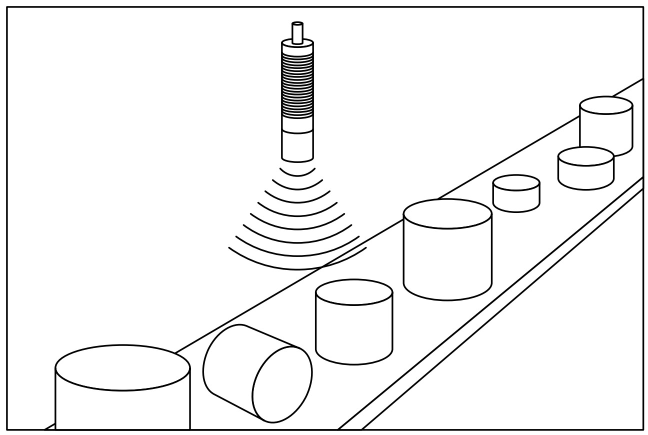
BERO Sensors

BERO is the trade name used by Siemens to identify its line of “no-touch” sensors. Siemens BERO sensors operate with no mechanical contact or wear. In the following application, for example, a BERO sensor is used to determine if cans are in the right position on a conveyor.



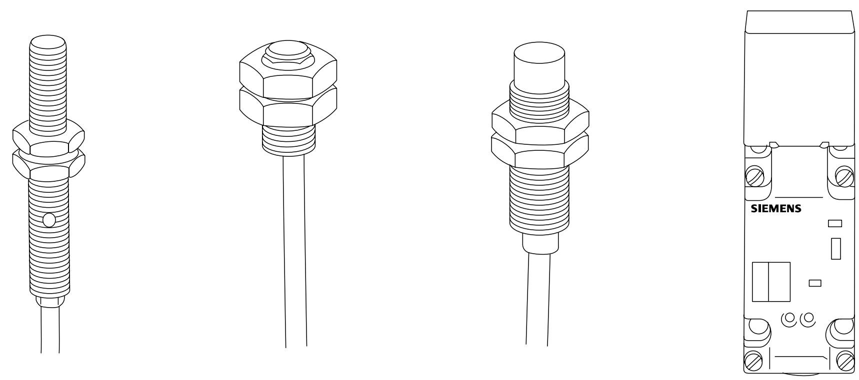
Types of BERO Sensors

There are four types of BERO sensors: inductive, capacitive, ultrasonic, and photoelectric. Inductive proximity sensors use an electromagnetic field to detect the presence of metal objects. Capacitive proximity sensors use an electrostatic field to detect the presence of any object. Ultrasonic proximity sensors use sound waves to detect the presence of objects. Photoelectric sensors react on changes in the received quantity of light. Some photoelectric sensors can even detect a specific color.

Sensor	Objects Detected	Technology
Inductive	Metal	Electromagnetic Field
Capacitive	Any	Electrostatic Field
Ultrasonic	Any	Sound Waves
Photoelectric	Any	Light

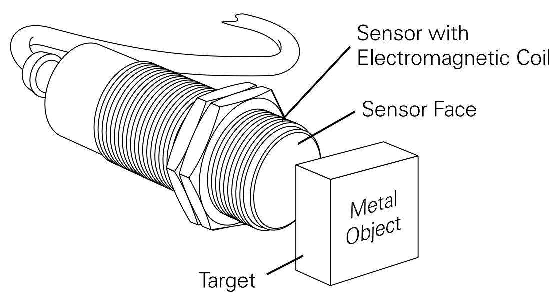
Inductive Proximity Sensors
Theory of Operation

In this section we will look at BERO inductive proximity sensors, and how they detect the presence of an object without coming into physical contact with it. Inductive proximity sensors are available in a variety of sizes and configurations to meet varying applications. Specific sensors will be covered in more detailed in the following section.



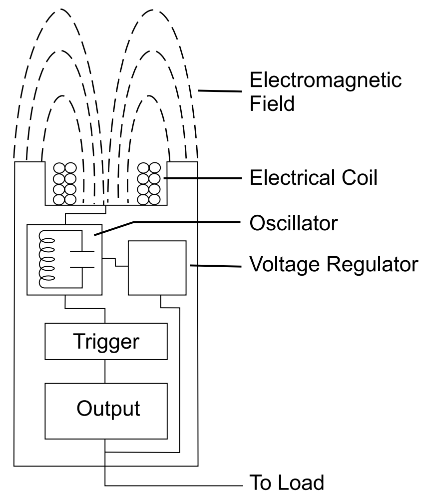
Electromagnetic Coil and Metal Target

The sensor incorporates an electromagnetic coil which is used to detect the presence of a conductive metal object. The sensor will ignore the presence of an object if it is not metal.

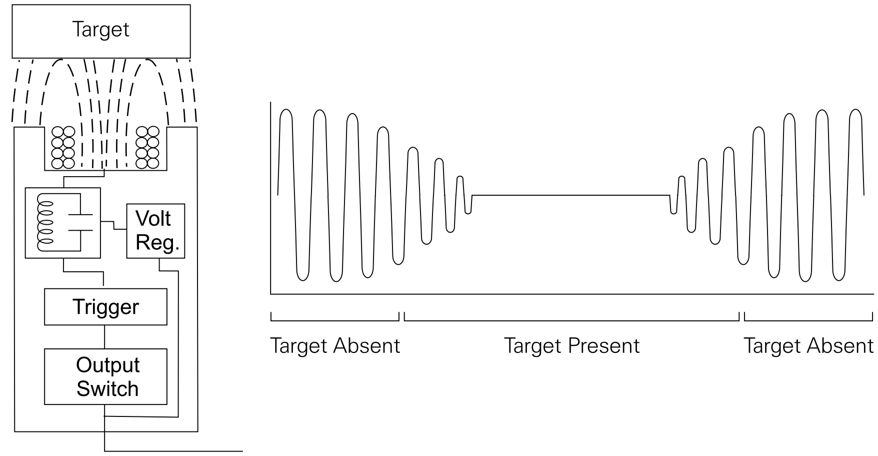


ECKO

Siemens BERO inductive proximity sensors are operated using an Eddy Current Killed Oscillator (ECKO) principle. This type of sensor consists of four elements: coil, oscillator, trigger circuit, and an output. The oscillator is an inductive capacitive tuned circuit that creates a radio frequency. The electromagnetic field produced by the oscillator is emitted from the coil away from the face of the sensor. The circuit has just enough feedback from the field to keep the oscillator going.



When a metal target enters the field, eddy currents circulate within the target. This causes a load on the sensor, decreasing the amplitude of the electromagnetic field. As the target approaches the sensor the eddy currents increase, increasing the load on the oscillator and further decreasing the amplitude of the field. The trigger circuit monitors the oscillator’s amplitude and at a predetermined level switches the output state of the sensor from its normal condition (on or off). As the target moves away from the sensor, the oscillator’s amplitude increases. At a predetermined level the trigger switches the output state of the sensor back to its normal condition (on or off).

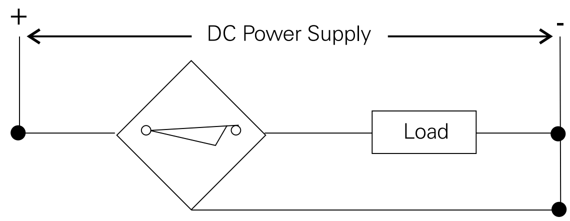


Operating Voltages

Siemens inductive proximity sensors include AC, DC, and AC/DC (universal voltage) models. The basic operating voltage ranges are from 10 to 30 VDC, 15 to 34 VDC, 10 to 65 VDC, 20 to 320 VDC, and 20 to 265 VAC.

Direct Current Devices

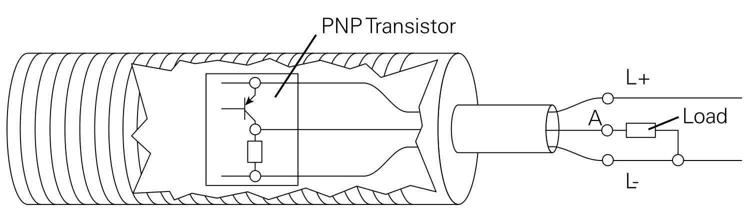
Direct current models are typically three-wire devices (two-wire also available) requiring a separate power supply. The sensor is connected between the positive and negative sides of the power supply. The load is connected between the sensor and one side of the power supply. The specific polarity of the connection depends on the sensor model. In the following example the load is connected between the negative side of the power supply and the sensor.



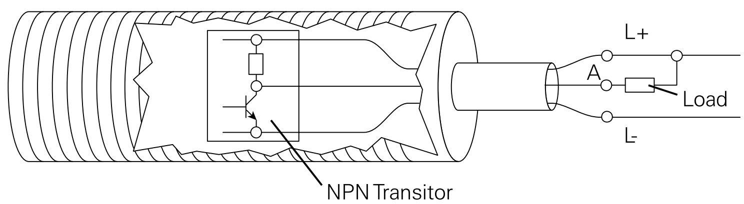
Output Configurations

Three-wire, DC proximity sensor can either be PNP (sourcing) or NPN (sinking). This refers to the type of transistor used in the output switching of the transistor.

The following drawing illustrates the output stage of a PNP sensor. The load is connected between the output (A) and the negative side of the power supply (L-). A PNP transistor switches the load to the positive side of the power supply (L+). When the transistor switches on, a complete path of current flow exists from L- through the load to L+. This is also referred to as current sourcing since in this configuration conventional current is (+ to -) sourced to the load. This terminology is often confusing to new users of sensors since electron current flow (- to +) is from the load into the sensor when the PNP transistor turns on.



The following drawing illustrates the output of an NPN sensor. The load is connected between the output (A) and the positive side of the power supply (L+). An NPN transistor switches the load to the negative side of the power supply (L-). This is also referred to as current sinking since the direction of conventional current is into the sensor when the transistor turns on. Again, the flow of electron current is in the opposite direction.

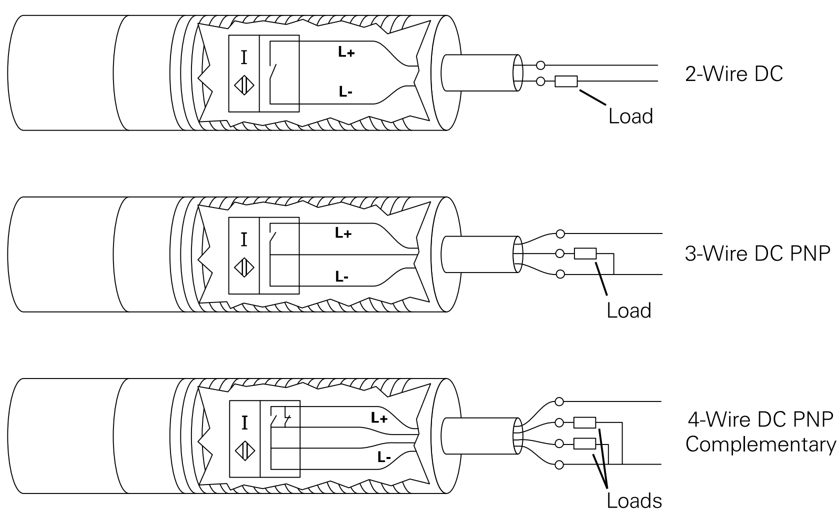


Normally Open (NO)
Normally Closed (NC)

Outputs are considered normally open (NO) or normally closed (NC) based on the condition of the transistor when a target is absent. If, for example, the PNP output is off when the target is absent then it is a normally open device. If the PNP output is on when the target is absent it is a normally closed device.

Complementary

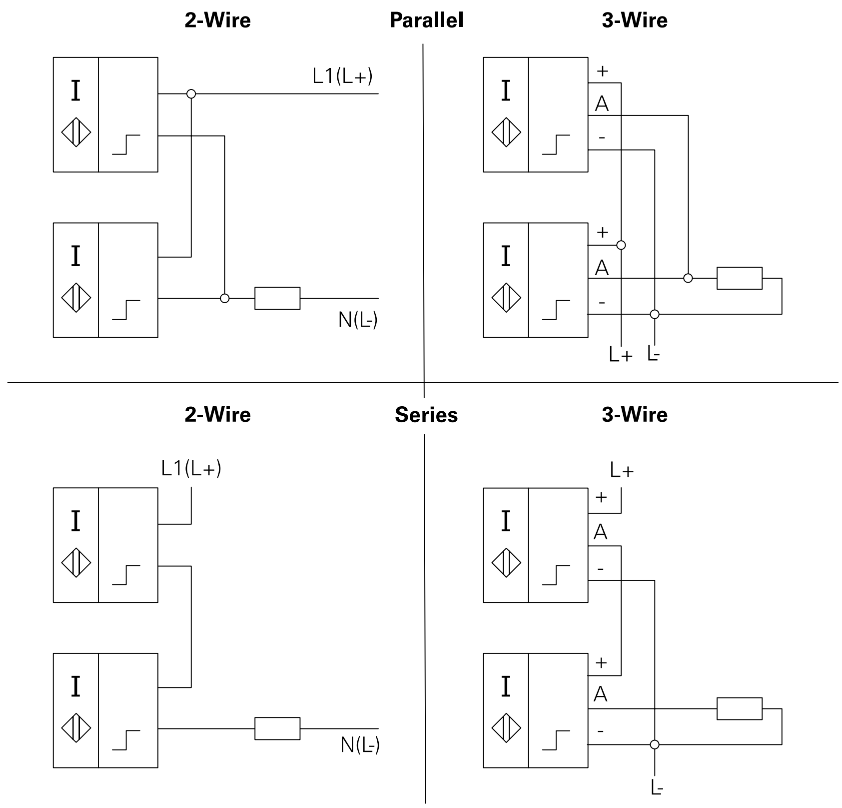
Transistor devices can also be complementary (four-wire). A complementary output is defined as having both normally open and normally closed contacts in the same sensor.



Series and Parallel Connections

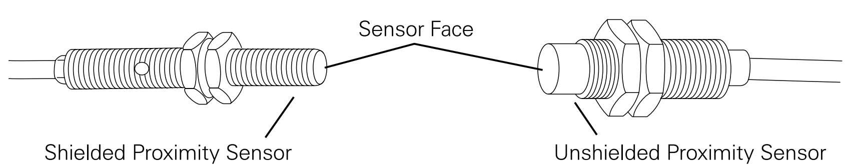
In some applications it may be desirable to use more than one sensor to control a process. Sensors can be connected in series or in parallel. When sensors are connected in series all the sensors must be on to turn on the output. When sensors are connected in parallel either sensor will turn the output on.

There are some limitations that must be considered when connecting sensors in series. In particular, the required supply voltage increases with the number of devices placed in series.



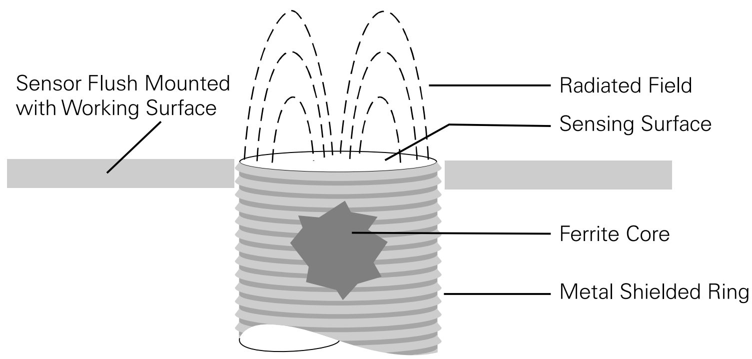
Shielding

Proximity sensors contain coils that are wound in ferrite cores. They can be shielded or unshielded. Unshielded sensors usually have a greater sensing distance than shielded sensors.



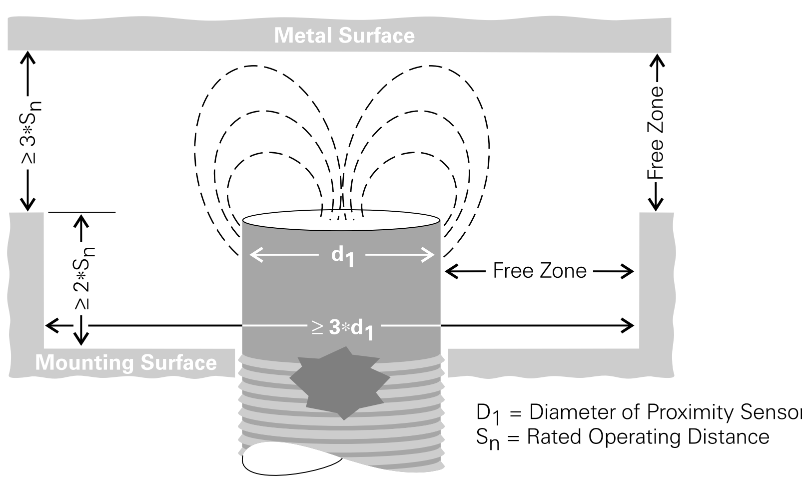
Shielded Proximity Sensors

The ferrite core concentrates the radiated field in the direction of use. A shielded proximity sensor has a metal ring placed around the core to restrict the lateral radiation of the field. Shielded proximity sensors can be flush mounted in metal. A metal-free space is recommended above and around the sensor's sensing surface. Refer to the sensor catalog for this specification. If there is a metal surface opposite the proximity sensor it must be at least three times the rated sensing distance of the sensor from the sensing surface.



Unshielded Proximity Sensors

An unshielded proximity sensor does not have a metal ring around the core to restrict lateral radiation of the field. Unshielded sensors cannot be flush mounted in metal. There must be an area around the sensing surface that is metal free. An area of at least three times the diameter of the sensing surface must be cleared around the sensing surface of the sensor. In addition, the sensor must be mounted so that the metal surface of the mounting area is at least two times the sensing distance from the sensing face. If there is a metal surface opposite of the proximity sensor it must be at least three times the rated sensing distance of the sensor from the sensing surface.

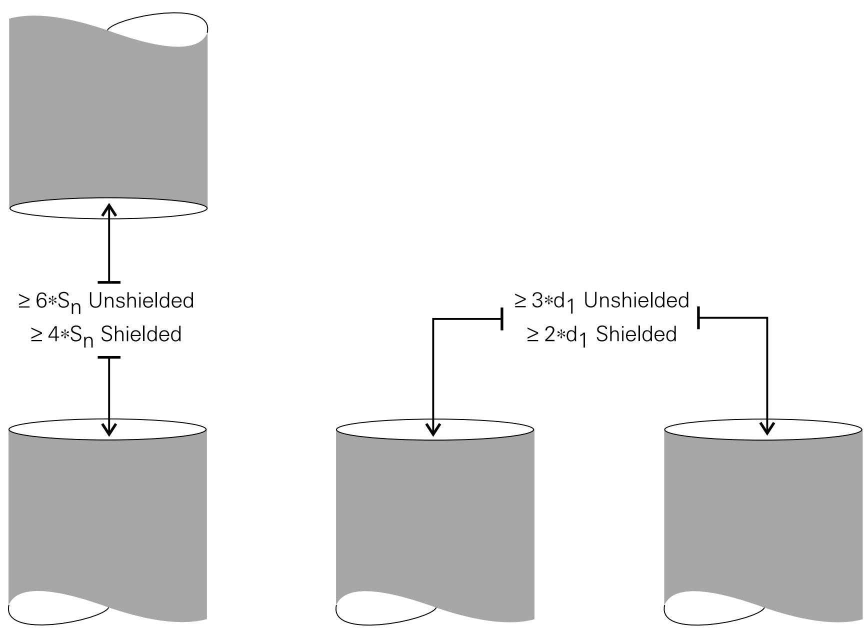


Mounting Multiple Sensors

Care must be taken when using multiple sensors. When two or more sensors are mounted adjacent to or opposite one another, interference or cross-talk can occur producing false outputs. The following guidelines can generally be used to minimize interference.

- Opposite shielded sensors should be separated by at least four times the rated sensing range
- Opposite unshielded sensors should be separated by at least six times the rated sensing range
- Adjacent shielded sensors should be separated by at least two times the diameter of the sensor face
- Adjacent unshielded sensors should be separated by at least three times the diameter of the sensor face

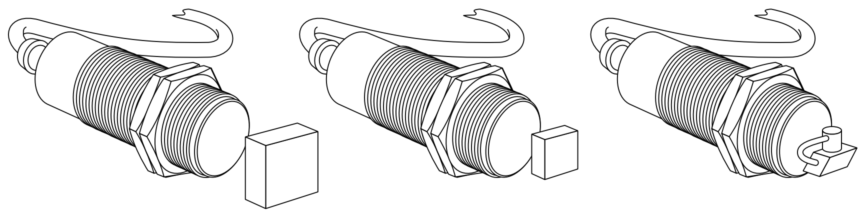
These are general guidelines. BERO proximity sensors have individual specifications which should be followed. For instance, some devices are rated as suitable for side-by-side mounting.



Standard Target

A standard target is defined as having a flat, smooth surface, made of mild steel that is 1 mm (0.04”) thick. Steel is available in various grades. Mild steel is composed of a higher content of iron and carbon. The standard target used with shielded sensors has sides equal to the diameter of the sensing face. The standard target used with unshielded sensors has sides equal to the diameter of the sensing face or three times the rated operating range, whichever is greater.

If the target is larger than the standard target, the sensing range does not change. However, if the target is smaller or irregular shaped the sensing distance (S_n) decreases. The smaller the area of the target the closer it must be to the sensing face to be detected.



Target Size Correction Factor

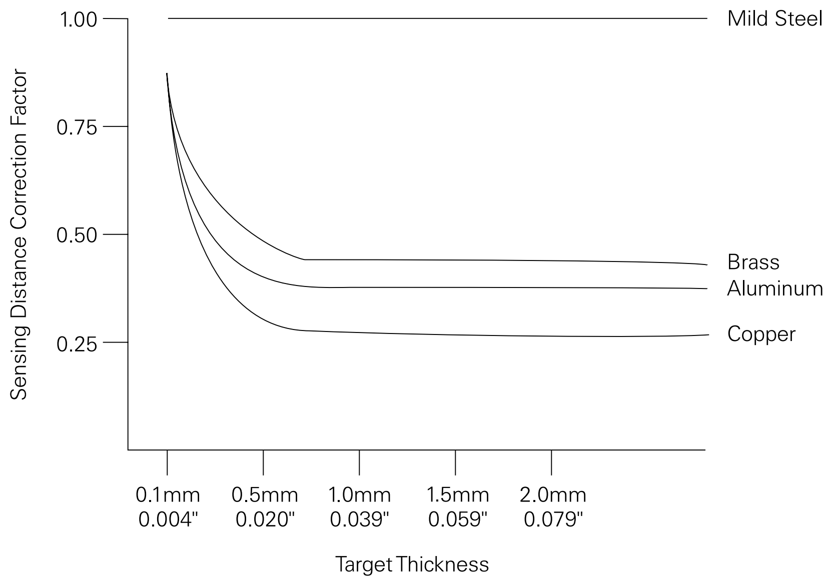
A correction factor can be applied when targets are smaller than the standard target. To determine the sensing distance for a target that is smaller than the standard target (S_{new}), multiply the rated sensing distance (S_{rated}) times the correction factor (T). If, for example, a shielded sensor has a rated sensing distance of 1 mm and the target is half the size of the standard target, the new sensing distance is 0.83 mm (1 mm x 0.83).

$S_{new} = S_{rated} \times T$
$S_{new} = 1 \text{ mm} \times 0.83$
$S_{new} = 0.83 \text{ mm}$

Size of Target Compared to Standard Target	Correction Factor	
	Shielded	Unshielded
25%	0.56	0.50
50%	0.83	0.73
75%	0.92	0.90
100%	1.00	1.00

Target Thickness

Thickness of the target is another factor that should be considered. The sensing distance is constant for the standard target. However, for nonferrous targets such as brass, aluminum, and copper a phenomenon known as "skin effect" occurs. Sensing distance decreases as the target thickness increases. If the target is other than the standard target a correction factor must be applied for the thickness of the target.



Target Material

The target material also has an effect on the sensing distance. When the material is other than mild steel correction factors need to be applied.

Material	Correction Factor	
	Shielded	Unshielded
Mild Steel, Carbon	1.00	1.00
Aluminum Foil	0.90	1.00
300 Series Stainless Steel	0.70	0.08
Brass	0.40	0.50
Aluminum	0.35	0.45
Copper	0.30	0.40

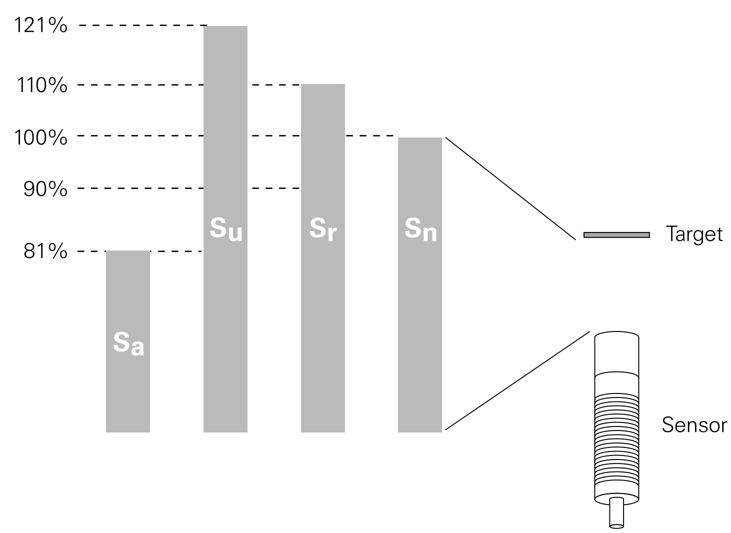
Rated Operating Distances

The rated sensing distance (S_n) is a theoretical value which does not take into account such things as manufacturing tolerances, operating temperature, and supply voltage. In some applications the sensor may recognize a target that is outside of the rated sensing distance. In other applications the target may not be recognized until it is closer than the rated sensing distance. Several other terms must be considered when evaluating an application.

The effective operating distance (S_r) is measured at nominal supply voltage at an ambient temperature of 23°C ± 0.5°. It takes into account manufacturing tolerances. The effective operating distance is ±10% of the rated operating distance. This means the target will be sensed between 0 and 90% of the rated sensing distance. Depending on the device, however, the effective sensing distance can be as far out as 110% of the rated sensing distance.

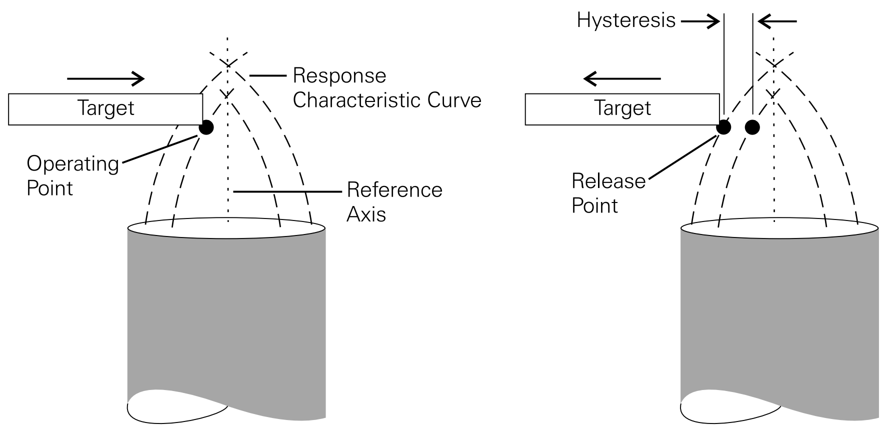
The useful switching distance (S_u) is the switching distance measured under specified temperature and voltage conditions. The useful switching distance is ±10% of the effective operating distance.

The guaranteed operating distance (S_a) is any switching distance for which an operation of the proximity switch within specific permissible operating conditions is guaranteed. The guaranteed operating distance is between 0 and 81% of the rated operating distance.



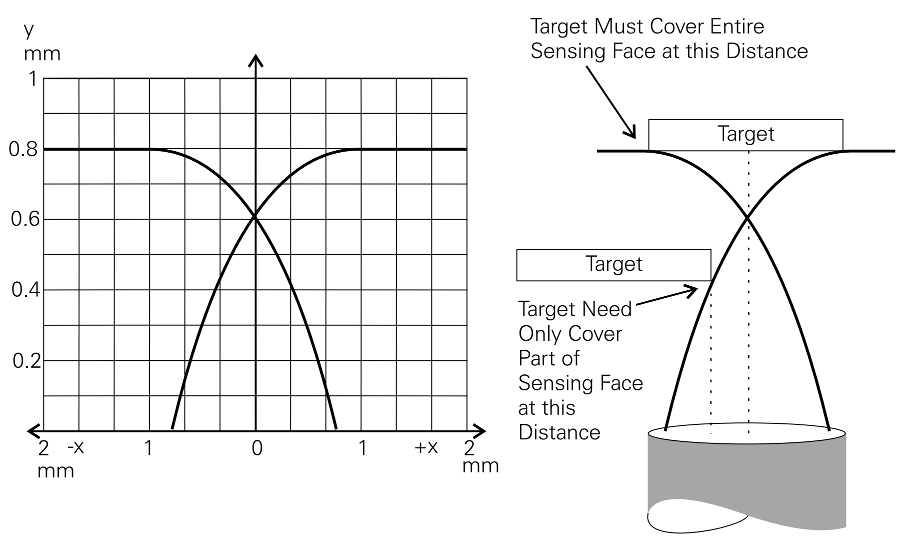
Response Characteristic

Proximity switches respond to an object only when it is in a defined area in front of the switch's sensing face. The point at which the proximity switch recognizes an incoming target is the operating point. The point at which an outgoing target causes the device to switch back to its normal state is called the release point. The area between these two points is called the hysteresis zone.



Response Curve

The size and shape of the response curve depends on the specific proximity switch. The following curve represents one type of proximity switch.



Review 2

1) An ___________ sensor uses an electromagnetic field and can only detect metal objects.

2) Which of the following is not an element of an inductive proximity sensor.

   a. Target
   b. Electrical Coil
   c. Oscillator
   d. Trigger Circuit
   e. Output

3) An area surrounding an unshielded inductive proximity sensor of at least ___________ times the area of the sensing face must be metal free.

4) Shielded inductive proximity sensors mounted opposite each other should be mounted at least ___________ times the rated sensing area from each other.

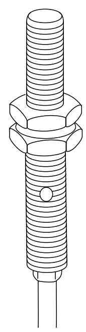
5) A standard target for an inductive proximity sensor is made of mild ___________ and is 1 mm thick.

6) A correction factor of ___________ should be applied to a shielded inductive proximity sensor when the target is made of brass.

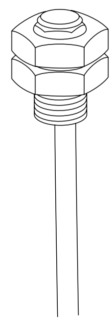
7) The guaranteed operating distance of an inductive proximity switch is between 0 and ___________ % of the rated operating distance.

Inductive Proximity Sensor Family

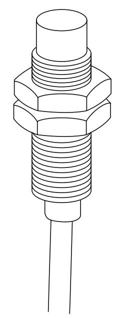
In this section we will look at the 3RG4 and 3RG04 families of inductive proximity sensors. 3RG4 refers to the first part of the part number that is used to identify this line of sensors.



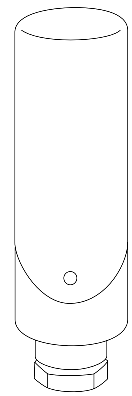
12 mm
Shielded



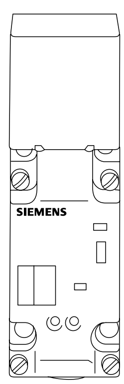
18 mm
Shorty



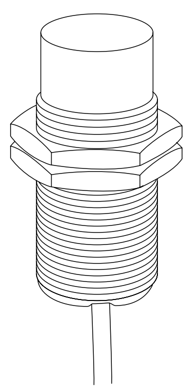
18 mm
Unshielded



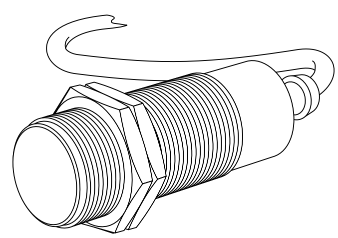
30 mm
Smooth Barrel



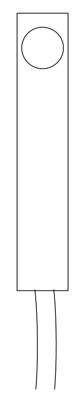
Limit Switch Style
Proximity Switch



30 mm
Unshielded



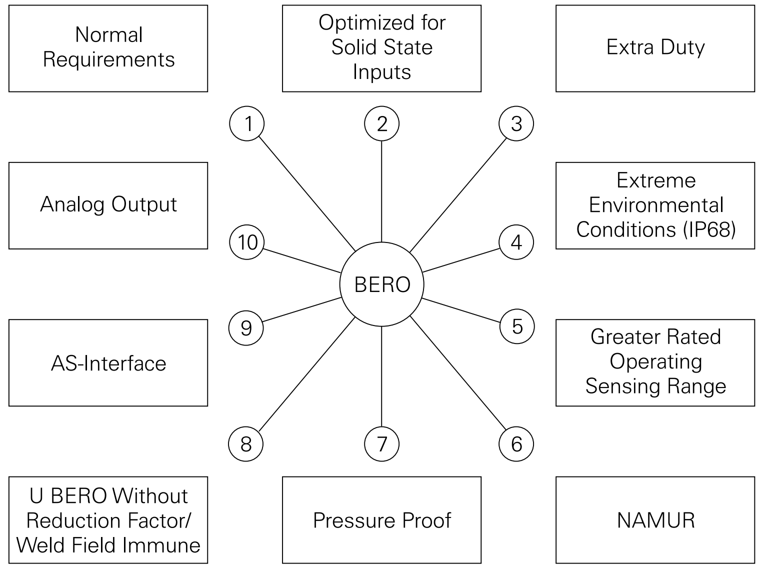
30 mm
Shielded



8 x 8 mm
Block

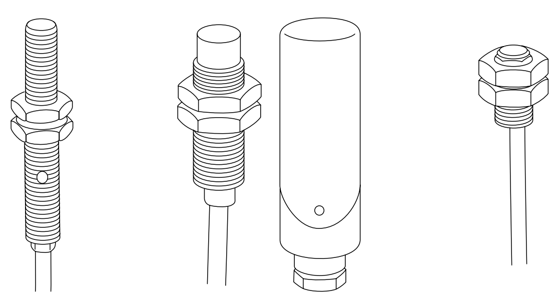
Categories

Inductive proximity sensors are available in ten categories. Each category will be briefly discussed and followed by a selection guide.



Normal Requirements Cylindrical

Inductive proximity sensors designed for normal requirements are also referred to as the standard series. These sensors will meet the needs of normal or standard applications. Standard series sensors used for normal requirements are available in several sizes, including the shorty version which is used where mounting space is limited. The diameter sensing face ranges from 3 mm to 34 mm. In addition, standard series sensors come with PNP or NPN outputs in 2, 3, or 4 wires. Standard series sensors can handle loads up to 200 mA.



Shielded Unshielded Shorty

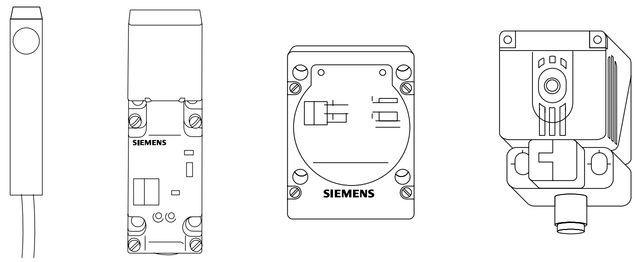
Normal Requirements Cylindrical Selection Guide

The following Inductive Proximity Selection Guide will help you find the right sensor for a given application. The housing dimension column refers to the diameter of the sensing face. The material column identifies if the sensor body is made of stainless steel (SST), brass, or a molded plastic.

Housing Dimension (mm)	Material	Shielded Unshielded	Sn (mm)	Operating Voltage	Wires
3, 4	SST	Shielded	0.6-0.8	10-30 VDC	3
5	Brass	Shielded	0.8	10-30 VDC	3
6.5	SST	Shielded	1.5	15-34 VDC	3
	SST	Shielded	1.5	10-30 VDC	3
	SST	Unshielded	2.5	15-34 VDC	3
8	SST	Shielded	1	15-34 VDC	3
	SST	Shielded	1	10-30 VDC	4
	Brass	Shielded	1.5	10-30 VDC	3
	SST	Shielded	1.5	15-34 VDC	3
	SST	Shielded	1.5	10-30 VDC	3, 4
	SST	Unshielded	2.5	15-34 VDC	3
12	Brass	Shielded	2	15-34 VDC	3, 4
	SST	Shielded	2	10-55 VDC	2
	SST	Shielded	2	20-250 VAC	2
	Brass	Shielded	2	20-250 VAC	2
	Brass	Unshielded	4	15-34 VDC	3, 4
	SST	Unshielded	4	10-55 VDC	2
	SST	Unshielded	4	20-250 VAC	2
	Brass	Unshielded	4	20-250 VAC	2
18	Brass	Shielded	5	15-34 VDC	3, 4
	SST	Shielded	5	10-30 VDC	4
	SST	Shielded	5	10-55 VDC	2
	SST	Shielded	5	20-250 VAC	2
	Brass	Shielded	5	20-250 VAC	2
	Brass	Unshielded	8	15-34 VDC	3,4
	SST	Unshielded	8	10-55 VDC	2
	SST	Unshielded	8	20-250 VAC	2
	Brass	Unshielded	8	20-250 VAC	2
20	Plastic	Unshielded	10	10-36 VDC	3
30	Brass	Shielded	10	15-34 VDC	3, 4
	Brass	Shielded	10	10-30 VDC	4
	SST	Shielded	10	10-55 VDC	2
	SST	Shielded	10	20-250 VAC	2
	Brass	Shielded	10	20-250 VAC	2
	Brass	Unshielded	15	15-34 VDC	3, 4
	SST	Unshielded	15	10-55 VDC	2
	SST	Unshielded	15	20-250 VAC	2
	Brass	Unshielded	15	20-250 VAC	2
34	Plastic	Unshielded	20	10-36 VDC	3

Normal Requirements Cubic Shape

Inductive proximity sensors designed for normal requirements are also available in a block or cubic shape.

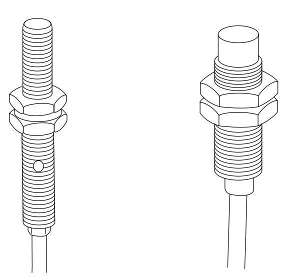


Normal Requirements Cubic Shape Selection Guide

Housing Dimension (mm)	Material	Shielded Unshielded	Sn (mm)	Operating Voltage	Wires
5x5	Brass	Shielded	0.8	10-30 VDC	3
8x8	Brass	Shielded	1.5	10-30 VDC	3
18 Tubular (Flat Pack)	Plastic	Shielded	4	10-30 VDC	3
40x26x12	Plastic	Shielded	2	15-34 VDC	3, 4
26x40x12	Plastic	Shielded	2	15-34 VDC	3
		Unshielded	4	15-34 VDC	3
40x32x12.5	Plastic	Shielded	2	15-34 VDC	4
Block with M14	Plastic	Shielded	2.5	15-34 VDC	3, 4
	Plastic	Unshielded	5	15-34 VDC	3, 4
40x40 (Limit Switch Style)	Plastic	Shielded	15	15-34 VDC	4
	Plastic	Unshielded	20	15-34 VDC	4
40x40x40	Plastic	Shielded	35	15-34 VDC	4
		Unshielded	35	15-34 VDC	4
40x40x40	Plastic	Shielded	35	20-265 VAC	2
		Unshielded	35	20-265 VAC	2
40x60 (Flat Pack)	Plastic	Shielded	25	15-34 VDC	4
	Plastic	Unshielded	30	15-34 VDC	4
40x80 (Flat Pack)	Plastic	Unshielded	40	15-34 VDC	4

Optimized for Solid State Inputs

These two-wire devices are optimized for use with solid state inputs such as PLCs and solid state timing relays. Optimized for solid state input sensors are available in tubular (shown) and block packs (not shown).

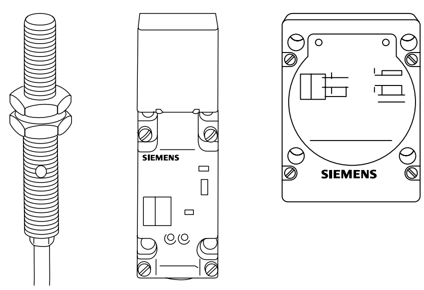


Optimized for Solid State Inputs Selection Guide

Housing Dimension (mm)	Material	Shielded Unshielded	Sn (mm)	Operating Voltage	Wires
8	SST	Shielded	1	15-34 VDC	2
12	Brass Brass	Shielded Unshielded	2 4	15-34 VDC 15-34 VDC	2 2
18	Brass Brass	Shielded Unshielded	5 8	15-34 VDC 15-34 VDC	2 2
30	Brass Brass	Shielded Unshielded	10 15	15-34 VDC 15-34 VDC	2 2
Block with M14	Plastic	Shielded	2.5	15-34 VDC	2
40x40 (Limit Switch Style)	Plastic Plastic	Shielded Unshielded	15 20	15-34 VDC 15-34 VDC	2 2

Extra Duty

Some applications require a higher operating voltage, or a faster switching frequency than is found with standard series sensors. This group of inductive proximity sensors provides a higher operating range and can handle loads up to 300 mA. These are two-wire and three-wire devices available in either normally open (NO) or normally closed (NC) configurations. They are available in cylindrical or cubic shape.

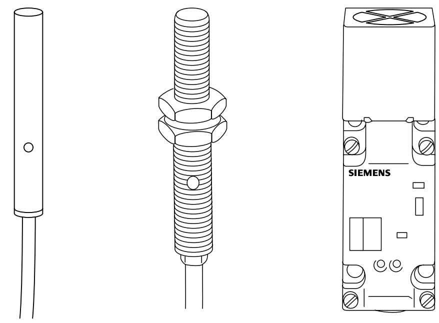


Extra Duty Selection Guide

Housing Dimension (mm)	Material	Shielded Unshielded	Sn (mm)	Operating Voltage	Wires
8	SST	Shielded	1	10-65 VDC	3
12	Brass	Shielded	2	20-265 VAC/ 20-320 VDC	2
	Brass	Shielded	2	10-65 VDC	3
	Brass	Unshielded	4	20-265 VAC/ 20-320 VDC	2
	Brass	Unshielded	4	10-65VDC	3
18	Brass	Shielded	10	20-265 VAC/ 20-320 VDC	2
	Brass	Shielded		10-65 VDC	3
	Brass	Unshielded		20-265 VAC/ 20-320 VDC	2
	Brass	Unshielded		10-65VDC	3
20	Plastic	Unshielded	10	20-265 VAC/ 20-320 VDC	2
30	Brass	Shielded	10	20-265 VAC/ 20-320 VDC	2
	Brass	Shielded	10	10-65 VDC	3
	Brass	Unshielded	15	20-265 VAC/ 20-320 VDC	2
	Brass	Unshielded	15	10-65VDC	3
34	Plastic	Unshielded	20	20-265 VAC/ 20-320 VDC	2
Block with M14	Plastic	Shielded	2.5	20-265 VAC/ 20-320 VDC	2
	Plastic	Shielded	2.5	10-65VDC	3
	Plastic	Unshielded	5	10-65 VDC	3
40x40 (Limit Switch Style)	Plastic	Shielded	15	20-265 VAC/ 20-320 VDC	2
	Plastic	Shielded	15	10-65 VDC	3
	Plastic	Unshielded	20	20-265 VAC/ 20-320 VDC	
	Plastic	Unshielded	20	10-65 VDC	
40x60 (Flat Pack)	Plastic	Unshielded	30	20-265 VAC/ 20-320 VDC	2
	Plastic	Unshielded	30	10-65 VDC	3
40x80 (Flat Pack)	Plastic	Shielded	30	20-265 VAC/ 20-320 VDC	2
	Plastic	Unshielded	40	20-265 VAC/ 20-320 VDC	2
	Plastic	Unshielded	40	20-265 VAC/ 20-320 VDC	2
	Plastic	Unshielded	40	10-65 VDC	3

Extreme Environmental Conditions (IP68)

IP protection is a European system of classification which indicates the degree of protection an enclosure provides against dust, liquids, solid objects, and personnel contact. The IP system of classification is accepted internationally. Proximity switches classified IP68 provide protection against the penetration of dust, complete protection against electrical shock, and protection against ingress of water on continuous submersion. These are three- and four-wire devices configured for NPN or PNP, normally closed (NC) or normally open (NO) outputs.

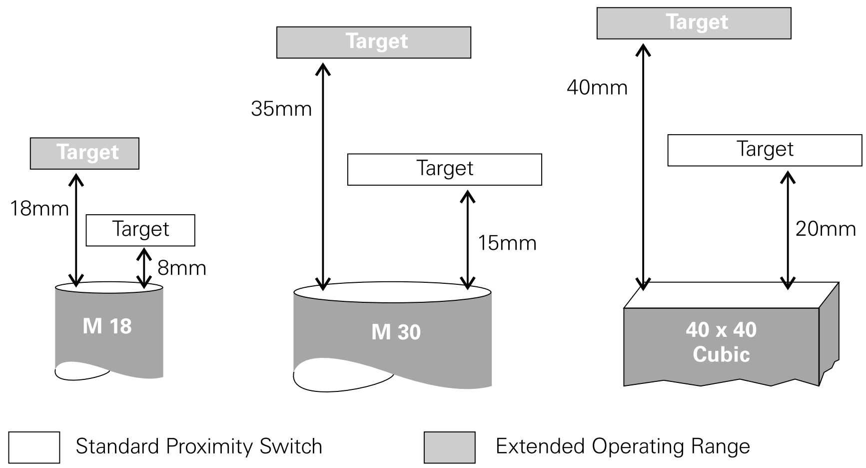


Extreme Environmental Conditions (IP68) Selection Guide

Housing Dimension (mm)	Material	Shielded Unshielded	Sn (mm)	Operating Voltage	Wires
4.5	SST	Shielded	0.6	10-30 VDC	3
6.5	Brass	Unshielded	2.5	10-30 VDC	3
8	Brass	Unshielded	2.5	10-30 VDC	3
12	Plastic	Shielded	2	15-34 VDC	3
	Brass	Shielded	2	15-34 VDC	3
	Plastic	Unshielded	4	15-34 VDC	3
	Brass	Unshielded	4	15-34 VDC	3
18	Plastic	Shielded	5	15-34 VDC	3
	Brass	Shielded	5	15-34 VDC	3
	Plastic	Unshielded	8	15-34 VDC	3
	Brass	Unshielded	8	15-34 VDC	3
	Plastic	Unshielded	8	20-265 VAC 20-250 VDC	2
	Plastic	Unshielded	8	10-65 VDC	3
30	Plastic	Shielded	10	15-34 VDC	3
	Brass	Shielded	10	15-34 VDC	3
	Plastic	Unshielded	15	15-34 VDC	3
	Brass	Unshielded	15	15-34 VDC	3
	Plastic	Unshielded	15	20-265 VAC 20-250 VDC	2
	Plastic	Unshielded	15	10-65 VDC	3
40x40 (Limit Switch Style)	Plastic	Shielded	15	15-34 VDC	4

Greater Rated Operating Sensing Range

These devices provide a greater operating distance in comparison with standard proximity switches. Devices are three-wire DC with PNP or NPN or AC and normally open (NO) or normally closed (NC) output configurations.



Greater Rated Operating Sensing Range Selection Guide

Housing Dimension (mm)	Material	Shielded Unshielded	Sn (mm)	Operating Voltage	Wires
6.5	Brass	Unshielded	3	10-30 VDC	3
8	SST	Shielded	2	15-34 VDC	3
	Brass	Unshielded	3	10-30 VDC	3
	Brass	Unshielded	6	10-30 VDC	3
12	Brass	Shielded	4	15-34 VDC	3
	Brass	Shielded	6	10-30 VDC	3
	Brass	Unshielded	10	10-30 VDC	3
18	Plastic	Shielded	8	15-34 VDC	3
	Brass	Unshielded	12	10-30 VDC	3
	Brass	Unshielded	20	10-30 VDC	3
30	Brass	Shielded	15	15-34 VDC	3
	Brass	Shielded	22	10-30 VDC	3
	Brass	Unshielded	40	10-30 VDC	3
8x8	Brass	Unshielded	3	10-30 VDC	3
40x40 (Limit Switch Style)	Plastic	Shielded	20	15-34 VDC	3
	Plastic	Unshielded	25	10-65 VDC	3
	Plastic	Unshielded	40/25(adj)	10-65 VDC	3
	Plastic	Unshielded	40	10-65 VDC	3
40x40 (Mini Base)	Plastic	Shielded	20	10-30 VDC	3
40x60 (Flat Pack)	Plastic	Unshielded	50	10-65 VDC	3
40x80 (Flat Pack)	Plastic	Unshielded	65	10-65 VDC	3

NAMUR

NAMUR is a standard issued by the Standards Committee of Measurement and Control of the chemical industry in Europe. Deutsche Industrie Normenausschuss (DIN) refers to a set of German standards now used in many countries. Like NAMUR, DIN 19234 is a set of standards for equipment used in hazardous locations.

Intrinsically Safe

NAMUR sensors are intrinsically safe only when used with an approved barrier power supply/output device and approved cabling.

It is beyond the scope of this course to offer a complete explanation on this subject. You are encouraged to become familiar with Articles 500 through 504 of the National Electrical Code® which cover the use of electrical equipment in locations where fire or explosions due to gas, flammable liquids, combustible dust, or ignitable fibers may be possible.

Hazardous Environments

Although you should never specify or suggest the type of location, it is important to understand regulations that apply to hazardous locations. It is the user's responsibility to contact local regulatory agencies to define the location as Division I or II and to comply with all applicable codes.

Divisions

Division I identifies a condition where hazardous materials are normally present in the atmosphere. Division II identifies conditions where an atmosphere may become hazardous as result of abnormal conditions. This may occur if, for example, a pipe containing a hazardous chemical begins to leak.

Classes and Groups

Hazardous locations are further defined by class and group. Class I, Groups A through D are chemical gases or liquids. Class II, Groups E, F, and G include flammable dust. Class III is not divided into groups. It includes all ignitable fibers and lints such as clothing fiber in textile mills.

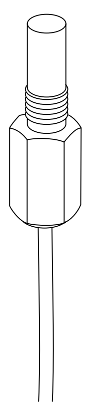
Group	Class I Groups A-D Gases and Liquids	Group	Class II Groups E-G Flammable Dust	Group	Class III Ignitable Fibers
A	Acetylene	E	Metallic Dust		Rayon
B	Hydrogen	F	Carbon Dust		Jute
C	Acetaldehyde Ethylene Methyl Ether	G	Grain Dust		
D	Acetone Gasoline Methanol Propane				

NAMUR Selection Guide

Housing Dimension (mm)	Material	Shielded Unshielded	Sn (mm)	Operating Voltage	Wires
4.5	SST	Shielded	0.8	5-25 VDC	2
8	SST	Shielded	1.5	5-25 VDC	2
12	SST	Shielded	2	5-25 VDC	2
	SST	Unshielded	4	5-25 VDC	2
18	SST	Shielded	5	5-25 VDC	2
	SST	Unshielded	8	5-25 VDC	2
30	SST	Shielded	10	5-25 VDC	2
	SST	Unshielded	15	5-25 VDC	2
40x40 (Limit Switch Style)	Plastic	Shielded	15	5-25 VDC	2

Pressure Proof

These devices are used in extremely dynamic pressure stressing such as the monitoring of piston or valve limit positions, speed monitoring and measurement of hydraulic motors, and vacuum applications. The operating voltage is 10 to 30 VDC, with loads up to 200 mA. The operating distance of devices rated up to 7253 psi is 3 mm. These are three-wire devices with a PNP or NPN, normally open (NO) or normally closed (NC) output.

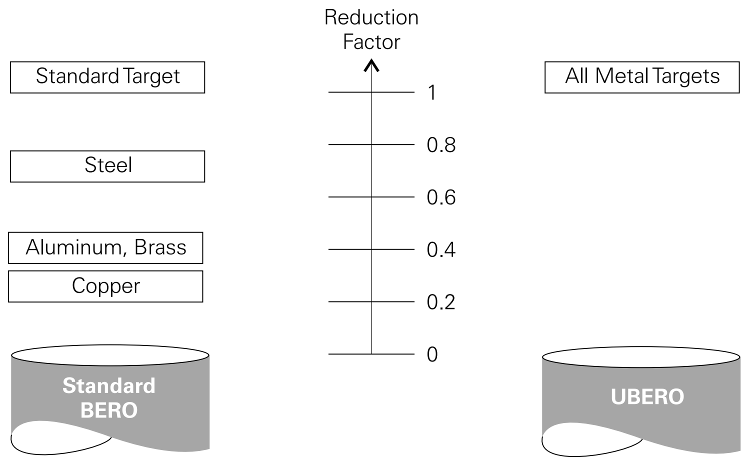


Pressure Proof Selection Guide

Housing Dimension (mm)	Material	Shielded Unshielded	Sn (mm)	Operating Voltage	Wires
12	SST	Unshielded	3	10-30 VDC	3

UBERO Without Reduction Factor/Weld Field Immune

Standard BERO proximity switches require a reduction factor for metals other than the standard target. UBERO products sense all metals without a reduction factor. They can also be used in applications near a strong magnetic fields.

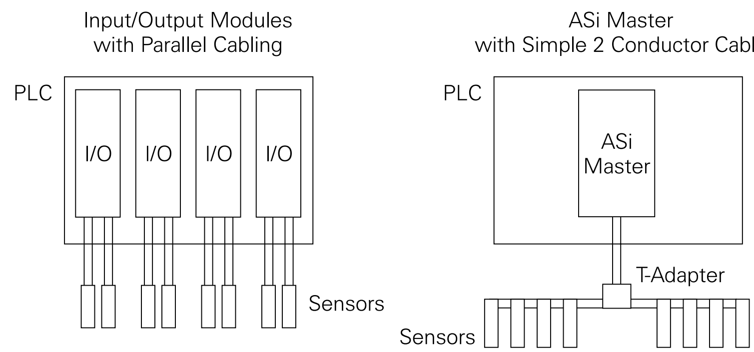


UBERO Without Reduction Factor/Weld Field Immune Selection Guide

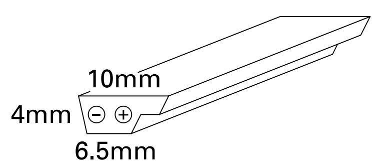
Housing Dimension (mm)	Material	Shielded Unshielded	Sn (mm)	Operating Voltage	Wires
8	SST	Shielded Unshielded	1.5 4	10-30 VDC 10-30 VDC	3 3
12	Brass or SST	Shielded Unshielded	2 8	10-30 VDC 10-30 VDC	3 3
18	Brass or SST	Shielded Unshielded	5 12	10-30 VDC 10-30 VDC	3 3
30	Brass or SST	Shielded Unshielded	10 20	10-30 VDC 10-30 VDC	3 3
40x40 (Limit Switch Style)	Plastic Plastic Plastic	Shielded Unshielded Unshielded	15 25 40	10-30 VDC 10-30 VDC 10-30 VDC	4 3 4
40x40 (Mini Base)	Plastic Plastic Plastic	Shielded Unshielded Unshielded	15 25 35	10-30 VDC 10-30 VDC 10-30 VDC	3 3 3
80x80	Plastic	Unshielded	75	10-30 VDC	4

AS-i

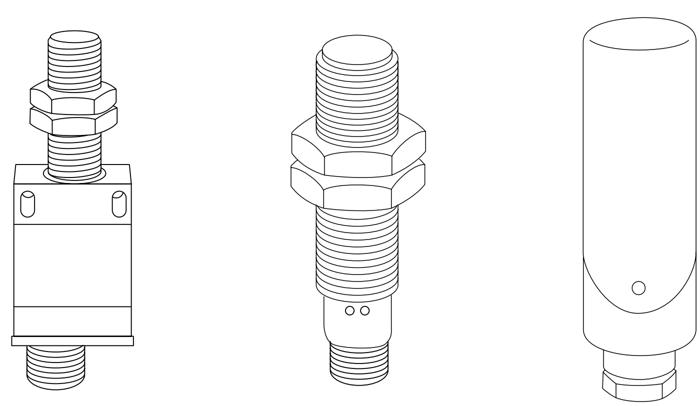
Actuator Sensor Interface (AS-i or AS-Interface) is a system for networking binary devices such as sensors. Until recently, extensive parallel control wiring was needed to connect sensors to the controlling device. PLCs, for example, use I/O modules to receive inputs from binary devices such as sensors. Binary outputs are used to turn on or off a process as the result of an input. Using conventional wiring it would take a cable harness of several parallel inputs to accomplish complex tasks.



AS-i replaces the complex cable harness with a simple 2-core cable. The cable is designed so that devices can only be connected correctly.



Inductive proximity sensors developed for use on AS-i have the AS-i chip and intelligence built into the device

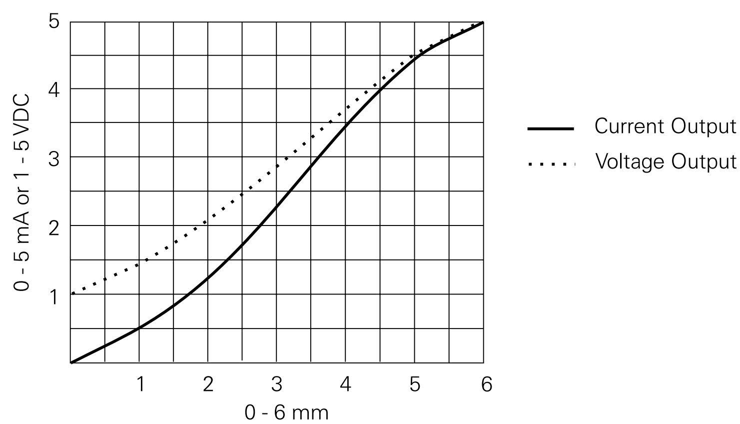


AS-i Selection Guide

Housing Dimension (mm)	Material	Shielded Unshielded	Sn (mm)	Operating Voltage
12	Brass	Shielded	2	20-32 VDC
18	Brass	Shielded	5	20-32 VDC
20	Plastic	Unshielded	10	20-32 VDC
30	Brass	Shielded	10	20-32 VDC
34	Plastic	Unshielded	20	20-32 VDC
40x40	Plastic	Shielded	15	20-32 VDC

Analog Output

These devices are used when an analog value is required. In some applications it may be desireable to know the distance a target is from the sensor. The rated sensing range of an inductive analog sensor is 0 to 6 mm. The output of the sensor increases from 1 to 5 VDC or 0 to 5 mA as the target is moved away from the sensor.



Analog Selection Guide

Housing Dimension (mm)	Material	Shielded Unshielded	Sn (mm)	Operating Voltage	Wires
12	Brass	Unshielded	0-6	10-30 VDC	4

Review 3

1) Inductive proximity sensors are divided into ___________ categories.

2) The maximum sensing range of an inductive proximity sensor with a cylindrical style housing in the standard series (normal requirements) is ___________ mm.

3) The maximum operating voltage that can be used on an inductive proximity sensor for increased electric requirements is ___________ VAC or ___________ VDC.

4) ___________ is a European system of classification which indicates the degree of protection an enclosure provides against dust, liquids, solid objects, and personnel contact.

5) The maximum sensing range of an inductive proximity sensor designated for greater rated distance is ___________ mm.

6) ___________ inductive proximity sensors detect all metals without a reduction factor.