FUNCTION PRINCIPLE OF INDUCTIVE SENSORS

An inductive sensor consists of a coil with a ferrite core, an oscillator, a demodulator, a signal gating and an amplifier.

The oscillator produces a high-frequency, electro-magnetic alternating field in the coil. This field exposes the coil as lines of electric flux, whereas the field is bundled aligned by the ferrite core. When the exposed lines of electric flux penetrate through metal, the metal induces eddy current and withdraws energy from the field.

The loss of energy causes dampness, the grade of dampness is the distance between sensor and detecting material.

The signal gating notices the dampness of the oscillator. When the dampness exceeds a certain dimension, the amplifier is active and changes the output state e.g. from OFF to ON. When the metal is removed from the sensor coverage, the amplifier returns to its original condition.

TECHNICAL TERMS

Switching Zone/Active Surface
The active switching zone is the area above the active surface, where the sensor reacts to the approach of metal, which means it changes the switching condition.

Working Distance
The working distance is each distance the sensor works properly.

Working Voltage
At a maximum residual ripple of 10 % the working voltage may not exceed or remain under the given minimum and maximum dimensions.

Flush Mount
The active surface may be installed flush in metal.

Quasi-Flush Mount
The sensor must jut out according to dimension ‘a’ of the surrounding conducting material.

<table>
<thead>
<tr>
<th>size</th>
<th>a (mm) mounting in steel or non-ferrous heavy metal</th>
<th>a (mm) mounting in stainless steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø6,5 Ø8/M8</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>M12</td>
<td>2</td>
<td>1,0</td>
</tr>
<tr>
<td>M18</td>
<td>4</td>
<td>1,5</td>
</tr>
<tr>
<td>M30</td>
<td>6</td>
<td>2,0</td>
</tr>
</tbody>
</table>

Rated Operating Current
is the current to let a sensor work for unlimited time (permanent working current). With analog output the current to load the output.

Hysteresis
Difference between ON and OFF. Values between 1 % and 15 % of the real sensing distance.

Shorttime Current
describes the current that an AC-device for a short duration (20 ms) is able to connect (e.g. when switching on).

Electric Wire Break Resistancy
This means at a 3-wire DC-sensor; that the interruption of one of the leading wires does not cause any malfunction. When an electric wire breaks, the output is defined blocked (no wrong output signal).

No-Load Current
describes the current that an active DC-proximity sensor is able to load.

Standard Target
All given sensing distances refer to a quadriform standard target of ST37 with 1 mm thickness.

The edge length equals the diameter of the active surface or the triple nominal sensing distance, if this value is larger than the diameter of the active surface.

Minimum Load Current
Load current, which is minimum necessary to enable the function of the proximity switch.
**WORKING SENSING DISTANCE**

**Sₐ**
The lowest effective sensing distance (81% of Sₙ) is named Working Sensing Distance (Sₐ). It describes the distance for the assured sensing distance, regarding and including all tolerances.

**REAL SENSING DISTANCE**

**Sₚ**
The Real Sensing Distance (Sₚ) regards assembly tolerances and productions dispersion and is measured by norm IEC 947-5-2 for nominal current and nominal surrounding temperature.

For inductive proximity switches the real sensing distance is within the range:

0.9 x Sₙ < Sₚ < 1.1 x Sₙ

**DIMENSIONED SENSING DISTANCE**

**Sₙ**
The dimensioned sensing distance (Sₙ) is a parameter not regarding dispersions and divergences by outer influences as voltage fluctuations, temperature divergences etc.

**EFFECTIVE SENSING DISTANCE**

**Sₘ**
The effective sensing distance (Sₘ) regards – additionally to the tolerances of the real sensing distance – the allowed tolerances for temperature – and voltage fluctuations.

For inductive proximity switches is the effective sensing distance within the following values of the given voltage – and temperature ranges:

0.9 x Sₚ < Sₘ < 1.1 x Sₚ

That means, a proximity switch may not show a sensing distance below 0.81 x Sₙ or 1.21 x Sₙ within the temperature range.

All data to sensing distances of inductive proximity switches refer to standard target ST37, thickness 1.0 mm. The exact measurement definitions are found in the IEC 947-5-2. Other materials than ST37 will result in variations of the sensing distance.

**CORRECTION FACTORS SENSING DISTANCE**

<table>
<thead>
<tr>
<th>Material</th>
<th>Sensing Distance Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST37</td>
<td>1.0 x Sₙ</td>
</tr>
<tr>
<td>Steel</td>
<td>approx. 1.0 x Sₙ</td>
</tr>
<tr>
<td>Chrome Nickel</td>
<td>approx. 1.0 x Sₙ</td>
</tr>
<tr>
<td>Brass</td>
<td>approx. 0.9 x Sₙ</td>
</tr>
<tr>
<td>Aluminum</td>
<td>approx. 0.5 x Sₙ</td>
</tr>
<tr>
<td>Copper</td>
<td>approx. 0.45 x Sₙ</td>
</tr>
</tbody>
</table>

**PROTECTION CLASSES**

Protection classes (according to IEC 529/DIN 40050) describe the protection against dust and humidity of the proximity switch:

**IP 20**
Protection against ingress of solid parts with a diameter larger than 12 mm. No special protection against ingress of liquids.

**IP 65**
Full protection against contact with voltage loaded parts; protection against ingress of dust; protection against spray water

**IP 67**
Full protection against contact with voltage loaded parts; protection against ingress of dust; protection against soak in water under following conditions: 1.0 m water depth; 30 minutes duration

**SWITCHING FREQUENCY**

equals the maximum possible quantity of switching sequences by second. The dampness results (according to IEC 947-5-2) with standard targets to a rotating, no-loaded material disc. The area ratio of iron to no-load material must be 1:2.

- either the switch-on signal is t₁ = 50 us or the
- switch-off signal is t₂ = 50 us
OPERATION OF INDUCTIVE PROXIMITY SWITCHES

NORMS AND ALLOWANCES

Quality to Norm

Proximity switches by Schönbuch Sensor are developed, manufactured and tested according to current norms and rules.

They refer to the present and valid IEC-publications, EN-norms or DIN VDE-rules as well as country specific rules.

For new developments, changes and modifications of existing products the newest norm issues on European and International base are referred to simultaneously.

Listing of Important DIN EN 50014 Publications, Norms and Regulations

DIN EN 50020
Elektrische Betriebsmittel für explosionsgefährdete Bereiche. Eigensicherheit.

IEC 947-1
EN 60947-1
DIN VDE 0660 Teil 100
Niederspannungsschaltgeräte, Teil 1: Allgemeine Festlegung

IEC 947-5-1
EN 60947-5-1
DIN VDE 0660 Teil 200
Niederspannungsschaltgeräte, Teil 5: Steuergeräte und Schaltelemente, Abschnitt eins; Elektromagnetische Steuergeräte

IEC 947-5-2
EN 60947-5-2
DIN VDE 0660 Teil 208
Schaltgeräte, Niederspannungsschaltgeräte, Hilfstromschalter, Nähe rungsschalter.

IEC 664
DIN VDE 0110
Bestimmungen für die Bernessung der Luft- und Kriechstrecken elek trischer Betriebsmittel.

EN 60204-1
DIN VDE 0113 Teil 1
Elektrische Ausrüstung von Industriemaschinen; Teil 1: Allgemeine Forderungen

DIN VDE 0160
Ausrüstung von Starkstromanlagen mit elektronischen Betriebsmitteln.

IEC 529
EN 60529
DIN 40050
Schutzarten durch Gehäuse (IP-Code)

DIN VDE 0165
Errichten elektrischer Anlagen in explosionsgefährdeten Bereichen.

Electromagnetic Compatibility

According to EG-Richtlinie [89/336 EWG] for electromagnetic compatibility [EMV-Richtlinie] there are requirements to the abilities of electrical and electronical devices, arrangements, systems or parts in order to enable proper function in the present electromagnetic surrounding.

These requirements are specified in the device-referring norms and rules:

Interference
EN 55011
The devices shown in the catalog refer to class B.

Interference Stability
DIN VDE 0843
Elektromagnetische Verträglichkeit von Mess-, Steuer- und Regeleinrichtungen in der industriellen Prozesstechnik.

DIN VDE 0843 Teil 2/
IEC 801-1”/EN 61000-4-2
Störfestigkeit gegen Entladung statischer Elektrizität.

DIN VDE 0843 Teil 3/
IEC 801-3/EN 61000-4-3
Störfestigkeit gegen elektromagnetische Felder.

DIN VDE 0843 Teil 4/
IEC 61000-4-4
Störfestigkeit gegen schnelle transiente Störgrößen (Burst).

IEC 255-5
Störfestigkeit gegen Stoßspannungen.

PrEN 60947-5-2 Annex ZA
EMV-Festigkeit von Näherungsschaltern

<table>
<thead>
<tr>
<th>norm</th>
<th>interference</th>
<th>inspection level</th>
</tr>
</thead>
</table>
| DIN VDE 0843 Teil 2/
IEC 801-1/EN 61000-4-2 | ESD | 4 kV / 8 kV AD |
| DIN VDE 0843 Teil 3/
IEC 801-3/EN 61000-4-3
80...1000 MHz | HF gestrahlt | 3 V / m |
| DIN VDE 0843 Teil 4/
IEC 801-4/EN 61000-4-4
Koppelzange | Burst | 2 kV |
| IEC 255-5 | Impulsspannungstest | 1kV, 500 Ohm DC |
| | | 5kV, 500 Ohm AC |

norm interference inspection level
Inductive proximity switches DC

- PNP-NO
- PNP-NC
- PNP-NO + NC
- NPN-NO
- NPN-NC
- NPN-NO + NC

Inductive proximity switches AC

- AC-NO
- AC-NC

Inductive proximity switches Namur

- NA

- All types CE marked
- Plastic construction on request