SIL Instructions

Safety-related parameters

Safety Integrity Level		SIL2
Operating Modes		Low and continuous demand mode
Achitecture		1oo1
Device Type		B
Hardware Fault Tolerance	HFT	0
Safe Failure Fraction	SFF	>90%
Failure rate for safe detected failures	λ_{SD}	$2{,}03 \cdot 10^{-7}$ 1/h
Failure rate for safe undetected failures	λ_{SU}	$2{,}37 \cdot 10^{-7}$ 1/h
Failure rate for dangerous detected failures	λ_{DD}	$3{,}41 \cdot 10^{-7}$ 1/h
Failure rate for dangerous undetected failures	λ_{DU}	$2{,}44 \cdot 10^{-8}$ 1/h
Probability of a dangerous undetected failure per hour	PFH	$2{,}44 \cdot 10^{-8}$ 1/h

Inspection Interval	T_1	1 year	2 years	3 years	5 years
Probability of a dangerous undetected failure on demand	PFD	$1{,}10 \cdot 10^{-4}$	$2{,}16 \cdot 10^{-4}$	$3{,}23 \cdot 10^{-4}$	$5{,}37 \cdot 10^{-4}$

for MTTR = MRT = 8 h

1 General Information

These SIL Instructions contain information and instructions for using the device as part of your protection system according to IEC/EN 61508. In addition to these instructions, please take all relevant legal requirements, applicable standards as well as the additional technical specifications on the accompanying data sheet into account (see www.labom.com).

1.1 Safe Function

The safe function of the device according to IEC/EN 61508 is the 4…20 mA current signal.

1.2 Validity

The safe function can only be guaranteed if the option "Functional safety according to IEC/EN 61508" has been chosen for the device. These devices are marked as shown on the right.

SIL marking on the unit.

2 Technical Data

The following technical data applies to the safe function of the device.

2.1 Accuracy

The accuracy according to the data sheet also applies during safe operation.

For devices with diaphragm seal take the error of the diaphragm seal into account as well.

For devices with ATC-option the accuracy for devices without ATC-option applies only.

Please observe that for devices with operating software for level applications inaccurate level parameters directly affect the accuracy of the level calculation. E. g. the less accurate the density is set, the more the calculated level deviates from the actual level.

2.2 Reaction Times

The reaction times indicate how long the device may need to reach a safe state (correct measured value or alarm current) in the worst possible case.

- In the event of a request: 220 ms
- In the event of fault detection: 100 ms

Note that any set damping value can extend the reaction time in the event of a request.

Additional elements in the process connection, such as capillaries, can extend the reaction time in the event of sudden pressure changes in the process.

2.3 Start-up Behaviour

A safe state is also guaranteed during initialisation or a phase of low voltage. After connecting the supply voltage, a current of < 3.6 mA (alarm current) is issued at the current output. Following completion of initialisation, after about 5 seconds, the current output jumps to a current proportional to the applied pressure or approaches the correct current according to the set damping value.

2.4 Troubleshooting

In the event of a critical device malfunction, an alarm current of < 3.6 mA or > 21 mA is permanently issued at the output.

The alarm current can be deactivated by a manual restart only.

3 Requirements for the Operator

The operator has to consider the following requirements to ensure that the safe function is not jeopardised.

3.1 Unsafe Operating Conditions

Avoid the following functions while using the devices as part of a protection system:

- HART multi-drop operation in fixed current mode
- Pressure or current simulation
- Adjustment of the current output

Communicating with the device via HART or the display module does not affect the safe function, providing no parameters are changed that affect the current signal.

The value at the current output is no longer proportional to the pressure when using the table function, for example, to map the tank shape when measuring the level. A fault in the support points of the table leads to a faulty signal current. There is a linear interpolation of the measurement between these support points. This reduces the accuracy between the support points.

When using the table function in SIL application, the operator should therefore take appropriate measures to ensure the correctness and sufficient accuracy of the table.

3.1.1 Ci4 LEVEL

For devices with operating software for level applications please pay attention to the following points:

Set the height offset first and then scale the current output (parameters „value for 4 mA“ and „value for 20 mA“). This is because the scaling of the current output is based on the height offset.

Ensure that the hydrostatic pressure of a completely filled tank does not exceed the nominal range of the device.

Ensure that the value for 4 mA does not represent a level that lies below the process connection of the device.

3.2 Requirements for Safe Operation

Avoid unsafe operating conditions (see 3.1).

Ensure compatibility of wetted materials with process media and cleaning agents.

Avoid environmental conditions that exceed the data sheet limits.

Avoid a pressure load that exceeds the permissible overpressure as per corresponding data sheet.

Monitor both alarm states (< 3.6 mA or > 21 mA) regardless of the alarm function setting.

Avoid an excessive supply voltage above 30 V.

3.3 Regular Inspections

Hazardous undetected faults during operation can be detected with a high level of certainty during regular inspections. The operator can define the inspection interval depending on the PFD value required.

Not only the device but the complete measuring chain should be tested during inspection. It is the responsibility of the plant operator to determine an adequate test of the safety function.

The following inspection procedure is recommended for the device to achieve a high fault detection.

- Set the current simulation to a value of < 3.6 mA and check whether the current output reaches this value
- Set the current simulation to a value of > 21 mA and check whether the current output reaches this value
- Apply one or more pressure values and check whether the current output corresponds to the applied pressure