


# OPTISONIC 3400 Technical Datasheet

## Robust, ultrasonic flowmeter for District Heating

- Dedicated for thermal energy measurement
- MID 2014/32/EU Annex VI (MI004 class 1, 2 or 3) / UK Measuring Instrument Regulations (MIR) 2016/No.1153 approved
- Accurate bi-directional flow measurement

OIML MID

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## 1.1 Robust ultrasonic flow meter for heating applications

The **OPTISONIC 3400** flowmeter is a unique, 3-beam, in-line, ultrasonic flowmeter, designed especially for measuring homogeneous conductive and non-conductive liquids, with high accuracy and reproducibility, over a long period of time. KROHNE is a main supplier of ultrasonic in-line process flowmeters for liquids with the largest global installed base/proven track record in terms of robustness and measurement accuracy.

Building on vast knowledge and expertise, KROHNE now introduces the type approved **OPTISONIC 3400** for district heating applications.




① High performance signal converter for all applications
② Robust body without moving parts

The **OPTISONIC 3400** ...features advanced meter diagnostics.

This provides extensive self-checking of internal circuits and information regarding the health of the flow sensor, but just as importantly, vital information about the process and process conditions.

The **OPTISONIC 3400** ...features velocity of sound.

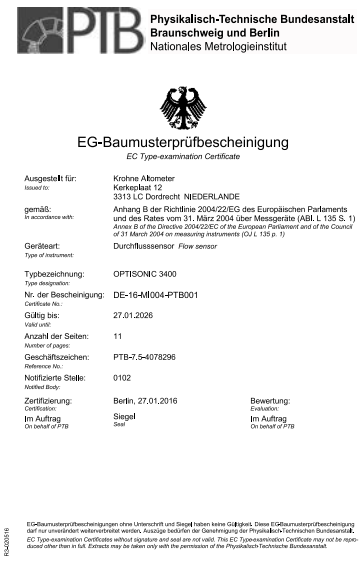
Another unique feature of the OPTISONIC 3400 is the free-of-charge measurement of the velocity of sound per acoustic path. For instance, this can supply information about pollution in the liquid, or changes in the process conditions.

### Highlights

- High performance signal converter for energy measurement applications
- Completely welded construction, wear and maintenance free
- Full bore, unobstructed sensor tube, without pressure loss and without moving parts
- Accurate bi-directional flow measurement, with three beams to measure continuously
- No influences of scaling
- Compact dimensions and easy installation and commissioning

## 1.2 Legal Metrology

KROHNE's OPTISONIC 3400 ultrasonic flowmeter provides excellent performance, due to the flow sensor design with 3 parallel acoustics paths, under all circumstances.



Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin
Nationales Metrologieinstitut

EG-Baumusterprüfbescheinigung
*EC Type-examination Certificate*

| | |
|---|---|
| Ausgestellt für: *Issued to:* | Krohne Altometer<br>Kerkeplaat 12<br>3313 LC Dordrecht NIEDERLANDE |
| gemäß: *In accordance with:* | Anhang B der Richtlinie 2004/22/EG des Europäischen Parlaments und des Rates vom 31. März 2004 über Messgeräte (ABl. L 135 S. 1)<br>*Annex B of the Directive 2004/22/EC of the European Parliament and of the Council of 31 March 2004 on measuring instruments (OJ L 135 p. 1)* |
| Geräteart: *Type of instrument:* | Durchflusssensor *Flow sensor* |
| Typbezeichnung: *Type designation:* | OPTISONIC 3400 |
| Nr. der Bescheinigung: *Certificate No.:* | DE-16-MI004-PTB001 |
| Gültig bis: *Valid until:* | 27.01.2026 |
| Anzahl der Seiten: *Number of pages:* | 11 |
| Geschäftszeichen: *Reference No.:* | PTB-7.5-4078296 |
| Notifizierte Stelle: *Notified Body:* | 0102 |
| Zertifizierung: *Certification:* | Berlin, 27.01.2016 |
| Im Auftrag *On behalf of PTB* | Siegel *Seal* |
| Bewertung: *Evaluation:* | Im Auftrag *On behalf of PTB* |

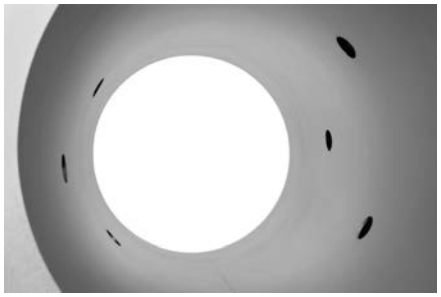
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RC-4200916

For thermal energy measurements OPTISONIC 3400 MI-004 is Class 1, 2 and 3 approved according to the latest Measurement Instrument Directive 2014/32/EU Annex VI MI-004 /UK Measuring Instrument Regulations 2016/No. 1153, reflecting our extensive experience in providing Custody Transfer measurement solutions in a range of industries and applications.

Heat metering systems consist of 3 main parts: temperature sensors, flowmeter and heat calculator. Heat demand is regulated by flow rather than by temperature. Therefore at low energy demand, low minimum flow measurement is a critical factor. Ultrasonic flow measurement starts already at zero flow, and is MI-004 approved starting from 0,1 m/s.

## 1.3 Flow sensor and signal converter details



**Engineers favourite flow meter**
- All welded sensor construction
- Patented inert metal transducer technology
- No moving parts
- Full bore unobstructed sensor
- No need for auxiliary parts



**Legal metrology**
The OPTISONIC 3400 liquid flowmeters compliant to legal metrology MID MI-004 (and harmonized CEN EN1434, OIML R74) are protected against manipulation.

As such the signal converter housing is sealed and the software is dedicated with relevant menu parameters that are blocked.

## 1.4 Measuring principle

- Like canoes crossing a river, acoustic signals are transmitted and received along a diagonal measuring path.
- A sound wave going downstream with the flow travels faster than a sound wave going upstream against the flow.
- The difference in transit time is directly proportional to the average flow velocity of the medium.

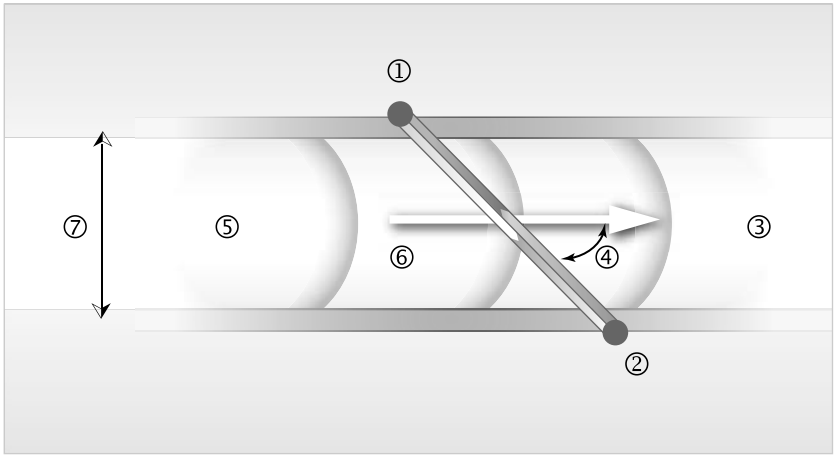



**Figure 1-1: Measuring principle**

① Transducer A
② Transducer B
③ Flow velocity
④ Angle of incidence
⑤ Velocity of sound of liquid
⑥ Path length
⑦ Inner diameter

## 2.1 Technical data

- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).*

### Measuring system

| | |
|---|---|
| Measuring principle | Ultrasonic transit time |
| Application range | Flow measurement of heated water |
| **Measured value** | |
| Primary measured value | Transit time |
| Secondary measured values | Volume flow, mass flow, flow speed, flow direction, velocity of sound, gain, signal to noise ratio, reliability of flow measurement, totalised volume or mass |

### Design

| | |
|---|---|
| Features | 3 parallel acoustic paths fully welded. |
| Modular construction | The measurement system consists of a measuring sensor and a signal converter. |
| Compact version | OPTISONIC 3400 |
| Remote version | OPTISONIC 3000 F with UFC 400 signal converter |
| Nominal diameter | DN25...2000 / 1...80" |
| Measurement range | 0.1...10 m/s / 0.33...33 fts<br>For more details refer to *MID/MIR Annex MI-004* on page 17 |
| **Signal converter** | |
| Inputs / outputs | Current (incl. HART®), pulse, frequency and/or status output, limit switch and/or control input (depending on the I/O version) |
| Totaliser | Optional 2 internal totalisers with a max. of 8 digits (e.g. for totalising volume and/or mass units) |
| Verification and self-diagnostics | Integrated verification, diagnostic functions: measuring device, process, measured values, device configuration, etc. |
| **Display and user interface** | |
| Graphic display | LC display, backlit white |
| | Size: 128 x 64 pixels<br>Corresponds to 59 x 31 mm = 2.32" x 1.22" |
| | Display turnable in 90° steps. |
| Operating elements | 4 push buttons for operator control of the signal converter without opening the housing. |
| Remote operation | PACTware™, including Device Type Manager (DTM) |
| | HART® handheld communicator (Emerson), AMS (Emerson), PDM (Siemens) |

| Display functions | |
|---|---|
| Operating menu | Programming of parameters at 2 measured value pages, 1 status page, 1 graphic page (measured values and descriptions adjustable as required) |
| Language of display texts ( as language package) | Standard: English, French, German, Dutch |
| | Russia: English, German, Russian |
| Measurement functions | **Units:** Metric, British and US units selectable as desired from lists for volume/mass flow and counting, velocity, temperature |
| | **Measured values:** volume flow, mass flow, flow speed, velocity of sound, gain, signal to noise ratio, flow direction, diagnostics |
| Diagnostic functions | **Standards:** VDI/NAMUR NE 107 |
| | **Status messages:** output of status messages via display, current and/or status output |
| | **Sensor diagnostics:** per acoustic path velocity of sound, flow speed, gain, signal to noise ratio |
| | **Process diagnostics:** empty pipe, signal integrity, cabling, flow conditions |
| | **Signal converter diagnostics:** data bus monitoring, I/O connections, electronics temperature, parameter and data integrity |

## Measuring accuracy

| Reference conditions | |
|---|---|
| Medium | Water |
| Temperature | +20°C / +68°F |
| Pressure | 1 bar / 14.5 psi |
| Inlet section | 10 DN |
| **Maximum measuring error** | |
| Class 1 | ± 1% (1 + 0.01 $q_p$ / q) = with limit of 3.5% |
| Class 2 | ± 2% (2 + 0.02 $q_p$ / q) = with limit of 5% |
| Class 3 | ± 3% (3 + 0.03 $q_p$ / q) = with limit of 5% |
| Calibration / Verification | **Standard** |
| | 3 Point calibration by a direct volume comparison |
| | **Optional** |
| | Verification to Measurement Instrument Directive (MID), Annex VI (MI-004) |
| MID MI-004 (Directive 2014/32/EU | EC-Type examination certificate to MID Annex VI (MI-004) |
| | Diameter: DN25....2000 |
| | Minimal straight inlet flow: 10 DN |
| | Minimal straight outlet flow: 3 DN |
| | Forward and reverse (bi-directional) flow |
| | Orientation: horizontal, vertical |
| | Ratio: up to 100 |
| | Maximum operating pressure:<br>40 bar- 580 psi at 20°C - 68°F / 32 bar - 460psi at 180°C - 356°F |
| | For more details refer to *MID/MIR Annex MI-004* on page 17 |
| Environmental class | Electromagnetic: E2 |
| | Mechanical: M1 |

## Operating conditions

| | |
|---|---|
| **Temperature** | |
| Process temperature | **Compact version:** -0...+90°C / 32...+194°F |
| | **Remote version:** 0...+180°C / +32...+356°F |
| | Carbon steel flanges;minimal process temperatures acc. to EN1092: -10°C / +14°F; ASME: -29°C / -20°F |
| Ambient temperature | -25...+55°C / -13...+131°F |
| | Ambient temperatures below -25°C / -13°F may affect the readability of the display. |
| Protect inside electronics against self-heating. Protect the signal converter from external heat sources such as direct sunlight, as higher temperatures reduce the life cycle of all electronic components. | |
| Storage temperature | -50...+70°C / -58...+158°F |
| **Pressure** | |
| Atmospheric | |
| EN 1092-1 | DN25...80: PN 40 |
| | DN100...150: PN 16 |
| | DN200...2000: PN 10 |
| ASME B16.5 | 1...80": 150 lb RF |
| | 1...80": 300 lb RF |
| **Properties of medium** | |
| Physical condition | Liquid, water, heated or chilled |
| Permissible gas content | ≤ 2% (volume) |
| Permissible solid content | ≤ 5% (volume) |

## Installation conditions

| | |
|---|---|
| Installation | For detailed information refer to *Installation* on page 22. |
| Inlet run | Minimal 10 DN (straight inlet) |
| Outlet run | Minimal 3 DN (straight outlet) |
| Dimensions and weights | For detailed information refer to *Dimensions and weights* on page 19. |

## Materials

| | |
|---|---|
| **Measuring sensor** | |
| Flanges (wetted) | DN25...65 / 1...2½": stainless steel 1.4401 / 1.4404 - AISI 316/316L |
| | DN80...2000 / 3...80": carbon steel A105N |
| | Option: stainless steel 1.4401 / 1.4404 - AISI 316/316L |
| | Other materials on request. |
| Measuring tube (wetted) | DN25...65 / 1...2½": stainless steel 1.4401 / 1.4404 - AISI 316/316L |
| | DN80...2000 / 3...80": carbon steel A106 gr B or equivalent |
| | Option: stainless steel 1.4404 / AISI 316L |
| Measuring sensor housing | DN25...300 / 1"...12": carbon steel |
| | Option: stainless steel 1.4404 / AISI 316L |
| Transducer | |
| Transducers (wetted) | Stainless steel 1.4404 / AISI 316L |
| Transducer holders incl. caps | DN350...2000 / 14"...80"; stainless steel 1.4404 / AISI 316L |
| Tube transducer cabling | Stainless steel 1.4404 / AISI 316L |
| Connection box and connection box support (remote version only) | Standard: die-cast aluminium; standard coated |
| | Option: stainless steel 316 / 1.4408 |
| Coating (flow sensor) | Standard coating |
| **Signal converter** | |
| Housing | Versions C and F: die-cast aluminium |
| | Option: stainless steel 316 / 1.4408 |
| Coating | Standard coating |

## Electrical connections

| | |
|---|---|
| Description of used abbreviations; Q = xxx; $I_{max}$ = maximum current; $V_{in}$ = xxx; $V_{int}$ = internal voltage; $V_{ext}$ = external voltage; $V_{int, max}$ = maximal internal voltage | |
| General | Electrical connection is carried out in conformity with the VDE 0100 directive "Regulations for electrical power installations with line voltages up to 1000 V" or equivalent national specifications. |
| Power supply | Standard: 100...230 VAC (-15% / +10%), 50/60 Hz |
| Power consumption | AC: 22 VA |
| Signal cable (remote version only) | MR06 (shielded cable with 6 coax cores): Ø 10.6 mm / 0.4" |
| | 5 m / 16 ft |
| | Option: 10...30 m / 33...98 ft |
| Cable entries | Standard: M20 x 1.5 (8...12 mm) |
| | Option: ½" NPT, PF ½ |

## Inputs and outputs

| | | | |
|---|---|---|---|
| General | All outputs are electrically isolated from each other and from all other circuits. | | |
| | All operating data and output values can be adjusted. | | |
| Description of used abbreviations | $V_{ext}$ = external voltage; $R_L$ = load + resistance;<br>$V_0$ = terminal voltage; $I_{nom}$ = nominal current<br>Safety limit values (Ex i):<br>$V_i$ = max. input voltage; $I_i$ = max. input current; $P_i$ = max. input power rating;<br>$C_i$ = max. input capacity; $L_i$ = max. input inductivity | | |
| **Current output** | | | |
| Output data | Measurement of volume flow, mass flow, flow speed, velocity of sound, gain, SNR, diagnostics (flow speed, VoS, SNR, gain), NAMUR NE107, HART® communication. | | |
| Temperature coefficient | Typically ± 30 ppm/K | | |
| Settings | **Without HART®** | | |
| | Q = 0%: 0...20 mA; Q = 100%: 10...20 mA | | |
| | Error identification: 3...22 mA | | |
| | **With HART®** | | |
| | Q = 0%: 4...20 mA; Q = 100%: 10...20 mA | | |
| | Error identification: 3...22 mA | | |
| | Q = 100%: 10...20 mA | | |
| | Error identification: 3...22 mA | | |
| Operating data | **Basic I/Os** | **Modular I/Os** | |
| Active | $V_{int, nom}$ = 24 VDC<br>I ≤ 22 mA<br>$R_L$ ≤ 1 kΩ | | |
| Passive | $V_{ext}$ ≤ 32 VDC<br>I ≤ 22 mA<br>$V_0$ ≥ 1.8 V<br>$R_{L, max} = (V_{ext} - V_0 / I_{max}$ | | |

| HART® | | | |
|---|---|---|---|
| Description | HART® protocol via active and passive current output | | |
| | HART® version: V7 | | |
| | Universal HART® parameter: completely integrated | | |
| Load | ≥ 250 Ω at HART® test point:<br>Note maximum load for current output! | | |
| Multidrop | Yes, current output = 10% e.g. 4 mA | | |
| | Multidrop addresses adjustable in operation menu 0...63 | | |
| Device drivers | DD for FC 375/475, AMS, PDM, DTM for FDT | | |
| **Pulse or frequency output** | | | |
| Output data | Volume flow, mass flow | | |
| Function | Pulse / frequency output is fixed and set in factory according order. | | |
| Pulse rate/frequency | 0.01...10000 pulses/s or Hz | | |
| Settings | For Q = 100%: 0.01...10000 pulses per second or pulses per unit volume | | |
| | Pulse width: adjustable as automatic, symmetric or fixed (0.05...2000 ms) | | |
| Operating data | Basic I/Os | Modular I/Os | |
| Active | - | $V_{nom}$ = 24 VDC | |
| | | $f_{max}$ in operating menu set to:<br>$f_{max}$ **≤ 100 Hz:**<br><br>I ≤ 20 mA<br><br>$R_{L, max}$ = 47 kΩ<br><br>open:<br>I ≤ 0.05 mA<br>closed:<br>$V_{0,nom}$ = 24 V at I = 20 mA | |
| | | $f_{max}$ in operating menu set to:<br>100 Hz < $f_{max}$ ≤ 10 kHz:<br><br>I ≤ 20 mA<br><br>$R_L$ ≤ 10 kΩ for f ≤ 1 kHz<br>$R_L$ ≤ 1 kΩ for f ≤ 10 kHz<br><br>open:<br>I ≤ 0.05 mA<br>closed:<br>$V_{0,nom}$ = 22.5 V at I = 1 mA<br>$V_{0,nom}$ = 21.5 V at I = 10 mA<br>$V_{0,nom}$ = 19 V at I = 20 mA | |

| | | | |
|---|---|---|---|
| Passive | $V_{ext}$ ≤ 32 VDC | | - |
| | $f_{max}$ in operating menu set to:<br>$f_{max}$ ≤ 100 Hz:<br><br>I ≤ 100 mA<br><br>$R_{L, max}$ = 47 kΩ<br>$R_{L, max} = (V_{ext} - V_0) / I_{max}$<br><br>open:<br>I ≤ 0.05 mA at $V_{ext}$ = 32 VDC<br>closed:<br>$V_{0, max}$ = 0.2 V at I ≤ 10 mA<br>$V_{0, max}$ = 2 V at I ≤ 100 mA | | |
| | $f_{max}$ in operating menu set to:<br>100 Hz < $f_{max}$ ≤ 10 kHz:<br><br>I ≤ 20 mA<br><br>$R_L$ ≤ 10 kΩ for f ≤ 1 kHz<br>$R_L$ ≤ 1 kΩ for f ≤ 10 kHz<br>$R_{L, max} = (V_{ext} - V_0) / I_{max}$<br><br>open:<br>I ≤ 0.05 mA at $V_{ext}$ = 32 VDC<br>closed:<br>$V_{0, max}$ = 1.5 V at I ≤ 1mA<br>$V_{0, max}$ = 2.5 V at I ≤ 10 mA<br>$V_{0, max}$ = 5.0 V at I ≤ 20 mA | | |
| NAMUR | - | Passive to<br>EN 60947-5-6<br><br>open:<br>$I_{nom}$ = 0.6 mA<br>closed:<br>$I_{nom}$ = 3.8 mA | |

| Status output / limit switch | | | |
|---|---|---|---|
| Function and settings | Adjustable as automatic measuring range conversion, display of flow direction, overflow, error, switching point | | |
| | Valve control with activated dosing function | | |
| Operating data | Basic I/Os | Modular I/Os | |
| Active | - | $V_{int}$ = 24 VDC<br><br>I ≤ 20 mA<br><br>$R_{L, max}$ = 47 kΩ<br><br>open:<br>I ≤ 0.05 mA<br>closed:<br>$V_{0, nom}$ = 24 V at<br>I = 20 mA | |
| Passive | $V_{ext}$ ≤ 32 VDC<br><br>I ≤ 100 mA<br><br>$R_{L, max}$ = 47 kΩ<br>$R_{L, max}$ =<br>$(V_{ext} - V_0) / I_{max}$<br><br>open:<br>I ≤ 0.05 mA at<br>$V_{ext}$ = 32 VDC<br>closed:<br>$V_{0, max}$ = 0.2 V at<br>I ≤ 10 mA<br>$V_{0, max}$ = 2 V at<br>I ≤ 100 mA | $V_{ext}$ = 32 VDC<br><br>I ≤ 100 mA<br><br>$R_{L, max}$ = 47 kΩ<br>$R_{L, max}$ =<br>$(V_{ext} - V_0) / I_{max}$<br><br>open:<br>I ≤ 0.05 mA at<br>$V_{ext}$ = 32 VDC<br>closed:<br>$V_{0, max}$ = 0.2 V at<br>I ≤ 10 mA<br>$V_{0, max}$ = 2 V at<br>I ≤ 100 mA | |
| NAMUR | - | Passive to<br>EN 60947-5-6<br><br>open:<br>$I_{nom}$ = 0.6 mA<br>closed:<br>$I_{nom}$ = 3.8 mA | |

| Control input | | | |
|---|---|---|---|
| Function | Hold value of the outputs (e.g. for cleaning work), set value of the outputs to "zero", counter and error reset, stop counter, range conversion, zero calibration | | |
| | Start of dosing when dosing function is activated. | | |
| Operating data | Basic I/Os | Modular I/Os | |
| Active | - | $V_{int}$ = 24 VDC<br><br>Terminals open:<br>$V_{0, nom}$ = 22 V<br><br>Terminals bridged:<br>$I_{nom}$ = 4 mA<br><br>On:<br>$V_0 \geq$ 12 V with<br>$I_{nom}$ = 1.9 mA<br><br>Off:<br>$V_0 \leq$ 10 V with<br>$I_{nom}$ = 1.9 mA | |
| Passive | $V_{ext} \leq$ 32 VDC<br><br>$I_{max}$ = 6.5 mA at<br>$V_{ext} \leq$ 24 VDC<br><br>$I_{max}$ = 8.2 mA at<br>$V_{ext} \leq$ 32 VDC<br><br>Contact closed (On):<br>$V_0 \geq$ 8 V with<br>$I_{nom}$ = 2.8 mA<br><br>Contact open (Off):<br>$V_0 \leq$ 2.5 V with<br>$I_{nom}$ = 0.4 mA | $V_{ext} \leq$ 32 VDC<br><br>$I_{max}$ = 9.5 mA at<br>$V_{ext} \leq$ 24 V<br><br>$I_{max}$ = 9.5 mA at<br>$V_{ext} \leq$ 32 V<br><br>Contact closed (On):<br>$V_0 \geq$ 3 V with<br>$I_{nom}$ = 1.9 mA<br><br>Contact open (Off):<br>$V_0 \leq$ 2.5 V with<br>$I_{nom}$ = 1.9 mA | |
| NAMUR | - | Active to<br>EN 60947-5-6<br><br>Contact open:<br>$V_{0, nom}$ = 8.7 V<br><br>Contact closed (On):<br>$I_{nom}$ = 7.8 mA<br><br>Contact open (off):<br>$V_{0, nom}$ = 6.3 V with<br>$I_{nom}$ = 1.9 mA<br><br>Identification for open terminals:<br>$V_0 \geq$ 8.1 V with<br>$I \leq$ 0.1 mA<br><br>Identification for short circuited terminals:<br>$V_0 \leq$ 1.2 V with<br>$I \geq$ 6.7 mA | |

## Approvals and certificates

| | |
|---|---|
| **CE** | |
| This device fulfils the statutory requirements of the relevant directives. The manufacturer certifies successful testing of the product by applying the conformity mark on the device. | |
| | For more information on the directives, standards and the approved certifications, please refer to the declaration of conformity supplied with the device or downloadable from the manufacturer's website. |
| NAMUR | NE 21, 43, 53, 80, 107 |
| MID directive | Directive 2014/32/EU, Annex VI (MI-004) and UK Measuring Instrument Regulations 2016/No. 1153<br>For more information, please refer to the dedicated documentation. |
| **Other approvals and standards** | |
| Non-Ex | Standard |
| **Hazardous areas** | |
| Ex zone 1 - 2 | For detailed information, please refer to the relevant Ex documentation. |
| | According to European directive 2014/34/EU (ATEX 114) and UK Equipement and Protective systems intended for use in Potentially Explosive Atmospheres Regulations 2016/No. 1107 |
| IECEx | Approval number: IECEx KIWA15.0033 X |
| ATEX | Approval number: KIWA 15ATEX0007 X |
| UKCA | Approval number: CSAE 22UKEX1058X |
| Protection category acc. to IEC 60529 | **Signal converter** |
| | Compact (C): IP66/67, NEMA 4X/6 |
| | Field (F): IP66/67, NEMA 4X/6 |
| | **Flow sensors** |
| | IP66/67, NEMA 4X/6 |
| Shock resistance | IEC 60068-2-27 |
| | 30 g for 18 ms |
| Vibration resistance | IEC 60068-2-6; 1 g up to 2000 Hz |
| | IEC 60721; 10 g |

## 2.2 MID/MIR Annex MI-004

All liquid flow meters for heated water e.g. thermal energy measurement, that are to be used for legal purposes in Europe, require certification under the Measurement Instrument Directive (MID) 2014/32/EU and UK Measuring Instrument Regulations (MIR) 2016/No.1153.

Annex VI (MI-004) of the MID applies to these liquid flow meters intended for the measurement of volume of heated water in residential, commercial, and industrial use. An EC-type examination certificate is valid in all countries of the European Union (UKCA certificate is valid in the UK).

The OPTISONIC 3400 has an EC type examination certificate and can be verified to the MID Annex VI (MI-004) for liquid flow meters with diameter DN25...DN2000 / 1"...80". The conformity assessment procedure followed for OPTISONIC 3400 is Module B (Type Examination) and Module D (Quality Assurance of the Production Process).

For accuracy class 1, 2 and 3:
The flow range, $Q_i$ and $Q_p$ must be defined as follows;

Ratio of $Q_p / Q_i \geq 10$

Minimum flow rate: $Q_p \geq 0.1 \times Q_p$ (max)

$Q_s$ = flow range

$Q_p$ = maximum flow

$Q_i$ = minimum flow

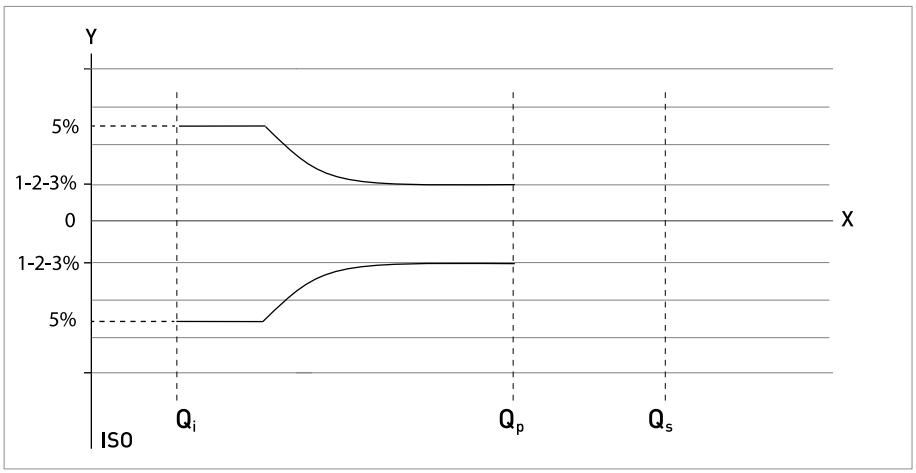



**Figure 2-1: ISO flow rates added to figure as comparison towards MID**
**X:** Flow rate
**Y [%]:** Maximum measuring error

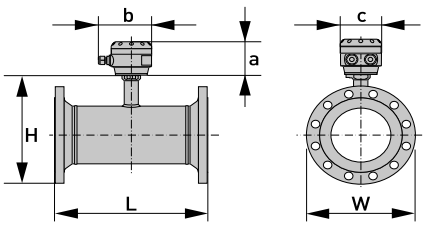
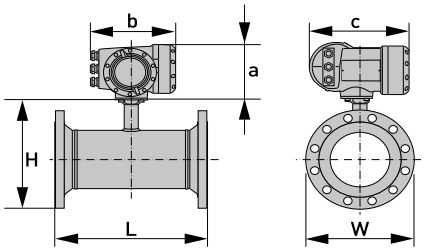
## MI-004 certified flow characteristics; valid for accuracy classes 1, 2 & 3

| DN Size | Maximum pressure rating | Overall length [mm] | | Flow rate [$m^3/h$] | | |
|---|---|---|---|---|---|---|
| | | Min. | Max. | $Q_s$ | $Q_p$ | $Q_i$ |
| 25 | PN 40 | 250 | 400 | 18 (27) | 18 | 0.18 |
| 32 | PN 40 | 260 | 400 | 29 (44) | 29 | 0.29 |
| 40 | PN 40 | 270 | 400 | 45 (68) | 45 | 0.45 |
| 50 | PN 40 | 300 | 475 | 71 (106) | 71 | 0.71 |
| 65 | PN 40 | 300 | 475 | 180 | 120 | 1.2 |
| 80 | PN 40 | 300 | 400 | 180 (270) | 180 | 1.8 |
| 100 | PN 40 * | 350 | 400 | 280 (430) | 280 | 2.8 |
| 125 | PN 40 * | 350 | 400 | 500 | 440 | 4.4 |
| 150 | PN 40 * | 350 | 400 | 630 | 630 | 6.3 |
| 200 | PN 40 * | 400 | 500 | 1130 | 1130 | 11.3 |
| 250 | PN 40 * | 400 | 600 | 1750 | 1750 | 17.5 |
| 300 | PN 40 * | 500 | 600 | 2500 | 2500 | 25.0 |
| 350 | PN 40 * | 500 | 880 | 3400 | 3400 | 34.0 |
| 400 | PN 40 * | 600 | 975 | 4500 | 4500 | 45.0 |
| 450 | PN 40 * | 600 | 1000 | 5750 | 5750 | 57.5 |
| 500 | PN 40 * | 600 | 1080 | 7000 | 7000 | 70.0 |
| 600 | PN 40 * | 600 | 1165 | 10000 | 10000 | 100 |
| 700 | PN 40 * | 800 | 1240 | 14000 | 14000 | 140 |
| 800 | PN 40 * | 800 | 1240 | 18000 | 18000 | 180 |
| 900 | PN 40 * | 900 | 1370 | 23000 | 23000 | 230 |
| 1000 | PN 40 * | 1000 | 1370 | 28000 | 28000 | 280 |
| 1200 | PN 40 * | 1200 | 1600 | 40000 | 40000 | 400 |
| 1400 | PN 40 * | 1400 | 1800 | 55000 | 55000 | 550 |
| 1600 | PN 40 * | 1600 | 2000 | 70000 | 70000 | 700 |
| 1800 | PN 40 * | 1600 | 2100 | 90000 | 90000 | 900 |
| 2000 | PN 40 * | 1800 | 2100 | 113000 | 113000 | 1130 |

* maximum pressure 40 bar- 580 psi at 20°C - 68°F / 32 bar - 460 psi at 180°C - 356°F

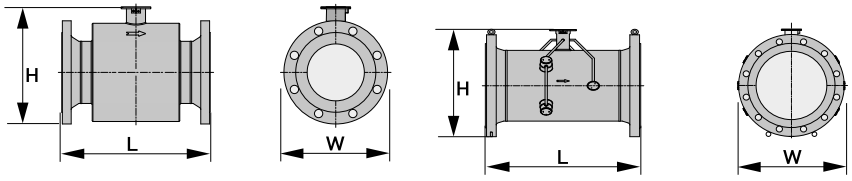
Between brackets ( ) ; $Q_s$ value only valid for accuracy classes 2 & 3

## 2.3 Dimensions and weights

| | | |
|---|---|---|
| **Remote version** |  | a = 88 mm / 3.5"<br>b = 139 mm / 5.5" ①<br>c = 106 mm / 4.2"<br>Total height = H + a ② |
| **Compact version** |  | a = 155 mm / 6.1"<br>b = 230 mm / 9.1" ①<br>c = 260 mm / 10.2"<br>Total height = H + a ② |

① The value may vary depending on the used cable glands.
② The value depends on version

### 2.3.1 Standard flow sensor




The following dimensions are applicable for the OPTISONIC 3400 in compact and remote versions.

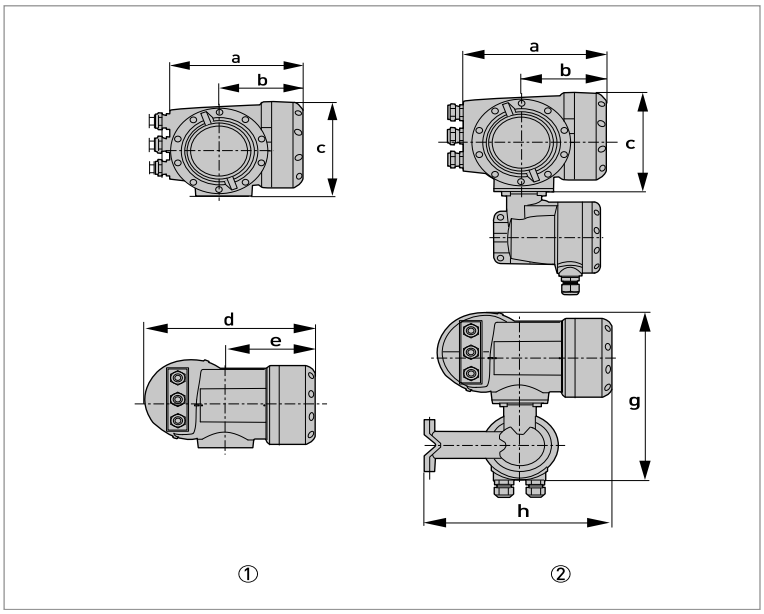
#### EN1092-1; Standard variant - PN 40

| Nominal size | Dimensions [mm], CS = carbon steel / SS = stainless steel / Di = inner diameter | | | | | Approx. weight [kg] | |
|---|---|---|---|---|---|---|---|
| DN | L | H | W | Di CS | Di SS | CS | SS |
| 25 | 250 | 155 | 115 | 27 | 27 | 8 | 8 |
| 32 | 260 | 156 | 140 | 35 | 35 | 9 | 10 |
| 40 | 270 | 173 | 150 | 39 | 41 | 11 | 14 |
| 50 | 300 | 193 | 165 | 53 | 53 | 14 | 17 |
| 65 | 300 | 203 | 185 | 63 | 63 | 18 | 19 |
| 80 | 300 | 238 | 200 | 78 | 81 | 17 | 18 |
| 100 | 350 | 268 | 235 | 102 | 104 | 24 | 24 |
| 125 | 350 | 297 | 270 | 127 | 130 | 30 | 29 |
| 150 | 400 | 326 | 300 | 154 | 158 | 37 | 37 |
| 200 | 400 | 427 | 375 | 207 | 207 | 63 | 63 |
| 250 | 500 | 492 | 450 | 260 | 260 | 100 | 100 |
| 300 | 500 | 547 | 515 | 308 | 308 | 140 | 140 |

*Other pressure classes like PN 25, PN 16, PN 10 or ASME 150, 300 lb are also MI-004 certified. Dimensions and weights are available on request.*

*Mounting length of larger diameters; on request.*

## 2.3.2 Signal converter housing




① Compact housing (C)
② Field housing (F)

### Dimensions and weights in mm and kg

| Version | Dimensions [mm] | | | | | | | Weight [kg] |
|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | g | h | |
| C | 202 | 120 | 155 | 260 | 137 | - | - | 4.2 |
| F | 202 | 120 | 155 | - | - | 295.8 | 277 | 5.7 |

### Dimensions and weights in inch and lb

| Version | Dimensions [inch] | | | | | | | Weight [lb] |
|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | g | h | |
| C | 7.75 | 4.75 | 6.10 | 10.20 | 5.40 | - | - | 9.30 |
| F | 7.75 | 4.75 | 6.10 | - | - | 11.60 | 10.90 | 12.60 |

## 3.1 Intended use

*Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.*

*The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.*

The OPTISONIC 3400 MI-004 is designed exclusively for bi-directional measurements on conductive and / or non-conductive fluids. Contaminations, like entrained gas, particles, 2 phase and non-homogeneous mixtures, can affect the acoustic signal and must be avoided.

The overall functionality of the OPTISONIC 3400 MI-004 flowmeter is the continuous measurement of actual volume flow, mass flow, flow speed, the velocity of sound, gain, SNR, totalized flow mass and diagnosis values.

## 3.2 General notes on installation

*Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.*

*Do a check of the packing list to make sure that you have all the elements given in the order.*

*Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.*

## 3.3 Vibration

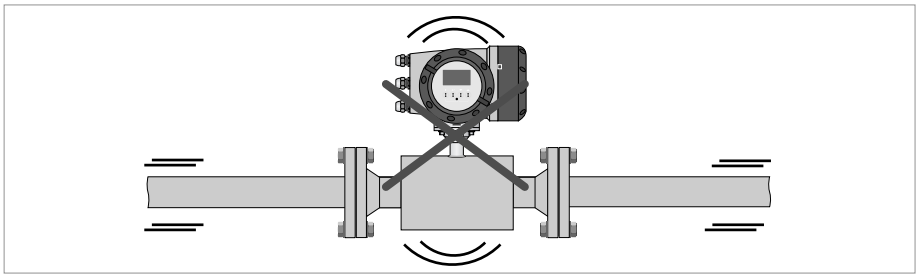


Figure 3-1: Avoid vibrations

*In case of expected vibrations, please install a remote signal converter (field version).*

## 3.4 Installation requirements signal converter

- Allow 10...20 cm / 3.9...7.9" of space at the sides and rear of the signal converter to permit free air circulation.
- Protect signal converter against direct solar radiation, install a sun shield if necessary.
- Signal converters installed in switchgear cabinets require adequate cooling, e.g. by fan or heat exchanger.
- Do not expose the signal converter to intense vibrations and mechanical shocks. The measuring devices are tested for a vibration/shock level as described in the chapter "Technical data".

## 3.5 Installation conditions

### 3.5.1 Inlet and outlet

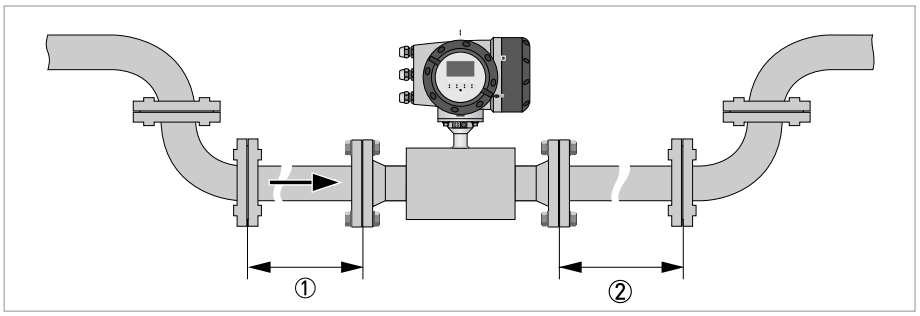



**Figure 3-2: Recommended inlet and outlet**

① Refer to chapter "Bends in 2 or 3 dimensions"
② ≥ 3 DN

### 3.5.2 Bends in 2 or 3 dimensions

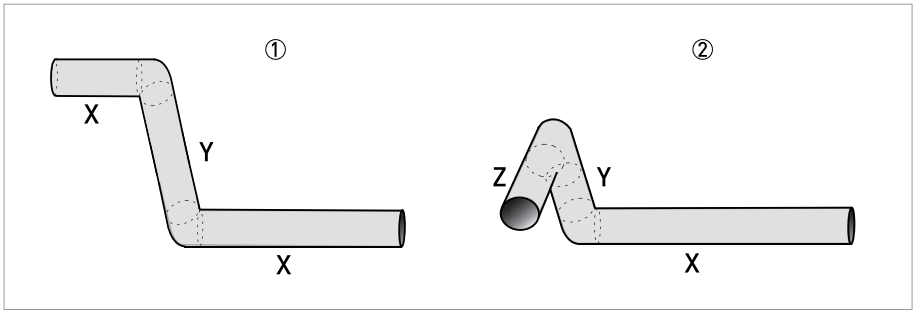



**Figure 3-3: 2 and/or 3 dimensional bends upstream of the flowmeter**

① 2 dimensions = X/Y
② 3 dimensions = X/Y/Z
Inlet length: using bends in 2 dimensions: ≥ 10 DN; when having bends in 3 dimensions: ≥ 15 DN

*2 dimensional bends occur in a vertical **or** horizontal plane (X/Y) only, while 3 dimensional bends occur in both vertical **and** horizontal plane (X/Y/Z).*

### 3.5.3 T-section

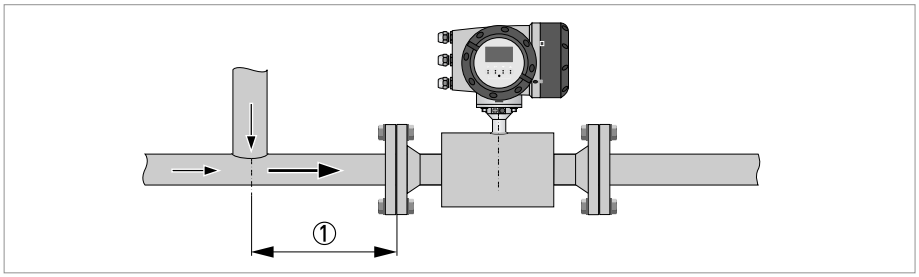



**Figure 3-4: Distance behind a T-section**

① ≥ 10 DN

### 3.5.4 Bends

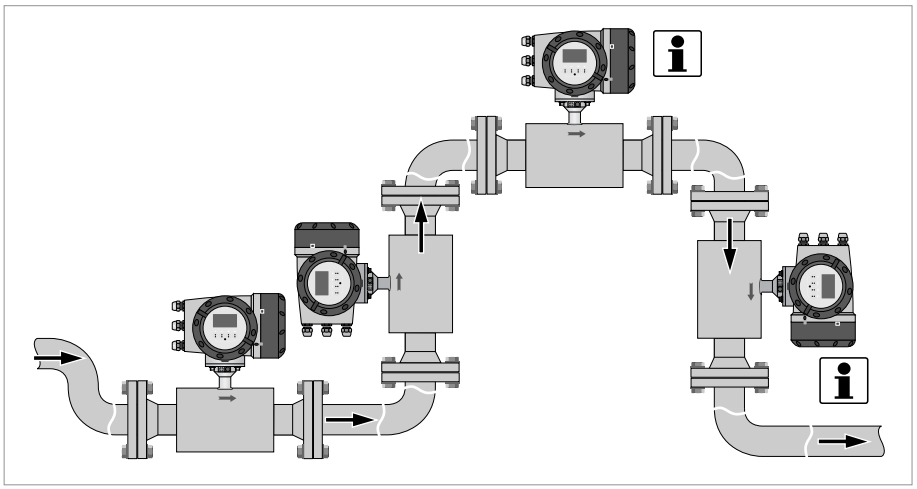


Figure 3-5: Installation in bending pipes (90°)

*NOTE!*
*Recommended installation positions are at a lowered or ascending section of the pipeline installation. Installation at the highest point will enlarge the risk of flowmeter malfunction, because of air/gas bubbles.*
*Vertical installation in combination with an open discharge has to be avoided.*
*Vertical installation with a controlled back-pressure is possible.*

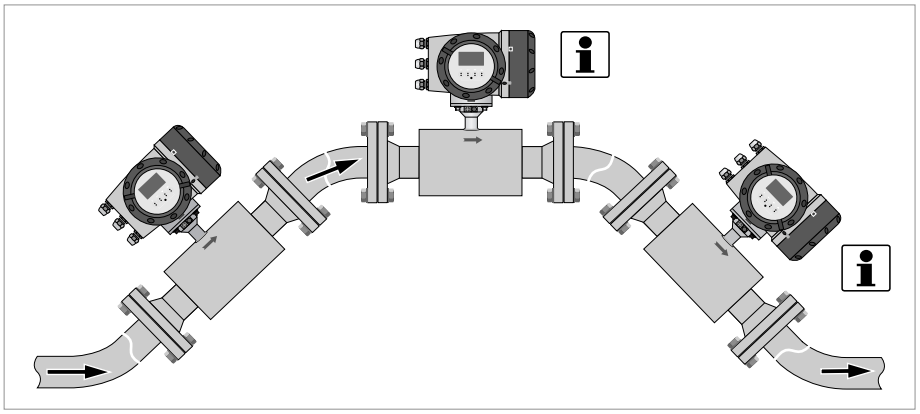


Figure 3-6: Installation in bending pipes (45°)

*NOTE!*
*Vertical installation on a descending slope in the pipeline is only recommended when the back-pressure is controlled.*

## 3.5.5 Control valve

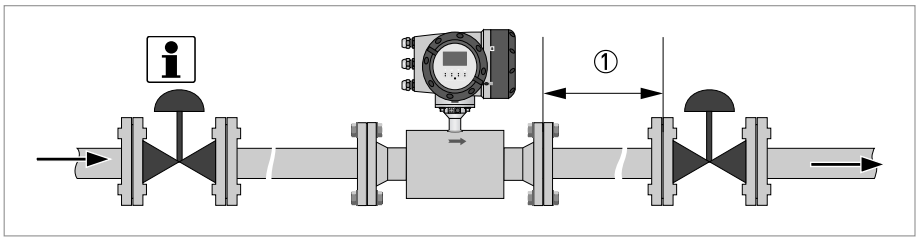



Figure 3-7: Installation in front of a control valve

① ≥ 3 DN

*NOTE!*
*Recommended position to install a flowmeter is upstream a control valve.*
*An ultrasonic flowmeter can be installed downstream of the control valve if there is no cavitation in the pipeline system (e.g. flow profile disturbances are resolved).*

## 3.5.6 Position of pump

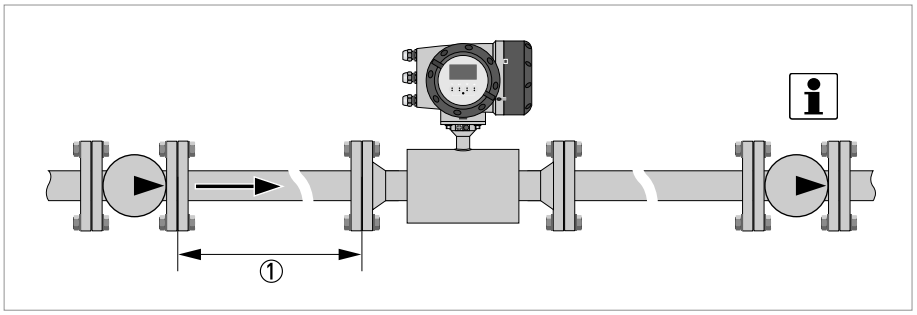



Figure 3-8: Installation behind a pump

① ≥ 15 DN

*NOTE!*
*Recommended position to install a flowmeter is downstream a pump (on a position where the flow disturbances of the pump are resolved).*
*An ultrasonic flowmeter can be installed in the suction line of a pump if there is no cavitation in the pipeline system.*

### 3.5.7 Open feed or discharge

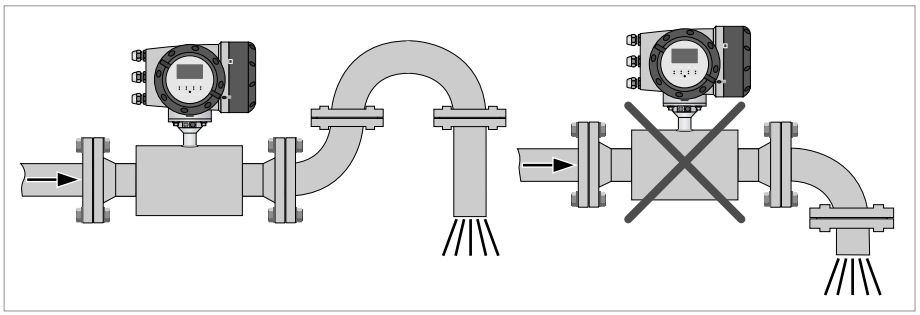


Figure 3-9: Open discharge

*Install the flowmeter on a lowered section of the pipe to ensure a full pipe condition through the meter.*

### 3.5.8 Insulation

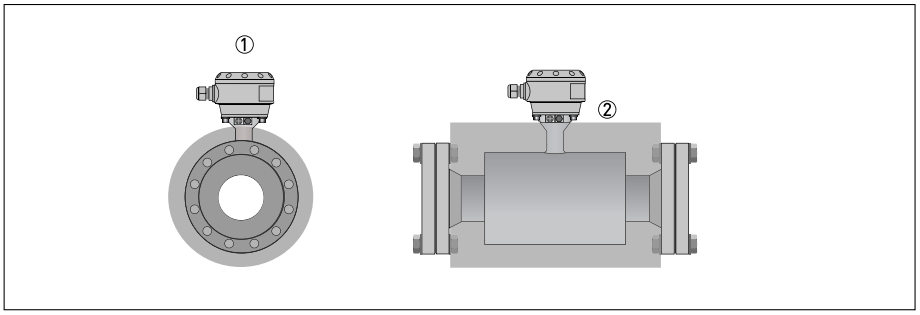



Figure 3-10: Insulation

① Connection box or compact converter
② Insulation area

*The flow sensor can be insulated completely, except for the connection box (or the signal converter on the compact version).*

For devices used in hazardous area, additional maximum temperature and insulation precautions apply. Please refer to the Ex documentation!

## 3.5.9 Flange deviation

*Max. permissible misalignment of pipe flange faces: $M_{max}$ 0.5 degree, according ASME B16.5 Individual flanges. See Appendix 12 ; Flange face alignment of the General Piping Requirements DEP 31.38.01.11-GEN*

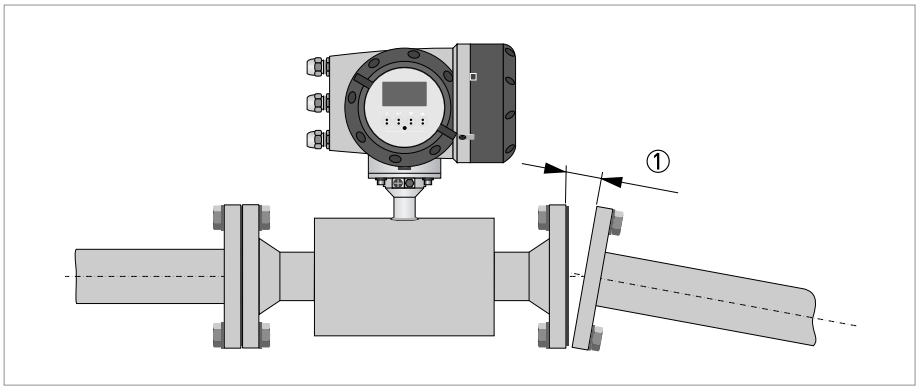



Figure 3-11: Flange deviation

① $M_{max}$

## 3.5.10 Mounting position

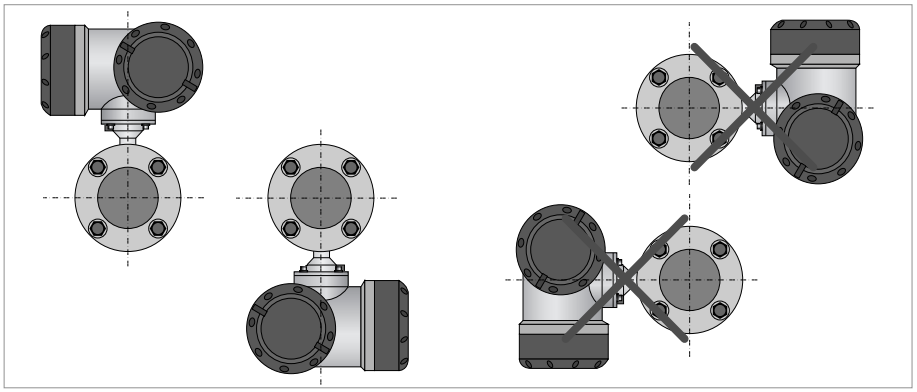


Figure 3-12: Installation position on horizontal pipe sections

## 4.1 Safety instructions

*All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!*

*Observe the national regulations for electrical installations!*

*For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.*

*Observe without fail the local occupational health and safety regulations.*
*Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.*

*Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.*

## 4.2 Signal cable (remote versions only)

The flow sensor is connected to the signal converter via one signal cable, with 6 (labelled) inner coax cables for the connection of maximal three acoustic paths.

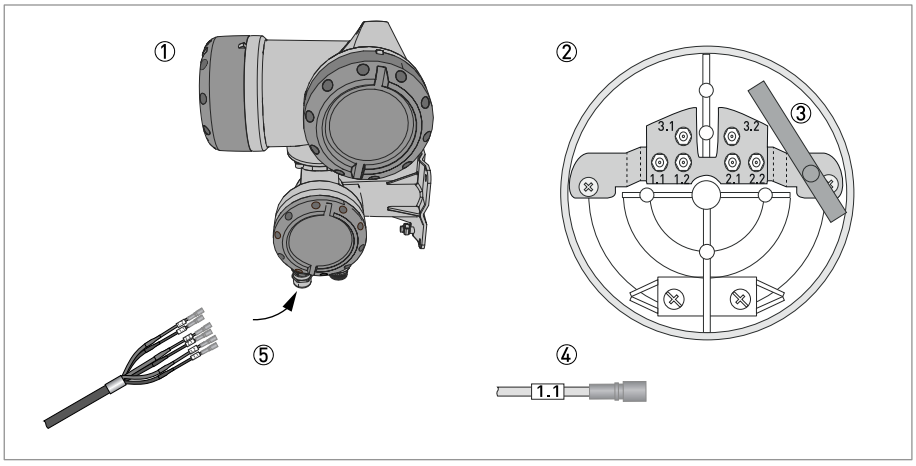



Figure 4-1: Construction of field version

① Signal converter
② Open connection box
③ Tool for releasing connectors
④ Marking on cable
⑤ Insert cable(s) into terminal compartment

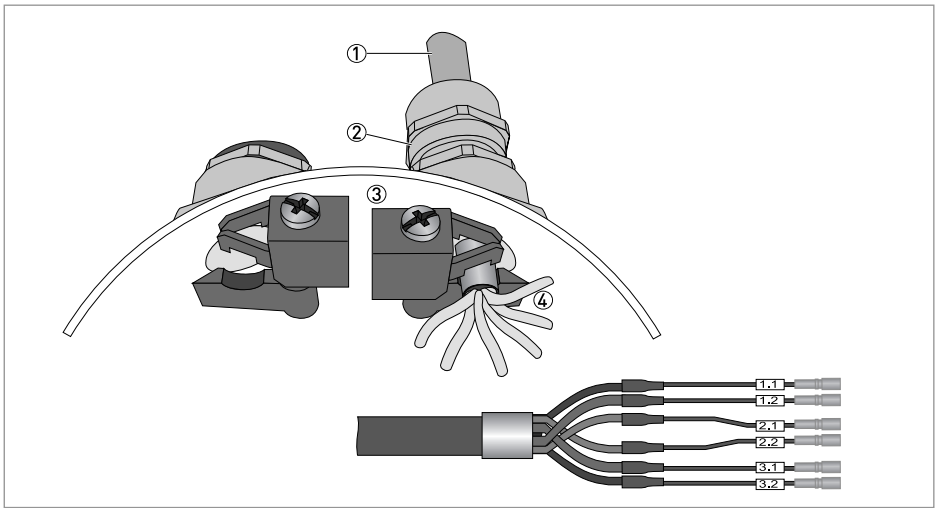



Figure 4-2: Clamp the cables on the shielding bush

① Cables
② Cable glands
③ Grounding clamps
④ Cable with metal shielding bush

## Electrical connection - Standard version

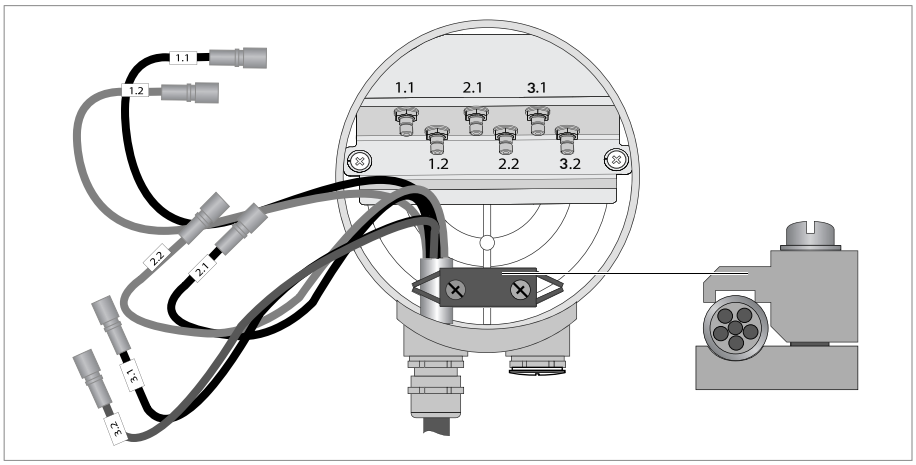



Figure 4-3: Connect the cables in the connection box of the flow sensor.

*Connect the cable on connector with similar numeral marking.*

## 4.3 Power supply

*If this device is intended for permanent connection to the mains, it is required (for example for service) to mount an external switch or circuit breaker near the device for disconnection from the mains. It shall be easily reachable by the operator and marked as the disconnecting device for this equipment.*
*The switch or circuit breaker and wiring has to be suitable for the application and shall also be in accordance with the local (safety) requirements of the (building) installation (e.g. IEC 60947-1 / -3).*

*For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.*

*The power terminals in the terminal compartments are equipped with additional hinged lids to prevent accidental contact.*

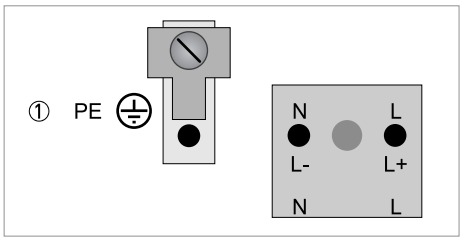



Figure 4-4: Power supply connection

① 100...230 VAC (-15% / +10%), 22 VA

*The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.*

### 100...230 VAC (tolerance range: -15% / +10%)

- Note the power supply voltage and frequency (50...60 Hz) on the nameplate.
- The protective ground terminal PE of the power supply must be connected to the separate U-clamp terminal in the terminal compartment of the signal converter.

*240 VAC+5% is included in the tolerance range.*

## 4.4 Input and outputs, overview

### 4.4.1 Combinations of the inputs/outputs (I/Os)

This signal converter is available in Basic version with fixed outputs or as a Modular I/O with a flexible I/O configuration and communication within the available options.

#### Basic version

- Has 1 current output with HART 7, 1 pulse output and 2 status outputs / limit switches.
- The pulse output can be set as status output/limit switch and one of the status outputs as a control input.

#### Modular version

- Depending on the task, the device can be configured with various output modules .

#### Ex option

- For hazardous areas, all of the input/output variants for compact and field housings with terminal compartment in the Ex d (pressure-resistant casing) or Ex e (increased safety) versions can be delivered.
- Please refer to the separate instructions for connection and operation of the Ex-devices.

## 4.4.2 Description of the CG-number

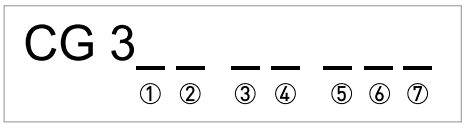



**Figure 4-5: Marking (CG number) of the electronics module and input/output variants**

① ID number: 5
② ID number: 0 = standard
③ Power supply option
④ Display (language versions)
⑤ Input/output version (I/O)
⑥ 1st optional module for connection terminal A
⑦ 2nd optional module for connection terminal B

The last 3 digits of the CG number ( ⑤ , ⑥ and ⑦ ) indicate the assignment of the terminal connections.Please refer to the following examples.

### Examples for CG number-35021100

| | |
|---|---|
| CG 350 21 100 | 100...230 VAC & standard display; basic I/O: $I_a$ or $I_p$ & $S_p$/$C_p$ & $S_p$ & $P_p$/$S_p$ |

### Description of abbreviations and CG identifier for possible optional modules on terminals A and B

| Abbreviation | Identifier for CG No. | Description |
|---|---|---|
| $I_a$ | A | Active current output |
| $I_p$ | B | Passive current output |
| $P_a$ / $S_a$ | C | Active pulse output, frequency output, status output or limit switch (changeable) |
| $P_p$ / $S_p$ | E | Passive pulse output, frequency output, status output or limit switch (changeable) |
| $C_a$ | G | Active control input |
| $C_p$ | K | Passive control input |
| - | 8 | No additional module installed |
| - | 0 | No further module possible |

### 4.4.3 Fixed, non-alterable input/output versions

This signal converter is available with various input/output combinations.

- The gray boxes in the tables denote unassigned or unused connection terminals.
- In the table, only the final digits of the CG no. are depicted.
- Connection terminal A+ is only operable in the basic input/output version.

| CG-No. | Connection terminals | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | A+ | A | A- | B | B- | C | C- | D | D- |

**Basic in-/output (I/O) (Standard)**

| | | | | | |
|---|---|---|---|---|---|
| 1 0 0 | | $I_p$ + HART® passive ① | $S_p$ / $C_p$ passive ② | $S_p$ passive | $P_p$ / $S_p$ passive ② |
| | $I_a$ + HART® active ① | | | | |

① Function changed by reconnecting
② Changeable

### 4.4.4 Alterable input/output versions

This signal converter is available with various input/output combinations.

- The gray boxes in the tables denote unassigned or unused connection terminals.
- In the table, only the final digits of the CG no. are depicted.
- Term. = (connection) terminal

| CG no. | Connection terminals | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | A+ | A | A- | B | B- | C | C- | D | D- |

**Modular IOs (option)**

| | | | | |
|---|---|---|---|---|
| 4 _ _ | | max. 2 optional modules for term. A + B | $I_a$ + HART® active | $P_a$ / $S_a$ active ① |
| 8 _ _ | | max. 2 optional modules for term. A + B | $I_p$ + HART® passive | $P_a$ / $S_a$ active ① |

① changeable

Please fill in this form and fax or email it to your local representative. Please include a sketch of the pipe layout as well, including the X, Y, Z dimensions.

## 5.1 Device Configuration Form

### Customer information:

| |
|---|
| Date: |
| Submitted by: |
| Company: |
| Address: |
| Telephone: |
| Fax: |
| E-mail: |

### Flow application data:

| |
|---|
| Reference information (name, tag etc): |
| New application<br>Existing application, currently using: |
| Measurement objective: |
| **Medium** |
| Liquid: |
| Gas content: |
| Solids content: |
| Density: |
| Velocity of sound: |
| **Flowrate** |
| Normal: |
| Minimum: |
| Maximum: |
| **Temperature** |
| Normal: |
| Minimum: |
| Maximum: |
| **Pressure** |
| Normal: |
| Minimum: |
| Maximum: |

## Piping details

| |
|---|
| Nominal pipe size: |
| Inner / outer diameter: |
| Wall thickness / schedule: |
| Pipe material: |
| Straight inlet / outlet section (DN): |
| Upstream situation<br>(elbows, valves, pumps): |
| Flow orientation (vertical up / horizontal / vertical down / other): |

## Environment details

| |
|---|
| Corrosive atmosphere: |
| Sea water: |
| High humidity (% R.H.) |
| Nuclear (radiation): |
| Hazardous area: |
| Additional details: |

## Hardware requirements:

| |
|---|
| Accuracy requested<br>(percentage of rate): |
| Power supply (voltage, AC / DC): |
| Analog output (4-20 mA) |
| Pulse (specify minimum pulse width, pulse value): |
| Digital protocol: |
| Options: |
| Remote mounted signal converter: |
| Specify cable length: |
| Accessories: |

## KROHNE – Products, Solutions and Services

- Process instrumentation for flow, level, temperature, pressure measurement and process analytics
- Flow metering, monitoring, wireless and remote metering solutions
- Engineering, commissioning, calibration, maintenance and training services

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