



Operating instructions
Electronic level sensor
LW2120

GB

11478388 / 00 09 / 2022

Contents

1	Preliminary note	4
1.1	Symbols used	4
1.2	Warnings used	4
2	Safety instructions	5
3	Intended use	6
3.1	Application area	6
3.1.1	Application examples	6
3.2	Restriction of the application area	7
4	Function	8
4.1	Measuring principle	8
4.1.1	Reflectivity, effect of dielectric constant	8
4.1.2	Foam and turbulence	9
4.1.3	Influence of vessel characteristics and installation	9
4.2	IO-Link	9
4.3	Outputs	9
4.3.1	Analogue output	9
4.3.2	Switching function	10
4.3.3	Defined state in the event of a fault (alert mode)	11
4.3.4	Simulation function	12
4.3.5	Damping function	12
4.4	Output response in different operating states	12
5	Mounting	13
5.1	Mounting position	13
5.2	Inclination	14
5.3	Polarisation and orientation	14
5.4	Beam angle and beam width	14
5.5	Installing the mounting bracket	15
5.6	Mounting the antenna extension	15
5.6.1	Remove the protective cap	15
5.6.2	Mount the antenna extension	16
5.7	Electrical connection	17
6	Parameter setting	18
6.1	Parameter setting via PC and IO-Link master	18
6.2	Parameter setting during operation	18
6.3	Parameter setting via Bluetooth adapter	19
6.4	Adjustable parameters	19
6.5	System commands	24
6.6	Example parameter setting	24
7	Operation	26
7.1	Function check	26
7.1.1	Detection quality check	26
7.2	Diagnostic messages, cause, troubleshooting	26
8	Troubleshooting	28
8.1	Troubleshooting incorrect level readings	28
8.1.1	Level too high / too low	28
8.1.2	Measured value is stuck	28
8.1.3	Measured value drops when level close to antenna	29
8.1.4	Measured value fluctuates	30
8.1.5	Measured value is occasionally unstable	31
8.1.6	Lagging of measured value during rapid level changes	31
8.1.7	Measured value correct at 0% (4 mA) but incorrect at 100% (20 mA)	32
8.1.8	Incorrect measured value when level is above 50%	32
8.1.9	Measured value drops to zero close to tank bottom	32
8.1.10	Level measurement is lost in an empty tank	33
8.1.11	Alert mode when level close to tank bottom	34
9	Maintenance, repair and disposal	35

10 Factory setting 36



11 Appendix 37

 11.1 Approvals and certificates 37

1 Preliminary note

You will find instructions, technical data, approvals and further information using the QR code on the unit / packaging or at www.ifm.com.

1.1 Symbols used

- ✓ Requirement
- ▶ Instructions
- ▷ Reaction, result
- [...] Designation of keys, buttons or indications
- Cross-reference
-  Important note
Non-compliance may result in malfunction or interference.
-  Information
Supplementary note

1.2 Warnings used



CAUTION

Warning of personal injury

- ▷ Slight reversible injuries may result.

2 Safety instructions

- 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 (→ Intended use).
- 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.
- Protect units and cables against damage.
- Standards and specifications → (Data sheet).



Radiated microwave energy:

The microwave energy radiated by the unit is far below that of mobile phones.

Maximum radiated energy: 2 mW.

According to the current state of science the operation of the unit can be classified to be harmless to human health.



CAUTION

With high process temperatures, parts of the unit may get hot.

- ▷ Risk of burns
- ▶ Do not touch the unit.
- ▶ Protect the housing against contact with flammable substances and unintentional contact.
- ▶ Allow the unit and process adapter to cool down before maintenance.

3 Intended use

The unit continuously monitors the level of liquids without contact.

Bulk materials are detected depending on their properties (conical heaps, grain size, dielectric constant, etc.).



The unit is suitable and approved for applications in closed tanks (according to ETSI EN 302 372) as well as in or above open tanks / plastic tanks (according to ETSI EN 302 729).

For applications in or above tanks / plastic tanks, the unit must be combined with the antenna extension. Mount the antenna extension (→ 16)

Without the antenna extension, the unit may only be used in an enclosed space (metal tank, concrete tank, or similar enclosure structures made of comparable damping material).

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.



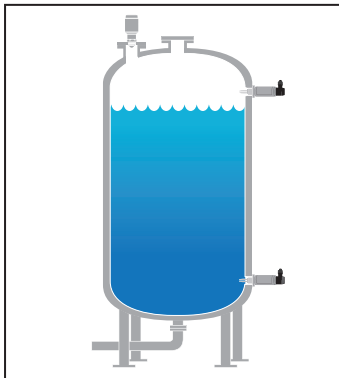
Available accessories: www.ifm.com.

3.1 Application area

With its top-down installation, the non-contacting radar technology is ideally suited for level monitoring and is virtually maintenance-free.

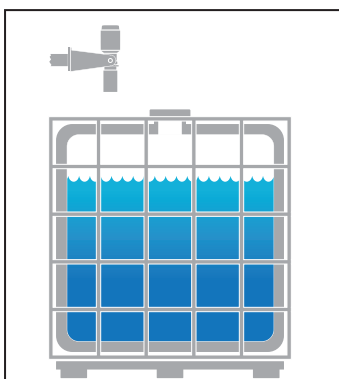
The unit combines the innovative 80 GHz technology with the FMCW method and smart algorithms to maximise measurement accuracy and reliability in challenging fast-filling / fast-emptying applications.

3.1.1 Application examples



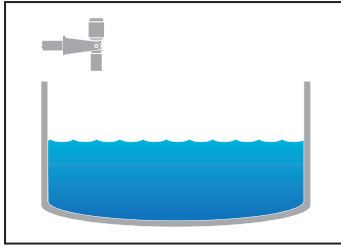
Storage tank:

Supports installation in a tank, ensuring smooth, uninterrupted production processes.



Plastic tank:

Level monitoring in small and medium-sized plastic tanks by measuring through the plastic roof.



Open application:

Level monitoring in open applications independent of surface and weather conditions.

3.2 Restriction of the application area

- The device is not approved for use in potentially explosive atmospheres.
- The unit is not suitable for all bulk materials (e.g. dry building materials) due to their very low dielectric constant.
- Detection of bulk materials with a higher dielectric constant (e.g. moist building materials due to their higher moisture content) may be possible. See: Reflectivity, effect of dielectric constant (→ 8)
- ▶ Check the function by performing an application test.
Note the influence of conical heaps and similar effects.
- ▶ The unit may only be installed in accordance with the applicable national and international radio regulations and statutory provisions (→ package leaflet).



Incorrect measurements may be caused by the following media:

- heavily foaming or turbulent surfaces.
- media which are very inhomogeneous, separate from each other thus forming separation layers (e.g. oil layer on water).
- ▶ Check the function by performing an application test.
- ▶ Installation in a steady area.
- ▷ In case of permanent signal loss, the unit generates an error message and switches the outputs to a defined state.

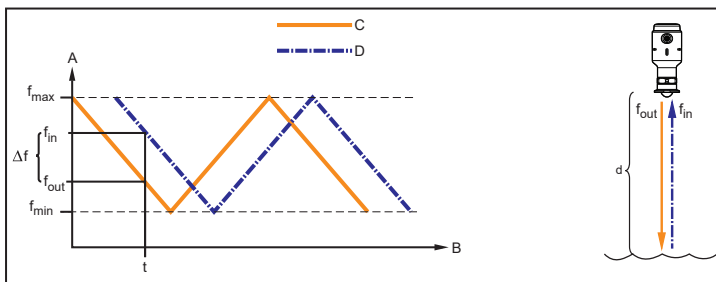


Hygienic adapters must be used to ensure FDA compliance.

4 Function

4.1 Measuring principle

The measuring principle of the unit is Frequency Modulated Continuous Wave (FMCW). The unit continuously emits electromagnetic waves in the GHz range with a constantly varying frequency towards the medium surface. Since the transmitter continuously changes the frequency of the transmitted signal, there will be a difference in frequency between the transmitted and the reflected signals (→ Fig. Measuring principle). The frequency of the reflected signal is subtracted from the frequency of the signal transmitted at that moment, resulting in a low frequency signal which is proportional to the distance to the medium surface. This signal is further processed to obtain fast, reliable, and highly accurate level measurements.



$\Delta f \sim d =$ distance
 A: frequency (GHz)
 B: time (s)
 C: transmitted signal
 D: reflected signal

Fig. 1: Measuring principle

Due to the 80 GHz technology used, the unit generates a very focused signal beam (beam angle 8° , without the antenna extension 10°). This extends the range of possible applications and enables installation even in small tanks and confined spaces (e.g. in tanks with agitators, heating coils, etc.).

4.1.1 Reflectivity, effect of dielectric constant

The reflectivity of the medium has a substantial effect on the reflected signal (echo amplitude). The reflectivity is directly dependent on the dielectric constant of the medium. A high dielectric constant provides better reflectivity, thus improving the performance of the level measurement. This also indirectly affects the maximum achievable level measuring range. Minimum dielectric constant: → Data sheet

Dielectric constant (also: relative permittivity) of some media	
Air (reference quantity)	1
Water	≈ 80
Salt water	≈ 32
Water, demineralised	≈ 30
Latex	≈ 25
Vinegar	≈ 24
Soot	≈ 18
Ceramic material	≈ 17
Guano / rock phosphate (application test recommended)	≈ 3
Vegetable oil (application test recommended)	≈ 2...4
Grist (application test recommended)	≈ 2...3
Malt (application test recommended)	≈ 2...3
Potash salt (application test recommended)	≈ 2
Coffee beans (not detected reliably)	≈ 1.5
Plaster / dry building materials (not detected reliably)	≈ 1.8
Fibre glass powder (not detected)	≈ 1.1

4.1.2 Foam and turbulence

Foaming liquids or turbulence may cause weak and varying echo amplitudes. Surface turbulence is not normally a problem unless it is excessive.

Measurement in foamy applications depends largely on the foam properties. If the foam is light and airy, the actual level is measured. For heavy and dense foam, the unit may measure the level of the foam's upper surface.

4.1.3 Influence of vessel characteristics and installation

The unit should be mounted so that objects such as heating coils, ladders and agitators are not in the radar signal path. These objects may cause false echoes which can affect the measurement and lead to measurement errors. However, the unit has built-in functions designed to reduce the influence from disturbing objects where such objects cannot be totally avoided. Vertical and inclined structures cause minimal effect since the radar signal is scattered rather than directed back to the antenna.

4.2 IO-Link

IO-Link is a communication system for connecting intelligent sensors and actuators to automation systems. IO-Link is standardised in the IEC 61131-9 standard.



General information on IO-Link at io-link.ifm



Input Output Device Description (IODD) with all parameters, process data and detailed descriptions of the device at documentation.ifm.com

IO-Link offers the following advantages:

- Interference-free transmission of all data and process values
- Parameter setting in the running process or presetting outside the application
- Parameters for identifying the connected devices in the system
- Additional parameters and diagnostic functions
- Automatic backup and restore of parameter sets in case of device replacement (data storage)
- Logging of parameter sets, process values and events
- Device description file (IODD - Input Output Device Description) for easy project planning
- Standardised electrical connection
- Remote maintenance

4.3 Outputs

The unit generates output signals according to the parameter setting. Two outputs are available:

- OUT1: switching output / IO-Link
- OUT2: analogue output 4...20 mA or switching output (configurable)

4.3.1 Analogue output

The unit provides an analogue signal proportional to the level (according to NAMUR NE43, DIN IEC 60381-1) or a switching signal on output OUT2. The analogue output can be configured.

- Parameter [ou2] = [I] sets output OUT2 as analogue output.
- Parameter [ASP2] sets at which measured value 4 mA are provided.
- Parameter [AEP2] sets at which measured value 20 mA are provided.

- If [ASP2] is set lower than [AEP2], a rising curve results; if [ASP2] is set higher than [AEP2], a dropping curve results (→ Fig. Analogue output).

Minimum distance between [ASP2] and [AEP2] = 20 % of the active zone

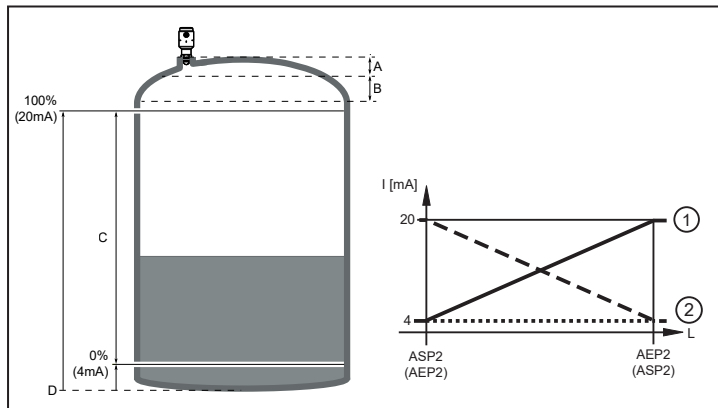


Fig. 2: Analogue output

- | | |
|--|-----------------------------------|
| A: Upper blind zone, configurable.
Adjustable parameters (→ □ 19) | I: current |
| B: zone with reduced accuracy | L: level |
| C: recommended measuring range | 1: rising curve ([ASP2]<[AEP2]) |
| D: zero point = reference point | 2: dropping curve ([ASP2]>[AEP2]) |

Note the tolerances and accuracies during the evaluation of the analogue signal (→ data sheet).

4.3.2 Switching function

Via switching output OUT1 (factory setting) or additionally via OUT2 (can be set) the unit signals that a set limit level has been reached or that the level is below the limit. The following switching functions can be selected:

- hysteresis function / normally open or normally closed (→ Fig. Single-point mode and fig. Two-point mode)
- window function / normally open or normally closed (→ Fig. Window function)

The hysteresis function can be applied in single-point mode and in two-point mode. Functionally, both modes are the same; only the setting method differs.

The explanations below refer to output OUT1.

Hysteresis function single-point mode:

- ▶ [SSC1 Config. Mode] must be set to [Single point].
- ▶ First the set point [SSC1 Param. SP1] is set, then the hysteresis [SSC1 Config. Hysteresis] with the requested difference (→ Fig. Single-point mode).

The normally open or normally closed function is set by [SSC1 Config. Logic]:
[no] = normally open / [nc] = normally closed.

Hysteresis function two-point mode:

- ▶ [SSC1 Config. Mode] must be set to [Two point].
- ▶ [SSC1 Param. SP1] sets the set point and [SSC1 Param. SP2] sets the reset point (→ Fig. Two-point mode).

The normally open or normally closed function is set by [SSC1 Config. Logic]:
[no] = normally open / [nc] = normally closed.

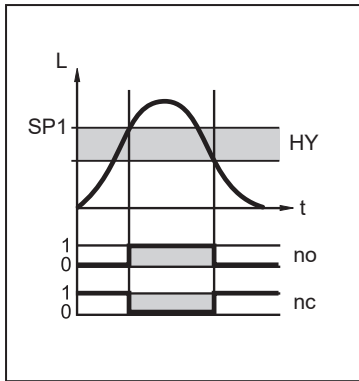


Fig. 3: Single-point mode

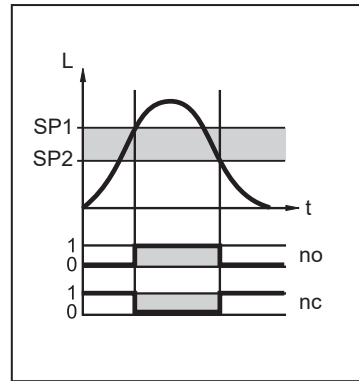


Fig. 4: Two-point mode

L: level
 t: time
 HY: hysteresis

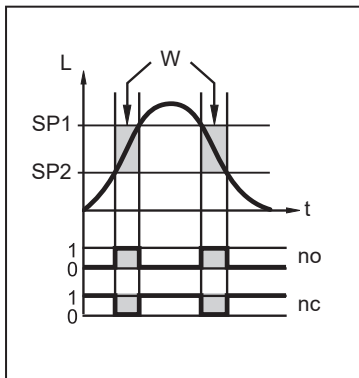
Window function:

► [SSC1 Config. Mode] must be set to [Window].

The width of the window can be set by means of the difference between [SSC1 Param. SP1] and [SSC1 Param. SP2] (→ Fig. Window function).

The normally open or normally closed function is set by [SSC1 Config. Logic]: [no] = normally open / [nc] = normally closed.

If desired, a hysteresis can be set at the window limits using [SSC1 Config. Hysteresis].



L: level
 t: time
 W: window

Fig. 5: Window function

The limit values [SSCx Param. SPx] are always absolute to the zero point = reference point (Fig. Analogue output). The hystereses [SSCx Config. Hysteresis] are always relative to the limit values.

For the switching outputs, a switch-on and switch-off delay of max. 60 s can be set (e.g. for especially long pump cycles). The switch-on delay always refers to the limit value, the switch-off delay always refers to the hysteresis.

4.3.3 Defined state in the event of a fault (alert mode)

For output OUT2, a state in the event of a fault can be defined.

If a fault is detected or if the signal quality is below a minimum value, the unit changes into the alert mode and output OUT2 passes into a defined state according to NAMUR recommendation (NE43). For this case, the response of the output can be set via the parameter [FOU2].

The unit can pass into the alert mode with a delay. This can be useful if short-term errors occur or the signal is reduced briefly (below the minimum value), e.g. due to turbulence or foam formation. The delay time can be set (parameter [Alert mode delay time]). During the delay time the last measured value is frozen. If the measured signal is received again in sufficient strength within the delay time, the

unit continues to work in normal operation. If, however, it is not received again with sufficient strength within the delay time, the unit passes into the alert mode and output OUT2 changes into the defined state.



In case of heavy foam build-up and turbulence, consider the option of creating a steady area.

4.3.4 Simulation function

Various levels can be simulated for set-up, maintenance or interference reduction. The duration of the simulation can be selected (1 min...1 h). The simulation can be started manually and runs until it is stopped manually or the set time elapses. During the simulation the outputs respond according to the simulated process values.

4.3.5 Damping function

With unstable level (e.g. turbulence, wave movements), the output response can be damped. During damping the determined level values are smoothed by means of a mean filter; the result is a steady curve.

Damping can be set by means of the parameter [dAP].

[dAP] indicates in seconds after what time 63 % of the final value is reached in the event of a sudden jump. After 5 x [dAP] almost 100 % has been reached.

4.4 Output response in different operating states

	OUT1	OUT2*
Initialisation	OFF	OFF
Normal operation	according to the level and [ou1] and [SSC1...] settings	according to the level and [ou2], [ASP2] and [AEP2] settings
Fault / alert mode	OFF	< 3.6 mA at [FOU2] = [OFF] > 21 mA at [FOU2] = [On]
* If analogue output [ou2] = [I] has been selected. If the switching function has been selected: see column OUT1.		

Additional information about the analogue output		
Full signal	With rising curve	20...20.5 mA
	With dropping curve	4...3.8 mA
Empty signal	With rising curve	4...3.8 mA
	With dropping curve	20...20.5 mA

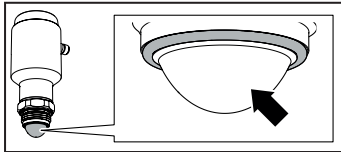
5 Mounting



CAUTION

With high process temperatures, parts of the unit may get hot.

- ▷ Risk of burns
- ▶ Do not touch the unit.
- ▶ Protect the housing against contact with flammable substances and unintentional contact.
- ▶ Allow the unit and process adapter to cool down before maintenance.



Careful handling of the antenna

- ▶ Be careful not to scratch or otherwise damage the antenna.



Before installing and removing the device:

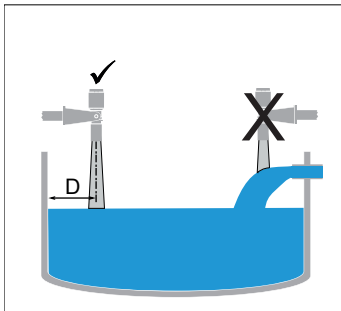
- ▶ Note dangers related to machine / medium temperatures.
- ▶ Before installation, observe the following mounting specifications.

5.1 Mounting position



The unit may only be installed in accordance with the applicable national and international radio regulations and statutory provisions (→ package leaflet).

- ▶ Observe the following when selecting the mounting position:
 - For optimal performance, the unit should be installed in locations with a clear and unobstructed view of the medium surface.
 - Mount in a location where there are no or minimal internal structures within the signal beam.
 - Do not mount the unit close to or above the inlet stream (→ Fig. Mounting).



- ▶ Distance to wall (D): $D_{\min} = 200 \text{ mm}$ (8 inch).
- ▶ Recommended: $\frac{1}{2}$ of tank radius.

Fig. 6: Mounting

5.2 Inclination

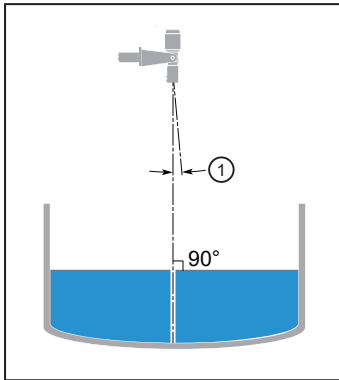


Fig. 7: Inclination

- ▶ Mount the unit vertically (90°) to ensure a good echo from the medium surface.
- ▶ Maximum inclination (1): 3° (Fig. Inclination).

5.3 Polarisation and orientation

The unit emits electromagnetic waves for level detection. The polarisation is the direction of the electrical component of these electromagnetic waves.

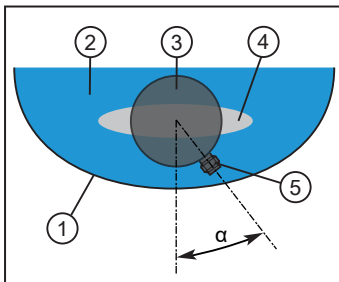


Fig. 8: Polarisation visualised from above

- 1: tank wall
- 2: level (medium to be detected)
- 3: LW2x70 level sensor
- 4: polarisation plane
- 5: electrical M12 connector
- α : optimum angle between connector and tank wall = 45°



When the housing is rotated, the direction of polarisation changes and hence the influence of the false echo on the measured value.

- ▶ Please keep this in mind when mounting or making changes later.

5.4 Beam angle and beam width

- ▶ Mount the unit with as few internal structures as possible within the signal beam.

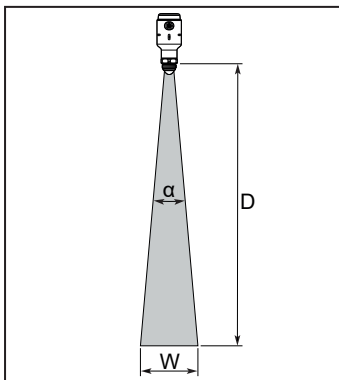


Fig. 9: Beam angle and beam width

Beam angle (α): 10° (8° with antenna extension)

Beam width (W) as a function of the distance (D):

Distance (D)	Beam width 8° (W)	Beam width 10° (W)
2 m (6.6 ft.)	0.3 m (0.9 ft.)	0.4 m (1.2 ft.)
4 m (13.1 ft.)	0.6 m (1.8 ft.)	0.7 m (2.3 ft.)
6 m (19.7 ft.)	0.8 m (2.8 ft.)	1.1 m (3.5 ft.)
8 m (26.2 ft.)	1.1 m (3.7 ft.)	1.4 m (4.6 ft.)
10 m (32.8 ft.)	1.4 m (4.7 ft.)	1.8 m (5.8 ft.)

5.5 Installing the mounting bracket

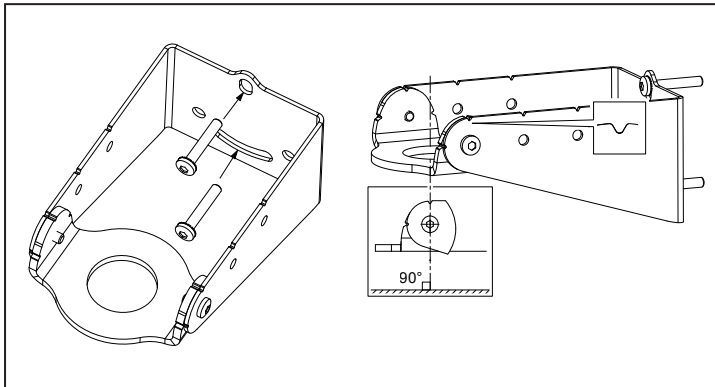


Fig. 10: Horizontal installation of the mounting bracket

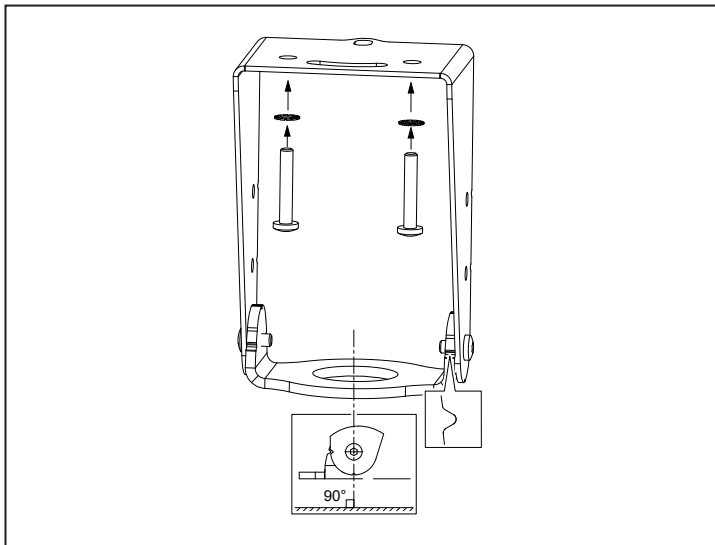


Fig. 11: Vertical installation of the mounting bracket

- ▶ Align and install the mounting bracket on a flat surface.
- ▶ To be able to change the device mounting area of the bracket, loosen the fixing screws of the bracket.
- ▶ Align the device mounting area of the bracket parallel to the surface of the medium.
- ▶ Hand-tighten the fixing screws of the mounting bracket.

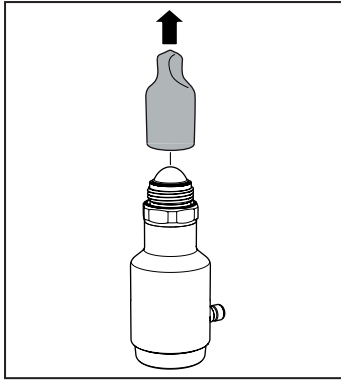
5.6 Mounting the antenna extension



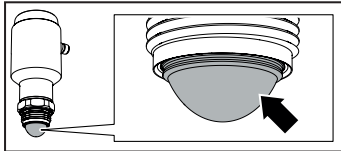
For applications in or above tanks / plastic tanks, the unit must be combined with the antenna extension. Intended use (→ [6](#))

5.6.1 Remove the protective cap

The protective cap protects the antenna from impacts during transport and storage.

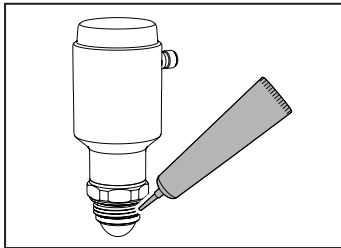


► Before installing, carefully remove the protective cap.



! ► Be careful not to scratch or otherwise damage the antenna.

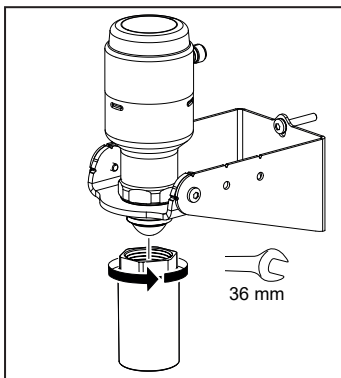
5.6.2 Mount the antenna extension



► Spread an adequate amount of lubricating paste on the unit thread.



The lubricating paste must be approved for the application and compatible with the elastomers used.



► Insert the unit through the opening in the mounting bracket.



► Be careful not to scratch or otherwise damage the antenna.

► Screw the antenna extension onto the thread.



Recommended tightening torque: 35 Nm.

5.7 Electrical connection



The unit must be connected by a qualified electrician.

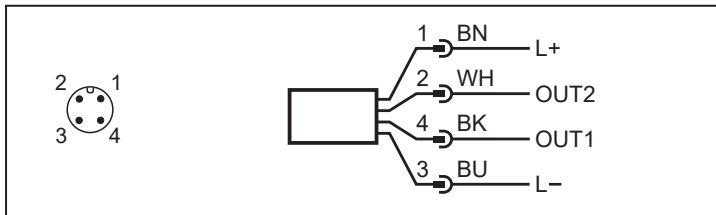
The national and international regulations for the installation of electrical equipment must be adhered to.

Supply voltage SELV, PELV according to the technical data sheet.

- ▶ Disconnect power.
- ▶ Connect the unit as follows:

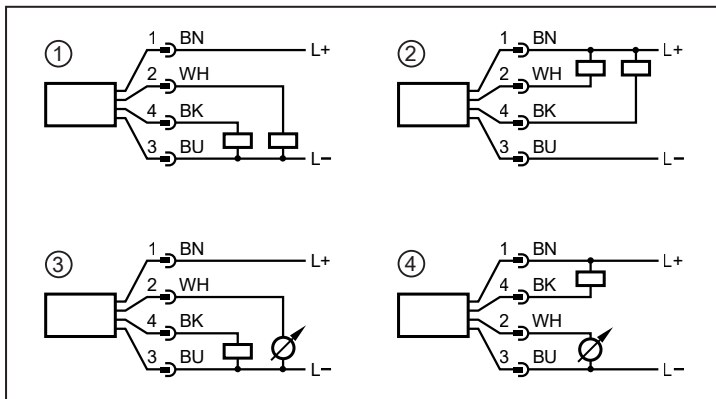


For marine applications (if approval available for the device), additional surge protection is required.








Pin	Core colour	
1:	BN	Brown
2:	WH	White
3:	BU	Blue
4:	BK	Black
OUT1: switching output or IO-Link		
OUT2: analogue output or switching output		
Colours to DIN EN 60947-5-2		

Circuit examples:



- 1: 2 x pnp
- 2: 2 x npn
- 3: 1 x pnp / 1 x analogue
- 4: 1 x npn / 1 x analogue

6 Parameter setting

-  Changing parameters during operation can influence the function of the plant.
 - ▶ Make sure that there will be no malfunctions or dangerous operation in your plant.
-  The device parameters are set via the IO-Link interface. For this, an IO-Link master, IO-Link parameter setting software (→ Accessories) and a suitable device description file (IODD) are required.
 - ▶ Always use the latest IODD: www.ifm.com
-  On delivery the unit is not operational: For set-up, the parameter [Reference height] must be configured first (→ Adjustable parameters). Otherwise, the unit will not change into the operating mode. Further settings are optional and can be made according to the requirements.
-  After a factory reset (button [Restore Factory Settings]), the device reboots and the factory settings are restored.
-  When the medium is changed, it may also be necessary to adapt the device settings.

6.1 Parameter setting via PC and IO-Link master

- ▶ Prepare the PC, software and master (→ Operating instructions of the respective units/software).
- ▶ Connect the unit to a USB IO-Link interface or a field compatible IO-Link master.

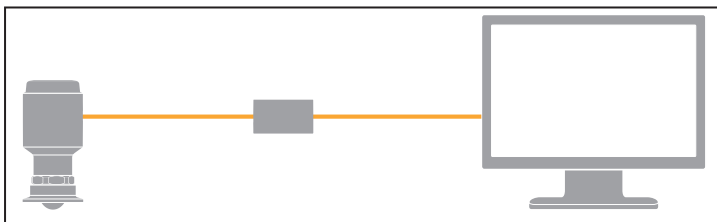


Fig. 12: Connection via the USB IO-Link interface

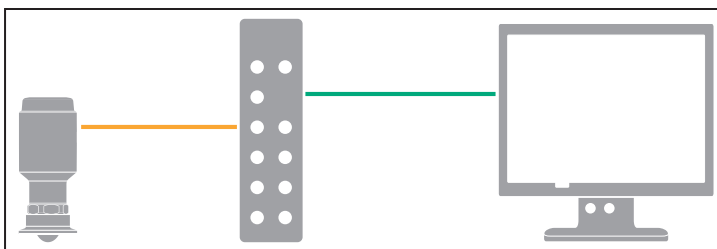



Fig. 13: Connection via the IO-Link master for field use

-  Before parameter setting, familiarise yourself with all the parameters.
 - ▶ Start the parameter setting software and set the parameters.
 - ▶ Check if the unit has accepted the parameter settings. If necessary, read the unit again.
 - ▶ Remove the USB IO-Link interface and put the unit into operation. When using a field compatible IO-Link master (depending on the application), disconnect the unit and master from the PC and connect to the field environment.

6.2 Parameter setting during operation

Make sure that the unit is connected to a PLC via an IO-Link-capable module (master).

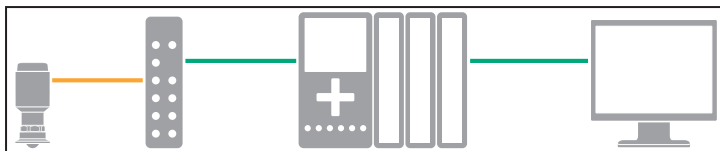


Fig. 14: Connection example with PLC

- ▶ Read the unit using a suitable IO-Link software (→ Observe the operating instructions of the respective software).
- ▶ Set the parameters.



Before parameter setting, familiarise yourself with all the parameters.

- ▶ Check if the unit has accepted the parameter settings. If necessary, read the unit again.
- ▶ Check whether the unit operates correctly.

6.3 Parameter setting via Bluetooth adapter



Using a Bluetooth adapter (→ IO-Link accessory) facilitates parameter setting of the device, e.g. for large containers or inaccessible mounting locations.

The possible parameter setting distance between the Bluetooth adapter and the device to be paired depends on local conditions.


- ▶ Using the Bluetooth adapter: → Bluetooth adapter operating instructions.




6.4 Adjustable parameters






Parameters marked with “!” (in the “Access” column) (e.g. [SSC1 Param. SP2]) are only active after selection of the assigned parameters.

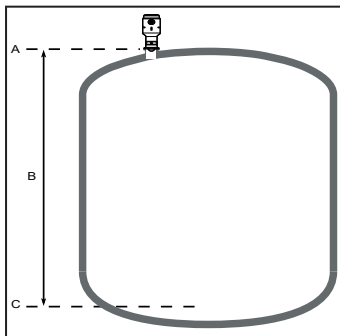
The abbreviations SSC1 and SSC2 below refer to the switching bits (switching signal channels) in the IO-Link process data flow. The switching signal channels are assigned to the physical outputs OUT1 and OUT2 via the parameters [ou1] and [ou2].

Parameter	Options	Explanation	Access
uni	[m] = metre [inch] = inch	Selection of the display unit.	
Reference height	Setting range: 0.2...15 m	Distance between unit and zero point (→ Fig. Reference height).  The reference height defines the zero point. The zero point might not necessarily correspond to the tank bottom. If necessary, set a tank offset (→ Fig. Tank offset).	
Tank offset	Setting range: -10...10 m	Distance between the zero point and the tank bottom (→ Fig. Tank offset).	
Upper blind zone	Setting range: 0...10 m	Serves to suppress false echoes, e.g. from nozzles. ▶ Check the echo peaks to detect the false echoes near the tank's upper edge.	

Parameter	Options	Explanation	Access
Negative level	[Equal to zero] = negative levels (below the zero point) are not displayed. [Permitted] = negative levels are displayed.	If the tank offset is > 0, the level value can be negative. This parameter defines whether negative levels are displayed or whether they should equal zero.  With the option [Permitted], even false echoes in the area of the (positive) tank offset are detected that affect the measurement and lead to measurement errors. With the option [Equal to zero], these false echoes can be suppressed.  The set value is not part of the data storage. It is not stored in the master.	
P-n	[PnP] = positive switching [nPn] = negative switching	Output polarity for the switching outputs.	
ou1	[SSC1] = configures OUT1 as switching output. OUT1 is assigned to SSC1 (switching channel 1). [OFF] = output OFF (high impedance)*	Output configuration for OUT1. *) This does not affect IO-Link communication.	
ou2	[I] = configures OUT2 as analogue output 4...20 mA. [SSC2] = configures OUT2 as a switching output. OUT2 is assigned to SSC2 (switching channel 2). [OFF] = output OFF (high impedance)	Output configuration for OUT2.	
dS1	Setting range: 0...60 s	Switching delay for SSC1 (switching channel 1). The switching delay behaves according to VD-MA*).	
dr1	Setting range: 0...60 s	Switch-off delay for SSC1 (switching channel 1). The switch-off delay behaves according to VD-MA*).	
SSC1 Param. SP1	Setting range: 0.005...15 m	Set point 1 for SSC1 (switching channel 1). Only available if SSC1 is not deactivated.  Set point 1 must be smaller than or equal to the set tank height [Reference height].	!
SSC1 Param. SP2	Setting range: 0...14.995 m	Set point 2 for SSC1 (switching channel 1). Only available with window function and two-point mode.	!
SSC1 Config. Logic	[no] = normally open [nc] = normally closed	Switching logic for SSC1 (switching signal channel 1).	
SSC1 Config Mode	[Deactivated] = switching behaviour deactivated [single point] = hysteresis function single point mode [window] = window function [two point] = hysteresis function two point mode	Switching mode for SSC1 (switching signal channel 1).	
SSC1 Config Hysteresis	Setting range 0...0.5 m	Switching hysteresis for SSC1 (switching channel 1). Only available in single-point mode and with window function.	!
dS2	Setting range: 0...60 s	Switching delay for SSC2 (switching channel 2). The switching delay behaves according to VD-MA*).	
dr2	Setting range: 0...60 s	Switch-off delay for SSC2 (switching channel 2). The switch-off delay behaves according to VD-MA*).	

Parameter	Options	Explanation	Access
SSC2 Param. SP1	Setting range: 0.005...15 m	Set point 1 for SSC2 (switching channel 2). Only available if SSC2 is not deactivated.  Set point 1 must be smaller than or equal to the set tank height [Reference height].	!
SSC2 Param. SP2	Setting range: 0...14.995 m	Set point 2 for SSC2 (switching channel 2). Only available with window function and two-point mode.	!
SSC2 Config. Logic	[no] = normally open [nc] = normally closed	Switching logic for SSC2 (switching signal channel 2).	
SSC2 Config. Mode	[Deactivated] = switching behaviour deactivated [single point] = hysteresis function single point mode [window] = window function [two point] = hysteresis function two point mode	Switching mode for SSC2 (switching signal channel 2).	
SSC2 Config. Hysteresis	Setting range 0...0.5 m	Switching hysteresis for SSC2 (switching channel 2). Only available in single-point mode and with window function.	!
ASP2	Setting range: 0...14 m	Analogue start point: measured value at which 4 mA will be provided Menu item only visible when analogue output is selected ([ou2] = [1]).	!
AEP2	Setting range: 0.2...15 m	Analogue end point: measured value at which 20 mA will be provided Menu item only visible when analogue output is selected ([ou2] = [1]).	!
FOU2	[On] = analogue output switches to a value > 21 mA in alarm mode. Switching output switches ON in alarm mode. [OFF] = analogue output switches to a value < 3.6 mA in alarm mode. Switching output switches OFF in alarm mode	Response of OUT2 in alert mode.	
dAP	Setting range: 0...600 s	Damping of the measured signal (filter).	
S.Lvl	Setting range: 0...10 m	Level to be simulated in simulation mode.  The set value is not part of the data storage. It is not stored in the master.	
S.Tim	[60 min] fixed setting.	Simulation time.	
Alert mode delay time	Setting range: 0...1000 s	When this time has elapsed, a lost measurement is communicated. Delay time for passing into the state defined with [FOU2]: Only effective in case of a fault. Defined state in the event of a fault (alert mode) (→ □ 11)  Adjust the delay time to the level change rate of the application. Recommendation: High level change rate = low delay time Low level change rate = high delay time	
Detection threshold	Setting range: 0...20,000 mV	The signal strength must be greater than the detection threshold to be recognised as a level. (→ Fig. Detection threshold).	

*) According to VDMA, the switch-on delay always has an effect on set point 1 (e.g. [SSC1 Param. SP1]), the switch-off delay always on the hysteresis or set point 2 (e.g. [SSC1 Param. SP2]) irrespective of whether the normally open or normally closed function is used.

Reference height:

- A: device reference point (lower edge/sealing edge of the process connection)
 B: reference height (measuring range)
 C: zero point (tank bottom or lower end of the measuring range)

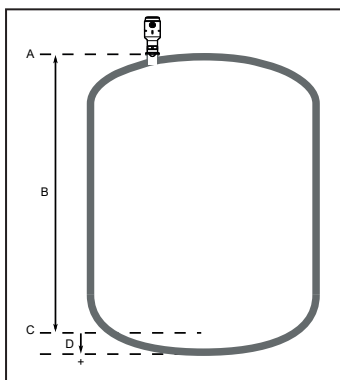
Fig. 15: Reference height



The reference height is used to define the zero point and thus the reference point for the level measurement.

For the setting [Tank offset] = [0], the following applies:

- Levels below zero are not detected; [0.0 m] is provided as process value.

Tank offset:

- A: device reference point (lower edge/sealing edge of the process connection)
 B: reference height (measuring range)
 C: zero point (lower end of the measuring range, tank bottom is lower)
 D: tank offset

Fig. 16: Tank offset



If the zero point does not match the tank bottom, the distance between zero point and tank bottom (D) can be entered as [Tank offset]. In the vast majority of cases, entering the reference height will be sufficient. In some cases, however, it may be advantageous to additionally set a tank offset. This way, the sensor knows the position of the tank bottom and may be able to better evaluate the tank echoes.

- ▶ Enter the distance between the zero point and the tank bottom (D) as [Tank offset].

If the tank bottom is located lower than the desired zero point, as shown in Fig. Tank offset:

- ▶ Enter values > 0 (positive values) for the tank offset. Unless the additional setting [Negative level] = [Permitted] is selected, the following applies:
 - ▷ False echoes within the tank offset (e.g. from agitators, heating coils, hopper or dished ends) are suppressed.
 - ▷ Levels within the tank offset are not detected; [0.0 m] is constantly provided as process value.

If the additional setting [Negative level] = [Permitted] is selected, the following applies:

- Negative levels (levels below the zero point) are displayed.

- False echoes within the tank offset which affect the measurement and lead to measurement errors are detected and, where necessary, communicated after the delay time has elapsed (see parameter [Alert mode delay time]).
- Take into account agitators and objects in the lower tank section that could cause false echoes.

If the tank bottom is above the desired zero point (e.g. in the case of an inclined tank bottom with outlet zone):

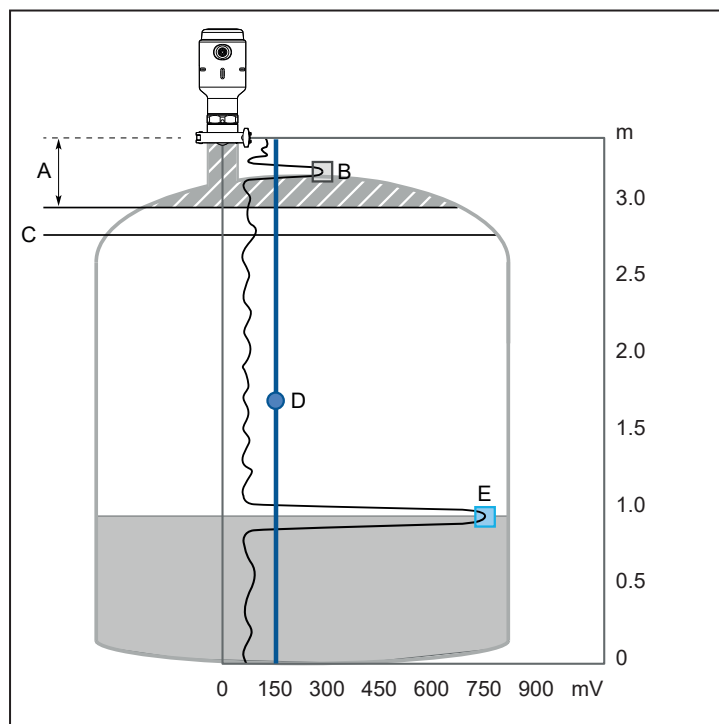
- ▶ Enter values < 0 (negative values) for the tank offset.
- ▷ The tank offset is added to the displayed process value. This means that the display and switch point refer to the actual level (e.g. the lowest point of the tank).



A faulty configuration can result in incorrect process values and avoidable error messages.

- ▶ Make sure that the tank geometry parameters are entered correctly.

Upper blind zone / detection threshold:



- A: upper blind zone
- B: disturbing echo of object
- C: 100% (20 mA) of the analogue range
- D: detection threshold
- E: medium surface echo

Fig. 17: Upper blind zone / detection threshold




Nozzles or other objects close to the antenna may cause disturbing reflections. Such reflections can be blocked out by configuring an upper blind zone (A).
Note: In the upper blind zone, the level is not detected.

- ▶ Make sure that the maximum level is limited, e.g. by using an overflow or by throttling the inlet.






The detection threshold (D) “cuts off” all reflections below the set threshold (in the fig. “Upper blind zone / detection threshold” to the left of the marked line D). Only reflections that exceed the threshold (in the fig. “Upper blind zone / detection threshold” to the right of the marked line D) are evaluated as potential level echoes and included in the further level calculation. Note the remarks: Detection quality check (→ 26)

6.5 System commands

Start simulation	Starts the simulation mode. The level set under the parameter [S.Lvl] is simulated.
Stop simulation	Stops the simulation.
Reset to factory settings.	Restore factory settings (all parameters).  On delivery the unit is not operational.

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.

6.6 Example parameter setting

- The unit is to monitor the level in an 8 m high tank.
- The unit is mounted in a nozzle (nozzle height: 150 mm).
- No tank offset is to be used.
- The medium is aqueous (beer or milk).
- The unit to be used is [m].
- Output OUT2 is to be configured as an analogue output.
- ▶ Reset the unit to factory settings:
Execute the system command [Reset to factory settings].
- ▷ This serves to avoid incorrect settings and establish a defined start situation.
- ▶ Set the unit:
(parameter [uni] = [m]).
- ▶ Set the tank height:
parameter [Reference height] = [8.000] m.
- ▷ The tank bottom may be interpreted as a low level.
In this case:
- ▶ Reduce the reference height and configure a tank offset.
- ▶ Define the upper blind zone:
parameter [Upper blind zone] = [200] mm.
- ▷ This setting is used to block out disturbing echoes from the nozzle.
- ▶ Deactivate damping:
parameter [dAP] = [0.0] s.
-  During a test phase, this can be useful to quickly detect level changes.
 - ▶ Reactivate if necessary.
- ▶ Set the delay time for the alert mode to zero:
parameter [Alert mode delay time] = [0] s.
-  During a test phase, this can be useful to quickly detect incorrect measurements and identify potential sources of error.
 - ▶ Reactivate if necessary.
- ▶ If necessary, adjust the sensitivity (parameter [Detection threshold]), observing the following instructions Detection quality check (→  26)
- ▶ Configure output OUT2 as an analogue output:
[ou2] = [I].

- ▶ Configure analogue output:
Use [ASP2] and [AEP2].
- ▶ Configure switching output OUT1:
Use [SSC1...] parameter.

7 Operation

7.1 Function check

After power-on and the required parameter setting the unit 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 correctly.



After power-on (or after sudden changes in distance), the unit first adjusts itself to the level. This adjustment algorithm requires a certain amount of time and serves to ensure reliable measurements. After this process, the measured value follows the actual level without delay, provided that stable measured values are continuously available.

7.1.1 Detection quality check



Using the diagnostic function [Echo peaks], the actual radar echoes of the unit can be viewed and analysed based on the specified distance and signal strength.

► If necessary, adjust the sensitivity using the [Detection threshold] parameter. Only change the preset value carefully in small steps. Observe the following instructions.



Turbulence, foam, changes in humidity (e.g. due to increased process temperatures) and steam can significantly affect the signal strength of the radar echoes.

It is recommended to check the detection quality under real operating conditions; otherwise, the expected influences should be taken into account when determining the detection threshold, and the detection quality should be checked later.



Recommendation: Use the factory setting wherever possible, which takes such influences into account.

7.2 Diagnostic messages, cause, troubleshooting

Diagnostic message	Possible cause	Recommended actions
Device hardware fault.	Electronics error	<ul style="list-style-type: none"> Restart the device. If the condition persists, replace the device.
General power supply fault.	Operating voltage drops below 18V during start-up.	Verify voltage supply.
Device software fault.	Internal software error	<ul style="list-style-type: none"> Restart the device. Restore factory settings and reconfigure the device. If the condition persists, replace the device.
Parameter error	Configuration error	<ul style="list-style-type: none"> If an analogue output is used, check upper and lower range values. If a digital output is used, check alert set points. If condition persists, restore default settings and reconfigure the device.
Short circuit	Short circuit on output OUT1 or OUT2.	Remove the short circuit
Device memory failure	Erroneous data record (e.g. due to a power failure when writing the data).	<ul style="list-style-type: none"> Restore, restart and reconfigure the device. If the condition persists, replace the device.

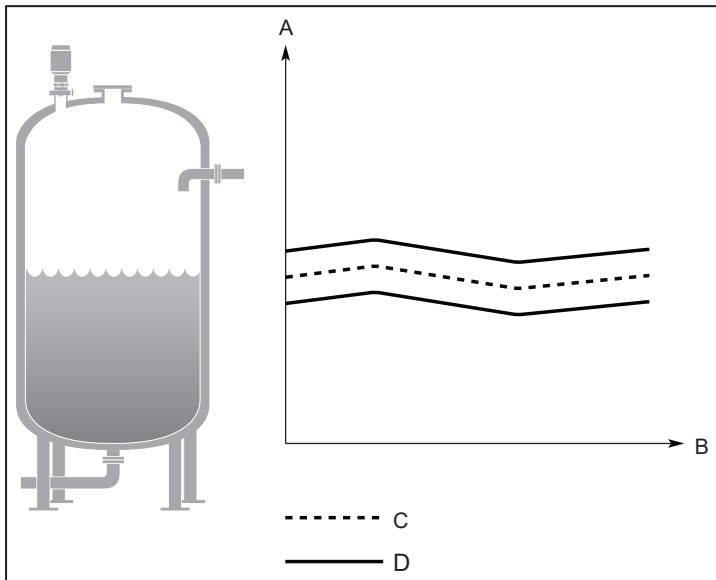
Diagnostic message	Possible cause	Recommended actions
No reflection signal	No valid level reading. Reasons may be multiple: <ul style="list-style-type: none"> No valid level echo in the measuring range. Wrong device configuration. 	<ul style="list-style-type: none"> Analyse echo peaks and check device configuration, especially the detection threshold. Check physical installation of device (e.g. antenna contamination). Consider increasing the [Alert mode delay time] parameter. Restore the default settings, restart and reconfigure the device. If the condition persists, replace the device.
Simulation active	The device is in simulation mode and is not reporting actual process information.	<ul style="list-style-type: none"> If this behaviour is not desired, stop the simulation mode. If the condition persists, restart the device.
Device temperature over-run.	Electronics temperature out of limits	<ul style="list-style-type: none"> Verify ambient temperature is within the operating range. Remove heat source. Remove cause. Provide cooling.
Device temperature under-run.	The electronics temperature is below the operating range.	<ul style="list-style-type: none"> Verify ambient temperature is within the operating range. Insulate device.
Primary supply voltage over-run.	Supply voltage is too high.	<ul style="list-style-type: none"> Verify operating voltage is between 18-30 V.
Primary supply voltage under-run.	Supply voltage is too low.	<ul style="list-style-type: none"> Verify operating voltage is between 18-30 V.
Maintenance required – Cleaning.	Product build-up on the antenna.	<ul style="list-style-type: none"> Clean the antenna.

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.

8 Troubleshooting

8.1 Troubleshooting incorrect level readings

8.1.1 Level too high / too low



A: level
 B: time
 C: actual level
 D: measured level

Possible cause:

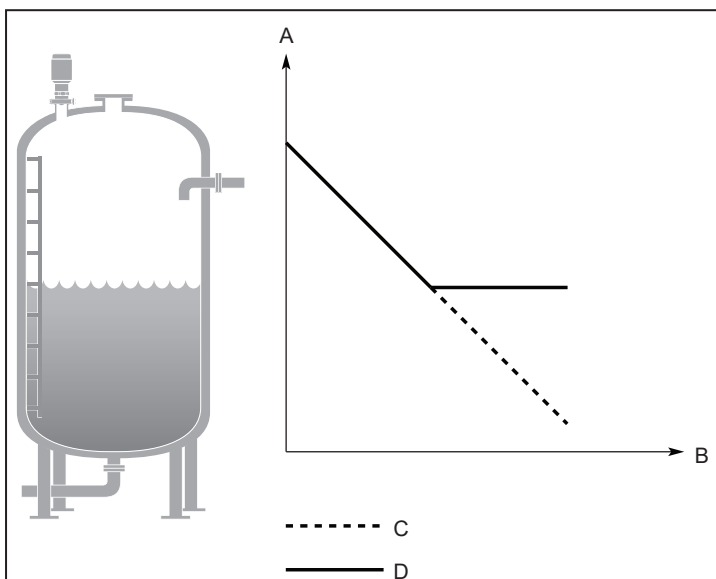
- Incorrect tank geometry configuration.

Recommended actions:

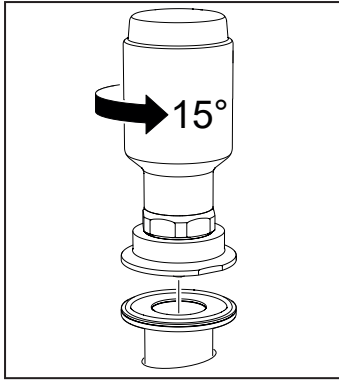
- Verify the tank geometry parameters are configured correctly, especially the reference height.
- Analyse the echo peaks and check the detection threshold.
- Restore default settings and reconfigure the device.

8.1.2 Measured value is stuck

Measured value gets stuck with decreasing level and in measuring range:



A: level
 B: time
 C: actual level
 D: measured level



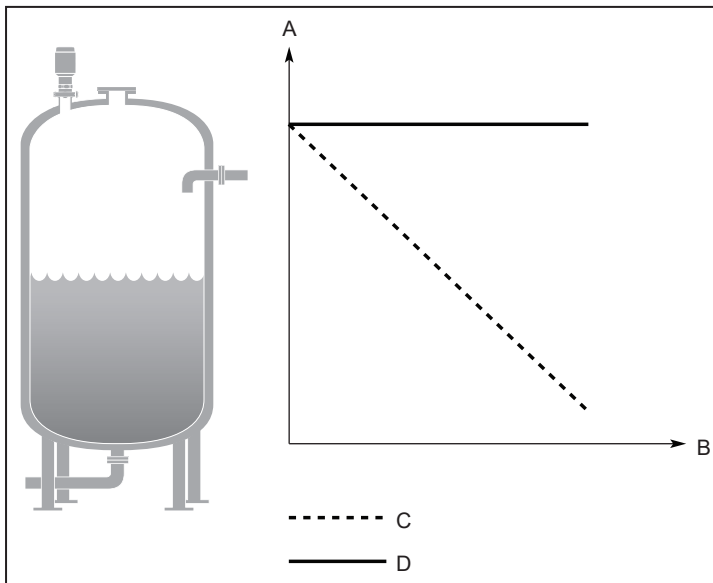
Possible cause:

- Disturbing object in the tank.

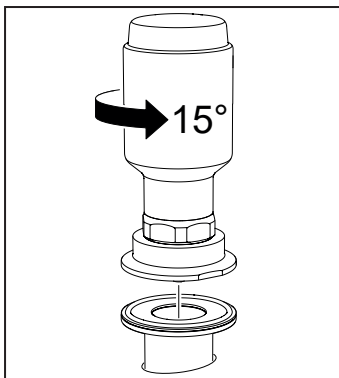
Recommended actions:

- Analyse the echo peaks and check the detection threshold.
- If possible, remove the disturbing object or change the device position.
- Rotate the unit in steps of about 15 degrees.
- ▶ After each step, check if impact of disturbing echoes is decreased by analysing the echo peaks.

Measured value gets stuck with decreasing level and full tank:



A: level
 B: time
 C: actual level
 D: measured level



Possible cause:

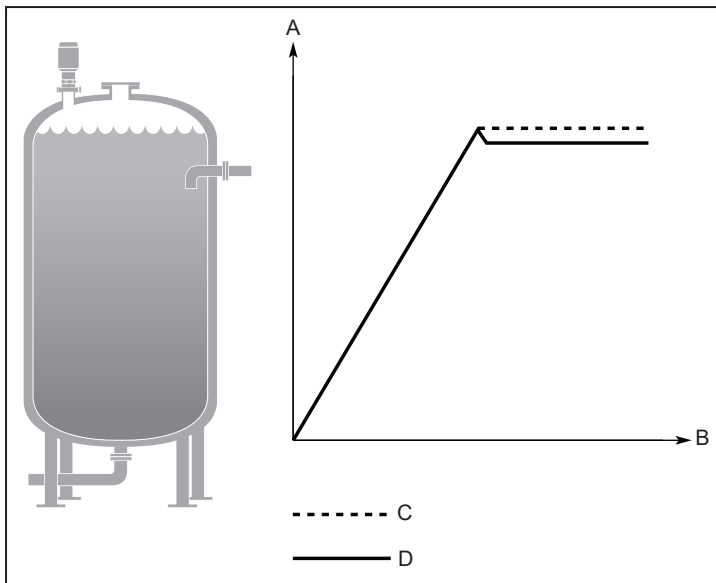
- Disturbing object near the antenna.

Recommended actions:

- Analyse the echo peaks and check the detection threshold.
- Increase the upper blind zone.
- If possible, remove the disturbing object or change the device position.
- Rotate the unit in steps of about 15 degrees.

8.1.3 Measured value drops when level close to antenna

Measured value drops to a lower value when level is close to antenna:



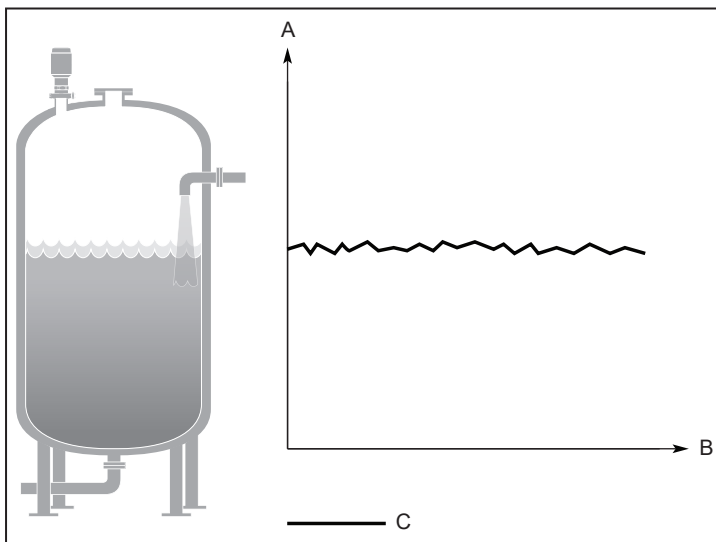
Possible cause:

- The level is within the upper blind zone and a false echo is interpreted as the level.

Recommended actions:

- Check the setting of the upper blind zone.
- Reduce the maximum permissible level, e.g. by adjusting the switch points.

8.1.4 Measured value fluctuates



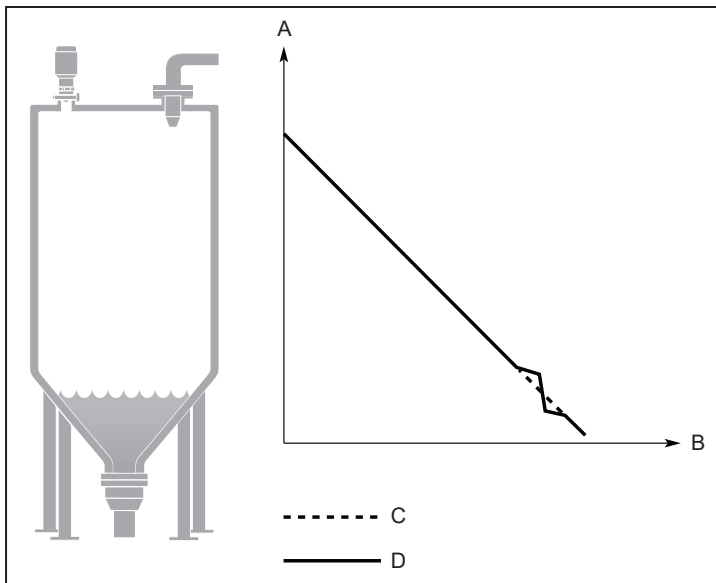
Possible cause:

- Excessive foaming or turbulence.

Recommended actions:

- Under turbulent conditions with low level rates, consider increasing the damping value (parameter [dAP]).
- Eliminate or mitigate the cause, e.g. by using an inlet pipe or by throttling the inlet.

8.1.5 Measured value is occasionally unstable



A: level
 B: time
 C: actual level
 D: measured level

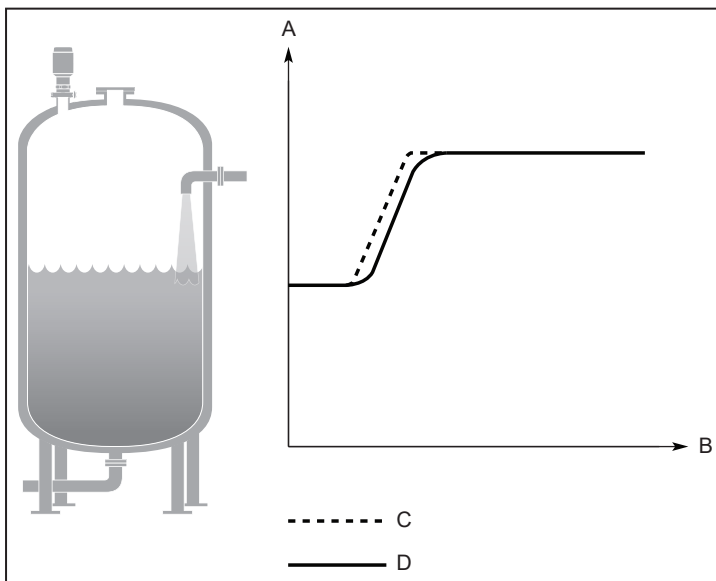
Possible cause:

- The level is close to a suppressed false echo.

Recommended actions:

- If possible, remove the disturbing object or change the device position.

8.1.6 Lagging of measured value during rapid level changes



A: level
 B: time
 C: actual level
 D: measured level

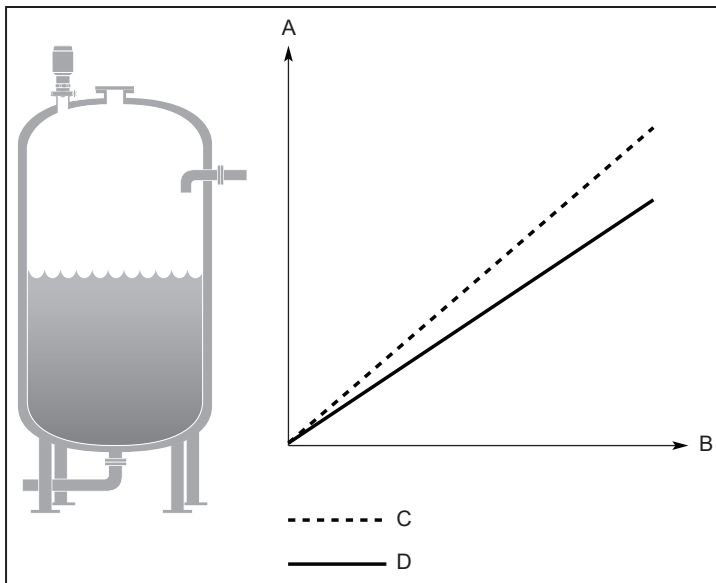
Possible cause:

- Damping value (parameter [dAP]) is set too high.

Recommended actions:

- Decrease the damping value
- If possible, reduce high level rate.

8.1.7 Measured value correct at 0% (4 mA) but incorrect at 100% (20 mA)



A: level
 B: time
 C: actual level
 D: measured level

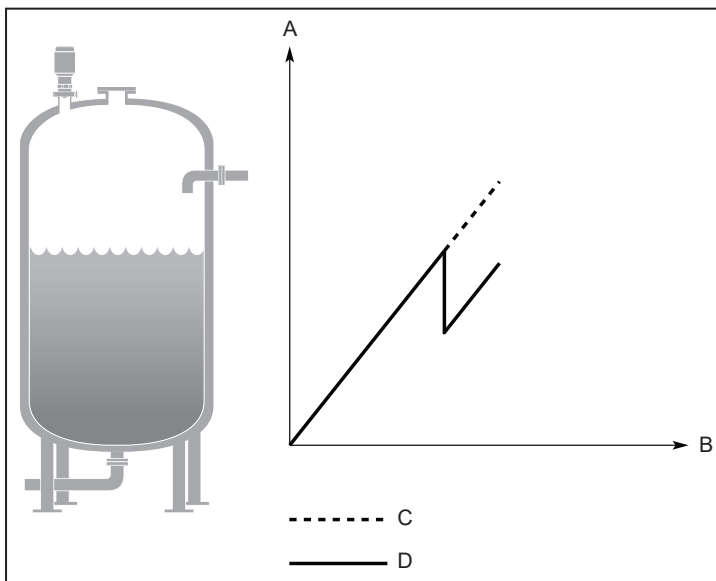
Possible cause:

- Analogue end point (parameter [AEP2]) is not set correctly.

Recommended actions:

- Correct parameter [AEP2].

8.1.8 Incorrect measured value when level is above 50%



A: level
 B: time
 C: actual level
 D: measured level

Possible cause:

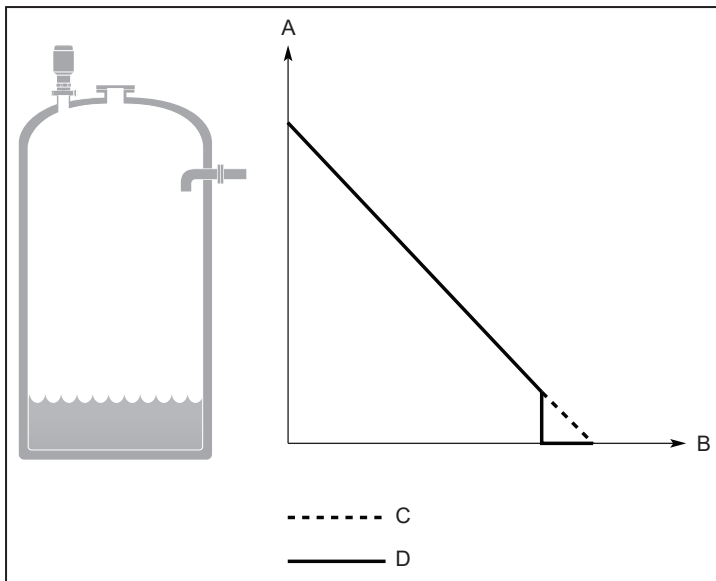
- Strong multiple reflections are interpreted as the level.

Recommended actions:

- Move the device to another position.

8.1.9 Measured value drops to zero close to tank bottom

Measured value drops to zero level in the tank bottom region:



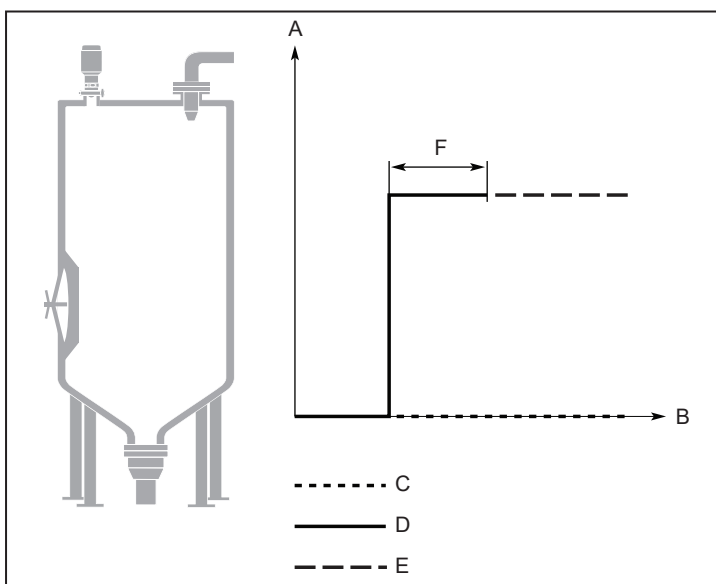
Possible cause:

- A strong tank bottom echo is interpreted as the level.

Recommended actions:

- Verify the reference height is configured correctly.
- With very low dielectric media: Reduce the reference height and configure a tank offset.

8.1.10 Level measurement is lost in an empty tank



Possible cause:

- When the manway door is opened inward, it generates a false echo which is interpreted as the level. After closing the door, the echo is lost and the transmitter reports - Level measurement lost -. The message is cleared when the tank is filled.

Recommended actions:

- Before opening the door, disconnect power to the device.
- After closing, restart the device.
- Move the device to another position.

8.1.11 Alert mode when level close to tank bottom

When the level is near the sloped tank bottom, the device enters the alert mode.

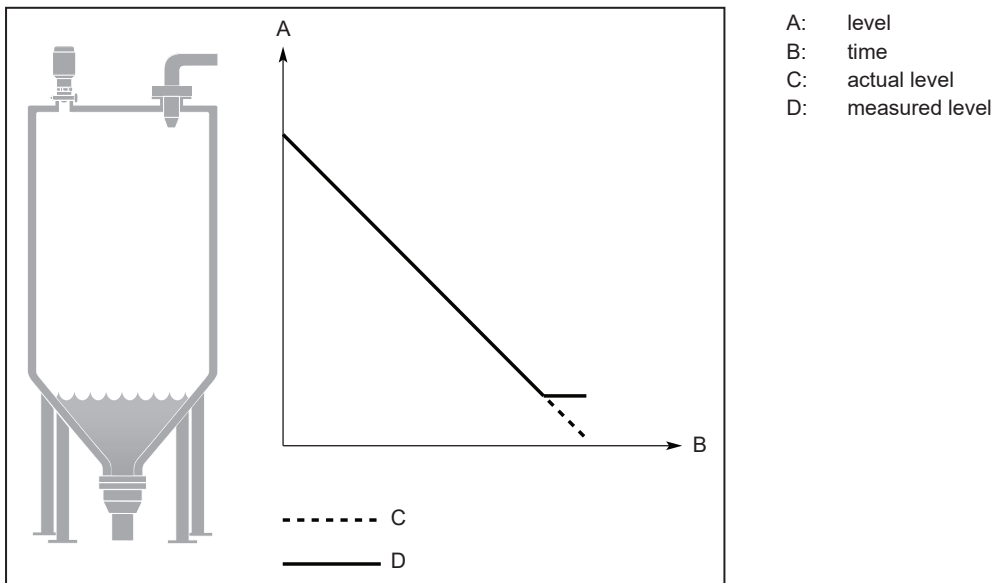


Fig. 18:

Possible cause:

- Radar signal is scattered to the side by the sloped tank bottom.

Recommended actions:

- Verify the tank geometry parameters are configured correctly (especially the reference height and the tank offset).

9 Maintenance, repair and disposal

The unit can be unscrewed from the adapter for cleaning.

- ▶ Check the unit and the mounting adapter at regular intervals and tighten again, if necessary.
- ▶ Only use suitable tools with plastic wrench flats for wetted surfaces.
- ▶ Clean the antenna (PTFE capsule) at regular intervals with appropriate agents to avoid contamination or formation of deposits in the long run.
- ▶ Ensure that the connection point between unit and adapter is not soiled or damaged during the cleaning process. Check sealing ring(s) for damage.

If sealing rings are damaged:

- ▶ Replace damaged parts. Available accessories: www.ifm.com

It is not possible to repair the unit.

- ▶ In case of return shipment, 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.
- ▶ After use dispose of the unit in an environmentally friendly way in accordance with the applicable national regulations.

10 Factory setting

Parameter	Factory setting	User setting	Access
Application Specific Tag	***		
Function Tag	***		
Location Tag	***		
uni	m		
Reference height	Initial value		
tank offset	0 (m)		
Upper blind zone	0 (m)		
P-n	PnP		
out1/out2	SSC1 / I (4...20 mA)		
dS1/dS2	0 (s)		
dr1/dr2	0 (s)		
SSCx* Param. SP1	0.2 (m)		!
SSCx* Param. SP2	0 (s)		!
SSC* Config. Logic	no		
SSC* Config. Mode	Single point		
SSC* Config. Hysteresis	0.05 (m)		!
ASP2	0 (m)		!
AEP2	0.2 (m)		!
FOU2	OFF		
dAP	2 (s)		
S.Lvl	5 (m)		
S.Tim	60 (min)		
Alert mode delay time	180 (s)		
Detection threshold	100 (mV)		

*x = 1 for OUT1, 2 for OUT2



Parameters marked with “!” (under Access) (e.g. [SSCx* Param. SP2]) are only active if the assigned parameters have been selected.

11 Appendix

11.1 Approvals and certificates

The EU declaration of conformity, approvals and country-specific certificates are available at:
www.ifm.com

Approval-related notes: → Packing slip