factors are:

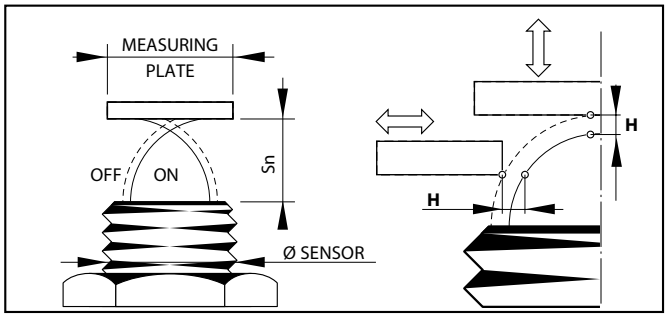
INDUCTIVE SENSORS	
Fe37	1 x Sn*
Stainless-steel	0,9 x Sn
Brass-Bronze	0,5 x Sn
Alluminium	0,4 x Sn
Copper	0,4 x Sn

CAPACITIVE SENSORS	
Metal	1 x Sn*
Water	1 x Sn
P.V.C.	0,5 x Sn
Glass	0,5 x Sn
Wood	0,4 x Sn

*Sn = Nominal switching distance

Hysteresis (H)

It is the distance between the point of switching on and the point of switching off of the trigger object. The value is a percentage of the nominal switching distance Sn.

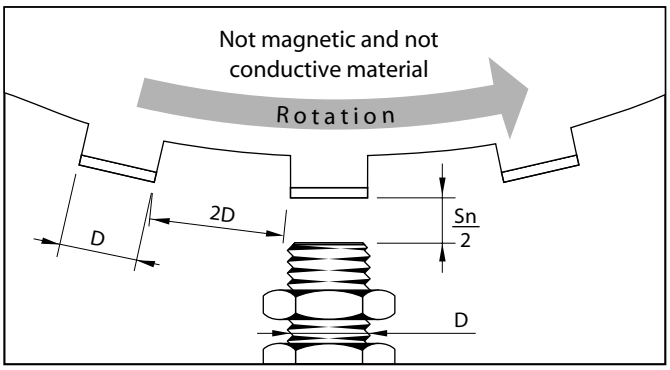


Repeatability (R) According to EN 60947-5-2

It is the precision by which the sensor switching commutation distance is repeated at the maximum supply voltage, at the temperature of 23 °C ± 5 °C with a load current = 100 mA, during a 8 hours period.
The value expresses the percentage of the difference between the maximum and the minimum measure related to the average value of the switching distance Sn.

Switching frequency

It is the maximum possible number of impulse repetition per second. This value is obtained by measurement with a cogged wheel in which cogs are of triggering material. The cogs are as large as the diameter of the sensor and the distance between two cogs is twice the diameter (according to the EN 60947-5-2).



ELECTRICAL PARAMETERS

RATED VOLTAGE
It indicates the power supply where the sensor works perfectly.

RESIDUAL RIPPLE
Maximum ripple allowed on supply DC voltage. It is shown in percentage referring to the medium value.

MAXIMUM OUTPUT CURRENT
The maximum output current of the sensor in continuous operation.

MINIMUM OUTPUT CURRENT
Minimum output current through the sensor to maintain normal operation.

MAXIMUM PEAK CURRENT
The maximum current the sensor can sustain in a limited period of time.

ABSORPTION
Current consumption of the sensor referred to the maximum value of the nominal voltage and without load.

VOLTAGE DROP
Voltage drop measured on switching circuit when output transistor is activated.

SHORT CIRCUIT PROTECTION
It takes place in presence of short circuit or overload to avoid any damage to inner circuits. When the short circuit is removed, the sensor is automatically reactivated.

PROTECTION AGAINST REVERSAL OF POLARITY
All the sensor with DC supply are protected against reversal of polarity, this prevents the internal components from being damaged by incorrect power supply connection.

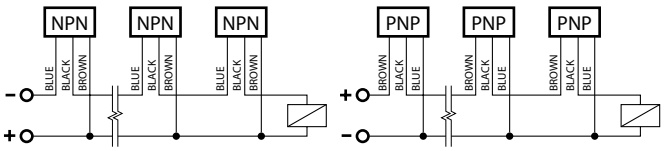
PROTECTION AGAINST INDUCTIVE LOADS
It protects sensor output in presence of high inductive loads. This protection is performed by a diode or zenner diod. If possible keep the power conductors separate.

PROTECTION DEGREE
The degree of protection of the housing and conform to the IEC 529 regulation.

START UP DELAY
Time interval between sensor supply connection and active output.

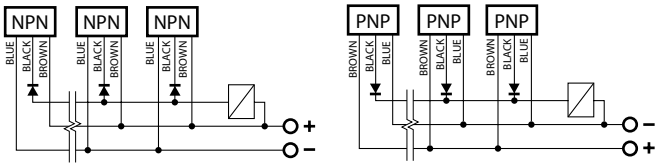
SERIES AND PARALLEL CONNECTIONS FOR NPN O PNP SENSORS

With this kind of connection take into account as follow:
1) voltage drop (C.D.T.) for each sensor (<1,8 V);
2) maximum load current of sensors reffering to self consumption of each sensor (< 10 mA) at output load.



Connection in parallel (OR)

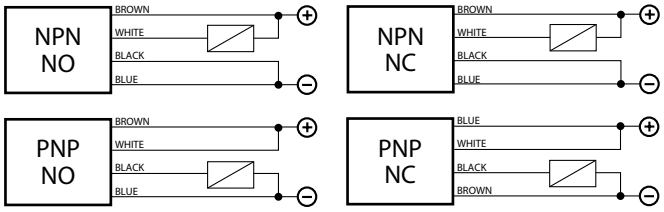
When omitting the diodes shown in the chart, use sensors with output stage, open collector type.



AMPLIFIED SENSORS 10-30 VDC 4 WIRES PROGRAMMABLE OUTPUT

Thanks to the output separated from the rest of circuit, sensors so connected provide important advantages, such as the possibility of 4 output configurations (NPN-NO, NPN-NC, PNP-NO, PNP-NC) on the same model and the possibility of connection in series.

OUTPUT DIAGRAM



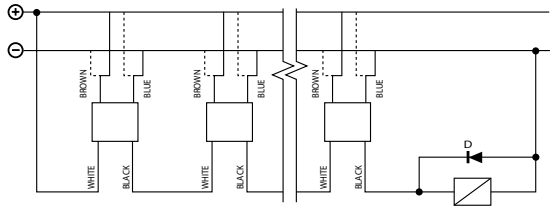
Connection in series (AND)

Connected in this way sensors activate only output when they are energized simultaneously. The maximum number of connectable sensors in connections of this type is given by the following formula:

n = (V supply - V load) / V residual

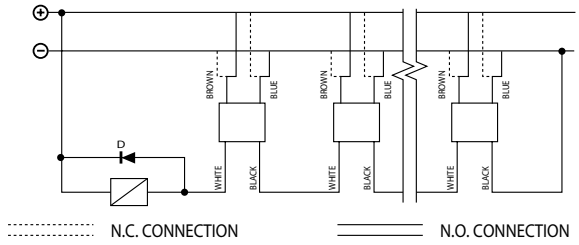
where: • V supply = voltage • V load = voltage for min. load energized
• V residual = residual voltage in the commutative circuit in ON state.

PNP CONFIGURATION



NOTE: In presence of inductive loads, when more sensors are connected in series, diode D should be connected in antiparallel to the load.

NPN CONFIGURATION

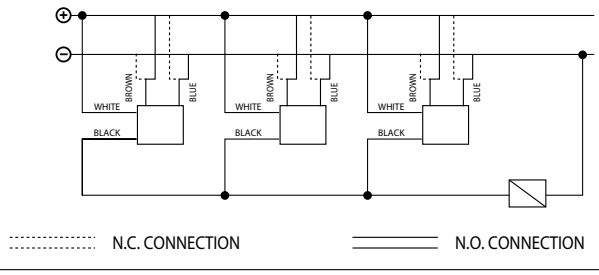


NOTE: In presence of inductive loads, when more sensors are connected in series, diode D should be connected in antiparallel to the load.

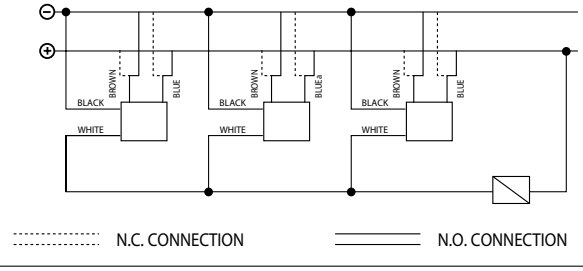
Connection in parallel (OR)

When connected in this way sensors can activate the common output independently, when energized. Thank to the real low leaking current, there is no actual limitation in the number of sensor that can be connected in parallel, providing that the min. current of load energized is mA.

PNP CONFIGURATION



NPN CONFIGURATION



SERIES AND PARALLEL CONNECTIONS FOR AC SENSORS

Alternate current sensors can be connected in parallel, but voltage drop (<6 V) at the sensor end must be taken into account.
When connecting in parallel, and current (without load) (<4 mA) of all sensors. Be careful at the minimum load (high load impedence).
These connections are not advisable as they may cause anomalities.

NOTICE FOR 24 VAC SUPPLY

In sensor with 24VAC supply it is important to pay attention to the voltage drop (<6 V) at the ends of the sensor and a possible drop in the connection cables between sensor and load.
In order to have a proper voltage on the load, it is advisable to encrease supply voltage by at least 6V.

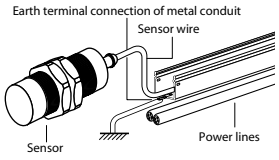
GENERAL SPECIFICATIONS

INSTRUCTIONS FOR CORRECT INSTALLATION

THESE SENSORS ARE NOT MADE FOR SAFETY APPLICATIONS AND FOR SAFETY DEVICES. THEREFORE THEY CANNOT BE USED TO PREVENT INJURIES TO PERSONS, DAMAGES, INDUSTRIAL DAMAGES, ACCIDENT.

Connections

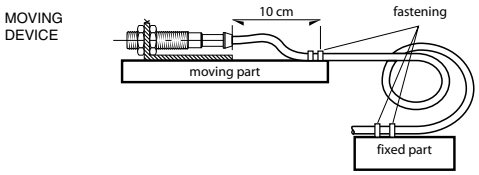
1) Do not exceed the voltage limits printed on the product label. For DC sensors, use stable tension.
2) Do not connect the sensors power supply cables down-stream from other devices and make sure they are directly connected to the mains.
3) If the power supply source is a switching voltage regulator, connect the FG (Frame Ground) terminal to the ground.
4) Connect to the ground the FG (Frame Ground) terminal and all metallic parts of every industrial machinery or not if a sensor is used in it.
5) Do not use the sensors near electromagnetic or high frequency fields.
6) The cables of sensors must be separate from the power supply cables, from the engines cables, from the inverters cables, or from any other electromagnetic device because induction noise could cause malfunction or damage to the inductive sensors. Separate the wires of the sensor from the above indicated lines and then insert the wires into an earthed metal conduit.



7) After making all operations men-tioned in the above point 6, if inductive interference exists, an adequate transient suppression filter must be used on the power supply line in proximity to the sensor.
8) When a large distance by the connection wires to the sensor has to be covered, use conductors with a cross-section of at least 0.50 mm^2 and do not exceed the maximum distance of 100 m.
9) The output signal of a sensor cannot be used during the start up delay (not more than 300 mS).
10) Several sensors should not be connected in series, whereas several sensors can be connected in parallel.

Assembly

1) For correct assembly and alignment, all the accessories supplied with the sensor must be used.
2) To regulate the sensitivity adjustment trimmer use a suitable screw-driver without exerting excessive force.
3) Do not turn too much fixing screws or nuts to avoid electrical or mechanical damages.
4) Mounting sensors side by side, leave an appropriate place between them to avoid mutual interference.
5) Do not pull the connection cable of the sensor. When the conditions of use result to be too hard (in places not protected from shocks or subjected to movements) use a protective sheath.

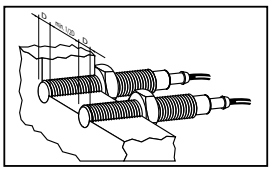


6) Avoid continuous movements between the sensor and its cable and follow the instructions given in the drawing.
7) Protect the sensitive surface of the sensor from shocks, mechanical pressures to avoid irreparable damages.
8) Install the sensor being careful that metallic (or of any other material) shavings shall not settle on the sensitive part of the sensor.
9) Do not use the sensors in presence of organic or liquid solvents or of any kind of acid.
10) Do not use the sensors outdoors without an adequate protection.
11) Do not exceed the indicated temperature limits.
12) Do not subject the appliance to strong vibrations or to shocks which can damage the sensor or can harm its impermeability.
13) Although some ranges of INFRA proximity sensors are protected to IP67, this does not mean that our devices can be used to detect objects in water or in the rain.

Further information

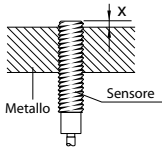
The manufacturer is not liable for the improper use of the product.
Any use and/or application which are not provided for by the instruction manuals must be previously and directly authorized by the same manufacturer.

Shielded types



These sensors are not effected by the surrounding metal and therefore the unit can be embedded in it. In order to avoid reciprocal interfe-rance when more sensors are installed side by side, the minimum distance between two sensors must be D/2 (D = sensor diameter).

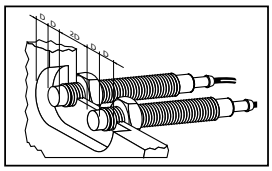
Increased range shielded types



For assembly in contact with the metal surface, observe the following values:

Ø	6,5	8	12	18	30
(mm) X	≥1	≥1	≥ 2	≥ 3,5	≥ 5

Not shielded types



As these sensors are effected by metal, the area close to the active surface should be free. This area can be of air, non-magnetic or non-conductive material. When sensors are installed side by side, the distance between two sensors should be 2D (D = sensor diameter).

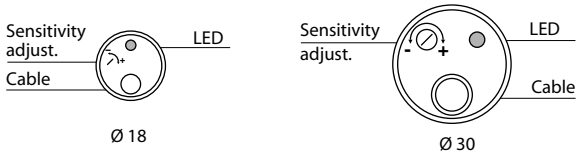
Torque setting for fastening nuts

Avoid over-tightening the fastening nuts in order not to damage the housing and to avoid breaking the internal circuit as a result.
Take particular care with the models which have a diameter less than 12 mm.

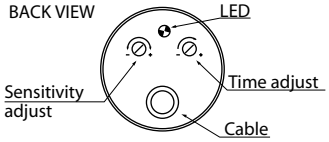
SENSITIVITY ADJUSTMENT FOR CAPACITIVE SENSORS

Sensitivity adjustment should be carried out when the sensor is installed in a definitive and stable position. Adjustment should be fixed in an intermediate position between minimum and maximum because, since air is a dielectric, a strong variation in humidity could cause inappropriate energising of the sensor (if adjustment is very fine).
The intervention range of the sensor depends on the type of material to be detected and its dimensions (see reduction factor table).
The distance can vary depending on the temperature variation by about ± 10% in a range of -20 to +70°C.
To increase sensitivity, turn the trimmer clockwise, to decrease sensitivity, turn it anti-clockwise.
To gain access to the trimmer, remove the plastic protection screw located at the back of the sensor.

Capacitive sensors



Capacitive sensors with ON/OFF time delay



To carry out the sensitivity adjustment of these models, first reset the timer trimmer.

Information

Although some ranges of INFRA photoelectric sensors are protected to IP67, this does not mean that our devices can be used to detect objects in water or in the rain.

POWER SUPPLY FOR SENSORS IN DC CURRENT

A stabilised source of voltage can be obtained using the table indicated beside.
Use the following ways to dimension the components:

$$VAC = (V\ RMS\ \text{transformer}) = \frac{(V\ OUT + 4.5) \times 1.1}{1.41}$$

$$C1 = \frac{(0.0053) \times I\ OUT}{2}\ \text{(value indicated in } \mu F\text{)}$$

$$VL1 = VAC \times 1.41 \times 1.2$$

If "ℓ" is bigger than 10 cm, add C4 beside the stabiliser
C4 = 100 µF ; VL4 = VAC x 1.41 x 1.2
C2 = 220 µF ; VL2 = VOUT x 1.2
C3 = 0,1 µF ; VL3 = 63 V
Note: the regulator must provide adequate power dissipation as:

$$P\ DISS. = \frac{(VAC \times 1.41) - VOUT}{I\ OUT\ max}$$

Where IOUT max. is the maximum available (supplied) current