Radar Level Measurement

BAS-RLM80 , BAS-RLM70

High performance level measurement for tank gauging systems

Operating Instructions

Radar sensor for continuous level measurement in bulk solids and liquids

BAS-RLM 80

4 … 20 mA/HART
2-wire

BAS-RLM 70

4 … 20 mA
4-wire

Basamad Afraz System

Contents

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1 About this document

1.1 Function

This instruction provides all the information you need for mounting, connection and setup as well as important instructions for maintenance, fault rectification, the exchange of parts and the safety of the user. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

1.2 Target group

This operating instructions manual is directed to trained personnel. The contents of this manual must be made available to the qualified personnel and implemented.

1.3 Symbols used

Document ID

Information, note, tip: This symbol indicates helpful additional information and tips for successful work.

Note: This symbol indicates notes to prevent failures, malfunctions, damage to devices or plants.

Caution: Non-observance of the information marked with this symbol may result in personal injury.

Warning: Non-observance of the information marked with this symbol may result in serious or fatal personal injury.

Danger: Non-observance of the information marked with this symbol results in serious or fatal personal injury.

Ex applications: This symbol indicates special instructions for Ex applications.

List

The dot set in front indicates a list with no implied sequence.

Sequence of actions

Numbers set in front indicate successive steps in a procedure.

Battery disposal

This symbol indicates special information about the disposal of batteries and accumulators.

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2 For your safety

2.1 Authorized personnel

All operations described in this documentation must be carried out only by trained, qualified personnel authorized by the plant operator. During work on and with the device, the required personal protective equipment must always be worn.

2.2 Appropriate use

BAS-RLM80 and BAS-RLM70 are a sensors for continuous level measurement.
You can find detailed information about the area of application in chapter "Product description".
Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

2.3 Warning about incorrect use

Inappropriate or incorrect use of this product can give rise to application-specific hazards, e.g. vessel overfill through incorrect mounting or adjustment. Damage to property and persons or environmental contamination can result. Also, the protective characteristics of the instrument can be impaired.

2.4 General safety instructions

This is a state-of-the-art instrument complying with all prevailing regulations and directives. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument. When measuring aggressive or corrosive media that can cause a dangerous situation if the instrument malfunctions, the operator has to implement suitable measures to make sure the instrument is functioning properly.

The safety instructions in this operating instructions manual, the national installation standards as well as the valid safety regulations and accident prevention rules must be observed by the user.

For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorized by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden. For safety reasons, only the accessory specified by the manufacturer must be used.

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To avoid any danger, the safety approval markings and safety tips on the device must also be observed.

The low transmitting power of the radar sensor is far below the internationally approved limits. No health impairments are to be expected with intended use.

3 Product description

The scope of delivery encompasses:

- BAS-RLM 70 radar sensor
- Hexagon socket wrench (for instruments with swivel holder)

The further scope of delivery encompasses:

- Documentation
  - Quick setup guide BAS-RLM 70
  - Instructions for optional instrument features
  - Ex-specific "Safety instructions" (with Ex versions)
  - If necessary, further certificates

Information:
Optional instrument features are also described in this operating instructions manual. The respective scope of delivery results from the order specification.

Application area

3.1 Principle of operation

The BAS-RLM 70 is a radar sensor for continuous level measurement of bulk solids under different process conditions. It is ideal for level measurement in very high silos, large bunkers and segmented vessels. The very good signal focusing ensures a simple setup and reliable measurement.

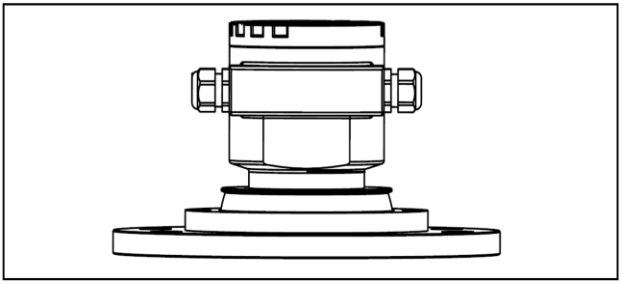

Fig. 2: Lens antenna system BAS-RLM 70

- Metal-jacketed lens antenna

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Functional principle

The instrument emits a continuous, frequency-modulated radar signal through its antenna. The emitted signal is reflected by the medium and received by the antenna as an echo with modified frequency. The frequency change is proportional to the distance and is converted into the level.

4 Mounting

4.1 General instructions

Protect your instrument against moisture ingress through the following measures:

- Use a suitable connection cable (see chapter "Connecting to power supply")
- Tighten the cable gland or plug connector
- Lead the connection cable downward in front of the cable entry or plug connector

This applies mainly to outdoor installations, in areas where high humidity is expected (e.g. through cleaning processes) and on cooled or heated vessels.

Note:

Make sure that the degree of contamination specified in chapter "Technical data" meets the existing ambient conditions.

Note:

Make sure that during installation or maintenance no moisture or dirt can get inside the instrument.

To maintain the housing protection, make sure that the housing lid is closed during operation and locked, if necessary.

Note:

For safety reasons, the instrument must only be operated within the permissible process conditions. You can find detailed information on the process conditions in chapter "*Technical data*" of the operating instructions or on the type label.

Hence make sure before mounting that all parts of the instrument exposed to the process are suitable for the existing process conditions.

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These are mainly:

- Active measuring component
- Process fitting
- Process seal

Process conditions in particular are:

- Process pressure
- Process temperature
- Chemical properties of the medium
- Abrasion and mechanical influences

Mounting strap

4.2 Mounting versions

The optional mounting strap allows simple mounting of the instrument on a wall, ceiling or boom. Especially in the case of open vessels, this is a simple and effective way to align the sensor to the surface of the bulk solid material.

The following versions are available:

- Length 300 mm
- Length 170 mm

Mounting strap - Ceiling mounting

The instrument is normally mounted vertically with a bracket on the ceiling.

This allows swiveling the sensor up to 180° for optimal orientation and rotating for optimal connection.

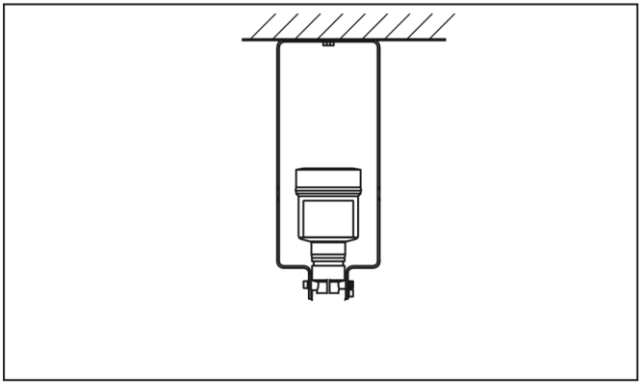

Fig. 3: Ceiling mounting via the mounting strap with length 300 mm

Mounting strap - Wall mounting

As an alternative the strap mounting is carried out horizontally or obliquely.

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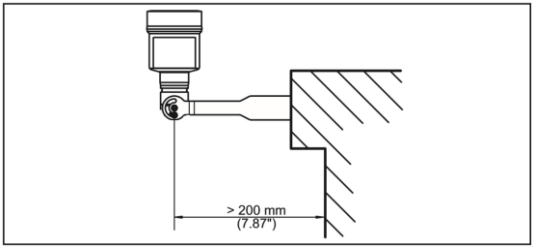

Fig. 4: Wall mounting horizontally via the mounting strap with length 170 mm

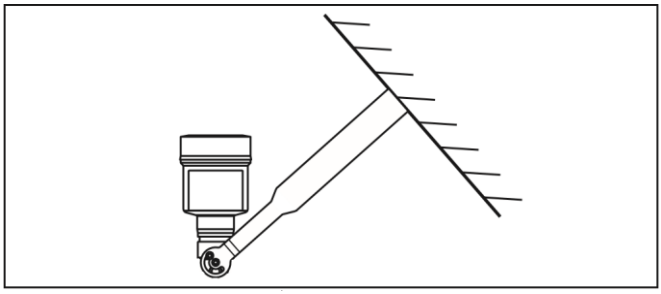

Fig. 5: Wall mounting with inclined wall via the mounting strap with length 300 mm

Flange

- Mounting the instrument on a socket with adapter flange

Swiveling Adapter Flange
The adapter flange is available from DN 100, ASME 4" and JIS 100. It is permanently connected with the radar sensor and sealed.

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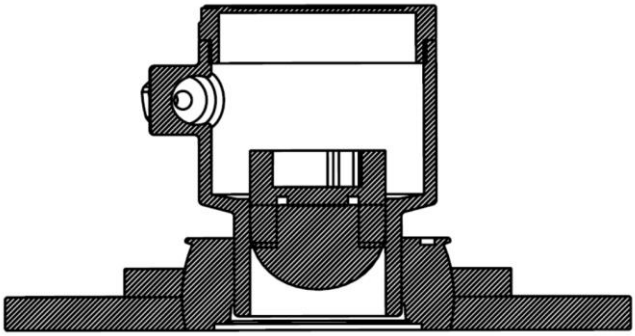

Fig. 7: Swiveling Adapter Flange

4.3 Mounting preparations, mounting strap

The mounting strap is supplied unassembled (optionally) and must be screwed to the sensor before setup with three hexagon socket screws M5 x 10 and spring washers. Max. torque, see chapter "*Technical data*". Required tools: Allen wrench size 4.

There are two different variants of screwing the strap to the sensor, see following illustration

:

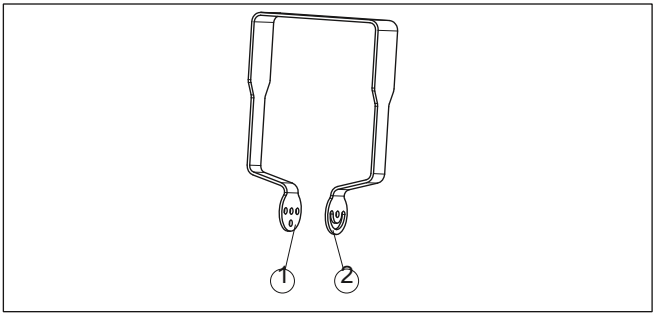

Fig. 8: Mounting strap for screwing to the sensor

1. For angle of inclination in steps
2. For angle of inclination, infinitely variable

Depending on the selected variant, the sensor can be rotated in the strap:

- Chamber housing
  - Angle of inclination in three steps 0°, 90° and 180°

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– Angle of inclination 180°, infinitely variable

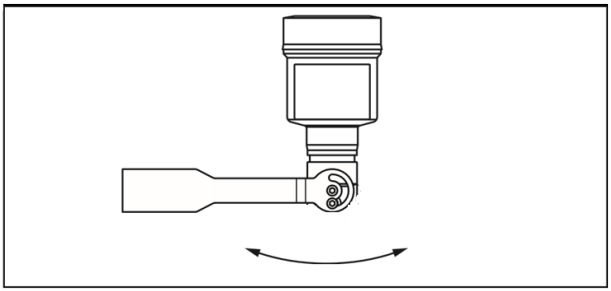

Fig. 9: Adjustment of the angle of inclination

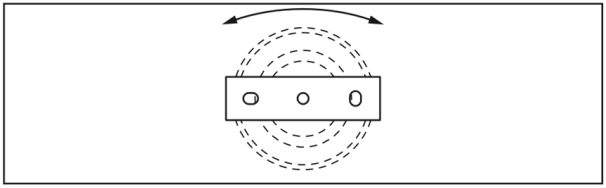

Fig. 10: Tuning by fastening in the center

Polarization

4.4 Mounting instructions

Radar sensors for level measurement emit electromagnetic waves. The polarization is the direction of the electrical component of these waves.
The polarization direction is marked by a nose on the housing, see following drawing:

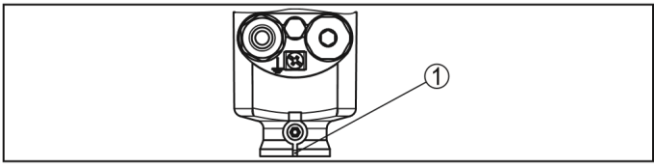

Fig. 11: Position of the polarization

1 Nose for marking the direction of polarization

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

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

Installation position

Mount the sensor at least 200 mm (7.874 in) away from the vessel wall.

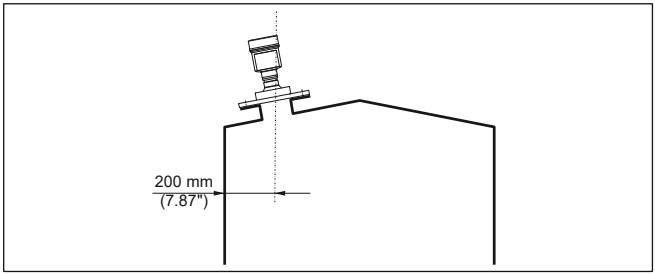

Fig. 12: Mounting the radar sensor on the vessel top

If you cannot maintain this distance, you should carry out a false signal suppression during setup. This applies particularly if buildup on the vessel wall is expected. In such cases, we recommend repeating the false signal suppression at a later date with existing buildup.

Inflowing medium

The instrument should not be mounted too close to the inflowing medium, as the radar signal could be disrupted.

Silo with filling from top

The optimal mounting position is opposite the filling aperture. To avoid heavy soiling, the distance to any filter or dust exhauster should be as large as possible.

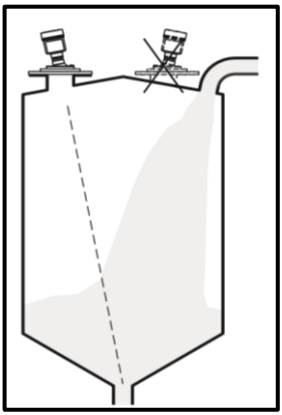

Fig. 13: Mounting of the radar sensor with inflowing medium

Silo with lateral filling

In bulk solids silos with lateral pneumatic filling the instrument should not be mounted above the filling stream, as the radar signal will be disrupted. The optimal mounting position is to the side of the filling aperture. To avoid heavy soiling, the distance to any filter or dust exhauster should be as large as possible.

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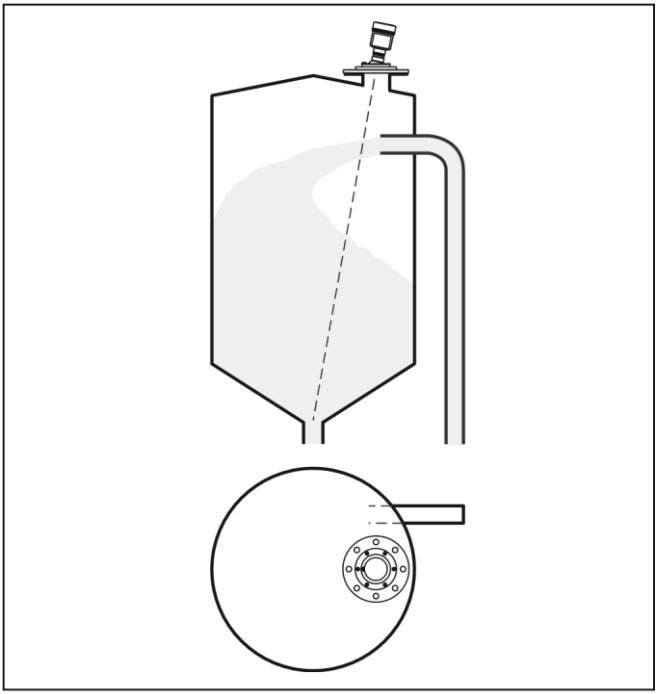

Fig. 14: Mounting of the radar sensor with inflowing medium

Mounting socket

For socket mounting, the socket should be as short as possible and Its end rounded. This reduces false reflections from the socket.

With threaded connection, the antenna end should protrude at least 5 mm (0.2 in) out of the socket.

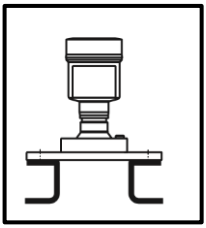

Fig. 15: Recommended socket mounting with BAS-RLM 70

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If the reflective properties of the medium are good, you can mount BAS-RLM 70 on sockets longer than the antenna. The socket end should be smooth and burr-free, if possible also rounded.

Note:
When mounting on longer sockets, we recommend carrying out a false signal suppression.

You will find recommended values for socket heights in the following illustration or the tables. The values come from typical applications. Deviating from the proposed dimensions, also longer sockets are possible, however the local conditions must be taken into account.

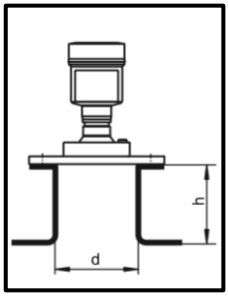

Fig. 16: Socket mounting with deviating socket dimensions of BAS-RLM 70

Metal-jacketed lens antenna

Socket diameter d		Socket length h	
100 mm	4"	≤ 500 mm	≤ 19.7 in
150 mm	6"	≤ 800 mm	≤ 31.5 in

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Orientation

In a cylindrical silo with conical outlet, the mounting is carried out on a third up to the half of the vessel radius from outside (see following drawing).

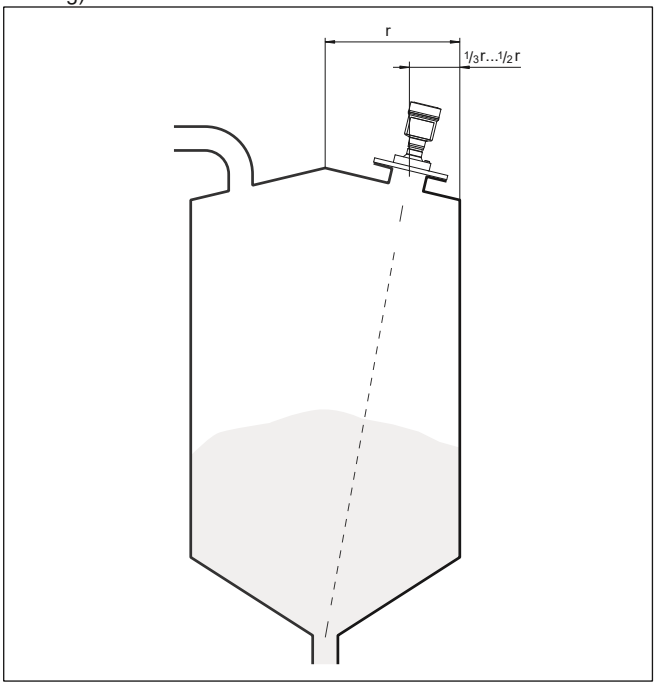

Fig. 17: Mounting position and orientation

Direct the sensor in such a way that the radar signal reaches the lowest vessel level. Hence it is possible to detect the complete vessel volume.

Tip:
The easiest way to align the sensor is with the optional swiveling holder. Determine the suitable inclination angle.

Alternatively, the angle of inclination can be determined using the following drawing and table. It depends on the measuring distance "d" and the distance "a" between vessel Centre and mounting position.

Check the alignment with a suitable level or water level.

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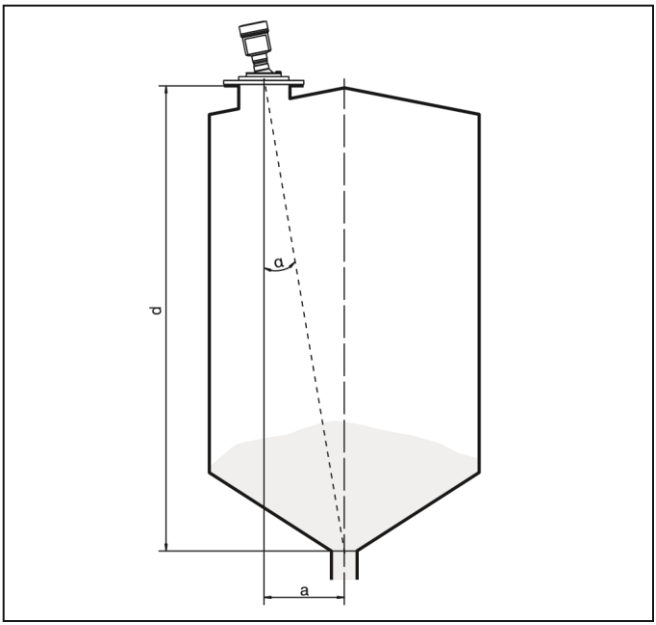

Fig. 18: Determination of the angle of inclination for alignment of BAS-RLM 70

Distance d (m)	2°	4°	6°	8°	10°
2	0.1	0.1	0.2	0.3	0.4
4	0.1	0.3	0.4	0.6	0.7
6	0.2	0.4	0.6	0.8	1.1
8	0.3	0.6	0.8	1.1	1.4
10	0.3	0.7	1.1	1.4	1.8
15	0.5	1	1.6	2.1	2.6
20	0.7	1.4	2.1	2.8	3.5
25	0.9	1.7	2.6	3.5	4.4
30	1	2.1	3.2	4.2	5.3

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Example:
In a vessel 20 m high, the installation position of the sensor is 1.4 m from the vessel Centre.

The necessary angle of inclination of 6° can be read out from this table.

Proceed as follows to adjust the angle of inclination with the swiveling holder:

1. Loosen the terminal screws of the swivel holder by one turn. Use a hexagon socket wrench, size 5.

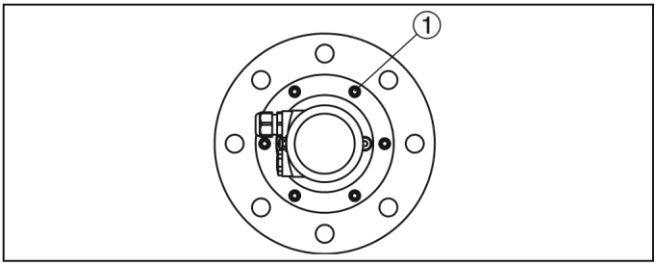

Fig. 19: BAS-RLM 70 with swiveling holder

1. Terminal screws (6 pcs.)
2. Align the sensor, check angle of inclination

Note:
The max. angle of inclination of the swiveling holder is approx. 10°

3. Re-tighten the terminal screws, max. torque sees chapter "*Technical data*".

Vessel installations

The mounting location of the radar sensor should be a place where no other equipment or fixtures cross the path of the radar signals.

Vessel installations, such as e.g. ladders, limit switches, heating spirals, struts, etc., can cause false echoes and impair the useful echo. Make sure when planning your measuring point that the radar sensor has a "clear view" to the measured product.

In case of existing vessel installations, a false signal suppression should be carried out during setup.

If large vessel installations such as struts or supports cause false echoes, these can be attenuated through supplementary measures. Small, inclined sheet metal baffles above the installations scatter the radar signals and prevent direct interfering reflections.

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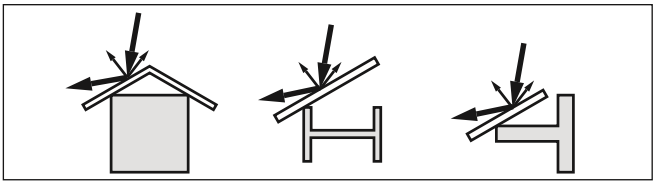

Fig. 20: Cover flat, large-area profiles with deflectors

Material heaps

Large material heaps are best measured with several instruments, which can be mounted on e.g. traverse cranes. For this type of application, it is advantageous to orient the sensor perpendicular to the bulk solid surface.
The sensors do not influence each other.

Information:
Keep in mind that for these applications, the sensors are designed for relatively slow level changes. If the sensor is used on a movable boom, the max. measuring rate must be observed (see chapter "*Technical data*").

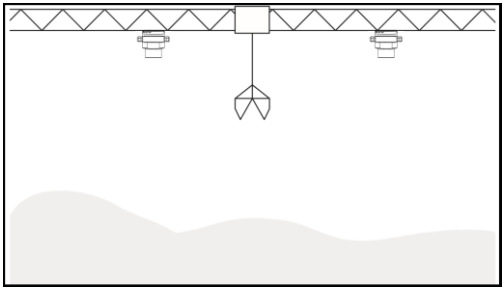

Fig. 21: Radar sensors in traverse crane

Mounting in the vessel insulation

Instruments for a temperature range up to 200° C have a spacer between process fitting and electronics housing. This spacer is used to thermally decouple the electronics from the high process temperatures.

Information:
The spacer may only be incorporated up to a maximum of 50 mm into the vessel insulation. Only then is a reliable temperature decoupling guaranteed.

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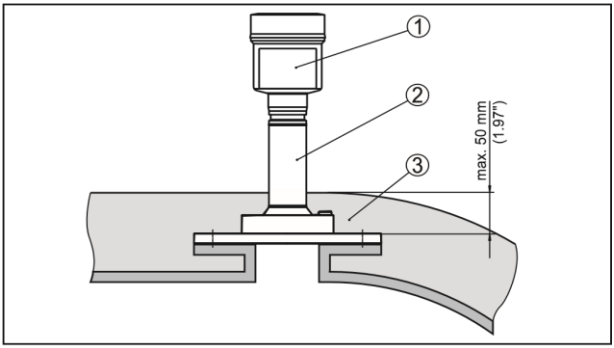

Fig. 22: Mounting the instrument on insulated vessels

1. Electronics housing
2. Spacer
3. Vessel insulation

Mounting in multiple chamber silo

The walls of multiple-chamber silos are often made of profile material, e.g. profile sheeting, to ensure the required stability. If the radar sensor is mounted very close to a heavily structured vessel wall, substantial interfering reflections can be generated. Thus the sensor should be mounted at the largest possible distance from the separating wall.

The best mounting location is on the outer wall of the silo, with the sensor pointing towards the discharge opening in the silo Centre. This can be accomplished, for example, with the mounting strap.

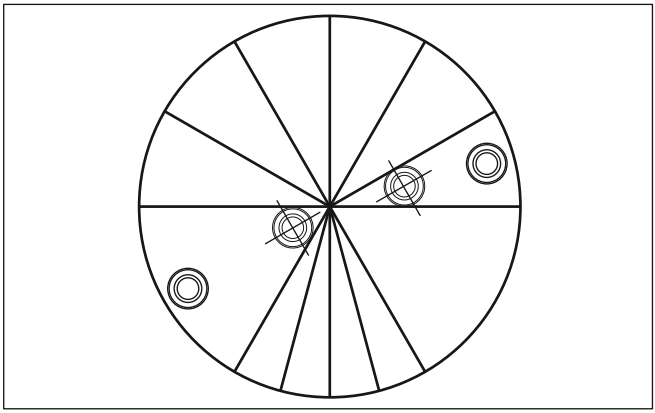

Fig. 23: Installation and orientation in multiple chamber silos

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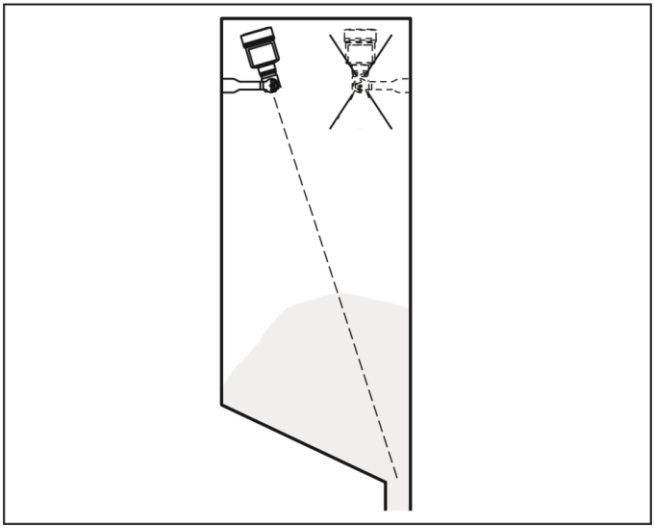

Fig. 24: Installation and orientation in multiple chamber silos

Dust deposits – Rinsing air connection

To avoid heavy buildup and dust on the antenna, the sensor should not be mounted close to the dust exhauster inside the vessel.

To protect the sensor against buildup, particularly in case of strong condensation, air rinsing is recommended.

Metal-jacketed lens antenna

The BAS-RLM 70 with metal-jacketed lens antenna is equipped with a rinsing air connection as a standard feature, see following graphics.

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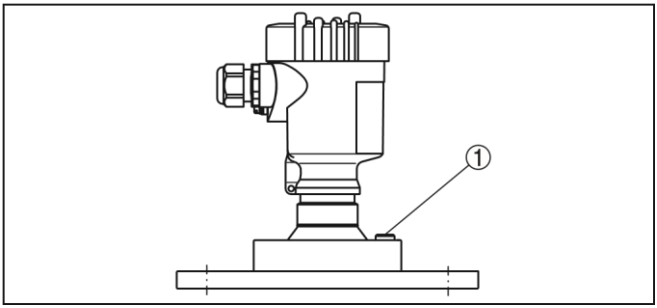

Fig. 25: Rinsing air connection on metal-jacketed lens antenna

5 Connecting to power supply

5.1 Preparing the connection

Safety instructions

Always keep in mind the following safety instructions:

- Carry out electrical connection by trained, qualified personnel authorized by the plant operator
- If overvoltage surges are expected, overvoltage arresters should be installed

Warning:
Only connect or disconnect in de-energized state.

Voltage supply

Power supply and current signal are carried on the same two-wire cable.
The operating voltage can differ depending on the instrument version.
The data for power supply are specified in chapter "Technical data".
Provide a reliable separation between the supply circuit and the mains circuits.
Power the instrument via an energy-limited circuit via Class 2 power supply unit.
Keep in mind the following additional factors that influence the operating voltage:

- Lower output voltage of the power supply unit under nominal load (e.g. with a sensor current of 20.5 mA or 22 mA in case of fault)
- Influence of additional instruments in the circuit

Connection cable

The instrument is connected with standard four-wire cable without shielding. If electromagnetic interference is expected which is above the

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test values of EN 61326-1 for industrial areas, shielded cable should be used.

Use cable with round cross section for instruments with housing and cable gland. Use a cable gland suitable for the cable diameter to ensure the seal effect of the cable gland (IP protection rating).

Cable glands

Metric threads

In the case of instrument housings with metric thread, the cable glands are screwed in at the factory. They are sealed with plastic plugs as transport protection.

Note:

You have to remove these plugs before electrical connection.

NPT thread

In the case of instrument housings with self-sealing NPT threads, it is not possible to have the cable entries screwed in at the factory. The free openings for the cable glands are therefore covered with red dust protection caps as transport protection.

Note:

Prior to setup you have to replace these protective caps with approved cable glands or close the openings with suitable blind plugs.
On plastic housings, the NPT cable gland or the Conduit steel tube must be screwed into the threaded insert without grease. Max. torque for all housings, see chapter "*Technical data*".

Cable screening and grounding

If shielded cable is required, the cable screening must be connected on both ends to ground potential. In the sensor, the cable screening is connected directly to the internal ground terminal. The ground terminal on the outside of the housing must be connected to the ground potential (low impedance).

In Ex systems, the grounding is carried out according to the installation regulations.

In electroplating plants as well as plants for cathodic corrosion protection it must be taken into account that significant potential differences exist. This can lead to unacceptably high currents in the cable screen if it is grounded at both ends.

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The metallic parts of the instrument (process fitting, sensor, concentric tube, etc.) are connected with the internal and external ground terminal on the housing. This connection exists either directly via the conductive metallic parts or, in case of instruments with external electronics, via the screen of the special connection cable.

You can find specifications on the potential connections inside the instrument in chapter "*Technical data*".

5.2 Connecting

Connection technology

The voltage supply and signal output are connected via the spring loaded terminals in the housing.

Connection to the display and adjustment module or to the interface adapter is carried out via contact pins in the housing.

Information:

The terminal block is pluggable and can be removed from the electronics. To do this, lift the terminal block with a small screwdriver and pull it out. When reinserting the terminal block, you should hear it snap in.

Connection procedure

Proceed as follows:

1. Unscrew the housing lid
2. If a display and adjustment module is installed, remove it by turning it slightly to the left
3. Loosen compression nut of the cable gland and remove blind plug
4. Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) of insulation from the ends of the individual wires
5. Insert the cable into the sensor through the cable entry
6. Insert the wire ends into the terminals according to the wiring plan

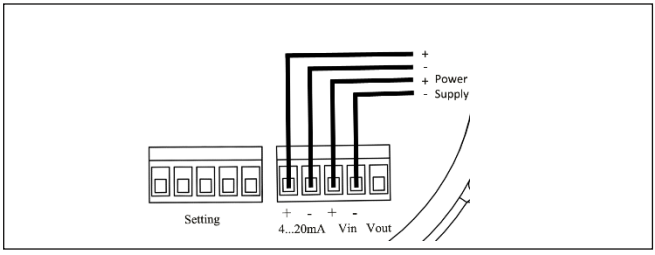

Fig. 28: Connection steps

Note:

Solid cores as well as flexible cores with wire end sleeves are inserted directly into the terminal openings. In case of flexible cores without end sleeves, press the terminal from above with a small screwdriver, the

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terminal opening is then free. When the screwdriver is released, the terminal closes again.

7 Check the hold of the wires in the terminals by lightly pulling on them
8 Connect the shielding to the internal ground terminal, connect the external ground terminal to potential equalization
9 Tighten the compression nut of the cable entry gland. The seal ring must completely encircle the cable
10 Reinsert the display and adjustment module, if one was installed
11 Screw the housing lid back on

The electrical connection is finished.

6 Supplement

6.1 Technical data

Note for approved instruments
The technical data in the respective safety instructions which are included in delivery are valid for approved instruments (e.g. with Ex approval). These data can differ from the data listed herein, for example regarding the process conditions or the voltage supply.

Materials and weights
SUS 316L/ Aluminum Alloy

Materials, wetted parts

Metal-jacketed lens antenna

- Process fitting	SUS 316L/ Aluminum Alloy
- Process seal	On site
- Antenna	PP, PEEK
- Adapter flange	Polypropylene-PP
- Seal, antenna system	FKM, EPDM

Rinsing connection

- Flushing ring	PP-GFK
- O-ring seal, rinsing connection	FKM, EPDM

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- Reflux valve	SUS
- Sealing, reflux valve	FKM, EPDM

Materials, non-wetted parts

Mounting parts

- Antenna cone	ABS
- Compression flange	Polypropylene-PP
- Mounting strap	SUS
- Fixing screws, mounting strap	SUS
- Fixing screws, adapter flange	SUS
- Plastic housing	Plastic PBT (Polyester)

Housing

- Aluminum housing	Aluminum, powder-coated
- Fixing screws, mounting strap	316L
- Stainless steel housing	316L
- Cable gland	PA, stainless steel, brass
- Sealing, cable gland	NBR
- Blind plug, cable gland	PA
- Seal between housing and housing lid	FKM, EPDM
- Ground terminal	SUS

Weights

- Instrument (depending on housing, process fitting and antenna)	approx. 1 … 2.7 kg

Input variable

Measured variable

The measured quantity is the distance between the end of the sensor antenna and the product surface. The reference plane for the measurement is the lower side of the flange.

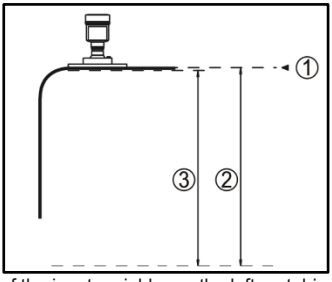

Fig. 48: Data of the input variable, on the left metal-jacketed lens antenna

1. *Reference plane*
2. *Measured variable, max. measuring range*

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3. Usable measuring range (recommended min. distance)

Measuring range	
- Max. measuring range	30 m (98.4 ft)
Output variable	
Output signal	4 … 20 mA
Range of the output signal	3.8 … 20.5 mA (default setting)
Signal resolution	0.3 µA
Resolution, digital	1 mm (0.039 in)
Fault signal, current output (adjustable)	≤ 3.6 mA, >=21 mA, last valid measured value
Max. output current	22 mA
Starting current	≤ 3.6 mA; ≤ 10 mA for 5 ms after switching on
Load	See load resistance under Power supply
Deviation	
Process reference conditions	
- Temperature	+18 … +30 °C (+64 … +86 °F)
- Relative humidity	45 … 75 %
- Air pressure	860 … 1060 mbar
Installation reference conditions	
- Min. distance to internal installations	> 200 mm (7.874 in)
- Reflector	Flat plate reflector, surface 0.5 x 0.5 m
- False Reflections	Biggest false signal, 20 dB smaller than the useful signal
Deviation with liquids Non-repeatability	≤ 1 mm (meas. distance > 0.5 m/1.64 ft)
Deviation with bulk solids	≤ 1 mm
Deviation with bulk solids	The values depend to a great extent on the application. Binding specifications are thus not possible.

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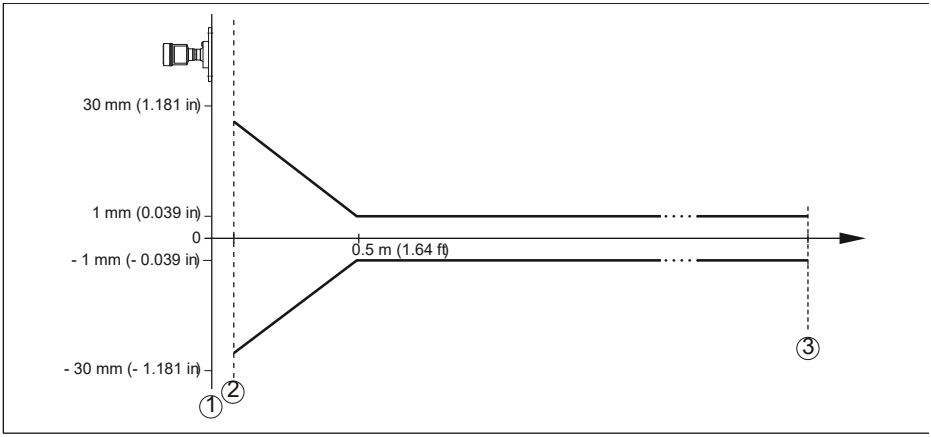

Fig. 49: Deviation under reference conditions

1 Reference plane
2 Recommended min. distance, specifications see below
3 Measuring range end

Recommended min. distance for typical bulk solids applications	
metal-jacketed lens antenna	250 mm (9.843 in)
Dead zone	150 mm (5.906 in)

Characteristics and performance data

Measuring cycle time	approx. 700 ms
Step response time	≤ 3 s
Beam angle	
- Metal-jacketed lens antenna	6°
Emitted HF power (depending on the parameter setting)	
- Average spectral transmission power density	-3 dBm/MHz EIRP
- Max. spectral transmission power density	+34 dBm/50 MHz EIRP
- Max. power density at a distance of 1m	<3 µW/cm²

Ambient conditions

Ambient, storage and transport temperature	-40 … +80 °C (-40 … +176 °F)

Process conditions

For the process conditions, please also note the specifications on the type label. The lowest value always applies.

Process temperature

Antenna lens	Seal	
PEEK	FKM	-40 … +200 °C (-40 … +392 °F)

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	EPDM	-40 … +130 °C (-40 … +266 °F)
PP	FKM	-40 … +80 °C (-40 … +176 °F)
	EPDM	-40 … +80 °C (-40 … +176 °F)

6.2 Dimensions

BAS-RLM 70, metal-jacketed lens antenna with swiveling holder

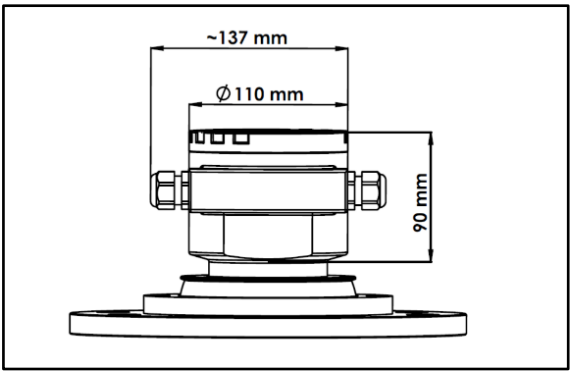

Fig. 2: Housing version with Swiveling holder

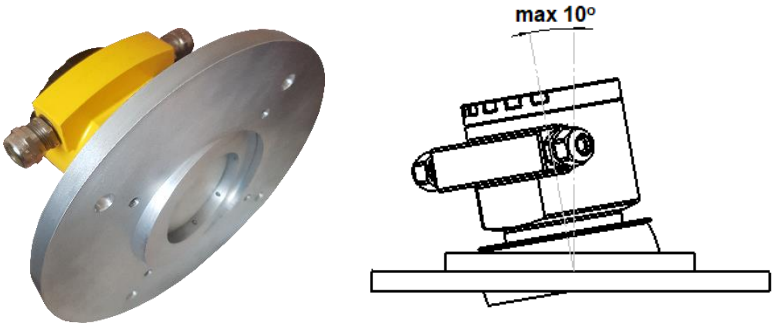

Fig. 2: Housing version with Swiveling holder

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