ALTOSONIC 5 Technical Datasheet

Ultrasonic liquid flowmeter for custody transfer

- Suitable for all flow regimes, no Reynolds limitation
- Integrated gas detection
- Significant easier small volume proving

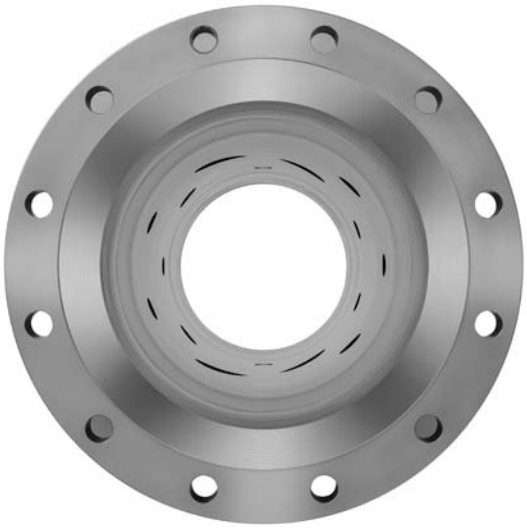
1.1 ALTOSONIC 5 flowmeter for custody transfer

The ALTOSONIC product line for fluids has established itself as the standard in multi-path custody transfer flow metering. The absence of obstructing and moving parts ensures no wear or pressure loss. This in combination with large meter sizes permits simplified configuration of metering systems.

Operation is maintenance free. Due to long-term stability, periodic calibration can be reduced to a minimum which results in drastically cutting costs for on-site equipment and procedures.

In addition, the diagnostics of the flowmeter will ensure a good performance and will prevent malfunctioning of the measurement by providing essential information upon which the operator is able to take preventive action.

This all results in considerable cost savings in both capital (CAPEX) and operational expenditure (OPEX).



Highlights

- All fluids and no Reynolds restriction
  - Widest certified turndown
  - Guaranteed performance in all flow regimes (laminar, transition and turbulent)
  - Multi-product application
  - From light to heavy crudes and LNG
  - Bi-directional flow measurement
- Proven long-term stability
  - No moving parts
  - Longest installed base (1996 - present)
  - No unscheduled downtime due to transducer failure since introduction
- Small footprint
  - Short inlet run
  - Short installation height
- Entrained gas detection (Full Pipe Guarantee)
  - Dedicated diagnostic path
  - Permanent diagnostics
- Compact prover compliance (SVP)

Industries

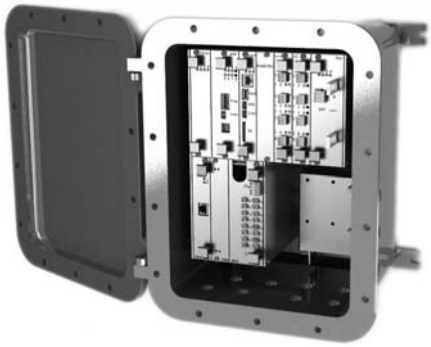
- Oil and gas
- Petrochemical
- Chemical

Applications

- Offshore oil production
- Onshore oil production
- Crude oil pipelines
- Multi-product pipelines
- Loading and off-loading terminals (crudes, refined products and LNG)
- Refineries

1.2 Options and variants

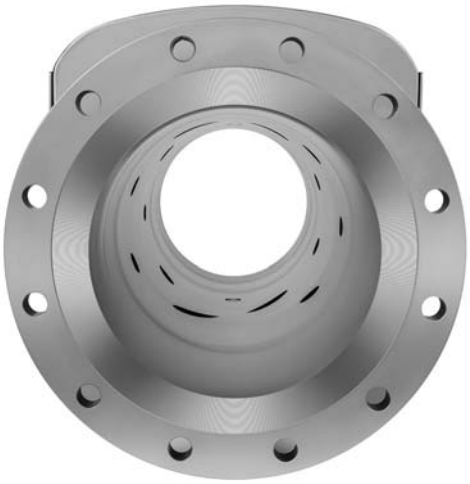
To be able to cover a wide range of applications, process conditions and ambient conditions, the ALTOSONIC 5 flowmeter consists of a flow sensor and a separate remote signal converter.
The flow sensor, installed in the pipeline, contains multiple ultrasonic transducers for flow measurement and diagnostics. In addition, a vertical mounted transducer pair will ensure that there is no gas on top of the liquid. To avoid influence from flow sensor expansion on the measurement a temperature sensor is integrated to compensate for this effect.



The remote signal converter determines the actual flow based on the information received from the flow sensor. Next to the flow, the signal converter will gather a large amount of diagnostic information such as signal-to-noise ratio, velocity of sound and profile. Based on this diagnostic information, the signal converter is able to determine the health of the measurement. In addition to gathering the information and diagnosing the health of the meter, all this information can be logged internally and is available whenever it is necessary.

Should a local display be required, an optional explosionproof display can be connected to the signal converter. The display can be configured to show any of the process and / or measuring data.

For custody transfer applications the standard flow has to be calculated by correcting for pressure and temperature. This is done by a flow computer. KROHNE offers the internationally recognized and approved flow computer, SUMMIT 8800, to fulfil this task.



Variants
- Standard, for viscosities up to 150 cSt
- High viscosity, for viscosities higher than 150 cSt
- Low temperature, for cryogenic process conditions such as LNG
- High temperature, up to 250°C (482°F)

Standard diagnostics

With the above instruments it is possible to build an excellent measuring system. But what if there is any doubt about the measuring results? Is this due to the measuring system itself or is it due to changing process conditions, such as air in the pipeline? With the Monitoring, Configuration and Diagnostics tool in the flowmeter it is not only possible to determine the cause, but it will also give the user a preventative warning in case of mal-functioning or changing of process conditions.

Example: During operation a thin layer of air occurs on top of the fluid. Assuming this layer displaces 0.1% of the fluid, the reading of the flowmeter will have an additional uncertainty of 0.1%, because an ultrasonic flowmeter assumes the pipe to be hundred percent full. By integrating a vertical diagnostic path the slightest bit of air will be detected and the user will be informed. Full-pipe detection is essential for every custody transfer transaction to guarantee the absence of gas in the pipeline.

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 liquids in custody transfer applications
Versions	Standard (STD)
	High Viscosity (HV)
	Low Temperature (LT)
	High Temperature (HT)
Measured value	Actual volume flow
Calculated value	Totalized flow, velocity of sound

Design

General	The ALTOSONIC 5 flowmeter consists of a flow sensor and a signal converter.
Flow sensor	
Construction	The flow sensor has an eight-path design with a central path for turbulent, transition or laminar flow differentation. It also includes a dedicated vertical diagnostic path for full pipe guarantee.
Nominal diameter	4"...24" / DN100...600
	Other diameters on request.
Signal converter	
Construction	The remote flameproof signal converter calculates the volume flow and the totalized volume, performs diagnostics and provides data logging functionality.
Functionality	Calculation of totalised volume
	Diagnosis of flow profiles
	Body temperature correction
	Logging of relevant parameters
	Optional display connection

Measuring accuracy

Measuring range	0...15 m/s (bidirectional)
	Reduced bore:
	Reynolds range: no limits (turbulent, transition and laminar flow regimes)
	Certified for custody transfer: 0.2...15 m/s (bidirectional)
	Full bore:
	Reynolds range: > 10000
	Certified for custody transfer: 0.5...15 m/s (bidirectional)
Linearity	0.10%, for Reynolds range > 10000 with a turndown of 30:1 (0.5...15 m/s)
	0.15%, for whole Reynolds range with a turndown of 75:1 (0.2...15 m/s)
Uncertainty	< ±0.027% according to API
Repeatability	according to API chapter 5.8 table B1
Zero stability	< 0.2 mm/s
Certified turndown	75:1

Ambient temperatures

Flow sensor	
ATEX, IECEx, DIV1/ZONE1	Standard: -20...+65°C / -4...+149°F
	Optional: -55...+65°C / -67...+149°F
Storage temperature	-40...+65°C / -40...+149°F
Signal converter	
ATEX	Standard: -20...+55°C / -4...+131°F
	Standard + heating: -50...+55°C / -58...+131°F
	Optional: -55...+55°C / -67...+131°F
IECEx	Standard: -20...+55°C / -4...+131°F
	Standard + heating: -50...+55°C / -58...+131°F
DIV1 / ZONE1 (C/US)	Standard: -20...+55°C / -4...+131°F
	Standard + heating: -55...+55°C / -67...+131°F
Storage temperature	-40...+65°C / -40...+149°F

Process conditions

Process temperature	Standard version: -40...+120°C / -40...+240°F	
	Low temperature version: -200...+120°C / -328...+240°F	
	High temperature version: -40...+250°C / -40...+482°F	
	High viscosity version: -40...+120°C / -40...+240°F	
Viscosity range	All versions: 0.1...150 cSt	
	High viscosity version: 0.1...1500 cSt	
Pressure range	ASME 150...600	
	Pressure rating according to ASME B16.5 (-29...+38°C / -20...+100°F):	
	Class 150 lbs:	Stainless steel: 19.0 bar / 275 psi
		Carbon steel: 19.6 bar / 285 psi
	Class 300 lbs:	Stainless steel: 49.6 bar / 720 psi
		Carbon steel: 51.1 bar / 740 psi
	Class 600 lbs:	Stainless steel: 99.3 bar / 1440 psi
		Carbon steel: 102.1 bar / 1480 psi
	Other pressure ranges on request.	
Minimum pressure requirement	For detailed information, refer to *Backpressure* on page 21.	
Water content	Velocity above 1 m/s: ≤ 6%	
	Velocity above 2 m/s: ≤ 10%	
Solids content	< 5% (volume)	
Air/gas content	< 2% (volume)	

Installation conditions

Installation	For detailed information, refer to *Mechanical installation* on page 15.
Dimensions and weights	For detailed information, refer to *Dimensions and weights* on page 12.
Altitude	< 2000 m
Overvoltage category	II
Pollution degree	3

Materials

Flanges (RF)	Stainless steel AISI 316 / 316 L (1.4404) (dual certified)
	Carbon steel ASTM A105 / A350 Gr.LF2
	Other materials / flange types on request
Measuring tube	Stainless steel AISI 316 / 316 L (1.4404) (dual certified)
	Carbon steel ASTM A105 / A350 Gr.LF2 / A106 Gr.B / A333 Gr.6
	Other materials on request
Converter housing	Standard: Copper free aluminum
	Option: Stainless steel 316 (1.4408) for offshore applications
Coating	Standard: Blasted (not coated)
	Option: Epoxy coating RAL 9006 (silver)
	Option: Offshore coating RAL 9006 (silver)

Electrical connections

Power supply	24 VDC +10%/-15%, 4A fuse, internally isolated
Power consumption	Standard version: 25...28 W
	With optional heater for low ambient temperatures: 24 VDC 175 W
Transducer signals	Intrinsically safe flow sensor circuits:
	U_i = 18 V, I_i = 210 mA, C_i = 100 nF, L_i = 700 µH, P_i = 1 W
	Intrinsically safe signal converter circuits:
	U_o = 6.51 V, I_o = 208 mA, C_o = 22 µF, L_o = 1.5 mH, P_o = 0.34 W
PT100 signal	Intrinsically safe (ia) circuit:
	U_i = 10 V, I_i = 10 mA, P_i = 200 mW
Cable entries	Standard: M20 x 1.5
	Option: ½" NPT, PF ½

Inputs and outputs

Available options	1x Ethernet
	4x RS485 serial Modbus master / slave output
	4x (Basic IO) or 8x (optional, extended IO) IO configurable input/output with: - Digital dual pulse, phase shifted - Alams - Analog values 0/4...20 mA inputs/outputs All circuits: galvanically isolated, rated < 16 V r.m.s. / 22.6 V peak / < 35 VDC
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.		
Electromagnetic compatibility	Directive: 2004/108/EC, NAMUR NE21/04		
	Harmonized standard: EN 61326-1		
Pressure Equipment Directive	Directive: 97/23/EC		
	Category I, II, III		
	Liquid group 1		
	Production module H		
Hazardous areas			
		Marking	Approval
ATEX	Flow sensor	II 2G Ex ia IIC T6...T2 Gb	FTZU 14 ATEX 0024X
	Signal converter	II 2G Ex d [ia] IIB T5 Gb	FTZU 14 ATEX 0131X
IECEx	Flow sensor	Ex ia IIC T6...T2 G	IECEX FTZU 14 .0020X
	Signal converter	Ex d [ia] IIB T5 Gb	IECEX FTZU 14.0029X
DIV 1	Flow sensor	Class I, Groups B, C, D, temp class T6...T2	LR 1338-1
	Signal converter	Class I, Groups B, C, D, temp class T5	LR 1338-2
Zone (Canada)	Flow sensor	Ex ia IIB+H2 T6...T2 Gb	LR 1338-1
	Signal converter	Ex ia IIB+H2 T5 Gb	LR 1338-2
Zone, ANSI/ISA (USA)	Flow sensor	Class I, Zone 1, AEx [ia] IIC T6...T2	LR 1338-1
	Signal converter	Class I, Zone 1, AEx d [ia] IIC T5	LR 1338-2
Other approvals and standards			
Ingress protection	IP66 or NEMA Type 4X		
OIML - R117	OIML TC 8548		

2.2 Dimensions and weights

- *All dimensions are provided as indication. They can vary slightly with different schedule sizes.*
- *Values for larger diameters are available on request.*

Flow sensor

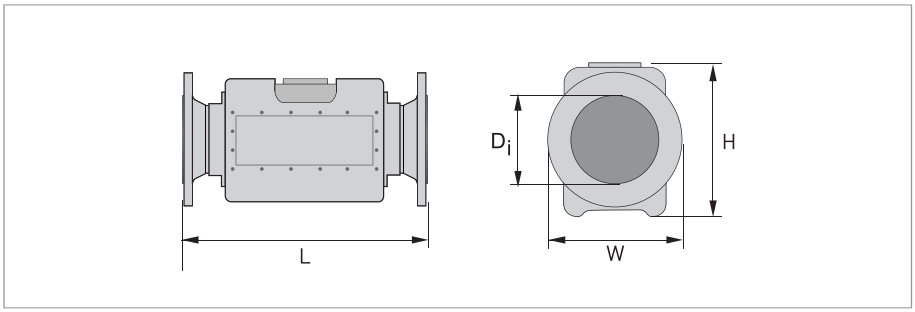


Figure 2-1: Dimensions of flow sensor

ASME 150 lb

Nominal size	Metric					Imperial				
	H [mm]	L [mm]	W [mm]	D_i [mm]	Weight [kg]	H [inch]	L [inch]	W [inch]	D_i [inch]	Weight [lbs]
4" / DN100	289	500	330	102.26	175	11.38	19.69	12.99	4.026	385
6" / DN150	340	600	380	154.08	310	13.39	23.62	14.96	6.066	682
8" / DN200	408	600	369	202.74	320	16.06	23.62	14.53	7.982	704
10" / DN250	510	900	450	254.56	230	20.08	35.43	17.72	10.022	506
12" / DN300	530	1000	490	304.74	310	20.87	39.37	19.29	11.998	682
14" / DN350	540	1100	540	336.54	460	21.26	43.31	21.26	13.250	1012
16" / DN400	600	1200	600	387.34	600	23.62	47.24	23.62	15.250	1320
18" / DN450	650	1350	635	437.94	860	25.59	53.15	25.00	17.242	1892
20" / DN500	700	1400	700	482.6	960	27.56	55.12	27.56	19.000	2112
24" / DN600	820	1650	820	584.2	1050	32.28	64.96	32.28	23.000	2310

ASME 300 lb

Nominal size	Metric					Imperial				
	H [mm]	L [mm]	W [mm]	D_i [mm]	Weight [kg]	H [inch]	L [inch]	W [inch]	D_i [inch]	Weight [lbs]
4" / DN100	289	500	330	102.26	195	11.38	19.69	12.99	4.026	429
6" / DN150	340	600	380	154.08	325	13.39	23.62	14.96	6.066	715
8" / DN200	396	600	343	202.74	335	15.59	23.62	13.50	7.982	737
10" / DN250	510	950	450	254.56	260	20.08	37.40	17.72	10.022	572
12" / DN300	530	1050	520	304.74	360	20.87	41.34	20.47	11.998	792
14" / DN350	590	1100	590	330.2	440	23.23	43.31	23.23	13.000	968
16" / DN400	650	1200	650	381	690	25.59	47.24	25.59	15.000	1518
18" / DN450	710	1350	710	428.6	900	27.95	53.15	27.95	16.874	1980
20" / DN500	780	1400	780	477.82	1120	30.71	55.12	30.71	18.812	2464
24" / DN600	920	1650	920	574.64	1300	36.22	64.96	36.22	22.624	2860

ASME 600 lb

Nominal size	Metric					Imperial				
	H [mm]	L [mm]	W [mm]	D_i [mm]	Weight [kg]	H [inch]	L [inch]	W [inch]	D_i [inch]	Weight [lbs]
4" / DN100	289	500	330	102.26	205	11.38	19.69	12.99	4.026	451
6" / DN150	340	600	380	148.36	350	13.39	23.62	14.96	5.762	770
8" / DN200	396	650	343	193.7	370	15.59	25.59	13.50	7.626	814
10" / DN250	510	1000	510	242.92	400	20.08	37.40	20.08	9.564	880
12" / DN300	560	1050	560	288.84	480	22.05	41.34	22.05	11.372	1056
14" / DN350	610	1150	610	317.5	650	24.02	45.28	24.02	12.500	1430
16" / DN400	690	1200	690	363.52	810	27.17	49.21	27.17	14.312	1782
18" / DN450	750	1300	750	409.3	960	29.53	51.18	29.53	16.11	2116
20" / DN500	820	1400	820	455.6	1250	32.28	55.12	32.28	17.94	2756
24" / DN600	940	1600	940	547.7	1910	37.01	62.99	37.01	21.56	4211

Signal converter

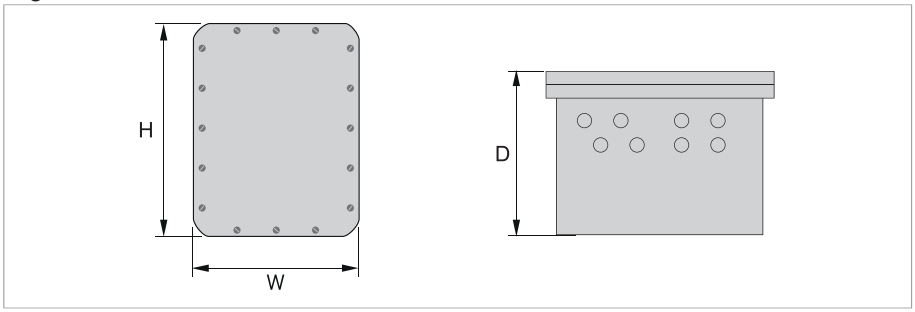


Figure 2-2: Dimensions of signal converter housing

Signal converter housing

Version	Metric				Imperial			
	H [mm]	W [mm]	D [mm]	Weight [kg]	H [inch]	W [inch]	D [inch]	Weight [lbs]
Aluminium (standard)	432	332	299	25.4	17.01	13.07	11.77	56.0
Stainless steel (offshore)	432	382	286	75	17.01	15.04	11.26	165.3
Aluminium (DIV 1 approved)	584	432	292	64	22.92	17.01	11.50	141.1

2.3 Flow table

Nominal size	Metric		Imperial	
	Q_{min} [m^3/h] 0.2 m/s	Q_{max}* [m^3/h] 15 m/s	Q_{min} [bbl/h] 0.7 ft/s	Q_{max}* [bbl/h] 50 ft/s
4" / DN100	5.6	425	35	2660
6" / DN150	12.6	950	80	5950
8" / DN200	22.6	1700	140	10700
10" / DN250	36	2700	225	17000
12" / DN300	50	3750	315	23500
14" / DN350	70	5250	440	32900
16" / DN400	90	6750	565	42300
18" / DN450	114	8560	715	53750
20" / DN500	140	10500	880	65850
24" / DN600	200	15000	1255	94000
*Ensure that there is enough backpressure to avoid flashing.				
Calculations are provided as indication, please ask KROHNE for detailed sizing.				

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 5 is a flowmeter for flow measurement of all liquids. It has a custody transfer approval for all liquids other than water.

3.2 Pre-installation requirements

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

- *Humidity: < 95% RH*
- *Ambient temperature: -55...+55°C / -67...+131°F*
- *Suitable for indoor and outdoor use.*
- *IP66 / NEMA 4X classification.*

3.3 Installation

3.3.1 Pipe diameters

Ensure that the inner diameter of the upstream pipe matches the specified connection diameter at the flange of the ultrasonic flow sensor within 1%. Contact the manufacturer if the inner diameter deviates more than 1%.
The inner diameter of the downstream pipe must be within 3% of the flow sensor.

The welds must be grinded to avoid flow disturbances.

3.3.2 Flow conditioners

An additional flow conditioner can be installed upstream of the flow sensor to minimize the influence of upstream perturbations.

If a flow conditioner is used, it is advised that the flow conditioner, the inlet pipe and the flow sensor are calibrated together.

3.3.3 Inlet and outlet

The inlet and outlet configurations mentioned are intended as general guidelines.

With flow conditioner for unidirectional use

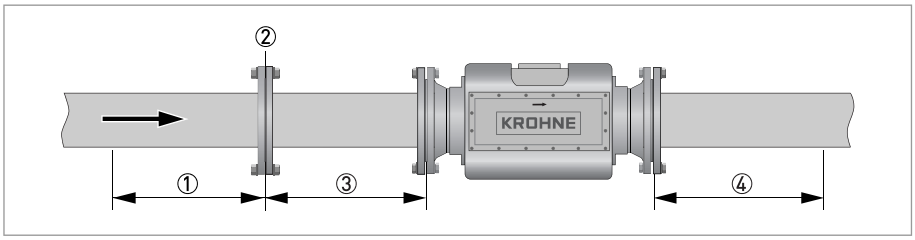


Figure 3-1: Required straight lengths for inlet and outlet

① Inlet section before flow conditioner: 5 DN
② Flow conditioner
③ Inlet section after flow conditioner: 5 DN
④ Outlet section: 3 DN

Please note that more straight inlet length will improve overall performance.

With flow conditioner for bidirectional use

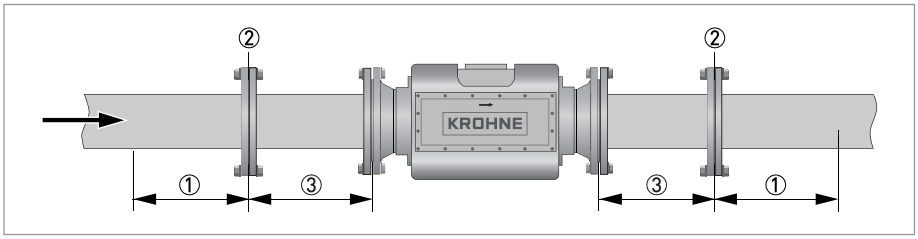


Figure 3-2: Required straight lengths for inlet and outlet

① Section before / after flow conditioner: 5 DN
② Flow conditioner
③ Section after / before flow conditioner: 5 DN

Without flow conditioner

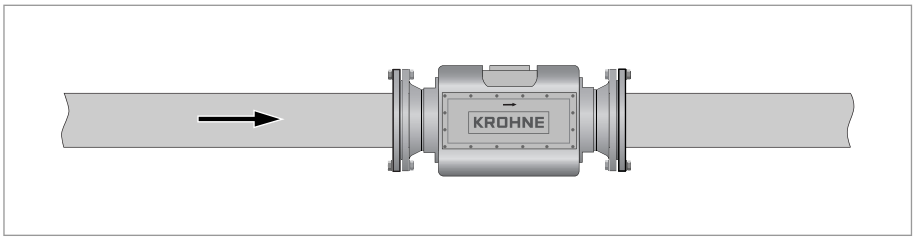


Figure 3-3: Required straight lengths for inlet and outlet

For applications without flow conditioner, the inlet and outlet lengths depend on the upstream piping arrangement and the liquid conditions (temperature, viscosity, flow rate). Please contact KROHNE for assistance.

3.3.4 Mounting position

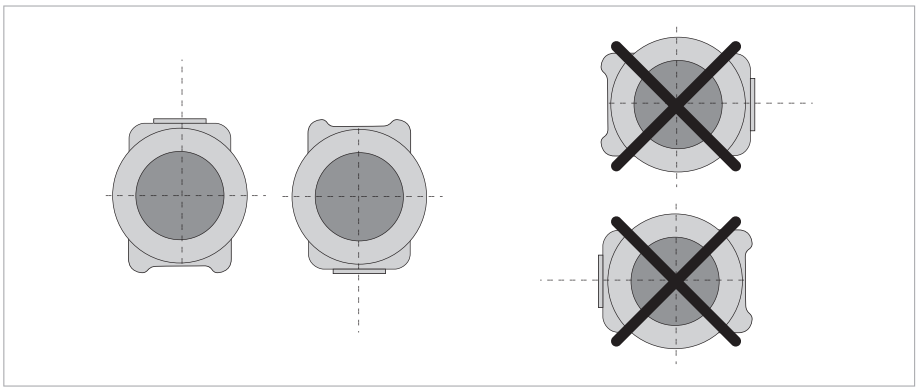


Figure 3-4: Mounting position

3.3.5 Support of the flow sensor

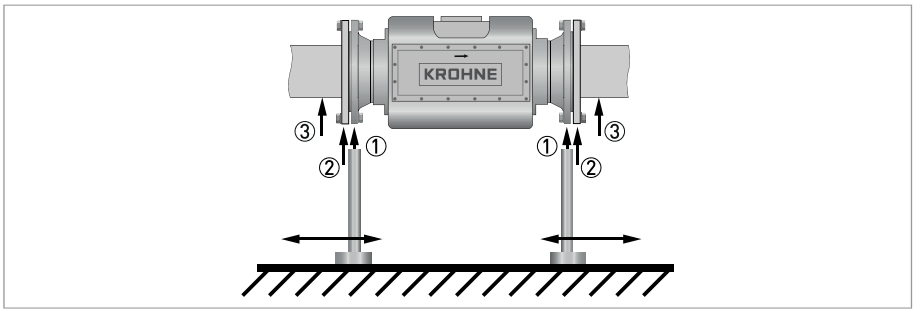


Figure 3-5: Support of flow sensor

① Preferred position of supports under flanges of flow sensor
② If preferred position is not possible, then use the mating flanges to support the flow sensor
③ If both flanges can not be used, then put the supports under the pipeline as close to the flow sensor as possible.

3.3.6 Flange deviation

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

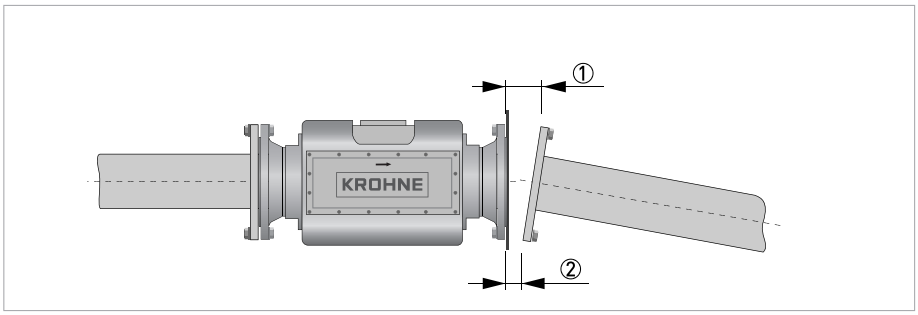


Figure 3-6: Flange deviation

① L_{max}
② L_{min}

3.3.7 Special considerations

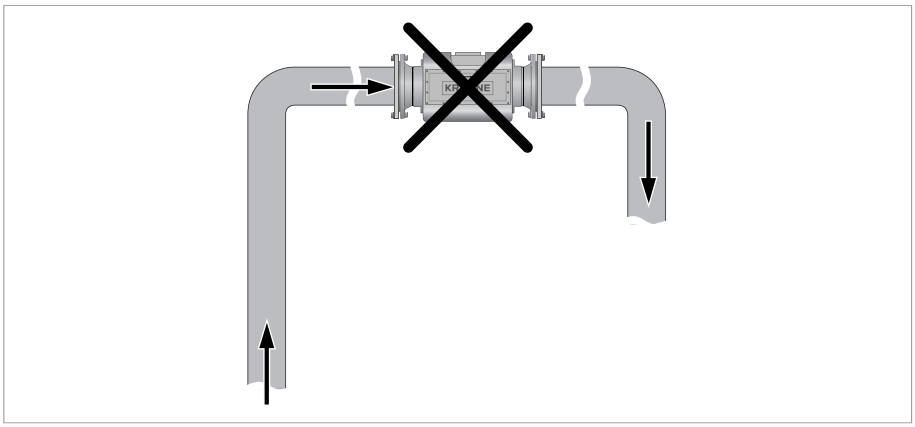


Figure 3-7: No installation at highest point

Do not install the flow sensor at the highest point, because air can collect there.

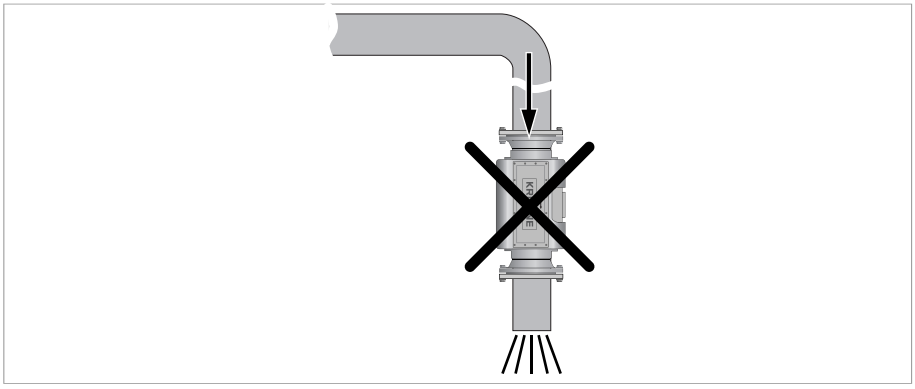


Figure 3-8: No installation in vertical line before free discharge

Do not install the flow sensor in a vertical line, because it is not sure that the pipe remains fully filled and / or is without vapour.

3.3.8 Air venting

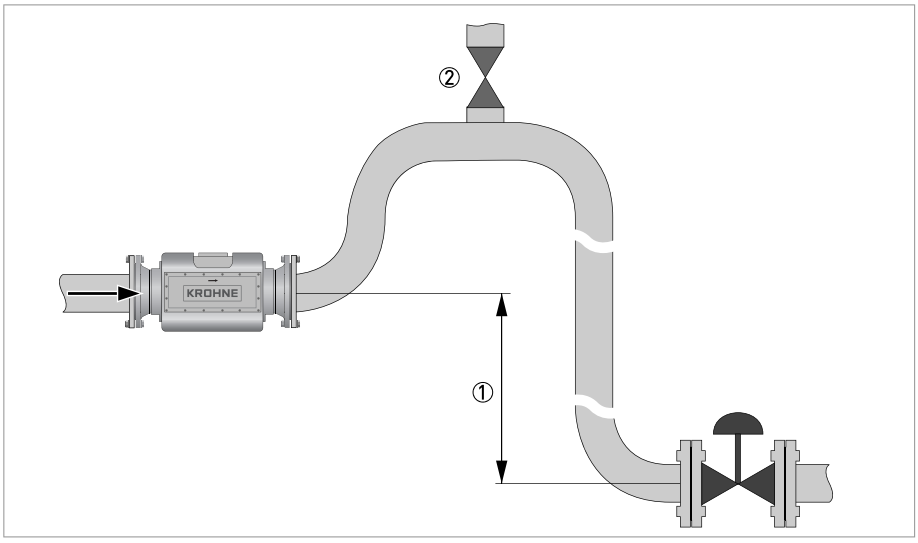


Figure 3-9: Air venting

① ≥ 5 m
② Air ventilation point

3.3.9 Pressure and temperature sensors

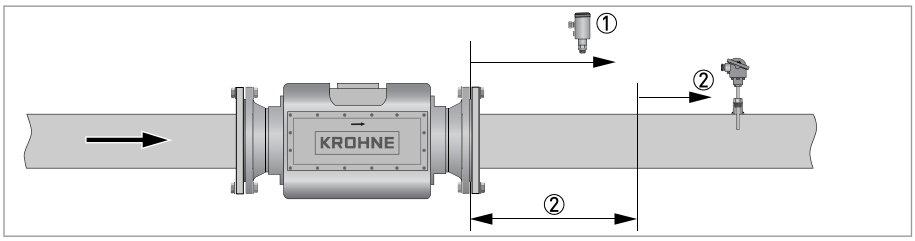


Figure 3-10: Location of pressure and temperature transmitters

① Install the pressure transmitter downstream of the flow sensor
② Install temperature transmitter at minimum 3 DN downstream of the flow sensor

If a bi-directional flow is used, then install the temperature transmitter at a distance of 10 DN of the flow sensor.

3.4 Backpressure

To prevent flashing / cavitation in the flow sensor, it should be installed in such a way that the flow sensor is always fully filled and has enough back pressure. As a guide line, the pressure should not go below the minimum limit as shown in the following graph.

To calculate the minimum required pressure in the pipeline to avoid flashing, you have to know the vapour pressure of the process liquid and add it to the pressure, found in the next figure.

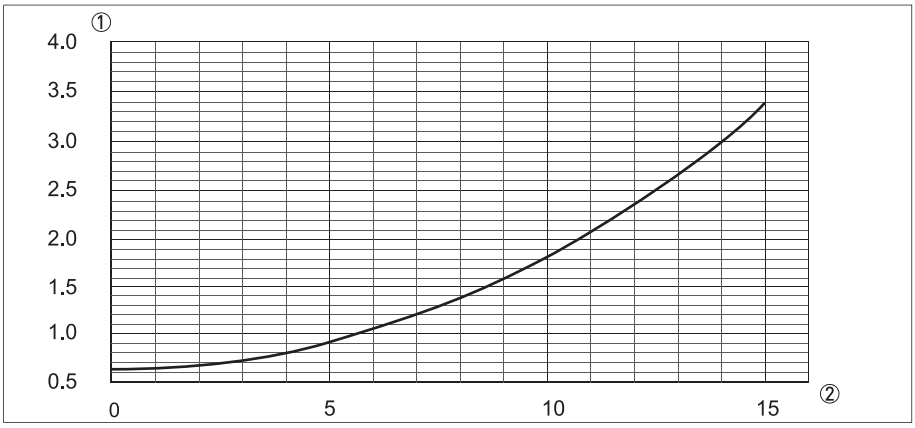


Figure 3-11: Needed pressure above vapour pressure

① ΔP [bar]
② Velocity [m/s]

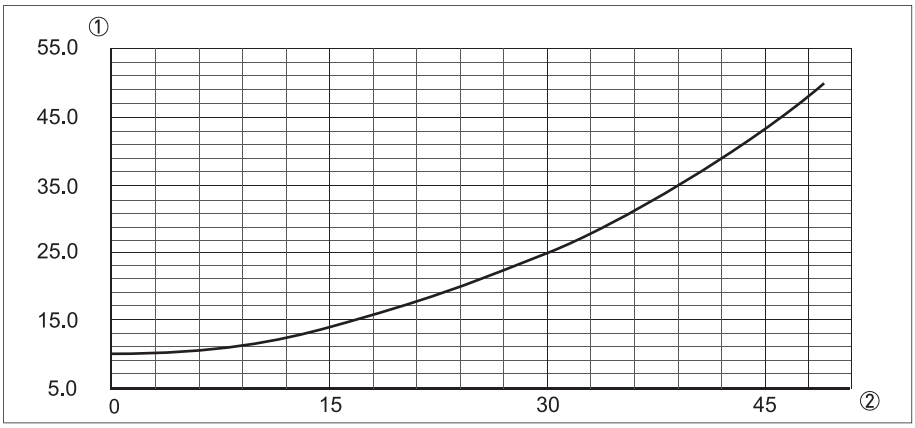


Figure 3-12: Needed pressure above vapour pressure

① ΔP [psi]
② Velocity [ft/s]

Example for crude oil, at velocity of 10 m/s:

① In technical documentation, find the vapour pressure P_v of crude oil. This is 0.7 bar(a).

② In the figure above, find the ΔP value at 10 m/s. This ΔP value is 1.8 bar.

③ Calculate the minimum required pressure $\mathbf{P_{min}} = P_v + \Delta P$. This will result in 0.7 + 1.8 = 2.5 bar as a minimum pressure for the pipe line.

3.5 Sunshades

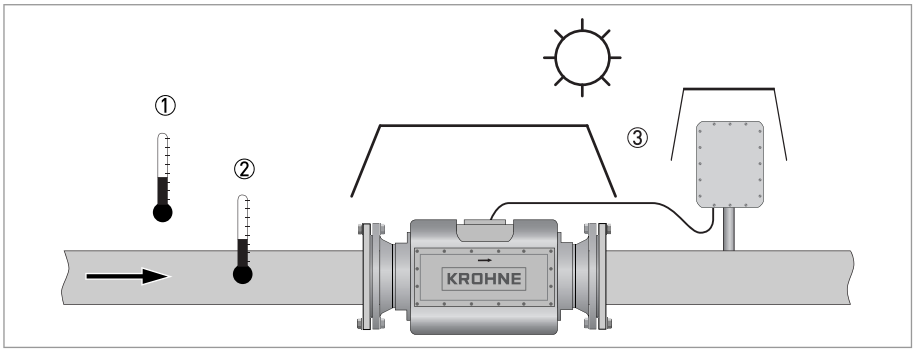


Figure 3-13: Temperatures

① Ambient temperature
② Process temperature
③ Use a sunshade to protect the flowmeter against direct solar radiation

Direct solar radiation causes temperature gradients in the metering section and must be avoided as much as possible. Use a sunshade or canopy to protect the flowmeter and the pressure and temperature transmitters against direct sunshine. Another option is to thermally insulate the complete metering section including the transmitters.

4.1 Overview of electrical installation

An overview of a typical connection diagram is shown below.

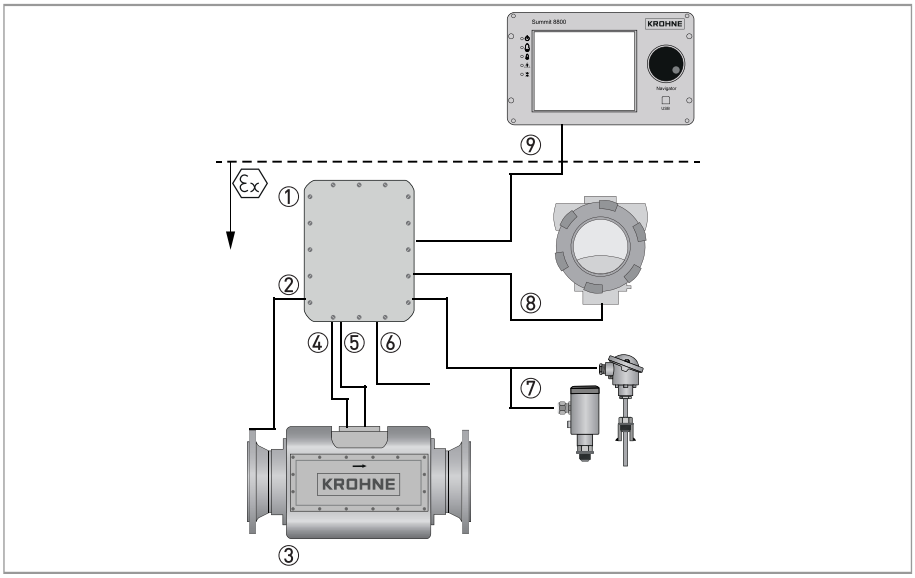


Figure 4-1: Overview electrical connections

① Signal converter
② Equipotential bonding wire (> 4 mm^2)
③ Flow sensor
④ Connection of body temperature (supplied with delivery)
⑤ Connection of three signal cables of flow sensor (supplied with delivery)
⑥ Power supply
⑦ Pressure and / or temperature transmitters (optional)
⑧ Display (optional)
⑨ Flow computer (optional) via:
- RS485, MODBUS
- Pulse / frequency

4.2 Flow sensor connections

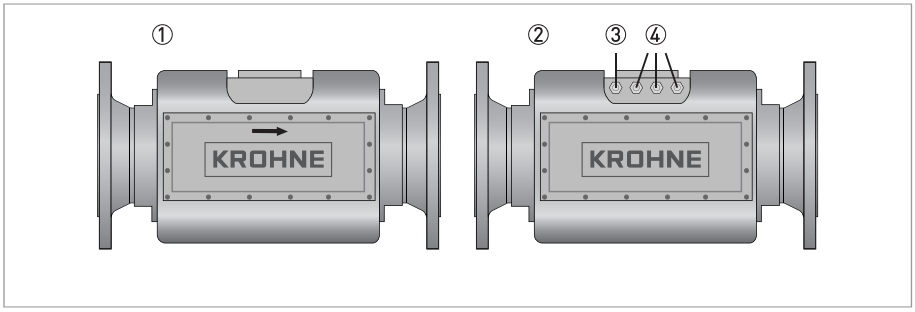


Figure 4-2: Location of cable glands

① Front side of the flow sensor
② Back side of the flow sensor
③ Cable entry for the PT100 cable
④ Cable entry for the signal cables

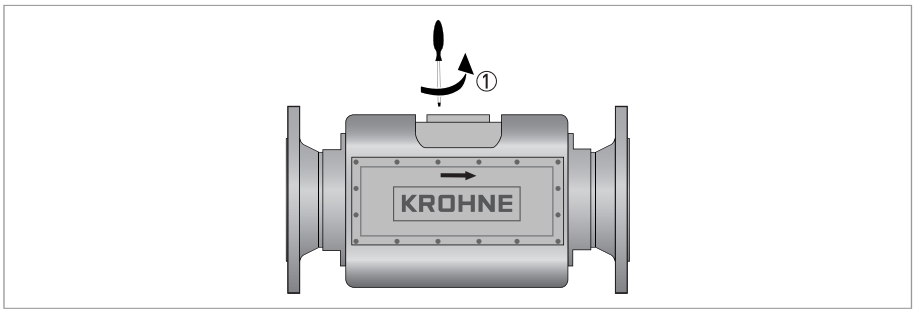


Figure 4-3: Removal of cover

① Loosening of screws to remove the cover

Use the factory supplied **sensor signal cables** to make the electrical connection between the flow sensor and the signal converter.
Each cable has six coaxial cables with pre-assembled SMB conectors. Lead the cable through the cable gland and connect it to terminal strip X1 as shown. All cables are numbered in the same way as the connector. Three cables are supplied, which means that two of the pre-assembled coax cables with SMB connectors will not be used.

Use the factory supplied **PT100 cable** to make the electrical connection between the flow sensor and the signal converter. Connect the numbered wires of the cable to terminal strip X2 with the same numbers.
This cable has four wires for temperature measurement. Feed the cable through the cable entry and connect it as shown. All wires are numbered in the same way as connector X2.

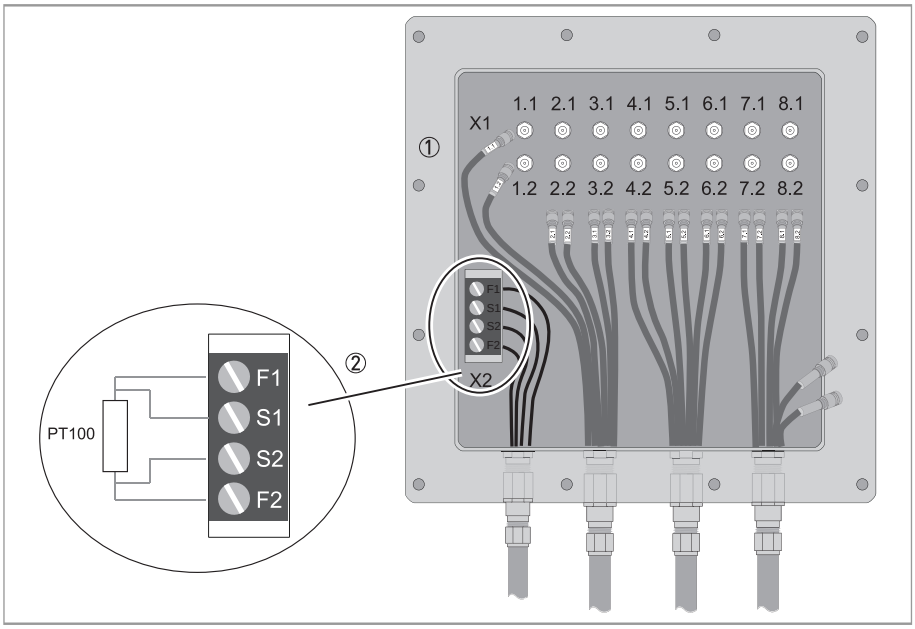


Figure 4-4: Electrical connections of flow sensor

① Terminal strip X1 for sensor signal cables.
② Terminal strip X2 for PT100 cable.

4.3 Signal converter connections

For the flow sensor and the signal converter that are used in a potentially explosive atmosphere, obey the following rules:

- *If the device is used in category 2G, certified cable entry devices MUST be used.*
- *Unused openings MUST be closed with certified closing elements.*
- *To avoid voltage and current addition, the intrinsically safe circuits must be separated and wired to EN 60079-14.*

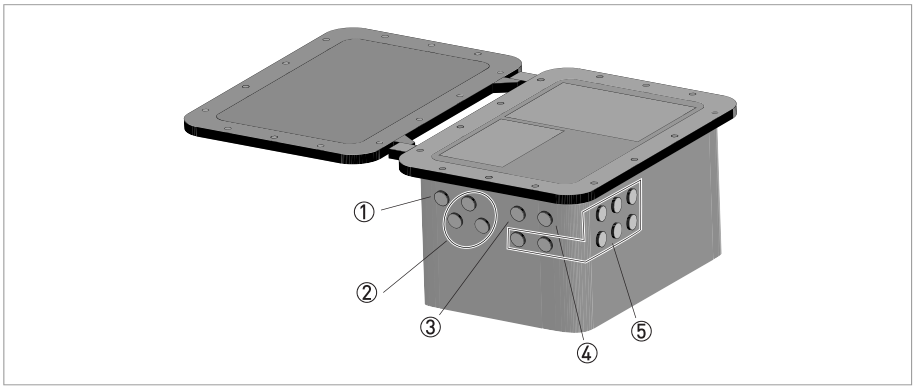


Figure 4-5: Location of cable glands

Number in Figure	Cable entry	Connection
①	PT100 cable, included in delivery	refer to *Multiplexer board (MUX) connections* on page 26
②	Sensor signal cable, included in delivery	refer to *Multiplexer board (MUX) connections* on page 26
③	Power supply cable, not included in delivery	refer to *Power Supply Board (PSB)* on page 38
④	Optional power supply cable for heating	-
⑤	I/O connections	refer to *Smart I0 board (SMART I0) connections* on page 28

Make absolutely sure that only certified cable glands, shielded cables and blind plugs are installed!

4.3.1 Multiplexer board (MUX) connections

The sensors and the body temperature sensor are connected to the MUX.

Use the factory supplied **sensor signal cables** to make the electrical connection between the flow sensor and the signal converter.
Each cable has six coaxial cables with pre-assembled SMB connectors. Lead the cable through the cable gland and connect it to the card as shown. All cables are numbered in the same way as the connector. Three cables are supplied, which means that two of the pre-assembled coax cables with SMB connectors will not be used.

Use the factory supplied **PT100 cable** to make the electrical connection between the flow sensor and the signal converter. Connect the numbered wires of the cable to the connector with the same numbers.

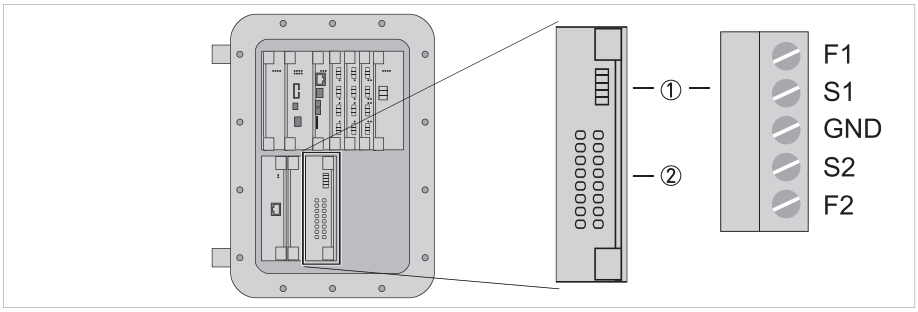


Figure 4-6: Multiplexer

① Connections for body temperature correction
② Connections of transducers of flow sensor

The GND terminal is not used, do not connect it.

4.3.2 Monitoring Configuration and Diagnostics (MCD) board connections

The MCD board contains the log file on an SD card as well as the configuration stored on an internal flash memory. TCP/IP can be used as Modbus over TCP/IP.

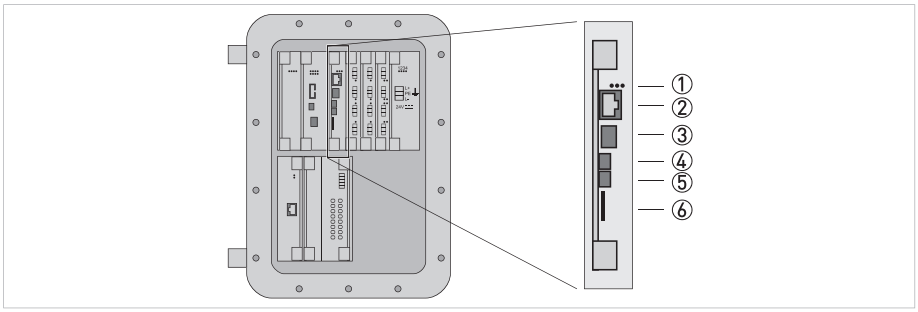


Figure 4-7: ALTOSONIC 5 MCD board

① Status lights, from left to right:
Red status 1
Red status 2
Green MCD power supply OK
② Ethernet connection 10/100 Mb
③ USB (only for service purposes by KROHNE service engineers)
④ mini USB (only for service purposes by KROHNE service engineers)
⑤ mini USB for configuration tool
⑥ SD card

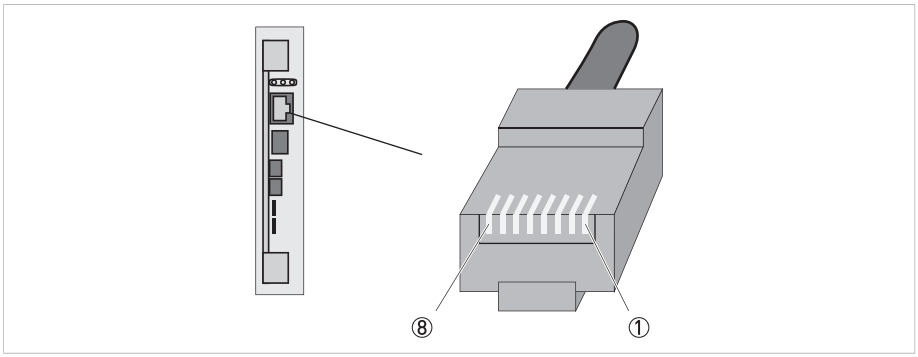


Figure 4-8: Ethernet RJ45 connector pin 1...8

RJ45 Ethernet connection pin	Wire color (T568A)	Wire color (T568B)	Function
1	white/green	white/orange	Transmit +
2	green	orange	Transmit -
3	white/orange	white/green	Receive +
4	blue	blue	Not used
5	white/blue	white/blue	Not used
6	orange	green	Receive -
7	white/brown	white/brown	Not used
8	brown	brown	Not used

4.3.3 Smart IO board (SMART IO) connections

The SMART IO board has multiple configurable IO's. The smart IO's can be configured either as digital input/output or analog input/output. All functions use the same connections. The function is defined by the chosen configuration.

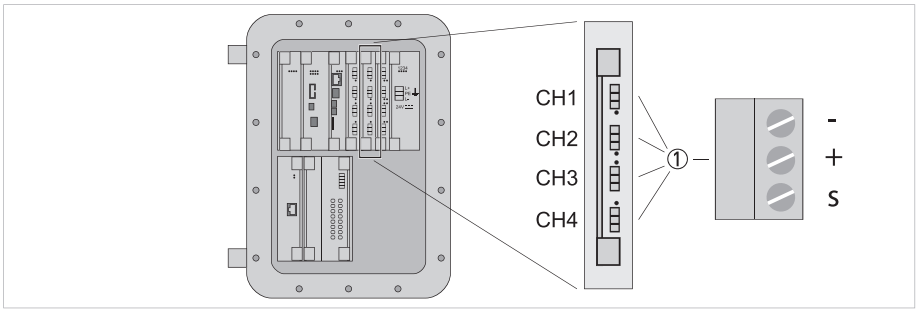


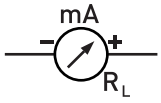
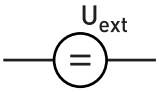
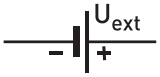
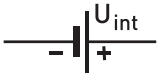
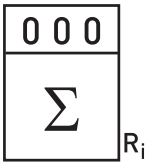
Figure 4-9:

① 4x configurable IO connection

Status lights for each channel

Function of LED	Meaning
Off	Channel is inactive
Slow short blinking	Channel not configured
Slow long blinking	Normal operation
Fast blinking	Channel is configured, but not connected correctly
Continuous on	An error occured

- *Passive mode: If a passive external device is connected, an external power supply is necessary to operate the connected devices (U_{ext}). If an active external device is connected, it can be connected directly.*
- *Active mode: The signal converter supplies the power to operate the connected passive devices, observe max. operating data. The maximum quantity of active outputs is limited to four.*
- *Terminals that are not used should not have any conductive connection to other electrically conductive parts.*

	mA meter 0...20 mA or 4...20 mA and other R_L is the internal resistance of the measuring point including the cable resistance
	DC voltage source (U_{ext}), external power supply, any connection polarity
	DC voltage source (U_{ext}), observe connection polarity according to connection diagrams
	Internal DC voltage source
	Controlled power source
	Electronic or electromagnetic counter At frequencies above 100 Hz, shielded cables must be used to connect the counters. R_i is the internal resistance of the counter

Inputs and outputs

Inputs and outputs can be configured in the MCD tool as described below. The limits of currents and voltage can be configured in the MCD per IO. Limitation of these adjustable values are:

- U_{int} = 3...23 V
- I_{max} < 25 mA

Active frequency output

The active output can be connected to a passive external instrument.

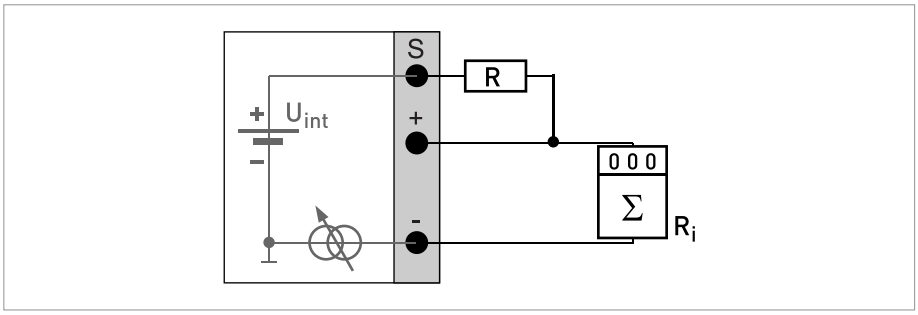


Figure 4-10: Frequency output, active

- Use terminals 'S' (Supply), '+' and '-'
- R: 1 kΩ (use resistor R to lower the resistance if the value is too high)

Passive frequency output

The passive output can be connected to a passive external device with an external power supply or directly to an active device.

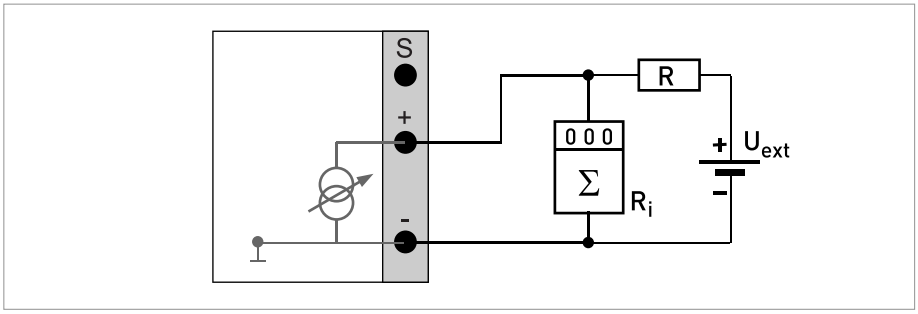


Figure 4-11: Frequency output, passive

- Use terminals '+' and '-'
- $U_{ext} \leq 27$ V

Active digital input

The active digital input can be connected to a passive external device.

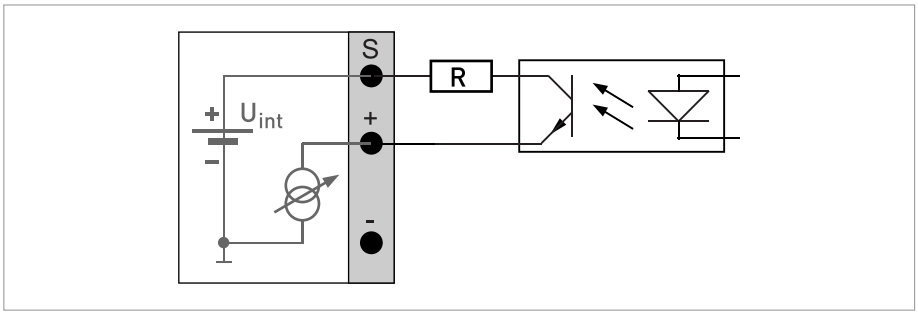


Figure 4-12: Digital input, active

- Use terminals 'S' (Supply) and '+'
- R: 1 kΩ

Passive digital input

The passive input can be connected to a passive external device with an external power supply or directly to an active device.

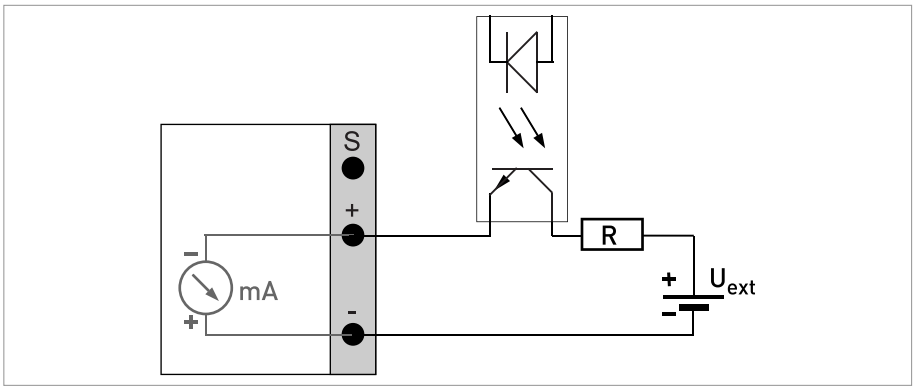


Figure 4-13: Digital input, passive, highside connection

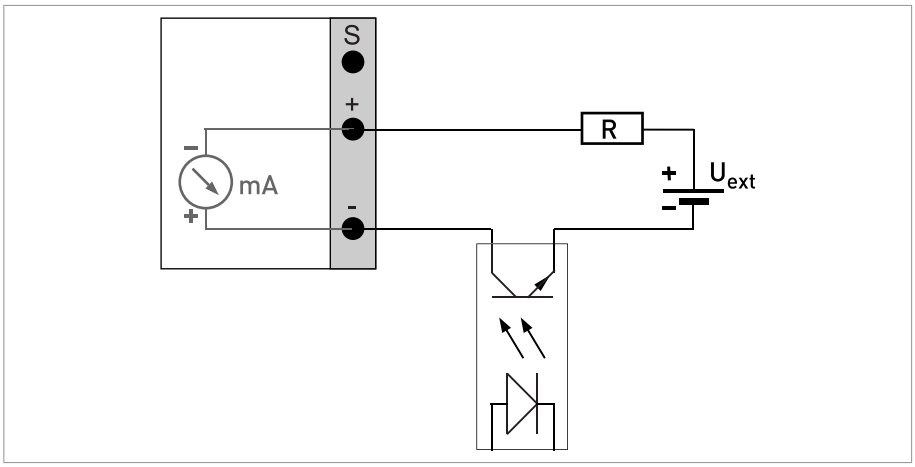


Figure 4-14: Digital input, passive, lowside connection

- Use terminals '+' and '-'
- $U_{ext} \leq 27$ V

Active digital output

The active output can be connected to a passive external device.

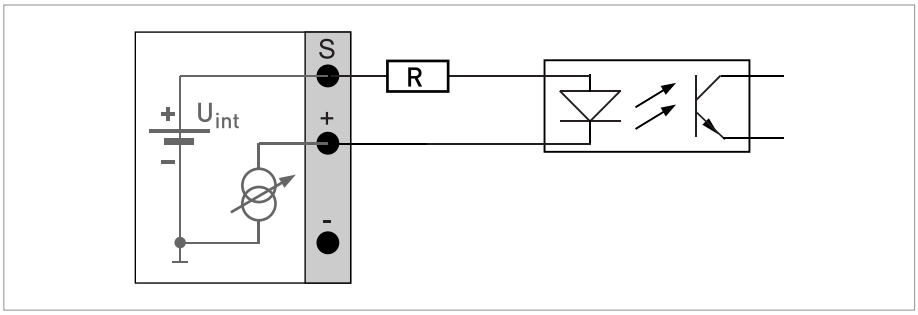


Figure 4-15: Digital output, active

- Use terminals 'S' (Supply) and '+'

Passive digital output

The passive output can be connected to a passive external device with an external power supply or directly to an active device.

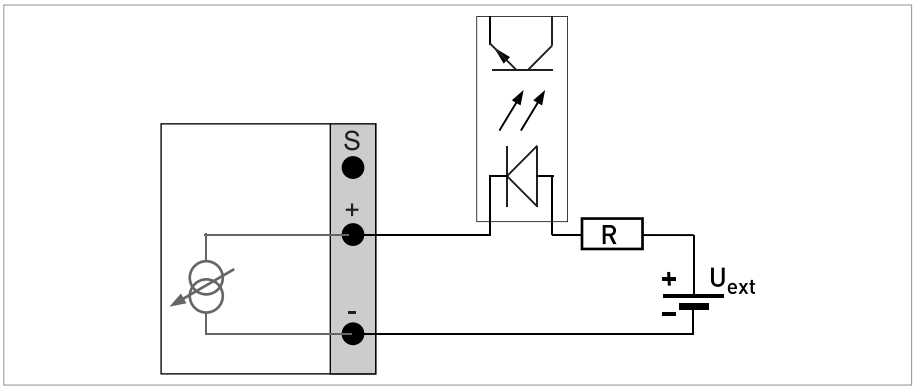


Figure 4-16: Digital output, passive, highside connection

- Use terminals '+' and '-'
- $U_{ext} \leq 27$ V

Active analog output

The active output can be connected to a passive external device.

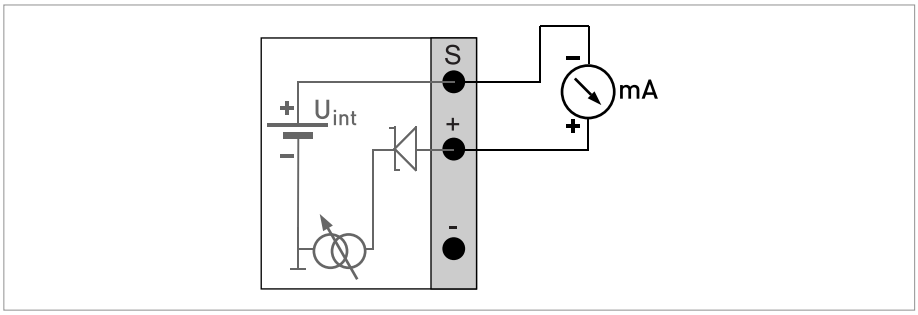


Figure 4-17: Analog output, active

- Use terminals 'S' (Supply) and '+'

Passive analog output

The passive output can be connected to a passive external device with an external power supply or directly to an active device.

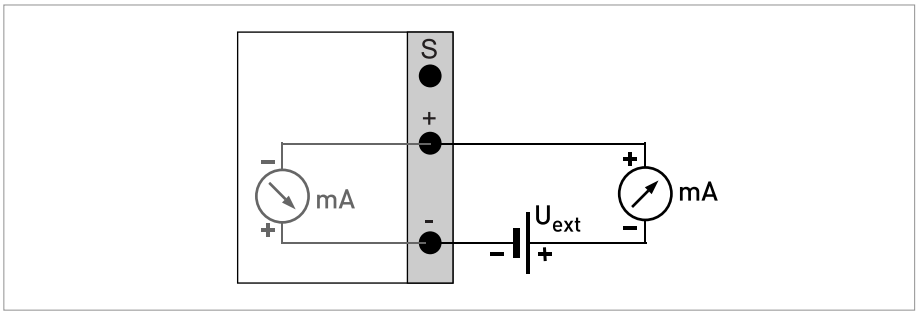


Figure 4-18: Analog output A, passive

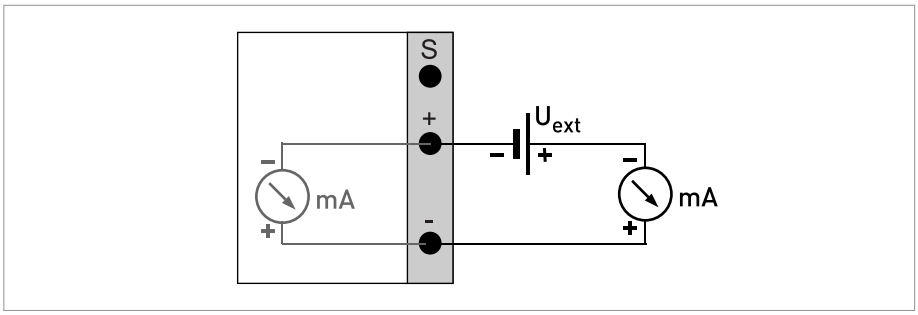


Figure 4-19: Analog output B, passive

- Use terminals '+' and '-'
- $U_{ext} \leq 27$ V

Active analog input

The active input can be connected to a passive external device.

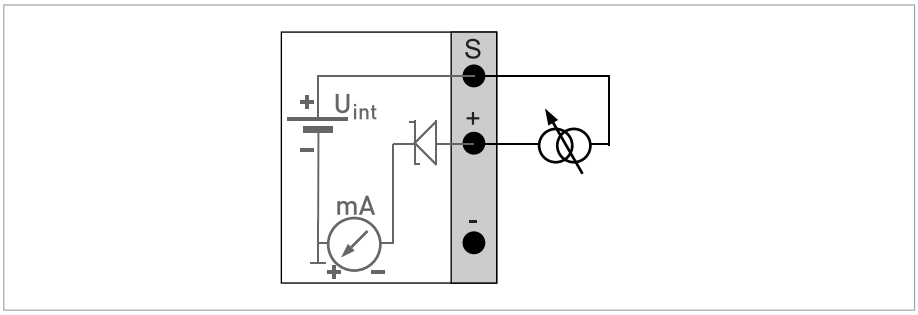


Figure 4-20: Analog input, active

- Use terminals 'S' (Supply) and '+'

Passive analog input

The passive output can be connected to a passive external device with an external power supply or directly to an active device.

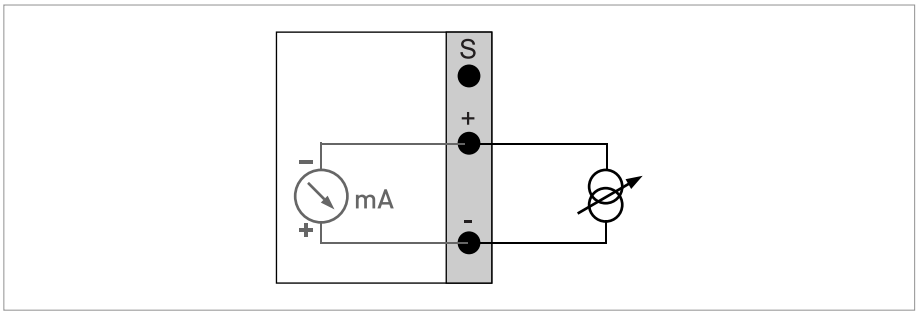


Figure 4-21: Analog input A, passive

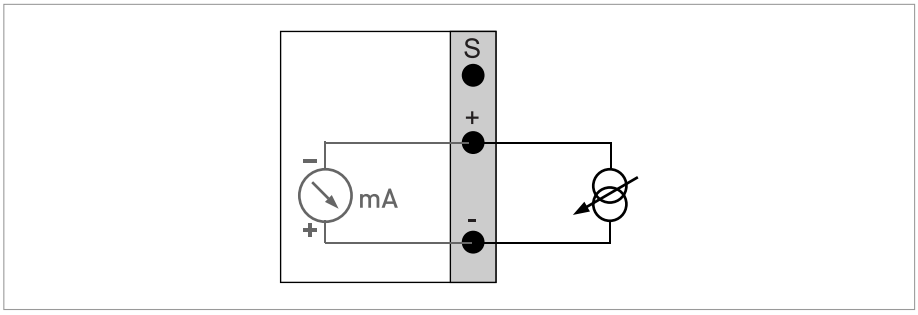


Figure 4-22: Analog input B, passive

- Use terminals '+' and '-'
- U_{max} = 27 V

4.3.4 RS485 IO board connections

The RS485 IO board has 4 serial communication channels. These channels are RS485 type of communication, the channel can be chosen as being slave or master in the configuration.

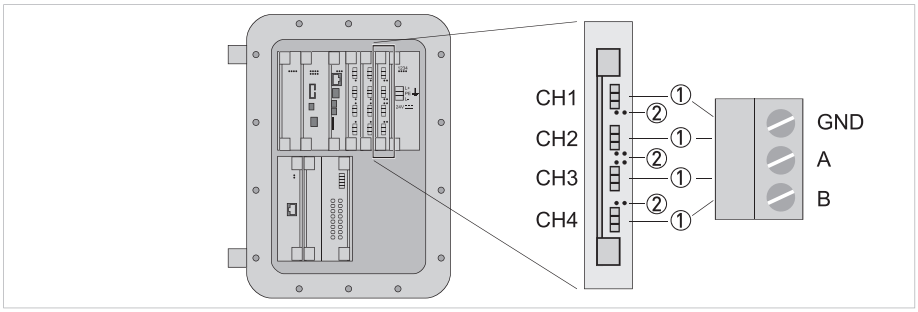


Figure 4-23: ALTOSONIC 5 RS485 IO board

① 4x RS485 connection
② 8x status LED for RS485 IO board

Status lights for each channel

Function of LED	Meaning
Off	Channel is inactive
Slow short blinking	Channel not configured
Slow long blinking	Normal operation
Fast blinking	Channel is configured, but not connected correctly
Continuous on	An error occured

All RS485 channels are galvanically isolated. The standard configuration is as follows:

- CH1: Modbus Master
- CH2: Modbus Slave 1
- CH3: Modbus Slave 2
- CH4: Backwards compatible for Ultrasonic Flow Processor ALTOSONIC V

A terminal resistor should be used if the cable is longer than 10 meter and high speed communication is used. To connect the termination resistor, a jumper must be set, that can be found on the communication board as shown in the next figure.

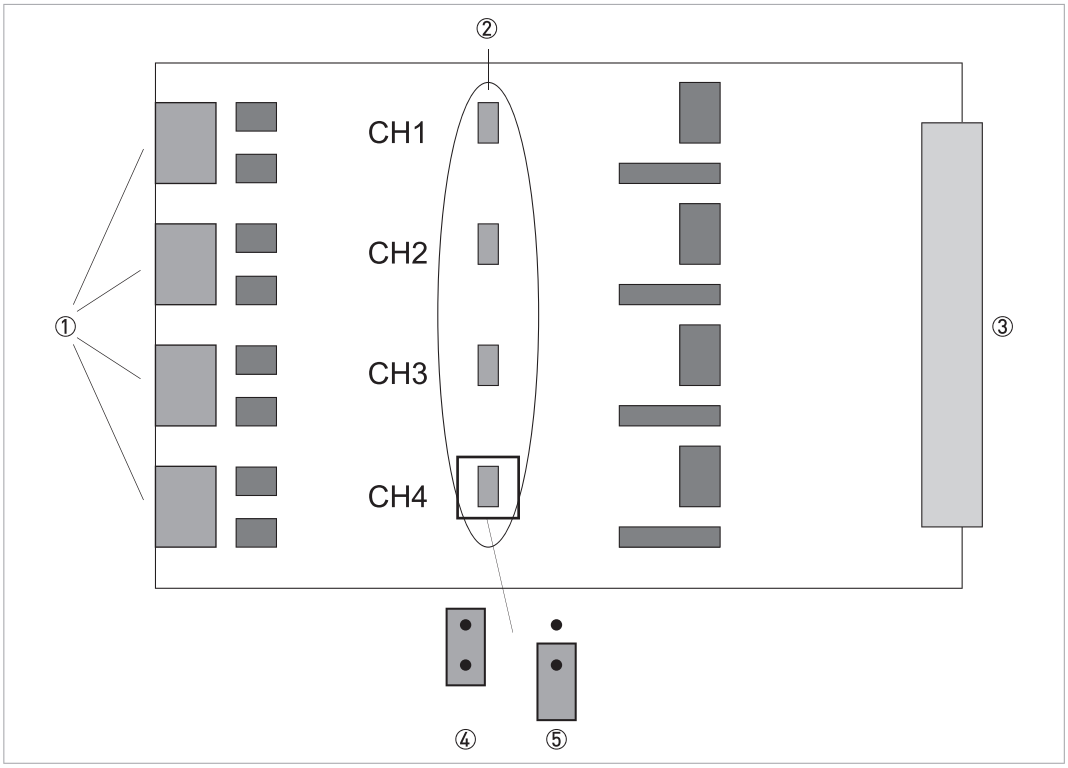


Figure 4-24: Jumpers on Communication board

① I/O connectors that are accessible on the front
② Jumpers (one for each I/O connector)
③ Multipole connector which connects the PCB to the backplane
④ Jumper is used: channel is terminated
⑤ Jumper is not used: channel is not terminated (factory default setting)

4.3.5 Power Supply Board (PSB)

The PSB supplies isolated power to all cards installed in the signal converter.

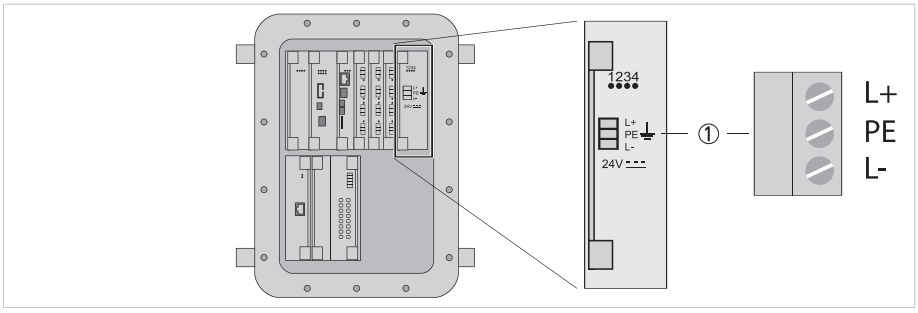


Figure 4-25: ALTOSONIC 5 PSB board

① Power Supply connections 24 V DC (+10/-15%)

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- Flow
- Level
- Temperature
- Pressure
- Process Analysis
- Services

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