

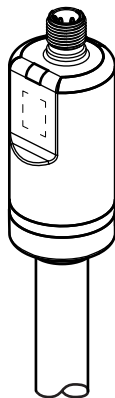


Operating instructions
Binary level sensor

LI513x

UK

11410834 / 00 08 / 2021



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1 Preliminary note

1.1 Symbols used

- Instruction
- > Reaction, result
- [...] Designation of keys, buttons or indications
- Cross-reference
-  Important note
Non-compliance may result in malfunction or interference.
-  Information
Supplementary note

2 Safety instructions

- The device described is a subcomponent for integration into a system.
 - The system architect is responsible for the safety of the system.
 - The system architect undertakes to perform a risk assessment and to create documentation in accordance with legal and normative requirements to be provided to the operator and user of the system. This documentation must contain all necessary information and safety instructions for the operator, the user and, if applicable, for any service personnel authorised by the architect of the system.
- Read this document before setting up the product and keep it during the entire service life.
- The product must be suitable for the corresponding applications and environmental conditions without any restrictions.
- Only use the product for its intended purpose (→ Functions and features).
- Only use the product for permissible media (→ Technical data).
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property may occur.
- The manufacturer assumes no liability or warranty for any consequences caused by tampering with the product or incorrect use by the operator.
- Installation, electrical connection, set-up, operation and maintenance of the product must be carried out by qualified personnel authorised by the machine operator.
- The unit complies with the standard EN 61000-6-4. The unit may cause radio interference in domestic areas. If interference occurs, the user must take appropriate actions.
- Protect units and cables against damage.

3 Items supplied

- Level sensor LI513x (x = coding of the probe length)
- Operating instructions or Quick setup guide
- Stainless steel tube clip (for fixing the installation height)

In addition, the following is necessary for installation and operation:

- Mounting material (→ Accessories)



Only use accessories from ifm electronic gmbh!

The optimum function is not ensured when using components from other manufacturers.

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Accessories: www.ifm.com

4 Functions and features

The unit monitors the level (point level) and the temperature of liquid media in tanks.

4.1 Application area

Water, hydrous media, oils, oil-based media, emulsions.

4.2 Restriction of the application area

- Use the product only for media to which the wetted materials are sufficiently resistant (→ Technical data sheet).
- The unit is not suitable for hygienic areas.
- The unit is not suitable for applications where the probe is subjected to permanent and high mechanical stress (e.g. bulk materials, abrasive media or fast flowing media containing solid particles).
- Highly conductive foam can trigger a switching operation. Check the consequences by performing a test in your application!

5 Function

5.1 Measuring principle level

The unit operates on the capacitive measuring principle. In direct contact with the medium the unit detects whether the requested level (point level) has been reached.

The relative permittivity (before: dielectric constant) of a medium is important for its detection. Media with a relative permittivity greater than 1.8 are reliably detected.

Electrically conductive and non conductive media are detected.



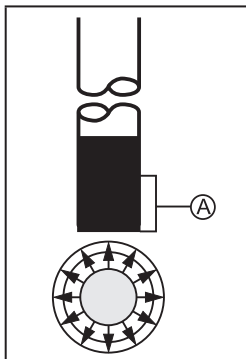
Relative permittivity of common media

Mineral oil	≈ 2
Coolant emulsion	≈ 25...75
Glycol	≈ 37
Water	≈ 80

The unit operates with radial detection characteristics. Therefore media below the active zone (A) are not detected.



When the unit is perfectly adjusted, the presence of certain media can be detected while build-up or foam is suppressed.



A: Active zone (28 mm)

5.2 Measuring principle temperature

The temperature is detected by a temperature element at the lower end of the probe and electronically evaluated.

5.3 Features of the unit

- The unit versions are offered with different probe lengths.
- Point level selectable by the installation length (→ 6).
- Parameter setting using the teach button (→ 9.1) or via IO-Link (→ 9.2).
- The unit has two switching outputs:
 - Output OUT1 is assigned to the process value "Level".
 - Output OUT2 can be assigned to the process value "Level" or "Temperature".
- Adjustment function (empty and full adjustment) to the medium to be detected.
- Defined state in case of a fault (→ 9.2.4)

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5.3.1 IO-Link

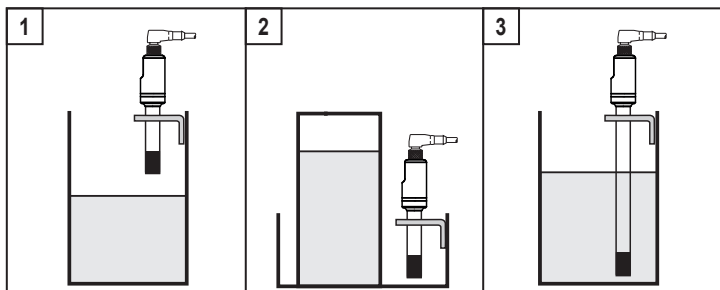
The device has an IO-Link communication interface which requires an IO-Link capable module (IO-Link master).

The IO-Link interface enables direct access to the process and diagnostic data and provides the possibility to set the parameters of the unit during operation.

In addition, communication is possible via a point-to-point connection with a USB IO-Link master.

The IODDs necessary for the configuration of the unit, detailed information about process data structure, diagnostic information, parameter addresses and the necessary information about the required IO-Link hardware and software can be found at www.ifm.com.

5.4 Application examples



- 1: Overflow protection in a supply tank for coolant emulsion.
- 2: Leakage monitoring in the overflow vessel of a hydraulic power unit.
- 3: Minimum level monitoring.

6 Installation

6.1 Installation location / environment

- Vertical installation from the top is preferred.
- The following minimum distances must be adhered to:

Distance tank bottom - end of the probe	10 mm
Distance metal tank wall - probe	20 mm
In case of plastic tanks: If possible, install the unit in the middle of the tank to prevent capacitive interference by objects outside the tank. When interference occurs: ► Provide for a metal screen (e.g. using a shielding plate, etc.).	
Distance between several LI513x units (distance from the centre of a probe to the centre of another probe): Reference values for standard applications:	
- Water / coolant emulsion in a grounded metal tank:	40 mm
- Oils in a grounded metal tank:	100 mm
- Water, media similar to water and oils in an ungrounded plastic tank:	200 mm
Distance between LI513x and LKxxxx units: (Distance from the centre of a probe to the centre of another probe)	60 mm
Metal-free space around the inductive teach button (→ 8)	20 mm



The indications refer to the factory setting (→ 13). Depending on the application and the customised settings, smaller distances may also be possible. In this case:

- Check the function by performing an application test.

6.2 Installation procedure

The unit is mounted using a mounting clamp or an adapter (→ Accessories).

- Observe the installation instructions for the adapter or mounting clamp used.
- Weld or screw the adapter into the tank / pipe.

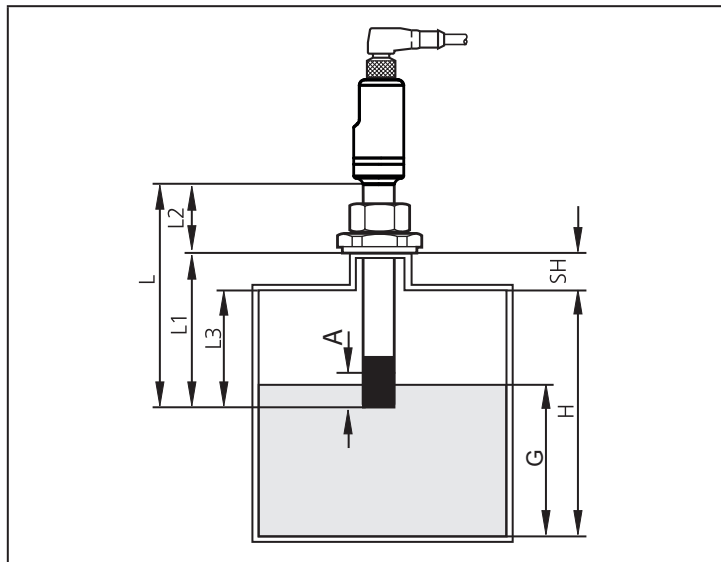
6.3 Set the installation depth



The unit switches when the level reaches the active zone (A).

The exact position (response level) depends on the following factors:

- characteristics of the medium
- installation conditions
- adjustment of the unit (→ 9)



G = point level

H = tank height

SH = height of the connection piece

L = probe length

L1 = installation depth

L2 = outside length

L3 = mounting length (at least 60 mm)

A = active zone (28 mm)

- Select the installation depth L1 and the outside length L2 so that at least half the active zone (A) is covered when the point level G has been reached:

$$L1 = (H - G) + \frac{1}{2} A + SH \quad \text{and} \quad L2 = L - L1$$

- Fix the set installation depth with the supplied stainless steel tube clip.

7 Electrical connection



The unit must be connected by a qualified electrician.

The national and international regulations for the installation of electrical equipment must be adhered to.

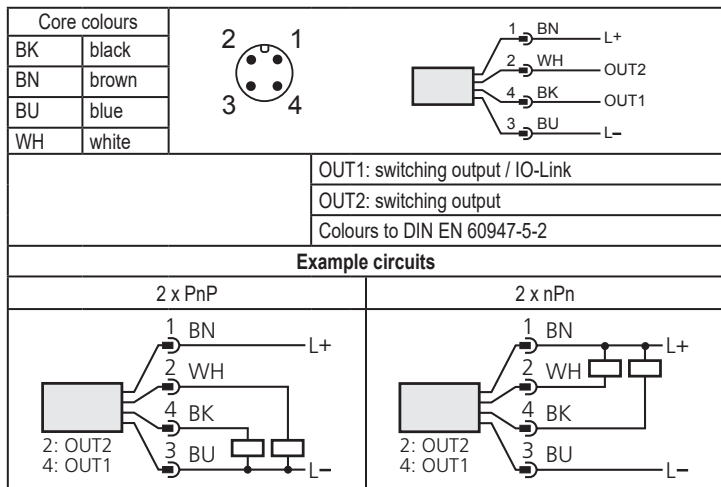
Voltage supply according to EN 50178, SELV, PELV.



For marine applications (if approval available for the device), additional surge protection is required.

► Disconnect power.

► Connect the unit as follows:



8 Operating and display elements

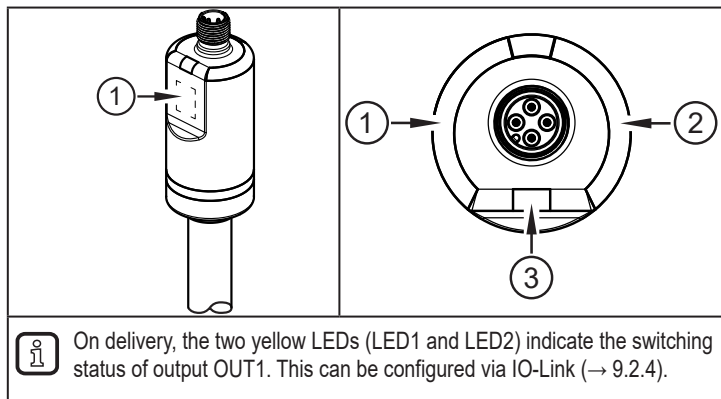


Fig. 1: view of the unit

1: inductive teach button

Fig. 2: top view

1: LED1 (yellow) = switching status OUT1

2: LED2 (yellow) = switching status OUT1 (OUT2)

3: LED3 (green) = operating status

 The inductive teach button is actuated with a metal object (e.g. a screwdriver 1 x 5,5 mm) by applying it flat to the teach surface. No operation is triggered by actuating the button briefly (less than 1 s) or continuously (longer than 30 s) (static activation)!

9 Parameter setting

On delivery, the unit is set to detecting water-based media (e.g. coolant emulsion). In many cases the factory setting is sufficient, so that no further settings are required.

► Check the function by performing an application test) (→ 10).

In case the factory settings are not sufficient:

► Adapt the unit to the application.

 The unit can be parameterized using the inductive teach button (→ 9.1) or via IO-Link (→ 9.2). Some functions are only available via IO-Link.



- Make sure that there will be no malfunctions / dangerous operation in your plant.

9.1 Parameter setting via the teach button



The teach button can be used to unlock the unit in a first step (→ 9.1.1) and then to adjust the unit sensitivity.

The unit sensitivity is adjusted by carrying out an empty adjustment and / or a full adjustment (→ 9.1.2) and (→ 9.1.2).

The switching thresholds (set point and reset point) are automatically defined with the adjustment procedure.



The teach operation only has an effect on the process value "level" while always affecting both outputs (OUT1 and OUT2).

All other parameter settings can only be made via IO-Link (→ 9.2).

Actuating the teach button: (→ 8)



The unit is locked at the beginning of operation and after 120 s of inactivity (operating hurdle to avoid unintentional input of incorrect values).

9.1.1 Unlock unit

- Actuate the teach button for at least 10 s.
- > The green LED3 flashes during these 10 s at approx. 1 Hz. The expiry of the 10 s is acknowledged with a double flash (at approx. 2 Hz).
- Release the teach button (remove metal object).
- > The green LED is lit permanently.
The unit is now unlocked.



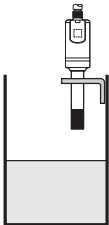
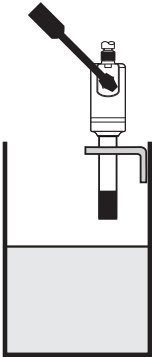
After 120 s of inactivity, the unit locks itself again automatically. Parameterisation can only be performed within this period.



The green LED will flash as signal if you try to perform operations while the unit is locked. The unit remains locked if the teach button is released before 10 s have expired.

9.1.2 Set for empty tank condition

By performing the empty adjustment, the unit is adjusted to the empty tank and the installation conditions (e.g. the distance to the tank wall / structures in the tank). Previous adjustment operations are deleted. By performing the empty adjustment, the unit is adjusted to maximum sensitivity which is particularly suitable for media with a low dielectric constant (e.g. oils).

1		► Empty the tank. In case the unit is used as a level switch or overflow prevention: Empty the tank until the medium is at least 20 mm below the end of the probe.
2		► Unlock the unit (→ 9.1.1)
3		► Actuate the teach button for at least 1 s / not longer than 4 s. > First, the green LED3 goes out briefly, then the two yellow LEDs flash slowly after 1 s (at approx. 1 Hz). ► Release the teach button (remove metal object). > Successful completion of the empty adjustment is acknowledged with a double flash of the green LED (at approx. 2 Hz).  While the unit is in factory setting, both yellow LEDs are off. > The unit is ready for operation.  While the unit is in factory setting, output 1 (OUT1) is set to normally open and output 2 (OUT2) to normally closed.



Modify output configuration: (→ 9.2).

9.1.3 Set for full tank condition

In case of aqueous media, in particular those where deposits or soiling are to be expected, the empty adjustment is not necessary and a full adjustment can be carried out immediately.



Where an empty adjustment has been carried out for aqueous media, it must be followed by a full adjustment to achieve a perfect adjustment of the unit sensitivity to the medium.

1		► Fill the tank until the active zone (A → 6.3) is completely covered.
2		► Unlock the unit (→ 9.1.1)
3		► Actuate the teach button for at least 4 s / not longer than 7 s. > First, the green LED3 goes out briefly, then the two yellow LEDs start flashing slowly after 1 s (at approx. 1 Hz) before flashing quickly after 4 s (at approx. 2 Hz). ► Release the teach button (remove metal object). > Successful completion of the full adjustment is acknowledged with a double flash of the green LED (at approx. 2 Hz).  While the unit is in factory setting, both yellow LEDs are lit. > The unit is ready for operation.  While the unit is in factory setting, output 1 (OUT1) is set to normally open and output 2 (OUT2) to normally closed.



Modify output configuration: (→ 9.2).

9.2 Parameter setting via IO-Link

A PC with USB IO-Link master (→ 9.2.1) or a programmed memory plug (→ 9.2.2) or a configured IO-Link environment (→ 9.2.3) is required to set the parameters.

9.2.1 Parameter setting via PC and IO-Link master

- ▶ Prepare PC, software and master. → Observe the operating instructions of the respective units / software (→ 5.3.1).
- ▶ Connect the unit to the USB IO-Link master (→ Accessories).
- ▶ Follow the menu of the IO-Link software.
- ▶ Set the parameters; adjustable parameters (→ 9.2.4).
- ▶ Check if the parameter setting was accepted by the unit. If necessary, read sensor again.
- ▶ Remove USB IO-Link master and put the unit into operation (→ 10).

9.2.2 Parameter setting via memory plug

Via a memory plug (→ Accessories), a parameter set can be written/transferred to the unit (→ 5.3.1). This procedure may be used e.g. for duplicating the parameter setting of one unit to another.

- ▶ Load suitable parameter set (e.g. using a PC) to the memory plug
→ observe the operating instructions of the memory plug.
- ▶ Make sure that the sensor has the original factory settings.
- ▶ Connect the memory plug between sensor and socket.
- > When voltage is supplied, the parameter set is transferred from the memory plug to the sensor.
- ▶ Remove the memory plug and put the unit into operation (→ 10).

9.2.3 Parameter setting during operation

- ▶ Make sure that the sensor is connected to an IO-Link-capable module (master) (→ 5.3.1).
- ▶ Read the sensor using a suitable IO-Link software → observe the operating instructions of the respective software.
- ▶ Set the parameters; adjustable parameters (→ 9.2.4).
- ▶ Check if the parameter setting was accepted by the unit. If necessary, read sensor again.
- ▶ Check whether the unit operates reliably.

9.2.4 Adjustable parameters and system commands

Parameter

uni.T	Selection of the temperature unit: [°C] = temperature is displayed in °C (degrees Celsius) [°F] = temperature is displayed in °F (degrees Fahrenheit)
P-n	Set output logic for the switching outputs: [PnP] = positive switching [nPn] = negative switching
SEL2	Allocation of switching output OUT2 to the process value: [LEVL] = level ¹⁾ [TEMP] = temperature
LED mode	Switching state display via LEDs (→ 8): [OUT1] = The two yellow LEDs (LED1 and LED2) indicate the switching status of output OUT1. [OUT1+OUT2] = LED1 indicates the switching status of OUT1 and LED2 the switching status of OUT2.
ou1	Output configuration for switching output OUT1 (level) [Hno] = hysteresis function / normally open [Hnc] = hysteresis function / normally closed [OFF] = output OFF (high impedance)
ou2	Output configuration for switching output OUT 2 (level / temperature) [Hno] = hysteresis function / normally open [Hnc] = hysteresis function / normally closed [Fno] = window function ²⁾ / normally open [Fnc] = window function ²⁾ / normally closed [OFF] = output OFF (high impedance)
SPx - LEVL	Switch point 1 or 2 for level.  [SPx] must be greater than [rPx]. If [SPx] is set to a value below [rPx], this is rejected by the device software. The values for [SPx] / [rPx] are set in per cent of the maximum process value. The process value is defined as follows: Process value in air (not predamped): approx. 0 % Process value in tap water = approx. 100 % ³⁾
rPx - LEVL	Switch-off point 1 or 2 for level

SP2 (FH2) - TEMP	Switch point 2 or upper temperature limit for window function ([SEL2]=[TEMP]).  [SP2 (FH2)] must be greater than [rP2 (FL2)]. If [SP2 (FH2)] is set to a value below [rP2 (FL2)], this is rejected by the device software.
rP2 (FL2) - TEMP	Switch point 2 or lower temperature limit for window function ([SEL2]=[TEMP]).
dS1 / dS2	Switching delay ⁴⁾ for OUT1 and OUT2. Setting range 0.0...10.0 s
dr1 / dr2	Switching delay ⁴⁾ for OUT1 and OUT2. Setting range 0.0...10.0 s
FOU1 / FOU2	Response of OUT1 or OUT2 in case of a fault: [OFF] = switching output switches OFF in case of a fault. [On] = switching output switches ON in case of a fault. [OU] = switching output reacts according to process value, if possible.
Lo.T	Minimum value memory for the temperature
Hi.T	Maximum value memory for the temperature
Unit locking. Local parameter setting	[Open] = parameter setting via teach button is permitted. [Locked] = parameter setting via teach button is locked.

¹⁾ This setting is not possible in combination with [ou2] = [Fno] or [Fnc].

²⁾ This setting is only possible in combination with [SEL2] = [TEMP].

³⁾ Tap water in grounded metal tank

⁴⁾ Response according to VDMA. According to VDMA the switch-on delay always has an effect on SP, the switch-off delay always on rP irrespective of whether the normally open or normally closed function is used.

System commands

Restore Factory Settings	Restore Factory Settings.
Empty teach	Empty adjustment, automatically sets the switching thresholds SP and rP. More information: (→ 9.1).
Full teach	Full adjustment to the medium, automatically sets the switching thresholds SP and rP. More information: (→ 9.1).
Reset [Hi.T] and [Lo.T]	Reset maximum and minimum value memory.
Flash On	Visual indication (double flash) for localisation ON. The indication automatically disappears after 1 minute.
Flash Off	Visual indication (double flash) for localisation OFF.

For further information, please refer to the IODD description (→ www.ifm.com) or to the context-specific parameter descriptions of the used parameter setting software.

9.2.5 Example parameter setting via IO-Link

- ▶ Set the switching output OUT2 to temperature measurement.
Example: [SEL2] = [TEMP]
- ▶ The temperature output OUT2 shall be set as alarm output (as normally closed with a high temperature threshold). Example: [ou2] = [Hnc]
- ▶ Set the alarm temperature to 80°C.
Example: [SP2 (FH2)-TEMP] = 80;
[rP2 (FL2)-TEMP] = 75.
- ▶ Transfer the sensor data to the unit.
- ▶ Carry out a full adjustment to the medium to be detected:
Fill the tank until the active zone (A → 6.3) of the unit is completely covered.
 - ▶ Execute the system command [full teach].

All other settings remain as set at the factory.

10 Operation

10.1 Function check

After power-on the device is in the operating mode. It carries out its measurement and evaluation functions and generates output signals according to the set parameters.

- Check whether the unit operates reliably.

10.2 Operating and diagnostic messages via IO-Link

IODD and IODD descriptive text as a pdf file at: → www.ifm.com

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10.3 Operating indication by LEDs

The following indications refer to the factory settings. In this state OUT1 = Hno and OUT2 = Hnc.

Both yellow LEDs (LED1 and LED2, → 8) indicate the switching status of output OUT1.

Operating status	LED1 (yellow) (OUT1)	LED2 (yellow) (OUT1)	LED3 (green) (Operating voltage)
Unit ready for operation, no medium detected	OFF	OFF	ON
Unit ready for operation, medium detected	ON	ON	ON
No operating voltage / operating voltage too low	OFF	OFF	OFF
Short circuit OUT1	flashes at 4 Hz		ON
Short circuit OUT2	flashes at 4 Hz		ON
Error / failure	OFF	OFF	flashes at 8 Hz
Visual indication for localisation	1 Hz double flashing		ON
Teach operation	(→ 9.1)		
Fault during the teach operation	8 Hz yellow/green flashing for 2 s		
Teach with locked unit (→ 9.1.1)	X	X	flashes at 1 Hz

X: according to level

10.4 Output response in different operating states

	OUT1	OUT2
Initialisation	OFF	OFF
Normal operation	acc. to level and [ou1] setting	acc. to process value ([SEL2] setting) and [ou2] setting
Fault	acc. to setting [FOU1]	acc. to setting [FOU2]

11 Technical data and scale drawing



Technical data sheet and scale drawing at: → www.ifm.com

12 Maintenance / Transport

- ▶ Clean the sensor tip at regular intervals to avoid contamination over time or formation of deposits.
- ▶ Do not use any hard or sharp objects (such as wire brushes) if you clean the sensor manually since they could damage the sensor.
- ▶ Check the sensor and the mounting adapter at regular intervals and tighten again, if necessary.



After removal of the unit or a change of media with dielectric constants that differ greatly (e.g. oil / water) another adjustment should be carried out.

- ▶ It is not possible to repair the unit.
- ▶ After use dispose of the unit in an environmentally friendly way in accordance with the applicable national regulations.
- ▶ In case of returns ensure that the unit is free from soiling, especially from dangerous and toxic substances.
- ▶ For transport only use appropriate packaging to avoid damage of the unit.

13 Factory setting

	Factory setting	User setting
Unit locking. Local parameter setting	OFF	
uni.T	°C	
P-n	PnP	
SEL2	LEVL	
LED mode	OUT1	
ou1	Hno	
ou2	Hnc	
SP1-LEVL	34 %	
SP2-LEVL	34 %	
rP1-LEVL	25 %	
rP2-LEVL	25 %	
SP2 (FH2) - TEMP	65°C	
rP2 (FL2) - TEMP	62°C	
dS1	0.0	
dS2	0.0	
dr1	0.0	
dr2	0.0	
FOU1	OFF	
FOU2	OFF	
Lo.T	---	
Hi.T	---	

Percentage values refer to the process value. 0% corresponds to the measured value in air (not predamped), 100 % corresponds to the measured value in water (tap water in a grounded metal tank).