

Safety sensors with new operating principle

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At SPS/ IPC/ Drives, the Schmersal Group introduced a new range of safety sensors operating according to a new principle, which can be wired in series ("daisy chained") without detriment to the control category. Apart from intelligent diagnostic and self-monitoring functions increasing the availability of the machine or plant to be monitored, the new range was developed in accordance with the IEC 61508 safety standard; therefore, the CSS 180 safety sensors are suitable for SIL 3 applications.

Safety sensors are increasingly – and not only in their traditional field of application, food industry - used as an alternative for electromechanical safety switches, i.e. for position monitoring at guard doors. Generally, safety sensors are used with magnetic reed contacts and coded actuator, which makes tampering with simple magnets impossible.



Image 1: At SPS/ IPC/ Drives, Schmersal introduced the new CSS range safety sensors.

The Schmersal Group offers a large program of safety sensors with different designs and switching distances. These sensors often have the same dimensions as frequently used safety switches such as the AZ 16, so that the constructor or the end user of the machine can choose his preferred type of safety switching device.

Specifications: high requirements

The BNS 16 and BNS 30 series that were introduced this summer also have reed contacts. But Schmersal also has developed a new range of sensors, complying with particular safety requirements. The specifications stipulated, amongst others, that the sensors already had to fulfil the requirements of the new safety standard IEC 61508 (see below). Furthermore, they had to be certified to the highest Control Category to EN 954-1 (Control Category 4) and to the product standard for electro-sensitive sensors, EN 60947-5-3 (PDF-M). And last but not least, they should be economic when integrated in the safety system.

New principle of operation

The result of these efforts was introduced at the SPS/ IPC/ Drives: the CSS range in compact M18 cylindrical housing. The high safety level and technical performance to be achieved by the sensors justified abandoning the conventional electromagnetic principle, where the actuator acts passively and only triggers the switching process by approaching the reed contact. Therefore, a new principle was developed, where the sensor and the actuator are a matched pair and communicate with each other: as the actuator approaches the sensor, the sensor excites the actuator at a predefined resonant frequency and then reads back the actuator oscillation. The sensor evaluates the actuator frequency and its

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distance to the actuator. Identification of the actuator is interpreted as a closed guard by the sensor and the safety outputs will be enabled.

Limit range of hysteresis is recognised

Apart from a high protection against tampering, this principle offers another advantage: if the sensor is operated near the limit of its switching distance, for example due to the sagging of a guard door, it is detected even before the safety outputs are disabled. In a similar way, faults that do not immediately compromise the safe operation of the sensor, for example a cross-wire short, are signalled as an advance warning. The machine can in this case be run down in a controlled manner.

Diagnostics

The new safety sensor is a dual-channel design with two short-circuit proof safe PNP outputs, each of which can switch up to 500 mA. Continuous internal function tests monitor the correct operation of the sensors and the safe outputs. The correct operation of the sensor, a fault in the sensor output, a cross-wire short and finally the actuation of the sensor itself by the actuator are signalled by the visual diagnostic 3 colour LED. The LED can also be used as an adjustment aid during fitting. Finally, general faults such as too high an ambient temperature are detected and indicated.

The „Daisy chain“ principle

Due to continuous international function tests and the monitoring of the safety outputs, a number of CSS safety sensors can be wired in series to form a chain. In this way, the monitoring of several guard doors of a unit with safety sensors considerably becomes easier and more economic. The safety sensors in this chain are self-monitoring. The last sensor in the chain provides the two short-circuit proof PNP outputs for further connection to the safety control circuit. The safety requirements according to EN 954-1, Control Category 4 remain fulfilled for the complete chain. Faults within the chain, e.g. a cross-wire short are detected. This includes faults in the wiring to the safety control monitor, which are also automatically detected. The safe outputs are disabled and the fault is indicated by the LED of the sensors and the electronic diagnostic outputs.

For large, extensive guard systems, the safety sensor is available with separate input and output cables. The series wired safety sensors can then be built up to a length of over two hundred metres by “daisy chaining” the devices. For compact systems where the control cables are parallel routed to a centralised control cabinet or for series wiring in junction boxes, the input and output leads of the safety sensor are combined in one cable. A single cable version is available for single sensor monitoring and is also suitable for the first sensor or as last sensor in a series.

The requirements of IEC 61508 are already fulfilled

Apart from Control Category 4 to EN 954-1, the CSS range safety sensors also fulfil the requirements for proximity devices with defined behaviour under fault conditions according to EN 60947-5-3

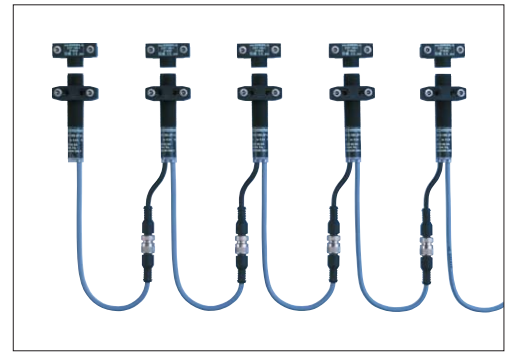


Image 2: Different variants are available, which can be wired in series („daisy chained“) without detriment to the control category.

with the classification self-monitoring (PDF –M). In this way, the user is always “safe”. The CSS range is always certified for the respective highest control categories.

Furthermore, the standard IEC 61508, the latest specification for ensuring universal compliance to international safety standards was used as a guideline for the development of the safety CSS safety sensor. Consequently, the CSS safety sensor can be used in SIL 3 applications to IEC 61508 (see below)

Compact design, multiple applications

Both the sensor and actuator are small and compact. The sensor and actuator are encapsulated, vibration-proof and suitable for application in harsh, dusty or dirty environments. They comply with the requirements for the degree of protection IP 65 or 67. If required, both the actuator and the sensor can be flush mounted. In this way, the sensors that are manufactured at the Schmersal Plant in Wuppertal have a wide range of applications. For the signal evaluation of the sensor chains, the Schmersal Group offers different safety control modules.



Image 3: The LED indicates the operating state of the safety sensor as well as errors, which are simultaneously signalled by the electronic diagnostic output as well.

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IEC 61508 – a new safety standard?

In the middle of 2001, the IEC 61508 standard (the series of standards relating to electrical/electronic/programmable electronic safety-related systems) was published as harmonised standard. Unlike EN 954 for instance, IEC 61508 is not a harmonised standard in the sense of the Machinery Directive. This standard aims at offering measures to increase the safety of large and complex plants and machinery, for instance in process engineering. This led to some kind of “rivalry” or competition with EN 954. The latter starts from a deterministic point of view for the determination of the Control Categories, whereas IEC 61508 rather adopts a probabilistic approach for the classification of its “SIL’s” (Safety Integrity Levels). This development is interesting for machine and plant builders, considering that the currently started revision of EN 954 is highly based upon the methodical approach of IEC 61508. Reviewing the (often criticised) EN 954 became necessary, since at IEC level another standard (IEC 62061, explicitly destined to machinery construction) is being prepared on the basis of IEC 61508. An important aim of the review is to ensure that the “new“ EN 954 (that will be called EN 13849-1) and IEC 61508 will have so much ground in common that both standards are compatible in real terms and that Machine Safety will no longer live in two different “worlds” in the future.

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