OPERATION OF INDUCTIVE PROXIMITY SWITCHES

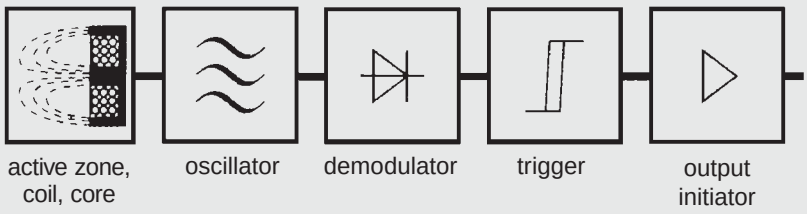
FUNCTION PRINCIPLE OF INDUCTIVE SENSORS

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 alined 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 it's original condition.



principle diagram of a proximity sensor

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.

size	a (mm) mounting in steel or non-ferrous heavy metal	a (mm) mounting in stainless steel
∅6,5 ∅8/M8	1	0
M12	2	1,0
M18	4	1,5
M30	6	2,0

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).

Stand-By Delay

is the duration between the connection of the operating voltage and the function of the sensor.

According to size and type approx. 50 ms to max 300 ms. During the stand-by delay the sensor remains defined blocked.

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).

No-Load Current

describes the current that an active DC-procimity 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.

OPERATION OF INDUCTIVE PROXIMITY SWITCHES

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 Sr

The Real Sensing Distance (Sr) 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 < Sr < 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 Su

The effective sensing distance (Su) 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 Sr < Su < 1,1 x Sr

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

ST37		1,0 x Sn
Steel	approx.	1,0 x Sn
Chrome Nickel	approx.	1,0 x Sn
Brass	approx.	0,9 x Sn
Aluminum	approx.	0,5 x Sn
Copper	approx.	0,45 x Sn

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

Protection Classes and Dimensioned Insulation Voltage

Protection Class 1:
Device with protective conductor connection

Protection Class 2:
Device with protective insulation

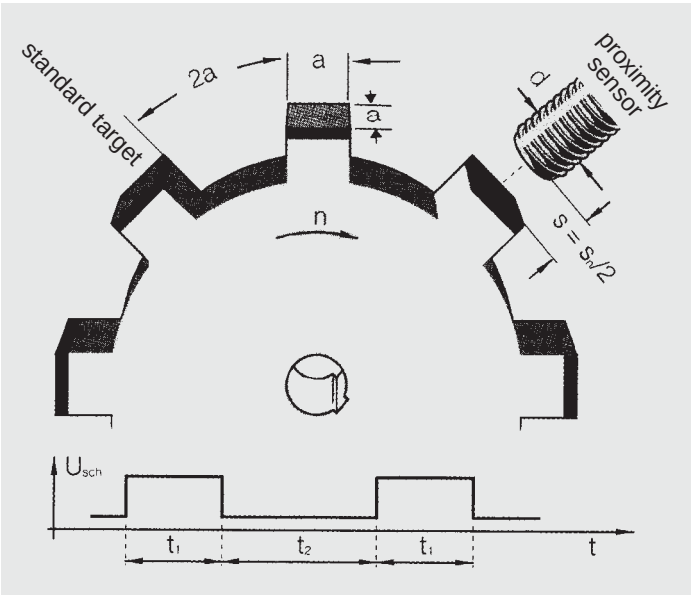
Protection Class 3:
Device for connection to protective low voltage

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.

The Rated Value of the Switching Frequency is reached when...

- either the switch-on signal is t1 = 50 us or the
- switch-off signal is t2 = 50 us



principle of frequency measuring

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, Hilfsstromschalter, Näherungsschalter.

IEC 664
DIN VDE 0110

Bestimmungen für die Bemessung der Luft- und Kriechstrecken elektrischer 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

Elektromagentische Verträglichkeit von Mess-, Steuer- und Regeleinrichtungen in der industriellen Prozesstechnik.

DIN VDE 0843 Teil 2/
IEC 801-,"/EN 61000-4-2

Störfestigkeit gegen Entladung statischer Elektrizität.

DIN VDE 0843 Teil 3/
IEC 801-3/EN 6100-4-3

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

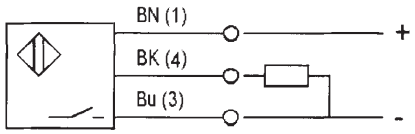
EMV-Festigkeit von Näherungsschaltern

norm	interference	inspection level
DIN VDE 0843 Teil 2/ IEC 801-2/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

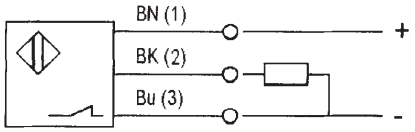
CONNECTIONS

Inductive proximity switches DC

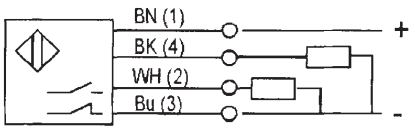
PNP-NO



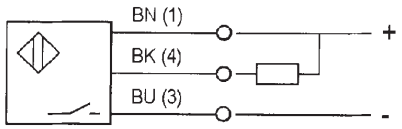
PNP-NC



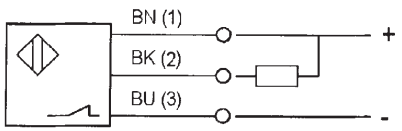
PNP-NO + NC



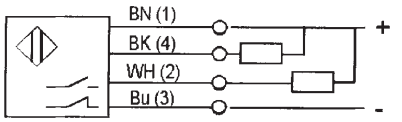
NPN-NO



NPN-NC

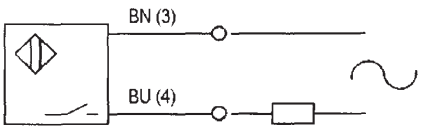


NPN-NO + NC

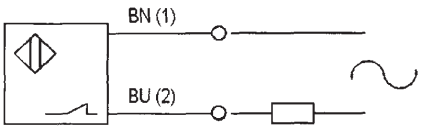


Inductive proximity switches

AC-NO

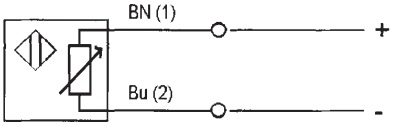


AC-NC



Inductive proximity switches Namur

NA



- All types CE marked
- Plastic construction on request