UFM 530 HT

Technical Datasheet

- Accurate, repeatable and long-lasting performance
- Efficient bundle waveguide technology
- Flow measurement even under harsh process conditions

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1.1 Robust solution for high temperature liquids

UFM 530 HT is a dual beam ultrasonic flow meter for crudes and a broad range of refined products, that are processed under extreme conditions (high temperature / high pressure). Also for accurate flow measurement of synthetic heat transfer oil at extreme high temperatures (500 °C) and rapidly changing temperatures, the UFM 530 HT offers a unique solution. The UFM 530 HT with its robust industrial construction performs with minimum operational – and maintenance costs, due to a solid fully welded construction without any moving parts and hence no wear.

UFM 530 HT is a combination of a UFS 500 HT flow sensor and a UFC 030 signal converter. The UFC 030 signal converter is installed separately from the high temperature UFS 500 HT flow sensor.

Highlights

- Major measurement even at temperatuers up to 500 °C
- Excellent long term stability and reliability
- No moving or intruding parts
- Robust construction, resistant to corrosive and abrasive products
- Dual parallel paths for Reynolds independency
- Wide selection of materials, sizes and pressure classes

Industries

Petrochemical - refineries:

- Vacuum distillation unit (VDU)
- Topping unit (atmospheric installations)
- Visbreaking unit
- Coker unit

Renewable energy - concentrated solar power (CSP):

- Solar field heat transfer circuit
- Thermal salt tanks
- Power block

Applications

- Furnace flow measurement
- Recycled product
- Reduced crude
- Vacuum residues
- Long residues
- Heavy bottom products
- Synthetic heat transfer fluids (HTF)
- Molten salt

1.2 Measuring principle

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

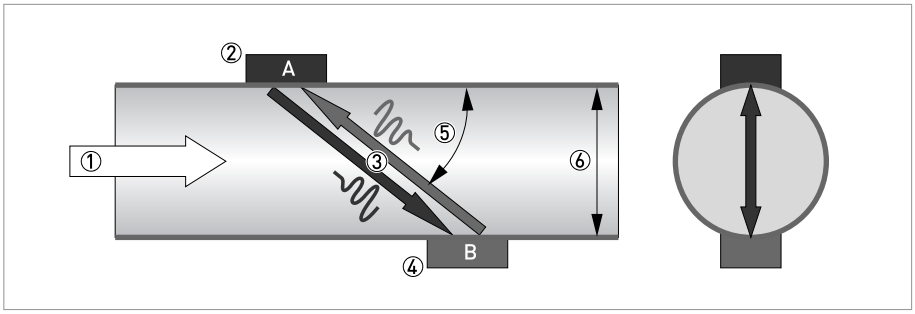


Figure 1-1: Measuring principle

① Flow velocity
② Transducer A
③ Acoustic path
④ Transducer B
⑤ Angle (between flow vector and acoustic path vector)
⑥ Diameter

2.1 Technical data

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

Measuring system

Measuring principle	Ultrasonic transit time.
Application range	(Non) conductive fluids.
Measured value	
Primary measured value	Transit time.
Secondary measured value	Volume flow rate, totalised volume, velocity of sound (VoS), signal strength, flow direction.

Design

	The measurement system consists of a measuring sensor and a signal converter. It is only available as separate version.
Measuring range	0.5...20 m/s / 1.7...66 ft/s
Signal converter	
Wall-mounted housing (W) - remote version	UFC 030 F
Measuring sensor	
UFS 500 HT is available in the following pipe diameters and building constructions:	
DN25...80 / 0.98...3/15"	Single beam construction.
DN100...300 / 3.94...11.81"	Dual beam construction.
	Larger diameters on request.
Options	
Inputs / outputs	Current (incl. HART®), pulse, frequency and/or status output, limit switch and/or control input (depending on the I/O version)
Counters	2 internal counters with a max. of 8 counter places (e.g. for counting volume and/or mass units)
Display and user interface	
Graphic display	3-Line local display with backlight
	Display turnable in 90° steps
	The readability of the display could be reduced at ambient temperatures below -25°C / -13°F
Operator input elements	3 keys for operator control of the signal converter
	Magnetic pin for operator control of the signal converter (optional)
Remote control	All DTM's and drivers are available at the internet homepage of the manufacturer
	PACTware® including Device Type Manager (DTM)

Display functions	
Menu	Display of volume flow, mass flow, flow speed, velocity of sound, gain, signal to noise ratio, diagnosis value, forward, reverse and counters,warning and diagnosis information, setting parameters via operating menu
Language of display texts	English, French, German

Measuring accuracy

Reference conditions	
Medium	Water
Temperature	20°C
Pressure	1 bar
Inlet section in DN	10 DN
Maximum measuring error	±1% of the measured value for Re > 5000 and v = 1...20 m/s (3.28...65.62 ft/s), temperature influence: 0.1% / 10 K.
	±1 cm/s at v < 1 m/s (±0,39"(s at v < 3,28 ft/s)
Repeatability	±0.3%
Calibration	2-point, water, under reference conditions.

Operating conditions

Temperature	
Process	Standard versions: -25...+500°C / -13...+932°F
	Ex versions: -25...+440°C / -13...+824°F
Ambient (signal converter)	-40...+65°C / -40...+149°F
Storage (signal converter)	-40...+70°C / -40...+158°F
Pressure	
Ambient	Atmospheric
EN 1092-1	DN25...80: PN40
	DN100...150: PN16
	DN200...300: PN10
	Higher pressure ratings on request.
ASME B16.5	1...12": 150 lbs
	Higher pressure ratings on request.
JIS	10K
Medium properties	
Physical condition	Liquids.
Permissible gas content (by volume)	<2%
Permissible solid particle content (by volume)	<5%
Viscosity	<100 cSt
	Higher viscosities on request
Recommended flow velocity	0.5...20 m/s / 1.7...66 ft/s

Installation conditions

Minimum inlet run	DN25...80 / ASME 0.98...3.15": 50 DN
	DN100...300 / ASME 3.94...11.81": 15 DN
Minimum outlet run	DN25...80 / ASME 0.98...3.15": 10 DN
	DN100...300 / ASME 3.94...11.81": 5 DN
Dimensions and weights	See chapter "Dimensions and weights".

Materials

Sensor	
Sensor material	Measuring tube (DN25...300 / 0,98...11,81"): Stainless steel 1.4404 (AISI 316L).
	Bundle wave guides: Stainless steel 1.4404 (AISI 316L).
	Connection box: Die-cast aluminium (polyurethane coating).
	Others materials on request
Process connections	
Flange	DN25...300 / 0,98...11,81": stainless steel 1.4404 (AISI 316L).
	Others materials on request
Finish (measuring tube)	No paint.
Converter	
Housing material	**Standard**
	Die-cast aluminum (polyurethane coated).
	Option
	Stainless steel 1.4404 (AISI 316L).
Finish	**Standard**
	Silver paint.
	Optional
	Offshore paint system, silver.

Electrical connections

Description of used abbreviations	Q = **XXX**; I_{max} = maximal current; U_{in} = **XXX**; U_{int} = internal voltage; U_{ext} = external voltage; $U_{int, max}$ = maximal internal voltage.
Galvanic insulation	All inputs/outputs are standard isolated from the power supply.
Power supply	
Voltage	100...240 VAC (+10% / -15%), 48...63 Hz.
	24 VAC (20...27 V), 24 VDC (18...32 V).
Power consumption	AC: 10 VA
	DC: 8 W
Cable entries (to power supply and sensor)	**Standard**
	M20 x 1.5
	Optional
	½" NPT or PF ½
Cable length	**Standard**
	5 m / 16.40 ft
	Optional
	10...30 m / 32.81...98.43 ft
Current output	
Function/output data	Measurement of volume flow rate, velocity of sound, signal strength, flow direction.
Settings	
	Q = 0%: 0...16 mA (HART versions: 4...16mA, in steps of 1 mA, limit 20...22 mA).
	Q = 100%: 4...20 mA.
Operating data/Connection	Active mode: U_{int} = 24 VDC, maximal load: 680 Ω.
	Passive mode: $U_{ext} \leq$ 24 VDC, maximal load: 680 Ω.
Pulse output	
Function/output data	Measurement of volume flow rate, actual volume, velocity of sound, signal strength, flow direction.
Settings	Calculated mass flow rate.
	Pulse or frequency: 0...2000 Hz, status: on/off.
Operating data/Connection	Active mode: U_{int} = 24 VDC, I_{max} = 50 mA.
	Passive mode: U_{ext} = 19...32 VDC, I_{max} = 150 mA.
Analog inputs	
Function/output data	Inputs for calculated (or user defined) mass flow rate.
Settings	For both inputs (A1 and A2): 4...20 mA.
Operating data/Connection	Active mode: I_{max} = 22 mA, maximal load: 58 Ω.
	Passive mode: I_{max} = 22 mA, maximal load: 58 Ω.
Digital input	
Function/output data	Reset totalised volume, reset errors, force outputs to zero.
Settings	On/off
Operating data/Connection	Active mode: $U_{max} \leq$ 24 VDC.
	Passive mode: $U_{max} \leq$ 24 VDC.

Approvals

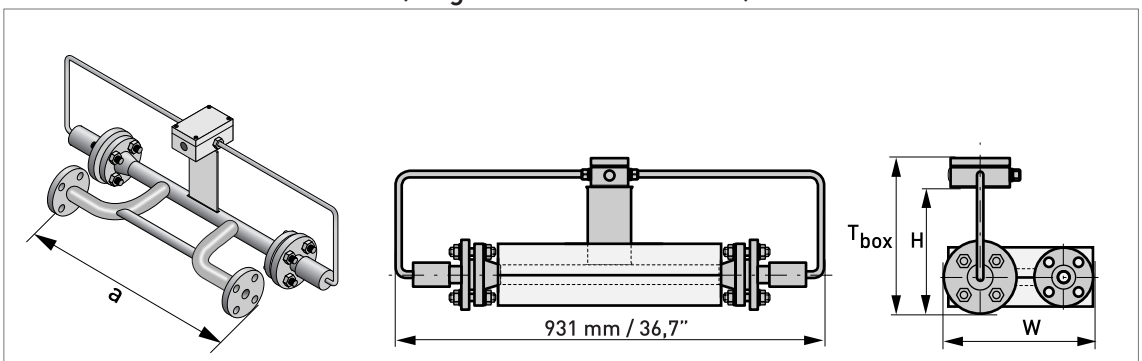
CE	See section 1.3.1.
Hazardous areas	
Ex zone 1	According to European Directive 94/9 EC (ATEX 100a).
FM Div. 1	Approval number 3016332
CSA	Approval number 1515313
Protection category according to IEC 529 / EN 60529	
Sensor	IP65 eq. NEMA 4 / 4X

Other diameters, pressure classes or materials than the above-mentioned on request.

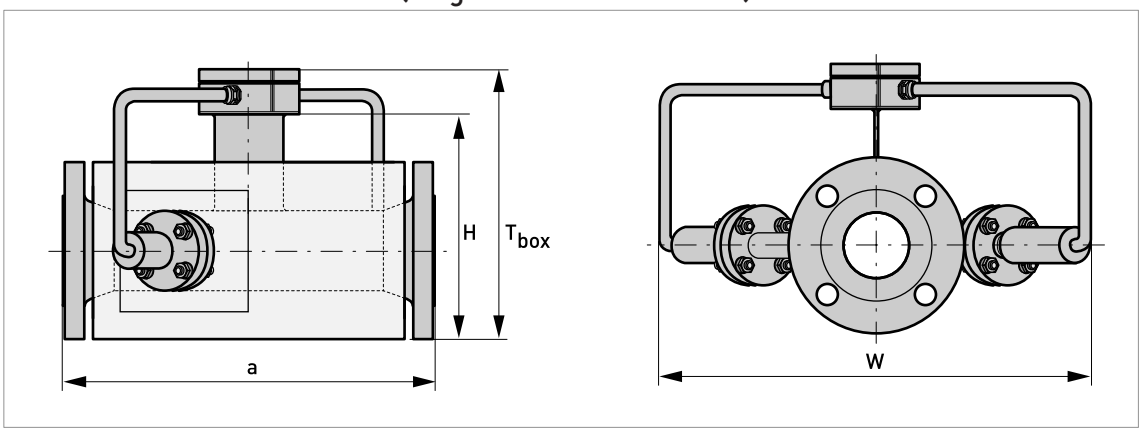
2.2 Dimensions and weight

2.2.1 Flow sensors

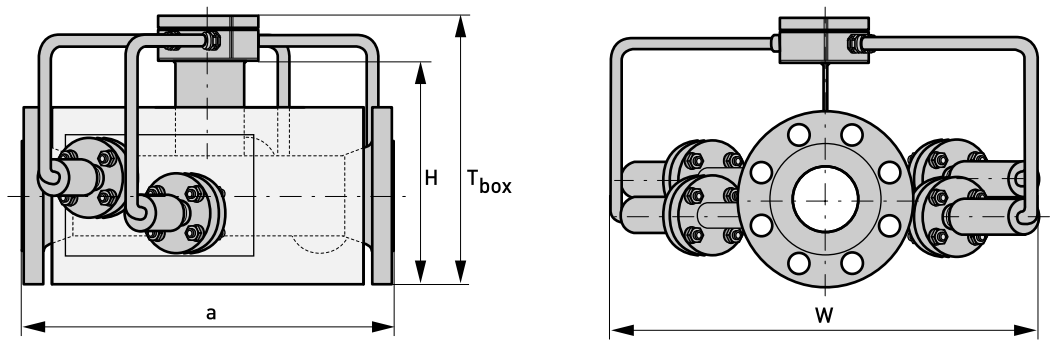
Front and side view DN25...40 (single beam construction)



Front and side view DN50...80 (single beam construction)



Front and side view ≥DN100 (dual beam construction)



DIN flanges

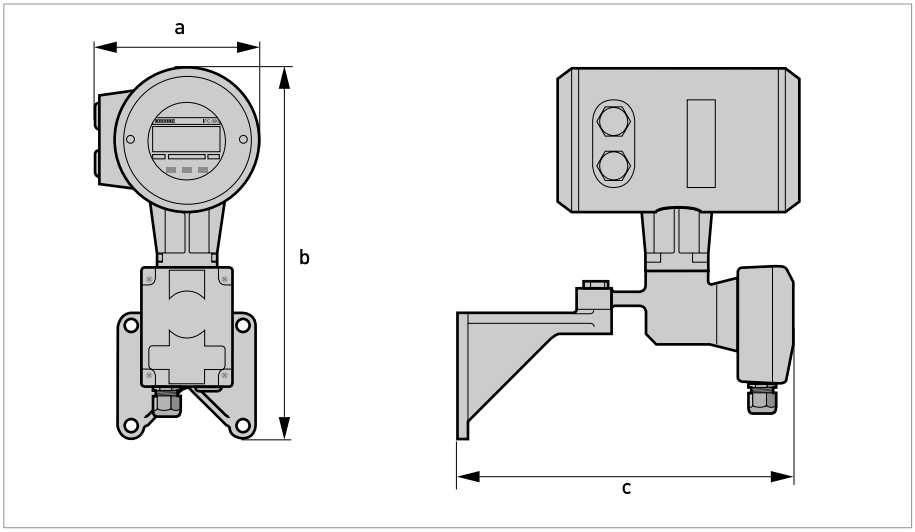
Nominal size	Nominal pressure	Material	Dimensions [mm]				Approx. weight
DN	[bar]	Tube/Flange	a	W	H	T_{box}	[kg]
25	40	Steel 1.4404	600	310	267	324	28
32	40	Steel 1.4404	600	325	267	324	29
40	40	Steel 1.4404	600	330	270	327	30
50	40	Steel 1.4404	600	500	283	340	27
80	40	Steel 1.4404	700	530	328	385	49
100	16	Steel 1.4404	800	550	353	410	56
150	16	Steel 1.4404	900	610	397	454	76
200	10	Steel 1.4404	1000	660	450	507	84

ASME flanges

Nominal size	Nominal pressure	Material	Dimensions [inch]				Approx. weight
ASME	[lbs]	Tube/Flange	a	W	H	T_{box}	[lbs]
1"	150	SS 316L	23.62	12.40	10.51	12.76	59.5
2"	150	SS 316L	23.62	19.69	10.90	13.15	57.3
3"	150	SS 316L	27.56	20.87	12.21	14.45	72.8
4"	150	SS 316L	31.50	21.26	13.46	15.71	130.1
6"	150	SS 316L	35.43	23.62	15.51	17.76	167.6
8"	150	SS 316L	39.37	25.59	17.80	20.04	229.3
10"	150	SS 316L	39.37	29.13	20.08	22.32	235.9
12"	150	SS 316L	39.37	31.10	20.63	22.87	299.8

Other diameters, pressure classes or materials than the above-mentioned on request.

2.2.2 UFC 030 signal converter



Version	Material	Dimensions [mm / inch]			Approx. weight [kg / lbs]
		a	b	c	
UFC 030 F	Aluminium	156 / 6.14	315 / 12.40	285 / 11.22	4.2 / 9.30
UFC 030 F / EEx	Aluminium	156 / 6.14	315 / 12.40	301 / 11.85	4.5/9.90
UFC 030 F / EEx	Stainless steel 1.4404	158 / 6.22	315 / 12.40	320 / 12.60	15/33.10

3.1 Intended use

This product is designed for the measurement of liquids with high temperatures up to 500°C / 932°F (Ex hazardous areas are limited to 440°C / 824°F).

3.2 Mounting

3.2.1 Mounting position of the flow sensor

Installation of the flow sensor is allowed in horizontal, slightly ascending and vertical pipe sections with up going flow direction (see next section). If installed in a horizontal or slightly ascending pipeline, the connection box of the flow sensor has to be up or down.

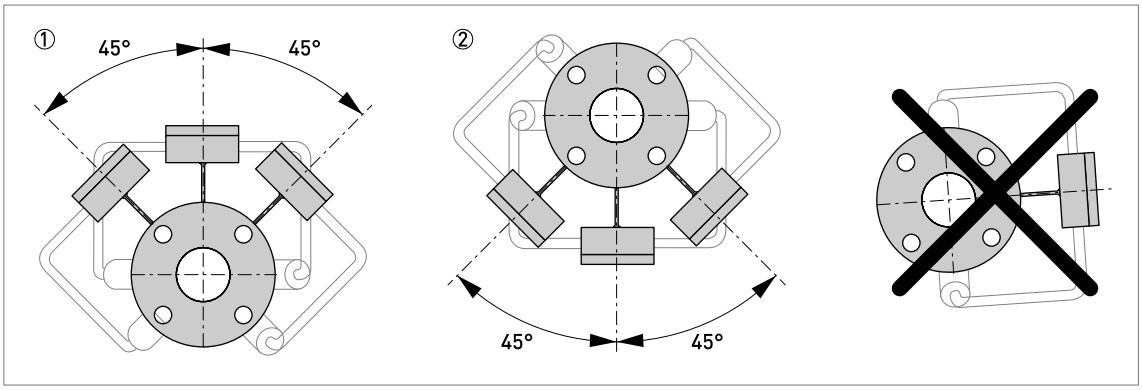


Figure 3-1: Allowed position of the flow sensor (up and down)

Do not unscrew the flanged transducer construction. This will cause direct contact with the high temperature liquid running through the flow sensor.

3.2.2 Mounting location of the flow sensor

For proper flow measurement the measuring tube must be completely filled at all times. When the sensors become non-wetted, a loss of signal message will be displayed. There is no damage when this occurs.

Observe the following precautions to avoid measuring errors or malfunctioning of the flow meter due to gas or air inclusions or an empty pipe.

Since gas will collect at the highest point of a pipe, installation of the flowmeter at that location should always be avoided. In long horizontal pipes the flow meter has to be installed in a slightly ascending pipe section. If not possible, ensure adequate velocity to prevent air, gas or vapour from collecting in the upper part of the flow tube.

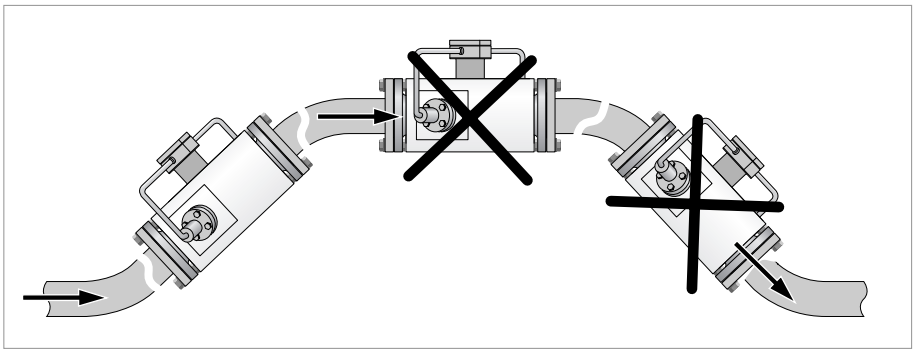


Figure 3-2: Avoid locations where gas can be present.

Also installation in a down going pipe should be avoided since a completely filled pipe may not be guaranteed due to cascading effects. Additionally flow profile distortion is possible.

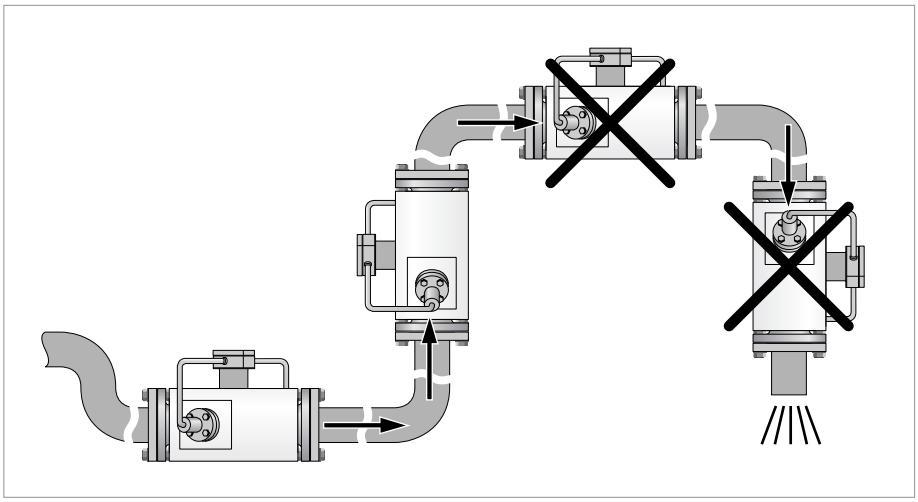


Figure 3-3: Avoid locations where gas can be present

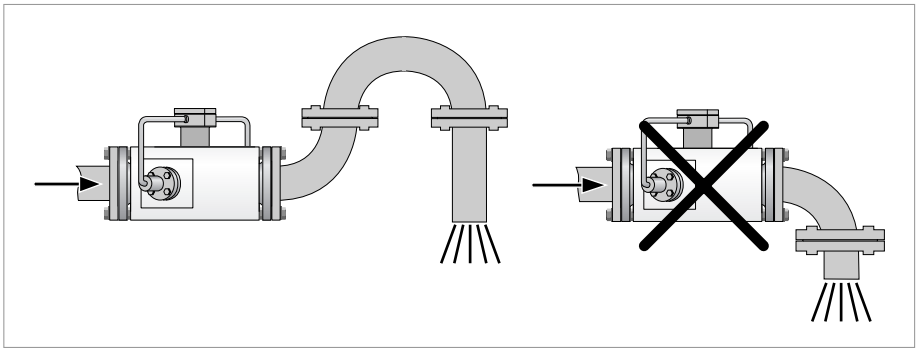


Figure 3-4: Ensure you have a completely filled pipe.

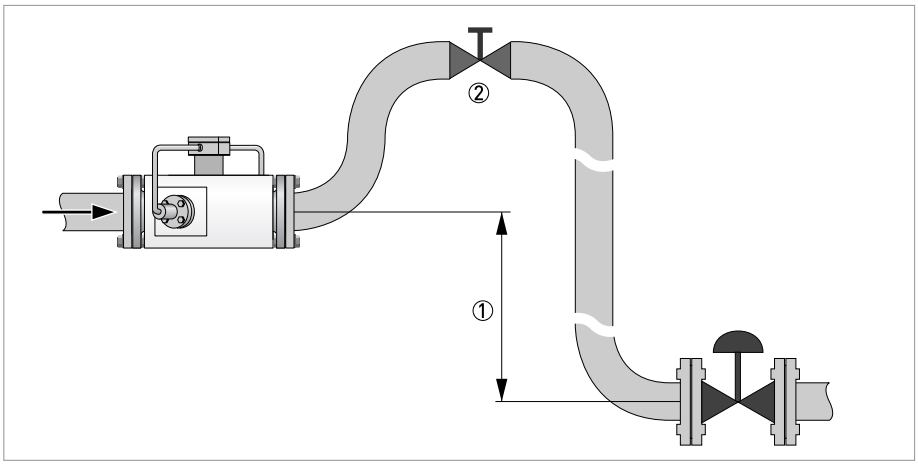


Figure 3-5: Air vent

① Level difference > 5 m / 16 ft
② Install an air vent.

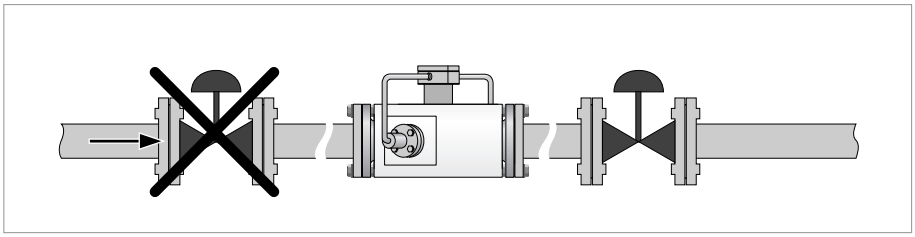


Figure 3-6: Install control valve downstream of the flow meter.

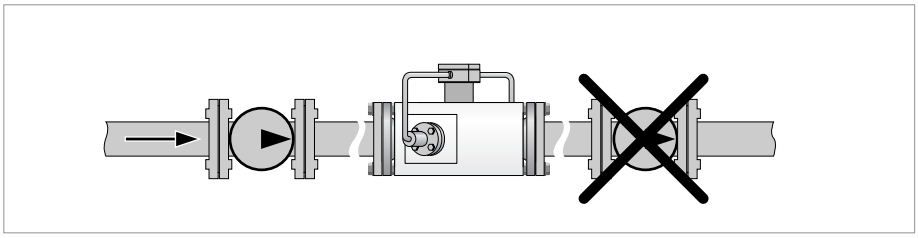


Figure 3-7: Install pump upstream of flowmeter.

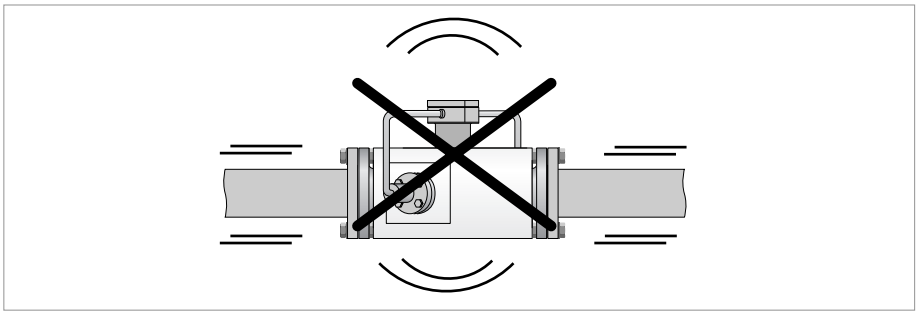


Figure 3-8: Avoid installation in vibrating pipelines.

3.2.3 Insulation

Complete insulation of the UFS 500 HT flow sensor is prohibited. Insulation is allowed up to the first flange of each transducer.

The connection box and the flanged transducers require adequate cooling by ambient air and must be protected against heat radiation by surrounding equipment.

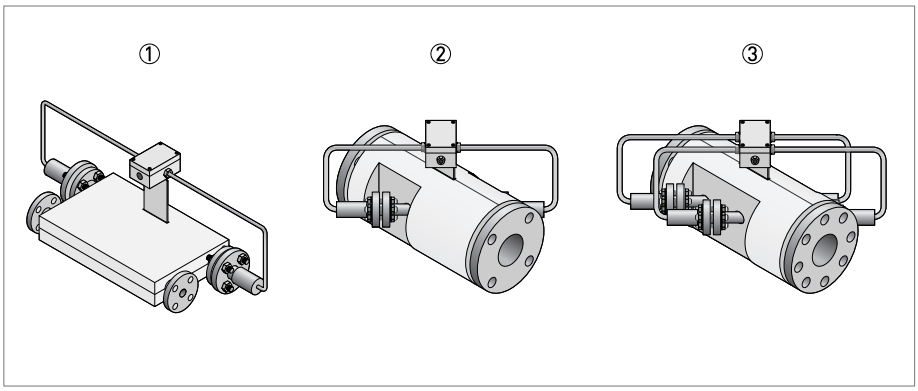


Figure 3-9: Approved insulations.

① Building construction "single beam" (DN25...40)
② Building construction "single beam" (DN50...80)
③ Building construction "dual beam" (≥DN100)

3.2.4 Pipe flanges

Refer to dimensional drawings for flange spacing and in addition allowance for thickness of gaskets.

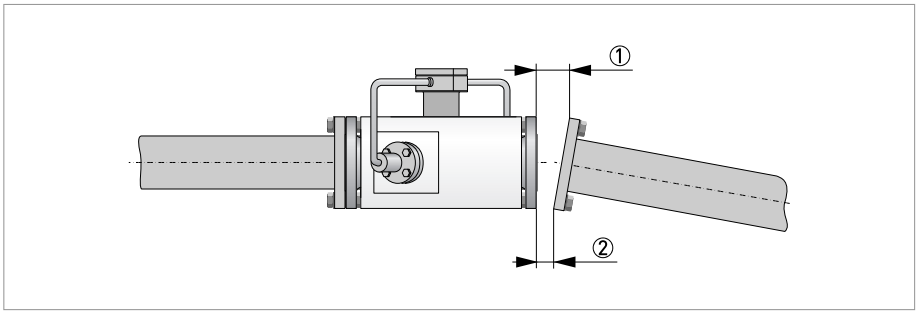


Figure 3-10: Maximum deviation between flanges

① L_{max}
② L_{min}

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

3.2.5 Pipes with cathodic protection

Pipes with electric corrosion protection are generally insulated inside and outside so that the fluid has no conductive connection to the ground. The flow meter must be insulated from the pipe. Observe the following instructions when installing the flow meter:

- The pipe flanges must be connected to each other using a copper cable (L), but must not be connected to the flowmeter.
- The bolts for the flange connections and the gaskets must be insulated. Use sleeves and washers that are made of insulating material (these must be provided by customer).

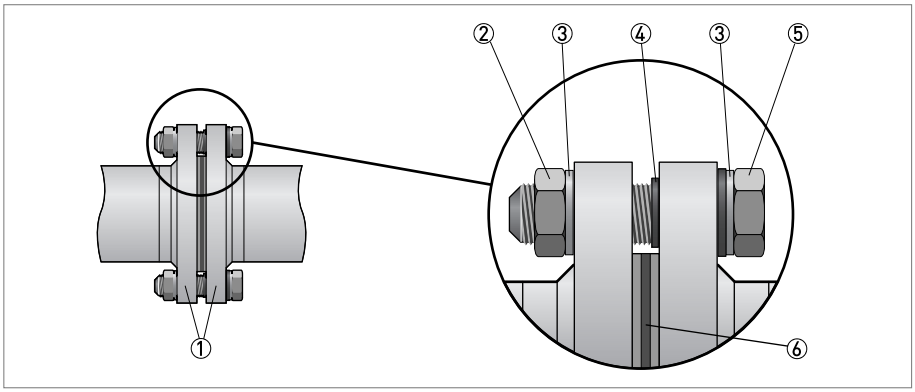


Figure 3-11: Cathodic protection

① Flanges (left one: of flow sensor, right one: of pipe)
② Nut
③ Washer
④ Insulating sleeve
⑤ Bolt
⑥ Gasket

4.1 Power supply of the converter

Environmental conditions

The flowmeter is designed to operate safe unter the following conditions. Observe them before the connection to the mains supply voltage is established:

- Indoor and outdoor use, usable up to protection category IP67 according to IEC 60529 (Note: IP67 is only warranted when using suitable cabling with the cable glands and covers mounted as specified).
- Maximum altitude: up to 2000 m above see level.
- Maximum relative humidity: up to 80%.
- Operation ambient temperature range: -40...+65°C.
- Storage temperature range: -40...+70°C.

Never allow dirt to accumulate on the gasket of the rear (blind) cover. A dirty gasket has to be cleaned, a damaged gasket must be replaced immediately.

Before the cables can be fastened to the power supply terminal, the rear (blind) cover has to be removed.

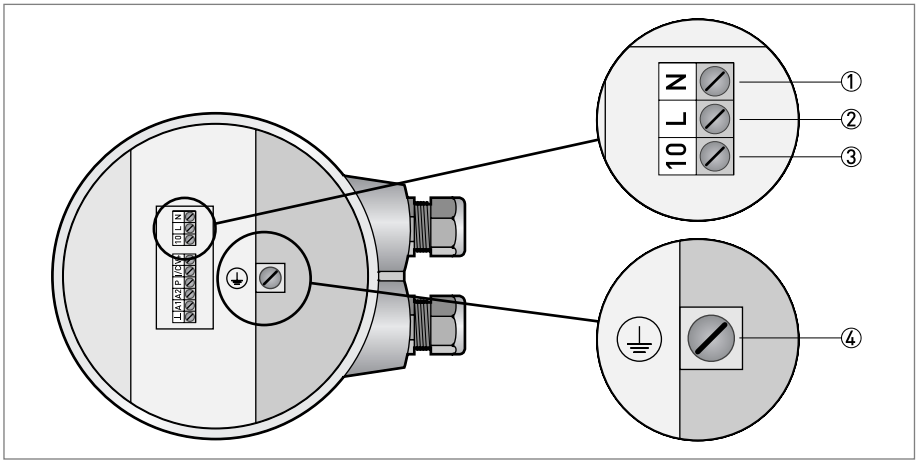


Figure 4-1: Terminals for power supply

Item number	Function	Specification
1	Neutral power supply.	
2	Life power supply.	Mains voltage AC supply: 100 VAC < U < 240 VAC (-15%, +10%), SELV AC/DC supply: 24 VDC (-25%, +33%), 24 VAC (-10%, +15%).
3	Reserved ground connection.	Not for protective earthing.
4	Protective ground connection (PE), Functional ground connection (FE).	Protective conductor clamp terminal. Conductors up to 4 mm^2 (11 AWG) need to be connected to this terminal.

4.2 Connection of signal cables

Connect the signal cable from the connection box of the UFS 500 HT sensor to the UFC 030 signal converter according to underneath drawings for the single beam and dual beam construction.

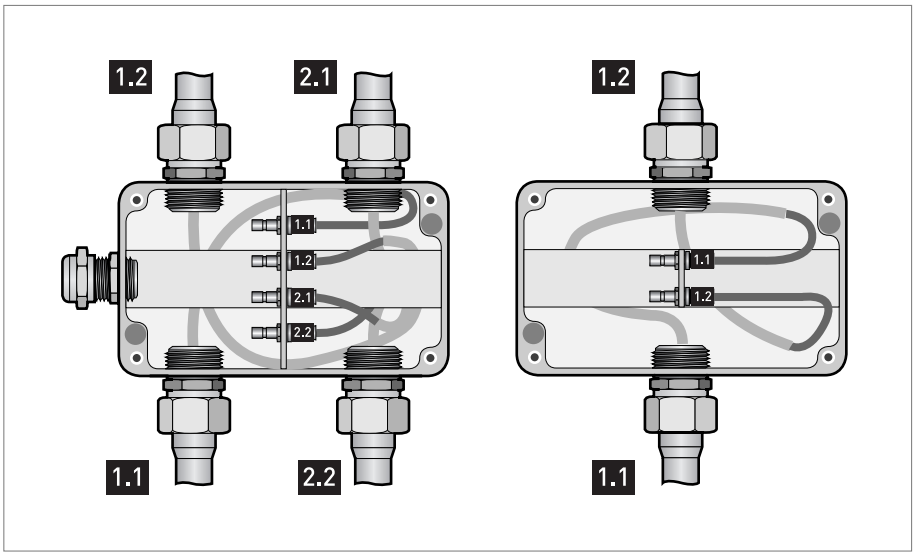


Figure 4-2: Connection of the sensor cables for dual beam (left) and single beam (right) building construction (sensor side)

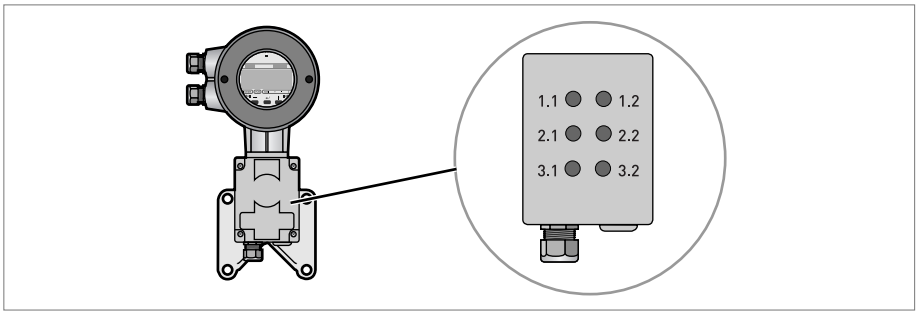


Figure 4-3: Connection of the sensor cables, converter side

4.3 Electrical connections of the signal inputs and outputs

For wiring of the signal inputs and outputs it is advised to use unshielded twisted pairs.

Please observe instrument polarity: current (I) is always flowing towards I, C, P, A1, A2 terminals (current sink).

The signal inputs and outputs terminals are located in the converter terminal box. It is accessible after removing the rear (blind) cover of the converter. There are versions for non Ex and for Ex applications.

4.3.1 Non Ex versions

Non Ex standard version

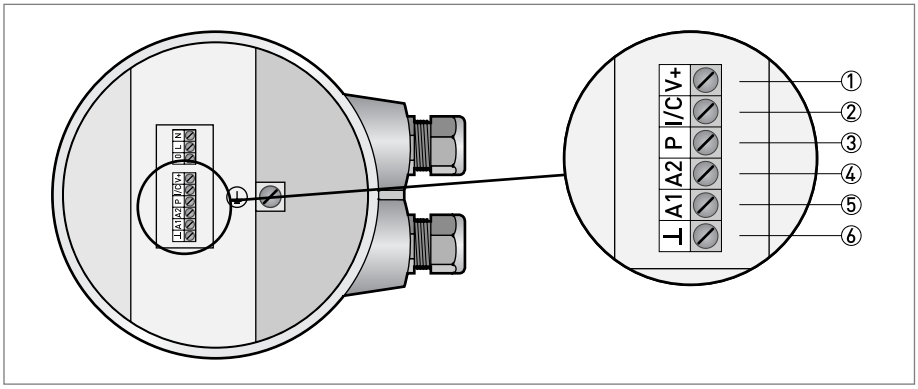


Figure 4-4: Terminals for standard instrument.

Terminal	Function	Specification
①	DC power supply from converter for active wiring of inputs and outputs.	22 VDC at full load, 24 VDC maximum, I ≤ 100 mA.
②	Combined current output (I) and digital input (C). Current output (I) includes HART-Communication.	Current output (I): I ≤ 22 mA, R_{load} ≤ 680 Ω, U_{max} = 15 VDC. Digital input (C): low = 0...5 VDC, high = 15...32 VDC (will be switched off when current output activated).
③	Pulse / frequency output.	I_{max} = 150 mA, U_{max} = 32 VDC / 24 VAC, maximal frequency = 2 kHz.
④	Analog input 2, for temperature or pressure measurement.	0(4)...20 mA, R_i = 58,2 Ω, fuse = 50 mA.
⑤	Analog input 1, for temperature measurement.	0(4)...20 mA, R_i = 58,2 Ω, fuse = 50 mA.
⑥	Common ground	-

Never use the active and passive mode at the same terminal simultaneously.
If HART-Communication is used, do not connect the pulse/frequency output P in active mode.

The electrical input and output signals can be connected either in active or in passive mode. In active mode DC supply voltage is provided from the terminal V+. In passive mode supply voltage is provided from an external source.

Non Ex version with Profibus PA

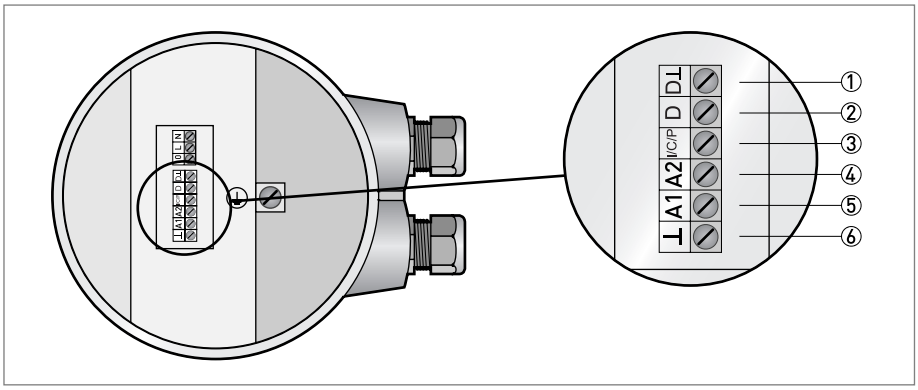


Figure 4-5: Terminals for instrument with Profibus PA (non Ex).

Terminal	Function	Specification
①	Communication connection -	For Fieldbus communication
②	Communication connection +	For Fieldbus communication
③	Combined current output (I), digital input (C) and Pulse / frequency output. Current output (I) includes HART-Communication.	Current output (I): I ≤ 22 mA, R_{load} ≤ 680 Ω, U_{max} = 15 VDC. Digital input (C): low = 0...5 VDC, high = 15...32 VDC (will be switched off when current output activated). Pulse output: I_{max} = 150 mA, U_{max} = 32 VDC / 24 VAC, maximal frequency = 2 kHz.
④	Analog input 2, for temperature or pressure measurement.	0(4)...20 mA, R_i = 58,2 Ω, fuse = 50 mA.
⑤	Analog input 1, for temperature measurement.	0(4)...20 mA, R_i = 58,2 Ω, fuse = 50 mA.
⑥	Common ground	

Non Ex HiPower version

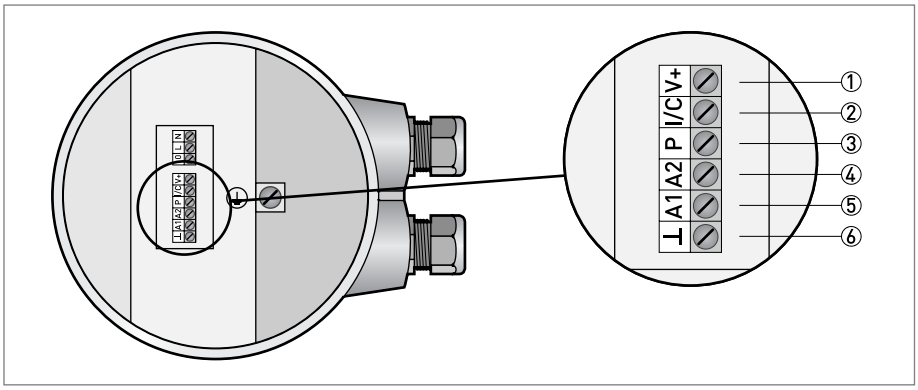


Figure 4-6: Terminals for non Ex HiPower instrument.

Terminal	Function	Specification
①	DC power supply from converter for active wiring of inputs and outputs.	22 VDC at full load, 24 VDC maximum, $I \leq 100$ mA.
②	Combined current output (I) and digital input (C). Current output (I) includes HART-Communication.	Current output (I): $I \leq 22$ mA, $R_{load} \leq 680\ \Omega$, $U_{max} = 15$ VDC. Digital input (C): low = 0...5 VDC, high = 15...32 VDC (will be switched off when current output activated).
③	Pulse / frequency output.	$I_{max} = 150$ mA, $U_{max} = 32$ VDC / 24 VAC, maximal frequency = 2 kHz.
④	Analog input 2, for temperature or pressure measurement.	0(4)...20 mA, $R_i = 58{,}2\ \Omega$, fuse = 50 mA.
⑤	Analog input 1, for temperature measurement.	0(4)...20 mA, $R_i = 58{,}2\ \Omega$, fuse = 50 mA.
⑥	Common ground	-

4.3.2 Ex versions

The electrical input and output signals must be connected in passive mode. The supply voltage must be provided from an external source.

Ex standard version

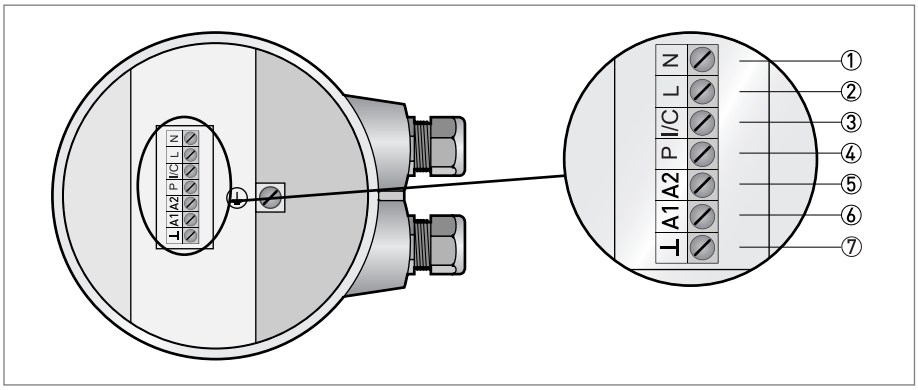


Figure 4-7: Terminals for Ex standard instrument

Terminal	Function	Specification
①	Neutral mains power supply	100...240 VAC, 24 VAC or 24 VDC
②	Live mains power supply	100...240 VAC, 24 VAC or 24 VDC
③	Combined current output (I) and digital input (C). Current output (I) includes HART-Communication.	Current output (I): I ≤ 22 mA, $R_{load} \leq 680\ \Omega$, U_{max} = 15 VDC. Digital input (C): low = 0...5 VDC, high = 15...32 VDC (will be switched off when current output activated).
④	Pulse / frequency output	I_{max} = 150 mA, U_{max} = 32 VDC / 24 VAC, maximal frequency = 2 kHz.
⑤	Analog input 2, for temperature or pressure measurement.	0(4)...20 mA, R_i = 58,2 Ω, fuse = 50 mA.
⑥	Analog input 1, for temperature measurement.	0(4)...20 mA, R_i = 58,2 Ω, fuse = 50 mA.
⑦	Common ground	

Ex NAMUR version

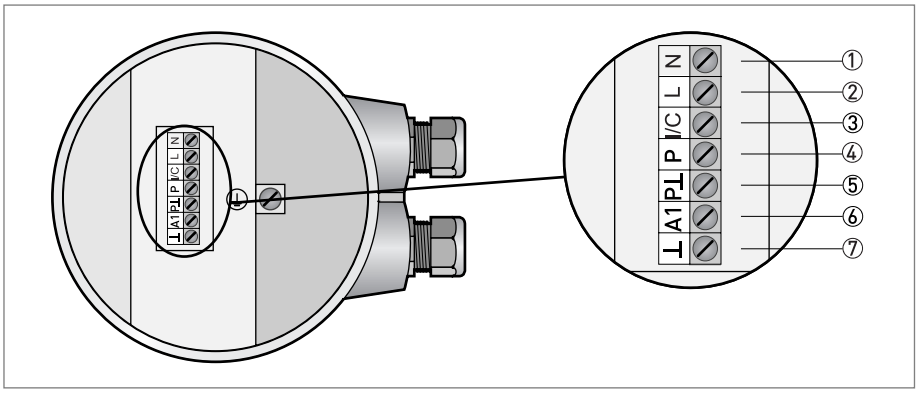


Figure 4-8: Terminals for Ex instrument with NAMUR

Terminal	Function	Specification
①	Neutral mains power supply	100...240 VAC, 24 VAC or 24 VDC
②	Live mains power supply	100...240 VAC, 24 VAC or 24 VDC
③	Combined current output (I) and digital input (C). Current output (I) includes HART-Communication.	Current output (I): I ≤ 22 mA, $R_{load} \leq 680\ \Omega$, U_{max} = 15 VDC. Digital input (C): low = 0...5 VDC, high = 15...32 VDC (will be switched off when current output activated).
④	Pulse / frequency output	I_{max} = 150 mA, U_{max} = 32 VDC / 24 VAC, maximal frequency = 2 kHz.
⑤	Ground for pulse output	
⑥	Analog input 1, for temperature measurement.	0(4)...20 mA, R_i = 58,2 Ω, fuse = 50 mA.
⑦	Common ground	

The current output of the UFC 030 F-EEx can be set according to NAMUR NE43. The current output will go either to 3.6 or 21.5 mA in case of failure indication.

The following Ex-i Modis versions have two Modis modules, providing intrinsically safe input / output circuits. Modis versions don't have analogue inputs A1 / A2.

Ex-i (Modis) version

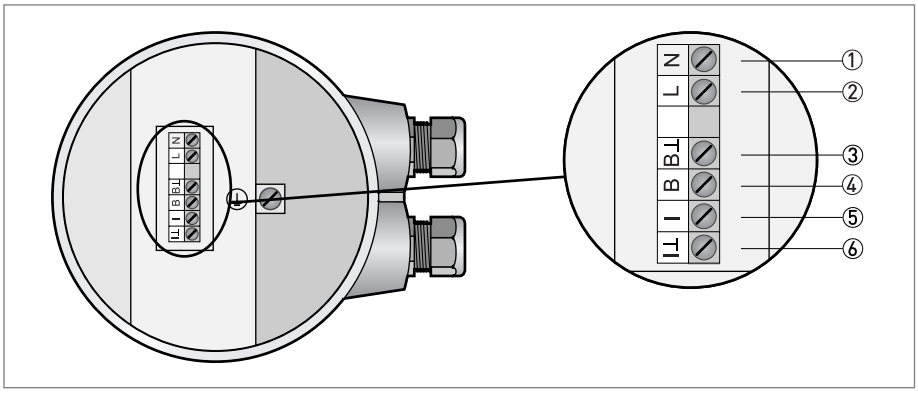


Figure 4-9: Terminals for instrument with Ex-i (Modis)

Terminal	Function	Specification
①	Neutral mains power supply	100...240 VAC, 24 VAC or 24 VDC
②	Live mains power supply	100...240 VAC, 24 VAC or 24 VDC
③	Ground for pulse, frequency or status output	
④	Pulse, frequency or status output	I_{max} = 150 mA, U_{max} = 32 VDC / 24 VAC, maximal frequency = 2 kHz.
⑤	Current output	Current output (I): I ≤ 22 mA, $R_{load} \leq 680\ \Omega$, U_{max} = 15 VDC.
⑥	Ground for current output	

Ex-i (Modis) version with Profibus PA

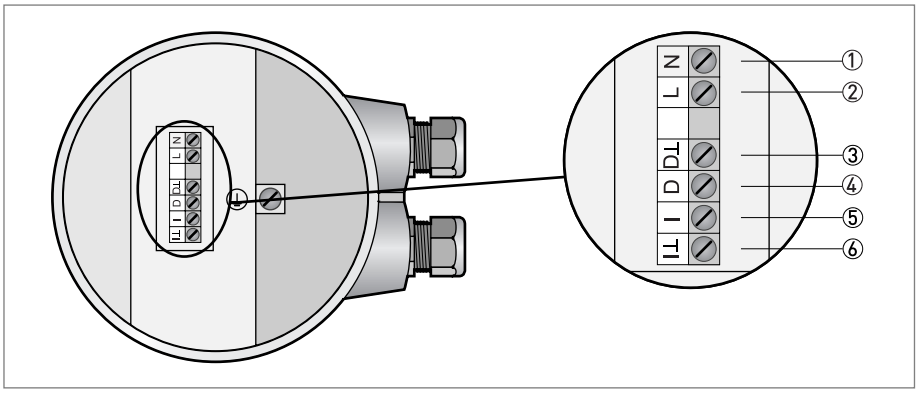


Figure 4-10: Terminals for Ex-i (Modis) version with Profibus PA

Terminal	Function	Specification
①	Neutral mains power supply	100...240 VAC, 24 VAC or 24 VDC
②	Live mains power supply	100...240 VAC, 24 VAC or 24 VDC
③	Profibus communication -	
④	Profibus communication +	
⑤	Current output	Current output (I): I ≤ 22 mA, $R_{load} \leq 680\ \Omega$, U_{max} = 15 VDC.
⑥	Ground for current output	