OPTISOUND 3010 C Handbook

Ultrasonic Level Transmitter

4 ... 20 mA/HART - four-wire
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Safety instructions for Ex areas

Take note of the Ex specific safety instructions for Ex applications. These instructions are attached as documents to each instrument with Ex approval and are part of the operating instructions manual.

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1 About this document

1.1 Function
This operating instructions manual provides all the information you need for mounting, connection and setup as well as important instructions for maintenance and fault rectification. 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 specialist personnel. The contents of this manual should be made available to these personnel and put into practice by them.

1.3 Symbols used

Information, tip, note
This symbol indicates helpful additional information.

Caution: If this warning is ignored, faults or malfunctions can result.

Warning: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.

Danger: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.

Ex applications
This symbol indicates special instructions for Ex applications.

SIL applications
This symbol indicates instructions for functional safety which must be taken into account particularly for safety-relevant applications.

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

→ Action
This arrow indicates a single action.

1 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.
2 For your safety

2.1 Authorised personnel
All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorised by the plant operator.

During work on and with the device the required personal protective equipment must always be worn.

2.2 Appropriate use
OPTISOUND 3010 C is a sensor 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.

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 authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

2.3 Warning about incorrect use
Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system components through incorrect mounting or adjustment.

2.4 General safety instructions
This is a state-of-the-art instrument complying with all prevailing regulations and guidelines. 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.

During the entire duration of use, the user is obliged to determine the compliance of the necessary occupational safety measures with the current valid rules and regulations and also take note of new regulations.

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 authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

The safety approval markings and safety tips on the device must also be observed.
2.5 Safety label on the instrument
The safety approval markings and safety tips on the device must be observed.

2.6 CE conformity
The device fulfills the legal requirements of the applicable EC guidelines. By affixing the CE marking, we confirm successful testing of the product.

Electromagnetic compatibility
The instruments are designed for use in an industrial environment. Nevertheless, electromagnetic interference from electrical conductors and radiated emissions must be taken into account, as is usual with a class A instrument according to EN 61326-1. If the instrument is used in a different environment, its electromagnetic compatibility with other devices must be ensured by suitable measures.

2.7 Fulfillment of NAMUR recommendations
NAMUR is the automation technology user association in the process industry in Germany. The published NAMUR recommendations are accepted as the standard in field instrumentation.

The device fulfills the requirements of the following NAMUR recommendations:
● NE 21 – Electromagnetic compatibility of equipment
● NE 53 – Compatibility of field devices and display/adjustment components

For further information see www.namur.de.
3 Product description

3.1 Configuration

Scope of delivery
The scope of delivery encompasses:
- OPTISOUND 3010 C ultrasonic sensor
- Documentation
  - This operating instructions manual
  - Ex-specific safety instructions (with Ex versions)
  - Operating instructions manual "Display and adjustment module" (optional)
  - If necessary, further certificates

Information:
In this operating instructions manual, the optional instrument features are described. The respective scope of delivery results from the order specification.

Constituent parts
The OPTISOUND 3010 C consists of the components:
- Transducer with integrated temperature sensor
- Housing with electronics
- Housing cover, optionally available with display and adjustment module

The components are available in different versions.

Fig. 1: OPTISOUND 3010 C with Alu double chamber housing
1 Housing cover with integrated display and adjustment module (optional)
2 Housing with electronics
3 Process fitting with transducer

Type label
The type label contains the most important data for identification and use of the instrument:
- Instrument type
- Article and serial number device
3.2 Principle of operation

Application area
OPTISOUND 3010 C is an ultrasonic sensor for continuous level measurement. It is suitable for liquids and solids in virtually all industries, particularly in the water and waste water industry.

Functional principle
The transducer of the ultrasonic sensor transmits short ultrasonic pulses to the measured product. These pulses are reflected by product surface and received back by the transducer as echoes. The running time of the ultrasonic pulses from emission to reception is proportional to the distance and hence the level. The determined level is converted into an appropriate output signal and outputted as measured value.

Voltage supply
Four-wire electronics with separate power supply.
The supply voltage range can differ depending on the instrument version.
The data for power supply are specified in chapter "Technical data".
Measured value transmission is carried out via the 4 ... 20 mA/HART output separate from power supply.

3.3 Packaging, transport and storage

Packaging
Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test based on ISO 4180.
The packaging of standard instruments consists of environment-friendly, recyclable cardboard. For special versions, PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

Transport
Transport must be carried out in due consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

Transport inspection
The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Storage
Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.
Unless otherwise indicated, the packages must be stored only under the following conditions:
- Not in the open
- Dry and dust free
- Not exposed to corrosive media
• Protected against solar radiation
• Avoiding mechanical shock and vibration

Storage and transport temperature

• Storage and transport temperature see chapter "Supplement - Technical data - Ambient conditions"
• Relative humidity 20 … 85 %
4 Mounting

4.1 General instructions

Installation position
Select an installation position you can easily reach for mounting and connecting as well as later retrofitting of a display and adjustment module. The housing can be rotated by 330° without the use of any tools. You can also install the display and adjustment module in four different positions (each displaced by 90°).

Moisture
Use the recommended cables (see chapter "Connecting to power supply") and tighten the cable gland.

You can give your OPTISOUND 3010 C additional protection against moisture penetration by leading the connection cable downward in front of the cable entry. Rain and condensation water can thus drain off. This applies mainly to outdoor mounting as well as installation in areas where high humidity is expected (e.g. through cleaning processes) or on cooled or heated vessels.

![Fig. 2: Measures against moisture ingress](image)

Cable entries - 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.

Prior to setup you have to replace these protective caps with approved cable glands or close the openings with suitable blind plugs.

Measuring range
The reference plane for the measuring range is the lower edge of the transducer.

Make sure that a minimum distance from the reference plane - the so-called dead zone, in which measurement is not possible - is maintained. The exact value of the dead zone is stated in chapter "Technical data".
Information:
If the medium reaches the transducer, buildup can form on it and cause faulty measurements later on.

Pressure/Vacuum
Gauge pressure in the vessel does not influence OPTISOUND 3010 C. Low pressure or vacuum does, however, damp the ultrasonic pulses. This influences the measuring result, particularly if the level is very low. With pressures under -0.2 bar (-20 kPa) you should use a different measuring principle, e.g. radar or guided radar (TDR).

4.2 Mounting instructions
Screw OPTISOUND 3010 C into the mounting socket with an appropriate spanner applied to the hexagon of the process fitting. Max. torque see chapter "Technical data".
**Warning:**
The housing must not be used to screw the instrument in! Applying tightening force can damage internal parts of the housing.

**Installation position**

When mounting the OPTISOUND 3010 C, keep a distance of at least 200 mm (7.874 in) to the vessel wall. If the sensor is installed in the center of dished or round vessel tops, multiple echoes can arise. These can, however, be suppressed by an appropriate adjustment (see chapter "Setup").

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

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*Fig. 5: Mounting on round vessel tops*

1. Reference plane
2. Vessel center or symmetry axis

In vessels with conical bottom it can be advantageous to mount the sensor in the center of the vessel, as measurement is then possible down to the lowest point of the vessel bottom.
Socket pieces should be dimensioned so that the lower end of the transducer protrudes at least 10 mm (0.394 in) out of the socket.

If the reflective properties of the medium are good, you can mount OPTISOUND 3010 C on sockets which are higher than the length of the transducer. You will find recommended values for socket heights in the following illustration. The socket end should be smooth and burr-free, if possible also rounded. Carry out a false echo storage.
Sensor orientation

In liquids, direct the sensor as perpendicular as possible to the product surface to achieve optimum measurement results.

![Sensor orientation in liquids](image)

Fig. 8: Deviating socket dimensions

<table>
<thead>
<tr>
<th>d</th>
<th>h</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 mm/3”</td>
<td>150 mm/6”</td>
</tr>
<tr>
<td>100 mm/4”</td>
<td>300 mm/12”</td>
</tr>
<tr>
<td>150 mm/6”</td>
<td>400 mm/16”</td>
</tr>
</tbody>
</table>

Fig. 9: Alignment in liquids

To reduce the min. distance to the medium, you can also mount OPTISOUND 3010 C with a beam deflector. By doing this, it is possible to fill the vessel nearly to maximum. Such an arrangement is suitable primarily for open vessels such as e.g. overflow basins.

![Beam deflector](image)

Fig. 10: Beam deflector

Vessel installations

The ultrasonic sensor should be installed at a location where no installations cross the ultrasonic beam.

Vessel installations such as for example, ladders, limit switches, heating spirals, struts etc. can cause false echoes that interfere with the useful echo. Make sure when planning your measuring site that the ultrasonic signals have a “clear view” to the measured product.

In case of existing vessel installations, a false echo storage 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 or plastic baffles above the installations scatter the ultrasonic signals and avoid direct false echoes.

**Fig. 11: Cover flat, large-area profiles with deflectors**

**Agitators**

If there are agitators in the vessel, a false signal storage should be carried out with the agitators in motion. This ensures that the interfering reflections from the agitators are saved with the blades in different positions.

**Fig. 12: Agitators**

**Inflowing medium**

Do not mount the instruments in or above the filling stream. Make sure that you detect the product surface, not the inflowing product.
Foam

Through the action of filling, stirring and other processes in the vessel, dense foams which considerably damp the emitted signals may form on the product surface.

If foams are causing measurement errors, the sensor should be used in a standpipe or, alternatively, the more suitable guided radar sensors (TDR) should be used.

Guided wave radar is unaffected by foam generation and is particularly suitable for such applications.

Air turbulences

If there are strong air currents in the vessel, e.g. due to strong winds in outdoor installations or air turbulence, e.g. by cyclone extraction you should mount OPTISOUND 3010 C in a standpipe or use a different measuring principle, e.g. radar or guided radar (TDR).

Standpipe measurement

By using a standpipe (surge or bypass tube), the influence of vessel installations, foam generation and turbulence is excluded.

Standpipes must extend all the way down to the requested min. level, as measurement is only possible within the tube.
Fig. 14: Standpipe in the tank
1 Vent hole ø 5 … 10 mm

OPTISOUND 3010 C can be used from tube diameters of 40 mm.
Avoid large gaps and thick welding joints when connecting the tubes.
Generally carry out a false echo storage.
Measurement in a standpipe is not recommended for extremely adhesive products.

Flow measurement with rectangular flume
The short examples give you introductory information on the flow measurement. Detailed planning information is available from flume manufacturers and in special literature.

Fig. 15: Flow measurement with rectangular flume: $d_{min} =$ min. distance of the sensor (see chapter "Technical data"); $h_{max} =$ max. filling of the rectangular flume
1 Overflow orifice (side view)
2 Headwater
3 Tail water
4 Overfall orifice (view from bottom water)

In general, the following points must be observed:
- Install the sensor on the headwater side
• Installation in the centre of the flume and vertical to the liquid surface
• Distance to the overfall orifice
• Distance of orifice opening above ground
• Min. distance of the orifice opening to bottom water
• Min. distance of the sensor to max. storage level

Flow measurement with Khafagi Venturi flume

![Diagram of flow measurement with Khafagi Venturi flume](image)

**Fig. 16:** Flow measurement with Khafagi-Venturi flume: $d = \text{Min. distance to sensor}$; $h_{\text{max}} = \text{max. filling of the flume}$; $B = \text{tightest constriction in the flume}$

1. Position sensor
2. Venturi flume

In general, the following points must be observed:

- Installation of the sensor at the inlet side
- Installation in the centre of the flume and vertical to the liquid surface
- Distance to the Venturi flume
- Min. distance of the sensor to max. storage level
5 Connecting to power supply

5.1 Preparing the connection

Safety instructions

Always keep in mind the following safety instructions:

Warning:
Connect only in the complete absence of line voltage.

- The electrical connection must only be carried out by trained personnel authorised by the plant operator.
- If overvoltage surges are expected, overvoltage arresters should be installed.

Note:
Install a separating facility for the instrument which is easy to access. The separating facility must be marked for the instrument (IEC/EN61010).

Voltage supply

Supply voltage and current output are carried on separate two-wire connection cables if reliable separation is required. The supply voltage range can differ depending on the instrument version.

The data for power supply are specified in chapter "Technical data".

The standard version can be operated with an earth-connected current output, the Exd version must be operated with a floating output.

This instrument is designed in protection class I. To maintain this protection class, it is absolutely necessary that the ground conductor be connected to the internal ground terminal. Take note of the general installation regulations.

Always connect the instrument to vessel ground (potential equalisation) or in case of plastic vessels to the next ground potential. For this purpose there is a ground terminal on the side of the instrument housing.

Connection cable

For power supply, an approved installation cable with PE conductor is required.

The 4 … 20 mA current output is connected with standard two-wire cable without screen. If electromagnetic interference is expected which is above the test values of EN 61326 for industrial areas, screened cable should be used.

Use cable with round cross section for instruments with housing and cable gland. To ensure the seal effect of the cable gland (IP protection rating), find out which cable outer diameter the cable gland is suitable for.

Use a cable gland fitting the cable diameter.

Cable screening and grounding

If screened cable is required, we recommend connecting the cable screen on both ends to ground potential. In the sensor, the screen must be 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).
Connecting to power supply

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

With the Exd version, the minus side of the signal output is galvanically connected to ground via protective diodes. When connecting the instrument to a grounded PLC, equalising currents can flow in case of potential differences which can cause malfunctions. Make sure that there is sufficient potential equalisation from the system side or realise the connection via switching amplifier.

5.2 Connection procedure
Proceed as follows:
1. Unscrew the housing lid
2. Loosen compression nut of the cable entry gland
3. Remove approx. 10 cm (4 in) of the cable mantle (current output), strip approx. 1 cm (0.4 in) insulation from the ends of the individual wires
4. Insert the cable into the sensor through the cable entry
5. Lift the opening levers of the terminals with a screwdriver
6. Insert the wire ends into the open terminals according to the wiring plan
7. Press down the opening levers of the terminals, you will hear the terminal spring closing
8. Check the hold of the wires in the terminals by lightly pulling on them
9. Connect the screen to the internal ground terminal, connect the outer ground terminal to potential equalisation
10. Tighten the compression nut of the cable entry gland. The seal ring must completely encircle the cable
11. Connect the lead cable for power supply in the same way according to the wiring plan, in addition connect the ground conductor to the inner ground terminal.
12. Screw the housing lid back on

The electrical connection is finished.
5.3 Wiring plan, double chamber housing

Fig. 18: Double chamber housing
1 Housing cover, connection compartment
2 Blind plug
3 Housing cover, electronics compartment
4 Filter element for air pressure compensation
5 Cable gland
5 Connecting to power supply

Electronics compartment

Fig. 19: Electronics compartment, double chamber housing
1 Internal connection cable to the connection compartment
2 Spring loaded terminals for display and adjustment module
3 Plug connector for service interface

Terminal compartment

Fig. 20: Terminal compartment, double chamber housing
1 Spring-loaded terminals for voltage supply
2 Plug connector for service interface
3 Ground terminal for connection of the cable screen
5.4 Switch-on phase

After connecting OPTISOUND 3010 C to power supply or after a voltage recurrence, the instrument carries out a self-check for approx. 30 seconds:

- Internal check of the electronics
- Indication of the instrument type, the firmware as well as the sensor TAGs (sensor designation)
- Output signal jumps briefly (approx. 10 seconds) to the set fault current

Then the corresponding current is outputted to the cable (the value corresponds to the actual level as well as the settings already carried out, e.g. factory setting).
6  Set up with the display and adjustment module

6.1  Insert display and adjustment module

The display and adjustment module can be inserted into the sensor and removed again at any time. It is not necessary to interrupt the power supply.

Proceed as follows for mounting the display and adjustment module:

1. Unscrew the housing lid
2. Place the display and adjustment module in the desired position on the electronics (you can choose any one of four different positions - each displaced by 90°)
3. Press the display and adjustment module onto the electronics and turn it to the right until it snaps in
4. Screw housing lid with inspection window tightly back on

Disassembly is carried out in reverse order.

The display and adjustment module is powered by the sensor, an additional connection is not necessary.

Note:
If you intend to retrofit OPTISOUND 3010 C with a display and adjustment module for continuous measured value indication, a higher cover with an inspection glass is required.
6.2 Adjustment system

You adjust the instrument via the four keys of the display and adjustment module. The individual menu items are shown on the LC display. You can find the functions of the individual keys in the previous illustration.

Key functions

- **[OK]** key:
  - Move to the menu overview
  - Confirm selected menu
  - Edit parameter
  - Save value

- **[->]** key to select:
  - Menu change
  - Select list entry
  - Select editing position

- **[+]** key:
  - Change value of the parameter

- **[ESC]** key:
  - Interrupt input
  - Jump to next higher menu

Adjustment system

You adjust the instrument via the four keys of the display and adjustment module. The individual menu items are shown on the LC display. You can find the functions of the individual keys in the previous illustration.

Time functions

By pushing the **[+]** and **[->]** keys once, the edited value or the cursor changes by one position. By pushing the keys longer than 1 s the change will be continuously.

By pushing the **[OK]** and **[ESC]** keys simultaneously for more than 5 s, a return to the basic menu is caused. The menu language is then switched over to "English".
Approx. 60 minutes after the last pressing of a key, an automatic reset to measured value indication is triggered. Any values not confirmed with [OK] will not be saved.

### 6.3 Setup steps

In HART-Multidrop mode (several sensors on one input) the address must be set before continuing with the parameter adjustment. You will find a detailed description in the operating instructions manual of the "Display and adjustment module".

#### Address setting HART multidrop

In HART mode, standard address 0 is used to connect the transmitter to the first sensor in the multidrop ring. The address can be changed using the [Address setting] high-level menu. The standard address 0 is recommended for this application.

#### Parameter adjustment

The sensor measures the distance from the sensor to the product surface. For indication of the real level, an allocation of the measured distance to the percentage height must be carried out.

The actual level is then calculated on the basis of these entered values. At the same time, the operating range of the sensor is limited from maximum range to the requested range.

![Diagram](image)

**Fig. 24: Parameter adjustment example min./max. adjustment**

1. Min. level = max. measuring distance
2. Max. level = min. measuring distance

The real product level during this adjustment is not important, because the min./max. adjustment is always carried out without changing the product level. These settings can be made ahead of time without the instrument having to be installed.

#### Basic adjustment - Min. adjustment

Proceed as follows:

1. Move from the measured value display to the main menu by pushing [OK].
2. Select the menu item "Basic adjustment" with [->] and confirm with [OK]. Now the menu item "Min. adjustment" is displayed.

3. Prepare the % value for editing with [OK] and set the cursor to the requested position with [->]. Set the requested percentage value with [+/-] and save with [OK]. The cursor jumps now to the distance value.

4. Enter the suitable distance value in m for the empty vessel (e.g. distance from the sensor to the vessel bottom) corresponding to the percentage value.

5. Save the settings with [OK] and move to "Max. adjustment" with [->].

**Basic adjustment - Max. adjustment**

1. Prepare the % value for editing with [OK] and set the cursor to the requested position with [->]. Set the requested percentage value with [+/-] and save with [OK]. The cursor jumps now to the distance value.

2. Enter the appropriate distance value in m (corresponding to the percentage value) for the full vessel. Keep in mind that the max. level must lie below the dead band.

3. Save the settings with [OK] and move to "Medium selection" with [->].

**Basic adjustment - Medium**

Each product has different reflective properties. In addition, there are various interfering factors which have to be taken into account: agitated product surfaces and foam generation (with liquids); dust generation, material cones and echoes from the vessel wall (with solids). To adapt the sensor to these different conditions, you should first select "Liquid" or "Solid".

With solids, you can also choose between "Powder/Dust", "Granular/Pellets" or "Ballast/Pebbles".
Through this additional selection, the sensor is adapted perfectly to the product and measurement reliability, particularly in products with poor reflective properties, is considerably increased.

Enter the requested parameters via the appropriate keys, save your settings and jump to the next menu item with the [->] key.

**Basic adjustment - Vessel form**

Apart from the medium, the vessel shape can also influence the measurement. To adapt the sensor to these measuring conditions, this menu item offers different options depending on whether liquid or bulk solid is selected. With "Liquids" these are "Storage tank", "Stilling tube", "Open vessel" or "Stirred vessel", with "Solid", "Silo" or "Bunker".

![Vessel form](image)

Enter the requested parameters via the appropriate keys, save your settings and jump to the next menu item with the [->] key.

**Basic adjustment - Damping**

To suppress fluctuations in the measured value display, e.g. caused by an agitated product surface, a damping can be set. This time can be between 0 and 999 seconds. Keep in mind that the reaction time of the entire measurement will then be longer and the sensor will react to measured value changes with a delay. In general, a period of a few seconds is sufficient to smooth the measured value display.

![Damping](image)

Enter the requested parameters via the appropriate keys, save your settings and jump to the next menu item with the [->] key.

**Basic adjustment - Linearization curve**

A linearisation is necessary for all vessels in which the vessel volume does not increase linearly with the level - e.g. in a horizontal cylindrical or spherical tank - and the indication or output of the volume is required. Corresponding linearisation curves are preprogrammed for these vessels. They represent the correlation between the level percentage and vessel volume. By activating the appropriate curve, the volume percentage of the vessel is displayed correctly. If the volume should not be displayed in percent but e.g. in l or kg, a scaling can be also set in the menu item "Display".

![Linearisation curve](image)

Enter the requested parameters via the appropriate keys, save your settings and jump to the next menu item with the [->] key.
Basic adjustment - Sensor TAG

In this menu item you can enter an unambiguous designation for the sensor, e.g. the measurement loop name or the tank or product designation. In digital systems and in the documentation of larger plants, a singular designation should be entered for exact identification of individual measuring points.

With this menu item, the Basic adjustment is finished and you can now jump to the main menu with the [ESC] key.

Display - Displayed value

In the menu item "Display" you can define how the measured value should be presented on the display.

The following indication values are available:
- Height
- Distance
- Current
- Scaled
- Percent
- Lin. percent

The selection "scaled" opens the menu items "Display unit" and "Scaling". In "Display unit" there are the following options:
- Height
- Ground
- Flow
- Volume
- Without unit

Depending on selection, the different units are in turn available.

In the menu item "Scaling", the requested numerical value with decimal point is entered for 0 % and 100 % of the measured value.

There is the following relationship between the indication value in the menu "Display" and the adjustment unit in the menu "Device settings":
- Indication value "Distance": Presentation of the measured value in the selected adjustment unit, e.g. m(d).
Display - Backlight

A background lighting integrated by default can be adjusted via the adjustment menu. The function depends on the height of the supply voltage. See "Technical data/Voltage supply".

In the default setting, the lightning is switched off.

Diagnosis - Peak value

The respective min. and max. measured values are saved in the sensor. The values are displayed in the menu item "Peak values".

- Min. and max. distance in m(d)
- Min. and max. temperature

Diagnosis - Measurement reliability

When non-contact level sensors are used, the measurement can be influenced by the respective process conditions. In this menu item, the measurement reliability of the level echo is displayed as dB value. The measurement reliability equals signal strength minus noise. The higher the value, the more reliable the measurement. With a functioning measurement, the values are > 10 dB.

Diagnostics - Device status

The instrument status is displayed in this menu item. If no failure is detected by the sensor, "OK" will be displayed. If a failure is detected, there will be a sensor-specific flashing fault signal, for example "E013". The failure is also displayed in clear text, for example "No measured value available".

Information:
The fault message as well as the clear text indication are also carried out in the measured value display.

Diagnosis - Curve selection

With ultrasonic sensors, the "Echo curve" represents the signal strength of the echoes over the measuring range. The unit of signal strength is "dB". The signal strength enables the judgement of the quality of the measurement.
The "False echo curve" displays the saved false echoes (see menu "Service") of the empty vessel as signal strength in "dB" over the measuring range.

Up to 3000 measured values are recorded (depending on the sensor) when starting a "Trend curve". Then the values can be displayed on a time axis. The oldest measured values are always deleted.

In the menu item "Choose curve", the respective curve is selected.

**Information:**
The trend recording is not activated when being shipped. It must be started by the user via the menu item "Start trend curve".

**Diagnosis - Curve presentation**

A comparison of the echo curve and the false echo curve allows a more detailed evaluation of measurement reliability. The selected curve is updated continuously. With the [OK] key, a submenu with zoom functions is opened.

The following functions are available with "Echo and false echo curve":
- "X-Zoom": Zoom function for the meas. distance
- "Y-Zoom": 1, 2, 5 and 10x signal magnification in "dB"
- "Unzoom": Reset the presentation to the nominal measuring range without magnification

In the menu item "Trend curve" the following are available:
- "X-Zoom": Resolution
  - 1 minute
  - 1 hour
  - 1 day
- "Stop/Start": Interrupt a recording or start a new recording
- "Unzoom": Reset the resolution to minutes

As default setting, the recording pattern has 1 minute. With the adjustment software PACTware, this pattern can be also set to 1 hour or 1 day.

**Service - False signal suppression**

High sockets or vessel installations, such as e.g. struts or agitators as well as buildup and weld joints on the vessel walls, cause interfering reflections which can impair the measurement. A false echo storage detects and marks these false echoes, so that they are no longer taken into account for the level measurement. A false echo memory should be created with low level so that all potential interfering reflections can be detected.
6 Set up with the display and adjustment module

Proceed as follows:

1. Move from the measured value display to the main menu by pushing [OK].
2. Select the menu item "Service" with [>] and confirm with [OK]. Now the menu item "False signal suppression" is displayed.
3. Confirm "False signal suppression - Change now" with [OK] and select in the below menu "Create new". Enter the actual distance from the sensor to the product surface. All false signals in this area are detected by the sensor and saved after confirming with [OK].

Note:
Check the distance to the product surface, because if an incorrect (too large) value is entered, the existing level will be saved as a false signal. The level would then no longer be detectable in this area.

Service - Extended setting

The menu item "Extended setting" offers the possibility to optimise OPTISOUND 3010 C for applications in which the level changes very quickly. To do this, select the function "Quick level change > 1 m/min."

Note:
Since with the function "Quick level change > 1 m/min." the generation of an average value of the signal processing is considerably reduced, false reflections by agitators or vessel installations can cause measured value fluctuations. A false echo memory is thus recommended.

Service - Current output

In the menu item "Current output" you determine the behaviour of the current output during operation and in case of failure. The following options are available:

Current output

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>4 ... 20 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20 ... 4 mA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Failure mode ¹)</th>
<th>Hold value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20.5 mA</td>
</tr>
<tr>
<td></td>
<td>22 mA</td>
</tr>
<tr>
<td></td>
<td>&lt; 3.6 mA</td>
</tr>
</tbody>
</table>

¹) Value of the current output in case of failure, e.g. if no valid measured value is delivered.
6 Set up with the display and adjustment module

<table>
<thead>
<tr>
<th></th>
<th>Min. current&lt;sup&gt;2)&lt;/sup&gt;</th>
<th>Max. current&lt;sup&gt;3)&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.8 mA</td>
<td>20 mA</td>
</tr>
<tr>
<td></td>
<td>4 mA</td>
<td>20.5 mA</td>
</tr>
</tbody>
</table>

The values in bold font represent the data of the factory setting.

In HART multidrop mode, the current is constantly 4 mA. This value does not change even in case of failure.

**Service - Simulation**

In this menu item you simulate a user-defined level or pressure value via the current output. This allows you to test the signal path, e.g. through connected indicating instruments or the input card of the control system.

The following simulation variables are available:

- Percent
- Current
- Pressure (with pressure transmitters)
- Distance (with radar and guided microwave)

With Profinbus PA sensors, the selection of the simulated value is made via the "Channel" in the menu "Basic adjustments".

How to start the simulation:

1. Push **[OK]**
2. Select the requested simulation variable with [->] and confirm with **[OK]**.
3. Set the requested numerical value with [+] and [->].
4. Push **[OK]**

The simulation is now running, with 4 … 20 mA/HART a current is outputted and with Profinbus PA or Foundation Fieldbus a digital value.

How to interrupt the simulation:

→ Push **[ESC]**

**Information:**

The simulation is automatically terminated 10 minutes after the last pressing of a key.

2) This value is not underrun during operation.

3) This value is not exceeded during operation.
If the function "Reset" is carried out, the sensor resets the values of the following menu items to the reset values (see chart):

<table>
<thead>
<tr>
<th>Function</th>
<th>Reset value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor address</td>
<td>126</td>
</tr>
<tr>
<td>Max. adjustment</td>
<td>0 m(d)</td>
</tr>
<tr>
<td>Min. adjustment</td>
<td>Meas. range end in m(d)</td>
</tr>
<tr>
<td>Medium</td>
<td>Liquid</td>
</tr>
<tr>
<td>Vessel form</td>
<td>not known</td>
</tr>
<tr>
<td>Damping</td>
<td>0 s</td>
</tr>
<tr>
<td>Linearization</td>
<td>Linear</td>
</tr>
<tr>
<td>Sensor-TAG</td>
<td>Sensor</td>
</tr>
<tr>
<td>Displayed value</td>
<td>Distance</td>
</tr>
<tr>
<td>Current output - characteristics</td>
<td>4 … 20 mA</td>
</tr>
<tr>
<td>Current output - max. current</td>
<td>20 mA</td>
</tr>
<tr>
<td>Current output - min. current</td>
<td>4 mA</td>
</tr>
<tr>
<td>Current output - failure</td>
<td>&lt; 3.6 mA</td>
</tr>
<tr>
<td>Unit of measurement</td>
<td>m(d)</td>
</tr>
</tbody>
</table>

The values of the following menu items are not reset to the reset values (see chart) with "Reset":

<table>
<thead>
<tr>
<th>Function</th>
<th>Reset value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backlight</td>
<td>No reset</td>
</tr>
<tr>
<td>Language</td>
<td>No reset</td>
</tr>
<tr>
<td>HART mode</td>
<td>No reset</td>
</tr>
</tbody>
</table>

**Default setting**

Like basic adjustment, but in addition, special parameters are reset to default values.

**Peak value indicator**

The min. and max. distance and temperature values are reset to the actual value.

**Service - Adjustment unit**

In this menu item you select the internal arithmetic unit of the sensor.

**Service - Language**

The sensor is already set to the ordered national language. In this menu item you can change the language. The following languages are available, e.g. in software version 3.50:

4) Sensor-specific basic adjustment.
5) Depending on the sensor type, see chapter "Technical data".
6) Special parameters are parameters which are set customer-specifically on the service level with the adjustment software PACTware.
Service - SIL

The functional safety is already activated Ex factory for instruments with SIL qualification. For instruments Ex factory without SIL qualification, the functional safety must be activated by the user for applications according to SIL via the indicating and adjustment module. The SIL factory setting cannot be deactivated by the user.

The activation of SIL has the following impact:

- In the menu item "Failure mode" under "Current output", the parameters "Hold value" and "20.5 mA" are blocked
- In the menu item "HART mode", the function "Multidrop" is blocked

**Note:**

For such applications, it is absolutely necessary to take note of "Safety Manual".

Service - HART mode

HART offers standard and multidrop mode.

The mode standard with the fixed address 0 means output of the measured value as 4 … 20 mA signal.

In Multidrop mode, up to 15 sensors can be operated on one two-wire cable. An address between 1 and 15 must be assigned to each sensor.  

In this menu item you determine the HART mode and enter the address for multidrop.

**Service - Copy sensor data**

This function enables reading out parameter adjustment data as well as writing parameter adjustment data into the sensor via the display and adjustment module. A description of the function is available in the operating instructions manual "Display and adjustment module".

7) The 4 … 20 mA signal of the HART sensor is switched off. The sensor consumes a constant current of 4 mA. The measuring signal is transmitted exclusively as digital HART signal.
The following data are read out or written with this function:

- Measured value presentation
- Adjustment
- Medium
- Vessel form
- Damping
- Linearisation curve
- Sensor-TAG
- Displayed value
- Display unit
- Scaling
- Current output
- Unit of measurement
- Language

The following safety-relevant data are not read out or written:

- HART mode
- PIN

Service - PIN

In this menu item, the PIN is activated/deactivated permanently. Entering a 4-digit PIN protects the sensor data against unauthorized access and unintentional modifications. If the PIN is activated permanently, it can be deactivated temporarily (i.e. for approx. 60 min.) in any menu item. The instrument is delivered with the PIN set to 0000.

Only the following functions are permitted with activated PIN:

- Select menu items and show data
- Read data from the sensor into the display and adjustment module.

Info

In this menu item the most important sensor information can be displayed:

- Instrument type
- Serial number: 8-digit number, e.g. 12345678
- Date of manufacture: Date of the factory calibration, e.g. 24. March 2015
- Software version: Edition of the sensor software, e.g. 3.80
6.4 Menu schematic

Basic adjustment

- **Date of last change using PC**: Date of the last change of sensor parameters via PC

- **Sensor details**, e.g. approval, process fitting, seal, measuring cell, measuring range, electronics, housing, cable entry, plug, cable length etc.

**Sensor characteristics**

- **Display now?**
6 Set up with the display and adjustment module

Display

- Set up with the display and adjustment module
  - OPTISOUND 3010 C • 4 … 20 mA/HART - four-wire

**Basic adjustment**
- Display
- Diagnostics
- Service
- Info

**Displayed value**
- Scaled

**Display unit**
- Volume
- m³

**Scaling**
- 0 % = 0.0 m³
- 100 % = 100.0 m³

Diagnostics

- Basic adjustment
  - Display
  - Diagnostics
  - Service
  - Info

**Peak value indicator**
- Distance min.: 0.234 m(d)
- Distance max.: 5.385 m(d)
- T-min.: 16.5 °C
- T-min.: 37.5 °C

**Meas. reliability**
- 36 dB

**Sensor status**
- OK

**Curve selection**
- Echo curve

Service

- Basic adjustment
  - Display
  - Diagnostics
  - Service
  - Info

**False signal suppression**
- Change now?

**Extended setting**
- None ▼

**Current output**
- Characteristic: 4-20 mA ▼
- Fail mode: < 3.6 mA ▼
- Min. current: 3.8 mA ▼

**Simulation**
- Start simulation?

**Unit of measurement**
- m(d) ▼
- select?

**Language**
- Deutsch ▼

**SIL**
- Not activated ▼

**HART mode**
- Standard
  - Address 0

**Copy sensor data**
- Copy sensor data?

**PIN**
- Enable?
6.9 Saving the parameter adjustment data

We recommend noting the adjusted data, e.g. in this operating instructions manual, and archiving them afterwards. They are thus available for multiple use or service purposes.

If OPTISOUND 3010 C is equipped with a display and adjustment module, the most important data can be read out of the sensor into the display and adjustment module. The procedure is described in the operating instructions manual "Display and adjustment module" in the menu item "Copy sensor data". The data remain there permanently even if the sensor power supply fails.

If it is necessary to exchange the sensor, the display and adjustment module is inserted into the replacement instrument and the data are written into the sensor under the menu item "Copy sensor data".
7 Maintenance and fault rectification

7.1 Maintenance
If the instrument is used properly, no special maintenance is required in normal operation.

7.2 Rectify faults
The operator of the system is responsible for taking suitable measures to rectify faults.

Reaction when malfunction occurs

Causes of malfunction
OPTISOUND 3010 C offers maximum reliability. Nevertheless, faults can occur during operation. These may be caused by the following, e.g.:

- Sensor
- Process
- Voltage supply
- Signal processing

Fault rectification
The first measures to be taken are to check the output signal and evaluate fault messages via the display/adjustment module. The procedure is described below.

Check the 4 ... 20 mA signal
Connect a multimeter in the suitable measuring range according to the wiring plan. The following table describes possible errors in the current signal and helps to eliminate them:

<table>
<thead>
<tr>
<th>Error</th>
<th>Cause</th>
<th>Rectification</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 ... 20 mA signal not stable</td>
<td>Level fluctuations</td>
<td>Set damping via the display and adjustment module</td>
</tr>
<tr>
<td>4 ... 20 mA signal missing</td>
<td>Electrical connection faulty</td>
<td>Check connection according to chapter &quot;Connection steps&quot; and if necessary, correct according to chapter &quot;Wiring plan&quot;</td>
</tr>
<tr>
<td></td>
<td>Voltage supply missing</td>
<td>Check cables for breaks; repair if necessary</td>
</tr>
<tr>
<td></td>
<td>Operating voltage too low or load resistance too high</td>
<td>Check, adapt if necessary</td>
</tr>
<tr>
<td>Current signal greater than 22 mA or less than 3.6 mA</td>
<td>Electronics module in the sensor defective</td>
<td>Exchange the instrument or send it in for repair</td>
</tr>
</tbody>
</table>

In Ex applications, the regulations for the wiring of intrinsically safe circuits must be observed.
7 Maintenance and fault rectification

Error messages via the display and adjustment module

<table>
<thead>
<tr>
<th>Error</th>
<th>Cause</th>
<th>Rectification</th>
</tr>
</thead>
</table>
| E013  | no measured value available | Sensor in boot phase  
Sensor does not find an echo, e.g. due to faulty installation or wrong parameter adjustment |
| E017  | Adjustment span too small | Carry out a fresh adjustment and increase the distance between min. and max. adjustment |
| E036  | no operable sensor software | Carry out a software update or send instrument for repair |
| E041  | Hardware error, electronics defective | Exchange the instrument or send it in for repair |

7.3 Exchanging the electronics module

If the electronics module is defective, it can be replaced by the user.

In Ex applications, only instruments and electronics modules with appropriate Ex approval may be used.

If there is no electronics module available on site, one can be ordered from the Krohne agency serving you.

7.4 Instrument repair

If a repair is necessary, please proceed as follows:

On our homepage in the Internet under http://www.krohne-mar.com/fileadmin/media-lounge/PDF-Download/Specimen_e.pdf you can download a return form.

By doing this you help us carry out the repair quickly and without having to call back for needed information.

- Print and fill out one form per instrument
- Clean the instrument and pack it damage-proof
- Attach the completed form and possibly also a safety data sheet to the instrument
8 Dismount

8.1 Dismounting steps

Warning:
Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel or pipeline, high temperatures, corrosive or toxic products etc.

Take note of chapters "Mounting" and "Connecting to power supply" and carry out the listed steps in reverse order.

8.2 Disposal

The instrument consists of materials which can be recycled by specialised recycling companies. We use recyclable materials and have designed the parts to be easily separable.

WEEE directive 2002/96/EG
This instrument is not subject to the WEEE directive 2002/96/EG and the respective national laws. Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.

Correct disposal avoids negative effects on humans and the environment and ensures recycling of useful raw materials.

Materials: see chapter "Technical data"

If you have no way to dispose of the old instrument properly, please contact us concerning return and disposal.
9 Supplement

9.1 Technical data

<table>
<thead>
<tr>
<th>General data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials, wetted parts</td>
</tr>
<tr>
<td>- Process fitting</td>
</tr>
<tr>
<td>- Transducer</td>
</tr>
<tr>
<td>- Seal transducer/process fitting</td>
</tr>
<tr>
<td>Materials, non-wetted parts</td>
</tr>
<tr>
<td>- Housing</td>
</tr>
<tr>
<td>- Seal between housing and housing cover</td>
</tr>
<tr>
<td>- Inspection window in housing cover</td>
</tr>
<tr>
<td>- Ground terminal</td>
</tr>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>Max. torque mounting boss</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output signal</td>
</tr>
<tr>
<td>HART output values</td>
</tr>
<tr>
<td>- HART value (Primary Value)</td>
</tr>
<tr>
<td>- HART value (Secondary Value)</td>
</tr>
<tr>
<td>- HART value (3rd Value)</td>
</tr>
<tr>
<td>Resolution</td>
</tr>
<tr>
<td>Failure signal current output (adjustable)</td>
</tr>
<tr>
<td>Current limitation</td>
</tr>
<tr>
<td>Load</td>
</tr>
<tr>
<td>Damping (63 % of the input variable)</td>
</tr>
<tr>
<td>Met NAMUR recommendation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured variable</td>
</tr>
<tr>
<td>Measuring range</td>
</tr>
<tr>
<td>- Liquids</td>
</tr>
<tr>
<td>- Bulk solids</td>
</tr>
<tr>
<td>Dead zone</td>
</tr>
</tbody>
</table>

Reference conditions to measuring accuracy (according to DIN EN 60770-1)

Reference conditions according to DIN EN 61298-1

- Temperature | +18 … +30 °C (+64 … +86 °F) |

<sup>8</sup> With inductive load ohmic share min. 25 Ω/mH.
9 Supplement

- Relative humidity 45 ... 75 %
- Air pressure 860 ... 1060 mbar/86 ... 106 kPa (12.5 ... 15.4 psig)

Other reference conditions
- Reflector ideal reflector, e.g. metal plate 2 x 2 m (6.56 x 6.56 ft)
- False reflections Biggest false signal, 20 dB smaller than the useful signal

Measuring characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrasonic frequency</td>
<td>70 kHz</td>
</tr>
<tr>
<td>Interval</td>
<td>&gt; 2 s (dependent on the parameter adjustment)</td>
</tr>
<tr>
<td>Abstrahlwinkel at -3 dB</td>
<td>11°</td>
</tr>
<tr>
<td>Step response or adjustment time³</td>
<td>&gt; 3 s (dependent on the parameter adjustment)</td>
</tr>
</tbody>
</table>

Measuring accuracy

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution, general</td>
<td>max. 1 mm</td>
</tr>
<tr>
<td>Deviation</td>
<td>see diagram</td>
</tr>
</tbody>
</table>

Fig. 25: Deviation OPTISOUND 3010 C

Influence of the ambient temperature to the sensor electronics¹⁰)

Average temperature coefficient of the zero signal (temperature error) 0.06 %/10 K

Ambient conditions
Ambient, storage and transport temperature -40 ... +70 °C (-40 ... +158 °F)

Process conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process pressure</td>
<td>-20 ... 200 kPa/-0.2 ... 2 bar (-2.9 ... 29 psig)</td>
</tr>
<tr>
<td>Process temperature (transducer temperature)</td>
<td></td>
</tr>
<tr>
<td>Seal EPDM</td>
<td>-40 ... +80 °C (-40 ... +176 °F)</td>
</tr>
<tr>
<td>Seal FKM</td>
<td>-20 ... +80 °C (-4 ... +176 °F)</td>
</tr>
</tbody>
</table>

³) Time to output the correct level (with max. 10 % deviation) after a sudden level change.
¹⁰) Relating to the nominal measuring range.
Vibration resistance | mechanical vibrations with 4 g and 5 … 100 Hz\textsuperscript{11)}

### Electromechanical data

**Cable entry**
- Double chamber housing
  - 1 x cable gland M20 x 1.5 (cable: Ø 5 … 9 mm), 1 x blind plug M20 x 1.5
  - 1 x closing cap ½ NPT, 1 x blind plug ½ NPT
- Spring-loaded terminals for wire cross-section up to 2.5 mm\(^2\) (AWG 14)

**Display and adjustment module**

| Voltage supply and data transmission | through the sensor |
| Indication | LC display in dot matrix |
| Adjustment elements | 4 keys |
| **Protection rating** |
| - unassembled | IP 20 |
| - mounted into the sensor without cover | IP 40 |
| **Material** |
| - Housing | ABS |
| - Inspection window | Polyester foil |

### Voltage supply

**Operating voltage**
- Non-Ex and Ex-d instrument: 20 … 72 V DC, 20 … 253 V AC, 50/60 Hz

**Power consumption**
- max. 4 VA; 2.1 W

### Electrical protective measures

| Protection rating |
| IP 66/IP 67 (NEMA 4X) |
| **Overvoltage category (IEC 61010-1)** |
| - up to 2000 m (6562 ft) above sea level | III |
| - up to 5000 m (16404 ft) above sea level | III - Only with connected overvoltage protection |
| - up to 5000 m (16404 ft) above sea level | II |
| **Protection rating (IEC 61010-1)** | I |

### Approvals

Depending on the version, instruments with approvals can have different technical data. For these instruments, please note the corresponding approval documents. They are included in the scope of delivery.

\textsuperscript{11)} Tested according to the guidelines of German Lloyd, GL directive 2.
9.2 Dimensions

OPTISOUND 3010 C

Fig. 26: OPTISOUND 3010 C

1. Dead zone: 0.25 m (0.82 ft)
2. Measuring range: with liquids up to 5 m (16.4 ft), with solids up to 2 m (6.562 ft)
9.3 Trademark

All the brands as well as trade and company names used are property of their lawful proprietor/originator.
KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature assemblies
- Pressure transmitters
- Analysis products
- Products and systems for the oil and gas industry

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