Info card
Inductive sensors

This info card is to be regarded as a supplement to the main position sensors catalogue and to the individual data sheets. For further information and contact addresses please visit our homepage at www.ifm.com.

Intended use

While in use the products are exposed to influences which 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. Non-compliance may result in death or serious injuries.

Operating principle of an inductive proximity switch

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

Eddy current losses in electrically-conductive materials are used for a switching signal.

Important Glossary

Active zone / active face Area above the sensing face in which the sensor reacts to the approach of the target.

Output function

Normally open: object within the active zone > output is switched.

Normally closed: object within the active zone > output is blocked.

Programmable: choice between normally closed or normally open.

Positive switching: positive output signal (to L-).

Negative switching: negative output signal (to L+).

Rated insulation voltage

AC units depending on UB: 140 V AC or 250 V AC
DC units with protection class II: 250 V AC
DC units with protection class III: 60 V DC

Rated short-circuit current

for short-circuit-proof units: 100 A

Rated impulse withstand voltage

AC units depending on UB: 140 V AC = 2.5 kV or 250 V AC = 4 kV (overvoltage category III)
DC units with protection class II: 4 kV (overvoltage category III)
DC units with protection class III: 0.8 kV (overvoltage category II)

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 The voltage range in which the sensor functions reliably. A stabilised and smoothed direct voltage should be used! Take into account residual ripple!

Utilisation category

AC units: AC-140 (control of small electromagnetic loads with holding currents < 200 mA)
DC units: DC-13 (control of solenoids)

Hysteresis

Difference between the switch-on and the 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!

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 x Sn, depending on which value is the highest.

Product standard

IEC 60947-5-2

Repeatability

Difference between any two Sr measurements. Max. 10 % of Sr.

Leakage current

Current for the internal supply of 2-wire units; also flows through the load when the output is blocked.

Switch point drift

The shifting of the switch point owing to changes in the ambient temperature.

Switching frequency Damping with standard target at half Sn. The ratio damped to undamped (tooth to gap) = 1 : 2.

Protection rating

IPxy According to IEC 60529

Test condition: 1 m water depth for 7 days
IP69K To ISO 20653 (replacement for DIN 40050-9)

Current consumption

Current for the internal supply of 3-wire DC units.

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 restrictions.

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 unit in an environmentally friendly way in accordance with the applicable national regulations.

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**Sensing range (referred to the standard target)**

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal sensing range $S_n$</td>
<td>characteristic value of the unit</td>
</tr>
<tr>
<td>Real sensing range $S_r$</td>
<td>individual deviation at room temperature between 90 % and 110 % of $S_n$</td>
</tr>
<tr>
<td>Useful sensing range $S_u$</td>
<td>= switch point drift between 90 % ($S_{l u m e n s} = S_a$) and 110 % ($S_{l u m e r} = S_r$) of $S_r$</td>
</tr>
<tr>
<td>Reliable sensing range</td>
<td>= reliably switched between 0 % and 81 % of $S_n$</td>
</tr>
<tr>
<td>Safe switch-off distance</td>
<td>$S_u + \text{max. hysteresis} = 143 %$ of $S_n$</td>
</tr>
</tbody>
</table>

**Correction factors**

- $V_2A$
- $M_a$
- $A_l$
- $C_u$

<table>
<thead>
<tr>
<th>Sr [%]</th>
<th>V2A</th>
<th>M_a</th>
<th>A_l</th>
<th>C_u</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Standard target

**Influence of the target size**

- $S_0$ [%]
- $S_n$ [%]

- $0$ to $100$%
- $0.2$ to $1.0$

$x$ axis: ratio actual target / standard target

**Lateral approach and ranges** (valid for structural steel, e.g. S235JR)

1. Typical switch-on curve (for slow approach)
2. Typical switch-off curve (for slow approach)
3. Poor repeatability
4. Good repeatability

Good repeatability of the switch point means: The closer the target is positioned to the sensing face, the better.

General recommendation:

- $a = 10\%$ of the nominal sensing range

**Tips on flush and non-flush mounting in metal**

**Installation instructions cylindrical designs**

**Flush:**

**Non-flush:**
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Installation instructions rectangular designs
Flush:
Non-flush:

If the required clear space is not observed for non-flush units, the sensor is predamped. This may lead to permanent switching.

Possibly deviating installation instructions for rectangular units with increased sensing range → Notes on mounting and operation.

Minimum clearance for installing units of the same type (side-by-side installation)
Applies to cylindrical and rectangular sensors.

Flush:
Non-flush:

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

Electrical connection

The unit must be connected by a qualified electrician.

① Use a miniature fuse according to the technical data sheet, if specified. Recommendation: Check the safe functioning of the unit after a short circuit.

② Negative switching
③ Positive switching
④ Sensor 1
⑤ Sensor n

Connection systems

Two-wire technology
(negative or positive switching)

3-wire technology
(negative or positive switching)

4-wire technology
(positive switching, normally closed and normally open)

Series connection (AND)

Series connection of 3-wire units
Max. 4 units. Power-on delay times, voltage drops and current consumptions add up. \(U_{\text{HIGH}}\) \(\text{(sensor)}\) and \(U_{\text{HIGH}}\) \(\text{(load)}\) must remain unchanged.

Series connection of 2-wire units
Not recommended because of undefined operation when blocked! Use special types which can be connected in series (max. 2 units). Voltage drops add up.
Parallel connection (OR)

Parallel connection 3-wire units
The current consumption of all non-switched units adds up. The units can be used in combination with mechanical switches.

Parallel connection 2-wire units
Not possible.

Configuration of cables and connectors
Colours: BK: black, BN brown, BU: blue, WH: white

Standard configuration for 3-wire DC:

<table>
<thead>
<tr>
<th></th>
<th>Cable</th>
<th>Terminal chamber</th>
<th>US-100 plug</th>
</tr>
</thead>
<tbody>
<tr>
<td>L+</td>
<td>BN</td>
<td>1 / 3</td>
<td>Pin 1 / BN</td>
</tr>
<tr>
<td>L−</td>
<td>BU</td>
<td>2 / 4</td>
<td>Pin 3 / BU</td>
</tr>
<tr>
<td>Output</td>
<td>BK</td>
<td>X</td>
<td>Pin 2 / WH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pin 4 / BK</td>
</tr>
</tbody>
</table>

Pin connection of the US-100 connections (view onto the plug of the unit)

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

For the cable and the pin configuration as well as the unit data of special versions please refer to the wiring diagrams in our main catalogue for position sensors.