OPTISONIC 3400 Technical Datasheet

Multi purpose, all-round, ultrasonic flowmeter for liquids

- Measurement of (non-) conductive, low and high viscous liquids, media temperature: -200°C to +250°C
- Accurate bi-directional measurement starting from a zero flow
- Advanced signal converter, with all I/O's and communication protocols

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1.1 Multipurpose, all-round ultrasonic flow meterin all process industries

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 **OPTISONIC 3400**. This flowmeter is able to measure:

- conductive and non-conductive liquids
- cryogenic and high process temperatures
- standard and straightforward applications and applications that require high performance
- non-viscous aqueous liquids and extreme viscous liquids
- low pressure ratings and extreme pressure ratings

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.

Available field buses are HART®7, Foundation Fieldbus, Profibus PA/DP and Modbus, all with NAMUR NE 107. These advanced diagnostic features makes process life comfortable, reliable and accurate over a long period of time.

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.

OPTICHECK technology built-in

OPTICHECK technology built-in

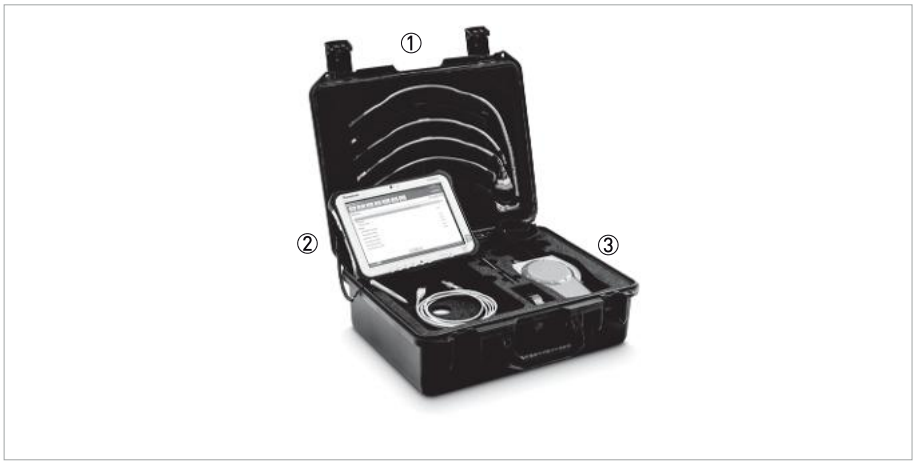
State-of-the-art measuring devices combine robust measuring principles and powerful electronics to produce a wide range of readings and device-specific data. OPTICHECK technology built-in leverages the features of the devices to translate their available comprehensive measuring system data into sophisticated diagnostics information for plant personnel. It goes beyond extensive device diagnostics, self-tests and on-site verification.

OPTICHECK tool for on-site verification

The OPTICHECK provides an inline health check of the device under test by an external tool.

A hard copy of the verification report can be printed for every flowmeter and verification data is digitally stored.

Contact us for more information or for an on-site service visit.



① Suitcase
② Tablet
③ OPTICHECK Master

Highlights

- Advanced signal converter with full range of I/O's and communication protocols
- Diagnostic functions according to NAMUR NE107
- Improved user interface: optical and push buttons
- 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
- Multi-purpose, all round, ultrasonic flowmeter for single phase liquids

Industries

- Chemicals
- Petrochemicals
- Oil & Gas
- Energy
- Water (utilities)

Applications

- Conductive and non-conductive liquids
- Cryogenic and high process temperature, low and extreme high pressure range
- Expanded applicability; for standard and high performance applications
- Measuring aqueous liquids as well as extreme viscous oils
- High turn down ratio; e.g. transportation pipeline measurements
- Broad pressure and temperature range (e.g. midstream oil measurements)
- Multiple products; e.g. allocation measurements in on/off loading
- Water utilities in all process industries; make-up water, boiler feed water, demineralised water

1.2 Variants

An **OPTISONIC 3400** flowmeter consists of an OPTISONIC 3000 flow sensor and an UFC 400 signal converter. The standard version is available as a compact and remote version. Next to standard, also variants for demanding applications can be supplied.

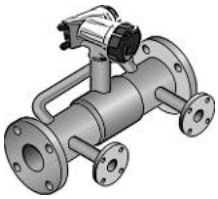
OPTISONIC 3000

Flow sensor variants for demanding applications

A full range of flow sensors to cover simple to difficult applications, such as:

- For extended process temperatures up to 250°C / 482°F (remote version)
- Cryogenic version: for extreme low process temperatures, as low as -200°C / -328°F (remote version, IP68)
- Flow sensor ≥ 14" and UFC 400 remote converter (aluminium or stainless steel housing)
- High viscous liquids: range from 100...1000 cSt

Variants available on request



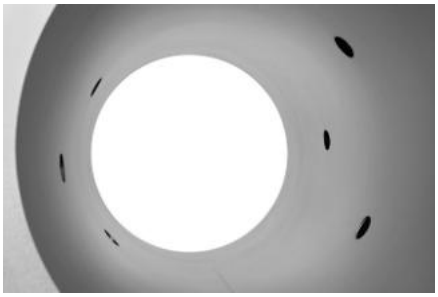
Including heating jacket

- for steam or thermal oil tracing of the flowmeter
- suitable for standard and variant for extended process temperatures (remote)

Flangeless, weld-in connections

- greenfield
- flexibility in inner pipe diameters

1.3 Features



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

UFC 400 signal converter - Compact and Remote(field)
- Display with 4 optical -or push buttons
- Many I/O configurations available
- Fieldbuses HART®7 (and HART registration)
- Optional Foundation Fieldbus, ITK6, Modbus /RS485, Profibus PA/DP (all included with NAMUR NE107 diagnostics)
- One universal software for all applications

Failure
Output signal invalid

Check function
Output signal (temporarily) invalid

Out of specification
Unreliability of output signal

Maintenance required
Output signal still valid

UFC 400 diagnostic capabilities: NE107
NE107 icons for status messages and error handling
- visible on UFC 400 display
- via all communication protocols
- Status messages are grouped by problem source
- User can change group or priority

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.

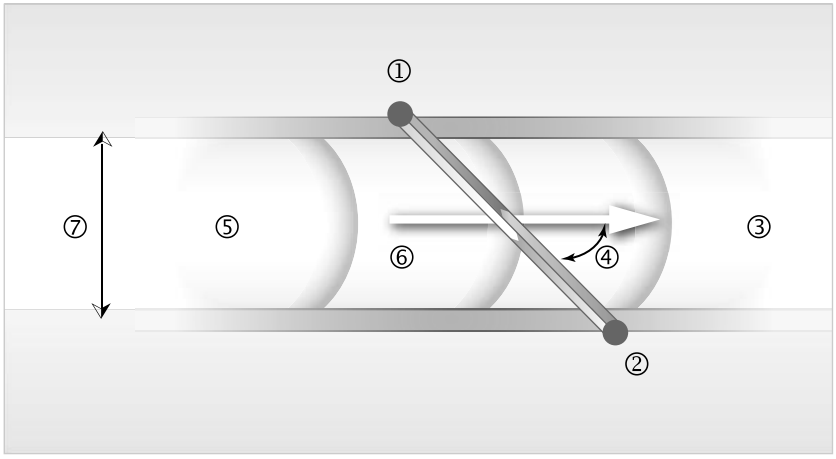


Figure 1-1: Measuring principle

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 (Download Center).*

Measuring system

Measuring principle	Ultrasonic transit time
Application range	Flow measurement of (non-) conductive fluids
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...3000 / 1...120"
Measurement range	0.3...20 m/s / 0.98...65 ft/s
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	2 (optional 3) 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.
Communication interfaces	Modbus RS485, HART® 7, Foundation Fieldbus ITK6, Profibus PA/DP Profile 3.02

Display and user interface	
Graphic display	LC display, backlit white
	Size: 128 x 64 pixels Corresponds to 59 x 31 mm = 2.32" x 1.22"
	Display turnable in 90° steps.
Operating elements	4 optical and push buttons for operator control of the signal converter without opening the housing.
	Option: Infrared interface (GDC)
Remote operation	PACTware™, including Device Type Manager (DTM)
	HART® handheld communicator (Emerson), AMS (Emerson), PDM (Siemens)
	All DTM's and drivers will be available at the internet homepage of the manufacturer.
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, HART® or via other bus interface
	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	
Standard	± 0.3% +2 mm/s of actual measured flow rate
Repeatability	± 0.2%
District heating	
Calibration / Verification	Refer for more information to the applicable documentation
	Standard
	3 Point calibration by a direct volume comparison
	Optional
	Verification to Measurement Instrument Directive /Regulations (EU-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 10 DN with a minimum of 1 meter/ 3.3 ft (straight inlet)
	Minimal straight outlet flow: 3 DN
	Forward and reverse (bi-directional) flow
	Orientation: horizontal, vertical
	Ratio: up to 100
	Maximum operating pressure: 40 bar- 580 psi at 20°C - 68°F / 32 bar - 460 psi at 180°C - 356°F
	for more details refer to *MID Annex MI-004* on page 22
Environmental class	Electromagnetic: E2
	Mechanical: M1

Operating conditions

Temperature	
Process temperature	**Compact version:** -45...+140°C / -49...+284°F max. ambient temperature of +50°C / +122°F
	Remote version: -45...+180°C / -49...+356°F
	Extended temperature version: -45...+250°C / -49...+482°F (only remote version
	Cryogenic version: -200...+180°C / -328...+356°F (only remote version, IP68, complete stainless steel)
	Carbon steel flanges; minimal process temperatures acc. to EN1092: -10°C / +14°F; ASME: -29°C / -20°F
Ambient temperature	Depending on the version and combination of outputs.
	Standard (die-cast aluminum converter housing): -40...+65°C / -40...+149°F
	Option (die-cast stainless steel converter housing): -40...+60°C / -40...+140°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, PN 25, PN 40
	DN200...1000: PN 10, PN 16, PN 25, PN 40
	DN1200...3000: PN 6, PN 10, PN 16, PN 25, PN 40
	Higher pressure ratings on request.
ASME B16.5	1...24": 150 lb RF
	1...24": 300 lb RF
	1...24": 600 lb RF
	1...24": 900 lb RF
	Larger diameters on request.
JIS	DN25...40: 20K
	DN50...300: 10K
Properties of medium	
Physical condition	Liquid, single phase (well mixed, rather clean)
Permissible gas content	≤ 2% (volume)
Permissible solid content	≤ 5% (volume)
Viscosity	**Standard:** Up to 100 cSt (for all diameters)
	Option: High viscosity variant up to 1000 cSt

Installation conditions

Installation	For detailed information refer to *Installation* on page 39.
Inlet run	Minimal 5 DN (straight inlet)
	If no details are known, minimal 10 DN recommended
Outlet run	Minimal 3 DN (straight outlet)
	If no details are known, minimal 5 DN recommended
Dimensions and weights	For detailed information refer to *Dimensions and weights* on page 24.

Materials

Measuring sensor	
Flanges (wetted)	DN25...65 / 1...2½": stainless steel 1.4401 / 1.4404 - AISI 316/316L
	DN80...3000 / 3...120": 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...3000 / 3...120": carbon steel A106 gr B or equivalent
	Option: stainless steel 1.4401 / 1.4404 - AISI 316/316L
	Other materials on request.
Measuring sensor housing	DN25...65 / 1...2½": stainless steel 1.4404 - AISI 316L
	DN80...300 / 3...12": carbon steel - sheet metal (larger sizes have individual sensor housings in stainless steel 1.4401 / 1.4404 - AISI 316/316L)
	Cryogenic (LT) versions DN25...3000 / 1"...120": stainless steel 1.4404 / AISI 316L
	DN80...3000 / 3...120" and XXT, HV variant and DN25...3000 / 1"...120": carbon steel - sheet metal
	Option: stainless steel 1.4404 - AISI 316L
Transducer	
Transducers (wetted)	Stainless steel 1.4404 / AISI 316L
	Other materials on request.
Transducer holders incl. caps	DN350...3000 / 14"...120"; 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 coating
	Option: stainless steel 316 / 1.4408
Coating (flow sensor)	Standard paint system (STAN-SIG-0001), 1 layer
	Option: Offshore coating (Category C5I High/ C5M High), 3 layer
NACE conformity	On request; wetted materials conform NACE MR 175/103
Signal converter	
Housing	Versions C and F: die-cast aluminium or stainless steel 316 / 1.4408
	Option: stainless steel 316 / 1.4408
Coating	Standard coating or uncoated (stainless steel version)
	Option: Offshore 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
	Option: 24 VAC/DC (AC: -15% / +10%; DC: -25% / +30%)
Power consumption	AC: 22 VA
	DC: 12 W
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; V_0 = terminal voltage; I_{nom} = nominal current Safety limit values (Ex i): V_i = max. input voltage; I_i = max. input current; P_i = max. input power rating; 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**	**Ex i**
Active	$V_{int, nom}$ = 24 VDC I ≤ 22 mA R_L ≤ 1 kΩ		$V_{int, nom}$ = 20 VDC I ≤ 22 mA R_L ≤ 450 Ω
			V_0 = 21 V I_0 = 90 mA P_0 = 0.5 W C_0 = 90 nF / L_0 = 2 mH C_0 = 110 nF / L_0 = 0.5 mH
Passive	V_{ext} ≤ 32 VDC I ≤ 22 mA V_0 ≥ 1.8 V $R_{L, max} = (V_{ext} - V_0)/I_{max}$		V_{ext} ≤ 32 VDC I ≤ 22 mA V_0 ≥ 4 V $R_{L, max} = (V_{ext} - V_0)/ I_{max}$
			V_i = 30 V I_i = 100 mA P_i = 1 W C_i = 10 nF L_i ~ 0 mH

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: 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	Adjustable as pulse or frequency output		
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	Ex i
Active	-	V_{nom} = 24 VDC	-
		f_{max} in operating menu set to: f_{max} **≤ 100 Hz:** I ≤ 20 mA $R_{L, max}$ = 47 kΩ open: I ≤ 0.05 mA closed: $V_{0,nom}$ = 24 V at I = 20 mA	
		f_{max} in operating menu set to: 100 Hz < f_{max} ≤ 10 kHz: I ≤ 20 mA R_L ≤ 10 kΩ for f ≤ 1 kHz R_L ≤ 1 kΩ for f ≤ 10 kHz open: I ≤ 0.05 mA closed: $V_{0,nom}$ = 22.5 V at I = 1 mA $V_{0,nom}$ = 21.5 V at I = 10 mA $V_{0,nom}$ = 19 V at I = 20 mA	

<table>
<tr><td rowspan="3">Passive</td><td colspan="2">V_{ext} ≤ 32 VDC</td><td rowspan="3">-</td></tr>
<tr><td colspan="2">f_{max} in operating menu set to:
f_{max} ≤ 100 Hz:

I ≤ 100 mA

$R_{L, max}$ = 47 kΩ
$R_{L, max} = (V_{ext} - V_0) / I_{max}$

open:
I ≤ 0.05 mA at V_{ext} = 32 VDC
closed:
$V_{0, max}$ = 0.2 V at I ≤ 10 mA
$V_{0, max}$ = 2 V at I ≤ 100 mA</td></tr>
<tr><td colspan="2">f_{max} in operating menu set to:
100 Hz < f_{max} ≤ 10 kHz:

I ≤ 20 mA

R_L ≤ 10 kΩ for f ≤ 1 kHz
R_L ≤ 1 kΩ for f ≤ 10 kHz
$R_{L, max} = (V_{ext} - V_0) / I_{max}$

open:
I ≤ 0.05 mA at V_{ext} = 32 VDC
closed:
$V_{0, max}$ = 1.5 V at I ≤ 1mA
$V_{0, max}$ = 2.5 V at I ≤ 10 mA
$V_{0, max}$ = 5.0 V at I ≤ 20 mA</td></tr>
<tr><td rowspan="2">NAMUR</td><td rowspan="2">-</td><td rowspan="2">Passive to EN 60947-5-6

open:
I_{nom} = 0.6 mA
closed:
I_{nom} = 3.8 mA</td><td>Passive to EN 60947-5-6

open:
I_{nom} = 0.43 mA
closed:
I_{nom} = 4.5 mA</td></tr>
<tr><td>V_i = 30 V
I_i = 100 mA
P_i = 1 W
C_i = 10 nF
L_i = 0 mH</td></tr>
</table>

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	Ex i
Active	-	V_{int} = 24 VDC I ≤ 20 mA $R_{L, max}$ = 47 kΩ open: I ≤ 0.05 mA closed: $V_{0, nom}$ = 24 V at I = 20 mA	-
Passive	V_{ext} ≤ 32 VDC I ≤ 100 mA $R_{L, max}$ = 47 kΩ $R_{L, max} = (V_{ext} - V_0) / I_{max}$ open: I ≤ 0.05 mA at V_{ext} = 32 VDC closed: $V_{0, max}$ = 0.2 V at I ≤ 10 mA $V_{0, max}$ = 2 V at I ≤ 100 mA	V_{ext} = 32 VDC I ≤ 100 mA $R_{L, max}$ = 47 kΩ $R_{L, max} = (V_{ext} - V_0) / I_{max}$ open: I ≤ 0.05 mA at V_{ext} = 32 VDC closed: $V_{0, max}$ = 0.2 V at I ≤ 10 mA $V_{0, max}$ = 2 V at I ≤ 100 mA	-
NAMUR	-	Passive to EN 60947-5-6 open: I_{nom} = 0.6 mA closed: I_{nom} = 3.8 mA	Passive to EN 60947-5-6 open: I_{nom} = 0.43 mA closed: I_{nom} = 4.5 mA V_i = 30 V I_i = 100 mA P_i = 1 W C_i = 10 nF L_i = 0 mH

<table>
<tr><td colspan="4">Control input</td></tr>
<tr><td rowspan="2">Function</td><td colspan="3">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</td></tr>
<tr><td colspan="3">Start of dosing when dosing function is activated.</td></tr>
<tr><td>Operating data</td><td>Basic I/Os</td><td>Modular I/Os</td><td>Ex i</td></tr>
<tr><td>Active</td><td>-</td><td>V_{int} = 24 VDC

Terminals open:
$V_{0, nom}$ = 22 V

Terminals bridged:
I_{nom} = 4 mA

On:
V_0 ≥ 12 V with
I_{nom} = 1.9 mA

Off:
V_0 ≤ 10 V with
I_{nom} = 1.9 mA</td><td>-</td></tr>
<tr><td>Passive</td><td>V_{ext} ≤ 32 VDC

I_{max} = 6.5 mA at
V_{ext} ≤ 24 VDC

I_{max} = 8.2 mA at
V_{ext} ≤ 32 VDC

Contact closed (On):
V_0 ≥ 8 V with
I_{nom} = 2.8 mA

Contact open (Off):
V_0 ≤ 2.5 V with
I_{nom} = 0.4 mA</td><td>V_{ext} ≤ 32 VDC

I_{max} = 9.5 mA at
V_{ext} ≤ 24 V

I_{max} = 9.5 mA at
V_{ext} ≤ 32 V

Contact closed (On):
V_0 ≥ 3 V with
I_{nom} = 1.9 mA

Contact open (Off):
V_0 ≤ 2.5 V with
I_{nom} = 1.9 mA</td><td>V_{ext} ≤ 32 VDC

I ≤ 6 mA at
V_{ext} = 24 V
I ≤ 6.6 mA at
V_{ext} = 32 V

On:
V_0 ≥ 5.5 V or
I ≥ 4 mA
Off:
V_0 ≤ 3.5 V or
I ≤ 0.5 mA

V_i = 30 V
I_i = 100 mA
P_i = 1 W
C_i = 10 nF
L_i = 0 mH</td></tr>
<tr><td>NAMUR</td><td>-</td><td>Active to
EN 60947-5-6

Contact open:
$V_{0, nom}$ = 8.7 V

Contact closed (On):
I_{nom} = 7.8 mA

Contact open (off):
$V_{0, nom}$ = 6.3 V with
I_{nom} = 1.9 mA

Identification for open terminals:
V_0 ≥ 8.1 V with
I ≤ 0.1 mA

Identification for short circuited terminals:
V_0 ≤ 1.2 V with
I ≥ 6.7 mA</td><td>-</td></tr>
</table>

PROFIBUS DP	
Description	Galvanically isolated acc. to IEC 61158
Profile version: 3.02	
Automatic data transmission rate recognition (max. 12 MBaud)	
Bus address adjustable via local display at the measuring device	
Function blocks	6 x analogue input block, 3 x totaliser function block, 1 x transducer block, 1 x physical block
Output data	Volume flow, mass flow, velocity of sound, flow speed, gain, SNR, electronic temperature, power supply Diagnostic data (Further meas. values and diagnostic data is available via acyclic access)
PROFIBUS PA	
Description	Galvanically isolated acc. to IEC 61158
	Profile version: 3.02
	Current consumption: 10.5 mA
	Permissible bus voltage: 9...32 V; in Ex application 9...24 V
	Bus interface with integrated reverse polarity protection
	Typical error current FDE (Fault Disconnection Electronic): 4.3 mA
	Bus address adjustable via local display on the measuring device
Function blocks	6 x analogue input block, 3 x totaliser function block, 1 x transducer block, 1 x physical block
Output data	Volume flow, mass flow, velocity of sound, flow speed, gain, SNR, electronic temperature, power supply Diagnostic data (Further meas. values and diagnostic data is available via acyclic access)
FOUNDATION Fieldbus	
Description	Galvanically isolated acc. to IEC 61158
	Current consumption: 10.5 mA
	Permissible bus voltage: 9...32 V; in Ex application 9...24 V
	Bus interface with integrated reverse polarity protection
	Link Master function (LM) supported
	Tested with Interoperable Test Kit (ITK) version 6.0
Function blocks	4 x analogue input, 2 x integrator, 1 x PID
Output data	Volume flow, mass flow, flow speed, electronic temperature, velocity of sound, gain, SNR Diagnostic data
MODBUS	
Description	Modbus RTU, Master / Slave, RS485
Address range	1...247
Supported function codes	01, 02, 03, 04, 05, 08, 16, 43
Supported Baudrate	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud

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). 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)
IECEx	Approval number: IECEx KIWA15.0033 X
ATEX	Approval number: KIWA 15ATEX0007 X
c**CSA**us; class 1 Div. 1 and 2	Approval number: 2593926 (pending: amendment for CS/CS sensor material)
DNV	Approval number: 13.0141 X
CRN	File: 0F04725.2
NEPSI	Sensor (F): approval number: GYJ18.1535X
	Converter (F): approval number: GYJ16.1460X
	Compact version (C): approval number: GYJ18.1535X
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
	Option: IP68, NEMA 6P
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 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.

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.

The OPTISONIC 3400 has an EC type examination certificate and can be verified to the MID Annex VI (MI-004) for liquid flow meters for class 2 and 3 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).

In general 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

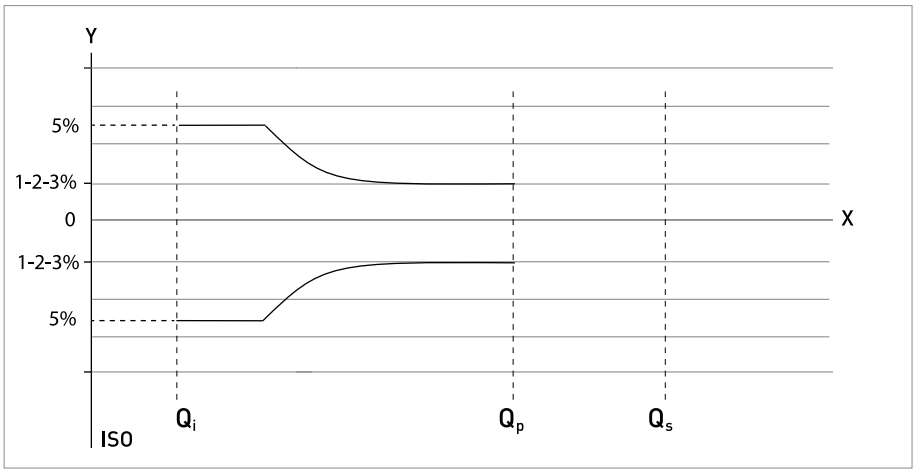


Figure 2-1: ISO flow rates added to figure as comparison towards MID
X: Flow rate
Y [%]: Maximum measuring error

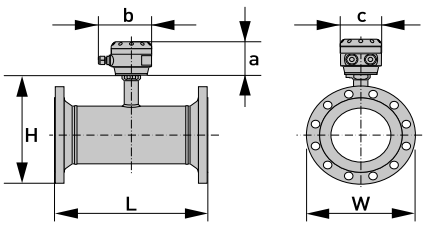
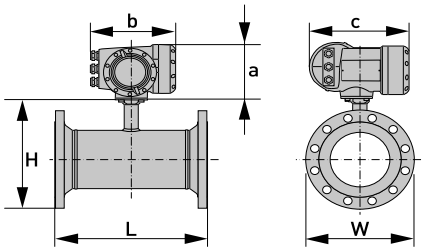
MI-004 certified flow characteristics; valid for accuracy classes 2 and 3

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

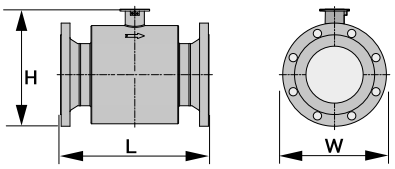
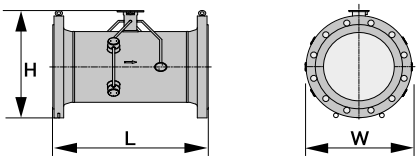
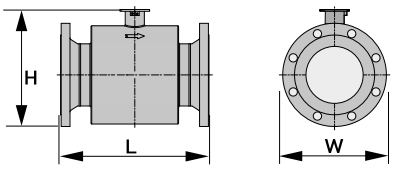
Between brackets ( ) ; Q_s value only valid for accuracy classes 2 & 3 (class 1 is not available).

2.3 Dimensions and weights

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

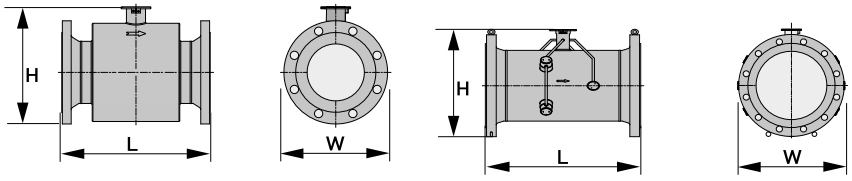
① The value may vary depending on the used cable glands.
② The value depends on version

2.3.1 Variants

Standard version and Extended temperature - High Viscosity - Cryogenic versions; ≤ DN300 / 12"		DIN: L= 250...500 mm / 9.8"...19.7" ANSI: L= 250...500 mm / 9.8"...19.7" * for Cryo - HV - XXT versions; ANSI: L= 250...550 mm / 9.8"...21.7"
Standard version; ≥ DN350 / 14"		DIN: L= 500...600 mm / 19.7"...23.6" ANSI: L= 700...800 mm / 27.6"...31.5"
Extended temperature - High Viscosity - Cryogenic version; ≥ DN350 / 14"		DIN: L= 500...750 mm / 19.7"...29.5" ANSI: L= 700...850 mm / 27.6"...33.5"

For all dimensions and options; see tables on next pages (tables not final)

2.3.2 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

EN1092-1; Standard variant - PN 25

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
100	350	268	235	102	104	24	23
125	350	297	270	127	130	30	29
150	400	326	300	154	158	37	37
200	400	419	360	207	207	61	61
250	450	479	425	255	255	80	80
300	500	532	485	305	305	102	102
350	500	539	555	330	330	126	126
400	600	596	620	379	379	172	167
450	700	654	670	441	441	199	199
500	700	707	730	488	488	252	252
600	800	817	845	588	588	335	355

EN1092-1; Standard variant - PN 16

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
100	350	261	220	102	104	20	19
125	350	287	250	127	130	20	20
150	350	319	285	154	158	30	29
200	400	409	340	207	207	51	47
250	400	469	405	255	255	64	64
300	500	520	460	305	305	84	84

EN1092-1; Standard variant - PN 10

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
200	400	409	340	207	207	48	48
250	400	464	395	255	255	55	55
300	500	512	445	305	305	71	71
350	500	517	505	341	341	69	69
400	600	572	565	388	388	90	90
450	600	623	615	441	441	97	101
500	600	674	670	487	487	118	118
600	600	779	780	585	585	157	157

ASME 150 lb; Standard variant

Nom. size	Dimensions						Inner diameter [Di]		Approx. weight			
	L		H		W		CS (carbon steel) / SS (stainless steel) ①		CS		SS	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[lb]	kg]	[lb]	[kg]
1	9.8	250	6.0	152	4.3	108	1.1	27	20	9	22	10
1¼	10.2	260	6.3	161	4.6	117	1.4	35	22	10	22	10
1½	10.6	270	6.9	174	5.0	127	1.5 ①	39 ①	26	12	26	12
2	11.8	300	7.4	187	6.0	152	2.1	53	33	15	35	16
2½	11.8	300	8.7	221	7.0	178	2.5	63	42	19	44	20
3	13.8	350	9.2	233	7.5	191	3.1	78	44	20	44	20
4	13.8	350	10.4	265	9.0	229	4.0	102	57	26	60	27
5	13.8	350	11.4	289	10.0	254	5.0	128	71	32	73	33
6	15.7	400	12.4	316	11.0	279	6.1	154	88	40	90	41
8	15.7	400	16.1	408	13.5	343	8.0	203	110	50	108	49
10	19.7	500	18.5	470	16.0	406	10.0	255	161	73	150	68
12	19.7	500	20.9	531	19.0	483	12.0	305	214	97	209	95
14	27.6	700	20.9	531	21.0	533	13.3	337	260	118	249	113
16	31.5	800	23.2	589	23.5	597	15.3	388	342	155	315	143
18	31.5	800	25.0	635	25.0	635	17.2	438	406	184	348	158
20	31.5	800	27.2	692	27.5	699	19.3	489	489	222	448	203
24	31.5	800	31.5	801	32.0	813	23.0 ①	584 ①	761	345	591	268
28	35.4	900	35.8	909	36.5	927	27.1 ①	687 ①	1052	477	-	-
32	39.4	1000	40.4	1027	41.8	1061	30.8 ①	783 ①	1598	725	-	-
36	43.3	1100	39.5	1004	46.0	1168	34.8 ①	884 ①	2006	910	-	-
40	47.2	1200	48.9	1243	50.8	1289	38.6 ①	980 ①	2621	1189	-	-

① Inner diameter SS differs from CS, consult manufacturer for more information.

ASME 300 lb; Standard variant

Nom. size	Dimensions						Inner diameter [Di]		Approx. weight			
	L		H		W		CS (carbon steel) / SS (stainless steel) ①		CS		SS	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[lb]	[kg]	[lb]	[kg]
1	9.8	250	6.3	160	4.9	124	1.1	27	22	10	24	11
1¼	10.2	260	6.6	169	5.3	133	1.4	35	22	10	22	10
1½	10.6	270	6.9	175	6.1	155	1.6	41	31	14	31	14
2	11.8	300	7.6	194	6.5	165	2.1	53	35	16	37	17
2½	11.8	300	9.0	227	7.5	191	2.5	63	44	20	44	20
3	13.8	350	9.6	243	8.3	210	3.1	78	53	24	55	25
4	15.7	400	10.9	278	10.0	254	4.0	102	79	36	82	37
5	15.7	400	11.9	301	11.0	279	5.0	128	97	44	99	45
6	17.7	450	13.2	335	12.5	318	6.1	154	128	58	130	59
8	17.7	450	16.8	427	15.0	381	8.0	203	190	86	179	81
10	19.7	500	19.2	489	17.5	445	9.7 ①	248 ①	280	127	256	116
12	23.6	600	21.4	544	20.5	521	11.8 ①	299 ①	421	191	388	176
14	27.6	700	22.0	560	23.0	584	13.1 ①	333 ①	489	222	467	212
16	31.5	800	24.3	617	25.5	648	15.0	381	688	312	642	291
18	31.5	800	26.5	674	28.0	711	16.5 ①	419 ①	882	400	811	368
20	31.5	800	28.8	731	30.5	775	18.4 ①	467 ①	1065	483	955	433
24	31.5	800	33.5	852	36.0	914	22.1 ①	560 ①	1537	697	1413	641

① Inner diameter SS differs from CS, consult manufacturer for more information.

ASME 600 lb; Standard variant

Nom. size	Dimensions						Inner diameter [Di]		Approx. weight			
	L		H		W		CS (carbon steel) / SS (stainless steel) ①		CS		SS	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[lb]	[kg]	[lb]	[kg]
1	10.6	270	6.3	160	4.9	124	1.1	27	24	11	24	11
1¼	10.6	270	6.6	169	5.3	133	1.4	35	24	11	24	11
1½	11.4	290	7.4	189	6.1	155	1.5 ①	39 ①	33	15	33	15
2	13.0	330	7.6	194	6.5	165	2.1	53	40	18	40	18
2½	13.0	330	9.0	227	7.5	191	2.5	63	51	23	51	23
3	15.7	400	9.6	243	8.3	210	2.9	74	62	28	64	29
4	15.7	400	11.3	287	10.8	273	3.6 ①	92 ①	110	50	108	49
5	19.7	500	12.9	327	13.0	330	4.8	122	172	78	174	79
6	19.7	500	13.9	354	14.0	356	5.5 ①	140 ①	223	101	216	98
8	19.7	500	17.6	446	16.5	419	7.6	194	298	135	302	137
10	23.6	600	20.5	521	20.0	508	9.6	243	527	239	487	221
12	23.6	600	23.0	583	22.0	559	11.4	289	628	285	586	266
14	27.6	700	22.4	569	23.8	603	12.1 ①	308 ①	767	348	714	324
16	31.5	800	25.0	636	27.0	686	13.9 ①	354 ①	1093	496	1010	458
18	31.5	800	27.2	690	29.3	743	15.7 ①	398 ①	1338	607	1210	549
20	35.4	900	29.5	750	32.0	813	17.4 ①	443 ①	1757	797	1601	726
24	35.4	900	34.0	865	37.0	940	20.9 ①	532 ①	2480	1125	2238	1015

① Inner diameter SS differs from CS, consult manufacturer for more information.

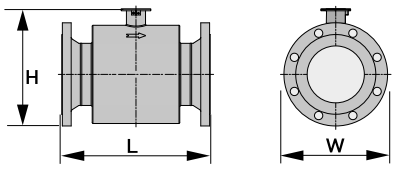
ASME 900 lb; Standard variant

Nom. size	Dimensions						Inner diameter [Di]		Approx. weight			
	L		H		W		CS (carbon steel) / SS (stainless steel) ①		CS		SS	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[lb]	[kg]	[lb]	[kg]
1	11.8	300	7.2	183	5.9	149	1.1	27	②	②	24	11
1½	11.8	300	7.8	198	7.0	178	1.6	41	②	②	33	15
2	14.6	370	9.0	230	8.5	216	2.1	53	②	②	64	29
3	17.7	450	10.7	271	9.5	241	2.6 ①	67 ①	93	42	95	43
4	17.7	450	12.1	309	11.5	292	3.4 ①	87 ①	143	65	137	62
6	23.6	600	14.9	379	15.0	381	5.2 ①	132 ①	309	140	306	139
8	31.5	800	19.3	490	18.5	470	7.0 ①	178 ①	562	255	540	245
10	31.5	800	22.6	574	21.5	546	9.1 ①	230 ①	772	350	750	340
12	35.4	900	24.6	625	24.0	610	10.8 ①	273 ①	1080	490	1025	465
14	35.4	900	23.2	589	25.2	641	11.8 ①	300 ①	1213	550	1146	520
16	39.4	1000	25.4	646	27.7	705	13.6 ①	344 ①	1565	710	1433	650
18	39.4	1000	28.0	712	31.0	787	15.3 ①	387 ①	2050	930	1940	880
20	43.3	1100	30.4	773	33.8	857	17.0 ①	432 ①	2624	1190	2535	1150
24	51.2	1300	36.1	916	41.0	1041	20.4 ①	518 ①	4718	2140	4475	2030

① Inner diameter SS differs from CS.

② Consult manufacturer for more information.

2.3.3 Variant flow sensor; XXT - High Viscosity and Cryogenic (SS) versions



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

EN1092-1; Extended temperature - High Viscosity and Cryogenic (SS) version - 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	10	10
40	270	173	150	39	41	11	13
50	300	193	165	53	53	15	16
65	300	203	185	63	63	19	19
80	350	238	200	81	81	17	18
100	350	268	235	104	104	24	23
125	350	297	270	130	130	30	29
150	400	326	300	158	158	37	36
200	500	427	375	207	207	69	69
250	550	492	450	260	260	101	101
300	550	547	515	308	308	137	137

EN1092-1; Extended temperature - High Viscosity and Cryogenic (SS) version - PN 25

Nominal size	Dimensions [mm], CS = carbon steel / SS = stainless steel / Di = inner diameter					Approxi. weight [kg]	
DN	L	H	W	Di CS	Di SS	CS	SS
100	350	268	235	104	104	29	29
125	350	297	270	130	130	29	29
150	400	326	300	158	158	38	38
200	500	419	360	207	207	61	61
250	550	479	425	260	259	82	82
300	550	532	485	308	308	108	108
350	600	594	555	338	338	148	148
400	650	652	620	389	389	186	186
450	700	702	670	439	439	223	223
500	750	752	730	488	488	290	290
600	800	857	845	586	586	362	362

EN1092-1; Extended temperature - High Viscosity and Cryogenic (SS) version - PN 16

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
100	350	261	220	104	104	23	23
125	350	287	250	130	130	29	29
150	350	319	285	158	158	38	38
200	450	409	340	207	207	49	49
250	500	469	405	260	260	67	68
300	500	520	460	310	310	82	82

EN1092-1; Extended temperature - High Viscosity and Cryogenic (SS) version - PN 10

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
200	450	409	340	207	207	50	50
250	500	464	395	260	260	66	66
300	500	512	445	310	310	75	75
350	500	559	505	342	342	91	91
400	600	624	565	393	393	114	114
450	600	674	615	443	443	130	130
500	650	722	670	494	494	151	151
600	700	824	780	594	594	195	195
700	750	929	895	694	③	280	③
800	900	1039	1015	794	③	380	③
900	900	1137	1115	889	③	469	③
1000	1000	1247	1230	991	③	595	③

③ TBD - Consult manufacturer for more information.

ASME 150 lb; Extended temperature - High Viscosity and Cryogenic versions

Nom. size	Dimensions						Inner diameter [Di]		Approx. weight			
	L		H		W		CS (carbon steel) / SS (stainless steel) ①		CS		SS	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[lb]	[kg]	[lb]	[kg]
1	9.8	250	6.0	152	4.3	108	1.1	27	20	9	20	9
1¼	10.2	260	6.3	161	4.6	117	1.4	35	24	11	22	10
1½	10.6	270	6.9	174	5.0	127	1.6	41	26	12	24	11
2	11.8	300	7.4	187	6.0	152	2.1	53	33	15	33	15
2½	11.8	300	8.7	221	7.0	178	2.5	63	42	19	42	19
3	13.8	350	9.2	233	7.5	191	3.1	78	44	20	44	20
4	13.8	350	10.4	265	9.0	229	4.0	102	57	26	57	26
5	13.8	350	11.4	289	10.0	254	5.0	128	71	32	71	32
6	15.7	400	12.4	316	11.0	279	6.1	154	88	40	88	40
8	17.7	450	16.1	408	13.5	343	8.0	203	119	54	115	52
10	21.7	550	18.5	470	16.0	406	10.0	255	168	76	159	72
12	21.7	550	20.9	531	19.0	483	12.0	305	216	99	216	99
14	27.6	700	20.9	531	21.0	533	13.3	337	311	141	298	135
16	31.5	800	23.2	589	23.5	597	15.3	388	399	181	373	169
18	31.5	800	25.0	635	25.0	635	17.2	438	470	213	414	188
20	31.5	800	27.2	692	27.5	699	19.3	489	560	254	518	235
24	33.5	850	31.5	801	32.0	813	23.3	591	869	394	692	314
28	35.4	900	37.2	945	36.5	927	27.1 ①	687 ①	1052	527	-	-
32	37.4	950	41.8	1062	41.8	1061	30.8 ①	783 ①	1598	769	-	-
36	41.3	1050	45.8	1163	46.0	1168	34.8 ①	884 ①	2006	963	-	-
40	43.3	1100	50.2	1276	50.8	1289	38.6 ①	980 ①	2621	1225	-	-

ASME 300 lb; Extended temperature - High Viscosity and Cryogenic versions

Nom. size	Dimensions						Inner diameter [Di]		Approx. weight			
	L		H		W		CS (carbon steel) / SS (stainless steel) ①		CS		SS	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[lb]	[kg]	[lb]	[kg]
1	9.8	250	6.3	160	4.9	124	1.1	27	22	10	22	10
1¼	10.2	260	6.6	169	5.3	133	1.4	35	24	11	22	10
1½	10.6	270	6.9	175	6.1	155	1.6	41	31	14	29	13
2	11.8	300	7.6	194	6.5	165	2.1	53	35	16	35	16
2½	11.8	300	9.0	227	7.5	191	2.5	63	44	20	44	20
3	13.8	350	9.6	243	8.3	210	3.1	78	53	24	53	24
4	15.7	400	10.9	278	10.0	254	4.0	102	79	36	79	36
5	15.7	400	11.9	301	11.0	279	5.0	128	97	44	97	44
6	17.7	450	13.2	335	12.5	318	6.1	154	128	58	128	58
8	19.7	500	16.8	427	15.0	381	8.0 ①	203 ①	203	92	187	85
10	21.7	550	19.2	489	17.5	445	9.7 ①	248 ①	288	135	265	120
12	23.6	600	21.4	544	20.5	521	11.8 ①	299 ①	428	194	392	178
14	27.6	700	24.0	609	23.0	584	13.1 ①	333 ①	536	243	518	235
16	31.5	800	26.2	665	25.5	648	15.0	381	699	317	697	316
18	31.5	800	28.4	722	28.0	711	16.5 ①	419 ①	941	427	871	395
20	31.5	800	30.5	774	30.5	775	18.4 ①	467 ①	1131	513	1023	464
24	33.5	850	34.8	884	36.0	914	22.1 ①	560 ①	1658	752	1530	694

ASME 600 lb; Extended temperature - High Viscosity and Cryogenic versions

Nom. size	Dimensions						Inner diameter [Di]		Approx. weight			
	L		H		W		CS (carbon steel) / SS (stainless steel) ①		CS		SS	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[lb]	[kg]	[lb]	[kg]
1	10.6	270	6.3	160	4.9	124	1.1	27	24	11	24	11
1¼	10.6	270	6.6	169	5.3	133	1.4	35	24	11	24	11
1½	11.4	290	7.4	189	6.1	155	1.5 ①	39 ①	33	15	33	15
2	13.0	330	7.6	194	6.5	165	2.1	53	40	18	40	18
2½	13.0	330	9.0	227	7.5	191	2.5	63	51	23	51	23
3	15.7	400	9.6	243	8.3	210	2.9	74	62	28	62	28
4	15.7	400	11.3	287	10.8	273	3.6 ①	92 ①	110	50	108	49
5	19.7	500	12.9	327	13.0	330	4.8	122	172	78	172	78
6	19.7	500	13.9	354	14.0	356	5.5 ①	140 ①	223	101	216	98
8	21.7	550	17.6	446	16.5	419	7.6	194	320	145	313	142
10	25.6	650	20.5	521	20.0	508	9.3 ①	236 ①	536	243	503	228
12	27.6	700	23.0	583	22.0	559	11.1 ①	281 ①	679	308	631	286
14	29.5	750	24.3	618	23.8	603	12.1 ①	308 ①	842	382	789	358
16	31.5	800	26.9	684	27.0	686	13.9 ①	354 ①	1155	524	1074	487
18	33.5	850	29.1	738	29.3	743	15.7 ①	398 ①	1442	654	1307	593
20	35.4	900	31.2	793	32.0	813	17.4 ①	443 ①	1832	831	1682	763
24	37.4	950	35.3	896	37.0	940	20.9 ①	532 ①	2630	1193	2383	1081

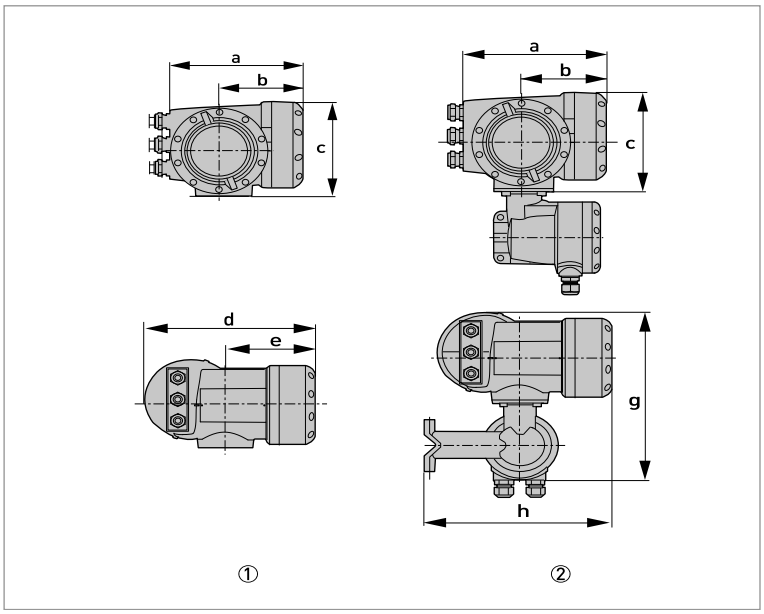
① Inner diameter SS differs from CS, consult manufacturer for more information.

ASME 900 lb; Extended temperature, High Viscosity and Cryogenic* versions

Nom. size	Dimensions						Inner diameter [Di]		Approx. weight			
	L		H		W		CS (carbon steel) / SS (stainless steel) ①		CS		SS	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[lb]	[kg]	[lb]	[kg]
3	17.7	450	10.7	271	9.5	241	2.6 ①	67 ①	93	42	93	42
4	17.7	450	12.1	309	11.5	292	3.4 ①	87 ①	143	65	141	64
6	23.6	600	14.9	379	15.0	381	5.2 ①	132 ①	309	140	304	138
8	31.5	800	18.6	472	18.5	470	7.0 ①	178 ①	540	245	503	228
10	31.5	800	21.6	550	21.5	546	8.5 ①	216 ①	809	367	756	343
12	35.4	900	24.0	609	24.0	610	10.1 ①	257 ①	1129	512	994	451
14	35.4	900	25.1	637	25.2	641	11.2 ①	284 ①	1303	591	1162	527
16	39.4	1000	27.3	694	27.7	705	13.1 ①	333 ①	1627	738	1517	688
18	39.4	1000	29.9	760	31.0	787	14.9 ①	378 ①	2112	958	2022	917
20	39.4	1000	32.6	828	33.8	857	16.5 ①	419 ①	2599	1179	2399	1088
24	51.2	1300	37.6	955	41.0	1041	19.9 ①	505 ①	4830	2191	4482	2033

① Inner diameter SS differs from CS, consult manufacturer for more information.
*Cryogenic and XXT versions not available for 8...24"

2.3.4 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 is designed exclusively for bi-directional measurements on conductive and / or non-conductive fluids, in closed completely filled pipeline circuits. 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 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 General requirements

The following precautions must be taken to ensure a reliable installation.

- *Make sure that there is adequate space on the sides.*
- *Protect the signal converter from direct sunlight and install a sunshade if necessary.*
- *Signal converters installed in control 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".*

3.3.1 Vibration

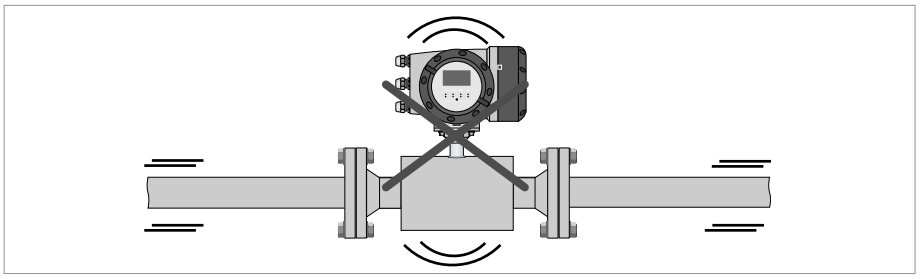


Figure 3-1: Avoid vibrations

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

3.4 Installation conditions

3.4.1 Inlet and outlet

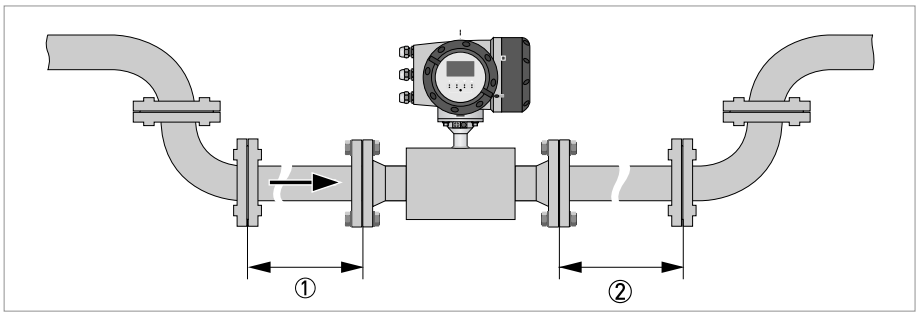


Figure 3-2: Recommended inlet and outlet

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

3.4.2 Bends in 2 or 3 dimensions

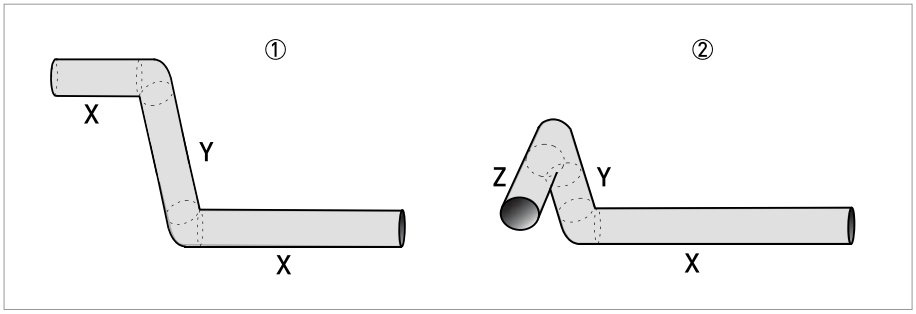


Figure 3-3: 2 and/or 3 dimensional bends upstream of the flowmeter

① 2 dimensions = X/Y
② 3 dimensions = X/Y/Z
Inlet length: using bends in 2 dimensions: ≥ 5 DN; when having bends in 3 dimensions: ≥ 10 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).*

3.4.3 T-section

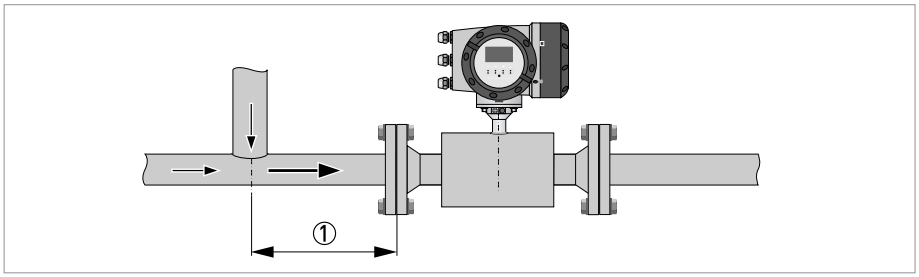


Figure 3-4: Distance behind a T-section

① ≥ 10 DN

3.4.4 Bends

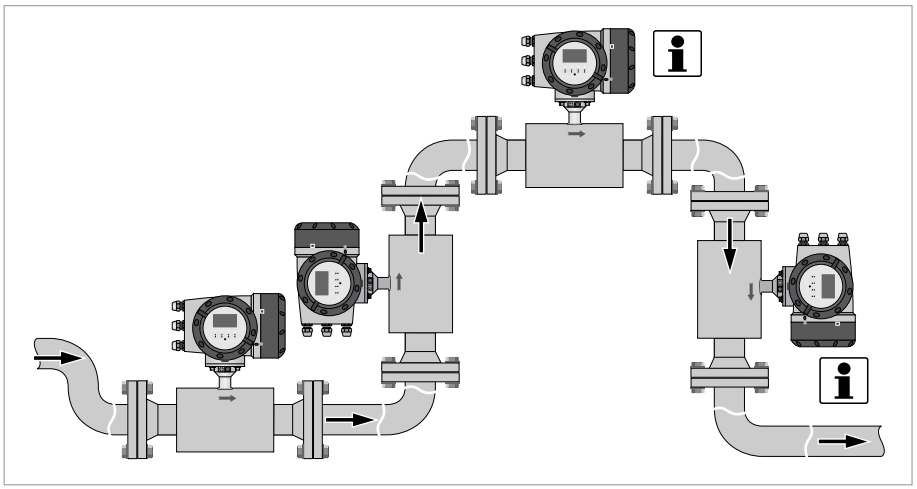


Figure 3-5: Installation in bending pipes (90°)

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.

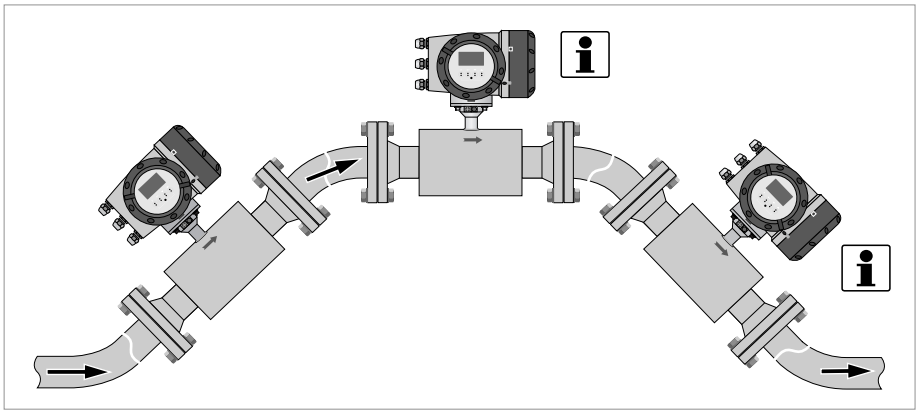


Figure 3-6: Installation in bending pipes (45°)

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

3.4.5 Control valve

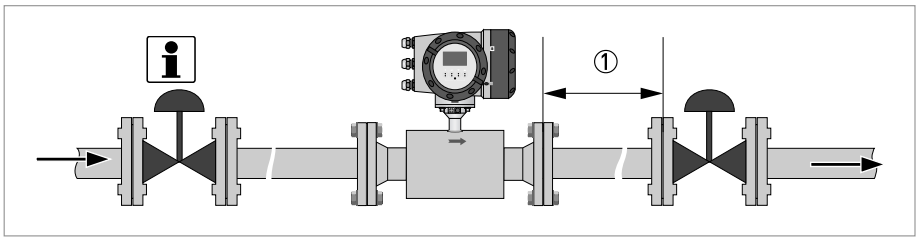


Figure 3-7: Installation in front of a control valve

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).

3.4.6 Position of pump

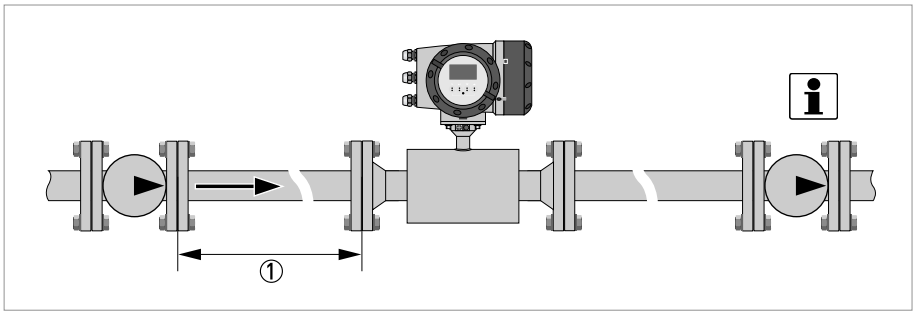


Figure 3-8: Installation behind a pump

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.

3.4.7 Open feed or discharge

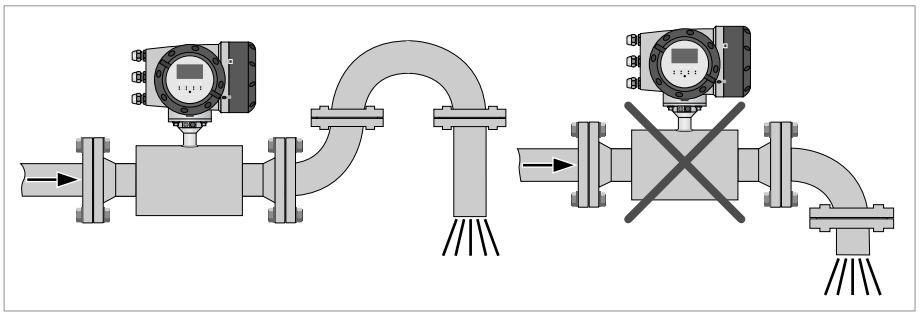


Figure 3-9: Open discharge

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

3.4.8 Insulation

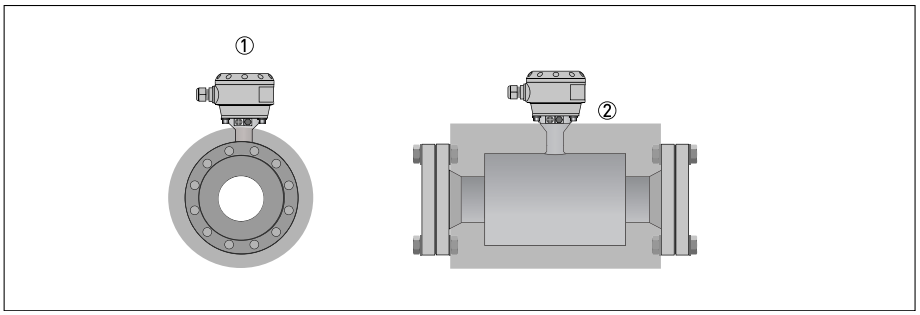


Figure 3-10: Insulation

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!

3.4.9 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

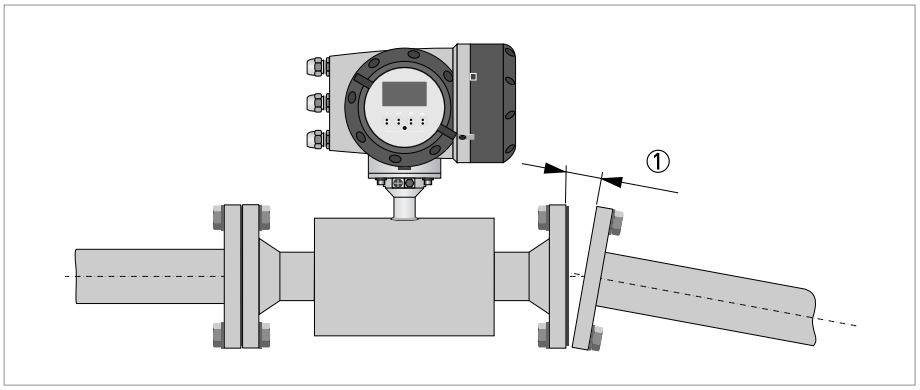


Figure 3-11: Flange deviation

① M_{max}

3.4.10 Mounting position

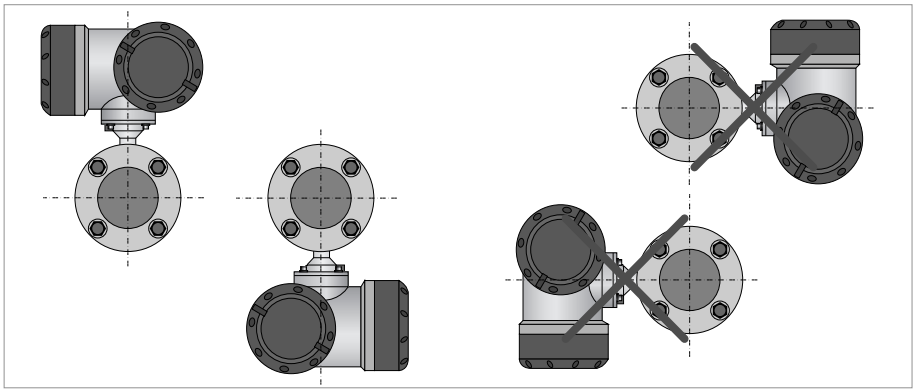


Figure 3-12: Installation position on horizontal pipe sections

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(labeled) inner coax cables for the connection of maximal three acoustic paths.

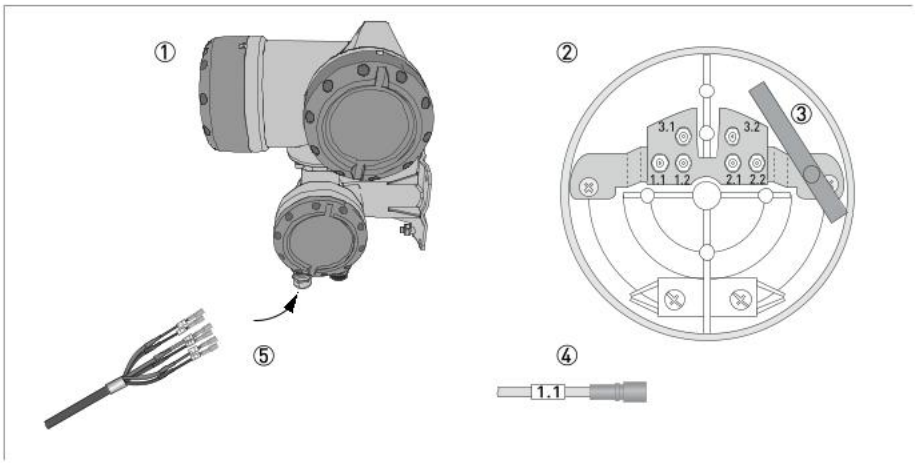


Figure 4-1: Construction of field version

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

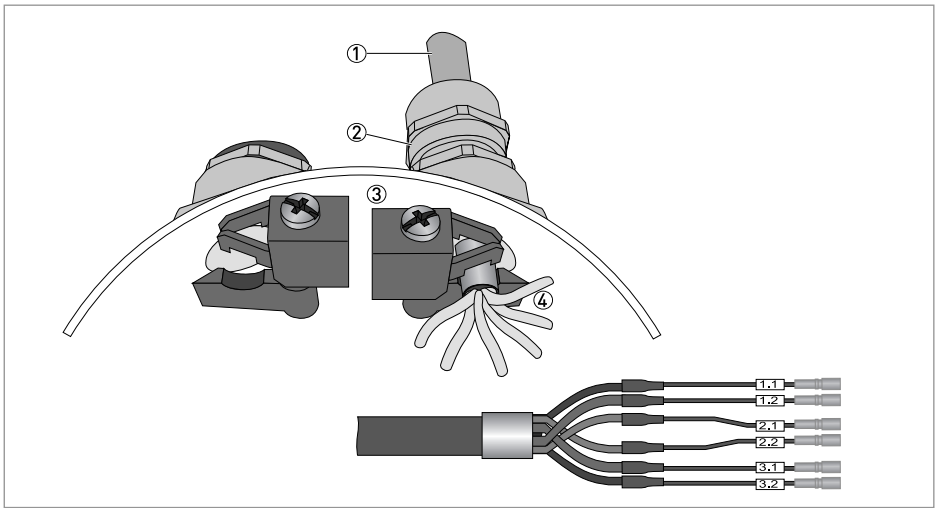


Figure 4-2: Clamp the cables on the shielding bush

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

Electrical connection - Standard version

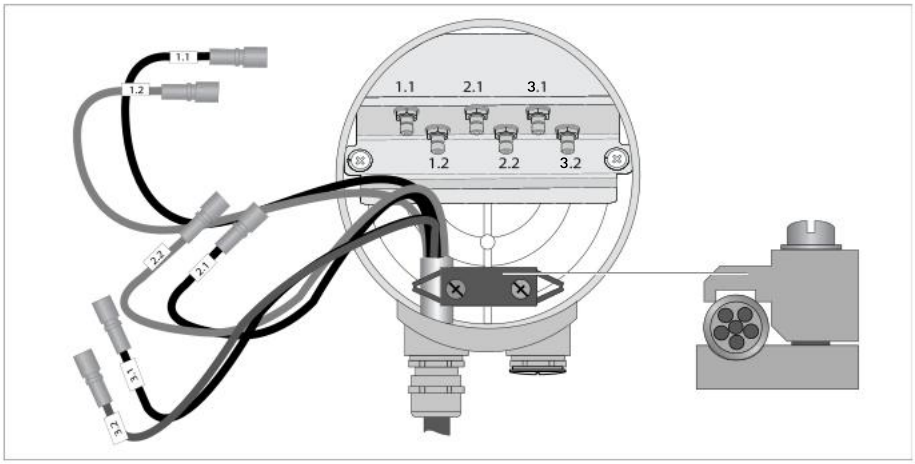


Figure 4-3: Connect the cables in the connection box of the flow sensor.

Depending on the ordered path version (1, 2 or 3) the terminal plate has the corresponding amount of connectors mounted.

Connection of flow sensor type Cryogenic (LT) and XXT

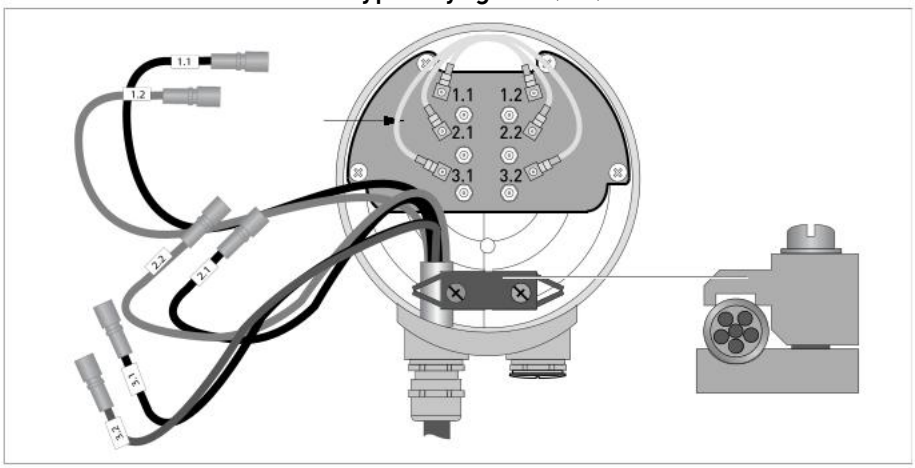


Figure 4-4: Connect the cables in the connection box of the flow sensor.

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.

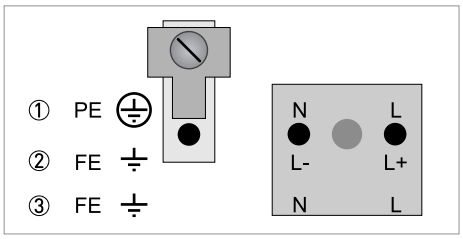


Figure 4-5: Power supply connection

① 100...230 VAC (-15% / +10%), 22 VA
② 24 VDC (-55% / +30%), 12 W
③ 24 VAC/DC (AC: -15% / +10%; DC: -25% / +30%), 22 VA or 12 W

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.

24 VDC (tolerance range: -55% / +30%)
24 VAC/DC (tolerance ranges: AC: -15% / +10%; DC: -25% / +30%)

- Note the data on the nameplate!
- For measurement process reasons, a functional ground **FE** must be connected to the separate U-clamp terminal in the terminal compartment of the signal converter.
- When connecting to functional extra-low voltages, provide a facility for protective separation (PELV) (acc. to VDE 0100 / VDE 0106 and/or IEC 60364 / IEC 61140 or relevant national regulations).

For 24 VDC, 12 VDC-10% 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.

Ex i version

- Depending on the task, the device can be configured with various output modules.
- Current outputs can be active or passive.
- Optionally available also with Foundation Fieldbus and Profibus PA/DP

Modular version

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

Bus systems

- The device allows intrinsically safe and non intrinsically safe bus interfaces in combination with additional modules.
- For connection and operation of bus systems, please note the supplementary manuals for the bus system.

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

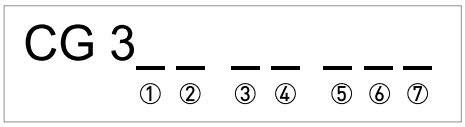


Figure 4-6: Marking (CG number) of the electronics module and input/output variants

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

CG 350 x1 100	100...230 VAC & standard display; basic I/O: I_a or I_p & S_p/C_p & S_p & P_p/S_p
CG 350 x1 7FK	100...230 VAC & standard display; modular I/O: I_a & P_N/S_N and optional module P_N/S_N & C_N
CG 350 x1 4EB	24 VDC & standard display; modular I/O: I_a & P_a/S_a and optional module P_p/S_p & I_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)
P_N / S_N	F	Passive pulse output, frequency output, status output or limit switch acc. to NAMUR (changeable)
C_a	G	Active control input
C_p	K	Passive control input
C_N	H	Active control input to NAMUR Signal converter monitors cable breaks and short circuits acc. to NAMUR EN 60947-5-6. Errors indicated on LC display. Error messages possible via status output.
-	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								
Ex-i in-/outputs (Option)									
2 0 0						I_a + HART® active		P_N / S_N NAMUR ②	
3 0 0						I_p + HART® passive		P_N / S_N NAMUR ②	
2 1 0		I_a active		P_N / S_N NAMUR C_p passive ②		I_a + HART® active		P_N / S_N NAMUR ②	
3 1 0		I_a active		P_N / S_N NAMUR C_p passive ②		I_p + HART® passive		P_N / S_N NAMUR ②	
2 2 0		I_p passive		P_N / S_N NAMUR C_p passive ②		I_a + HART® active		P_N / S_N NAMUR ②	
3 2 0		I_p passive		P_N / S_N NAMUR C_p passive ②		I_p + HART® passive		P_N / S_N NAMUR ②	

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 grey 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	
6 _ _		max. 2 optional modules for term. A + B				I_a + HART® active		P_p / S_p passive ①	
B _ _		max. 2 optional modules for term. A + B				I_p + HART® passive		P_p / S_p passive ①	
7 _ _		max. 2 optional modules for term. A + B				I_a + HART® active		P_N / S_N NAMUR ①	
C _ _		max. 2 optional modules for term. A + B				I_p + HART® passive		P_N / S_N NAMUR ①	
PROFIBUS PA/DP									
D _ _		max. 2 optional modules for term. A + B				PA+ (2)	PA- (2)	PA+ (1)	PA- (1)
F _ _		max. 2 optional modules for term. A + B				PA+ (2)	PA- (2)	PA+ (1)	PA- (1)
FOUNDATION Fieldbus (option)									
E _ _		max. 2 optional modules for term. A + B				V/D+ (2)	V/D- (2)	V/D+ (1)	V/D- (1)
Modbus (option)									
G _ _ ②		max. 2 optional modules for term. A + B					Common	Sign. B (D1)	Sign. A (D0)

① Changeable
② Not activated bus terminator

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 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 (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 (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:

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- Flow metering, monitoring, wireless and remote metering solutions
- Engineering, commissioning, calibration, maintenance and training services

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