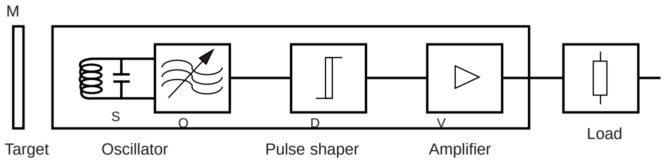
Operating principles

Figure 1 illustrates the principle of an Inductive Proximity Detector (I.P.D.)



The I.P.D. signals the presence of a metal object "M" close to its sensing face.
It contains a high-frequency oscillator "O" whose oscillating circuit coil "S", located in a magnetic ferrite open on one side, forms the sensing face. An alternating magnetic field is created in front of this. On entering this field, any metal part "M" causes eddy currents, thus reducing the amplitude of oscillation. This reduced amplitude is converted by the pulse shaper "D" into an output signal amplified by "V".

Operating characteristics:

Sensing distance S: Distance at which the target determines a change in the status of the output signal, as it approaches the sensing face.

Nominal sensing distance Sn: Conventional value used to describe the device. Does not take account of dispersion (due to manufacturing, temperature, voltage).

Actual sensing distance Sr: Actual value measured from constant parameters (temperature, voltage, installation conditions etc), which must be between 90 and 110 % of the nominal sensing distance Sn.

0.9 Sn < Sr < 1.1 Sn

Usable sensing distance Su: Value measured within the specified limits of the temperature and voltage zones, which must be between 81% and 121% of the nominal sensing distance Sn.

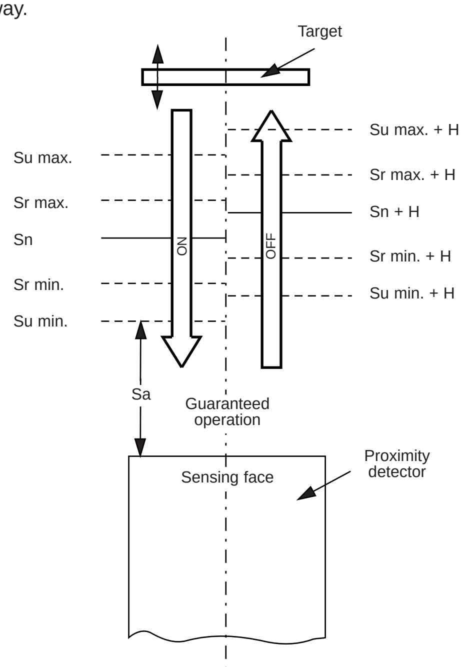
0.81 Sn < Su < 1.21 Sn

Operating sensing distance Sa: Distance within which the detector will operate correctly in specified conditions.

0 < Sa < 0.81 Sn

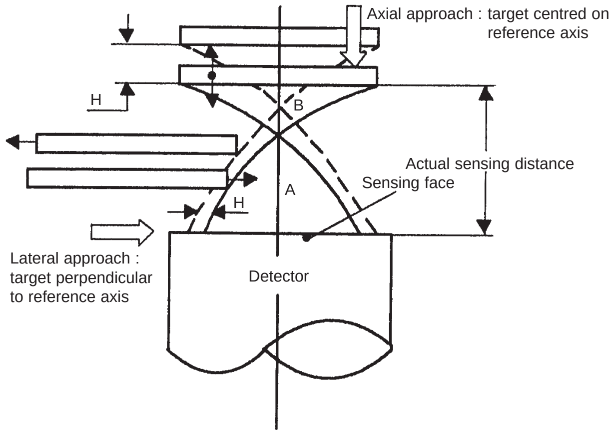
Repeatability R: Value of variation in the actual sensing distance Sr in specified conditions (time, temperature, voltage).

Differential travel H: Distance between the pick-up point when the target approaches the detector and the drop-out point when the target moves away.



Method of measuring sensing distances: according to standard EN 50010.

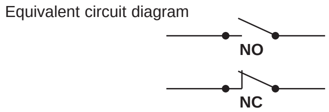
Lateral approach and axial approach:



Electrical characteristics:

Normally open function (NO): Corresponds to a detector whose output allows the current to pass through when the target is detected.

Normally closed function (NC): Corresponds to a detector whose output blocks the current when the target is detected.



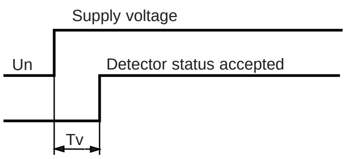
Voltage drop Ud: Voltage measured across the active output of the detector in closed state under its nominal operating current (load current Ia).

Load current Ia: Maximum current with which the detector permanently operates correctly.

Leakage current Ir: Current which continues to circulate in the load and in the output circuit when the detector is in the open state.

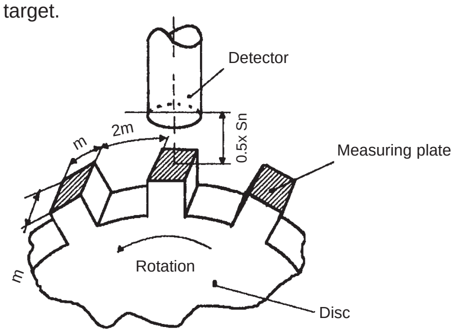
Minimum operating current Im: Current necessary to maintain conduction of the switching element.

Time delay before availability Tv: Time necessary for the sensor output signal to operate when powering up.



Switching frequency F: Number of operating cycles carried out during a specified time. It is measured according to the method shown below (Standard EN 50010 NFC 63075).

m : width of the target.

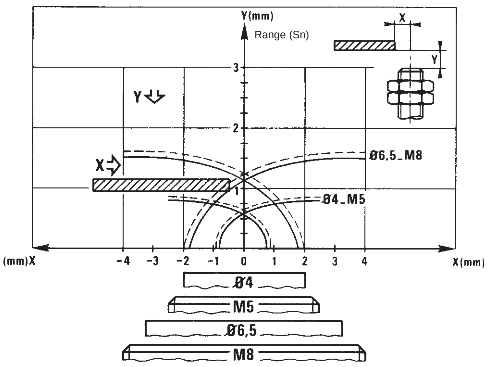


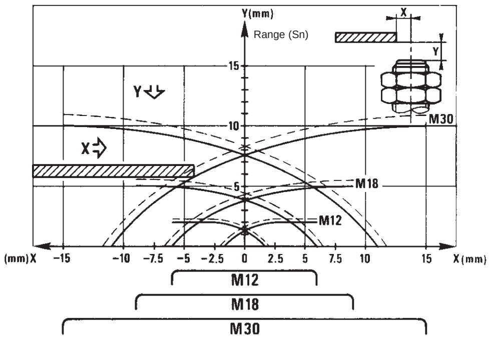
Operating voltage Un: Voltage range within which the detector maintains its specified characteristics.

Ripple voltage: Ratio between the amplitude of an alternating voltage (peak to peak) and the direct voltage on which it is superimposed.

Detection characteristic curves - cylindrical CENELEC types

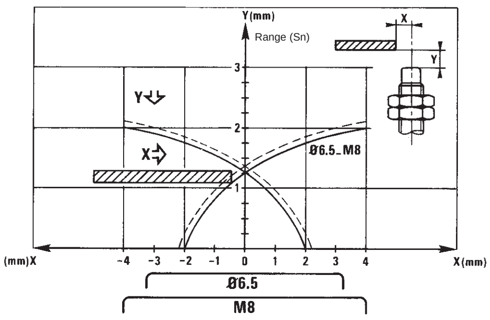
Screened versions

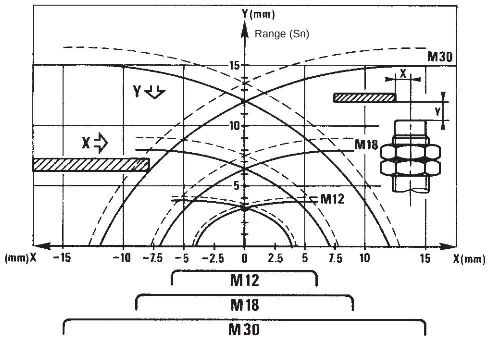




– Approach detection curve
- - Withdrawal detection curve (side detection)
Sn Nominal sensing distance

Non-screened versions





– Approach detection curve
- - Withdrawal detection curve (side detection)
Sn Nominal sensing distance

SCREENED IPD

Ø mm	Dimensions (mm) of sensed plate of A37 steel	Nominal sensing distance Sn (mm)
Ø4	5 x 5 x 1	0............0.8
M5	5 x 5 x 1	0............0.8
Ø6.5	8 x 8 x 1	0............1.5
M8	8 x 8 x 1	0............1.5
M8 ext	8 x 8 x 1	0............3
M12	12 x 12 x 1	0............2
M12 ext	12 x 12 x 1	0............6
M18	18 x 18 x 1	0............5
M18 ext	18 x 18 x 1	0............12
M30	30 x 30 x 1	0............10

NON-SCREENED IPD

Ø mm	Dimensions (mm) of sensed plate of A37 steel	Nominal sensing distance Sn (mm)
Ø6.5	8 x 8 x 1	0............2.5
M8	8 x 8 x 1	0............2.5
M12	12 x 12 x 1	0............4
M18	18 x 18 x 1	0............8
M30	30 x 30 x 1	0............15

Notes

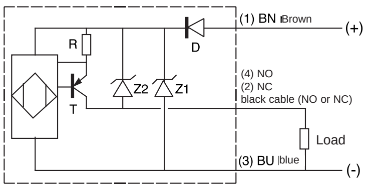
When materials other than steel are detected, the following correction factors must be applied :

Material	Correction factor
A37 mild steel	1
316 stainless steel	0.85
Brass	0.40
Aluminium	0.35
Copper	0.30

Electrical connection

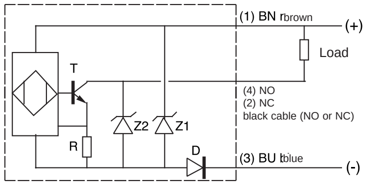
3-wire DC

PNP version



PNP output: load connected to negative supply

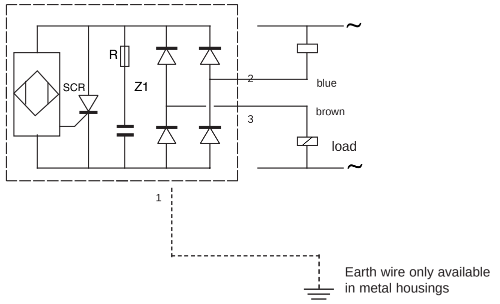
NPN version



NPN output: load connected to positive supply

2-wire AC

Polarity reversible

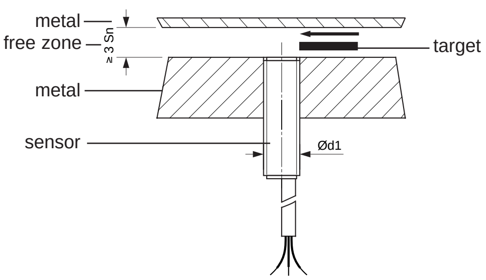


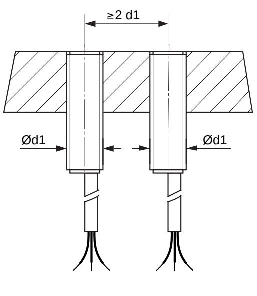
Installation

"Screened" sensors can be inset in surrounding metal rising flush with the sensing face. With **"non-screened"** versions, check that there is no metal in the immediate vicinity of the sensing face.
European standards define the minimum distance which must be allowed between two sensors and/or between sensors and surrounding metal articles so that the sensors will not be affected.

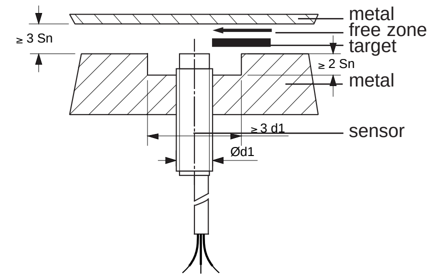
The figures given below (which are in line with European standards) are for mounting in mild steel (A 37) with non-restrictive operating conditions. Where there are multiple constraints (deposits, temperature, etc) additional correcting factors will need to be applied.

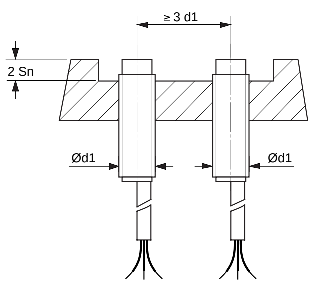
Screened





Non-screened





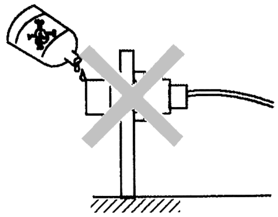
The sensing face of the sensor must not be positioned below the surface of the metal.

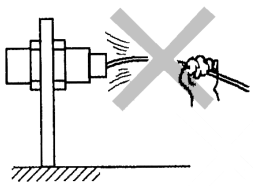
Sn: Nominal sensing distance
d1: diameter of IPD

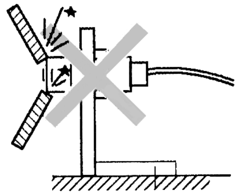
Where two sensors are installed facing one another, a gap of 10 x Sn must be left between the two sensing faces.

Mechanical installation advice

Protection:



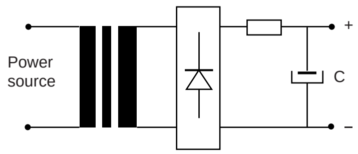




- Protect the cable against sharp objects or excessive heat.
- Do not exert a pulling force of more than 5 kg on the cable.
- The detectors are unable to withstand severe mechanical impact. The bracket must be sufficiently rigid to resist shock and vibration.
- Avoid using the detectors in a corrosive environment such as near strong acids, etc. (e.g. Nitric Acid).
- When a plastic detector is used in a chemical environment it is advisable to first verify the plastic's resistance to the chemical.

Electrical installation advice

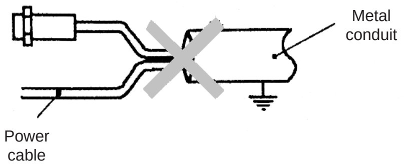
Power supply:



- Opposite is an example of a DC power supply for detectors using smoothing. To ensure that the resulting voltage is less than the maximum operating voltage of the detector, use a capacitor "C" to remove spikes and ripples greater than ± 10 %.
Ideally, use a transformer with a secondary voltage less than your required voltage.

  Eg. 17.5 VAC from the secondary of the transformer to obtain less than 24 VDC.

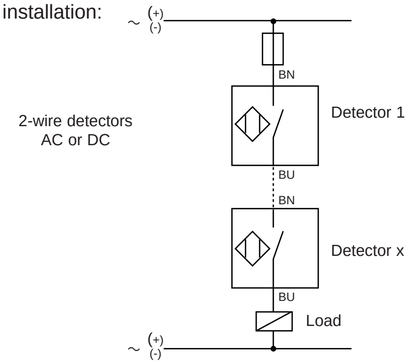
Connection:



- Limit the length of the cables to 100 m and the capacitance of the line to 0.1 µF. Also separate detector cables and power cables as far as possible.

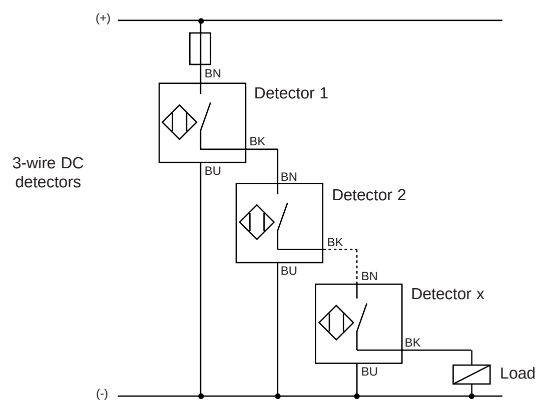
Connecting more than one sensor:

Series installation:



- It is possible to connect detectors in series:
  - Ensure that the voltage at the terminals of each sensor is less than or equal to the minimum operating voltage (in off-state).
  - In on-state, check that there is sufficient voltage available to activate the load.

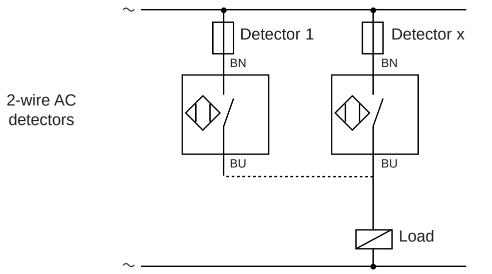
  This connection method is not possible if multivoltage sensors are used.



- With this connection method, add the voltage drop of each detector together and deduct from the supply voltage to ensure there is sufficient voltage to activate the load.

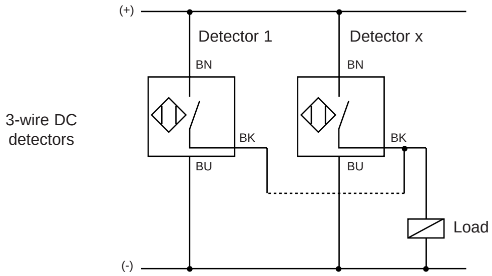
  Note: detector 1 carries all the current for the additional detectors.

Parallel installation:



- With this type of installation the sum of the off-state leakage currents must be less than the current needed to drive the load.

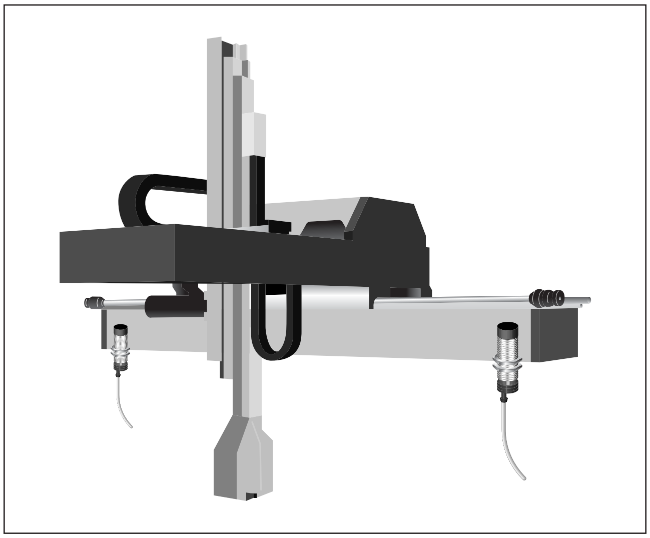
  Note: this installation should only be used with detectors which are activated one at a time.



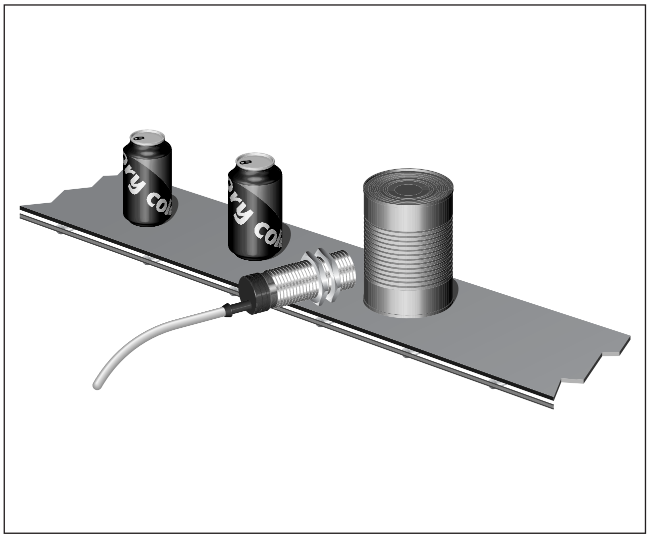
- It is possible to connect 3-wire detectors in this configuration without any problems.

Examples of applications

- **Part positioning**

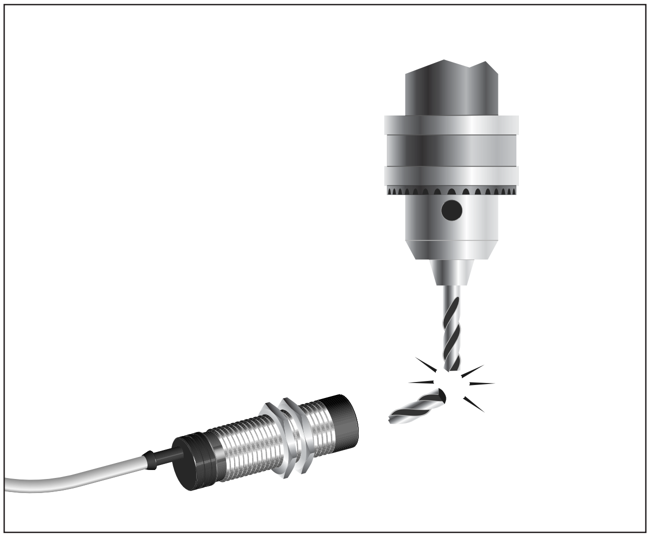


- **Parts recognition - Metal detection**

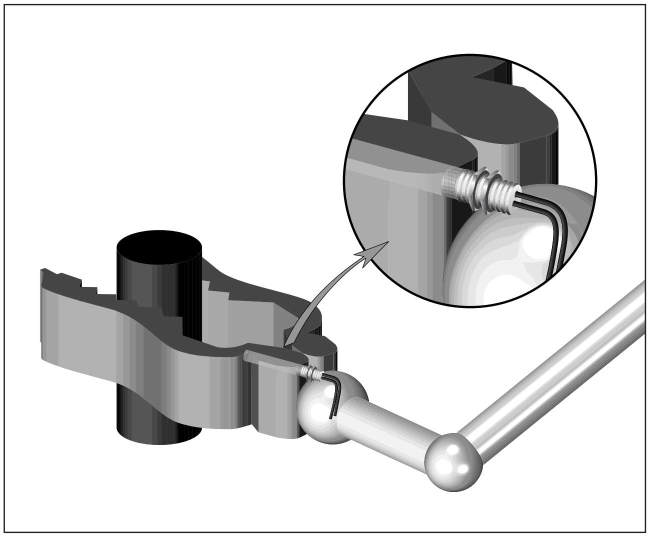


Examples of applications

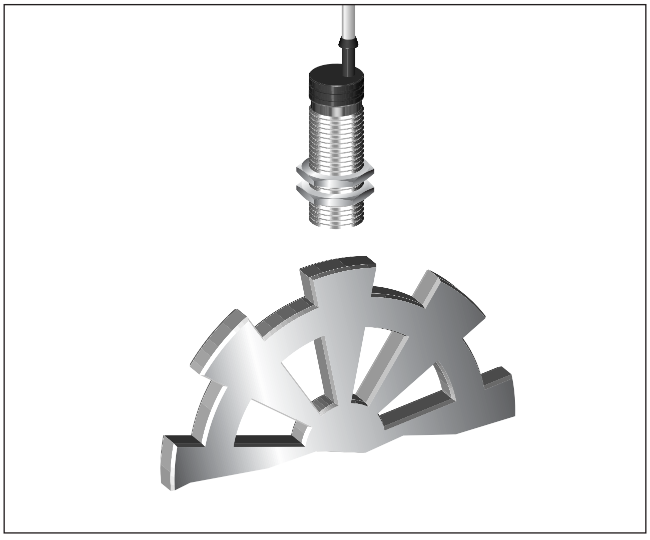
■ **Detection of broken drill**



■ **Control of robot grip**



■ **Rotation control**



■ **Screw detection**