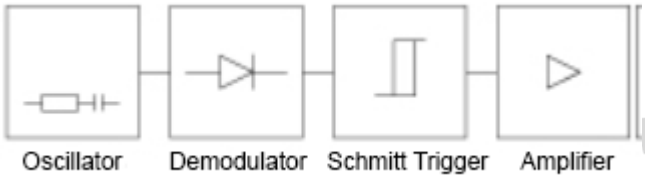
Inductive sensors

Inductive sensors are non-contact sensors that respond only to metals. They can directly send signals to relays, solenoid valves, measuring systems, and electronic control circuits such as PLCs.

Operating Principle and Structure of Inductive Sensors:

The structure of these sensors consists of four main stages.



The core of these sensors consists of a high-frequency oscillator that can be influenced by metallic objects. This oscillator generates an electromagnetic field in the sensor's sensing area. When a metal object approaches, eddy currents are induced in the object, which absorb energy from the field, resulting in a reduction in the oscillator's amplitude.

Since the demodulator stage detects the oscillator's amplitude, the reduction in amplitude is transmitted to the Schmitt Trigger stage, which in turn activates the output stage.

Standard object:

It is a square-shaped piece of ST37 steel used for testing the switching distance.
(according to IEC 947-5-2 standard)
The thickness of the piece is 1 mm, and the side length of this square can be in the following sizes.
- Equal to the diameter of the sensor
- Three times the nominal switching distance of the sensor (3Sn)

Correction Factors:

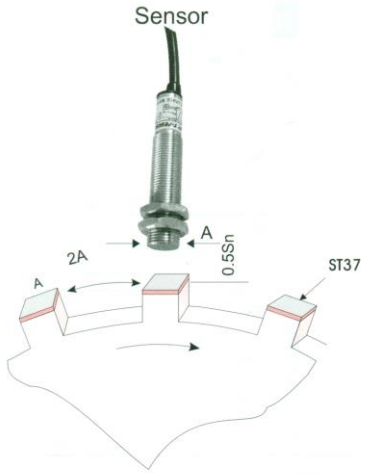
The switching distance will change with smaller dimensions of the standard piece or when using a metal other than ST37 steel.
The table below shows the correction factors for different metals.

Metal type	Correction Factors
ST37 Steel	1.0
Nickel	0.9
Brass	0.5
Copper	0.45
Aluminum	0.4

For example, if a sensor performs the switching operation at a distance of 10 mm in front of steel, the same sensor will perform the switching operation at a distance of 4.5 mm in front of copper.

Switching Frequency:

The maximum number of on/off cycles a sensor can perform in one second. (This unit is expressed in Hertz, Hz)
This parameter is measured according to the DIN EN 50010 standard under the following conditions.



Switching Distance (S):

The distance between the standard target and the sensor's sensitive surface during the switching operation. (EN 50010 Standard)

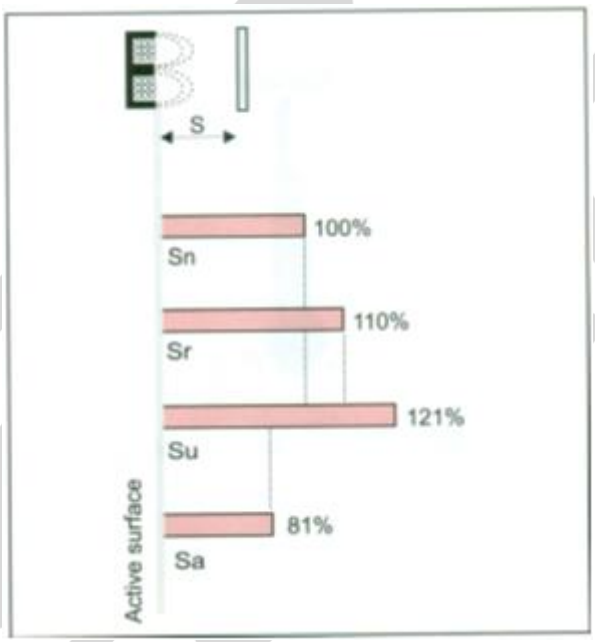
Switching Distance (S):
The distance between the standard target and the sensor's sensitive surface during the switching operation. (EN 50010 Standard)

Nominal Switching Distance (Sn):
The distance defined under conventional conditions, without considering variable parameters such as temperature, supply voltage, etc.

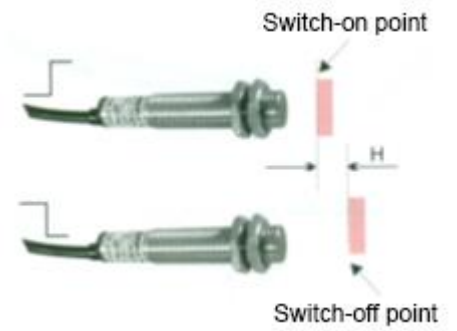
Effective Switching Distance (Sr):
The switching distance under nominal voltage and a temperature of 20°C. In this case, tolerances and variable parameters are taken into account.
0.9Sn < Sr < 1.1Sn

Useful Switching Distance (Su):
The distance at which the switching operation occurs within the permissible temperature and voltage range.
0.81Sn < Su < 1.21Sn

Operational Switching Distance (Sa):
The distance at which the sensor's performance is guaranteed under permissible conditions.
0 < Sa < 0.81Sn



Hysteresis (H):
The distance between the switch-on point (when the target approaches the sensor) and the switch-off point (when the target moves away from the sensor). The maximum value is 10% of the nominal switching distance. (EN 60947-5-2 Standard)



or more inductive sensors are installed close to or opposite each other, the following conditions

Repeatability (R):
The ability to repeat the useful switching distance under a supply voltage (V) and measured under the following conditions:
- Ambient temperature: 23 ± 5°C
- Ambient humidity: 50 to 70%
- Test duration: 8 hours
(The tolerance for this parameter, according to EN 60947-5-2 Standard, is a maximum of ±0.1Sr)

Thermal Stability:
The variation in the effective switching distance due to temperature changes, according to EN 60947-5-2 Standard, is a maximum of 10% within the temperature range of -20°C to +60°C.
ΔSr/Sr ≤ 10%
Ambient Temperature (Ta):
The temperature range within which the sensor's performance is guaranteed.

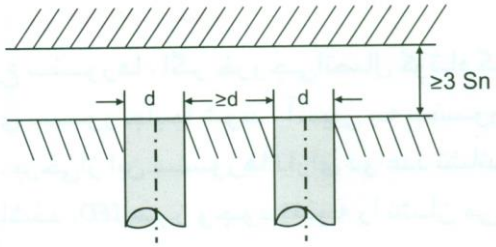
Protection Class:
The inductive sensors manufactured by this company are produced with a protection class of IP67 (DIN 50050).

Installation of Inductive Sensors:
When two must be observed.

Central office : No 36 , karimkhan ave. , darvazeh tehran , tabriz , iran ; zip code : 5157913399 ; P.O. box : 51575-5140
Email : info@tabrizpeguh.com ; Website : www.tabrizpeguh.com ; Tel : +984133330490 ; Fax : +984133318200

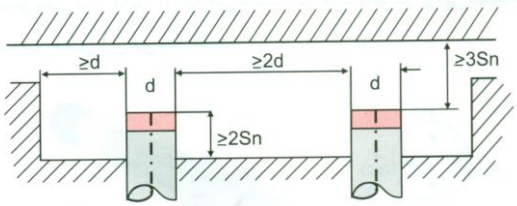
A) Installation of FLUSH Inductive Sensors:

FLUSH (Shielded) sensors are those where the sensitive part of the sensor is enclosed by a metal housing. When two or more of these sensors are installed flush on the metal surface of a device, the installation distances shown in the figure below must be observed.



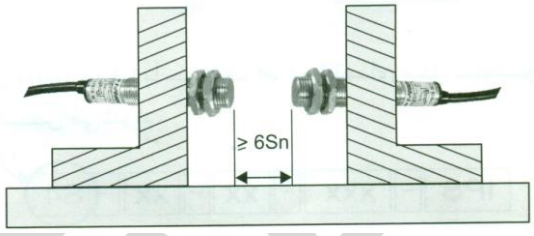
B) Installation of Non-FLUSH Inductive Sensors:

In Non-FLUSH (Unshielded) sensors, the sensitive part of the sensor is outside the metal housing. The switching distance of these sensors is greater than that of FLUSH sensors, but their switching frequency is comparatively lower. The installation distances shown in the figure below must be observed.



C) Installation of Inductive Sensors Opposite Each Other:

When two inductive sensors are installed opposite each other, a minimum distance of 6Sn must be maintained.

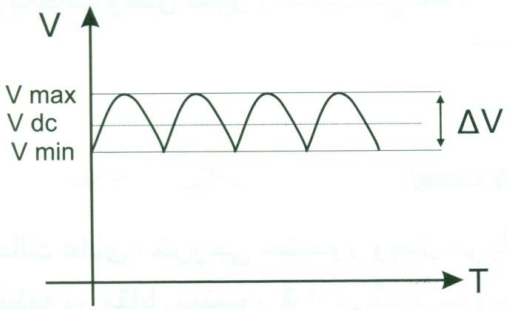


Supply Voltage (V supply):

The maximum and minimum voltage range within which the sensor operates reliably.

Ripple (ΔV):

The alternating component of the rectified output voltage signal from the power supply, with a maximum value of 10% of the supply voltage.



Reminder:

In cases where there is a possibility of interference, rectifiers equipped with voltage stabilization regulators and filters can be used.

Leakage Current:

The current that flows through two-wire sensors in the off state.

No-Load Current:

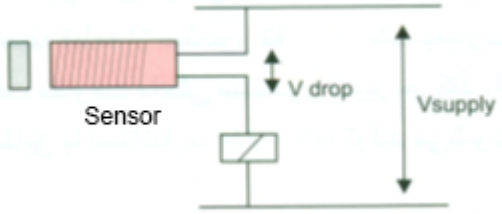
The current that flows through the sensor when its power supply wires are connected to the power source.

Maximum Load Current:

The maximum continuous current that can pass through the sensor's output.

Voltage Drop:

The maximum voltage across the sensor's output stage in the switched-on state, with the permissible current flowing through it.



Output Indication:

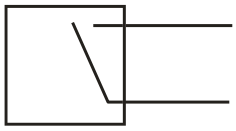
The output performance of most sensors is indicated by an LED light.

Sensor Output Functions:

Sensors are categorized into several types based on their output characteristics:

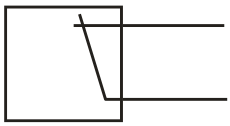
Normally Open:

In the normal state, the sensor output is off, and when an object is placed in front of the sensor, the output switches from off to on.



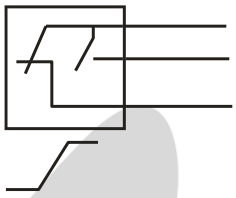
Normally Closed:

In the normal state, the sensor output is on, and when an object is placed in front of the sensor, the output switches from on to off.



Complementary:

These sensors have both normally open and normally closed outputs.



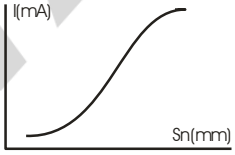
Analog Sensor:

In these sensors, the output is a continuous voltage or current that depends on the distance of the object from the sensor. In other words, the internal resistance of the sensor changes. These sensors are manufactured in accordance with the DIN 19234 standard.

Namur Inductive Sensors:

(DIN 19234 Standard)

These are two-wire sensors whose internal resistance changes based on the distance of the object from the sensor. Typically, these sensors are connected to the power supply through a 1KΩ resistor.



Sensor Protection:

TabrizPeguh sensors are produced with standard outputs. However, in some cases, sensors with protected outputs are also manufactured.

A) Standard Output:

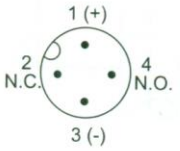
All TabrizPeguh sensors are protected against reverse polarity of the power supply and over voltages caused by the disconnection of inductive loads. However, there is a risk of sensor damage if the output and power supply wires are incorrectly connected.

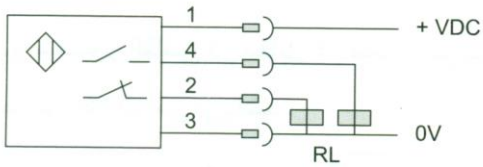
B) Protected Output:

In these sensors, no damage occurs if the output is short-circuited or if the sensor wires are swapped.

Connector-Type Sensors:

Some TabrizPeguh sensors are available with connector tails. Please refer to an example of such a sensor and its wiring.



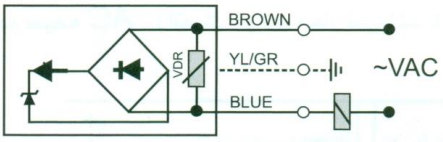


These sensors are identified by the letters "S4" at the end of the sensor model.

Types of Inductive Sensors:

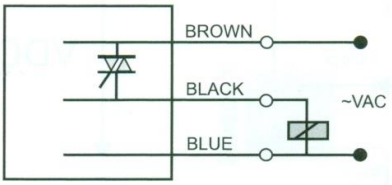
Inductive sensors are classified into the following types based on the number of wires, supply voltage, and output type.

Two-Wire AC:
- Load Connection: Series
- Load Type: Contactor, relay, etc.
- Normally Open Sensor Code: IPS-2… -OA-…
- Normally Closed Sensor Code: IPS-2… -CA-…

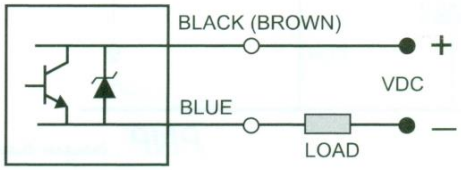


Note: Some AC sensors have three wires, with the third wire connected to the sensor body and must be connected to the system ground (Earth).*

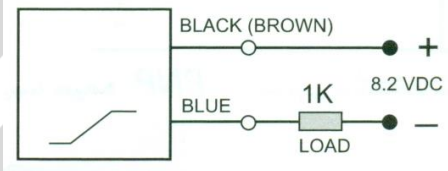
Three-Wire AC:
- Load Type: Contactor, relay, etc.
- Normally Open Sensor Code: IPS-3… -OA-…
- Normally Closed Sensor Code: IPS-3… -CA-…



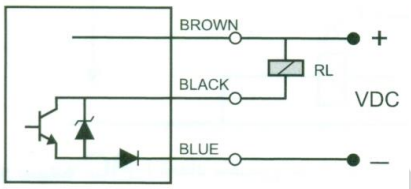
Two-Wire DC:
- Load Type: Contactor, relay, etc.
- Normally Open Sensor Code: IPS-3… -OD-…
- Normally Closed Sensor Code: IPS-3… -CD-…



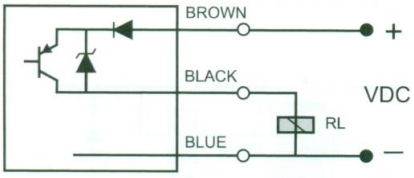
Two-Wire Namur:
- Power Supply: 8.2VDC
- Load Connection: Series
- Load Type: 1KΩ resistor, electronic card, etc.
- Sensor Code: IPS-2… -Nm-…



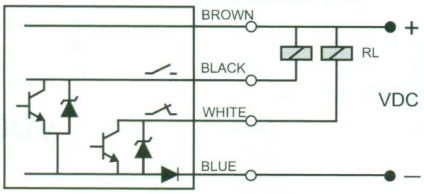
Three-Wire NPN:
- Power Supply: DC voltage (10-60V or 10-30V)
- Load Type: Relay, electronic card, PLC input, etc.
- Normally Open Sensor Code: IPS-3… -ON-…
- Normally Closed Sensor Code: IPS-3… -CN-…



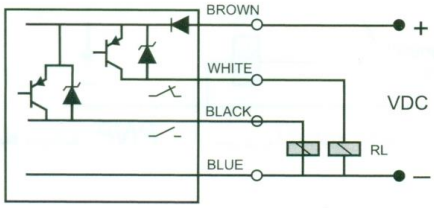
Three-Wire PNP:
- Power Supply: DC voltage (10-60V or 10-30V)
- Load Type: Relay, electronic card, PLC input, etc.
- Normally Open Sensor Code: IPS-3… -OP-…
- Normally Closed Sensor Code: IPS-3… -CP-…



Four-Wire NPN:
- Power Supply: DC voltage (10-60V or 10-30V)
- Load Type: Relay, electronic card, PLC input, etc.
- Normally Open Sensor Code: IPS-4… -N-…

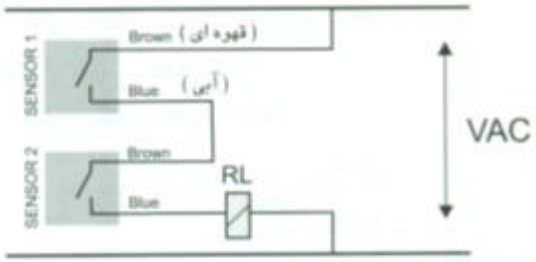


Four-Wire PNP:
- Power Supply: DC voltage (10-60V or 10-30V)
- Load Type: Relay, electronic card, PLC input, etc.
- Normally Open Sensor Code: IPS-4… -P-…



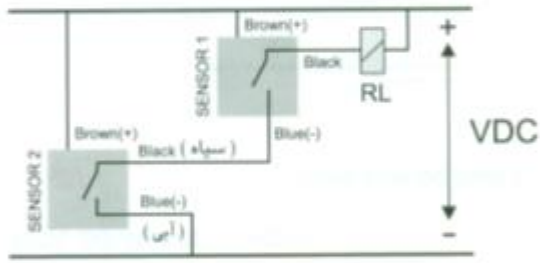
Central office : No 36 , karimkhan ave. , darvazeh tehran , tabriz , iran ; zip code : 5157913399 ; P.O. box : 51575-5140
Email : info@tabrizpeguh.com ; Website : www.tabrizpeguh.com ; Tel : +984133330490 ; Fax : +984133318200

Series Connection of Inductive Sensors:

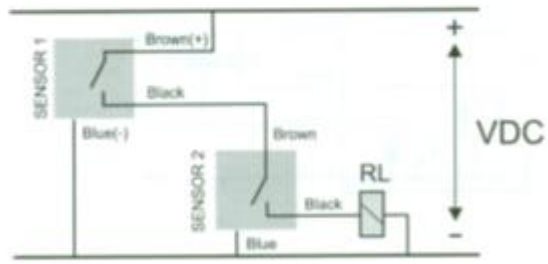


2 Wire AC sensor (max 2 sensors)

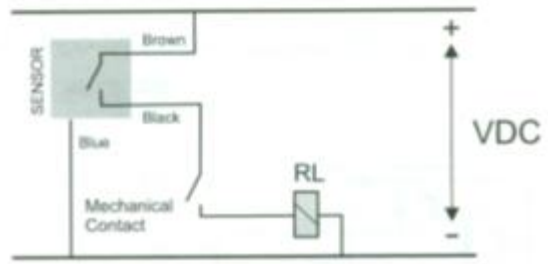
2 Wire DC sensor (not allowed)



3 Wire NPN sensor



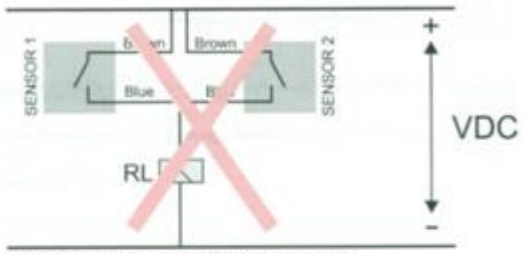
3 Wire PNP sensor



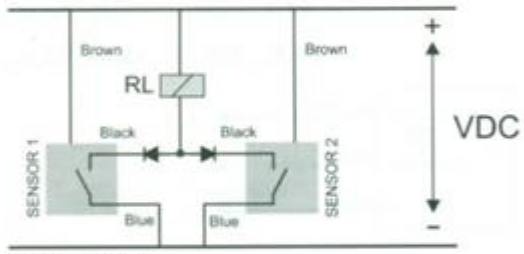
3 Wire PNP sensor with mechanical contact

Parallel Connection of Inductive Sensors:

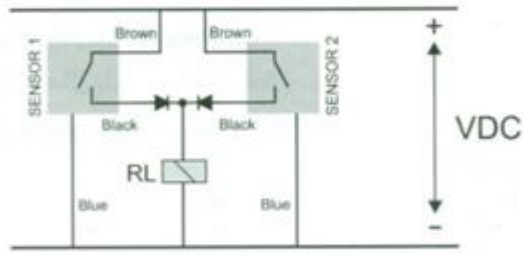
2 Wire AC sensor (not allowed)



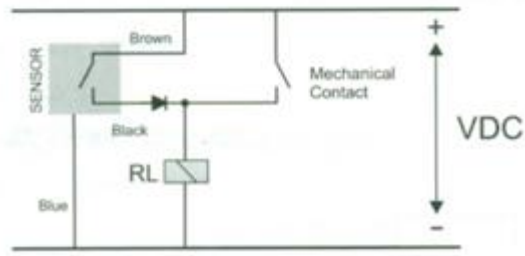
2 Wire DC sensor (not allowed)



3 Wire NPN sensor



3 Wire PNP sensor

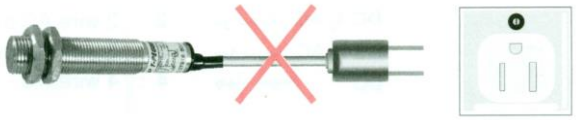


3 Wire PNP sensor with mechanical contact

Central office : No 36 , karimkhan ave. , darvazeh tehran , tabriz , iran ; zip code : 5157913399 ; P.O. box : 51575-5140
Email : info@tabrizpeguh.com ; Website : www.tabrizpeguh.com ; Tel : +984133330490 ; Fax : +984133318200

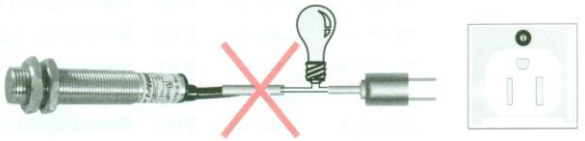
Precautions

- Avoid connecting two-wire AC sensors to the mains power without a load. This will cause sensor damage.

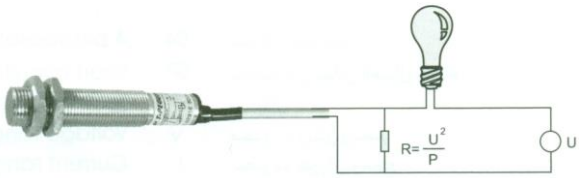


- Avoid connecting two-wire DC sensors to a battery or power supply without a load. This will cause sensor damage.

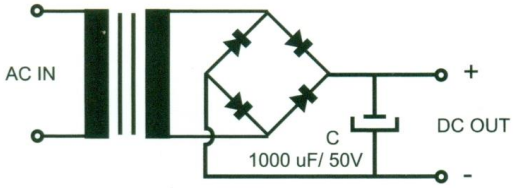
- Avoid using a lamp as a load for AC sensors. The ohmic impedance of a lamp is low when it is off (cold lamp), which results in a high current passing through the sensor at the moment of switching, potentially causing sensor damage.



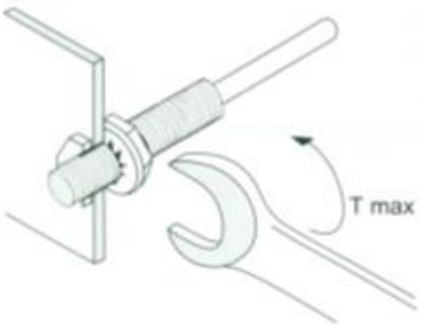
- If you must use a lamp as a load, it is recommended to use a resistor as shown in the figure below.



- When using DC power supplies in combination with sensor circuits, a capacitor should be used to reduce power supply ripple.



- When securing sensors at the installation site, it is mandatory to observe the maximum applied torque. The table below specifies this value for different sensors.



⌀ (mm)	T max (Nm)
12	15
18	35
30	50

- During sensor installation, ensure to check the operating voltage range. This range is indicated on the sensor's label.

- When using the sensor, ensure to observe its permissible current. The maximum permissible current is indicated on the sensor's label.

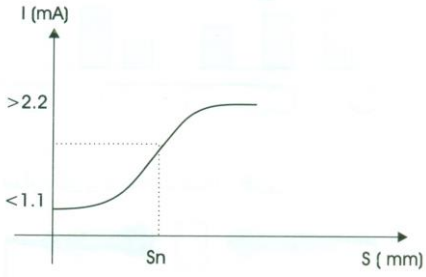
Namur Inductive Sensor:

(DIN 19234 Standard)

These are two-wire sensors whose internal resistance changes based on the distance of the object from the sensor. Typically, these sensors are connected to the power supply through a 1KΩ resistor.

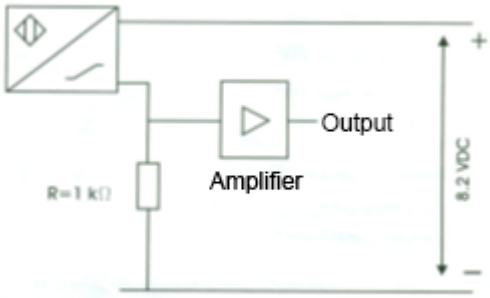
Characteristic Curve:

The characteristic curve of these sensors is shown in the figure below.



Due to the circuit wiring, the short-circuit current across the sensor is limited, making these sensors suitable for use in explosive environments due to this limitation.

By using amplifiers specifically designed for these sensors, they can be used as inductive switches.

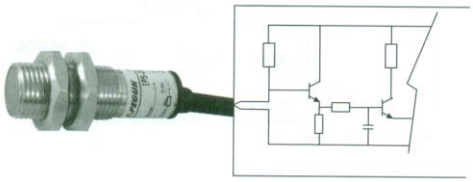


General Application Methods:

These sensors can generally be used in one of the following two ways:

A - Direct Connection to the Electrical Circuit:

When connecting these sensors to electronic circuits, attention should be paid to their characteristic curve. In electronic devices such as counters, tachometers, control circuits, and similar applications, these sensors are often used in the input stage.

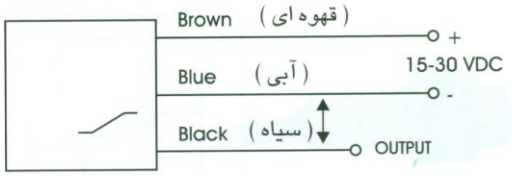


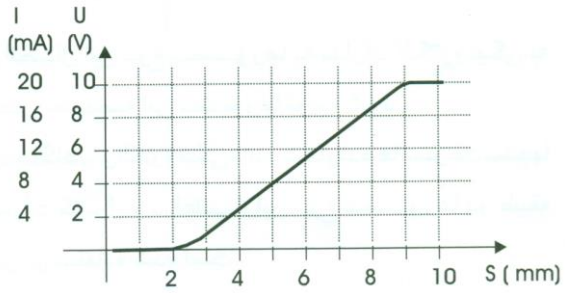
B - Direct Connection to an Amplifier:

Special amplifiers designed for these sensors are available, operating at 220V or 24V.

Analog Inductive Sensor:

Analog inductive sensors are sensors that react to metals. This reaction appears as a linear voltage or current at the output. The curve below shows an example of the output characteristics of these sensors.



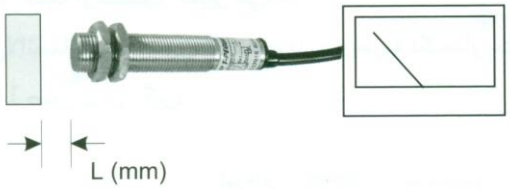


Based on the characteristic curve above, it can be observed that the beginning and end of the curve are non-linear. These sensors are produced in various diameters and also in cubic shapes.

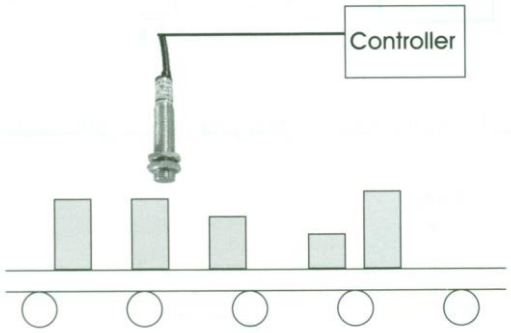
General Specifications:

- Power Supply: 15 – 30 VDC
- Output:
  - Voltage: 0-10 V
  - Current: 4-20 mA

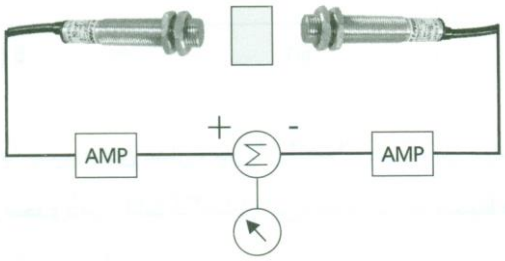
Applications:



- Measuring the distance of the object from the sensor
- Separation of parts with different dimensions



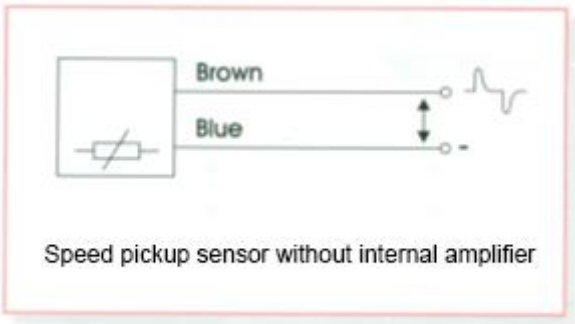
- Measuring the thickness of metal parts



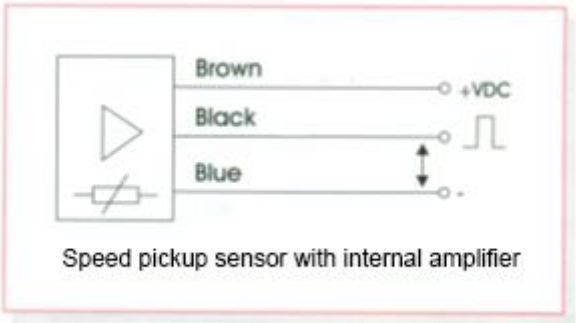
Central office : No 36 , karimkhan ave. , darvazeh tehran , tabriz , iran ; zip code : 5157913399 ; P.O. box : 51575-5140
Email : info@tabrizpeguh.com ; Website : www.tabrizpeguh.com ; Tel : +984133330490 ; Fax : +984133318200

Magnetic Speed pickup Sensors:

Magnetic speed pickup sensors are used to measure speed (speed sensors or speed pickups). The sensitive part of these sensors contains a magnetic field, which changes due to the movement of gear teeth. Since the output of these sensors is inductive, these field changes appear as pulses at the output. Some of these sensors require an amplifier at the output.



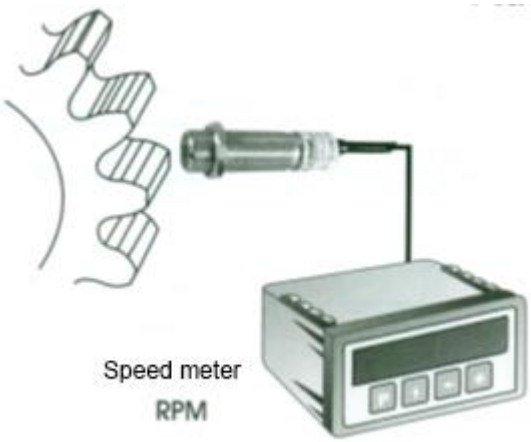
Speed pickup sensor without internal amplifier



Speed pickup sensor with internal amplifier

Applications:

- Measuring the speed of motors, locomotives, gears, pumps, turbines, and more.



Central office : No 36 , karimkhan ave. , darvazeh tehran , tabriz , iran ; zip code : 5157913399 ; P.O. box : 51575-5140
Email : info@tabrizpeguh.com ; Website : www.tabrizpeguh.com ; Tel : +984133330490 ; Fax : +984133318200