OPTISOUND 3010 C - 3030 C
Ultrasonic Level Gauge
for liquids

- Level measurement during processing and storage of liquids
- Sumps, water and wastewater basins
- Noncontact flow measurement and detection in open channels
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Take note of safety instructions for Ex application

Please note the Ex specific safety information which you will find on our homepage www.krohne-mar.com and which come with the appropriate instrument. In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units. The sensors must only be operated on intrinsically safe circuits. The permissible electrical values are stated in the certificate.
1 Description of the measuring principle

Measuring principle
Short ultrasonic pulses in the range of 35 kHz to 70 kHz are emitted by the transducer to the product surface, reflected there and received by the transducer. The pulses travel at the speed of sound - the elapsed time from emission to reception of the signals depends on the level in the vessel.

The latest microcomputer technology and the proven processing software select the level echo from among any number of false echoes and calculate the exact distance to the product surface. An integrated temperature sensor detects the temperature in the vessel and compensates the influence of temperature on the signal running time.

By simply entering the vessel dimensions, a level-proportional signal is generated from the distance. It is not necessary to fill the vessel for adjustment.

Wide application range
OPTISOUND 3010 C, 3020 C and 3030 C ultrasonic sensors are especially suitable for level measurement of liquids, but are also good for solids. The instruments differ in the measuring range, the transducer version and the process fitting. Through different, adapted emitting frequencies, levels in a measuring range of 5 \( \text{m} \) (16.4 \( \text{ft} \) \( \ldots \) 49.2 \( \text{ft} \)) can be measured. Resistant materials for transducers and process fittings also allow applications in corrosive products (depending on the model). A practical mounting strap (option) enables easy orientation of OPTISOUND 3030 C.

Unaffected by product properties
Fluctuations in product composition or even complete product changes do not influence the measuring result. A fresh adjustment is not necessary.

Service and maintenance friendly
Thanks to the non-contact measuring principle, OPTISOUND sensors are particularly easy to service and maintain.
1.1 Application examples

Open basins

Fig. 1: Level measurement in an open basin with OPTISOUND 3010 C

A typical application for OPTISOUND 3010 C sensors is level measurement on open basins. Products such as rain water or sewage water, i.e. with impurities. Here is where the advantages of non-contact measurement with OPTISOUND come into their own: simple and maintenance-free. The degree of pollution of the water or an accumulation of mud in the basin is not important, because OPTISOUND measures the surface.

Sludge container

Fig. 2: Level measurement in a container with OPTISOUND 3030 C

In sewage treatment plants, the accumulated sludge is dewatered and transported via conveyor belts to containers. The OPTISOUND 3030 C sensor measures the filling of the container. An empty container can thus be readied in good time before the max. level is reached. Thanks to the metal transducer diaphragm, measurement functionality is also ensured even under conditions of fluctuating temperatures and steam generation.
2 Type overview

OPTISOUND 3010 C

Applications: liquids and solids in virtually all industries, particularly in water and waste water management

Measuring range:
- Liquids: 0.25 ... 5 m (0.8 ... 16.4 ft)
- Solids: 0.25 ... 2 m (0.8 ... 6.6 ft)

Process fitting: G1½A of PVDF

Process temperature: -40 ... 80°C (-40 ... +176°F)

Process pressure: -0.2 ... 2 bar (-20 ... 200 kPa)

(-2.9 ... 29 psi)

Signal output: two-wire/four-wire 4 ... 20 mA/HART

as OPTISOUND 3010 C

OPTISOUND 3020 C

Applications: as OPTISOUND 3010 C

Measuring range:
- Liquids: 0.4 ... 8 m (1.3 ... 26.2 ft)
- Solids: 0.4 ... 3.5 m (1.3 ... 11.5 ft)

Process fitting: G2A of PVDF

Process temperature: -40 ... 80°C (-40 ... +176°F)

Process pressure: -0.2 ... 2 bar (-20 ... 200 kPa)

(-2.9 ... 29 psi)

Signal output: two-wire/four-wire 4 ... 20 mA/HART

OPTISOUND 3030 C

Applications: as OPTISOUND 3020 C

Measuring range:
- Liquids: 0.4 ... 8 m (1.3 ... 26.2 ft)
- Solids: 0.4 ... 3.5 m (1.3 ... 11.5 ft)

Process fitting: G2A of PVDF

Process temperature: -40 ... 80°C (-40 ... +176°F)

Process pressure: -0.2 ... 2 bar (-20 ... 200 kPa)

(-2.9 ... 29 psi)

Signal output: two-wire/four-wire 4 ... 20 mA/HART
OPTISOUND 3030 C

Applications: liquids and solids in virtually all industries
Measuring range: liquids: 0.6 ... 15 m (2 ... 49.2 ft) solids: 0.6 ... 7 m (2 ... 23 ft)
Process fitting: compression flange DN 100 or mounting strap
Process temperature: -40 ... 80°C (-40 ... +176°F)
Process pressure: -0.2 ... 1.0 bar (-20 ... 100 kPa)
(-2.9 ... 14.5 psi)
Signal output: two-wire/four-wire 4 ... 20 mA/HART
**Type overview**

**Indicating and adjustment module**

**Housing**
- Plastic
- Stainless steel
- Aluminium
- Aluminium (double chamber)

**Electronics**
- 4 ... 20 mA/HART
- 4 ... 20 mA/HART – four-wire

**Sensors**
- Transducer 1½"
- Transducer 2"
- Transducer 4"

**Approvals**
- Gas explosion protection

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**Ultrasonic – Level measurement in liquids**

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3 Mounting information

Measuring range

The reference plane for the measurement is the lower edge of the transducer. All statements concerning the measuring range as well as the internal signal processing refer to this.

With all instruments, a min. distance from the lower edge of the flange - the so-called dead zone, in which measurement is not possible - must be maintained. The exact value of the dead zone, depending on the instrument version, is stated in the Technical data.

![Diagram of mounting information]

Fig. 3: Min. distance to the max. level

1 Dead zone
2 Reference plane for the measurement

Note:
If the product reaches the transducer, buildup can form on it over a period of time and later cause measurement errors.

![Diagram of measuring range and max. measuring distance]

Fig. 4: Measuring range and max. measuring distance

1 full
2 empty (max. measuring distance)
3 max. measuring range

Pressure/Vacuum

Gauge pressure in the vessel does not influence OPTISOUND. Low pressure or vacuum, 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) use a different measuring principle, e.g. radar or guided radar (TDR).

Installation position

When mounting OPTISOUND, keep a distance of at least 200 mm to the vessel wall. If the sensor is installed in the center of dished or spherical vessel tops, multiple echoes can arise. These can, however, be faded out by an appropriate adjustment.
If you cannot keep this distance, a false echo storage should be carried out during setup. This applies particularly if buildup on the vessel wall is expected. In this case, we recommend repeating the false echo storage later on with existing buildup.

![Diagram](image)

**Fig. 5: Mounting on dished 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.

![Diagram](image)

**Fig. 6: Vessel with conical bottom**

**Socket**

The mounting socket should preferably be dimensioned to allow the lower edge of the transducer to protrude at least 10 mm out of the socket.
If the reflective properties of the medium are good, you can mount OPTISOUND on sockets longer than the transducer. You will find recommended values of the socket heights in the following illustrations. The socket end should be smooth and burr-free, if possible also rounded. A false echo storage is recommended.

**Fig. 7: Recommended socket mounting**

**Fig. 8: Deviating socket dimensions with OPTISOUND 3010 C**

**Fig. 9: Deviating socket dimensions with OPTISOUND 3020 C**
Sensor orientation

With liquids, align the sensor as close to vertical as possible to achieve optimum measuring results.

![Sensor orientation diagram](image)

To reduce the min. distance to the medium, you can also mount OPTISOUND with a beam deflector of corrosion-resistant material. 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 diagram](image)

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 superimposed on the wanted echo. Make sure when planning your measuring location that the ultrasonic signals have "free access" to the measured product.

If there are 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. 13: Cover smooth profiles with defectors](image)

**Inflowing material**

The instruments must not be mounted in or above the filling stream. Make sure that the product surface and not the inflowing material is detected.

![Fig. 14: Inflowing liquid](image)

**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 sensors with guided radar (TDR) should be used.

Guided radar is not influenced by foam generation and is particularly suitable for such applications.

**Air flow**

If there are strong air currents in the vessel, e.g. due to strong winds in outdoor installations, or because of air turbulence, you should mount OPTISOUND 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.
A standpipe measurement with OPTISOUND is possible with the following tube diameters:
- OPTISOUND 3010 C from 40 mm
- OPTISOUND 3020 C from 50 mm
- OPTISOUND 3030 C from 100 mm.

Avoid large gaps and thick welding joints when connecting the tubes. A false echo storage should always be carried out. Measurement in a standpipe is not recommended for very adhesive products.
4 Electrical connection

4.1 General requirements
The power supply range can differ depending on the instrument version. The exact range is stated in the Technical data.

Take note of country-specific installation standards (e.g. the VDE regulations in Germany) as well as prevailing safety regulations and accident prevention rules.

In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units.

4.2 Supply voltage

4 … 20 mA/HART two-wire
Power supply and current signal are carried over the same two-wire connection cable. The requirements on the power supply are stated in the Technical data of this Product Information manual.

4 … 20 mA/HART four-wire
Power supply and current output are carried on two separate connection cables.

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

The 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 conductor terminal.

4.3 Connection cable and installation
The sensors are connected with standard cable without screen. An outer cable diameter of 5 … 9 mm ensures the seal effect of the cable entry.

As an option, OPTISOUND are also available with standard plug connectors (see Technical data).

If strong electromagnetic interference is expected, screened cable should be used for the signal lines.

In Ex applications, the corresponding installation regulations must be noted for the connection cable.

4.4 Cable screening and grounding
If screened cable is required, the cable screen must be connected on both ends to ground potential. If potential equalisation currents are expected, the connection on the evaluation side must be made via a ceramic capacitor (e.g. 1 nF, 1500 V).
4.5  Wiring plans

**Single chamber housing**

![Diagram](image1)

*Fig. 16: Connection HART two-wire*

1  Power supply and signal output

**Double chamber housing – two-wire**

![Diagram](image2)

*Fig. 17: Connection HART two-wire*

1  Power supply and signal output

**Double chamber housing – 4 ... 20 mA/HART four-wire**

![Diagram](image3)

*Fig. 18: Connection 4 ... 20 mA/HART four-wire*

1  Supply voltage
2  Signal output
5 Adjustment

5.1 Adjustment, general
OPTISOUND can be adjusted with the following adjustment media:
- the indicating and adjustment module
- a HART handheld (4 … 20 mA/HART)

The entered parameters are generally saved in OPTISOUND, optionally also in the indicating/adjustment module.

5.2 Compatibility acc. to NAMUR NE 53
OPTISOUND meet NAMUR recommendation NE 53.

The parameter adjustment of the basic sensor functions is independent of the software version. The range of available functions depends on the respective software version of the individual components.
5.3 Adjustment with the indicating/adjustment module

Setup and indication

The indication and adjustment module can be plugged into OPTISOUND sensors. It can be placed in four different positions on the instrument (each displaced by 90°). Indication and adjustment are made via four keys and a clear, graphic-capable dot matrix indication. The adjustment menu with language selection is clearly structured and enables easy setup. After setup, the indicating/adjustment module serves as indicating instrument: through the screwed cover with glass insert, measured values can be read directly in the requested unit and presentation.

Adjustment

![Diagram of indicating and adjustment elements]

**Fig. 19: Indicating and adjustment elements**

1. LC display
2. Indication of the menu item number
3. Adjustment keys

Key functions

- **[OK]** key:
  - move to the menu overview
  - confirm selected menu
  - edit parameter
  - save value
- **[→]** key to select:
  - menu change
  - list entry
  - editing position
- **[+]** key:
  - modify value of a parameter
- **[ESC]** key:
  - interrupt input
  - jump to the next higher menu
6 Technical data

General data

OPTISOUND 3010 C and 3020 C
Materials, wetted parts
- Process fitting
- Transducer
- Seal transducer/process fitting
PVDF
PVDF
EPDM

OPTISOUND 3030 C
Materials, wetted parts
- Mounting strap
- Process fitting
- Transducer diaphragm
- Seal transducer/process fitting
1.4301
UP
1.4571
EPDM

Materials, non-wetted parts
- Compression flange (OPTISOUND 3010 C)
- Housing
Plastic PBT (Polyester), Alu-die casting powder-coated, 316L (stainless steel 1.4435)

- Seal ring between housing and housing cover
- Inspection window in housing cover for indicating/adjustment module
- Ground terminal
NBR (stainless steel housing), silicone (Alu/plastic housing)
Polycarbonate
Stainless steel 1.4571/1.4435

Weight
- OPTISOUND 3010 C and 3020 C
1.8 ... 4.0 kg (4.0 ... 8.8 lbs), depending on process fitting and housing

- OPTISOUND 3030 C
2.7 ... 5.7 kg (6 ... 12.6 lbs), depending on process fitting and housing

Output variable

Output signal
4 ... 20 mA/HART

Resolution
1.6 µA

Fault signal
current output unchanged; 20.5 mA; 22 mA; <3.6 mA (adjustable)

Current limitation
22 mA

Load
see load diagram in Power supply

Integration time (63 % of the input variable)
0 ... 999 s, adjustable

Rise time
500 ms (ti: 0 s, 0 ... 100 %)

Fulfilled NAMUR recommendation
NE 43

Integration time (63 % of the input variable)
0 ... 999 s, adjustable

Rise time
500 ms (ti: 0 s, 0 ... 100 %)

Input variable

Parameter
distance between lower edge of the transducer and product surface
### Technical data

#### Ultrasonic – Level measurement in liquids

- **Dead zone**
  - OPTISOUND 3010 C: 0.25 m (0.8 ft)
  - OPTISOUND 3020 C: 0.4 m (1.3 ft)
  - OPTISOUND 3030 C: 0.6 m (2 ft)
- **Measuring range**
  - OPTISOUND 3010 C: up to 5 m (16.4 ft) liquid/up to 2 m (6.6 ft) solid
  - OPTISOUND 3020 C: up to 8 m (26.2 ft) liquid/up to 3.5 m (11.5 ft) solid
  - OPTISOUND 3030 C: up to 15 m (49.2 ft) liquid/up to 7 m (23 ft) solid
- **Accuracy** (similar to DIN EN 60770-1)
  - Reference conditions acc. to DIN EN 61298-1
    - Temperature: 18 … 30°C (64 … 86°F)
    - Relative humidity: 45 … 75%
    - Atmospheric pressure: 860 … 1060 mbar (86 … 106 kPa/12.5 … 15.4 psi)
- **Characteristic curve deviation and measurement characteristics**
  - Average temperature coefficient of the zero signal (temperature error): 0.06 %/10 K
  - Resolution, general: max. 1 mm
  - Ultrasonic frequency
    - OPTISOUND 3010 C: 70 kHz
    - OPTISOUND 3020 C: 54 kHz
    - OPTISOUND 3030 C: 35 kHz
  - Interval: >2 s (dependent on the parameter adjustment)
  - Beam angle
    - OPTISOUND 3010 C and 3020 C: 5.5°
    - OPTISOUND 3030 C: 3°
  - Adjustment time
    - OPTISOUND 3010 C: >3 s (dependent on the parameter adjustment)
    - OPTISOUND 3020 C: >3 s (dependent on the parameter adjustment)
    - OPTISOUND 3030 C: >3 s (dependent on the parameter adjustment)

### OPTISOUND 3010 C

- **Accuracy**
  - Better than 0.2 % or ±4 mm (see diagram)

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1) Relating to the nominal range, incl. hysteresis and repeatability, determined acc. to the limit point method.

2) Time to output the correct level (with max. 10 % deviation) after a sudden level change.
Technical data

**OPTISOUND 3020 C**

**Accuracy**

better than 0.2 % or ±4 mm (see diagram)

**OPTISOUND 3030 C**

**Accuracy**

better than 0.2 % or ±6 mm (see diagram)
**Ambient conditions**

Ambient, storage and transport temperature
- without indicating and adjustment module
  - -40 ... +80°C (-40 ... +176°F)
- the indicating and adjustment module
  - -20 ... +70°C (-4 ... +158°F)
- Version IP 66/IP 68 1 bar with connection cable PE
  - -20 ... +60°C (-4 ... +140°F)

**Process conditions**

Vessel pressure
- OPTISOUND 3010 C and 3020 C
  - -20 ... 200 kPa (-0.2 ... 2 bar)
- OPTISOUND 3030 C with compression flange
  - -20 ... 100 kPa (-0.2 ... 1 bar)
- OPTISOUND 3030 C with mounting strap
  - 0 kPa (0 bar), because no sealing possibility

Process temperature (transducer temperature)
- -40 ... +80°C (-40 ... +176°F)

Vibration resistance
- mechanical vibrations with 4 g and 5 ... 100 Hz

**Electromechanical data**

Cable entry/
- Single chamber housing
  - 1x cable entry M20x1.5 (cable-ø 5 ... 9 mm), 1x blind stopper M20x1.5
  - or:
    - 1x closing cap ½ NPT, 1x blind stopper ½ NPT
- Double chamber housing
  - 1x cable entry M20x1.5 (cable-ø 5 ... 9 mm), 1x blind stopper M20x1.5
  - or:
    - 1x closing cap ½ NPT, 1x blind stopper ½ NPT
  - or:
    - Spring-loaded terminals
      - for wire cross sections up to 2.5 mm²

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3) Tested acc. to the regulations of German Lloyd, GL directive 2
__Indicating and adjustment module__

- **Power supply and data transmission**: through sensor via gold-plated sliding contacts (I²C bus)
- **Indication**: LC display in full dot matrix
- **Adjustment elements**: 4 keys
- **Protection**
  - unassembled: IP 20
  - mounted into the sensor without cover: IP 40
- **Materials**
  - **Housing**: ABS
  - **Inspection window**: Polyester foil

__Supply voltage__

- **Power supply – two-wire instrument**
  - non-Ex instrument: 14 ... 36 V DC
  - EEx ia instrument: 14 ... 30 V DC
- **Permissible residual ripple**
  - < 100 Hz: Uss < 1 V
  - 100 Hz ... 10 kHz: Uss < 10 mV
- **Load**: see diagram

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Fig. 23: Voltage diagram

1. HART load
2. Voltage limit EEx ia instrument
3. Voltage limit non-Ex instrument
4. Supply voltage

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Supply voltage – four-wire instrument: 20 ... 72 V DC, 20 ... 253 V AC, 50/60 Hz

Power consumption – four-wire instrument: max. 4 VA; max. 2.1 W
Electrical protective measures

Protection: IP 66/IP 68 (0.2 bar)
Overvoltage category: III
Protection class:
- Two-wire: II
- Four-wire: I

Approvals OPTISOUND 3010 C and 3020 C

ATEX: ATEX II 1G, 1/2G, 2G EEx ia IIC T6

CE conformity


41 Deviating data with Ex applications: see separate safety instructions.
51 Depending on order specification.
7 Dimensions

Housing

Fig. 24: Housing versions (with integrated indicating/adjustment module the housing height or width is increased by 9 mm/0.35 in)

1 Plastic housing
2 Stainless steel housing
3 Aluminium double chamber housing
4 Aluminium housing

OPTISOUND 3010 C

Fig. 25: OPTISOUND 3010 C

1 Dead band: 0.25 m (0.8 ft)
2 Meas. range: in liquids up to 5 m (16.4 ft), in solids up to 2 m (6.6 ft)
OPTISOUND 3020 C

![Diagram of OPTISOUND 3020 C]

**Fig. 26: OPTISOUND 3020 C**

1. Dead zone: 0.4 m (1.3 ft)
2. Meas. range: in liquids up to 8 m (26.2 ft), in solids up to 3.5 m (11.5 ft)

OPTISOUND 3030 C

![Diagram of OPTISOUND 3030 C]

**Fig. 27: OPTISOUND 3030 C**

1. Mounting strap
2. Compression flange
3. Dead zone: 0.6 m (2 ft)
4. Meas. range: in liquids up to 15 m (49.2 ft), in solids up to 7 m (23 ft)