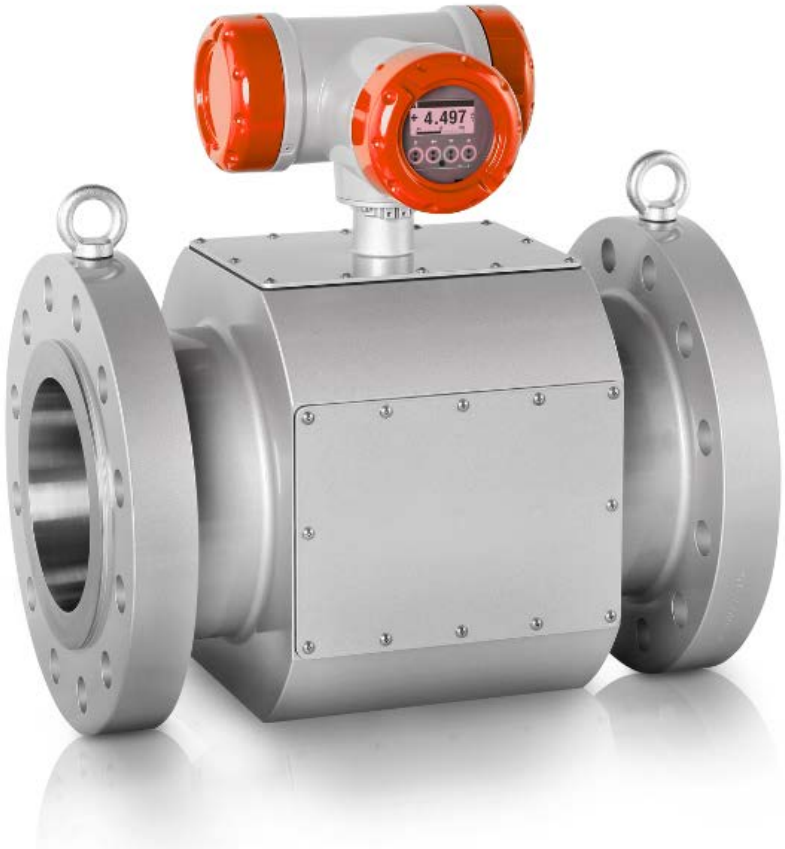


ALTOSONIC V12

Technical Datasheet

Ultrasonic gas flowmeter for custody transfer

- Complete product family for widest application range
- No flow conditioner and only 5D straight inlet to comply to AGA 9, ISO 17089, OIML and MID
- Dedicated ultrasonic chords for diagnostics and predictive maintenance

OIML Ex FM APPROVED

GUIDANT
POWERED BY KROHNE

1.1 Custody transfer measurement of natural gas

Since the introduction of the world's first 12 chord meter, the ALTOSONIC V12 has become the new industry standard. The flowmeter was the first to achieve the OIML R137 Class 0.5 requirements. The unique combination of the path configuration and the diagnostic features makes the ALTOSONIC V12 the compelling choice for long-term accurate, stable and reliable measurement.

The ultrasonic gas flowmeter ALTOSONIC V12 has low ownership cost, a small footprint and detects the risk of contamination in the internal surface to maintain a reliable measurement and high accuracy in the field.

Highlights

- Complete product family for widest application range
- First ever ultrasonic flow meter with OIML R137 class 0.5 approval
- No flow conditioner and only 5D straight inlet to comply to AGA 9, ISO 17089, OIML and MID
- Dedicated ultrasonic chords for diagnostics and predictive maintenance
- Five plane measurement for excellent swirl immunity and built-in redundancy
- Remote expert system to verify custody transfer accuracy 24/7

Industries

- Oil & Gas
- Nitrogen
- Hydrogen
- CO_2

Applications

- Natural gas transmission pipeline
- Metering & regulation stations
- Liquefaction and regasification
- Border stations
- Underground gas storage
- On- and offshore exploration

1.2 Variants

ALTOSONIC V12 Direct

Direct path configuration to enable flow measurement of natural gas with extremely high concentrations of CO_2.

ALTOSONIC V12

12 chord ultrasonic flowmeter. Designed to offer the highest possible measurement accuracy of natural gas.

ALTOSONIC V12 Check

Second flow converter using the vertical path for an additional integrated check measurement.

ALTOSONIC V12 Twin

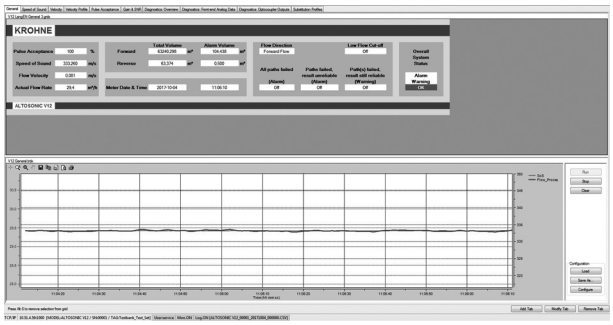
Two flowmeters combined with two independent custody transfer measurements within one installation, no additional spool sections or flow conditioners required.

1.3 Features

	Basic system: Condition-Based Monitoring	Expert system: KROHNE Care
Velocity of sound comparison per path	•	•
Signal acceptance check per path	•	•
AGC (automatic gain control) check per path	•	•
SNR (signal to noise ratio) per path	•	•
In plane swirl compensation by reflection	•	•
Dedicated path for bottom-fouling detection	•	•
Visualization of flow profile	•	•
Remote access, web-based user interface		•
24/7 monitoring of measurement integrity		•
Simple traffic-light structure to indicate meter's health		•
Easy to print report with overall health indication		•
Interpretation of cause of alarm		•
Storage of data for 10 years in auditable format		•
Automatic trending and tuning of diagnostics parameters		•
Predictive Maintenance		•

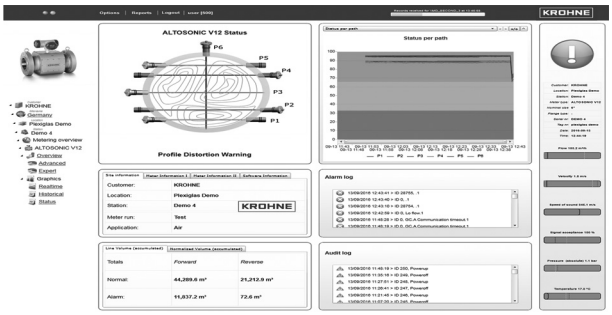
Diagnostic packages

The ALTOSONIC V12 uses diagnostics for performance monitoring. The meter has two possible diagnostic packages. The basic system is included as a standard. The meter design including the diagnostic package provides the operator with continuous monitoring of measurement integrity. This is the basis for extending recalibration interval.



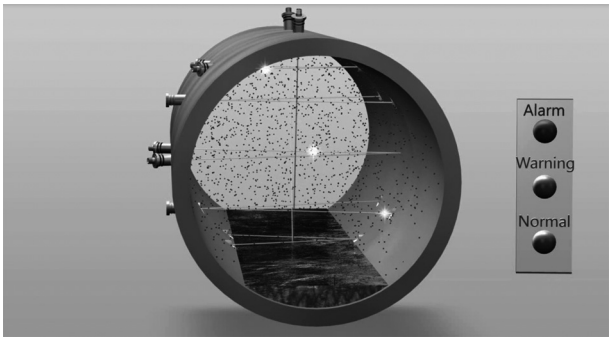
Standard diagnostics

The simplest way to use standard diagnostics on the ALTOSONIC V12 is to install the monitoring and configuration software tool on a PC and connect it to the modbus port of the ALTOSONIC V12. The V12 will automatically give an alarm when the acceptance of the CT accuracy exceeds a redefined treshold. The CBM system is standard included in the metering package. This package has all diagnostic features available such as signal acceptance, flow velocity, gain, signal noise ratios, speed of sound etc. The software is available as a free download on the KROHNE website and does not require a specific licence or annual fee.
It is also possible to program standard diagnostics into a flow computer or a DCS system, as long as it is connected to one of the modbus ports.



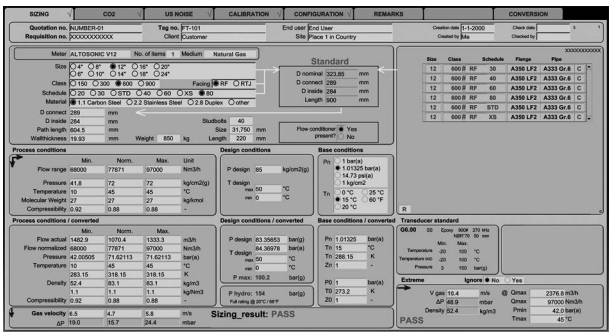
KROHNE Care expert system

The web-based expert diagnostic system KROHNE Care runs 24/7 inside the electronics unit of ALTOSONIC V12 and can be accessed from anywhere in the world with a standard browser without installing additional software.
Based on extensive research a complete model was developed that allows monitoring of health care and can distinguish the different forms of contamination that can occur inside a meter. The user no longer needs to wonder why parameters such as velocity of sound, signal to noise ratio and automatic gain control have changed; KROHNE Care simply tells you that there is contamination at the bottom of your meter – in plain language.



Bottom-fouling detection

ALTOSONIC V12 is the first meter to offer an ultrasonic chord that is fully dedicated to detection of bottom fouling. While more traditional meters can find major blockages, such as a blocked hole in the flow conditioner, the vertical diagnostics chord allows ALTOSONIC V12 to detect very thin layers of contamination (condensate, water, solids) at the bottom of the meter.



Evaluation for ALTOSONIC V12

For natural gas measurement a number of process variables are important, such as pressure, flow rate, CO2 concentration, ultrasonic noise, calibration requirements, etc. Each application is evaluated with the KROHNE internal EVA sizing package to make sure that the meter will work flawlessly from the moment it is installed.

1.4 Measuring principle

The ultrasonic gas flowmeter operates according to the principle of measuring the transit time of an ultrasonic sound wave. A gas velocity is derived from the difference in transit time of a sound wave travelling in a direction with the flow direction and the sound wave travelling in the opposite direction.

The trajectory of the sound wave is called the acoustic path. A chord is the direct path crossing the pipe from one side to the opposite side. Using reflection, an acoustic path can consist of two or more chords. The name ALTOSONIC V12 is related to its design where 12 chords build 6 acoustic paths.

2.1 Technical data table

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

Measuring system

Measuring principle	Ultrasonic transit time
Application range	Flow measurement of natural gases with a minimum of 75% methane.
	Other applications on request.
Measured value	
Primary measured value	Transit time
Secondary measured values	Actual volume flow and totalised flow rate

Design

Construction	The ALTOSONIC V12 measurement system consists of a meter body with ultrasonic transducers and a signal converter for signal processing and metrological relevant counter display on top of the meter body.
Nominal diameter	DN100...600 / 4"...24"l
	Other diameters on request.
Flow range	For more detailed information, refer to *Flow tables* on page 15.
Signal converter	
Inputs / outputs	Digital output: 4x
	Serial: 2x Modbus over RS 485 (individually configurable)
	Ethernet: 1x (non-Custody transfer)
	Current output: 1x 4...20 mA (non-Custody transfer)
Inputs / outputs with KROHNE Care board	Signals from the KROHNE Care board are categorised non-Custody transfer. Only signals coming directly from the base electronic unit are certified for Custody transfer purpose.
	Digital output: 5x
	Serial: 4x Modbus over RS 485 (individually configurable)
	Ethernet: 3x
	Current output: 2x 4...20 mA
	Current input: 1x Multidrop (dual) HART®

Display and user interface	
Graphic display	LCD display, backlit white
	Size: 256x128 pixels, corresponds to 59x31 mm = 2.32"x1.22".
	Display turnable in 90° steps.
	The readability of the display could be reduced at ambient temperatures below -25°C / -13°F.
Operator input elements	4 optical keys for operator control of the signal converter without opening the housing.
Display functions	
Language of display texts	English, French, German, Dutch, Russian
Units	Metric and imperial units selectable from list / free unit.

Measuring accuracy

Accuracy for $Q_t...Q_{max}$	≤ ±0.1% of measured flow rate, for high pressure flow calibrated after applying linearization.
	≤ ±0.2% of measured flow rate, for high pressure flow calibrated after applying curve shift.
	≤ ±0.5% of measured flow rate before justering.
Repeatability	< ± 0.05%

Operating conditions

Temperature	
Process temperature	**Standard transducer, class T4:**
	-40...+100°C / -40...+212°F
	Titanium transducer, class T3:
	-40...+175°C / -40...+347°F
Ambient temperature	-40...+60°C / -40...+140°F
Storage temperature	-40...+70°C / -40...+158°F
Pressure	
Pressure range	1...450 bar / 0.1...45MPa / 15...6525 psi (ASME 150...2500)
	All sensor designs at full rating acc. to below flange standards for standard materials.
Properties of medium	
Wet gas content	Typically ≤ 1% Liquid Volume Fraction (LVF).
CO_2 content	Depends on diameter and pressure.
Minimum pressure requirement	Depends on diameter and CO_2 concentration.
Contact manufacturer for detailed sizing.	

Materials

Flanges	Standard: low temperature carbon steel A350 LF2
	Option: stainless steel, Duplex
Measuring tube	≤ 24": low temperature carbon steel A350 LF2
	> 24": low temperature carbon steel A333 GR6
	Option: stainless steel, Duplex
Coating	Inside: corrosion preservative oil film
	Outside: 1 layer PSX 700 160 µm
	Other outside coatings available on request.
Converter housing	Stainless steel 316 (1.4408)

Electrical connections

Power supply	24 VDC (± 10%) / 3 A
Power consumption	Without integrated KROHNE Care: ≤ 10 W
	With integrated KROHNE Care: ≤ 17 W
Cable entries	Standard: M20 x 1.5
	Option: ½" NPT, PF ½

Inputs and outputs

MODBUS	
Description	Modbus RTU or Modbus ASCII, Slave, RS485 (galvanically isolated)
Transmission procedure	Half duplex, asynchronous
Address range	1...247
Supported function codes	03, 04, 06, 08, 16
Supported Baudrate	50, 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 56000, 64000, 115200, 128000 Baud

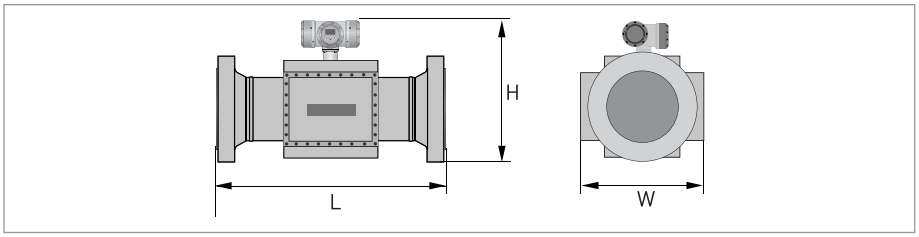
Approvals and certificates

CE	
This device fulfills the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark.	
	For full information of the EU directive & standards and the approved certifications; please refer to the CE declaration or the website of the manufacturer.
Electromagnetic compatibility	Directive: 2014/30/EU
	Harmonized standard: EN 61326-1, EN 61326-2, EN 61326-3
Pressure Equipment Directive (PED)	Directive: 2014/68/EU
	Category I, II, III
	Gas group 1
	Production module H
Equipment used in explosive atmosphere (ATEX)	Directive: 2014/34/EU
	Zone 1
	Harmonized standard: EN 60079-0, EN 60079-1, EN 60079-7, EN 60079-18
	Certificate number: FTZU 18 ATEX 0007X
Other approvals, standards and certificates	
IECEx	Standards: IEC 60079-0, IEC 60079-1, IEC 60079-7, IEC 60079-18
	Certificate number: IECEx FTZU 18.0006X
Canada CSA	Standards: C22.2 No.30, C22.2 No.25, C22.2 No.94.2, C22.2 No. 61010-1, C22.2 No. 60079-40
	DIV 1
	Certificate number: QPS LR1338-3
US America FM & UL	Standards: FM 3615, ANSI/UL 50E, UL 61010-1
	DIV 1
	Certificate number: QPS LR1338-3
	DIV 2
	Certificate number: QPS LR1338-12
China	**Ex. safety:**
	Standards: GB 3836-1, GB 3836-2, GB 3823-3, GB3836-9
	Certficate number: NEPSI GYJ16.1212X
	Metrology:
	Certificate number: PAC 2009-F265
Russia	**Ex. safety:**
	Standards: CU TR 012
	Certificate number: EAC RU C-NL.AA87.B.00264/19
	Metrology:
	Pattern certificate number: NL.C.29.004.A No 43620
Custody transfer	OIML R137 class 0.5 and class 1.0
	Compliant with AGA 9 and ISO 17089-2010.
Measurement Instrument Directive (MID)	Directive: 2014/32/EU
	EC type examination certificate number T11664

Ingress protection code	Standards: IEC/EN 60529
	IP 66/67
	Standard: NEMA 250
	NEMA 4X
Other worldwide approvals and certificates also available on request.	
Equipment marking	
Standard	**Product marking**
ATEX (zone 1)	**With transducer type G7.nn or G11.nn:**
	II 2G Ex db eb IIB+H_2 T6...T3 Gb
	With transducer type G6.nn:
	II 2G Ex db eb ma IIB+H_2 T6...T4 Gb
IECEx (zone 1)	**With transducer type G7.nn or G11.nn:**
	II 2G Ex db eb IIB+H2 T6...T3 Gb
	With transducer type G6.nn:
	II 2G Ex db eb ma IIB+H2 T6...T4 Gb
Canada + USA (DIV1)	Class I, Division 1, Groups CD T5 or T4
	Class II, Division 1, Groups EFG
	Class III, Division 1 and 2
	Type 4x; approved process seal
Canada + USA (DIV2)	Class I, Division 2, Groups BCD T5 or T4
	Class II, Division 2, Groups EFG
	Class III, Division 1 and 2
	Type 4x; approved process seal
USA (zone 1)	Class I, Zone 1, IIB T5/T4

2.2 Dimensions and weights

- *Flowmeters with diameters ≥ 6" and ASME ≤ 900 lb are standard equipped with transducers that are retractable under pressure.*
- *All measures are provided as indication. They can vary slightly with different schedule sizes.*
- *Values for larger diameters are available on request.*
- *Values for meters with marking US America (DIV 1) Class I, Division I are available on request.*



ASME 150 lb

Nominal size	Metric			Imperial		
	H [mm]	L [mm]	Weight [kg]	H [inch]	L [inch]	Weight [lbs]
4" / DN100	520	400	151	20.47	15.75	333
6"/ DN150	570	450	238	22.44	17.72	525
8"/ DN200	620	600	351	24.41	23.62	774
10" / DN250	660	750	498	25.98	29.53	1098
12" / DN300	740	900	719	29.13	35.43	1585
14" / DN350	780	1050	911	30.71	41.34	2009
16" / DN400	840	1200	1027	33.07	47.24	2265
18" / DN450	890	1350	1185	35.04	53.15	2613
20"/ DN500	940	1500	1628	37.01	59.06	3590
24" / DN600	1050	1800	2185	41.34	70.87	4818

ASME 300 lb

Nominal size	Metric			Imperial		
	H [mm]	L [mm]	Weight [kg]	H [inch]	L [inch]	Weight [lbs]
4" / DN100	520	400	158	20.47	15.75	348
6"/ DN150	570	450	248	22.44	17.72	547
8"/ DN200	620	600	371	24.41	23.62	818
10" / DN250	680	750	533	26.77	29.53	1175
12" / DN300	760	900	755	29.92	35.43	1665
14" / DN350	810	1050	1008	31.89	41.34	2223
16" / DN400	870	1200	1239	34.25	47.24	2732
18" / DN450	920	1350	1324	36.22	53.15	2919
20"/ DN500	980	1500	1826	38.58	59.06	4026
24" / DN600	1100	1800	2465	43.31	70.87	5435

ASME 600 lb

Nominal size	Metric			Imperial		
	H [mm]	L [mm]	Weight [kg]	H [inch]	L [inch]	Weight [lbs]
4" / DN100	520	400	168	20.47	15.75	370
6"/ DN150	575	450	271	22.64	17.72	598
8"/ DN200	630	600	411	24.80	23.62	906
10" / DN250	710	750	618	27.95	29.53	1363
12" / DN300	780	900	850	30.71	35.43	1874
14" / DN350	815	1050	1070	32.09	41.34	2359
16" / DN400	880	1200	1213	34.65	47.24	2675
18" / DN450	930	1350	1535	36.61	53.15	3385
20"/ DN500	1000	1500	1738	39.37	59.06	3832
24" / DN600	1100	1800	2369	43.31	70.87	5223

ASME 900 lb

Nominal size	Metric			Imperial		
	H [mm]	L [mm]	Weight [kg]	H [inch]	L [inch]	Weight [lbs]
4" / DN100 ①	520	400	176	20.47	15.75	388
6"/ DN150	590	600	324	23.23	23.62	714
8"/ DN200	660	600	464	25.98	23.62	1023
10" / DN250	730	750	684	28.74	29.53	1508
12" / DN300	810	900	957	31.89	35.43	2110
14" / DN350	840	1050	1190	33.07	41.34	2624
16" / DN400	890	1200	1306	35.04	47.24	2880
18" / DN450	960	1350	1738	37.80	53.15	3832
20"/ DN500	1020	1500	2069	40.16	59.06	4562
24" / DN600	1160	1800	3537	45.67	70.87	7798

① Minimum Inner diameter: 80 mm / 3.15" (= sch 80).

Sizes of other pressure classes are available on request.

2.3 Flow tables

For the flow rates, please refer to the metrological certificates.

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 ALTOSONIC V12 is an ultrasonic gas flowmeter for high accurate and custody transfer applications.

3.2 Pre-installation requirements

The equipment is designed for safe operation under conditions according to the following classifications:

- *Pollution degree 2: this means that normally only nonconductive (dry) pollution will occur. Temporary conductivity caused by condensation can occur.*
- *Protection class I: this means the equipment must be earthed.*
- *Humidity: <95% RH*
- *Ambient temperature: -40...+60°C / -40...+140°F*
- *Suitable for indoor and outdoor use.*
- *IP66 / NEMA 4X classification.*

The flowmeter should be protected from corrosive chemicals or gases and dust or particles accumulation.

Do not perform a hydrostatic test of the installed flowmeter.

The flowmeter has been hydrostatically tested during manufacturing (see reports) and must not be retested with the ultrasonic sensors installed. Water will protude in the sensor pockets and remain. This will create acoustic shortcuts and possibly cause the flowmeter to start operating in failure.

To avoid the risk of ignition as a result of electrostatic charging, the equipment cannot be used in locations where:

- *high charge generating processes occur*
- *mechanical friction and/or separation can occur*
- *electron emission (e.g. near electrostatic equipment) can occur*

3.3 Installation

3.3.1 Mounting position

Install the ultrasonic gas flowmeter in horizontal position with the flow arrow indicator on the nameplate or on the meter body in the direction of the positive (forward) gas flow.
Make sure that the converter is on top of the flowmeter after the installation.
Check the weight of the meter. Typically the weight of the meter will be considerably more than the same length of pipe line.

Make sure that there is enough free room for maintenance around the flowmeter. If you ever have to exchange transducers under pression, keep the advised free distance, measured from the centerline of the flowmeter:

Size	Advised length [mm]
DN150 / 6"	1284
DN200 / 8"	1307
DN250 / 10"	1332
DN300 / 12"	1359
DN350 / 14"	1367
DN400 / 16"	1385
DN450 / 18"	1411
DN500 / 20"	1436
DN600 / 24"	1487
DN700 / 30"	1563

To support the meter, additional supports might be needed, preferably two, one on either side of the meter.
Always support the meter at its flanges, the weight of the meter shall never rest on the case around the transducers and the cabling.
If supports can not be placed under the meter flanges, supports may be placed under the mating flanges of the pipeline. If supports can only be placed under the pipeline sections upstream or downstream of the meter, these supports shall be as close as possible to the meter. In this case a calculation must be made to verify that the load on the pipeline will not exceed acceptable values.
The meter should be installed in the pipe line with gaskets, nuts and bolts according to the type and size of the flanges of the gas flowmeter. The flanges of the meter should match with the flanges of the pipeline where the meter should be installed. Make sure that the gaskets do not protude into the flow as this can reduce the accuracy of the flowmeter.
In order to install the gas flowmeter, the pipeline must have a slot of such length that the meter including the gaskets fits nicely in the slot. It should not be necessary to use excessive force to tighten the bolts in order to close the gaps on either side of the meter. Nor should the slot be too small, implying the slot has to be widened by applying brute force to fit the meter and gaskets in the slot.
For tightening the bolts of the flanges, apply a lubricant as required, in accordance with the materials as used and applicable standards.
Tighten the bolts of the flanges with a torque according to the standards applicable to the flanges and materials used.

3.3.2 Pipe diameters and lengths

According to international standards and recommendation like AGA 9 and ISO 17089 it is advised that the inner diameter of upstream and downstream pipes matches the specified connection diameter of the ultrasonic flowmeter within 1%.

3.3.3 Flow conditioners

Although the flowmeter is a highly accurate device, an additional flow conditioner can be installed upstream of the flowmeter in order to minimise installation uncertainty or shorten the inlet, in particular when a strongly distorted flow velocity profile is expected, or when the available space for a metering run is critical. If a flow conditioner is used, the total inlet length may be reduced to only 5 DN: having 2 DN upstream of the flow conditioner and 3 DN in between the flow conditioner and the flowmeter.

- *Preferred model is the "perforated plate" type.*
- *When a flow conditioner is included in the metering run, it is strongly advised to use the same flow conditioner and inlet pipe configuration during a flow (wet) calibration (see e.g. ISO 17089 or AGA-9 for detailed requirements).*

3.3.4 Inlet and outlet for uni-directional use

Without flow conditioner

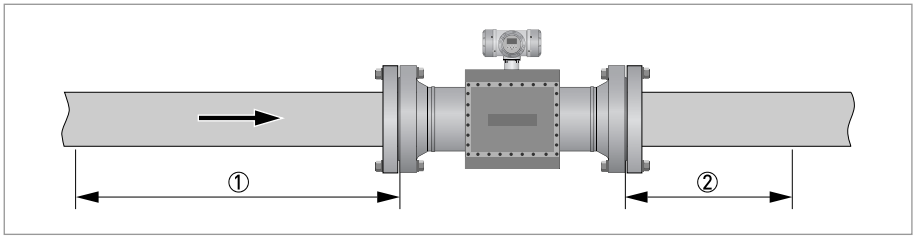


Figure 3-1: Required straight lengths for inlet and outlet

① Inlet section
② Outlet section

The following table is valid for the ALTOSONIC V12, ALTOSONIC V12 Check and ALTOSONIC V12 Twin versions and for mild and severe flow disturbances.

Accuracy	Inlet ①	Outlet ②
OIML R137 class 0.5	10 DN ①	2 DN
OIML R137 class 1.0	10 DN	2 DN
MID MI-002 class 1.0	10 DN	2 DN
AGA-9 class 1.0	10 DN	2 DN
ISO 17089 class 1.0	10 DN	2 DN

① Only for mild flow disturbances

With flow conditioner

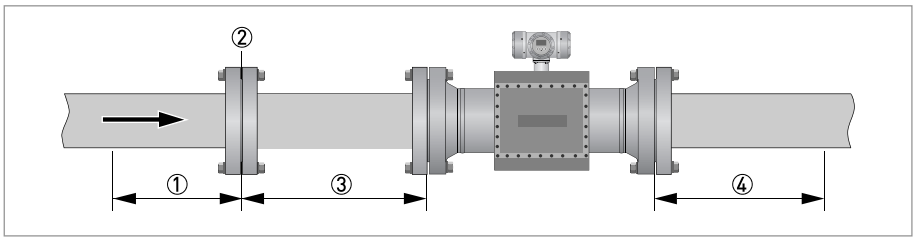


Figure 3-2: Required straight lengths for inlet and outlet

① Inlet section before flow conditioner
② Flow conditioner (perforated plate)
③ Inlet section after flow conditioner
④ Outlet section

The following tables show an inlet section before and after the flow conditioner. The information is valid for mild and severe flow disturbances.

For ALTOSONIC V12, ALTOSONIC V12 Check and ALTOSONIC V12 Twin versions

Accuracy	Inlet ①	Inlet ③	Outlet ④
OIML R137 class 0.5	2 DN	3 DN	2 DN
MID MI-002 class 1.0	2 DN	3 DN	2 DN
AGA-9 class 1.0	2 DN	3 DN	2 DN
ISO 17089 class 1.0	2 DN	3 DN	3 DN

For ALTOSONIC V12 D version

Accuracy	Inlet ①	Inlet ③	Outlet ④
OIML R137 class 1.0	2 DN	8 DN	2 DN
MID MI-002 class 1.0	2 DN	8 DN	2 DN
AGA-9 class 1.0	2 DN	8 DN	2 DN
ISO 17089 class 1.0	2 DN	8 DN	3 DN

3.3.5 Control valves

Under adverse circumstances ultrasonic gas flowmeters can suffer from interference from noise generated by pressure control valves (PCV). In case the frequency spectrum of the PCV-noise extends in the range of the operation frequency of the ultrasonic transducers and the strength of the noise results in a signal to noise ratio smaller than the critical value, the ultrasonic flowmeter will not be able to operate. Consult the manufacturer for advice in case a PCV with high pressure cut will be operated close to the ultrasonic flowmeter.

3.3.6 P and T sensors

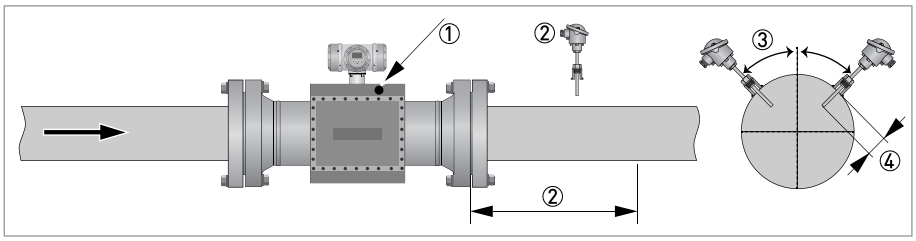


Figure 3-3: Location of pressure and temperature sensors

① Install pressure sensor on body of flowmeter at Pr point
② Install temperature sensor at 1.5...3 DN downstream of flowmeter
(3...5 DN for bi-directional flow applications)
③ Install temperature sensor at an angle of no more than 45 degrees from the vertical
④ Install temperature sensor with an insertion depth between 0.1 and 0.33 of nominal pipe diameter

- *Use a Pt100 element with thermowell and transmitter as temperature sensor. Preferably use tapered thermowells to avoid vibrations.*
- *Connect the pressure sensor to the Pr-point in the meter body using an intermediate isolation valve and/or valve manifold.*

Either use a suitable blind plug or blind flange (and sealing as required) to blind the pressure port, or a pressure sensing line should be connected in an appropriate way.
A pressure sensing line should be properly supported to avoid vibrations and to prevent the weight of the sensing line from applying a strain on the pressure port connection.

3.4 Temperatures

The device must not be heated by radiated heat (e.g. exposure to the sun) to a converter surface temperature above the maximum permissible ambient temperature.

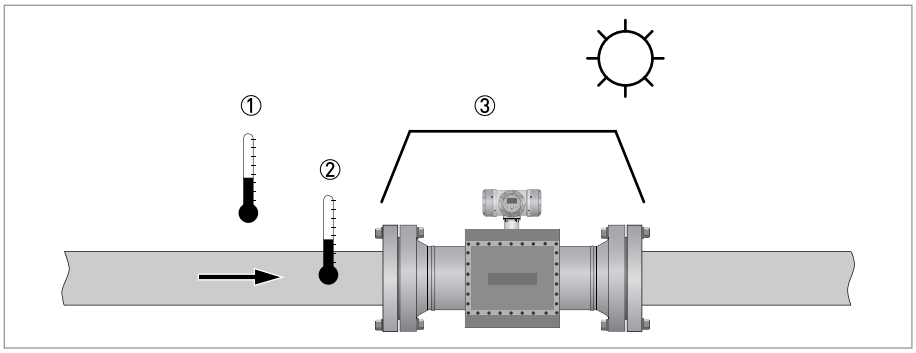
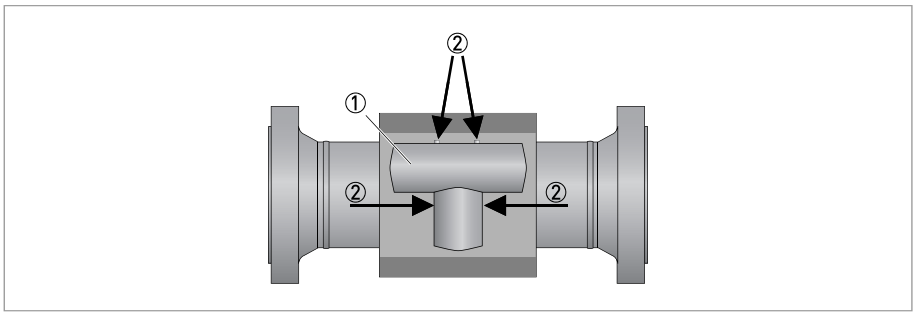


Figure 3-4: Temperatures

① Ambient temperature
② Process gas temperature
③ Use a sun shade to protect the flowmeter against direct solar radiation.

SUNSHADE
Direct solar radiation introduces temperature gradients in the metering section and must be avoided as much as possible. Use a sunshade or canopy over the flow, pressure and temperature sensors to protect against direct exposure to sunshine. Another option is to thermally insulate the complete metering section including the sensors.

As an option, KROHNE has also developed a sun shade specifically for the electronics. This can be ordered separately and can easily be installed as presented in the figure below.



① Put sunshade in correct position
② Tighten screw to install sunshade

For more detailed information about temperatures, refer to *Technical data table* on page 9.

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.

For all applications, cable must be used that are resistant to high temperatures if the process temperature is 65°C / 149°F or higher.

4.2 Outputs

1. *In order to prevent unauthorized or inadvertent opening and removal of the covers, an interlocking device is provided for each cover. Before a cover can be rotated (counter clockwise) for opening, release this interlocking device with a 2.5 mm Allen key.*
2. *The foot of the converter housing provide an earthing point, this must be connected to the nearest safety earth conductor.*
3. *Only open the converter housing one minute after the power has been switched off and after it has been verified that there is no risk due to the presence of potentially explosive gas.*

Overview of the terminals for the outputs

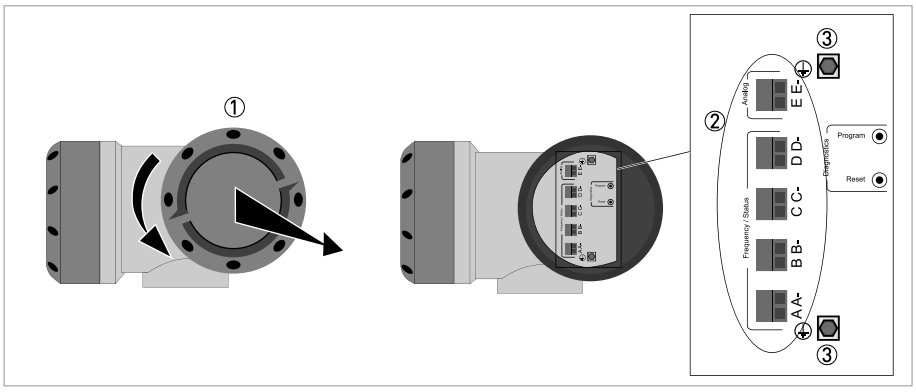


Figure 4-1: Terminal compartment for inputs and outputs, versions with KROHNE Care

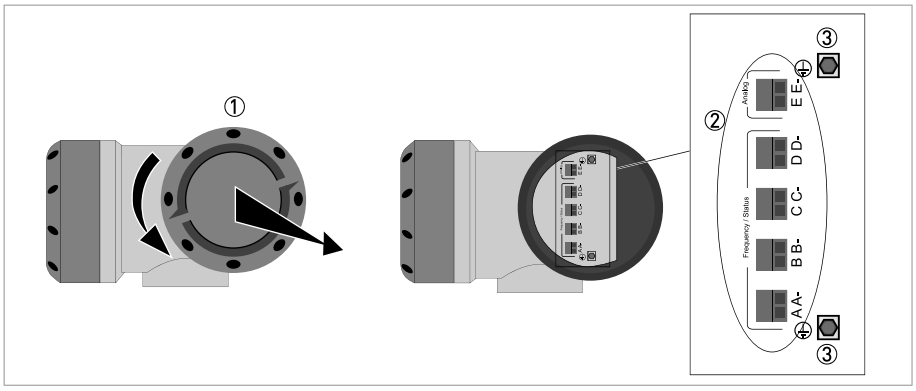


Figure 4-2: Terminal compartment for inputs and outputs, versions without KROHNE Care

The Program and Reset buttons are only available for versions with KROHNE Care.

CONNECTIONS	FUNCTION
A, A-	Digital pulse output, max. 20 mA
B, B-	Digital pulse output, max. 20 mA
C, C-	Digital output, max. 10 mA
D, D-	Digital output, max. 10 mA
E, E-	Current output

Table 4-1: Overview of outputs

Each time a housing cover is opened, the thread should be cleaned and greased.
Use only resin-free and acid-free grease.
Ensure that the housing gasket is properly fitted, clean and undamaged.

The next sections show more details of the outputs.

4.2.1 Digital pulse outputs

- Connectors A/A- and B/B- are used for this output.
- The digital outputs are passive open collector outputs, galvanically isolated from each other and from the main circuit. To use these outputs an external voltage source and current limiting resistors must be used (NEC class 2 power supply (max. 100 VA, 24 VDC, IEC 61010-1, clause 6.3.1 and 6.3.2).
  Criteria:
  $-U_{min} \leq$ 1 VDC (optocoupler on)
  - $U_{ext, nom}$ = 24 VDC (U_{ext} is external power supply, max = 32 VDC)

  - $I \leq$ 20 mA

  - $R_{L,min} = (U_{ext} - 1) / I_{max}$ (R_L is limiting resistor)

  Example: for U_{ext} = 24 VDC and I_{max} = 20 mA: $R_{L,min}$ = 1.15 kΩ (use $\geq$ 1.2 kΩ)
- By default the digital I/O connections are set as a pulse/frequency output (B 90° shifted to A), having a frequency proportional to the volume flow rate (actual volume: under process conditions). It is possible to assign another variable to control this output (defined by means of parameter settings).
- Use shielded cables in order to reduce radiation from electrical interferences (EMC).

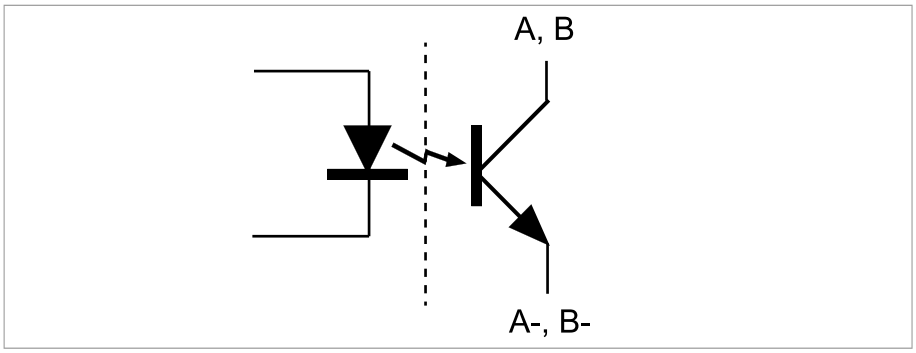


Figure 4-3: Digital pulse output

① Open the housing cover.
② Push the prepared cable through the cable entry and connect the necessary conductors.
③ Connect the shield if necessary.

- Close the cover of the terminal compartment.
- Close the housing cover.

Each time a housing cover is opened, the thread should be cleaned and greased.
Use only resin-free and acid-free grease.
Ensure that the housing gasket is properly fitted, clean and undamaged.

4.2.2 Digital outputs

- Connectors C/C- and D/D- are used for this output.
- The digital outputs are passive open collector outputs, galvanically isolated from each other and from the main circuit. To use these outputs an external voltage source and current limiting resistors must be used (NEC class 2 power supply (max. 100 VA, 24 VDC, IEC 61010-1, clause 6.3.1 and 6.3.2).
  Criteria:
  $-U_{min} \leq$ 2.5 VDC (optocoupler on)
  - $U_{ext, nom}$ = 24 VDC (U_{ext} is external power supply, max = 32 VDC)

  - $I \leq$ 10 mA

  - $R_{L,min} = (U_{ext} - 2.5) / I_{max}$ (R_L is limiting resistor)

  Example: for U_{ext} = 24 VDC and I_{max} = 10 mA: $R_{L,min}$ = 2.15 kΩ (use $\geq$ 2.2 kΩ)
- By default the next two digital I/O connections are defined as status outputs (Alarm / Error and Reverse flow). However the function of these outputs can be programmed to various alarms or status signals. One of the status outputs may be programmed to a second pulse output, having the same frequency as the first pulse output, however the phase difference can be set to either 0, 90, 180 or 270 degrees.
- Use shielded cables in order to reduce radiation from electrical interferences (EMC).

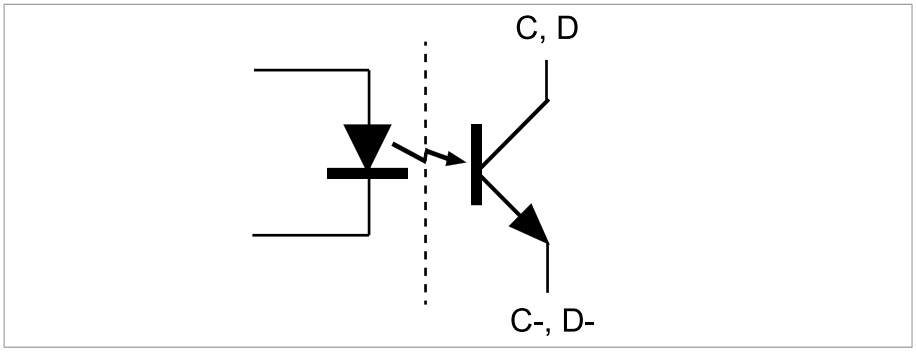


Figure 4-4: Digital output

① Open the housing cover.
② Push the prepared cable through the cable entry and connect the necessary conductors.
③ Connect the shield if necessary.

- Close the cover of the terminal compartment.
- Close the housing cover.

Each time a housing cover is opened, the thread should be cleaned and greased.
Use only resin-free and acid-free grease.
Ensure that the housing gasket is properly fitted, clean and undamaged.

4.2.3 Analog I/O connections

1. *In order to prevent unauthorized or inadvertent opening and removal of the covers, an interlocking device is provided for each cover. Before a cover can be rotated (counter clockwise) for opening, release this interlocking device with a 2.5 mm Allen key.*
2. *The foot of the converter housing provide an earthing point, this must be connected to the nearest safety earth conductor.*
3. *Only open the converter housing one minute after the power has been switched off and after it has been verified that there is no risk due to the presence of potentially explosive gas.*

- The analog output are passive outputs, galvanically isolated from each other and from the main circuit. To use these outputs an external voltage source and current limiting resistors must be used (NEC class 2 power supply (max. 100 VA, 24 VDC, IEC 61010-1, clause 6.3.1 and 6.3.2).
  Criteria:
  - $U_{ext} \leq$ 32 VDC at I = 22 mA (U_{ext} is external power supply)

  - U_0 = 2 V (U_0 is lowest voltage used)

  - $R_L = (U_{ext} - U_o) / Imax$ (R_L is limiting resistor)

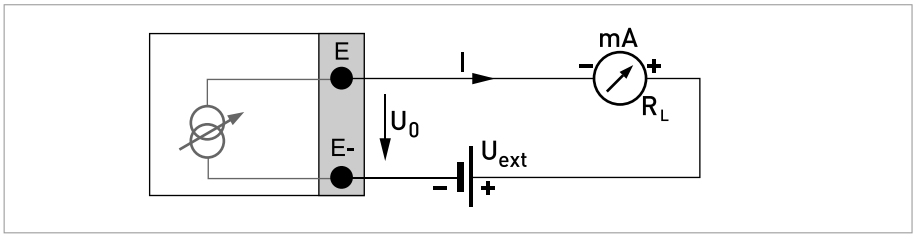


Figure 4-5: Current output passive

4.2.4 Emulation of a turbine meter

To emulate a turbine meter, use the following setup and settings:

- A/A-: Frequency output related to the line flow
- B/B-: Frequency output inverted related to the line flow whereby this frequency output will stop operating if data valid alarm on status bit C/C- will occur.

Place the frequency output B/B- in series with status bit C/C- as presented in the figure shown below.

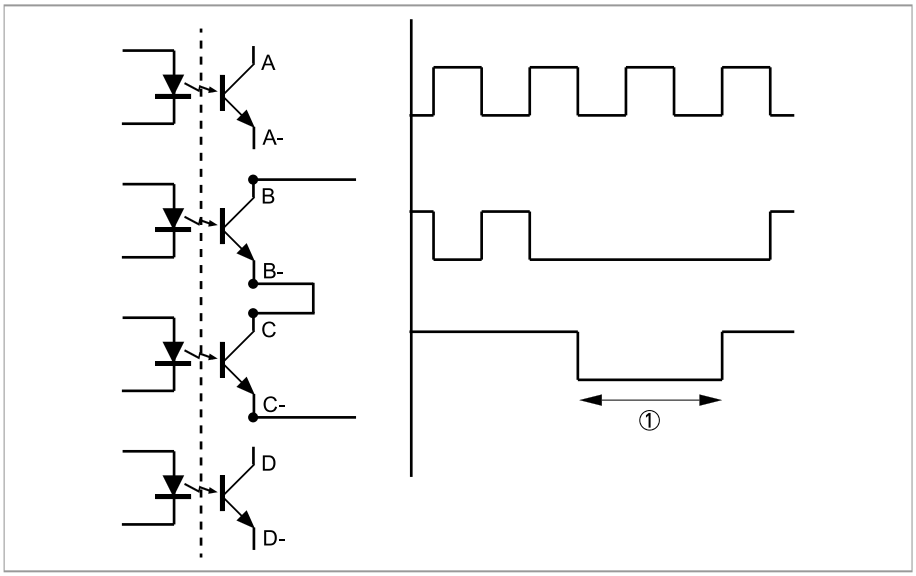


Figure 4-6: Connection diagram for turbine emulation

① Alarm

4.3 Serial data communication (RS 485)

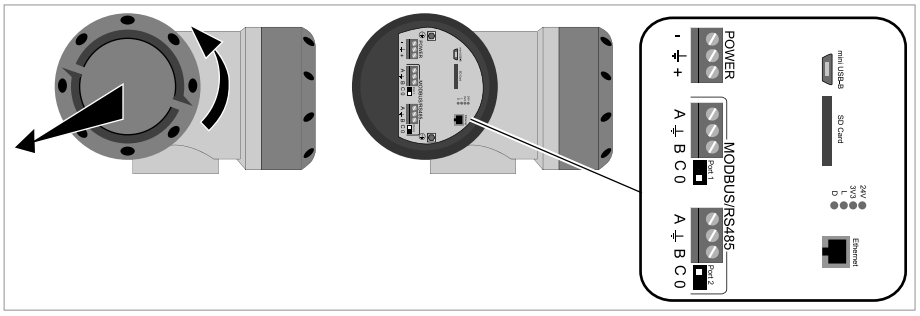


Figure 4-7: Connection of serial data communication

4.4 KROHNE Care board

With this KROHNE Care board, there are some more (non-Custody Transfer) I/O connections:

- 1x USB
- 2x ethernet
- 1x analog output
- 1x digital output
- 2x Modbus/RS485 (master and/or slave)
- 1x multidrop (dual) HART

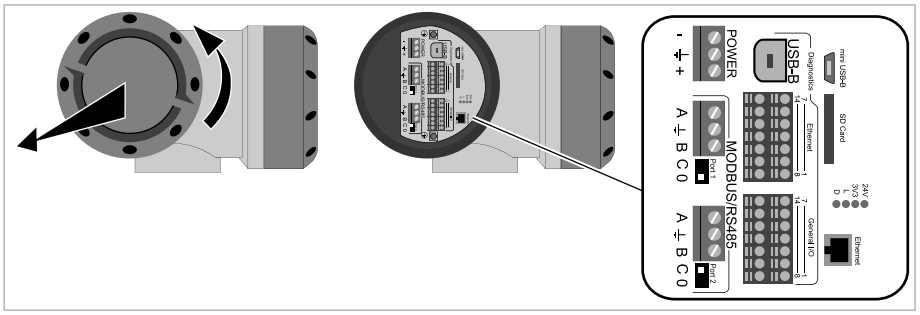


Figure 4-8: Overview of connectors with KROHNE Care

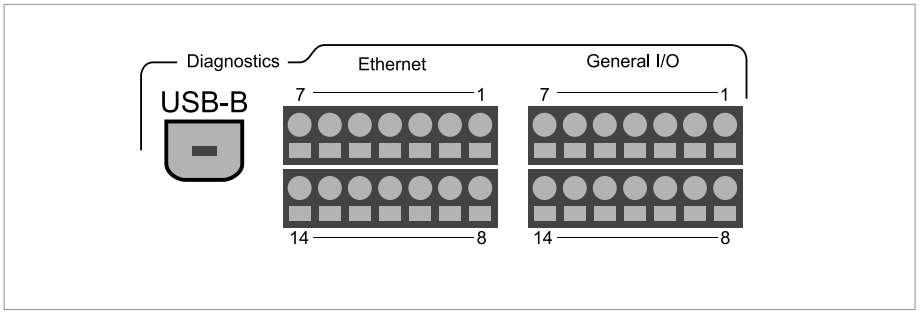


Figure 4-9: Connectors of KROHNE Care

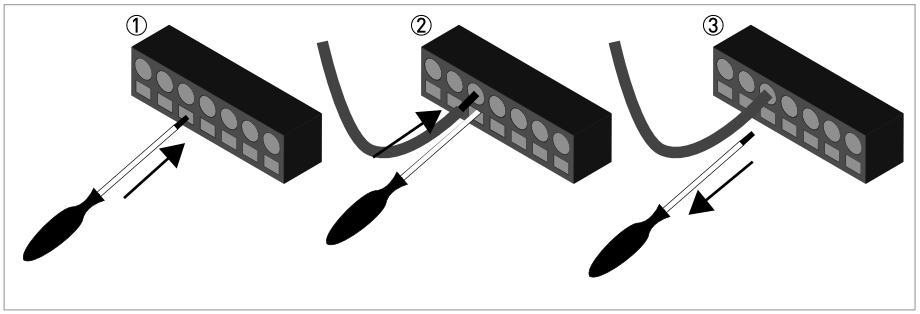


Figure 4-10: How to use the Ethernet and General I/O connectors

① Insert a flat-headed screwdriver into the square opening
② Insert the stripped cable into the round opening
③ Remove the screwdriver

4.5 Power connection

- *Use a 24 VDC power supply to power the flowmeter, which complies to NEC class 2 (max. 100 VA, 24 VDC ±10% , see also IEC 61010-1, clause 6.3.1 and 6.3.2). The maximum power consumption is 17 W. The power supply must be able to supply 3 A (needed during start-up).*
- *The protective earth conductor (1...4 mm^2, AWG 17...AWG 11) of the power supply must be connected to the protective conductor clamp terminal size M5, which is press-fitted in the terminal compartment.*
- *Use a cable entry to lead the power supply cable to the electronics. The power delivered from the power converter inside the unit is limited to a maximum of 15 W according to the "fold-back" principle (when the admissible internal power consumption is exceeded the delivered power is reduced to zero). Separately the current consumption is limited to appr. 1A.*
  Requires typically 3 x 1.5 mm^2 (AWG 15) conductors.

- *The protective conductor clamp or GND of the connector can be used for the shielding of the cable.*
- *The electronics is protected against connecting a power supply with the wrong polarity.*

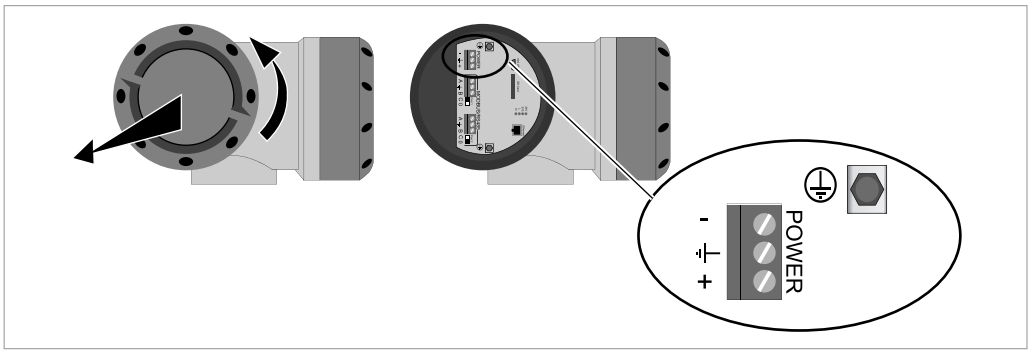


Figure 4-11: Location of power connector

4.6 Cabling

Use the standard stainless steel cable glands, refer to the figure below.

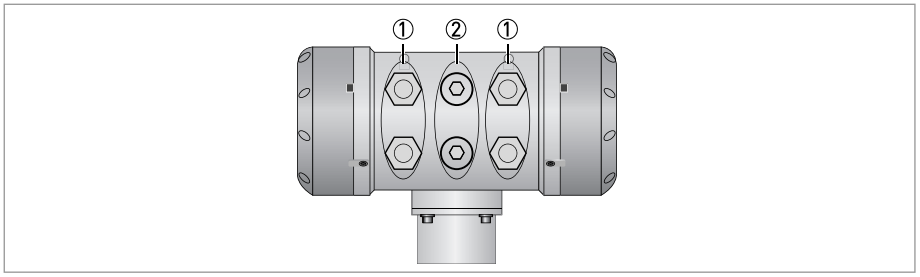


Figure 4-12: Location of cable glands

① Glands for universal use, i.e. for:
- signal output (frequency / pulse)
- power supply 24 VDC
- RS485 Modbus (optional UTP cable for KROHNE Care Expert system)
- signal output (frequency / pulse)

② Ex-d approved blind plug

- *Replace any unused cable gland by an Ex-d blind plug!*
- *The temperature rating of all cables must have a temperature rating of at least 65°C / 149°F. In case the process design temperature exceeds 65°C, the cables must have a temperature rating as high as the maximum process design temperature.*

Only use Ex-d approved cable glands. The enclosure entries that are not used must be closed with Ex-d approved blind plugs.

We recommend to use screened cable with twisted pairs for connecting power, serial outputs and the status signals. The screen can be used to connect the ground terminal.

Length of power supply cable versus diameter

Length of cable between power supply and flowmeter		Required minimum copper cross section
[m]	[ft]	
70	230	2 x 0.5 mm^2 (AWG 20)
100	328	2 x 0.75 mm^2 (AWG 18)
200	656	2 x 1.5 mm^2 (AWG 15)
400	1312	2 x 4 mm^2 (AWG 11)

4.7 Grounding

There are two screw connection points (one M5 thread and one M4 thread) to attach a ground conductor. They can be used to connect the upstream and downstream piping to the flowmeter (Equipotential).

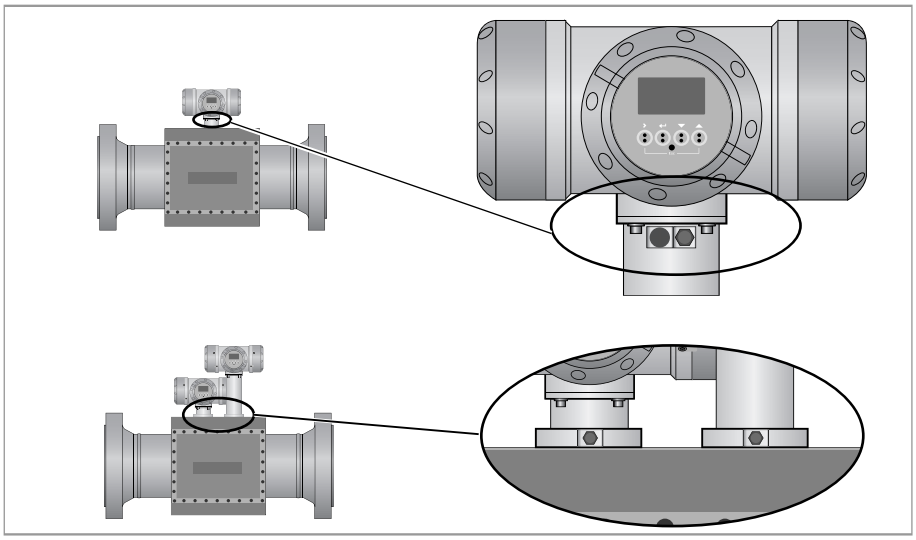


Figure 4-13: Location of grounding connectors

The specifications contained herein are subject to change without notice and any user of said specifications should verify from the manufacture that the specifications are currently in effect. Otherwise, the manufacturer assumes no responsibility for the use of specifications which may have been changed and are no longer in effect.

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