Info card

Inductive analogue sensors with IO-Link

ℹ This info card serves as a supplement to the main position sensors catalogue and to the individual data sheets. For further information and contact addresses, please visit our website at **www.ifm.com**.

Functions and features

While in use, the products are exposed to influences that may have an effect on function, life, quality and reliability of the product.

It is the customer's responsibility to ensure that the products are suitable for the intended application. This applies in particular to applications in hazardous areas and with adverse environmental influence such as pressure, chemicals, temperature fluctuations, moisture and radiation as well as mechanical stress, especially if the products are not installed properly.

Using the products in applications where the safety of people depends on the function of the product is not permitted. If these instructions are not adhered to, death or severe injury may occur.

Operating principle of an inductive proximity switch with IO-Link

Coil and capacitor form an LC resonant circuit, also called basic sensor.

If a target penetrates the sensing field, eddy currents are generated in the target, taking away energy from the sensor. The circuit ensures that even when a target is in contact with the sensor a process value is provided depending on the distance.
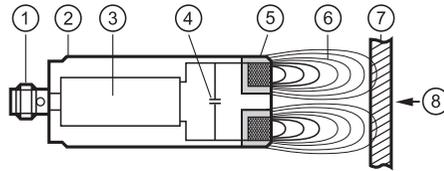
① Connection
② Housing
③ External electronics
④ Capacitor
⑤ Coil
⑥ Alternating electromagnetic field = active zone
⑦ Target = electrically conductive material
⑧ Ideal direction of movement of the target

Glossary of important terms

Active zone	Area above the sensing face in which the sensor reacts to the approach of the target.
Number of switch-on operations	0...max. (→ IODD). Starts again at 0 when the maximum value has been reached.
Output function (adjustable)	Normally open: Object within the active zone > output switched. Normally closed: Object within the active zone > output blocked. Positive switching: Positive output signal (to L-). Negative switching: Negative output signal (to L+).
Switch-off delay	Configurable in steps of 100 ms.
Rated insulation voltage	DC units with protection class II: 250 V AC.
Rated short-circuit current	For short-circuit-proof units: 100 A.
Rated impulse withstand voltage	DC units with protection class II: 4 kV (≙ overvoltage category III).
Power-on delay time	The time the sensor needs to be ready for operation after application of the operating voltage (in the millisecond range).
Operating voltage	Voltage range in which the sensor operates reliably. A stabilised and smoothed direct voltage should be used! Take into account residual ripple!

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Operating hours	0...max. (→ IODD). Remains when the maximum value has been reached.
Damping	Smoothing the output signal (PDV) with fluctuating distance value; configurable in steps of 10 ms.
Switch-on delay	Configurable in steps of 100 ms.
Setting range	Range in which a switch point can be set.
Utilisation category	DC units: DC-13 (control of solenoids).
Hysteresis	Difference between switch-on and switch-off point.
Short-circuit protection	ifm sensors which are protected against excessive current by means of a pulsed short-circuit protection. The inrush current of incandescent lamps, electronic relays and low resistance loads may cause this protection to cut in and turn the sensor off!
Linearity error	Deviation of the output characteristics from the preset value characteristics.
Measuring range	Range in which the process value changes.
Final value of the measuring range	Maximum value the process value can reach within the measuring range.
Standard target	Square-shaped steel plate (e.g. S235JR) of a thickness of 1 mm with a side length equal to the diameter of the sensing face or $3 \times S_n$, depending on which value is the highest.
Product standard	IEC 60947-5-2
Switch point drift	The shifting of the switch point due to changes in the ambient temperature.
Protection rating	IPxy According to IEC 60529 IP68 Test condition: 1 m water depth for 7 days IP 69K According to ISO 20653 (substitute for DIN 40050-9)
Current consumption	Current for the internal supply of DC units.
Temperature drift	See switch point drift.
Transport and storage conditions	Unless otherwise indicated in the data sheet, the following applies: Transport and storage temperature: Min. = - 40 °C. Max. = max. Ambient temperature according to the data sheet. The relative air humidity (RH) must not exceed 50 % at +70 °C. At lower temperatures, a higher air humidity is permissible. Shelf life: 5 years. Transport and storage height: no limitations.
Degree of soiling	Inductive proximity sensors are designed for degree of soiling 3.
Maintenance, repair and disposal	If used correctly, no maintenance and repair measures are necessary. Only the manufacturer is allowed to repair the unit. After use, dispose of the device in an environmentally friendly way in accordance with the applicable national regulations.
Repeatability	Difference between any two measurements within the measuring range.

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Correction factors

S_r [%]

100 *
V2A
50 Ms
Al
0 Cu

* Standard target

Values → data sheet
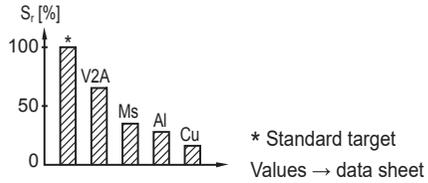
ℹ With materials and sizes deviating from the standard target, the short range signal via IO-Link cannot be guaranteed.

## Visualisation of the process value with measuring range and setting range in case of frontal damping


① OL*
4095
3800
3500
3000
2500
② 2000
1500
400 500
③ ④
UL* ⑥
⑤ [mm]
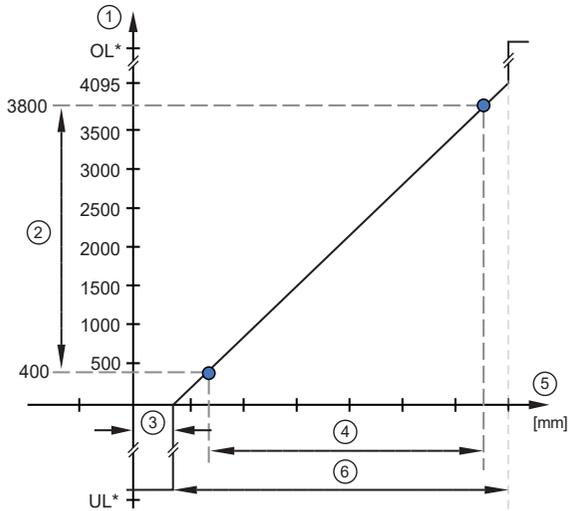
① Process data value
② PDV setting range (process data variable)
③ Short range
④ Switch point setting range

⑤ Distance to the sensing face
⑥ Measuring range

* → IODD

Parameters	Description
SP1 / SP2	Switch point 1 / 2 of SSC1 (PIN 4) or SSC2 (IO-Link data bit).
	Conditions:
	• SP1 between 400 and 3800, SP2 between 388 and 3686.
	• SP1 > SP2 + 3 %.
	Measuring range = 0...4095.
	• 32760 = OL (outside the measuring range).
	• -32760 = UL (outside the measuring range).

Hysteresis in % referred to the process value

① [%]
20
15
10
5
②
0 1000 2000 3000 4000

① Hysteresis
② Process value

UK
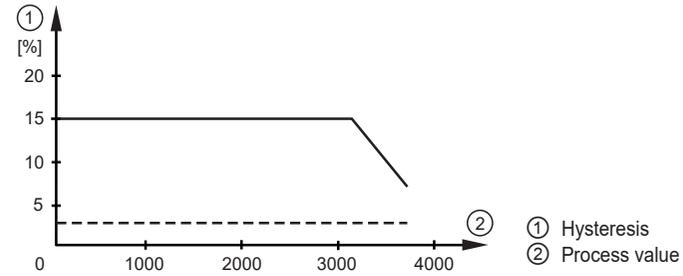
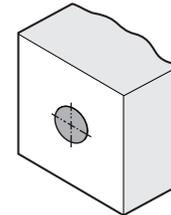## Approach and ranges (valid for structural steel, e.g. S235JR)

② ≤ ½ Sn
① 3×Sn
d
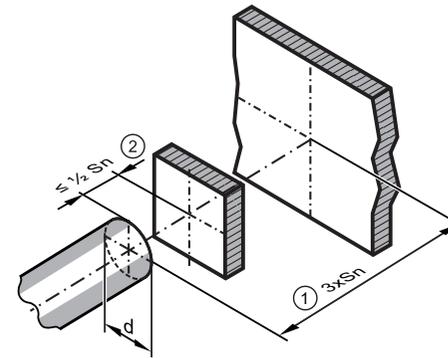
① Distance to the background
② Recommended target distance in SIO mode
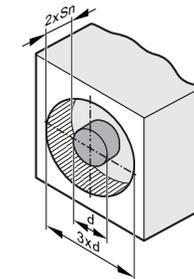
Information on flush and non-flush mounting in metal

Installation instructions cylindrical housings
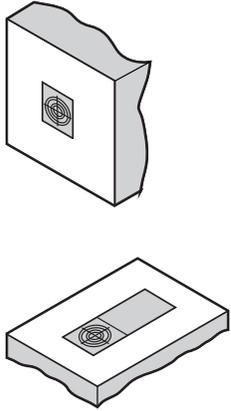
flush:

non-flush:

2×Sn
d
3×d

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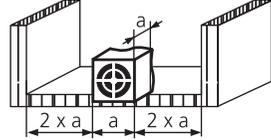Inductive analogue sensors with IO-Link

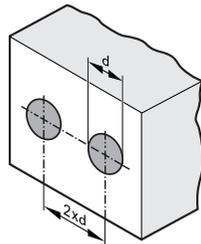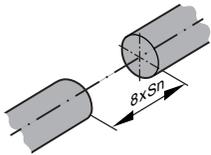## Installation instructions for rectangular housings
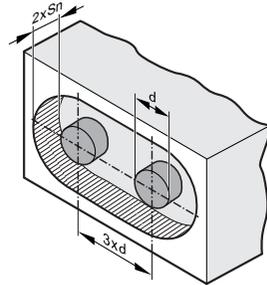
flush:

non-flush:

Minimum clearance when installing sensors of the same type
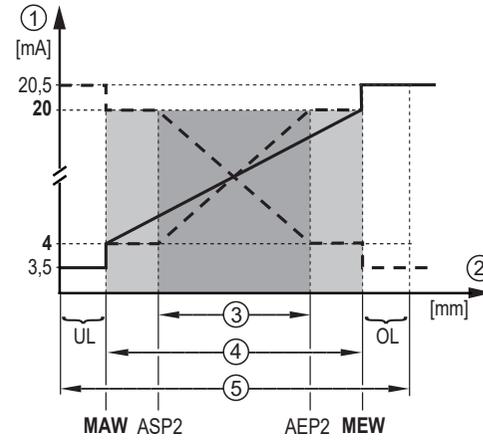
Applies to cylindrical and rectangular sensors.

flush:

non-flush:

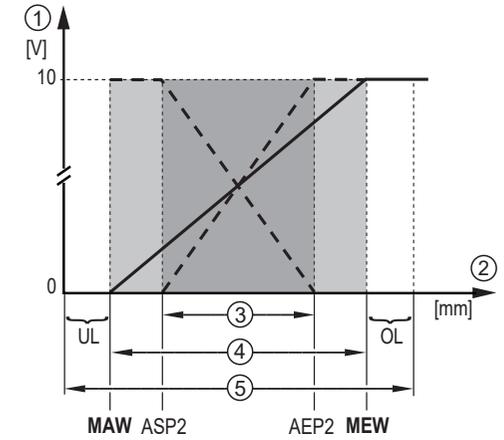ℹ The minimum distance between units may only be disregarded for units with different oscillator frequencies or different sensing principles.

Visualisation of the analogue signal in case of frontal damping

Analogue characteristic curve I

Analogue characteristic curve U

① Analogue signal
② Measured value
③ Scaled measuring range
④ Measuring range
⑤ Detection zone

MAW: Initial value of the measuring range for non-scaled measuring range.
MEW: Final value of the measuring range with non-scaled measuring range.
ASP2:   Analogue start point with scaled measuring range.
AEP2:   Analogue end point with scaled measuring range.
UL: Value below measuring range (short range).
OL: Measuring range exceeded.

ℹ Conditions:
- ASP2 and AEP2 must be within the measuring range (0...4095).
- ASP2 / AEP2.
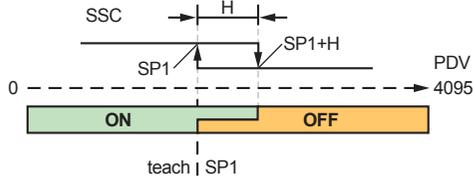- [AEP2] - [ASP2] = 819.

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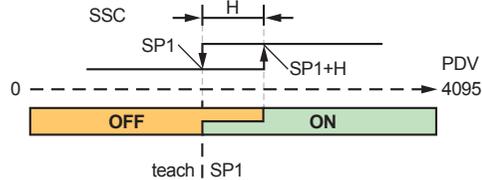Inductive analogue sensors with IO-Link

Switch point definition IO-Link

Single-point mode (presence detection) according to smart sensor profile

Normally open (switch point logic = 0)

SSC
H
SP1+H
SP1
PDV
0 — 4095
ON   OFF
teach | SP1

SP1   Switch-on point
SP1 + H   Reset point

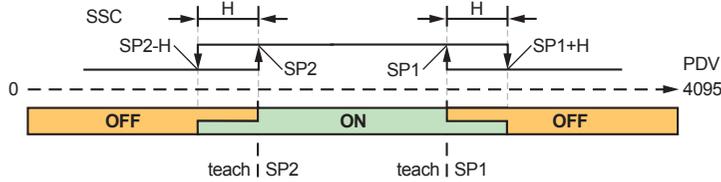**Normally closed** (switch point logic = 1)

SSC
H
SP1
SP1+H
PDV
0 — 4095
OFF   ON
teach | SP1

SP1   Reset point
SP1 + H   Switch-on point

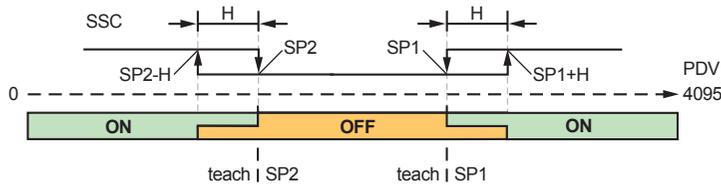### Window mode (presence detection) according to smart sensor profile

Normally open (switch point logic = 0)

SSC
H   H
SP2-H   SP2   SP1   SP1+H
PDV
0 — 4095
OFF   ON   OFF
teach | SP2   teach | SP1

SP1   Switch-on point
SP1 + H   Reset point
SP2   Switch-on point
SP2 - H   Reset point

Normally closed (switch point logic = 1)

SSC
H   H
SP2   SP1
SP2-H   SP1+H
PDV
0 — 4095
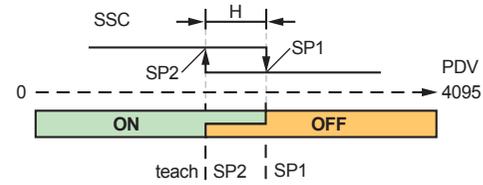ON   OFF   ON
teach | SP2   teach | SP1

SP1   Reset point
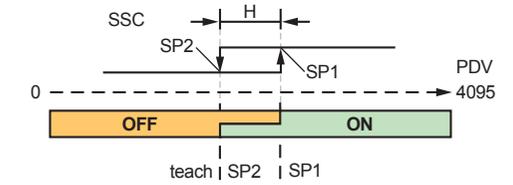SP1 + H   Switch-on point
SP2   Reset point
SP2 - H   Switch-on point

Two-point mode (presence detection) according to smart sensor profile

Normally open (switch point logic = 0)

SSC
H
SP1
SP2
PDV
0 — 4095
ON   OFF
teach | SP2 | SP1

SP1   Reset point
SP2   Switch-on point

Normally closed (switch point logic = 1)

SSC
H
SP2
SP1
PDV
0 — 4095
OFF   ON
teach | SP2 | SP1

SP1   Switch-on point
SP2   Reset point

Conditions:
- SP1 between 400 and 3800, SP2 between 388 and 3686.
- SP1 > SP2 + 3%.
- SP1 + H ≤ 4066.
- H between 3 and 15 %.

SP   Switch point   SSC   Switching signal channel
H   Hysteresis   PDV   Process data variable

IO-Link diagnostic data

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Process variable range over-run:	Warning
Process value below the valid range:	Warning
Hardware failure in the device (e.g. sensor head damaged):	Error message
Device temperature not reached:	Warning
Admissible device temperature exceeded:	Warning
Flashing sequence active:	Warning

Connection systems

! The unit must be connected by a qualified electrician.

1 BN   L+
4 BK
2 WH
3 BU   L−

2: OUT1
4: OUT2
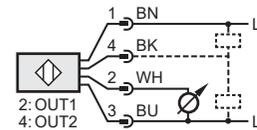
4: OUT / IO-Link

Pin configuration of the US-100 connectors (view onto the plug at the unit)

Pin 1: BN
Pin 2: WH
Pin 3: BU
Pin 4: BK

2   1
3   4
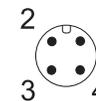
Colours:
BK: black
BN: brown
BU: blue
WH: white

UK