

Isolating amplifiers and inductive proximity sensors (slot sensors) in fail-safe technology

General

The safety amplifiers are self monitoring amplifiers which can be used for circuits where failsafety is important. A pertaining expertise is available about tests carried out in accordance with DIN 4788, under special consideration of item 5.2.5.4. In addition, all inductive proximity switches of the SN or S1N series, made by Pepperl & Fuchs, and the isolating amplifiers KHA6-SH-Ex1 resp. KFD2-SH-Ex1 were tested according to DIN VDE 660 part 209 (TÜV [TECHNICAL SURVEYANCE BOARD] certificate available). The control circuit of the amplifier is galvanically separated from the supply voltage as well as from the output. The interconnection of one of the above mentioned proximity sensors and the respective add-on amplifiers complies with the provisions for non contact positioning switches used for safety functions (VDE 660, part 200/209). The output complies with VDE 0435, and is active with non attenuated proximity sensors executed in SN technique and with attenuated proximity sensors in S1N technique. Instead of a safety proximity sensor it is also possible to use a contact homologated for safety circuits, but in this case a resistance of approx. 1.5 kOhm must be provided for the contact in series. The switching condition of the output is indicated by a built-in LED. The output circuit is designed in a way to allow for commercial control contactors without a protective wiring. The apparatus - equipped with an electronic output - may either be integrated into a safety chain, or used for driving a relay homologated for safety circuits.

Intrinsic safety

The apparatus is provided with intrinsically safe control circuits, and is related electrical operating material in the meaning of the European standards EN 50 014 and EN 50 020. The intrinsically safe control circuits are homologated for use in areas with protection [EEx ia], or [EEx ib] IIB, or IIC, respectively. Due to the galvanic separation, no equipotential bonding or earthing is required.

Isolating amplifiers in fail safe technology acc. to VDE 0660/part 209

DIN VDE 0660 part 209/1.88 was introduced to meet the increasing safety requirements.

In part 209 of DIN VDE 0660 the non contact positioning switch (BWP) is defined as an electrically operating device for safety functions by which the switching operation is released by a change in optic, magnetic and other fields.

The most important requirement in a case of failure is the double failsafety of the BWP for safety functions.

The most important definition established for the BWP is its safe condition for safety functions with a switch-off command prevailing at the output of the BWP (circuit open, no voltage at the output). In this condition, the counterpart assumes its safest position.

In case of failure, the BWP must immediately assume its safe condition or - with the protective function guaranteed - at the next switching operation at the latest. If the failure remains unnoticed, further failures must be expected and maintenance of the failsafe function must be guaranteed whenever a further failure occurs.

The following failures are implied:

1. Short circuits in the component or in the connection wire outside a closed electrical mounting space, with the exception of resistances and transformers of a specific type of construction.
2. Interruption in components and wires.
3. No make and break response of a relay.
4. No make and break functions of contacts.
5. Defects in integrated circuits.

For the failsafety of switching apparatus, DIN VDE 0660 part 209 in harmony with VDE 0113 coercively prescribes the use of two relays, the output contacts of which must be switched in series.

When one relay fails, e.g. by welding of the switching contacts or by a mechanical defect in the construction of the relay, the second relay must continue to be effective in order to cause an interruption. Moreover, to be able to realize and establish the failure of one of the two relays, these must be interlocked in the exciting circuit in a way to show the defect of the relay by the next switching operation at the latest, thus excluding the possibility of another switching operation by of the deficient relay.

In case of a failure of one of the relays, this working behaviour of the two relays guarantees that the secured condition of the switching apparatus once set (contact circuit open) can no longer be returned to a good function.

In the failure assessment of the partial components of the inductive proximity sensor provided with a safety function, the authorized test offices proceed in a way to presume one failure only each time. If, however, further or more failures occur due to the first, these follow-on failures will be valued as a first failure, and will be considered accordingly in the failure analysis. With respect to failure resistance, the safety functions must be of the type not to be affected by the expected interfering fields. Defined minimum values exist for wire conducted interference voltages causing interfering voltages and currents due to magnetic, electric, electrostatic and electromagnetic fields by inductive or capacitive coupling to the wires.

TÜV [TECHNICAL SURVEYANCE BOARD] tested non contact positioning switch (BWP)

The BWP, isolating amplifier and proximity sensor was submitted to TÜV [TECHNICAL SURVEYANCE BOARD] to be tested. TÜV has tested this safety isolating amplifier and inductive proximity sensor as precisely defined in the test report as a technical switching unit, and has stated in the test result that this BWP is appropriate for general use in safety engineering.

In addition, attestations of conformity of PTB are available for the evaluation apparatus and the allocated sensors, permitting the use of the apparatus as related electrical operating material (isolation amplifier) or electrical operating material (sensors) in accordance with DIN EN 50020 (explosion type of protection "intrinsically safe").

BIA tested non contact positioning switch (BWP)

In its capacity as an official test office, the institute for industrial safety (BIA) of the Employers Liability Insurance Association carries out tests of forcibly opening positioning switches offering a function for personal protection. The switches are evaluated in accordance with the technical rules effective at the given time and with the test principles of the Association. As TÜV, the BIA carries out tests in accordance with DIN/VDE 660, part 209. The basis of these tests is GS-ET 14. In an additional test, the drifting behaviour of the input is evaluated among other items.

Inductive proximity sensors (slot sensors) in fail-safe technology

The SN series

If a metal is within the active range of the proximity sensor, the output of the subsequent safety amplifier locks, i.e. the output relay drops.

If no metal is within the active range of the proximity switch, the output of the subsequent safety amplifier is switched, i.e. the output relay is attracted.

The slot sensors types SJ 2 SN and SJ 3.5 SN we use are supplied in a plastic casing. The tight sealing of the casing and its cover and the moulding of the switch - free from cavities - under vacuum prevent any penetration of humidity. The type of protection is IP 68.

The S1N series

Contrary to the S-series, the S1N proximity sensors may only be attenuated with non ferrous metals, preferably aluminium. In addition, the direction of action has been reversed.

If a non ferrous metal is within the active range of the proximity sensor, the output of the subsequent safety amplifier switches (1-signal), i.e. the output relay is attracted.

If no non ferrous metal is within the active range, or somebody tries to operate the proximity sensor with the help of Fe metals, the secured condition is created, i.e. the output of the subsequent safety amplifier is locked (0 signal), i.e. the output relay drops.