Safety manual in accordance with the EN 61508 series of standards

44 799 13752003

Level detector type LS 300 ... and Measuring Transducer type LS 500 H SIL ...

I Range of application

The level detector type LS 300 ... and the measuring transducer type LS 500 H SIL ... are suitable for areas in which a safety-related subsystem (overfill protection or dry-running protection respectively as control) according to EN 61508 with SIL 2 is mandatory.

II Standards

The subsystem is designed in accordance with the following standards

EN 61508:2010, all Parts	Functional safety of electrical/electronic/programmable electronic safety-related systems
EN IEC 61326-3-2:2018	Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – Industrial applications with specified electromagnetic environment

III Instructions for safe ...

III.a ... use

This safety guide applies to all level detectors type LS 300 ... and the following measuring transducers from hardware version 1.0.1.255 and from firmware version 1.0.1.255:

LS 500 H SIL	Measuring transducer as overfill protection resp. control, assessed according to functional safety
LS 500 H SIL T	Measuring transducer as dry-run protection resp. control, assessed according to functional safety

From firmware version 1.1.0.255, the firmware version can be read with MODBUS-RTU Protocol from the transmitter via the RS-485 interface. To do this, use the Function Code 03 (Read Holding Registers) with following addresses:

Address	Content	Meaning
0x0040	0x0101	Version number digit 1 (main version) and digit 2 (features)
0x0041	0x00FF	Version number digit 3 (bug fixes) and digit 4 (release)

Table III.a: Storage of the version number in registers

The safety function is mapped by the sensor relay. This not only shows the alarm condition if the relay is deactivated, but also if there is a diagnostic error. The SIL Error relay and the SIL Error LED additionally indicate the SIL Error but are not part of the safety function.

The response times of the level detector LS 300 ... with measuring transducer LS 500 H SIL ... are maximal two seconds when used as overfill protection respectively control and approximately (typically at room temperature) 20 s when used as dry-run protection respectively control.

The level detector type LS 300 ... was subjected to a vibration test in accordance with VdTÜV-information sheet overfill protection 100-part 2. It is therefore suitable for vibration environments with 10 Hz to 55 Hz and 2 g. A shock test was not performed.

A vibration and shock test were not carried out with the measuring transducer LS 500 H SIL ...

III.b ... assembling and dismantling

For level detectors with connection housings only the cover of the housing may be removed for the electrical installation. After the installation the connection housing must be closed again.

At measuring transducers, only the cover of the housing may be removed to operate the test button.

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III.c ... installation

The installation must be carried out only with the power disconnected!

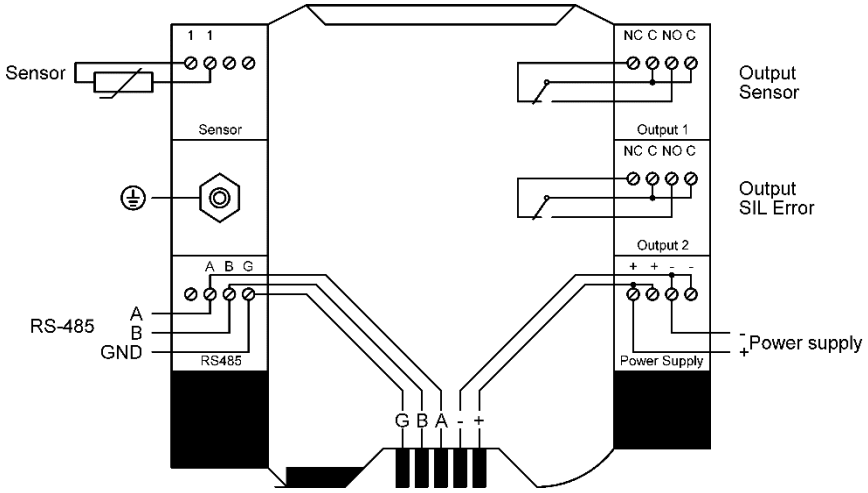

Figure III.c: Wiring diagram

III.d ... adjustment

No SIL-relevant adjustments are required for operation of the sensors.

III.e ... putting into service

Before putting into service, all devices must be checked of right installation and connection. The electrical supply, as well of connected devices, must be checked.

When using the measuring transducer as dry run protection respectively control, it should be observed that the sensor relay activates about two seconds after switching on.

III.f ... maintenance (servicing and emergency repair)

Device is generally maintenance-free. In case of a defect, it must be send back to FAFNIR or one of its representations.

Nevertheless, the functionality of the system should be checked at appropriate intervals, but at least once a year. The operator shall be responsible for the type and frequency of inspection within the specified period.

If the level detector is surfaced, the PTC thermistor in the level detector can be cooled by means of the test button on the measuring transducer (corresponds to the immersion). If the level detector is immersed, remove it from the medium and wait until the PTC thermistor is heated up.

Pressing the test button of a surfaced level detector switches to the "immersed" state after less than a second and the sensor relay is deactivated. If the button is still being pressed, then after about five seconds (two seconds with firmware version 1.0.1.255) additionally the SIL-Error (scanner transistor; see Table III.f) is triggered and the SIL relay is activated.

If a SIL Error has occurred, the measuring transducer must be de-energized to force a restart.

Starting with firmware version 1.3.0.255, a restart can also be forced in the event of a SIL error by pressing the test button for ten seconds.

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To facilitate the diagnostics in case of a SIL error, a flashing code is output with the "Error" LED as of firmware version 1.2.0.255 and hardware version 1.1.0.255, whereby the actual cause can be identified. The corresponding blink code is issued continuously, each with a short pause. The following blink codes are used:

SIL error	Blink code
Memory	1
Checksum	2
Relay	3
Scanner resistance	4
Scanner transistor	5
Isolation	6

Table III.f: The blink codes of LED "Error"

To ensure that a short circuit can be detected directly on the level sensor even with a higher cable length, the cable resistance must be < 30 Ω (with firmware version 1.0.1.255 < 2.5 Ω).

An insulation failure on the level sensor is only conditionally recognized and not displayed up to and including firmware version 1.1.0.255 and hardware version 1.0.2.255. From firmware version 1.2.0.255 and hardware version 1.1.0.255 this error is detected and displayed.

IV Technical data

Auxiliary energy

LS 300 … via LS 500 H SIL …
LS 500 H SIL … 23 V_{DC} … 30 V_{DC}; 4.5 W

Output circuit (potential-free changeover contacts from LS 500 H SIL …)

Sensor relay (LS 300 … outside potential explosive atmosphere)

Alternating voltage AC U ≤ 250 V; I ≤ 5 A; P ≤ 500 VA; cos φ ≥ 0.7
Direct current DC U ≤ 50 V/110 V/250 V; I ≤ 5 A/1 A/400 mA; P ≤ 400 W/110 W/100 W
Minimum switching load 5 V / 10 mA

Sensor relay (LS 300 … inside potential explosive atmosphere)

Alternating voltage AC U ≤ 42 V; I ≤ 5 A; P ≤ 100 VA; cos φ ≥ 0.7
Direct current DC U ≤ 60 V; I ≤ 5 A; P ≤ 100 W
Minimum switching load 5 V / 10 mA

SIL error relay (LS 300 … outside potential explosive atmosphere)

Alternating voltage AC U ≤ 250 V; I ≤ 5 A; P ≤ 500 VA; cos φ ≥ 0.7
Direct current DC U ≤ 24 V/110 V/220 V; I ≤ 5 A/300 mA/120 mA; P ≤ 240 W/33 W/26 W
Minimum switching load 300 mW (5 V / 5 mA)

SIL error relay (LS 300 … inside potential explosive atmosphere)

Alternating voltage AC U ≤ 250 V; I ≤ 5 A; P ≤ 100 VA; cos φ ≥ 0.7
Direct current DC U ≤ 24 V/110 V/220 V; I ≤ 5 A/300 mA/120 mA; P ≤ 100 W/33 W/26 W
Minimum switching load 300 mW (5 V / 5 mA)

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Temperatures

LS 300 …	Medium temperature T_F	Ambient temperature T_a
Standard	-25 °C … +50 °C	-25 °C … +80 °C
High (H type)	-25 °C … +80 °C	
Highest (HH type)	-10 °C … +110 °C	
Low (L type)	-40 °C … +50 °C	-40 °C … +80 °C

Table IV.a: Temperatures of the Level detector LS 300 …

LS 500 H SIL … -25 °C … +50 °C

Pressures (only LS 300 …)

Standard 0 bar … 3 bar
Special version 0 bar … 25 bar

Degree of protection provided by enclosure

LS 300 … ≥ IP67
LS 500 H SIL … IP20

Safety-related performance parameter

Parameter		Wert		
Safety Integrity Level		SIL 2		
Mode of operation	as protection	low demand mode		
	as control	high demand mode		
Hardware Fault Tolerance		HFT = 0		
Safety-related subsystem		Type B		
Failure rate [h^{-1}]		λ_S = 1,96E-06	λ_{DD} = 2,12E-06	λ_{DU} = 6,83E-07
Average frequency of dangerous failure per hour, PFD_{avg} resp. PFH [h^{-1}]		See failure rate λ_{DU}		
Mean time to restoration		MTTR = 8 h		
Interval of the retest		T_1 = 1 year		
Architecture		1001		
Useful lifetime		20 years		

Table IV.b: Safety related parameter

V Additional requirements for software elements

There are no requirements for software elements.

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