OPTIFLUX 2000 Technical Datasheet

Electromagnetic flow sensor

- For all water and wastewater applications
- Wide range of approvals for potable water
- Robust, fully welded construction

The documentation is only complete when used in combination with the relevant documentation for the signal converter.

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1.1 Reliable solution for the water and wastewater industry

The **OPTIFLUX 2000** is designed to meet the demands for all water and waste water applications including groundwater, potable water, waste water, sludge and sewage, industry water and salt water.

The OPTIFLUX 2000 has a field proven and unsurpassed lifetime. This is assured by the fully welded construction, full bore pipe, absence of moving parts and wear resistant liner materials. The sensor has the widest diameter range available in the market: from DN25 up to DN3000.

① Robust fully welded construction
② Diameter range: DN25...DN3000
③ PP, PO and hard rubber liners

Highlights

- Rugged liners suitable for any water and wastewater application
- Proven and unsurpassed lifetime, huge installed base
- Tamper proof, fully welded construction, also available in customer specific constructions
- Drinking water approvals including KTW, KIWA, ACS, DVGW, NSF, WRAS
- Suitable for subsoil installation and constant flooding (IP68)
- Bi-directional flow metering
- Compliant with requirements for custody transfer (MID MI-001, OIML R49, ISO 4064, EN 14154)
- Standard in house wet calibration of sensors up to diameter DN3000
- Easy installation and commissioning
- No grounding rings with virtual reference option on IFC 300
- In-situ verification with OPTICHECK
- Extensive diagnostic capabilities
- Maintenance-free

Industries

- Water
- Wastewater
- Pulp & Paper
- Minerals & Mining
- Iron, Steel & Metals
- Power

Applications

- Water abstraction
- Water purification and desalination
- Drinking water distribution networks
- Revenue metering or billing
- Leakage detection
- Irrigation
- Industry water
- Cooling water
- Wastewater
- Sewage and sludge
- Sea water

1.2 Options

The reliable solution for the water and wastewater industry

From standard to customized
For easy ordering the standard range of the OPTIFLUX 2000F covers all popular sizes, flange materials and connections (ASME, EN, JIS, AWWA). But KROHNE does not stop here. Our extensive engineering department is dedicated to provide solutions for all specifications not covered by our standard range. Requests for special sizes, flange connections, pressure ratings, building lengths, and materials, will always get a serious review. Whenever possible we will engineer a flow meter that fits your application.

Easy installation
Fitting the OPTIFLUX 2000 is easy with the flanged design and standard ISO insertion lengths. To further ease the operation, the OPTIFLUX 2000 can be installed without filters and straighteners. Even grounding rings are not required with the patented **"Virtual Reference"** option on the IFC 300 converter.

IP68
Installation in measurement chambers subject to (constant) flooding is possible with the IP68 rated version. The chambers can even be completely surpassed if the IP68 version is combined with our special subsoil coating, allowing the OPTIFLUX 2000 to be installed directly in the ground.

Custody transfer

In combination with the IFC 300 converter the OPTIFLUX 2000 is suitable for custody transfer applications. It meets the requirements of OIML R49 and can be verified according to Annex MI-001 of the Measuring Instruments Directive (MID)

All water meters for legal metrology purposes in Europe require certification under the MID. The EC type examination certificate for the OPTIFLUX 2300 is valid for the compact and the remote version and applies for forward and reverse flow.

1.3 Measuring principle

An electrically conductive fluid flows inside an electrically insulated pipe through a magnetic field. This magnetic field is generated by a current, flowing through a pair of field coils. Inside of the fluid, a voltage U is generated:

$$U = v * k * B * D$$

in which:
v = mean flow velocity
k = factor correcting for geometry
B = magnetic field strength
D = inner diameter of flow meter

The signal voltage U is picked off by electrodes and is proportional to the mean flow velocity v and thus the flow rate q. A signal converter is used to amplify the signal voltage, filter it and convert it into signals for totalising, recording and output processing.

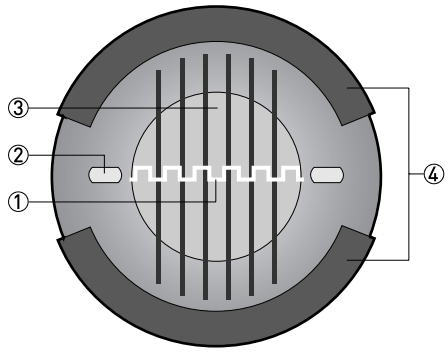


Figure 1-1: Measuring principle

① Induced voltage (proportional to flow velocity)
② Electrodes
③ Magnetic field
④ Field coils

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	Faraday's law of induction
Application range	Electrically conductive fluids
Measured value	
Primary measured value	Flow velocity
Secondary measured value	Volume flow

Design

Features	Fully welded maintenance-free sensor.
	Large diameter range DN25...3000
	Rugged liners approved for drinking water.
	Large standard range but also available in customer specific diameter, length and pressure rating.
Modular construction	The measurement system consists of a flow sensor and a signal converter. It is available as compact and as separate version. Additional information can be found in the documentation of the signal converter.
Compact version	With IFC 050 converter: OPTIFLUX 2050 C
	With IFC 100 converter: OPTIFLUX 2100 C
	With IFC 300 converter: OPTIFLUX 2300 C
Remote version	In wall (W) mount version with IFC 050 converter: OPTIFLUX 2050 W
	In wall (W) mount version with IFC 100 converter: OPTIFLUX 2100 W
	In field (F), wall (W) or rack (R) mount version with IFC 300 converter: OPTIFLUX 2300 F, W or R
Nominal diameter	With IFC 050 converter: DN25...1200 / 1...48"
	With IFC 100 converter: DN25...1200 / 1...48"
	With IFC 300 converter: DN25...3000 / 1...120"

Measuring accuracy

Reference conditions	Medium: water	
	Temperature: +10...+30°C / +50...+86°F	
	Operating pressure: 1 bar / 14.5 psi	
	Inlet section ≥ 5 DN	
	Electrical conductivity: ≥ 300 µS/cm	
Maximum measuring error	IFC 050: 0.5% of the measured value above 0.5 m/s; below 0.5 m/s, deviation ± 2.5 mm/s	
	IFC 100: down to 0.3% of the measured value ±1 mm/s	
	IFC 300: down to 0.2% of the measured value ±1 mm/s	
	The maximum measuring error depends on the installation conditions.	
	For detailed information refer to *Measuring accuracy* on page 19.	
Repeatability	±0.1% of the measured value, minimum 1 mm/s	
Calibration / Verification	**Standard:**	
	2 point calibration by a direct volume comparison.	
	Optional:	
	Verification to Measurement Instrument Directive (MID), Annex MI-001. Standard: Verification at Ratio (Q3/Q1) = 80, Q3 ≥ 2 m/s Optional: Verification at Ratio (Q3/Q1) > 80 on request	
	Only in combination with the IFC 300 signal converter.	
MID Annex MI-001 (Directive 2004/22/EC)	**EC-Type examination certificate to MID Annex MI-001**	
	Only in combination with the IFC 300 signal converter.	
	Diameter range: DN25...1600	
	Forward and reverse (bi-directional) flow	
	Liquid temperature range: +0.1°C / 50°C	
	For detailed information refer to *Legal metrology* on page 14.	
OIML R49	**Certificate of conformity to OIML R49**	
	Only in combination with the IFC 300 signal converter.	
	Diameter range	Class 1:DN65...1600
		Class 2: DN25...50
	Forward and reverse (bi-directional) flow	
	Liquid temperature range: +0.1°C / 50°C	
	For detailed information refer to *Legal metrology* on page 14.	

Operating conditions

Temperature	
For detailed information in pressure / temperature refer to *Pressure derating* on page 20	
	For Ex versions different temperatures are valid. Please refer to the relevant Ex documentation for details.
Process temperature	Hard rubber liner: -5...+80°C / 23...+176°F
	Polypropylene liner: -5...+90°C / 23...+194°F
	Polyolefin liner: -5...+80°C / 23...+176°F
Ambient temperature	**Standard** (with aluminium converter housing): standard flanges:
	-20…+65°C / -4 ...+149°F
	Option (with aluminium converter housing): low temperature carbon steel flanges or stainless steel flanges
	-40…+65°C / -40…+149°F
	Option (with stainless steel converter housing): low temperature carbon steel flanges or stainless steel flanges
	-40...+55°C / -40…+130°F
Protect electronics against self-heating at ambient temperatures above +55°C / +131°F.	
Storage temperature	-50...+70°C / -58...+158°F
Measurement range	-12...+12 m/s / -40...+40 ft/s
Pressure	
For detailed information in pressure / temperature refer to *Pressure derating* on page 20	
EN 1092-1	DN2200...3000: PN 2.5
	DN1200...2000: PN 6
	DN200...1000: PN 10
	DN65 and DN100...150: PN 16
	DN25...50 and DN80: PN 40
	Other pressures on request
ASME B16.5	1...24": 150 & 300 lb RF
	Other pressures on request
JIS	DN50...1000 / 2...40": 10 K
	DN25...40 / 1...1½": 20 K
	Other pressures on request
AWWA (class B or D FF)	**Option:**
	DN700...1000 / 28...40": ≤ 10 bar / 145 psi
	DN1200...2000 / 48...80": ≤ 6 bar / 87 psi
DIN	PN16 - 6 bar rated; DN700...2000
	PN10 - 6 bar rated; DN700...2000
	PN6 - 2 bar rated; DN700...2000
Vacuum load	For detailed information refer to *Vacuum load* on page 23.
Pressure loss	Negligible

Chemical properties	
Physical condition	Electrically conductive liquids
Electrical conductivity	Standard: ≥ 5 µS/cm
	Demineralized water: ≥ 20 µS/cm
Permissible gas content (volume)	IFC 050: ≤ 3%
	IFC 100: ≤ 3%
	IFC 300: ≤ 5%
Permissible solid content (volume)	IFC 050: ≤ 10%
	IFC 100: ≤ 10%
	IFC 300: ≤ 70%

Installation conditions

Installation	Assure that the flow sensor is always fully filled.
	For detailed information refer to *Installation* on page 27.
Flow direction	Forward and reverse
	Arrow on flow sensor indicates flow direction.
Inlet run	≥ 5 DN
Outlet run	≥ 2 DN
Dimensions and weights	For detailed information refer to *Dimensions and weights* on page 24.

Materials

Sensor housing	Sheet steel
	Other materials on request
Measuring tube	Austenitic stainless steel
Flanges	Carbon steel
	Other materials on request
Liner	**Standard:**
	DN25...150 / 1...6": polypropylene
	DN200...3000 / 8...120": hard rubber
	Option:
	DN25...150 / 1...6": hard rubber
	DN200...1000 / 8...40": polyolefin
Protective coating	On exterior of the meter: flanges, housing, signal converter (compact version) and / or connection box (field version)
	Standard: polyurethane coating
	Option: subsoil coating, offshore coating
Connection box	Only for remote versions
	Standard: die-cast aluminium
	Option: stainless steel
Measuring electrodes	Standard: Hastelloy® C
	Option: stainless steel, titanium
	Other materials on request

Grounding rings	Standard: stainless steel
	Option: Hastelloy® C, titanium, tantalum
	Grounding rings can be omitted with virtual reference option for the IFC 300 signal converter.
Reference electrode (optional)	Standard: Hastelloy® C
	Option: stainless steel, titanium
	Other materials on request

Process connections

Flange	
EN 1092-1	DN25...3000 in PN 2.5...40
ASME	1...24" in 150 & 300 lb RF
JIS	DN25...1000 in 10...20 K
AWWA	DN700...2000 in 6...10 bar
Design of gasket surface	RF
	Other sizes or pressure ratings on request.

Electrical connections

	For full detail; see the relevant documentation of the signal converter
Signal cable (remote versions only)	
Type A (DS)	**In combination with the IFC 050, IFC 100 and IFC 300 signal converter**
	Standard cable, double shielded. Max. length: 600 m / 1950 ft (depends on electrical conductivity and measuring sensor)
Type B (BTS)	**Only in combination with the IFC 300 signal converter**
	Optional cable, triple shielded. Max. length: 600 m / 1950 ft (depends on electrical conductivity and measuring sensor)
I/O	For full details of I/O options, including data streams and protocols, see technical datasheet of the relevant signal converter.

Approvals and certificates

CE	
	This device fulfils the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark.
Electromagnetic compatibility	Directive: 2004/108/EC, NAMUR NE21/04
	Harmonized standard: EN 61326-1 : 2006
Low voltage directive	Directive: 2006/95/EC
	Harmonized standard: EN 61010 : 2010
Pressure equipment directive	Directive: 97/23/EC
	Category I, II, III or SEP
	Fluid group 1
	Production module H

Hazardous areas	
ATEX	Please check the relevant Ex documentation for details.
	Compact version with IFC 100 signal converter
	II 2 GD
	Compact version with IFC 300 signal converter
	II 2 GD or II 2(1) GD
	Remote version
	II 2 GD
FM	**In combination with IFC 300 signal converter**
	Class I, Div. 2, Groups A, B, C and D
	Class II, Div. 2, Groups F and G
	Class III, Div. 2, Groups F and G
CSA	**In combination with IFC 300 signal converter**
	Class I, Div. 2, Groups A, B, C and D
	Class II, Div. 2, Groups F and G
NEPSI	GYJ05234 / GYJ05237
	Ex me ia IIC T6...T3
	Ex de ia II T6...T3
	Ex qe ia IIC T6...T3
	Ex e ia IIC T6...T3
Other approvals and standards	
Custody transfer	Only in combination with the IFC 300 signal converter.
	MID Annex MI-001 type examination certificate
	OIML R49 certificate of conformity
	Conformity with ISO 4064 and EN 14154
Drinking water approvals	Hard rubber liner: NSF / ANSI standard 61 / ACS, KTW(<60°C), DVGW-W270, KIWA on request.
	Polypropylene liner: ACS, KIWA, KTW, NSF / ANSI standard 61, WRAS
	Polyolefin liner: ACS, KTW (<60°C), DVGW-W270, WRAS
Protection category acc. to IEC 529 / EN 60529	**Standard:**
	IP66 / 67 (NEMA 4/4X/6)
	Option:
	IP68 (NEMA 6P)
	IP68 is only available for separate design and with a stainless steel connection box.
Shock test	IEC 68-2-27
	30 g for 18 ms
Vibration test	IEC 68-2-64
	f = 20 - 2000 Hz, rms = 4.5 g, t = 30 min.

2.2 Legal metrology

*OIML R49 and MID Annex MI-001 is **only** available in combination with the IFC 300 signal converter!*

2.2.1 OIML R49

The OPTIFLUX 2300 has a certificate of conformity with the international recommendation OIML R49. The certificate has been issued by NMi (Dutch board of weight and measures).
The OIML R49 recommendation (2006) concerns water meters intended for the metering of cold potable and hot water. The measuring range of the flowmeter is determined by Q3 (nominal flow rate) and R (ratio).

The OPTIFLUX 2300 meets the requirements for water meters of accuracy class 1 and 2.

- For accuracy class 1, the maximum permissible error for water meters is ±1% for the upper flow rate zone and ±3% for the lower flow rate zones.
- For accuracy class 2, the maximum permissible error for water meters is ±2% for the upper flow rate zone and ±5% for the lower flow rate zones.

According to OIML R49, accuracy class 1 designation shall be applied only to flowmeter with $Q3 \geq 100\ m^3/h$.

Q1 = Q3 / R
Q2 = Q1 * 1.6
Q3 = Q1 * R
Q4 = Q3 * 1.25

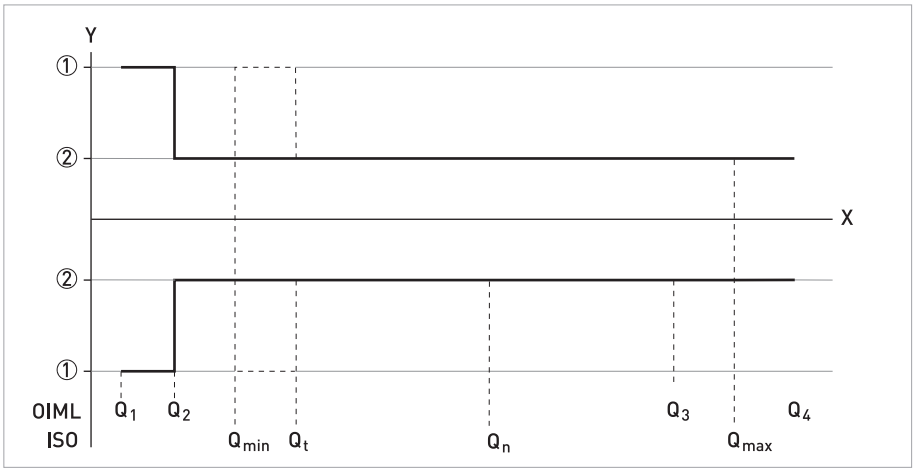


Figure 2-1: ISO flow rates added to figure as comparison towards OIML
X: Flow rate
Y [%]: Maximum measuring error

① ±3% for class 1, ±5% for class 2 devices
② ±1% for class 1, ±2% for class 2 devices

OIML R49 Class 1

DN	Span (R)	Flow rate [m^3/h]			
		Minimum Q1	Transitional Q2	Permanent Q3	Overload Q4
65	630	0.1587	0.25	100	125
80	630	0.254	0.40	160	200
100	630	0.3968	0.6	250	312.5
125	630	0.6349	1.0	400	500
150	630	0.6349	1.0	400	500
200	1000	1.0	1.6	1000	1250
250	1000	1.6	2.6	1600	2000
300	1000	2.5	4.0	2500	3125
350	500	5.0	8.0	2500	3125
400	500	8.0	12.8	4000	5000
450	500	8.0	12.8	4000	5000
500	500	12.6	20.2	6300	7875
600	160	39.375	63	6300	7875
700	80	125	200	10000	12500
800	80	125	200	10000	12500
900	80	200	320	16000	20000
1000	80	200	320	16000	20000
1200	80	200	320	16000	20000
1600	80	312.5	500	25000	31250

OIML R49 Class 2

DN	Span (R)	Flow rate [m^3/h]			
		Minimum Q1	Transitional Q2	Permanent Q3	Overload Q4
25	400	0.040	0.064	16	20
32	400	0.0625	0.10	25	31.3
40	400	0.0625	0.10	25	31.3
50	400	0.10	0.16	40	50

For DN65 to DN1600; same values (DN, R, Q1, Q2, Q3, Q4) as for OIML R49 class 1 are applicable.

2.2.2 MID Annex MI-001

All new designs of water meters that are to be used for legal purposes in Europe require certification under the Measurement Instrument Directive (MID) 2004/22/EC.
Annex MI-001 of the MID applies to water meters intended for the measurement of volume of clean, cold or heated water in residential, commercial and light industrial use. An EC-type examination certificate is valid in all countries of the European Union.

The OPTIFLUX 2300 has an EC-type examination certificate and can be verified to the MID Annex MI-001 for water meters with diameter DN25...DN1600. The conformity assessment procedure followed for OPTIFLUX 2300 is Module B (Type Examination) and Module D (Quality Assurance of the Production Process).

The maximim permissible error on volumes delivered between Q2 (transitional) flow rate and Q4 (overload) flow rate is ±2%.
The maximum permissible error on volumes delivered between Q1 (minimum) flow rate and Q2 (transitional) flow rate is ±5%.

Q1 = Q3 / R

Q2 = Q1 * 1.6

Q3 = Q1 * R

Q4 = Q3 * 1.25

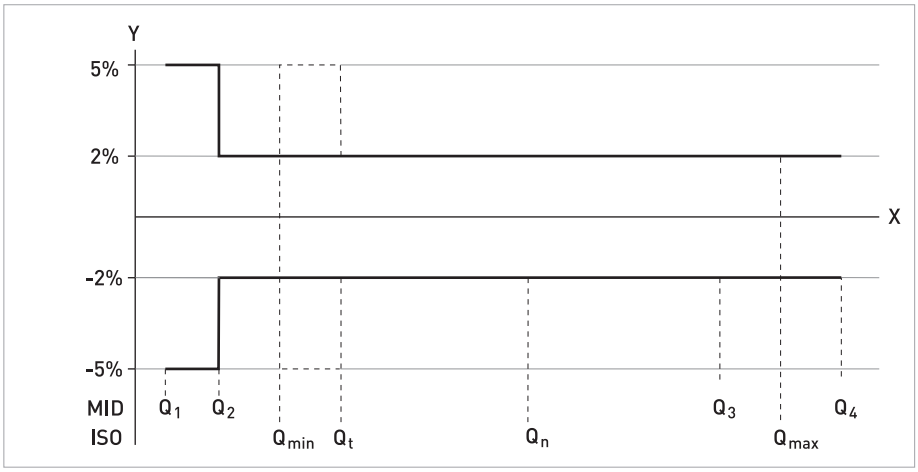


Figure 2-2: ISO flow rates added to figure as comparison towards MID
X: Flow rate
Y [%]: Maximum measuring error

MI-001 certified flow characteristics

DN	Span (R) Q3 / Q1	Flow rate [m^3/h]			
		Minimum Q1	Transitional Q2	Permanent Q3	Overload Q4
25	400	0.040	0.064	16	20
32	400	0.0625	0.10	25	31.3
40	400	0.0625	0.10	25	31.3
50	400	0.10	0.16	40	50
65	625	0.1587	0.25	100	125
80	640	0.254	0.40	160	200
100	625	0.3968	0.6	250	312.5
125	667	0.6349	1.0	400	500
150	667	0.6349	1.0	400	500
200	1000	1.0	1.6	1000	1250
250	1000	1.6	2.6	1600	2000
300	1000	2.5	4.0	2500	3125
350	500	5.0	8.0	2500	3125
400	500	8.0	12.8	4000	5000
450	500	8.0	12.8	4000	5000
500	500	12.6	20.2	6300	7875
600	160	39.375	63	6300	7875
700	80	125	200	10000	12500
800	80	125	200	10000	12500
900	80	200	320	16000	20000
1000	80	200	320	16000	20000
1200	80	200	320	16000	20000
1600	80	312.5	500	25000	31250

Verification to MI-001 and to OIML R49 class 2 is carried out at the following values for R, Q1, Q2 and Q3.
Verification to OIML R49 class 1 and at other values for R and Q3 available on request.

Verification to MI-001

DN	Span (R) Q3 / Q1	Flow rate [m^3/h]		
		Q1	Q2	Q3
25	80	0.05	0.08	4
32	80	0.125	0.20	10
40	80	0.125	0.20	10
50	80	0.2	0.32	16
65	80	0.3125	0.50	25
80	80	0.5	0.80	40
100	80	0.7875	1.26	63
125	80	1.250	2.00	100
150	80	2.0	3.2	160
200	80	3.125	5.0	250
250	80	5.0	8.0	400
350	80	5.0	8.0	400
300	80	7.875	12.6	630
350	80	12.5	20.0	1000
400	80	12.5	20.0	1000
450	80	12.5	20	1000
500	80	20.0	32	1600
600	80	50.0	80	4000
700	80	125	200	10000
800	80	125	200	10000
900	80	200	320	16000
1000	80	200	320	16000
1200	80	200	320	16000
1600	80	312.5	500	25000

2.3 Measuring accuracy

Each flowmeter is standard wet calibrated under reference conditions by direct volume comparison. The performance of the flowmeter is defined and documented in an individual calibration certificate.

Reference conditions

- Medium: water
- Temperature: +10...30°C / +50...86°F
- Operating pressure: 1 bar / 14.5 psi
- Inlet section: ≥ 5 DN
- Electrical conductivity: ≥ 300 µS/cm

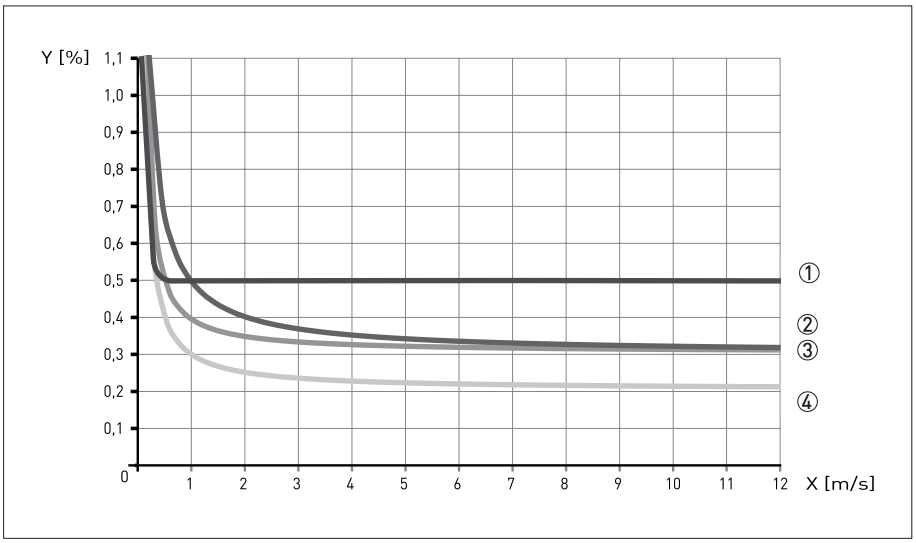


Figure 2-3: Flow velocity vs. accuracy
X [m/s] : flow velocity
Y [%]: deviation from the actual measured value (mv)

Accuracy

Sensor diameter	Converter type	Accuracy	Curve
DN25...1200 / 1...48"	IFC 050	0.5% of mv above 0,5 m/s, below 0,5 m/s, deviation ± 2.5 mm/s	①
DN25...1200 / 1...48"	IFC 100	0.3% of mv + 1 mm/s	③
DN25...1600 / 1...64"	IFC 300	0.2% of mv + 1 mm/s	④
DN1800...3000 / > 64"	IFC 300	0.3% of mv + 2 mm/s	②

2.4 Pressure derating

The graphs below refer to the maximum pressure as a function of the temperature for the flanges of the flowmeter (per specified flange material).

Please note that the specified values only refer to the flanges. The maximum value for the flowmeter can futher be limited by the maximum value for other materials (o.a. the liner)

For A = Carbonsteel A 105 & B = Stainless steel 316L
X/Y axes in all graphs ; X = Temperature in [°C] / Y = Pressure in [bar]
x/y axes in all graphs ; x = Temperature in [°F] / y = Pressure in [psi]

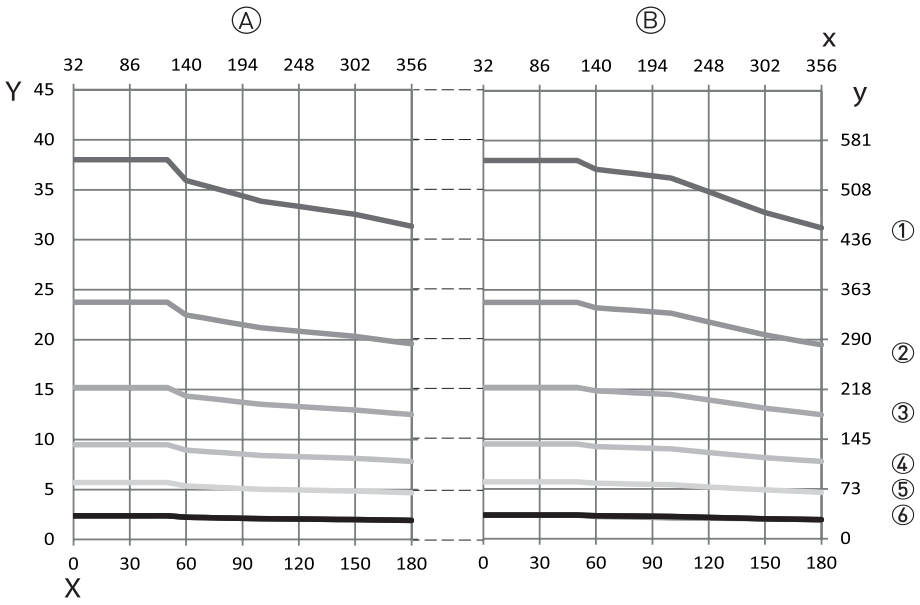


Figure 2-4: Presurre derating; EN 1092-1

① PN 2.5
② PN 6
③ PN 10
④ PN 16
⑤ PN 25
⑥ PN 40

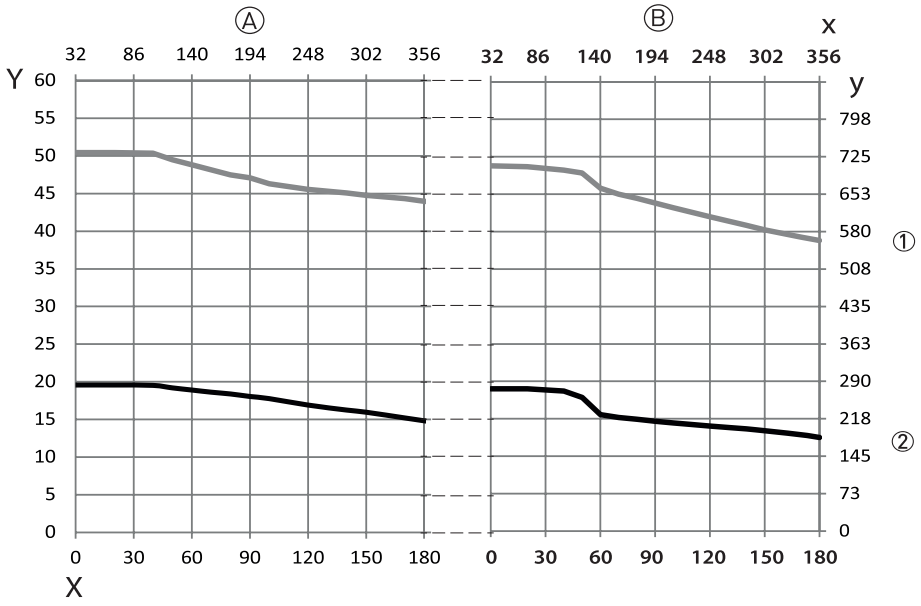


Figure 2-5: Presurre derating; ANSI B 16.5

① 300 lbs
② 150 lbs

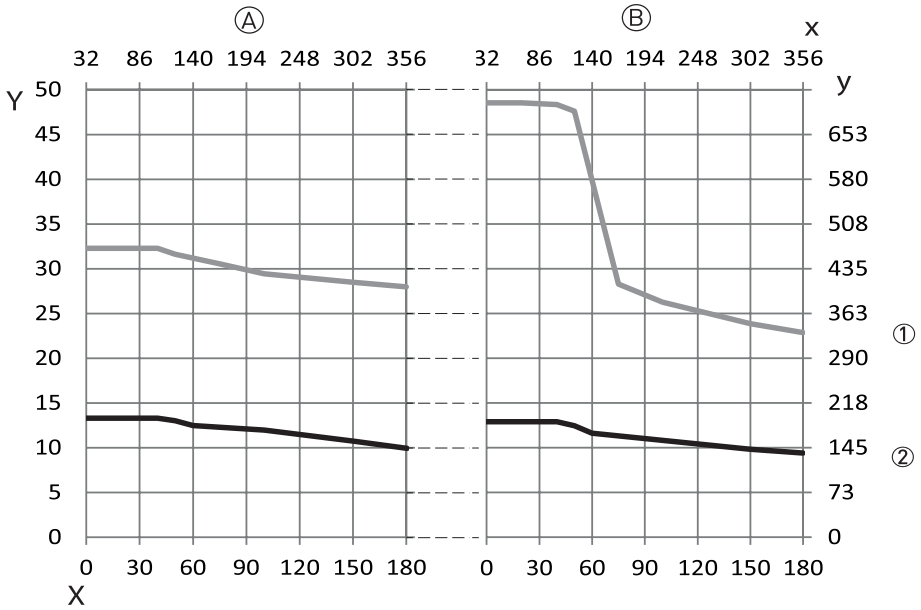


Figure 2-6: Pressure derating; JIS B2220

① 20K
② 10K

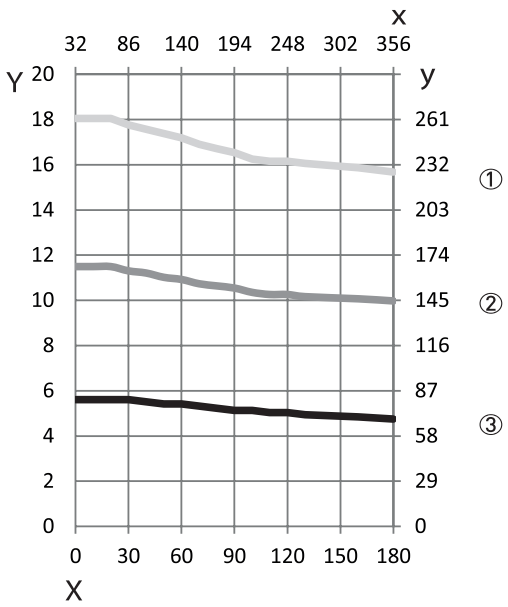


Figure 2-7: Presurre derating; AWWA C207

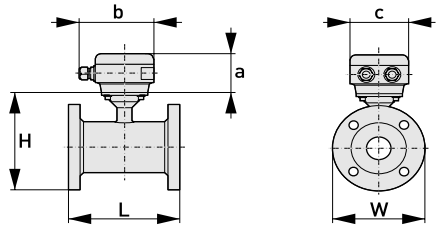
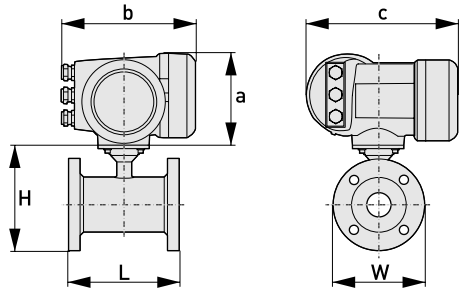
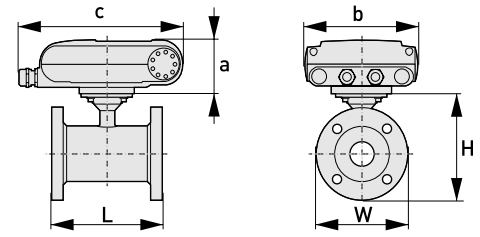
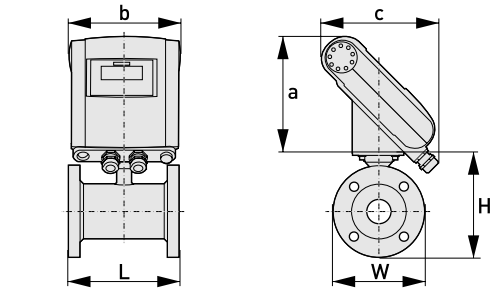
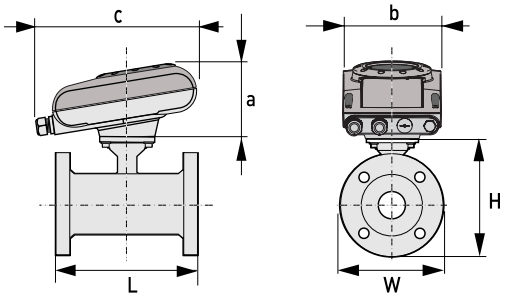
① Class D2 [>12"]
② Class D1 [4...12"]
③ Class B

2.5 Vacuum load

Diameter	Vacuum load in mbar abs. at a process temperature of			
[mm]	20°C	40°C	60°C	80°C
Hard rubber				
DN200...300	250	250	400	400
DN350...1000	500	500	600	600
DN1200...3000	600	600	750	750
Polypropylene				
DN25...150	250	250	400	400
Polyolefin				
DN200...1000	0	0	0	0

Diameter	Vacuum load in psia at process temperature of			
[inches]	68°F	104°F	140°F	176°F
Hard rubber				
8...12"	3.6	3.6	5.8	5.8
14...40"	7.3	7.3	8.7	8.7
48...120"	8.7	8.7	10.9	10.9
Polypropylene				
1...6"	3.6	3.6	5.8	5.8
Polyolefin				
8...40"	0	0	0	0

2.6 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
Compact version with IFC 300		a = 155 mm / 6,1" b = 230 mm / 9.1" ① c = 260 mm / 10.2" Total height = H + a
Compact version with IFC 100 (0°)		a = 82 mm / 3.2" b = 161 mm / 6.3" c = 257 mm / 10.1" ① Total height = H + a
Compact version with IFC 100 (45°)		a = 186 mm / 7.3" b = 161 mm / 6.3" c = 184 mm / 2.7" ① Total height = H + a
Compact version with IFC 050 (10°)		a = 101 mm / 3.98" b = 157 mm / 6.18" c = 260 mm / 10.24" ① Total height = H + a

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

- *All data given in the following tables are based on standard versions of the flow sensor only.*
- *Especially for smaller nominal sizes of the flow sensor, the signal converter can be bigger than the flow sensor.*
- *Note that for other pressure ratings than mentioned, the dimensions may be different.*
- *For full information on signal converter dimensions see relevant documentation.*

EN 1092-1

Nominal size DN [mm]	Dimensions [mm]				Approx. weight [kg]
	Standard length	ISO Insertion length	H	W	
25	150	200	140	115	5
32	150	200	157	140	6
40	150	200	166	150	7
50	200	200	186	165	11
65	200	200	200	185	9
80	200	200	209	200	14
100	250	250	237	220	15
125	250	250	266	250	19
150	300	300	300	285	27
200	350	350	361	340	34
250	400	450	408	395	48
300	500	500	458	445	58
350	500	550	510	505	78
400	600	600	568	565	101
450	600	-	618	615	111
500	600	-	671	670	130
600	600	-	781	780	165
700	700	-	898	895	248
800	800	-	1012	1015	331
900	900	-	1114	1115	430
1000	1000	-	1225	1230	507
1200	1200	-	1417	1405	555
1400	1400	-	1619	1630	765
1600	1600	-	1819	1830	1035
1800	1800	-	2027	2045	1470
2000	2000	-	2259	2265	1860

ASME B16.5 / 150 lb flanges

Nominal size [inches]	Dimensions [inches]			Approx. weight [lb]
	L	H	W	
1"	5.91	5.39	4.25	7
1½"	5.91	6.10	5.00	11
2"	7.87	7.05	5.98	18
3"	7.87	8.03	7.50	26
4"	9.84	9.49	9.00	44
5"	9.84	10.55	10.00	49
6"	11.81	11.69	11.00	64
8"	13.78	14.25	13.50	95
10"	15.75	16.30	16.00	143
12"	19.69	18.78	19.00	207
14"	27.56	20.67	21.00	284
16"	31.50	22.95	23.50	364
18"	31.50	24.72	25.00	410
20"	31.50	26.97	27.50	492
24"	31.50	31.38	32.00	675

ASME B16.5 / 300 lb flanges

Nominal size [inches]	Dimensions [inches]			Approx. weight [lb]
	L	H	W	
1"	5.91	5.71	4.87	11
1½"	7.87	6.65	6.13	13
2"	9.84	7.32	6.50	22
3"	9.84	8.43	8.25	31
4"	11.81	10.00	10.00	44
6"	12.60	12.44	12.50	73
8"	15.75	15.04	15.00	157
10"	19.69	17.05	17.50	247
12"	23.62	20.00	20.50	375
14"	27.56	21.65	23.00	474
16"	31.50	23.98	25.50	639
20"	31.50	28.46	30.50	937
24"	31.50	33.39	36.00	1345

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.

This electromagnetic flowmeter is designed exclusively to measure the flow of electrically conductive, liquid media.

If the device is not used according to the operating conditions (refer to chapter Technical data), the intended protection could be affected.

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.

3.2.1 Vibration

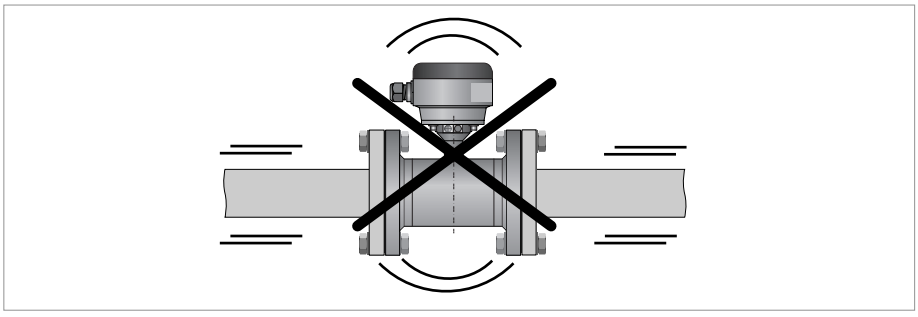


Figure 3-1: Avoid vibrations

3.2.2 Magnetic field

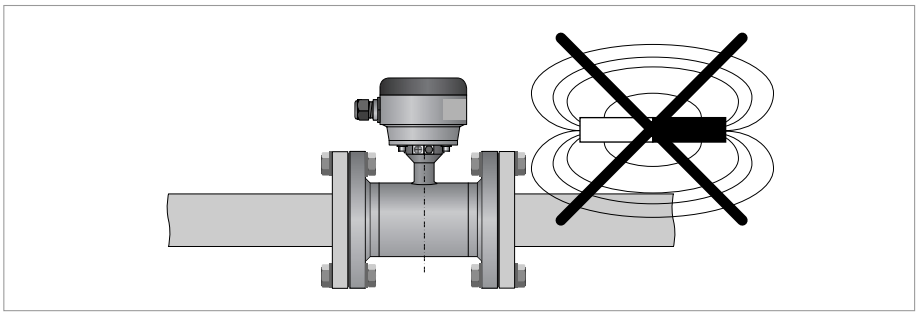


Figure 3-2: Avoid magnetic fields

3.3 Installation conditions

3.3.1 Inlet and outlet

Use straight inlet and outlet pipe sections to prevent flow distortion or swirl, caused by bends and T- sections.

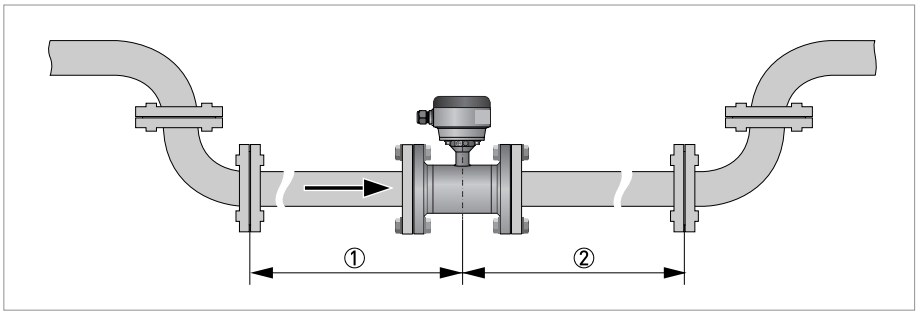


Figure 3-3: Recommended inlet and outlet section

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

3.3.2 Bends in 2 or 3 dimensions

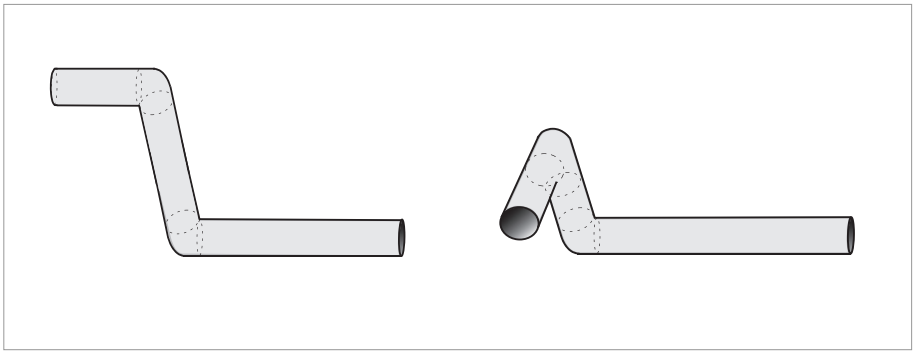


Figure 3-4: 2 and 3 dimensional bends, in front of flowmeter

① Bends in 2 dimensions: ≥ 5 DN; bends in 3 dimensions: ≥ 10 DN

3.3.3 T-section

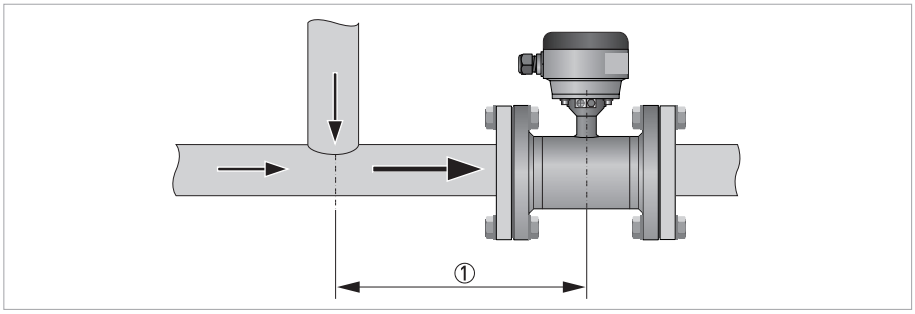


Figure 3-5: Distance behind a T-section

① ≥ 10 DN

3.3.4 Bends

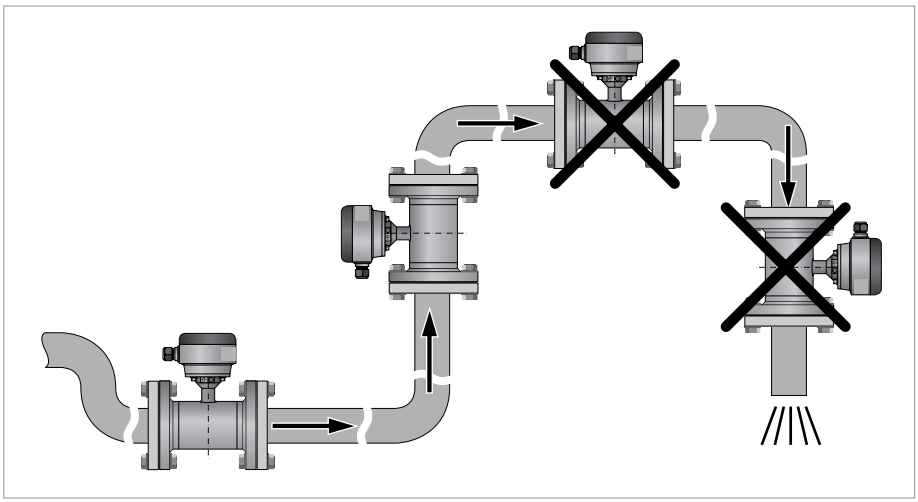


Figure 3-6: Installation in bending pipes

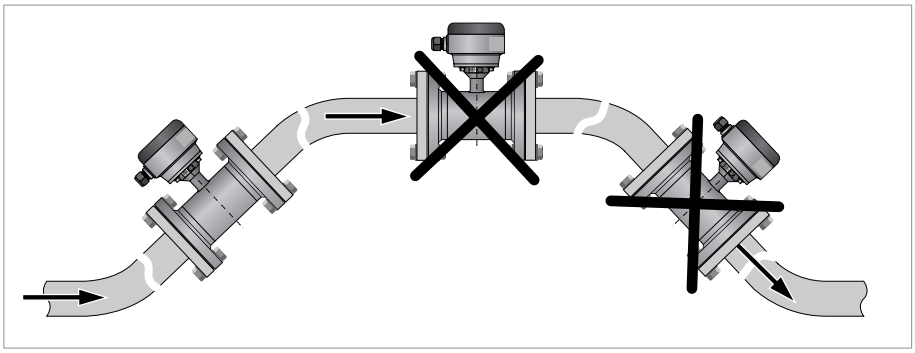


Figure 3-7: Installation in bending pipes

Avoid draining or partial filling of the flow sensor

3.3.5 Open feed or discharge

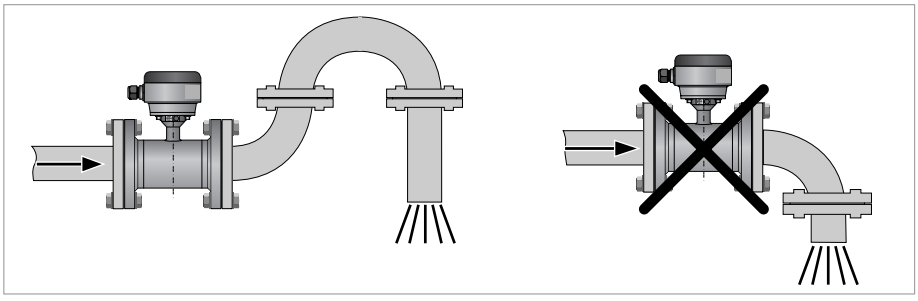


Figure 3-8: Installation in front of an open discharge

3.3.6 Flange deviation

Max. permissible deviation of pipe flange faces:
L_{max} - L_{min} ≤ 0.5 mm / 0.02"

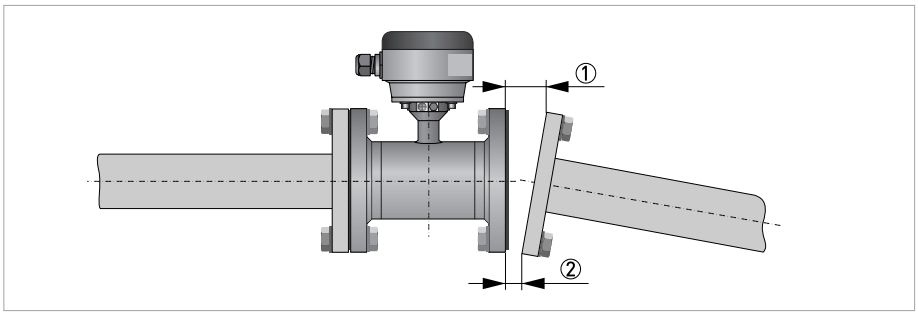


Figure 3-9: Flange deviation

① L_{max}
② L_{min}

3.3.7 Pump

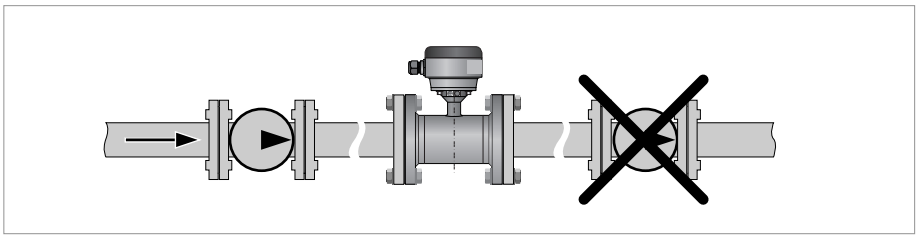


Figure 3-10: Installation behind a pump

3.3.8 Control valve

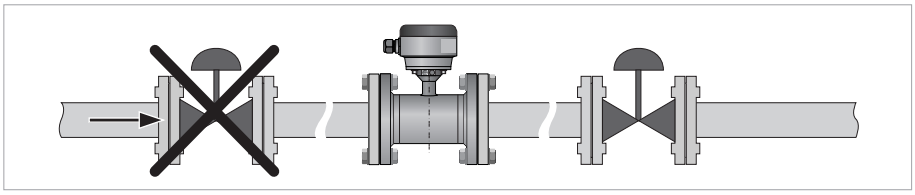


Figure 3-11: Installation in front of a control valve

3.3.9 Air venting and vacuum forces

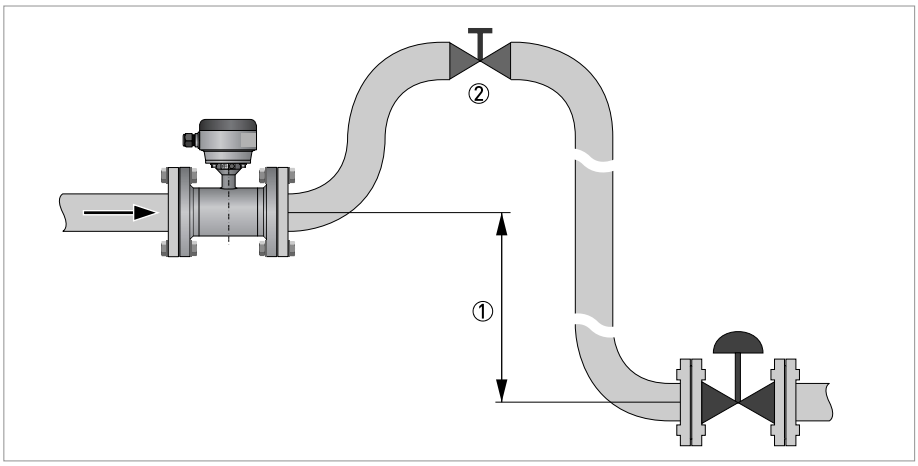


Figure 3-12: Air venting

① ≥ 5 m
② Air ventilation point

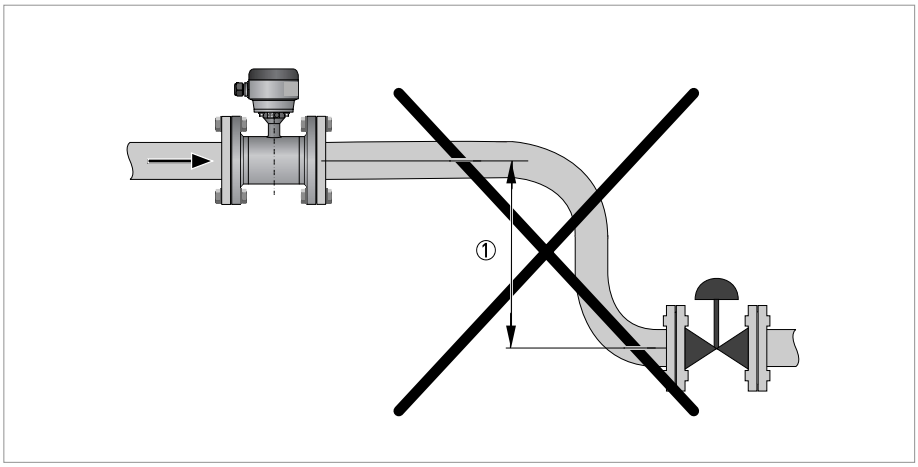


Figure 3-13: Vacuum

① ≥ 5 m

3.3.10 Mounting position

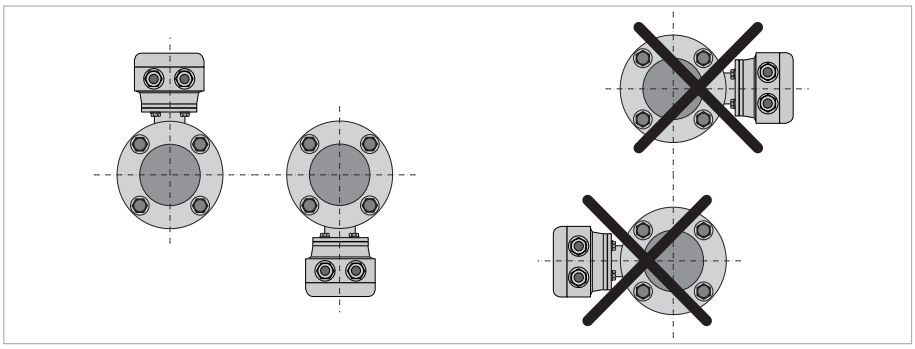


Figure 3-14: Mounting position

3.4 Mounting

3.4.1 Torques and pressures

The maximum pressure and torques values for the flowmeter are theoretical and calculated for optimum conditions and use with carbon steel flanges.

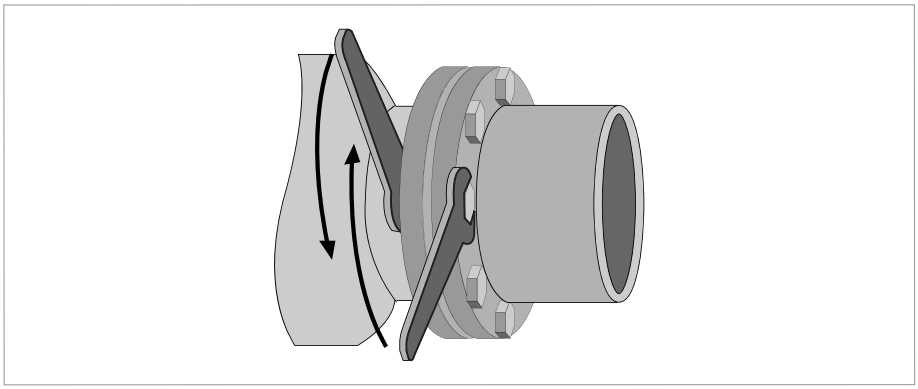


Figure 3-15: Tightening of bolts

Tightening of bolts

- Always tighten the bolts uniformely and in diagonally opposite sequence.
- Do not exceed the maximum torque value.
- Step 1: Apply approx. 50% of max. torque given in table.
- Step 2: Apply approx. 80% of max. torque given in table.
- Step 3: Apply 100% of max. torque given in table.

Nominal size DN [mm]	Pressure rating	Bolts	Max. torque [Nm] ①		
			Polyolefin	Polypropylene	Hard rubber
25	PN 40	4 x M 12	-	22	11
32	PN 40	4 x M 16	-	37	19
40	PN 40	4 x M 16	-	43	25
50	PN 40	4 x M 16	-	55	31
65	PN 16	② x M 16	-	51	42
65	PN 40	8 x M 16	-	38	21
80	PN 40	8 x M 16	-	47	25
100	PN 16	8 x M 16	-	39	30
125	PN 16	8 x M 16	-	53	40
150	PN 16	8 x M 20	-	68	47
200	PN 10	8 x M 20	68	-	68
200	PN 16	12 x M 20	45	-	45
250	PN 10	12 x M 20	65	-	65
250	PN 16	12 x M 24	78	-	78
300	PN 10	12 x M 20	76	-	76
300	PN 16	12 x M 24	105	-	105
350	PN 10	16 x M 20	75	-	75
400	PN 10	16 x M 24	104	-	104
450	PN 10	20 x M 24	93	-	93
500	PN 10	20 x M 24	107	-	107
600	PN 10	20 x M 27	138	-	138
700	PN 10	24 x M 27	163	-	163
800	PN 10	24 x M 30	219	-	219
900	PN 10	28 x M 30	205	-	205
1000	PN 10	28 x M 33	261	-	261

① The specified torque values are dependent on variables (temperature, bolt material, gasket material, lubricants, etc.) which are not within the control of the manufacturer. Therefore the values should be regarded as indicative only.

② DN65 / PN16 is available with standard 8 bolt holes. On request 4 bolt holes is optional.

Other sizes / pressure ratings on request.

Nominal size [inch]	Flange class [lb]	Bolts	Max. torque [lbf.ft] ①		
			Polyolefin	Polypropylene	Hard rubber
1	150	4 x 1/2"	-	6.7	3.2
1 1/2	150	4 x 1/2"	-	13	9
2	150	4 x 5/8"	-	24	17
3	150	4 x 5/8"	-	43	29
4	150	8 x 5/8"	-	34	23
6	150	8 x 3/4"	-	61	38
8	150	8 x 3/4"	51	-	51
10	150	12 x 7/8"	58	-	58
12	150	12 x 7/8"	77	-	77
14	150	12 x 1"	69	-	69
16	150	16 x 1"	67	-	67
18	150	16 x 1 1/8"	105	-	105
20	150	20 x 1 1/8"	94	-	94
24	150	20 x 1 1/4"	133	-	133
28	150	28 x 1 1/4"	119	-	119
32	150	28 x 1 1/2"	191	-	191
36	150	32 x 1 1/2"	198	-	198
40	150	36 x 1 1/2"	198	-	198

① The specified torque values are dependent on variables (temperature, bolt material, gasket material, lubricants, etc.) which are not within the control of the manufacturer. Therefore the values should be regarded as indicative only.

Other sizes / pressure ratings on request.

- *Pressures are applicable at 20° C / 68° F.*
- *For higher temperatures, the pressure ratings are as per ASME B16.5.*

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!

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 Grounding

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

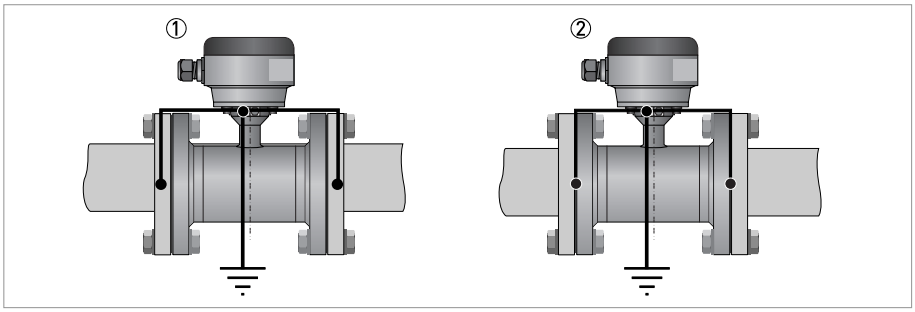


Figure 4-1: Grounding

① Metal pipelines, not internally coated. Grounding without grounding rings.
② Metal pipelines with internal coating and non-conductive pipelines. Grounding with grounding rings.

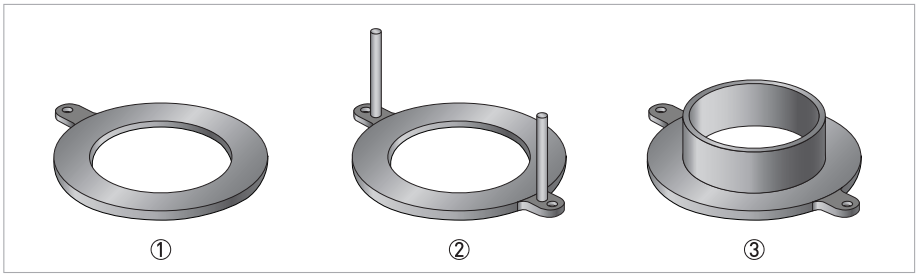


Figure 4-2: Different types of grounding rings

① Grounding ring number 1
② Grounding ring number 2
③ Grounding ring number 3

Grounding ring number 1:

- 3 mm / 0.1" thick (tantalum: 0.5 mm / 0.02")

Grounding ring number 2:

- 3 mm / 0.1" thick
- Prevents damage to the flanges during transport and installation
- Especially for flow sensors with PTFE liner

Grounding ring number 3:

- 3 mm / 0.1" thick
- With cylindrical neck (length 30 mm / 1.25" for DN10...150 / 3/8...6")
- Prevents damage to the liner when abrasive liquids are used

4.3 Virtual reference for IFC 300 (C, W and F version)

The virtual reference option on the IFC 300 flow converter provides complete isolation of the measurement circuit.

Benefits of virtual reference:

- Grounding rings or grounding electrodes can be omitted.
- Safety increases by reducing the number of potential leakage points.
- The installation of the flowmeters is much easier.

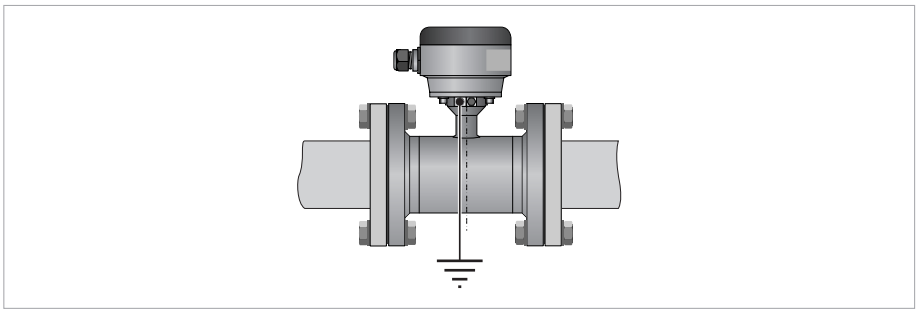


Figure 4-3: Virtual reference

Minimum requirements:

- Size: ≥ DN10
- Electrical conductivity: ≥ 200 µS/cm
- Electrode cable: max. 50 m / 164 ft, type DS

4.4 Connection diagrams

For the connection diagrams please refer to the documentation of the applicable signal converter.

KROHNE product overview

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

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www.krohne.com

KROHNE

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IFC 100 Technical Datasheet

Signal converter for electromagnetic flowmeters

- Extended accuracy option
- Diagnostics of device and application
- Certified for use in hazardous areas

The documentation is only complete when used in combination with the relevant documentation for the flow sensor.

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1.1 The all-round solution

The **IFC 100** electromagnetic signal converter combines an attractive price with a wide range of features and benefits including an excellent measuring accuracy.
The signal converter is compatible with almost any flow sensor in the OPTIFLUX and WATERFLUX range.

The signal converter converter supplies the current required by two field coils to generate a magnetic field. It converts the flow proportional signal voltage into digital values and filters out noise and interference signals. From the filtered signal, the flow velocity, the volume flow and the mass flow are calculated.

The **IFC 100** signal converter provides a large variety of flowmeter and process diagnostic functions guaranteeing reliable measurements. Detection of deposits or coating on the electrodes, temperature and conductivity changes in the medium, gas bubbles or solids, and an empty pipe are good examples of process diagnostics functions.

The flow velocity and volume can be read from the display or in analogue form via the current output (4...20 mA) as well as by frequency, pulse and status outputs. Measuring values and diagnostic information can be transmitted via interfaces including HART®, RS485 Modbus, Foundation Fieldbus and Profibus.

(signal converter in wall-mounted aluminium housing)

① Large graphic display with backlit
② Push buttons (4) for operator control without opening the housing
③ Intuitive navigation and quick menu setup

Highlights

- For operation with a wide range of OPTIFLUX and WATERFLUX flow sensors
- For flow sensors over a diameter range from DN2.5 up to DN1200
- Housing in aluminium with a polyester topcoat or in stainless steel (option)
- Tropicalized electronics to protect it from humidity (option)
- Available outputs: 4...20 mA current output, pulse/frequency output, status output/limit switch and Ex i I/O (option)
- HART® as standard
- Communication to third party systems via Foundation Fieldbus, Profibus PA/DP or Modbus
- Control input option
- Power supply via 100…230 VAC (standard) or 24 VDC or 24 VAC/DC (optional)
- Clearly readable values due to angle of the signal converter housing which prevents dirt and dust on the display
- Extended calibration option for higher measuring accuracy down to 0.2% of the measuring value
- Excellent price/performance ratio

Industries

- Machinery
- Water & Wastewater
- HVAC, energy management
- Chemical
- Food and Beverages
- Metals and Mining

Applications

- Flow in electrically conductive mediums with a minimum conductivity of 5 µS/cm
- Water flow measurements in a wide range of industries
- Water based chemicals
- Sludge and slurries
- Sanitary applications and (HoCIP, SIP) liquid food & beverages

1.2 Options and variants

Compact or remote wall-mounted housing

(signal converter in wall-mounted aluminium housing)

For an optimal reading of the display, the compact variant comes in a 0° and a 45° version.

The signal converter can be rotated in 90° increments to suit different installation positions.

The compact 0° version is designed for flowmeters in vertical pipelines, the compact 45° version for horizontal installations.

The wall mounted signal converter can be installed remotely for locations where the sensor is difficult to access, or ambient temperature conditions or vibrations prevent a compact variant.

Variant for use in hazardous areas

(Compact version as 0° version)

The IFC 100 signal converter is available in a variant suitable for hazardous areas with approvals to ATEX, IECEx, FM, CSA and NEPSI.

Stainless steel housing (option)

(signal converter in wall-mounted stainless steel housing)

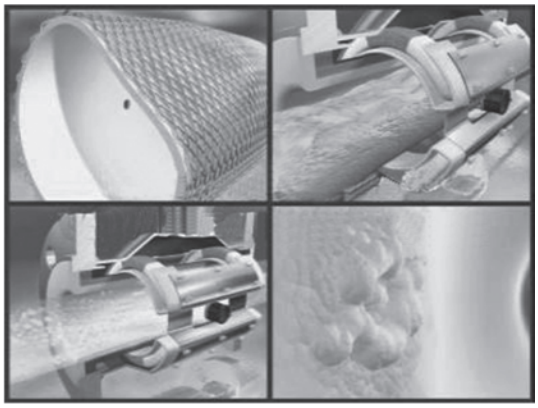
Whereas the standard housing material is aluminium with a polyester topcoat, the **IFC 100** can optionally be ordered in a stainless steel housing.

The robust housing is suitable for many applications in the food and beverage industry.
It is designed for environments where extreme chemicals or aggressive cleaning are used.

The housing is dual rated to IP67/69 protection category to resist wash down cleaning and no glass is used for the display window.

Thanks to the mounting angle for the compact housing and the rounding edges in wall-mount position nor dirt or water cannot compile on the surface.

Diagnostics of device and application



The primary focus of a user for a flowmeter is that it delivers reliable measurements. To achieve this all our electromagnetic flowmeters are calibrated before leaving the factory.

In addition, the **IFC 100** provides a range diagnostic functions on the flow sensor, signal converter and process, integrated in the signal converter.

Potential problems including gas bubbles, solids, electrode corrosion, deposits on electrodes, conductivity changes, empty pipe can be detected by the diagnostics features.

OPTICHECK tool for on-site verification

(Suitcase with OPTICHECK and all cables and accesssories)

The OPTICHECK provides an inline health check of the device under test by an external tool.
When the tool is connected on site, it gathers measuring data to ensure that the flowmeter performs within 1% of its factory calibration.

The baseline can be historic repair data from the factory or on-site test results after performing a full verification.

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

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

1.3 Signal converter/flow sensor combination possibilities

Flow sensor	Flow sensor + signal converter IFC 100	
	Compact (0°/45° version)	Remote wall-mounted housing
OPTIFLUX 1000	OPTIFLUX 1100 C	OPTIFLUX 1100 W
OPTIFLUX 2000	OPTIFLUX 2100 C	OPTIFLUX 2100 W
OPTIFLUX 4000	OPTIFLUX 4100 C	OPTIFLUX 4100 W
OPTIFLUX 5000	OPTIFLUX 5100 C	OPTIFLUX 5100 W
OPTIFLUX 6000	OPTIFLUX 6100 C	OPTIFLUX 6100 W
WATERFLUX 3000	WATERFLUX 3100 C	WATERFLUX 3100 W

1.4 Measuring principle

An electrically conductive fluid flows inside an electrically insulated pipe through a magnetic field. This magnetic field is generated by a current, flowing through a pair of field coils. Inside of the fluid, a voltage U is generated:
U = v * k * B * D

in which:
v = mean flow velocity
k = factor correcting for geometry
B = magnetic field strength
D = inner diameter of flowmeter

The signal voltage U is picked off by electrodes and is proportional to the mean flow velocity v and thus the flow rate Q. A signal converter is used to amplify the signal voltage, filter it and convert it into signals for totalizing, recording and output processing.

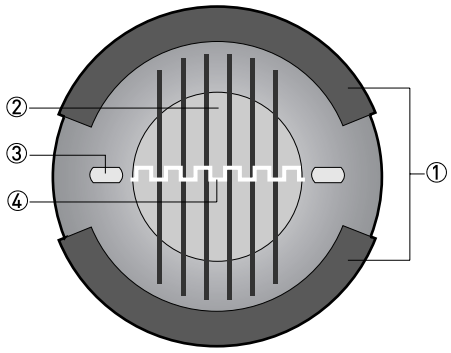


Figure 1-1: Measuring principle

① Field coils
② Magnetic field
③ Electrodes
④ Induced voltage (proportional to flow velocity)

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	Faraday's law of induction
Application range	Continuous measurement of current volume flow, flow velocity, conductivity, mass flow (at constant density), coil temperature of the flow sensor

Design

Modular construction	The measuring system consists of a flow sensor and a signal converter.
Flow sensor	
OPTIFLUX 1000	DN10...150 / 3/8...6"
OPTIFLUX 2000	DN25...1200 / 1...48"
OPTIFLUX 4000	DN2.5...1200 / 1/10...48"
OPTIFLUX 5000	Flange: DN15...300 / 1/2...12" Sandwich: DN2.5...100 / 1/10...4"
OPTIFLUX 6000	DN2.5...150 / 1/10...6"
WATERFLUX 3000	DN25...600 / 1...24"
	With the exception of the OPTIFLUX 1000 and WATERFLUX 3000 all flow sensors are also available in an Ex version.
Signal converter	
Compact version (C)	IFC 100 C (0° & 45° version)
Remote version (W)	IFC 100 W
	All signal converters are also available in an Ex version.
Options	
Outputs	Current output (incl. HART®), pulse output, frequency output, status output and/or limit switch
Counter	2 internal counters with a max. of 10 counter places (e.g. for counting volume and/or mass units)
Verification	Integrated verification, diagnostic functions: measuring device, empty pipe detection, stabilisation
Communication interfaces	HART® as standard
	Foundation Fieldbus, Profibus PA/DP or Modbus

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"
	Ambient temperatures below -25°C / -13°F may affect the readability of the display.
Operating elements	4 push buttons for operator control of the signal converter without opening the housing.
Remote control	PACTware™ (including Device Type Manager (DTM))
	HART® Hand Held Communicator from Emerson Process
	AMS® from Emerson Process
	PDM® from Siemens
	All DTMs and drivers are available free of charge from the manufacturer's website.
Display functions	
Operating menu	Setting the parameters using 2 measuring pages, 1 status page, 1 graphic page (measured values and graphics are freely adjustable)
Language display texts (as language package)	Standard: English, French, German, Dutch, Portuguese, Swedish, Spanish, Italian
	Eastern Europe: English, Slovenian, Czech, Hungarian
	Northern Europe: English, Danish, Polish, Finnish, Norwegian
	Southern Europe: English, Turkish
	China: English, German, Chinese
	Russia: English, German, Russian
Units	Metric, British and US units selectable as required from lists for volume / mass flow and counting, flow velocity, electrical conductivity, temperature

Measuring accuracy

Max. measuring accuracy	**Standard:** ±0.3% of the measured value ± 1 mm/s; depending on the flow sensor
	Option (optimised accuracy with extended calibration): ±0.2% of the measured value ± 1.5 mm/s; depending on the flow sensor
	For detailed information and accuracy curves refer to *Measuring accuracy* on page 25.
	Special calibrations are available on request.
	Current output electronics: ±10 µA; ±100 ppm/°C (typically: ±30 ppm/°C)
Repeatability	±0.1%

Operating conditions

Temperature	
Process temperature	Refer to technical data for the flow sensor.
Ambient temperature	Depending on the version and combination of outputs.
	It is a good idea to protect the signal converter from external heat sources such as direct sunlight as higher temperatures reduce the life cycle of all electronic components.
	Ambient temperatures below -25°C / -13°F may affect the readability of the display.
Storage temperature	-40…+70°C / -40…+158°F
Pressure	
Medium	Refer to technical data for the flow sensor.
Ambient pressure	Atmospheric
Chemical properties	
Electrical conductivity	All media except for water: ≥ 5 µS/cm (also refer to the technical data for the flow sensor)
	Water: ≥ 20 µS/cm
State of aggregation	Conductive, liquid media
Solid content (volume)	≤ 10% for OPTIFLUX flow sensors
Gas content (volume)	≤ 3% for OPTIFLUX flow sensors
Flow rate	For detailed information, refer to chapter "Flow tables".
Other conditions	
Ingress protection acc. to IEC 529 / EN 60529	Standard version with aluminium housing: IP66/67 (acc. to NEMA 4/4X) Optional version with stainless steel housing: IP69

Installation conditions

Installation	For detailed information, refer to chapter "Installation conditions".
Inlet / outlet sections	Refer to technical data for the flow sensor.
Dimensions and weight	For detailed information refer to chapter "Dimensions and weight".

Materials

Signal converter housing	Standard: Aluminium with a polyester topcoat Option: Stainless steel 1.4404 / AISI 316L
Flow sensor	For housing materials, process connections, liners, grounding electrodes and gaskets, refer to technical data for the flow sensor.

Electrical connection

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	100…230 VAC (-15% / +10%), 50/60 Hz; non-Ex: standard; Ex: optional 240 VAC + 5% is included in the tolerance range.
	24 VDC (-55% / +30%); only available as non-Ex version 12 VDC - 10% is included in the tolerance range.
	24 VAC/DC (AC: -15% / +10%; DC: -25% / +30%); non-Ex: standard; Ex: optional 12 V is **not** included in the tolerance range.
Power consumption	AC: 7 VA
	DC: 4 W
Signal cable	Only necessary for remote versions.
	DS 300 (type A) Max. length: 600 m / 1968 ft (depending on electrical conductivity and flow sensor version)
Cable entries	Standard: M20 x 1.5 (8...12 mm)
	Option: 1/2 NPT, PF 1/2

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 abbreviations	U_{ext} = external voltage; R_L = load + resistance; U_o = terminal voltage; I_{nom} = nominal current

Current output		
Output data	Volume flow, mass flow, diagnostic value, flow velocity, coil temperature, conductivity	
Settings	**Without HART®**	
	Q = 0%: 0…20 mA; Q = 100%: 10…21.5 mA	
	Error identification: 20…22 mA	
	With HART®	
	Q = 0%: 4…20 mA; Q = 100%: 10…21.5 mA	
	Error identification: 3…22 mA	
Operating data	**Basic I/Os**	**Ex i I/Os**
Active	$U_{int, nom}$ = 20 VDC I ≤ 22 mA R_L ≤ 750 Ω	-
	HART® at terminals A	
Passive	U_{ext} ≤ 32 VDC I ≤ 22 mA U_0 ≥ 2 V at I = 22 mA $R_L \leq (U_{ext} - U_0) / I_{max}$	U_{ext} ≤ 32 VDC I ≤ 22 mA U_0 ≥ 4 V $R_L \leq (U_{ext} - U_0) / I_{max}$
		U_i = 30 V I_i = 130 mA P_i = 1 W C_i = 10 nF L_i ~ 0 mH
	HART® at terminals A	HART® at terminals C
HART®		
Description	HART® protocol via active and passive current output	
	HART® version: V5	
	Universal Common Practice HART® parameter: completely supported	
Load	≥ 250 Ω at HART® test point; Note maximum load for current output!	
Multi-drop mode	Yes, current output = 4 mA	
	Multi-drop address adjustable in operation menu 1…15	
Device drivers	Available for FC 375/475, AMS, PDM, FDT/DTM	
Registration (HART Communication Foundation)	Yes	

Pulse output / frequency output		
Output data	Pulse output: volume flow, mass flow	
	Frequency output: volume flow, mass flow, diagnostic value, flow velocity, coil temperature, conductivity	
Function	Can be set as a pulse output or frequency output	
Pulse rate/frequency	0.25...10000 Hz	
	For Modbus I/O: 0.25...1000 Hz	
Settings	Pulses per volume or mass unit or max. frequency for 100% flow	
	Pulse width: adjustable as automatic, symmetric or fixed (0.05...2000 ms)	
Operating data	**Basic I/Os**	**Ex i I/Os**
Passive	$U_{ext} \leq 32$ VDC	-
	f_{max} in operating menu set to $f_{max} \leq 100$ Hz: $I \leq 100$ mA open: $I \leq 0.05$ mA at $U_{ext} = 32$ VDC closed: $U_{0, max} = 0.2$ V at $I \leq 10$ mA $U_{0, max} = 2$ V at $I \leq 100$ mA	
	f_{max} in operating menu set to 100 Hz < $f_{max} \leq 10$ kHz: $I \leq 20$ mA open: $I \leq 0.05$ mA at $U_{ext} = 32$ VDC closed: $U_{0, max} = 1.5$ V at $I \leq 1$ mA $U_{0, max} = 2.5$ V at $I \leq 10$ mA $U_{0, max} = 5.0$ V at $I \leq 20$ mA	-
NAMUR	-	Passive to EN 60947-5-6 open: $I_{nom} = 0.77$ mA closed: $I_{nom} = 4.7$ mA
		$U_i = 30$ V $I_i = 130$ mA $P_i = 1$ W $C_i = 10$ nF $L_i = 0$ mH
Operating data	**Modbus**	
Passive	$U_{ext} \leq 32$ VDC	
	f_{max} in the operating menu set to $f_{max} \leq 1$ kHz: $I \leq 100$ mA open: $I \leq 0.05$ mA at $U_{ext} = 32$ VDC closed: $U_{0, max} = 0.2$ V at $I \leq 10$ mA $U_{0, max} = 2$ V at $I \leq 100$ mA	

Low flow cut off		
Function	Switching point and hysteresis separately adjustable for each output, counter and the display	
Switching point	Set in increments of 0.1%.	
	0…20% (current output, frequency output) or 0...±9.999 m/s (pulse output)	
Hysteresis	Set in increments of 0.1%.	
	0…5% (current output, frequency output) or 0…5 m/s (pulse output)	
Time constant		
Function	The time constant corresponds to the elapsed time until 67% of the end value has been reached according to a step function.	
Settings	Set in increments of 0.1 seconds.	
	0…100 seconds	
Status output / limit switch		
Function and settings	Adjustable as automatic measuring range conversion, display of flow direction, counter overflow, error, switching point or empty pipe detection	
	Valve control with activated dosing function	
	Status and/or control: ON or OFF	
Operating data	**Basic I/Os + Modbus**	**Ex i I/Os**
Passive	$U_{ext} \leq 32$ VDC $I \leq 100$ mA open: $I \leq 0.05$ mA at $U_{ext} = 32$ VDC closed: $U_{0, max} = 0.2$ V at $I \leq 10$ mA $U_{0, max} = 2$ V at $I \leq 100$ mA	-
NAMUR	-	Passive to EN 60947-5-6 open: $I_{nom} = 0.77$ mA closed: $I_{nom} = 4.7$ mA
		$U_i = 30$ V $I_i = 130$ mA $P_i = 1$ W $C_i = 10$ nF $L_i = 0$ mH

Control input		
Function	Hold value of the outputs (e.g. for cleaning work), set value of the outputs to "zero", counter and error reset, range change.	
	Start of dosing when dosing function is activated.	
Operating data	**Basic I/Os**	**Ex i I/Os + Modbus**
Passive	$U_{ext} \leq 32$ VDC I_{nom} = 6.5 mA at U_{ext} = 24 VDC I_{nom} = 8.2 mA at U_{ext} = 32 VDC Contact closed (on): $U_0 \geq 8$ V at I_{nom} = 2.8 mA Contact open (off): $U_0 \leq 2.5$ V at I_{nom} = 0.4 mA	-
PROFIBUS DP		
Description	Galvanically isolated acc. to IEC 61158-2	
	PA profile version: class B, V3.02	
	Automatic data transmission rate recognition (max. 1.5 MBaud)	
	Bus address adjustable via local display at the measuring device	
Function blocks	5 x analogue input, 3 x totaliser	
Output data	Volume flow, mass flow, volume counter 1 + 2, mass counter, velocity, coil temperature, conductivity	
PROFIBUS PA		
Description	Galvanically isolated acc. to IEC 61158-2	
	PA profile version: class B, V3.02	
	Current consumption: 10.5 mA	
	Permissible bus voltage: 9…32 VDC; in Ex application: 9...24 VDC	
	Bus interface with integrated reverse polarity protection	
	Typical error current FDE (Fault Disconnection Electronic): 6 mA	
	Bus address adjustable via local display at the measuring device	
Function blocks	5 x analogue input, 3 x totaliser	
Output data	Volume flow, mass flow, volume counter 1 + 2, mass counter, velocity, coil temperature, conductivity	
FOUNDATION Fieldbus		
Description	Galvanically isolated acc. to IEC 61158-2	
	Current consumption: 10.5 mA	
	Permissible bus voltage: 9…32 VDC; in Ex application: 9...24 VDC	
	Bus interface with integrated reverse polarity protection	
	Link Master function (LM) supported	
	Tested with Interoperable Test Kit (ITK) version 5.2	
Function blocks	3 x analogue input, 2 x integrator, 1 x PID	
Output data	Volume flow, mass flow, velocity, coil temperature, conductivity, electronics temperature	

Modbus	
Description	Modbus RTU, Master / Slave, RS485
Address range	1…247
Broadcast	Supported with function code 16
Supported Baud rate	1200, 2400, 3600, 4800, 9600, 19200, 38400, 57600, 115200 Baud

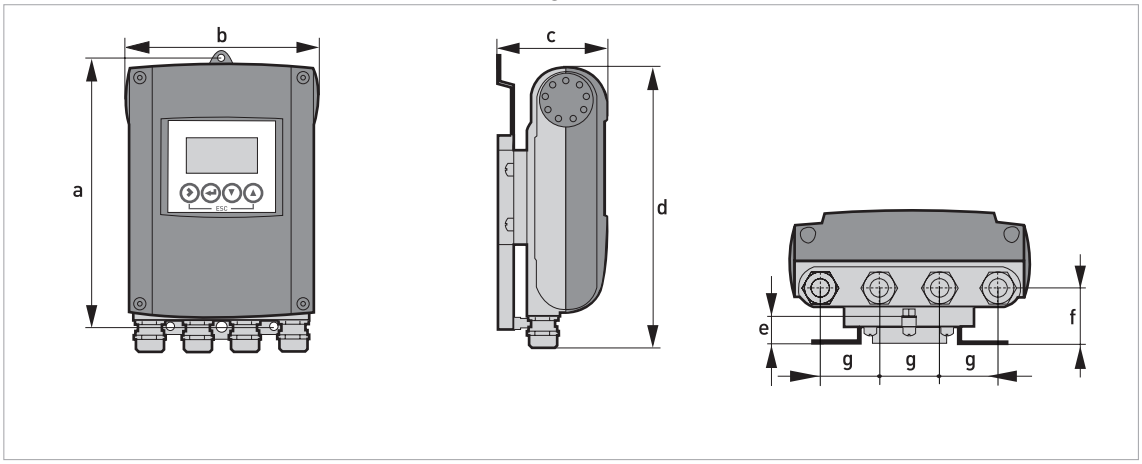
Approvals and certificates

CE	This device fulfils the statutory requirements of the relevant EU directives. The manufacturer certifies successful testing of the product by applying the CE mark.
	For full information of the EU directives & standards and the approved certifications, please refer to the EU declaration or the manufacturer website.
Non-Ex	Standard
Hazardous areas	
ATEX	**Option (only OPTIFLUX 2100 C and OPTIFLUX 4100 C)**
	II 2 G Ex e [ia] mb IIC T4 (DN10...20; DN200...300; DN350...3000)
	II 2 G Ex d e [ia] mb IIC T4 (DN25...150)
	II 2 G Ex e [ia] mb q T4/T3 (DN25...150; DN200...300)
	II 2 D Ex tD A21 IP64 T120°C (all nominal sizes)
	Option (only W version)
	II 2 G Ex e [ia] mb IIC T4
	II 2 D Ex tD A21 IP64 T135°C
IECEx	**Option (only OPTIFLUX 2100 C and OPTIFLUX 4100 C)**
	Ex e [ia] mb IIC T4 (DN10...20; DN200...300; DN350...3000)
	Ex d e [ia] mb IIC T4 (DN25...150)
	Ex tD A21 IP64 T120°C (all nominal sizes)
	Option (only W version)
	Ex e [ia] mb IIC T4
	Ex tD A21 IP64 T135°C
FM/CSA	**Option (only OPTIFLUX 2100 C and OPTIFLUX 4100 C)**
	Class I, Div 2, Group A, B, C and D
	Option (only W version)
	Class I, Div 2, Group A, B, C and D
	Ordinary location
Other standards and approvals	
Electromagnetic compatibility (EMC)	2004/108/EC in conjunction with EN 61326-1 (A1, A2)
Shock and vibration resistance	IEC 68-2-27, IEC 68-2-64
NAMUR	NE 21, NE 43, NE 53

2.2 Dimensions and weight

2.2.1 Housing

Wall-mounted version, aluminium housing



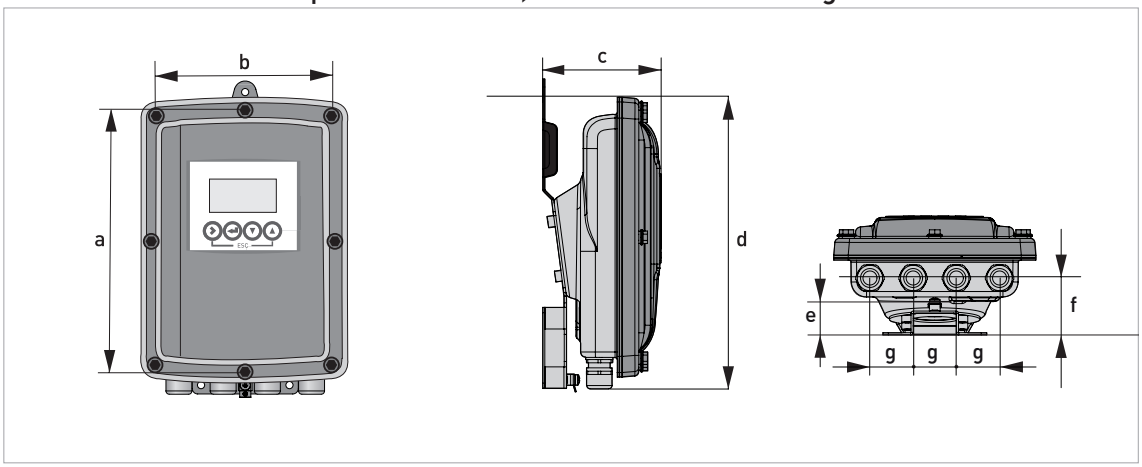
Dimensions and weights in mm and kg

	Dimensions [mm]							Weight [kg]
	a	b	c	d	e	f	g	
Wall-mounted version	241	161	95.2	257	19.3	39.7	40	1.9

Dimensions and weights in inch and lb

	Dimensions [inch]							Weight [lb]
	a	b	c	d	e	f	g	
Wall-mounted version	9.50	6.34	3.75	10.12	0.76	1.56	1.57	4.2

Wall-mounted and compact 10° version, stainless steel housing



Dimensions and weights in mm and kg

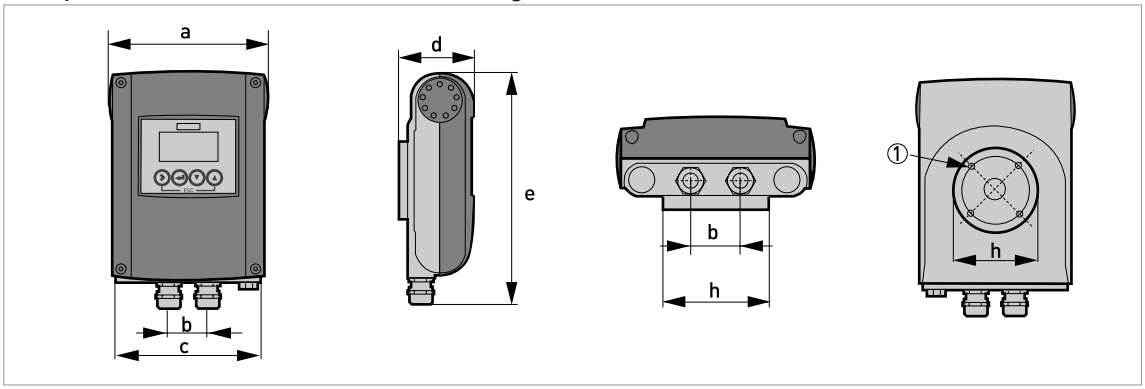
	Dimensions [mm]							Weight [kg]
	a	b	c	d	e	f	g	
Wall-mounted version	268	187	110	276	29	53	40	Approx. 3.5

Dimensions and weights in inch and lb

	Dimensions [inch]							Weight [lb]
	a	b	c	d	e	f	g	
Wall-mounted version	10.55	7.36	4.33	10.87	1.14	2.09	1.57	Approx. 7.2

The compact 10° version is without mounting plate.

Compact 0° version, aluminium housing



① 4 x M 6

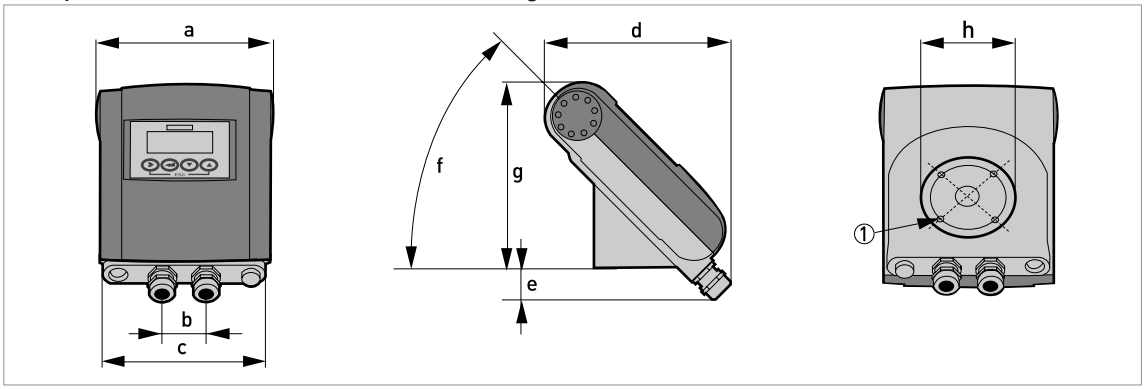
Dimensions and weights in mm and kg

	Dimensions [mm]								Weight [kg]
	a	b	c	d	e	f	g	h	
0° version	161	40	155	81.5	257	-	-	Ø72	Std: 1.9 Ex: 2.4

Dimensions and weights in inch and lb

	Dimensions [inch]								Weight [lb]
	a	b	c	d	e	f	g	h	
0° version	6.34	1.57	6.1	3.21	10.12	-	-	Ø2.83	Std: 4.2 Ex: 5.3

Compact 45° version, aluminium housing



① 4 x M 6

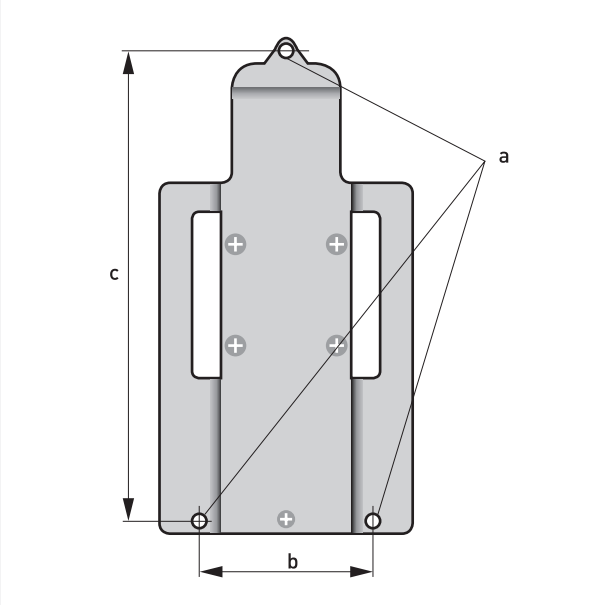
Dimensions and weights in mm and kg

	Dimensions [mm]								Weight [kg]
	a	b	c	d	e	f	g	h	
45° version	161	40	155	184	27.4	45°	186	Ø72	Std: 2.1 Ex: 2.6

Dimensions and weights in inch and lb

	Dimensions [inch]								Weight [lb]
	a	b	c	d	e	f	g	h	
45° version	6.34	1.57	6.10	7.24	1.08	45°	7.32	Ø2.83	Std: 4.6 Ex: 5.7

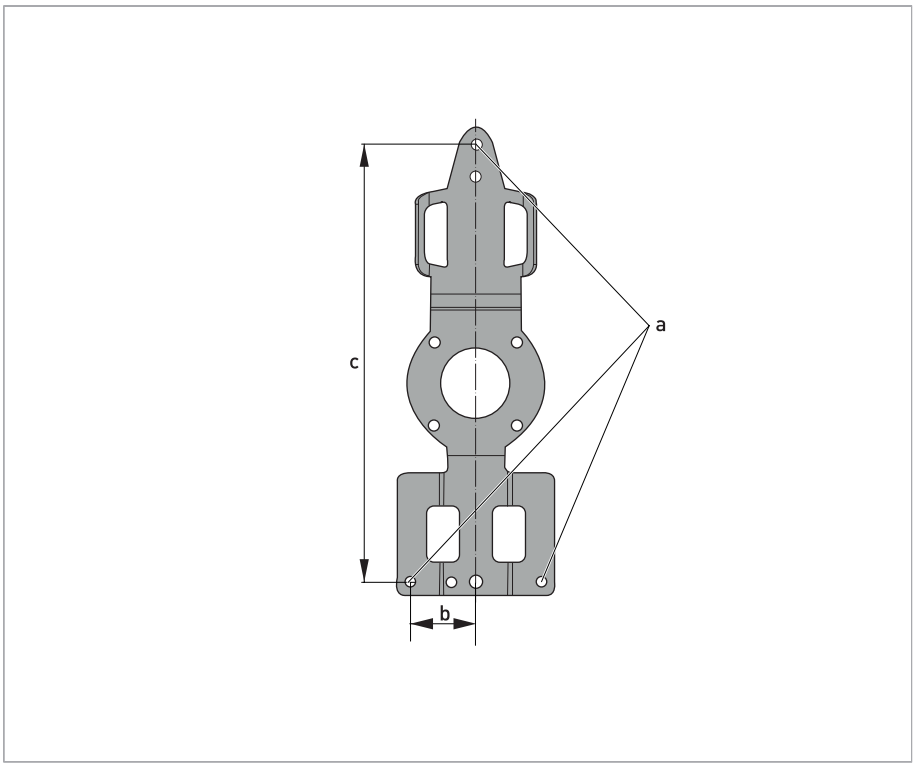
2.2.2 Mounting plate of wall-mounted version, aluminium housing



Dimensions in mm and inch

	[mm]	[inch]
a	Ø6.5	Ø0.26
b	87.2	3.4
c	241	9.5

2.2.3 Mounting plate of wall-mounted version, stainless steel housing



	[mm]	[inch]
a	Ø6.5	Ø0.26
b	40	1.6
c	267.9	10.55

2.3 Flow tables

Flow rate in m/s and m^3/h

	$Q_{100\ \%}$ in m^3/h			
v [m/s]	0.3	1	3	12
DN [mm]	Minimum flow	Nominal flow		Maximum flow
2.5	0.005	0.02	0.05	0.21
4	0.01	0.05	0.14	0.54
6	0.03	0.10	0.31	1.22
10	0.08	0.28	0.85	3.39
15	0.19	0.64	1.91	7.63
20	0.34	1.13	3.39	13.57
25	0.53	1.77	5.30	21.21
32	0.87	2.90	8.69	34.74
40	1.36	4.52	13.57	54.29
50	2.12	7.07	21.21	84.82
65	3.58	11.95	35.84	143.35
80	5.43	18.10	54.29	217.15
100	8.48	28.27	84.82	339.29
125	13.25	44.18	132.54	530.15
150	19.09	63.62	190.85	763.40
200	33.93	113.10	339.30	1357.20
250	53.01	176.71	530.13	2120.52
300	76.34	254.47	763.41	3053.64
350	103.91	346.36	1039.08	4156.32
400	135.72	452.39	1357.17	5428.68
450	171.77	572.51	1717.65	6870.60
500	212.06	706.86	2120.58	8482.32
600	305.37	1017.90	3053.70	12214.80
700	415.62	1385.40	4156.20	16624.80
800	542.88	1809.60	5428.80	21715.20
900	687.06	2290.20	6870.60	27482.40
1000	848.22	2827.40	8482.20	33928.80
1200	1221.45	3421.20	12214.50	48858.00

Flow rate in ft/s and US gallons/min

	$Q_{100\ \%}$ in US gallons/min			
v [ft/s]	1	3.3	10	40
DN [inch]	Minimum flow	Nominal flow		Maximum flow
1/10	0.02	0.09	0.23	0.93
1/8	0.06	0.22	0.60	2.39
1/4	0.13	0.44	1.34	5.38
3/8	0.37	1.23	3.73	14.94
1/2	0.84	2.82	8.40	33.61
3/4	1.49	4.98	14.94	59.76
1	2.33	7.79	23.34	93.36
1.25	3.82	12.77	38.24	152.97
1.5	5.98	19.90	59.75	239.02
2	9.34	31.13	93.37	373.47
2.5	15.78	52.61	159.79	631.16
3	23.90	79.69	239.02	956.09
4	37.35	124.47	373.46	1493.84
5	58.35	194.48	583.24	2334.17
6	84.03	279.97	840.29	3361.17
8	149.39	497.92	1493.29	5975.57
10	233.41	777.96	2334.09	9336.37
12	336.12	1120.29	3361.19	13444.77
14	457.59	1525.15	4574.93	18299.73
16	597.54	1991.60	5975.44	23901.76
18	756.26	2520.61	7562.58	30250.34
20	933.86	3112.56	9336.63	37346.53
24	1344.50	4481.22	13445.04	53780.15
28	1829.92	6099.12	18299.20	73196.79
32	2390.23	7966.64	23902.29	95609.15
36	3025.03	10082.42	30250.34	121001.37
40	3734.50	12447.09	37346.00	149384.01
48	5377.88	17924.47	53778.83	215115.30

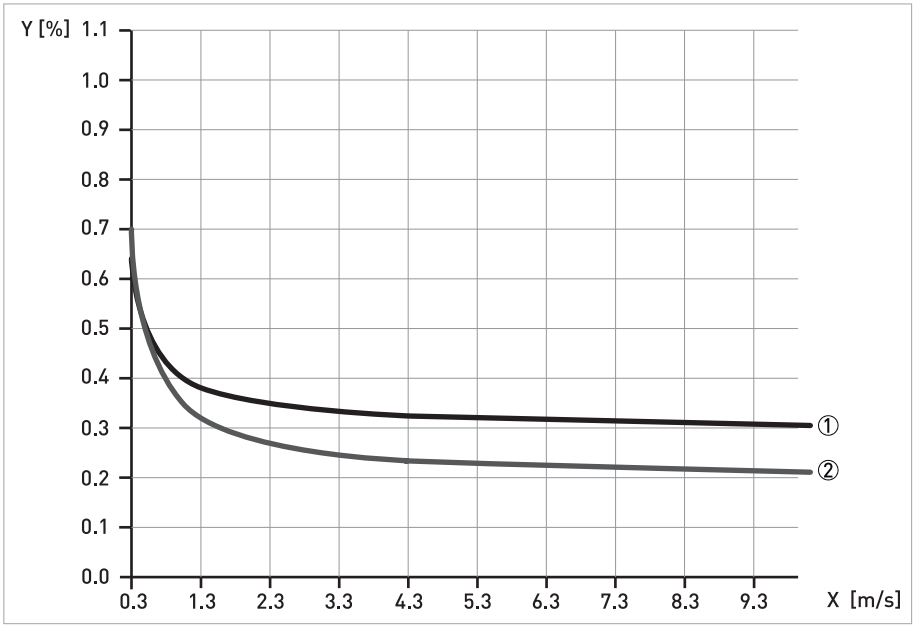
2.4 Measuring accuracy

Every electromagnetic flowmeter is calibrated by direct volume comparison. The wet calibration validates the performance of the flowmeter under reference conditions against accuracy limits.

The accuracy limits of electromagnetic flowmeters are typically the result of the combined effect of linearity, zero point stability and calibration uncertainty.

Reference conditions

- Medium: water
- Temperature: +5...+35°C / +41...+95°F
- Operating pressure: 0.1...5 barg / 1.5...72.5 psig
- Inlet section: ≥ 5 DN
- Outlet section: ≥ 2 DN



X [m/s]: flow velocity
Y [%]: deviation from the actual measured value (mv)

	DN [mm]	DN [inch]	Standard accuracy ①	Optimised accuracy ②
OPTIFLUX 1100	10…150	3/8…6	±0.4% of mv ± 1 mm/s; as ① + 0.1%	-
OPTIFLUX 4100 / 5100 / 6100	2.5…6	1/10…1/4		
OPTIFLUX 2100 / 4100 / 5100 / 6100	10…1200	3/8…48	±0.3% of mv ± 1 mm/s	±0.2% of mv ± 1.5 mm/s Extended calibration at 2 points
WATERFLUX 3100	25...600	1...24	±0.3% of mv ± 1 mm/s	-

3.1 Intended use

The electromagnetic flowmeters are designed exclusively to measure the flow and conductivity of electrically conductive, liquid media.

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

If the device is not used according to the operating conditions (refer to chapter "Technical data"), the intended protection could be affected.

This device is a Group 1, Class A device as specified within CISPR11:2009. It is intended for use in industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

3.2 Installation specifications

The following precautions must be taken to ensure reliable installation.

- *Make sure that there is adequate space to the sides.*
- *Protect the signal converter from direct sunlight and install a sun shade 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. The measuring devices are tested for a vibration level in accordance with IEC 68-2-64.*

3.3 Mounting of the compact version

Turning the housing of the compact version is not permitted.

The signal converter is mounted directly on the flow sensor. For installation of the flowmeter, please observe the instructions in the supplied product documentation for the flow sensor.

3.4 Mounting the wall-mounted housing, remote version

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

3.4.1 Wall mounting

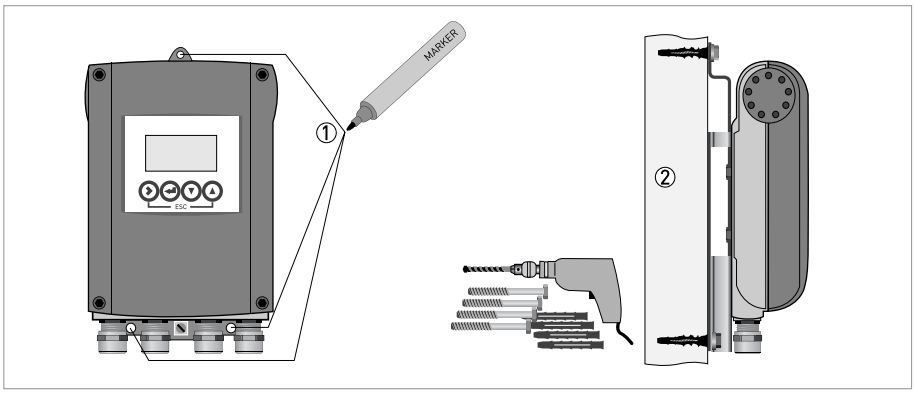
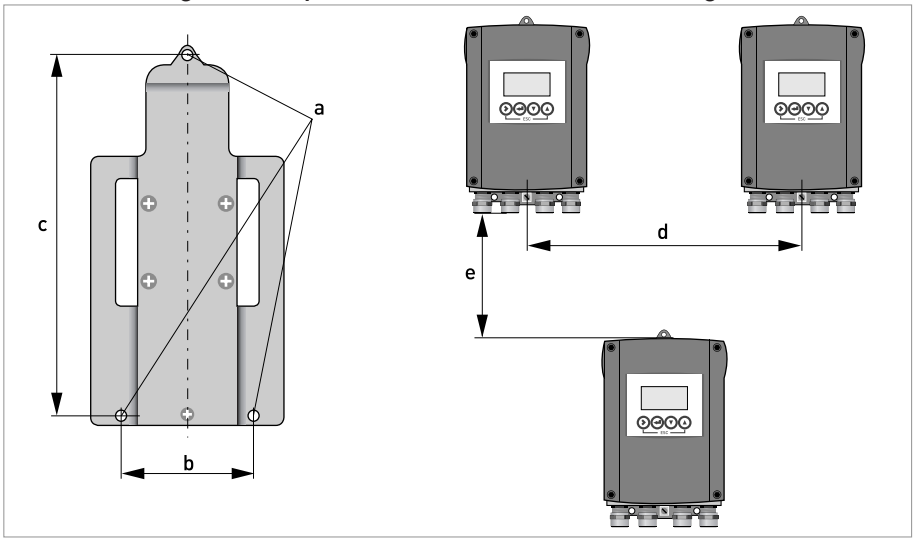


Figure 3-1: Mounting the wall-mounted housing

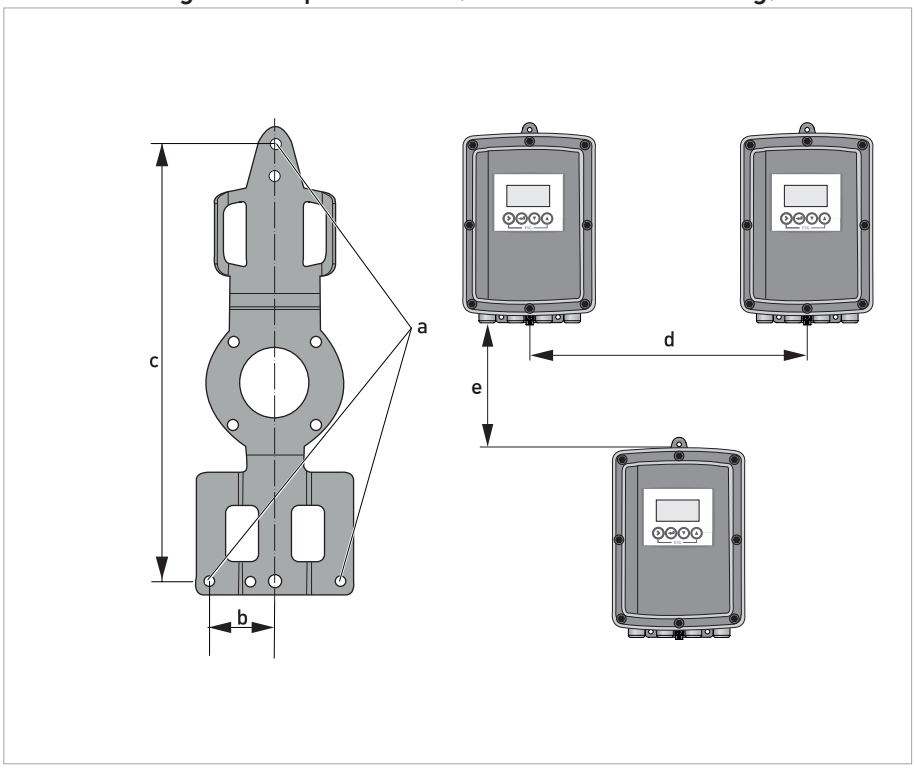
① Prepare the holes with the aid of the mounting plate. For further information refer to *Mounting plate of wall-mounted version, aluminium housing* on page 21.
② Fasten the device securely to the wall with the mounting plate.

Wall mounting of multiple devices (aluminium housing)



	[mm]	[inch]
a	Ø6.5	Ø0.26
b	87.2	3.4
c	241	9.5
d	310	12.2
e	257	10.1

Wall mounting of multiple devices (stainless steel housing)



	[mm]	[inch]
a	Ø6.5	Ø0.26
b	268	10.5
c	40	1.6
d	336	13.2
e	257	10.1

4.1 Important notes on electrical connection

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 regulations.

- *Use suitable cable entries for the various electrical cables.*
- *The flow sensor and signal converter have been configured together at the factory. For this reason, please connect the devices in pairs. Ensure that the flow sensor constant GK/GKL (see nameplates) are identically set.*
- *If delivered separately or when installing devices that were not configured together, set the signal converter to the DN size and GK/GKL of the flow sensor.*

4.2 Preparing the signal and field current cables

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

4.2.1 Signal cable A (type DS 300), construction

- Signal cable A is a double-shielded cable for signal transmission between the flow sensor and signal converter.
- Bending radius: ≥ 50 mm / 2"

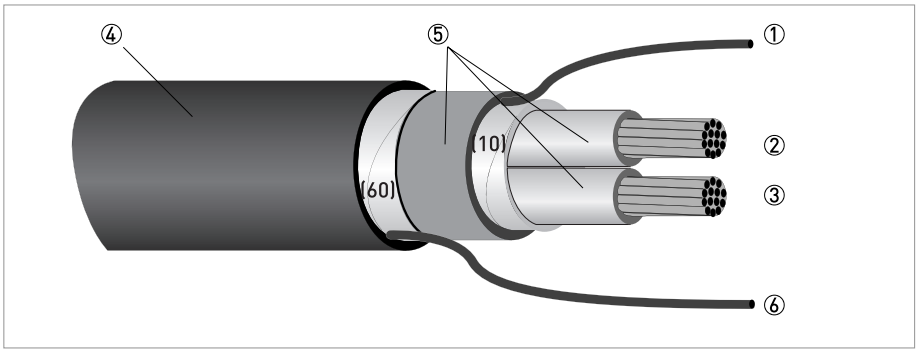


Figure 4-1: Construction of signal cable A

① Stranded drain wire (1) for the inner shield (10), 1.0 mm^2 Cu / AWG 17 (not insulated, bare)
② Insulated wire (2), 0.5 mm^2 Cu / AWG 20
③ Insulated wire (3), 0.5 mm^2 Cu / AWG 20
④ Outer sheath
⑤ Insulation layers
⑥ Stranded drain wire (6) for the outer shield (60)

4.2.2 Length of signal cable A

For temperatures of the medium above 150° C / 300° F, a special signal cable and a ZD intermediate socket are necessary. These are available including the changed electrical connection diagrams.

Flow sensor	Nominal diameter		Min. electrical conductivity [µS/cm]	Curve for signal cable A
	DN [mm]	[inch]		
OPTIFLUX 1000 F	10...150	3/8...6	5	A1
OPTIFLUX 2000 F	25...150	1...6	20	A1
	200...1200	8...48	20	A2
OPTIFLUX 4000 F	2.5...150	1/10...6	5	A1
	200...1200	8...48	5	A2
OPTIFLUX 5000 F	2.5...100	1/10...4	5	A1
	150...250	6...10	5	A2
OPTIFLUX 6000 F	2.5...150	1/10...6	5	A1
WATERFLUX 3000 F	25...600	1...24	20	A1

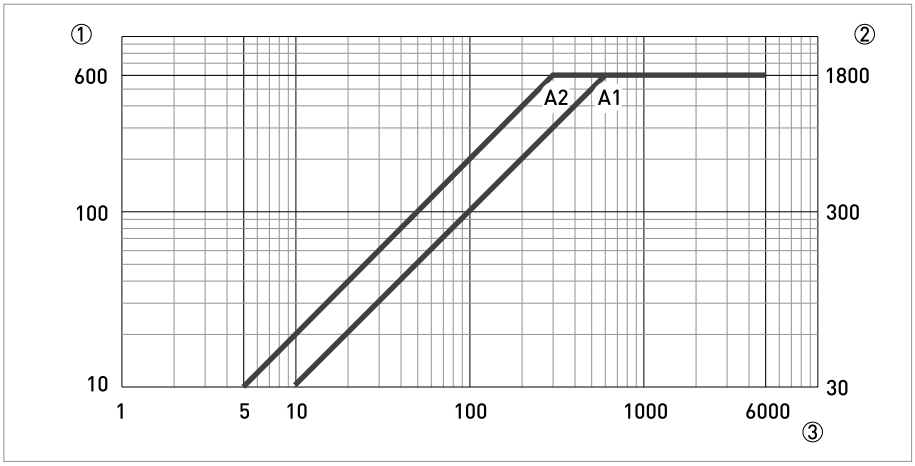


Figure 4-2: Maximum length of signal cable A

① Maximum length of signal cable A between the flow sensor and signal converter [m]
② Maximum length of signal cable A between the flow sensor and signal converter [ft]
③ Electrical conductivity of the medium being measured [µS/cm]

4.2.3 Connection diagram for signal and field current cable

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

- A shielded 2-wire copper cable is used as the field current cable. The shielding **MUST** be connected in the housing of the flow sensor and signal converter.
- The outer shield (60) is connected in the terminal compartment of the flow sensor directly via the shield and a clip.
- Bending radius of signal and field current cable: ≥ 50 mm / 2"
- The following illustration is schematic. The positions of the electrical connection terminals may vary depending on the housing version.

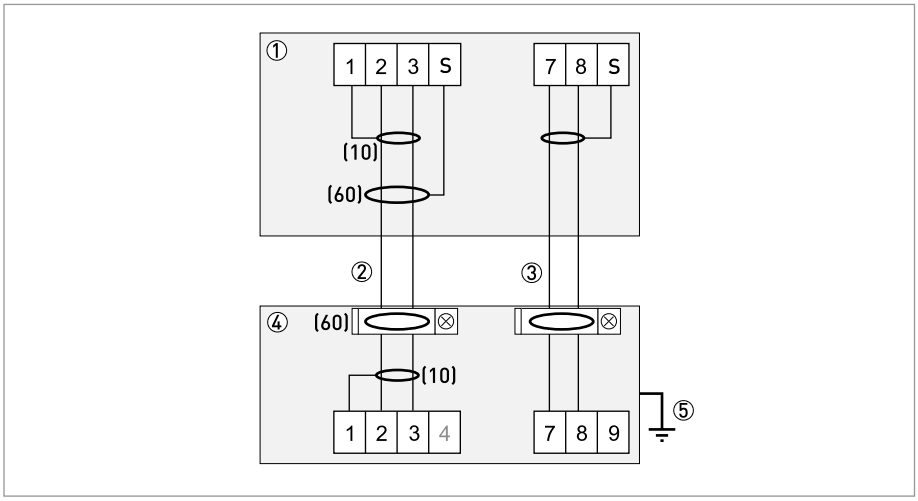


Figure 4-3: Connection diagram for signal and field current cable

① Electrical terminal compartment in the signal converter
② Signal cable A
③ Field current cable C
④ Electrical terminal compartment in the flow sensor
⑤ Functional ground FE

4.3 Connecting the power supply

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

- The housings of the devices, which are designed to protect the electronic equipment from dust and moisture, should be kept well closed at all times. Creepage distances and clearances are dimensioned to VDE 0110 and IEC 664 for pollution severity 2. Supply circuits are designed for overvoltage category III and the output circuits for overvoltage category II.
- Fuse protection ($I_N \leq 16$ A) for the infeed power circuit, and also a separator (switch, circuit breaker) to isolate the signal converter must be provided.

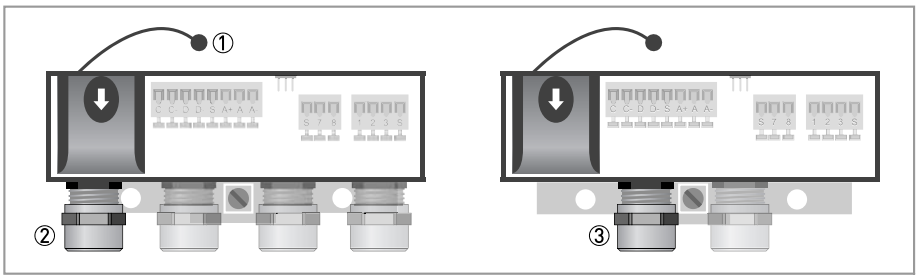


Figure 4-4: Terminal compartment for power supply

① Retaining band of the cover
② Cable entry for power supply, remote version
③ Cable entry for power supply, compact version

Version overview

Version	Non-Ex	Ex
100...230 VAC	Standard	Optional
24 VDC	Standard	-
24 VAC/DC	Standard	Optional

- Open the cover of the electrical terminal compartment by pressing down and pulling forwards at the same time.

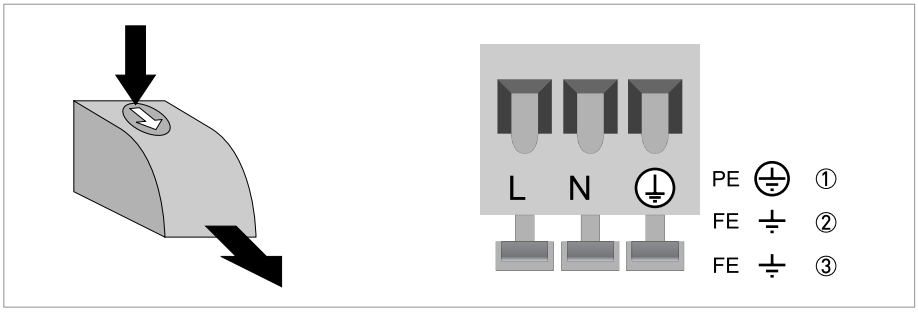


Figure 4-5: Power supply connection

① 100...230 VAC (-15% / +10%), 8 VA
② 24 VDC (-55% / +30%), 4 W
③ 24 VAC/DC (AC: -15% / +10%; DC: -25% / +30%), 7 VA or 4 W

- Close the cover after the power has been connected.

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

- Note the power supply voltage and frequency (50...60 Hz) on the nameplate.

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

24 VDC (tolerance range: -55% / +30%)

- Note the data on the nameplate!
- When connecting to functional extra-low voltages, provide a facility for protective separation (PELV) (acc. to VDE 0100 / VDE 0106 and/or IEC 364 / IEC 536 or relevant national regulations).

12 VDC - 10% is included in the tolerance range.

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

- AC: Note the power supply voltage and frequency (50...60 Hz) on the nameplate.
- AC/DC: When connecting to functional extra-low voltages, provide a facility for protective separation (PELV) (acc. to VDE 0100 / VDE 0106 and/or IEC 364 / IEC 536 or relevant national regulations).

*12 V is **not** included in the tolerance range.*

4.4 Inputs and outputs, overview

4.4.1 Description of the CG number

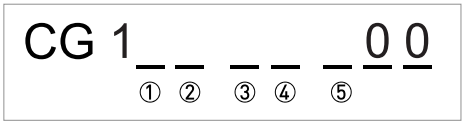


Figure 4-6: Marking (CG number) of the electronics module and output variants

① ID number: 0
② ID number: 0 = standard; 9 = special
③ Power supply
④ Display (language versions)
⑤ Output version

4.4.2 Fixed, non-alterable output versions

This signal converter is available with various 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.
- Connection terminal A+ is only operable in the basic output version.

Basic outputs (I/O) (Standard)

CG no.	Connection terminals							
	C	C-	D	D-	S	A+	A	A-
1 0 0	S_p / C_p passive ①		P_p / S_p passive ①		②		I_p + HART® passive ③	
						I_a + HART® active ③		

① Function change by software
② Shielding
③ Function changed by reconnecting

Description of the used abbreviations

I_a	I_p	Current output active or passive
P_p		Pulse/frequency output passive
S_p		Status output / limit switch passive
C_p		Control input passive

Ex i, Profibus PA + DP, Foundation Fieldbus and Modbus (I/O) (Option)

CG no.	Connection terminals						
	D	D-	S	C	C-	B	B-

Ex i (Option)

3 0 0	P_p / S_p passive ①		②	I_p + HART® passive		

PROFIBUS PA (Option)

D 0 0	PA+ (1)	PA+ (2)	②	PA- (1)	PA- (2)	

FOUNDATION Fieldbus (Option)

E 0 0	V/D+ (1)	V/D+ (2)	②	V/D- (1)	V/D- (2)	

PROFIBUS DP (Option)

F 0 0	RxD/TxD+ / P / +B (1)	RxD/TxD- / N / -A (1)	②	Termination N / -T	Termination P / +T	RxD/TxD+ / P / +B (2)	RxD/TxD- / N / -A (2)

Modbus (Option)

G 0 0	P_p / S_p passive		②	+3.3 V; 560 Ω	Common	Sign. A (D0-)	Sign. B (D1+)

① Function change by software
② Shielding

Supplementary instructions related to the communication busses Foundation Fieldbus, Profibus PA/DP and Modbus are available on the website (Download Center).

4.5 Laying electrical cables correctly

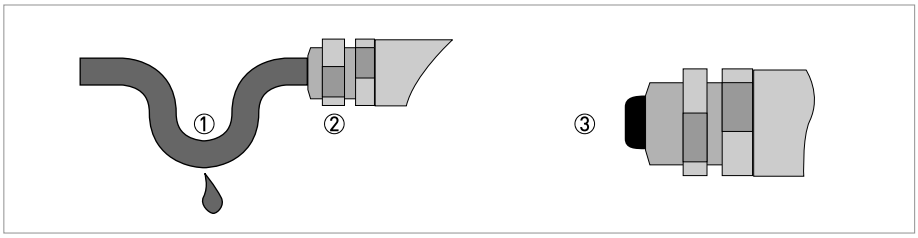


Figure 4-7: Protect housing from dust and water

① For compact versions with nearly horizontally-oriented cable entries, lay the necessary electric cables with a drip loop as shown in the illustration.
② Tighten the screw connection of the cable entry securely.
③ Seal cable entries that are not needed with a plug.

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