



Operating instructions
Electronic level sensor
LW2720

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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

- The unit 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 (→ 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.
- The standards the unit complies with include TLPR and CISPR 11. Further standards and specifications: → data sheet.



Radiated microwave energy:

The microwave energy radiated by the unit is much 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 heat up.

- ▷ 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

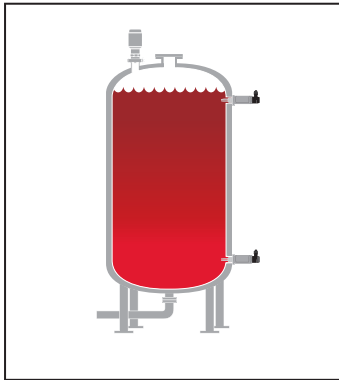
The unit continuously monitors the level of liquids in tanks without contact. Bulk materials are detected depending on their properties (conical heaps, grain size, dielectric constant, etc.).

3.1 Application area

Non-contacting radar technology is ideally suited for food and beverage applications as it is maintenance-free, has a top-down installation that reduces the risk of leakages, and is unaffected by process conditions such as density, viscosity, temperature, pressure and pH.

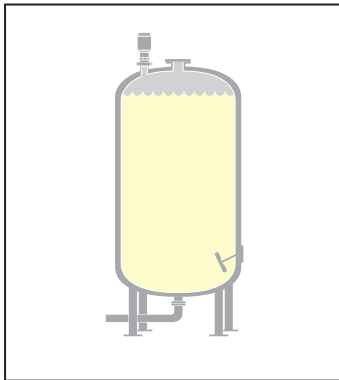
The unit combines the innovative 80 GHz technology with the FMCW method and smart algorithms to maximise measurement accuracy and reliability, even in small tanks and challenging fast-filling / fast-emptying vessels.

3.1.1 Application examples



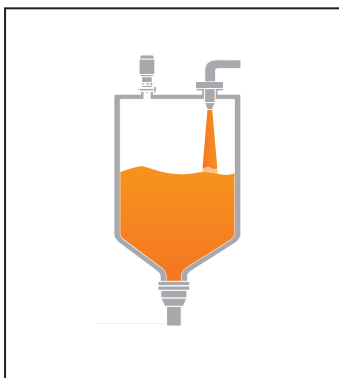
Storage tank:

Provides insight into the tank and ensures production runs smoothly without interruption.



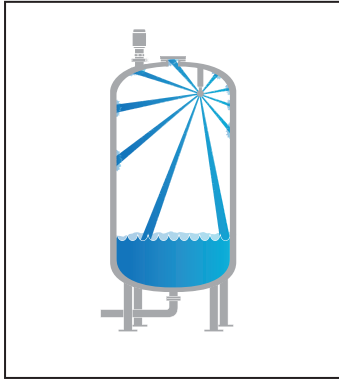
Mixing tank:

Ensures correct filling and storage levels in tanks with agitators.



Batch filling:

Optimises the batch filling process.



CIP process:

The unit withstands standard CIP routines and SIP routines up to 140 °C.

Optimisation of cleaning agent storage.

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3.2 Restriction of the application area

- The unit is not suitable for some bulk materials (e.g. coffee beans) due to their often very low dielectric constant.
- Detection of bulk materials with a higher dielectric constant (e.g. grist due to its higher moisture content) may be possible. See: Reflectivity, effect of dielectric constant (→ □ 9)
- ▶ Check the function by performing an application test.
- The unit is a TLPR device. TLPR (Tank Level Probing Radar) equipment are devices for level measurement in a closed space only (i.e. metallic, reinforced concrete or fibreglass tanks, or similar enclosure structures made of comparable attenuating material).
- ▶ Installation must be carried out in accordance with the requirements of the following standard: ETSI EN 302 372 (TLPR), Annex E
- Use preferably in metal tanks. When used in electrically non-conductive tanks (e.g. fibreglass tanks):
 - there may be deterioration caused by electromagnetic interference from other devices (noise immunity according to EN 61326-1). Corrective measures: Non-metallic tanks (→ □ 15)
 - or if the mounting position is unfavourable, nearby objects outside the tank may cause disturbing echoes.



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.

4 Items supplied

- LW2720 level sensor.
- Product information with safety instructions and reference to the complete operating instructions at www.ifm.com.

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.

5 Function

5.1 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.

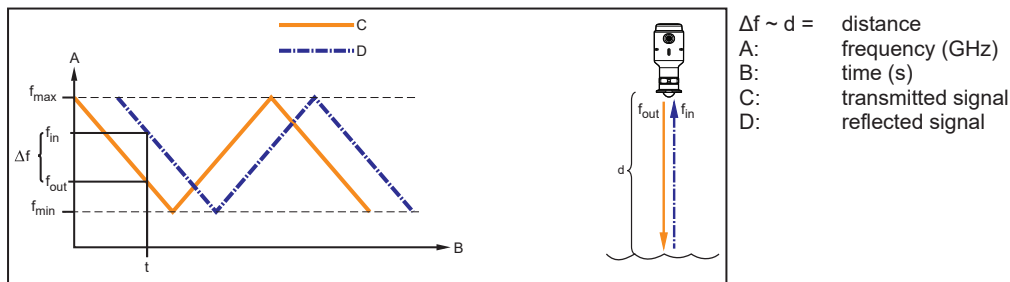


Fig. 1: Measuring principle

Due to the 80 GHz technology used, the unit generates a very focused signal beam (beam angle approx. 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.).

5.1.1 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
Beer brew	≈ 25
Vinegar	≈ 24
Maize starch	≈ 18
Coarse soya flour, 19% moisture	≈ 18
Coarse soya flour, dry (application test recommended)	≈ 3
Vegetable oil (application test recommended)	≈ 2...4
Grist (application test recommended)	≈ 2...3
Malt (application test recommended)	≈ 2...3
Skimmed milk powder (application test recommended)	≈ 2
Palm oil (not detected reliably)	≈ 1.8
Coffee beans (not detected reliably)	≈ 1.5

5.1.2 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.

5.1.3 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.

5.2 IO-Link

The unit 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 IO-DDs 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.

5.3 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)

5.3.1 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] = [1] 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

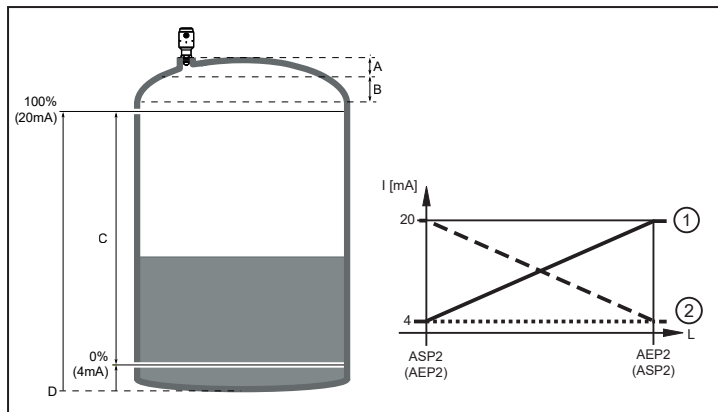


Fig. 2: Analogue output

A: blind zone
 B: zone with reduced accuracy
 C: recommended measuring range
 D: zero point = reference point

I: current
 L: level
 1: rising curve ($[ASP2] < [AEP2]$)
 2: dropping curve ($[ASP2] > [AEP2]$)

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

5.3.2 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).
- ▶ [SSC1 Param. SP1] must be greater than [SSC1 Param. SP2].

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

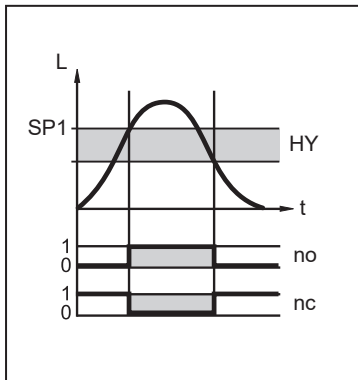


Fig. 3: Single-point mode

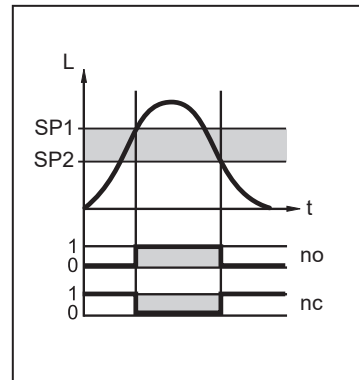


Fig. 4: Two-point mode

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).

► [SSC1 Param. SP1] must be greater than [SSC1 Param. SP2].

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].

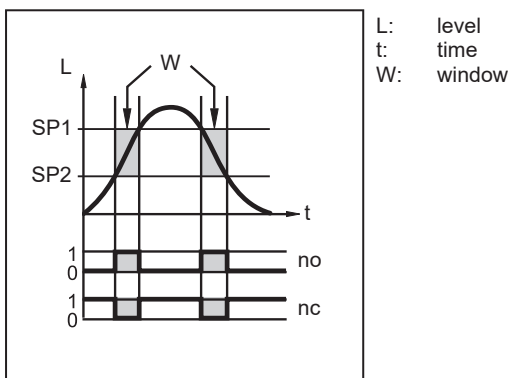


Fig. 5: Window function

L: level
t: time
W: window

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.

5.3.3 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 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 in 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.

5.3.4 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

5.3.5 Damping function

With unsteady 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.

5.4 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

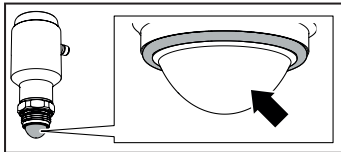
6 Mounting



CAUTION

With high process temperatures, parts of the unit may heat up.

- ▷ 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 unit:

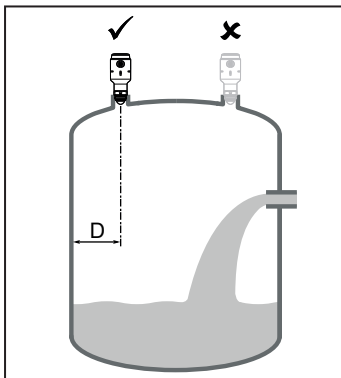
- ▶ Make sure that no pressure is applied to the system. Also always take into account the potential dangers related to extreme machine and medium temperatures.
- ▶ Before installing the unit, observe the following mounting specifications.

6.1 Mounting position



The unit is a TLPR device. TLPR (Tank Level Probing Radar) equipment are devices for level measurement in a closed space only (i.e. metallic, reinforced concrete or fibreglass tanks, or similar enclosure structures made of comparable attenuating material).

- ▶ Use preferably in metal tanks. When used in electrically non-conductive tanks: Non-metallic tanks (→ □ 15)
- ▶ Further requirements: ETSI EN 302 372 (TLPR), Annex E
- ▶ 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.
 - The unit should be mounted with as few internal structures as possible within the signal beam.
 - Do not mount the unit close to or above the inlet stream (→ Fig. Mounting).
 - Do not position the unit directly above a side manway door.



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

Fig. 6: Mounting

6.2 Inclination

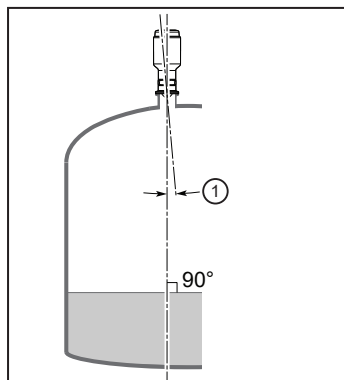


Fig. 7: Inclination

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

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6.3 Non-metallic tanks

Non-metallic tanks are, for example, fibreglass tanks.

! Nearby objects outside the tank may cause disturbing radar echoes as such materials may allow radar waves to pass through. Corrective measures:

- ▶ The unit should be positioned so that objects close to the tank are kept outside the signal beam.

! When installed in non-metallic tanks, there may be deterioration caused by electromagnetic interference from other devices. Corrective measures:

- ▶ Apply a shielding screen / metal foil between the level sensor and other electrical devices.
- ▶ Additional installation in a metal pipe. Consider the beam angle of the unit when selecting a pipe diameter.

6.4 Beam angle and beam width

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

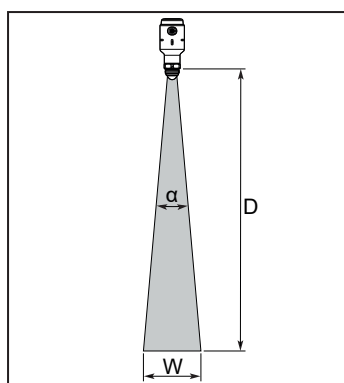


Fig. 8: Beam angle and beam width

Beam angle (α): 10°

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

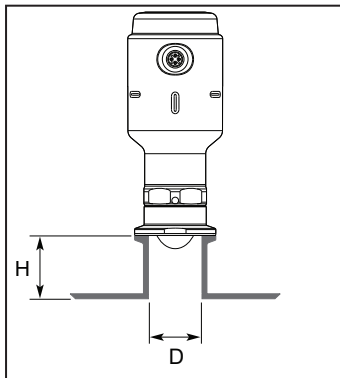
Distance (D)	Beam width (W)
2 m (6.6 ft.)	0.4 m (1.2 ft.)
4 m (13.1 ft.)	0.7 m (2.3 ft.)
6 m (19.7 ft.)	1.1 m (3.5 ft.)
8 m (26.2 ft.)	1.4 m (4.6 ft.)
10 m (32.8 ft.)	1.8 m (5.8 ft.)

! The signal beam may penetrate the side wall of non-metallic tanks (e.g. fibreglass tanks).

- ▶ Such materials are largely transparent to the radar signal. Nearby objects outside the tank may cause disturbing radar echoes.

6.5 Nozzle requirements

- ▶ To allow the radar waves to propagate undisturbed, the specified nozzle dimensions should be observed (→ Fig. Nozzle dimensions and table).
- ▶ The inside of the nozzle must be smooth (i.e. avoid bad welding, rust, or deposit).



Maximum nozzle height (H) as a function of the nozzle diameter (D):

Nozzle diameter (D)	Nozzle height (H)
40 mm (1.5 in.)	150 mm (5.9 in.)
50 mm (2 in.)	200 mm (7.9 in.)
80 mm (3 in.)	300 mm (11.8 in.)
100 mm (4 in.)	400 mm (15.8 in.)
150 mm (6 in.)	600 mm (23.6 in.)

Fig. 9: Nozzle dimensions

6.6 Notes for hygienic applications

The unit withstands standard CIP routines and SIP routines up to 140 °C.

- ▶ To conform with applicable hygienic standards and food and beverage legislation and regulations, make sure:
 - the unit is installed in a closed tank.
 - the unit is installed with hygienic adapter and O-ring/seal.
- ▶ It is the responsibility of the user to ensure:
 - the materials used (→ Data sheet) are suitable for the media to be detected and the cleaning/sanitising processes.
 - the installation of the unit is drainable and cleanable.
 - that the joint/clamping between the unit and the nozzle is compatible with the tank pressure and media.
 - that for the application an M12 connector with appropriate ingress protection against dirt and moisture is used.

6.6.1 Notes on the use according to EHEDG



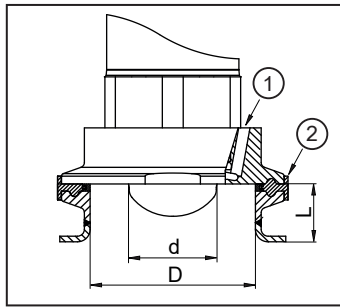
The unit is suited for CIP (cleaning in process) when installed correctly.

- ▶ Observe the application limits (temperature and material resistance) according to the data sheet.
- ▶ Ensure that the installation of the unit in the system complies with EHEDG guidelines.
- ▶ Use self-draining installation.
- ▶ Only use process adapters permitted according to EHEDG with special seals required by the EHEDG position paper.



The gasket of the system interface must not be in contact with the sealing point of the sensor.

- ▶ In case of structures in a tank, the installation must be flush mount. If not possible then direct water jet cleaning and cleaning of dead spaces must be possible.
- ▶ Install leakage ports so that they are clearly visible.



1: Leakage port
2: Seal

- ▶ To avoid dead space adhere to the dimensions:
 $L < (D - d)$
 $d = 25 \text{ mm}$

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6.6.2 Notes on the use according to 3-A®

- ▶ Make sure that the sensor is integrated into the system according to 3-A.
- ▶ Use only adapters with 3-A qualification and marked with the 3-A symbol. Available accessories: www.ifm.com.

The process connection must be provided with a leakage port. This is ensured when installed using adapters with 3-A approval.

- ▶ Install leakage ports so that they are clearly visible.
- ▶ It is recommended to choose an installation position where the probe and the process connection can be cleaned with a spray ball.

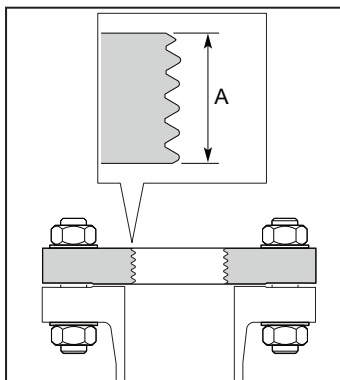


For use according to 3-A, special regulations apply for cleaning and maintenance.



Not suitable for systems that have to meet the criteria of E9.2 of the 3A standard 63-04.

6.7 Mounting in a threaded connection



Thread length requirements (A) for the G1 process connection on the tank:

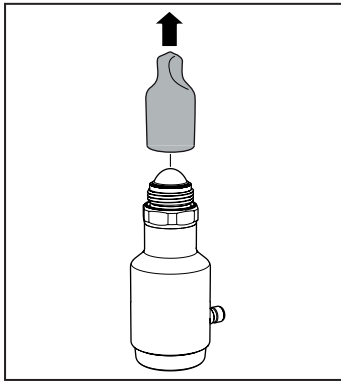
Required thread length (A)	
A_{\min}	8 mm (0.32 in.)
A_{\max}	16 mm (0.63 in.)

Fig. 10: Threaded mounting

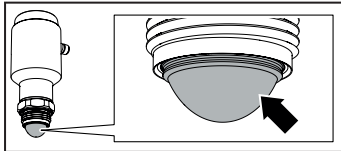
6.8 Mounting preparations

6.8.1 Remove the protective cap

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



► Before installing, carefully remove the protective cap.

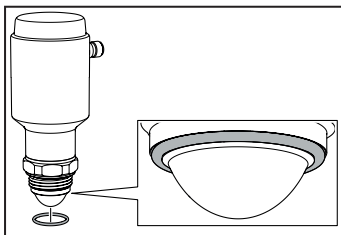


► Be careful not to scratch or otherwise damage the antenna.

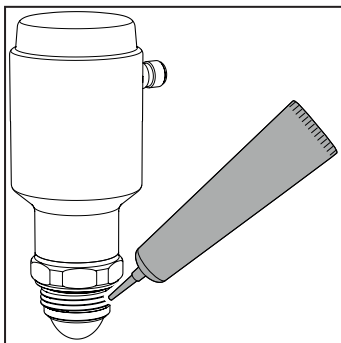
6.8.2 Place the O-ring, grease the thread



The matching O-ring (EPDM) is supplied with the adapter. More O-rings are available as accessories.



► Place the O-ring in the groove of the unit.

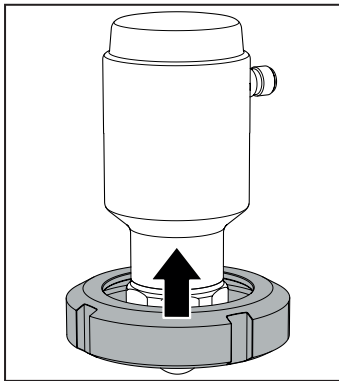


► Lightly grease the thread of the unit with lubricating paste.

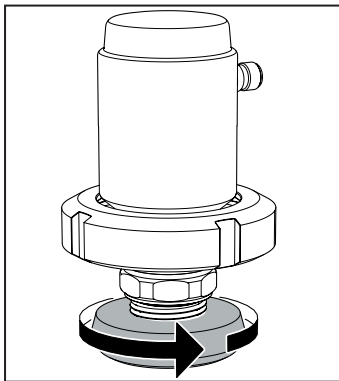


The paste must be approved for the application and compatible with the elastomers used.

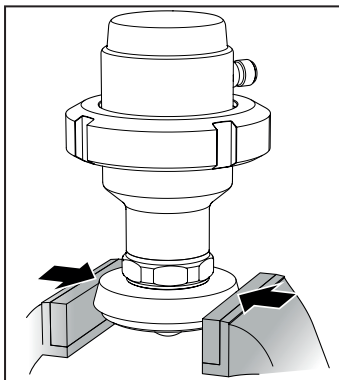
6.8.3 Premount the adapter for pipe fittings



- ▶ Slide the coupling nut up over the bottom of the unit.

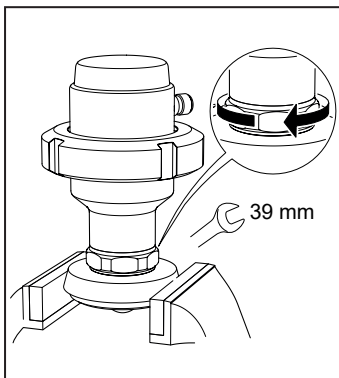


- ▶ Make sure that the O-ring is mounted in the groove of the unit.
- ▶ Screw the adapter onto the unit until it is hand-tight.



- ▶ Secure the unit and adapter using a vice.

! Use suitable vice jaws (protectors). Do not over-tighten the vice as it might damage the adapter.



- ▶ Tighten firmly. Recommended tightening torque: 35 Nm.

! Further tightening may affect the sealing. Replace the O-ring or the entire process connection if the seal area is damaged.

6.8.4 Install the welding aid

Install the welding aid:

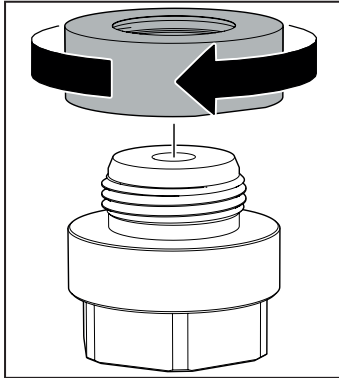
The welding aid absorbs heat during the welding process and can prevent warping of the weld-in adapter.

**CAUTION**

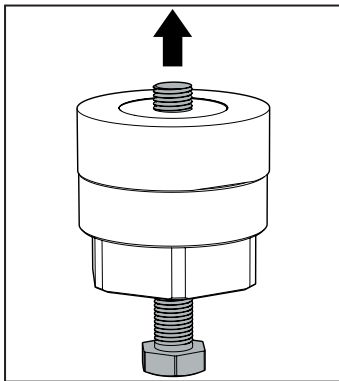
During the welding operation, the adapter and the welding aid can increase in temperature to over 65 °C (149 °F).

▷ Risk of burns

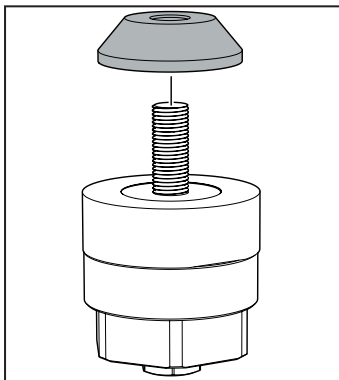
▶ Let the components of the welding aid and weld-in adapter cool down before removal.



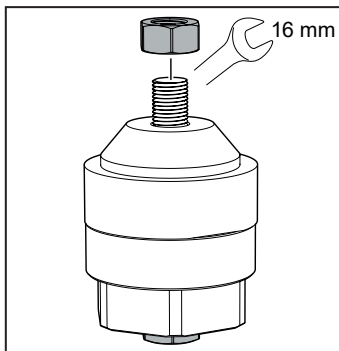
▶ Hand-tighten the weld-in adapter on the welding aid.



▶ Insert the clamping bolt through welding aid opening.



▶ Mount the counter plate.



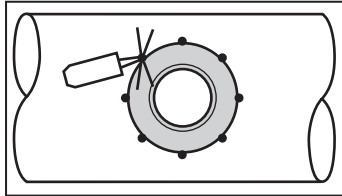
▶ Hand-tighten the nut.

Weld the weld-in adapter to the tank:

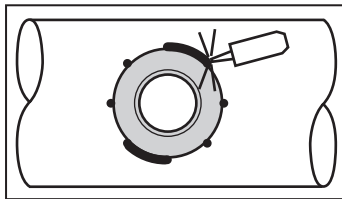


Welding operation:

- ▶ During welding and the following cooling phase the unit must not be in place.
- ▶ During welding, avoid overheating of the adapter and observe sufficient cooling phases.
- ▶ While welding, the adapter must not warp.
- ▶ The sealing edge of the adapter must not be damaged by weld spatter or similar. Ensure sufficient protection of the sealing edge before starting the welding process.



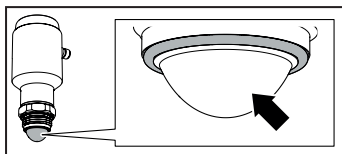
- ▶ Fix the adapter in several spots with a sufficient adhesive force. Apply the fixing points at equal distances opposite each other.



- ▶ Apply the welding seams between the fixing points opposite each other. Ensure sufficient intervals between the individual sections to avoid glowing through or warping of the adapter due to overheating.

- ▶ Allow the adapter and the welding aid to cool.
- ▶ If used: Remove the welding aid.
- ▶ Remove deposits from the thread.

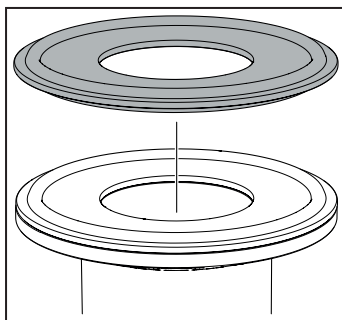
6.9 Mount the unit in the tank



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

6.9.1 Mount the unit with Tri Clamp adapter

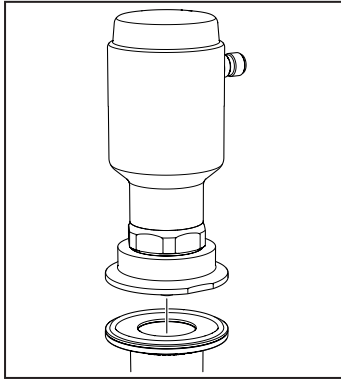
- ▶ Make sure that the O-ring is mounted in the groove of the unit.
- ▶ Screw the Tri Clamp adapter onto the unit (not shown). Tighten to the recommended torque (→ Installation instructions of the adapter).



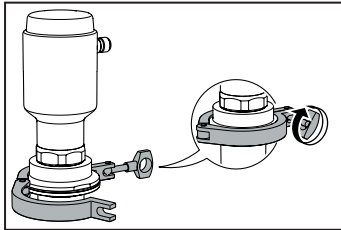
- ▶ Place a suitable gasket on top of the tank flange.



- ▶ The inner diameter of the selected clamp gasket must correspond to the inner diameter of the tank flange. The inside of the gasket must be flush with the inner diameter of the tank flange.

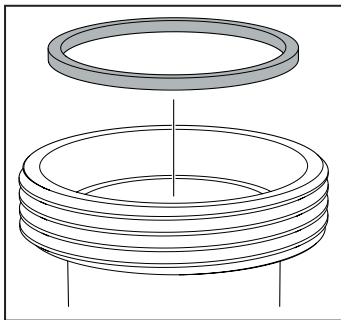


- ▶ Lower the unit with the mounted Tri Clamp adapter onto the tank nozzle.

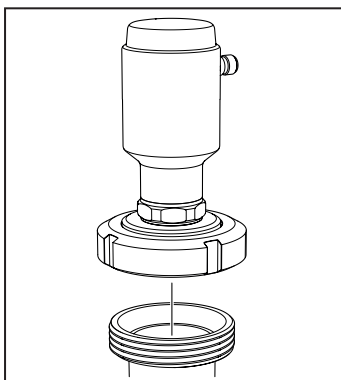


- ▶ Tighten the clamp to the recommended torque (→ Manufacturer's installation instructions).

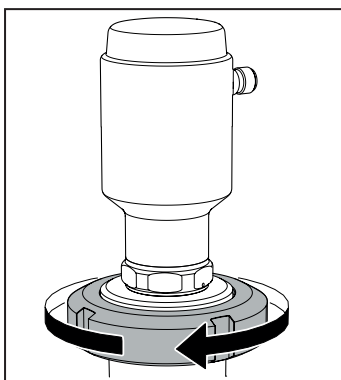
6.9.2 Mount the unit with pipe fitting



- ▶ Place a suitable gasket on top of the tank flange.



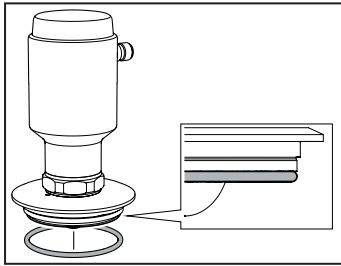
- ▶ Lower the unit with the mounted adapter for pipe fittings onto the tank nozzle.



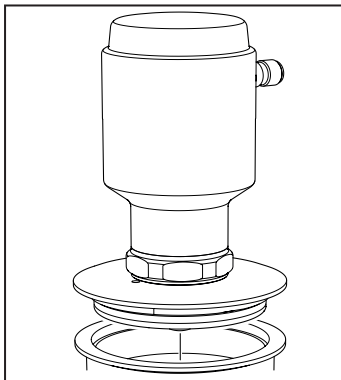
- ▶ Tighten the coupling nut to the recommended torque (→ Manufacturer's installation instructions).

6.9.3 Mount the unit with VARIVENT® adapter

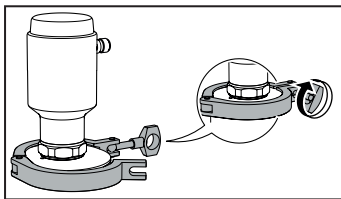
- ▶ Make sure that the O-ring is mounted in the groove of the unit.
- ▶ Screw the VARIVENT adapter onto the unit (not shown). Tighten to the recommended torque (→ Installation instructions of the adapter).



- ▶ Mount a suitable gasket at the bottom of the VARIVENT adapter.

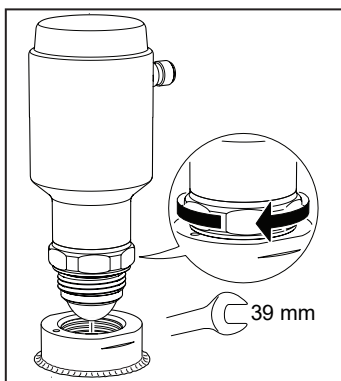


- ▶ Lower the unit with the mounted VARIVENT adapter onto the tank nozzle.



- ▶ Tighten the clamp to the recommended torque (→ Manufacturer's installation instructions).

6.9.4 Install the weld-in adapter on the unit

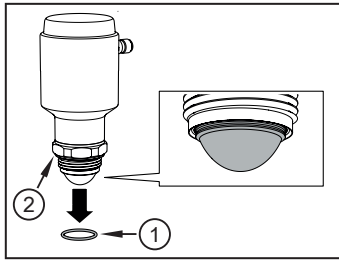


- ▶ Make sure that the O-ring is mounted in the groove of the unit.
- ▶ Screw the unit into the weld-in adapter.
- ▶ Recommended tightening torque: 35 Nm.

6.9.5 Mount the unit with G1 connection

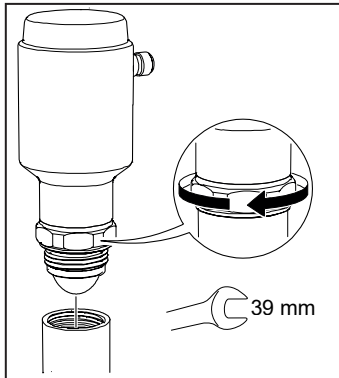


Only for non-hygienic applications (e.g. secondary applications).



- ▶ Remove the O-ring (1) from the unit before mounting.

Otherwise, the O-ring may come off due to the missing end stop and enter the process. In this case, the seal is formed by the rear flat seal (2) (non-hygienic).



- ▶ Make sure that the rear flat seal (profiled sealing ring) is on the unit.
- ▶ Screw the unit into the adapter.
- ▶ Recommended tightening torque: 35 Nm.

7 Electrical connection

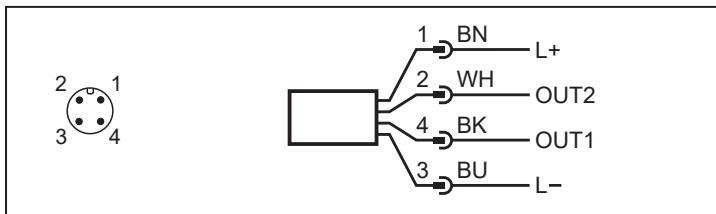
! The unit must be connected by a qualified electrician.

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.

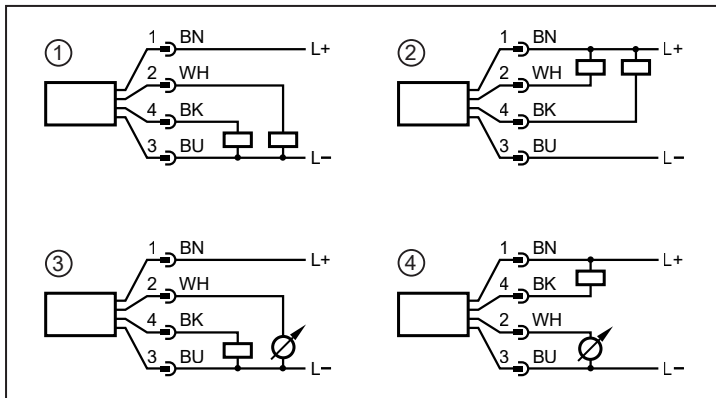
- ▶ Disconnect power.
- ▶ Connect the unit as follows:

! 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

8 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
-  When the medium is changed, it may also be necessary to adapt the device settings.

8.1 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.

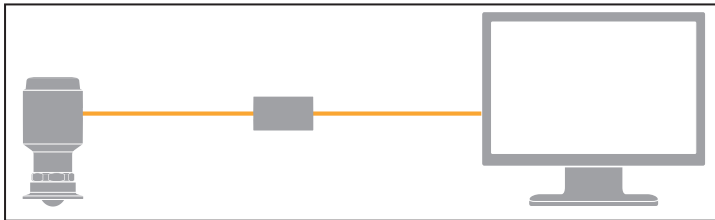


Fig. 11: Connection via the USB IO-Link interface

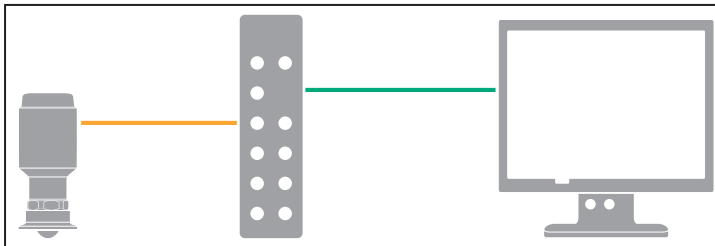



Fig. 12: Connection via the IO-Link master for field use

-  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.

8.2 Parameter setting during operation

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

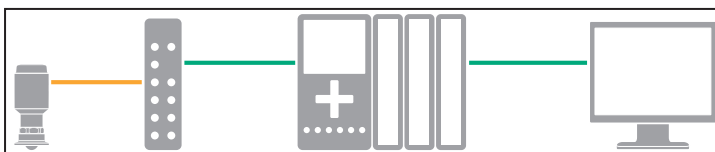


Fig. 13: Connection example with PLC

- ▶ 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.



GB




8.3 Adjustable parameters




Parameters marked with “!” (in the “Access” column) (e.g. [SSC1 Param. SP2]) are only active if the assigned parameters have been selected.

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].

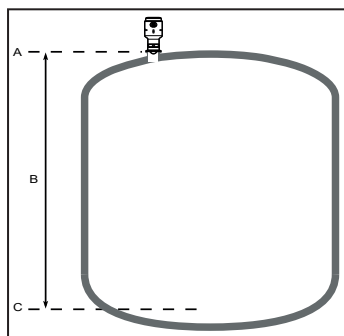
Parameter	Options	Explanation	Access
uni	[m] = metre [inch] = inch	Selection of the display unit.	
Reference height	Setting range: 0.2...15 m	Distance between unit and zero point (→ Fig. Reference height).  ▶ Ensure that the reference height corresponds to the actual tank height. If necessary, configure 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 (→ Fig. Upper blind zone).	
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 signal channel 1). [OFF] = output OFF (high impedance)*	Output configuration for OUT1. *) This does not affect the IO-Link communication.	
ou2	[I] = configures OUT2 as switching output 4...20 mA. [SSC2] = configures OUT2 as switching output. OUT2 is assigned to SSC2 (switching signal channel 2). [OFF] = output OFF (high impedance)	Output configuration for OUT2.	
dS1	Setting range: 0...60 s	Switch-on delay for SSC1 (switching signal channel 1). The switch-on delay reacts according to VD-MA*).	
dr1	Setting range: 0...60 s	Switch-off delay for SSC1 (switching signal channel 1). The switch-off delay reacts according to VD-MA*).	
SSC1 Param. SP1	Setting range: 0.005...15 m	Set point 1 for SSC1 (switching signal 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].	!

Parameter	Options	Explanation	Access
SSC1 Param. SP2	Setting range: 0...14.995 m	Set point 2 for SSC1 (switching signal channel 1). Only available with window function and in two-point mode.  Set point 2 must be smaller than set point 1. If set point 2 is set higher than set point 1, this will be rejected by the device software.	!
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 signal channel 1). Only available in single-point mode and with window function.	!
dS2	Setting range: 0...60 s	Switch-on delay for SSC2 (switching signal channel 2). The switch-on delay reacts according to VDMA*)	
dr2	Setting range: 0...60 s	Switch-off delay for SSC2 (switching signal channel 2). The switch-off delay reacts according to VDMA*)	
SSC2 Param. SP1	Setting range: 0.005...15 m	Set point 1 for SSC2 (switching signal 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 signal channel 2). Only available with window function and in two-point mode.  Set point 2 must be smaller than set point 1. If set point 2 is set higher than set point 1, this will be rejected by the device software.	!
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 signal 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 is output Menu item only visible if analogue output ([ou2] = [I]) is selected.	!
AEP2	Setting range: 0.2...15 m	Analogue end point: measured value at which 20 mA is output Menu item only visible if analogue output ([ou2] = [I]) is selected.	!

Parameter	Options	Explanation	Access
FOU2	[On] = analogue output switches to a value > 21 mA in alert mode. Switching output switches ON in alert mode. [OFF] = analogue output switches to a value < 3.6 mA in alert mode. Switching output switches OFF in alert 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	The time delay for transfer to alert mode. Only effective in case of a fault. Defined state in the event of a fault (alert mode) (→ □ 12)	
Detection threshold	Setting range: 0...20,000 mV	Level detection threshold (→ 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 reset 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. 14: Reference height



The measuring range ends at the zero point (C).

- Levels below zero are not detected; [0.0 m] is provided as process value.
- If the level drops below zero, the unit briefly sends the process value [NoData] and the error message [No reflection signal].

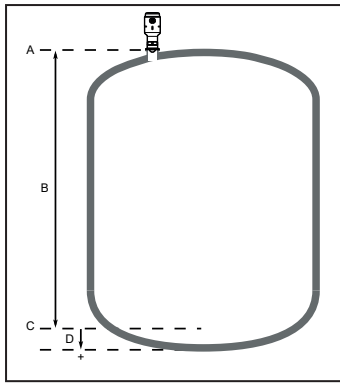
If this behaviour is not desired:

- ▶ Ensure that the level does not fall below the minimum (position C), e.g. by selecting suitable switch points (or by throttling the outlet).

Or alternatively:

- ▶ Enter a tank offset (→ Fig. Tank offset)

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. 15: Tank offset



If the tank bottom does not correspond to the zero point:

- ▶ 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.
 - ▷ False echoes within the tank offset (e.g. from agitators, heating coils, hopper or dished ends) are suppressed.
 - ▷ If the level falls below the zero point, no error message is issued as long as the level does not also fall below the tank offset. Levels within the tank offset are not detected; [0.0 m] is constantly provided as process value.
- 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:

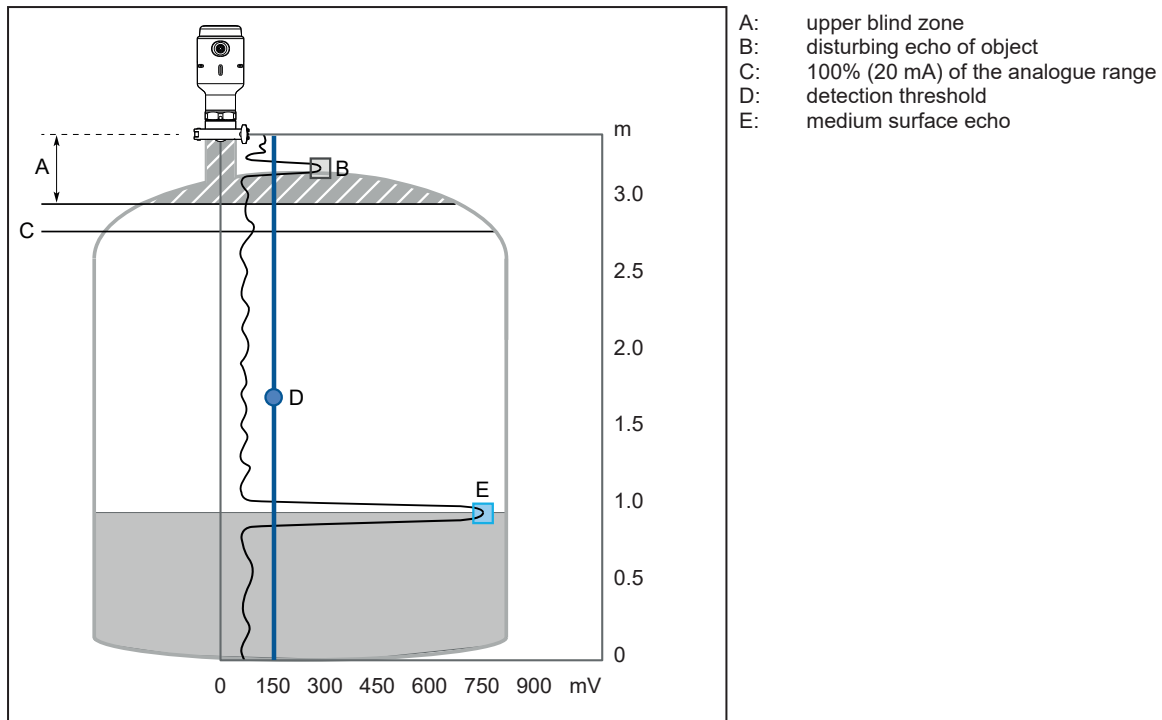


Fig. 16: Upper blind zone / detection threshold



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 or not reliably detected.

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




8.4 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	Restores the factory settings (all parameters)

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.

8.5 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 [Factory reset].
- ▷ 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:
 - ▶ Correct the tank 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.
- ▶ Set the detection threshold to 1,000 mV for test purposes:
parameter [Detection threshold] = [1000] mV.
-  Even with a high detection threshold, aqueous media can be detected with sufficient reliability. Depending on false echoes and the properties of the medium, a different detection threshold may be required. The echo peaks emitted by the unit are helpful for assessing the detection threshold.
- ▶ Configure output OUT2 as an analogue output:
[ou2] = [I].
- ▶ Configure analogue output:
Use [ASP2] and [AEP2].
- ▶ Configure switching output OUT1:
Use [SSC1...] parameter.

9 Operation

9.1 Function check

After power-on 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.

9.1.1 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 detection threshold using the [Detection threshold] parameter.



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.

9.2 Diagnostic messages, cause, troubleshooting

Diagnostic message	Possible cause	Recommended actions
Hardware fault in the unit.	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.

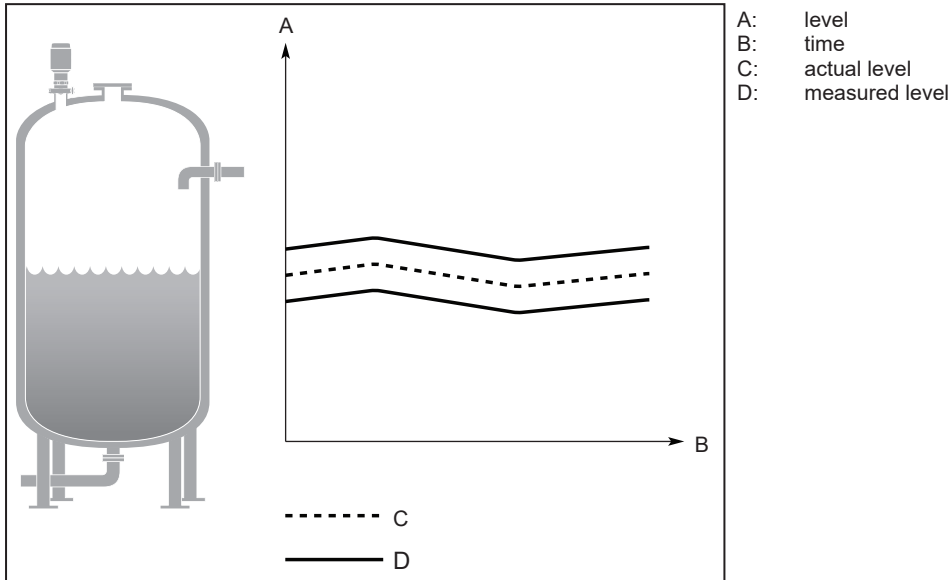
Diagnostic message	Possible cause	Recommended actions
No reflection signal	No valid level reading. Reasons may be multiple: <ul style="list-style-type: none"> No valid level echo in the measuring range. Wrong device configuration. 	<ul style="list-style-type: none"> Analyse echo peaks and check device 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.
Admissible device temperature exceeded.	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.
Admissible device temperature not reached.	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 overvoltage.	Supply voltage is too high.	<ul style="list-style-type: none"> Verify operating voltage is between 18-30 V.
Primary supply undervoltage.	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.

10 Troubleshooting

10.1 Troubleshooting incorrect level readings

10.1.1 Level too high / too low



Possible cause:

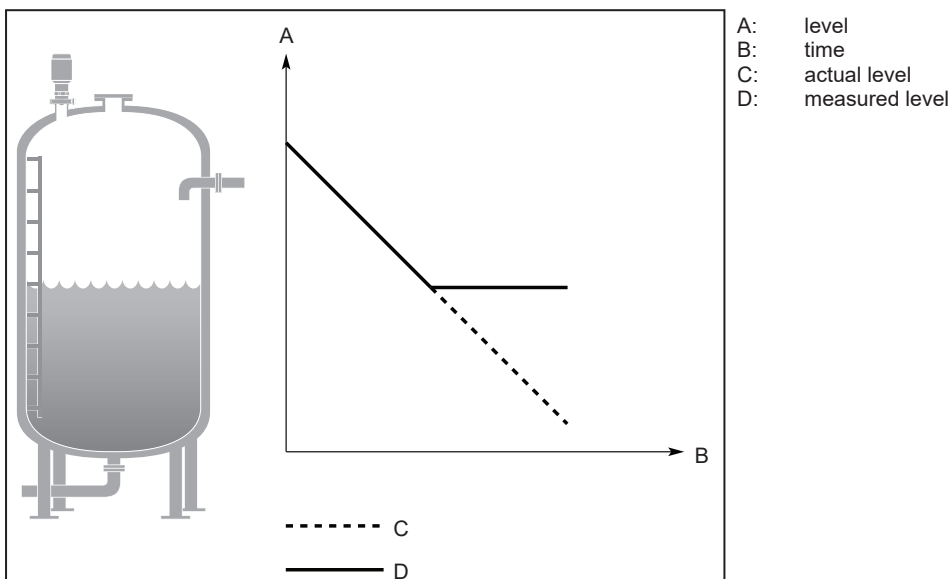
- Incorrect tank geometry configuration.

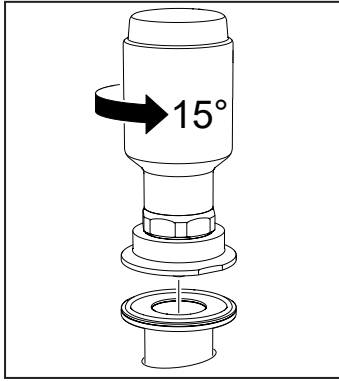
Recommended actions:

- 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.

10.1.2 Measured value is stuck

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





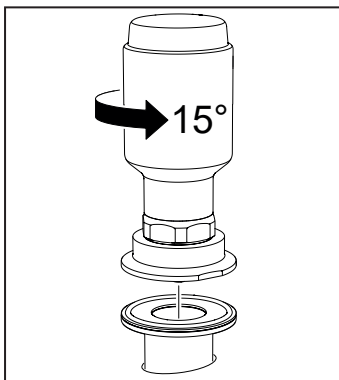
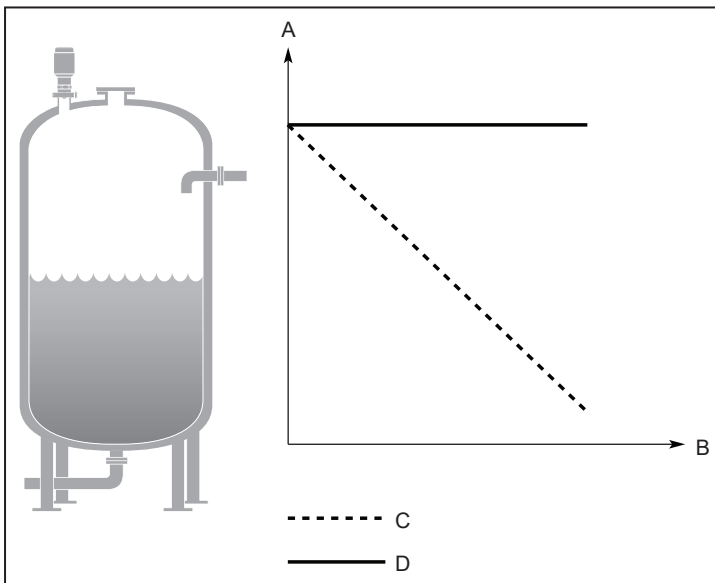
Possible cause:

- 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:



Possible cause:

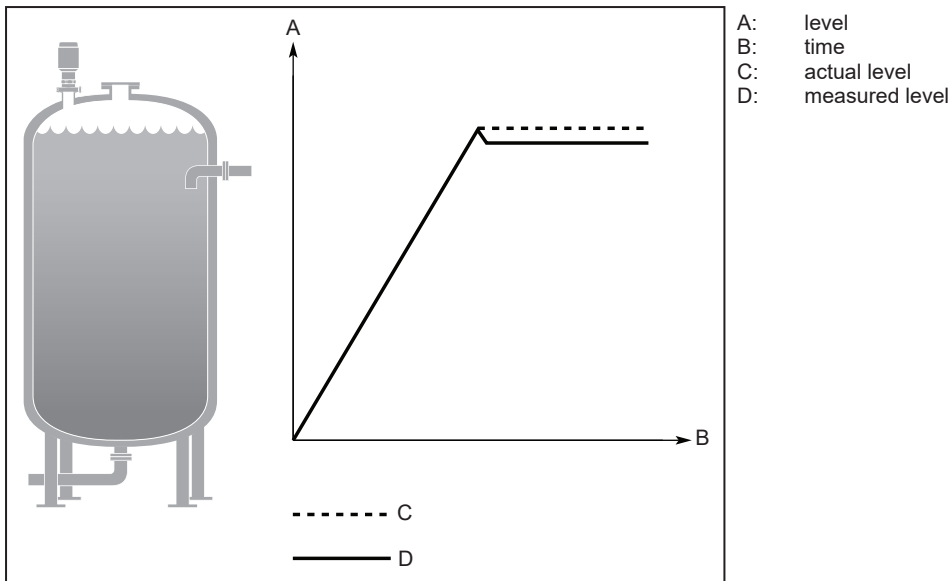
- Disturbing object near the antenna.

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.

10.1.3 Measured value drops when level close to antenna

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



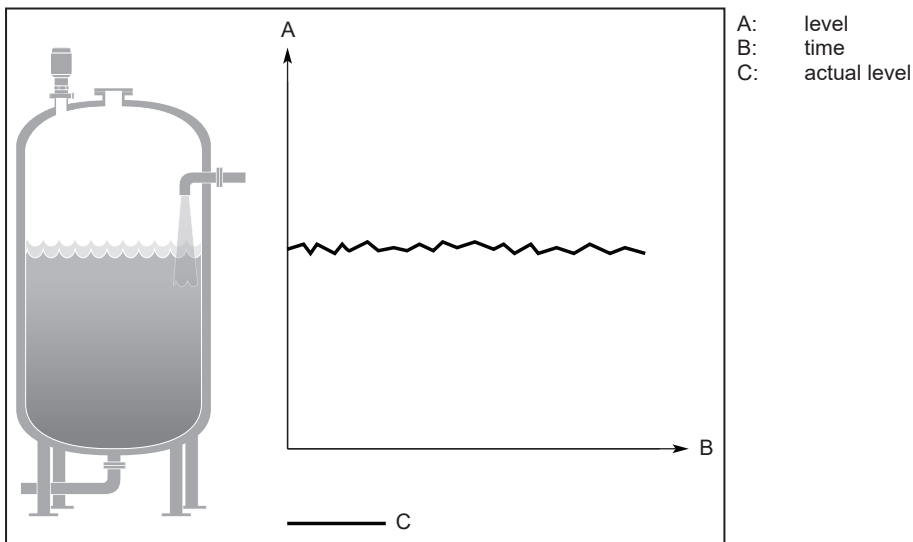
Possible cause:

- 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.

10.1.4 Measured value fluctuates



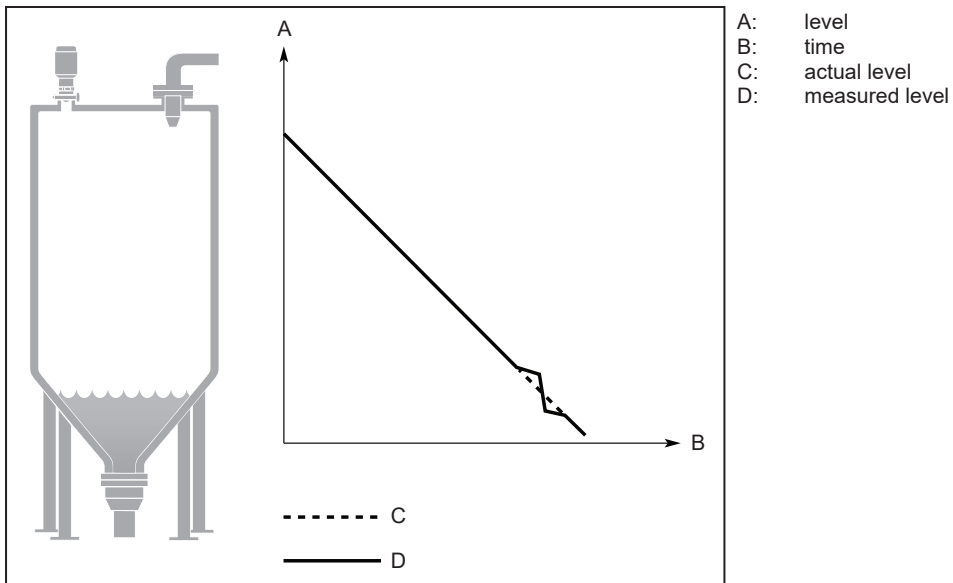
Possible cause:

- 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.

10.1.5 Measured value is occasionally unstable



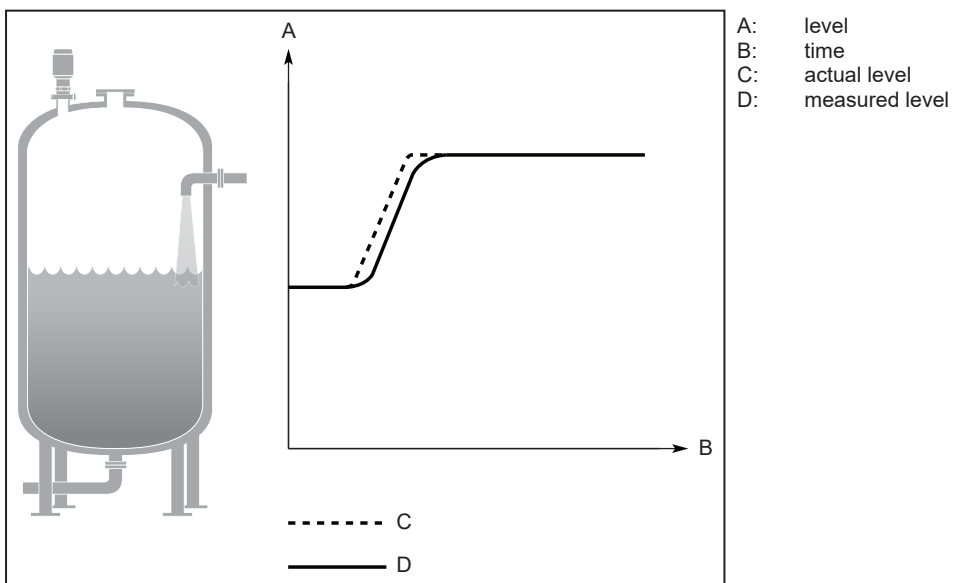
Possible cause:

- The level is close to a suppressed false echo.

Recommended actions:

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

10.1.6 Lagging of measured value during rapid level changes



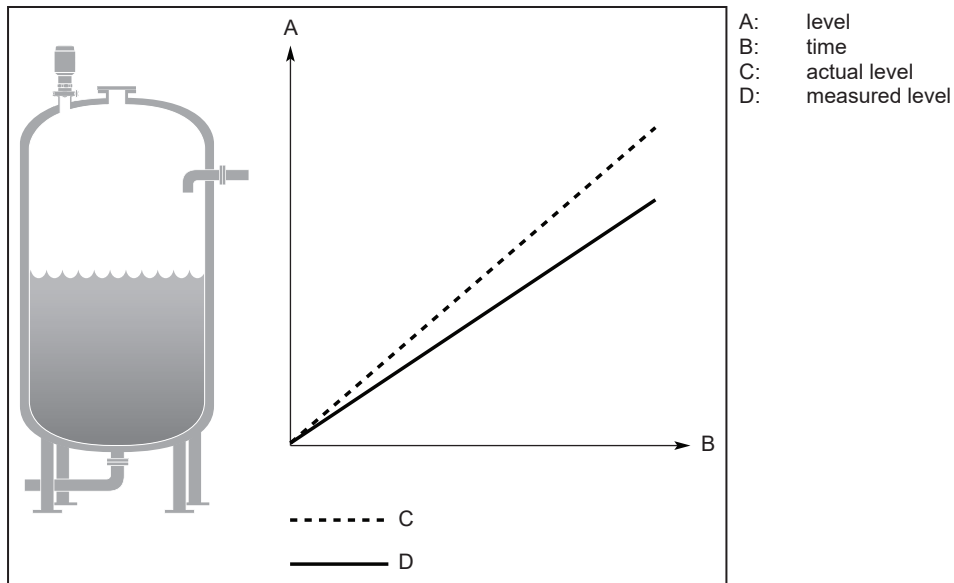
Possible cause:

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

Recommended actions:

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

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



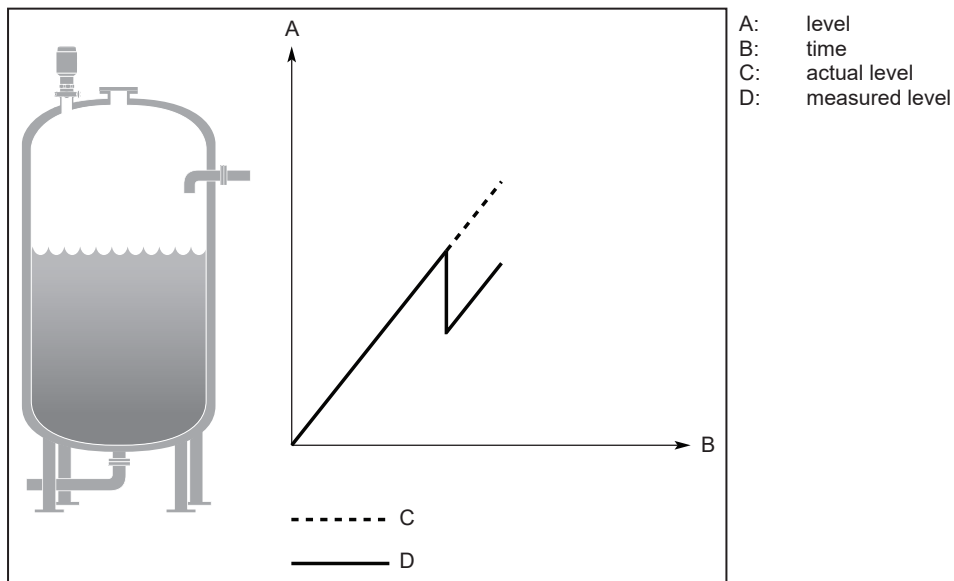
Possible cause:

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

Recommended actions:

- Correct parameter [AEP2].

10.1.8 Incorrect measured value when level is above 50%



Possible cause:

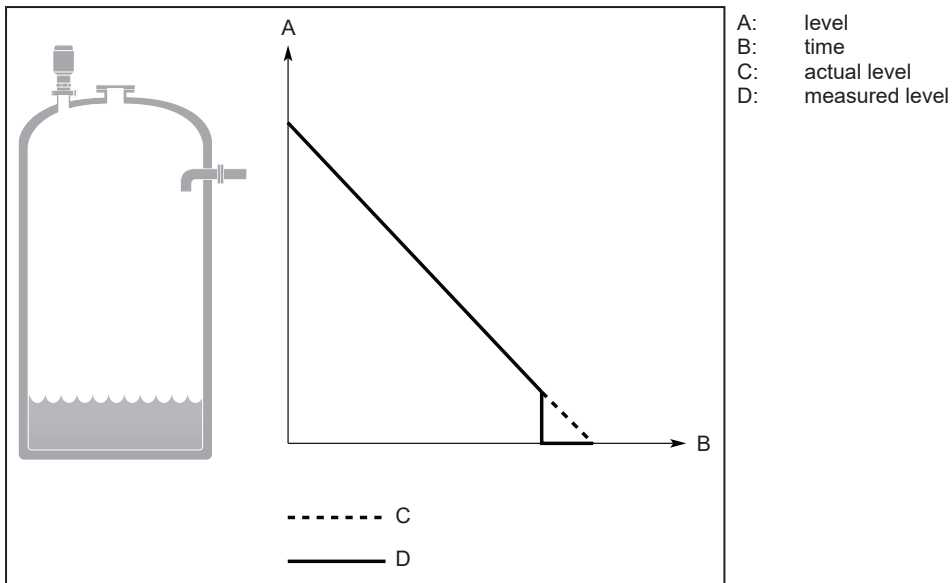
- Strong multiple reflections are interpreted as the level.

Recommended actions:

- Move the device to another position.

10.1.9 Measured value drops to zero close to tank bottom

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



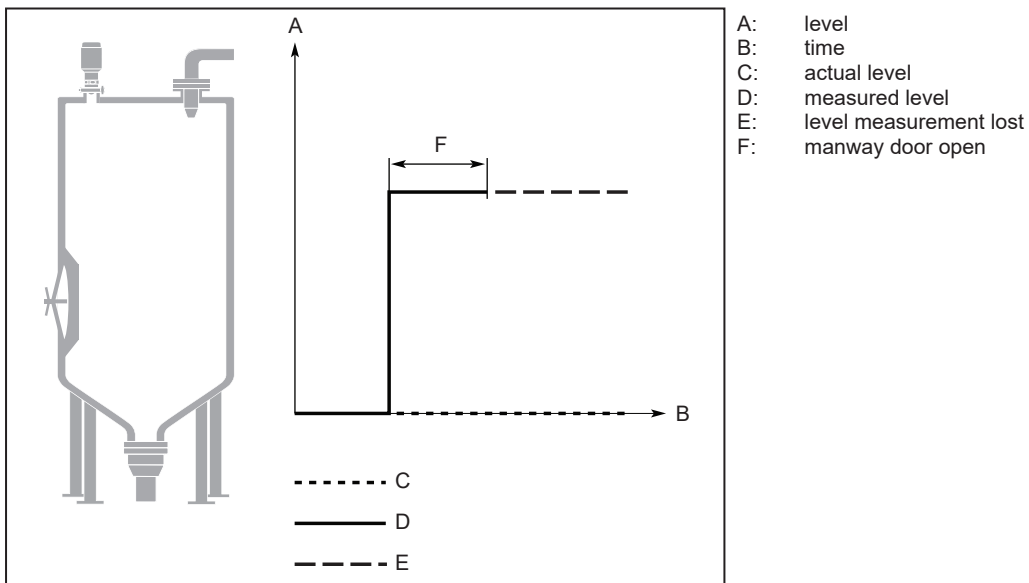
Possible cause:

- 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.

10.1.10 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.

10.1.11 Alert mode when level close to tank bottom

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

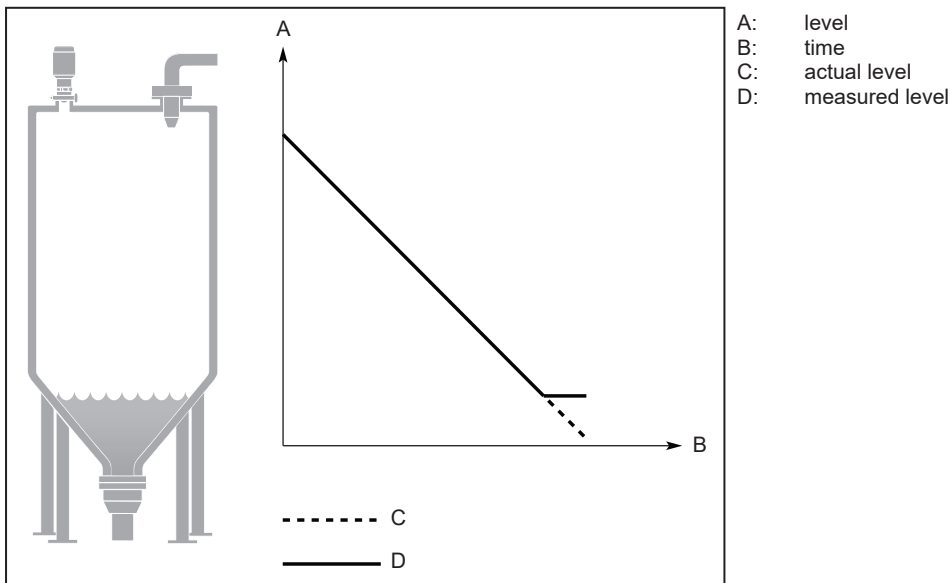


Fig. 17:

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).

11 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.

12 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.

13 Appendix

13.1 Approvals and certificates

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

Approval-related notes: → Packing slip