

Ultrasonic flowmeter BAMOFLONIC PFA



USER MANUAL

BAMO INTERNATIONAL

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Ultrasonic flowmeter
BAMOFLONIC PFA

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1. PRECAUTIONS

- Installation, commissioning and maintenance must be carried out by qualified personnel.
- Operation of the device must be in accordance with and strictly limited to the applications, as mentioned below.
- The power supply must comply with the values specified in the technical data.
- Disconnect all power sources from the unit when performing maintenance.
- The personnel in charge must read and respect the operating instructions.
- The installer must ensure that the instrument is connected according to the wiring diagrams.

2. APPLICATIONS

Flow measurements or dosing sequences of aggressive or neutral liquids:

- Chemicals strongly alkaline or acidic
- CIP (Clean In Place)
- Lixivate, etc.

BAMO Mesures cannot be held responsible for any damage caused by improper use or modification of the instrument.

3. DESCRIPTION

BAMOFLONIC - PFA applies propagation ultrasonic waves principle to measure the speed of a liquid, then to calculate the corresponding flow-rate. Therefore, it is convenient for liquids electrically conductive or not.

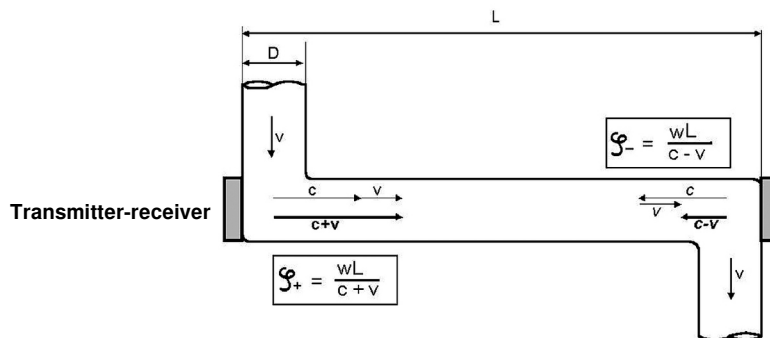
Important : The liquid must be homogeneous and clear.

As no moving parts are concerned, BAMOFLONIC operates without mechanical wear. Wet parts are of PFA.

If liquid properties differ from water (viscosity, waves propagation, etc.), it is recommended to use the remote display unit. It allows to display and modify the flowmeter parameters (output signals, reset of totalizer, dosing function, etc.).

4. MEASURING PRINCIPLE

Ultrasonic flow measurement is based on the phase difference principle. Two transmitter-receiver located opposite each other transmit and receive ultrasonic signals. When the fluid does not flow between these two sensors, they receive the emitted waves in the same phase, i.e. without phase shift. Conversely, in the presence of flow, there is a phase shift. The phase shift differs when measuring against or in the direction of flow. This difference is directly proportional to the flow-rate. The relationship between flow velocity and pipe diameter determines the mass flow rate.



L: Measuring tube length
K: Factor
D: \varnothing of measuring tube
v: Flow speed
c: Speed of sound in the liquid
 φ_+ : Phase in the direction of flow
 φ_- : Phase in the counter direction of flow

$$v \approx K * (\varphi_- - \varphi_+)$$

Fig. 1 : Principe de mesure de débit par ultrasons

4.1 Operational safety

Extensive testing guarantees the highest level of safety. The protection class is IP 67. The BAMOFLONIC PFA meets the requirements of the EC standards, on electromagnetic compatibility EN 50081-2 and EN 50082- 2, and EN 60601-1 for low voltage.

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5. INSTALLATION

Warning

The housing of BAMOFLONIC PFA has an arrow showing the direction of flow to be respected.

To obtain the fastest possible detection, it is essential to keep the shortest possible distance between the BAMOFLONIC PFA and the storage tank of liquid. Measuring accuracy can only be guaranteed when the line is full and the liquid does not outgas. For dosing applications, it is recommended to install it as close as possible to the control valve, as the cross section of a hose line increases with the system pressure, with the effect of reproducible deviations.

- Make sure that the flow remains linear and free of cavitation.
- Depending on the liquid being measured, it may be useful to have sufficient back pressure at the outlet of the BAMOFLONIC PFA to prevent cavitation.
- Make sure that the mechanical pipe connections are properly tightened.

Caution

The use of teflon tape is totally prohibited.

The presence of particles in the liquid can cause measurement errors.

Important:

In the case of a pump in piping system, the BAMOFLONIC PFA must be installed on the pressure side in the flow direction. Check in the specifications, the maximum pressure supported by the flowmeter.

For reliable measurement, use pipe straight lengths before the inlet and after the outlet of the flowmeter:

Nominal diameter	ND 7	ND 10	ND 15	ND 20
Upstream length		5 cm	40 cm	60 cm
Downstream length		0cm	20 cm	

5.1 Mounting of the flowmeter

The flow meter is connected with flexible hoses. For a better performance, the BAMOFLONIC PFA will be mounted in the vertical axis of the pipe. It is not recommended to install the flow meter after a dosing valve. The flowmeter can operate without load. To avoid bubbles in the liquid, the flowmeter should be installed on the pressure side of the pump.

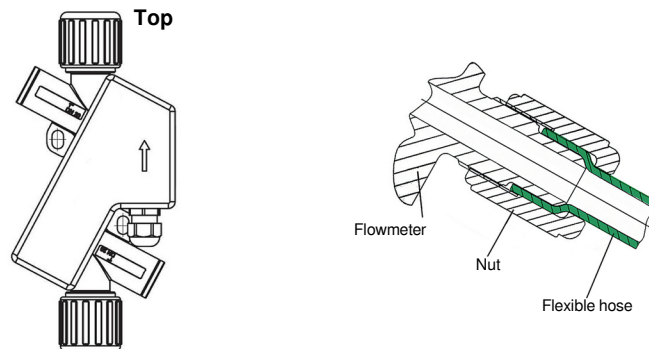


Fig. 2: Mounting direction

5.2 FLARE fittings: Pipe dimensions

Nominal diameter	ND 7	ND 10	ND 15	ND 20
Internal Ø of the pipe	7 mm	10 mm	15 mm	20 mm
External Ø of the pipe	8 mm	12 mm	18 mm	25 mm
External Ø of the pipe in the fitting	10 mm	13 mm	20 mm	28 mm

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6. ELECTRIC CONNECTIONS

6.1 Connector M12 - 5-pin

Make sure that the BAMOFLONIC PFA is switched off and that there is no direct power supply before any installation, removal or electrical wiring work on the BAMOFLONIC PFA.

PIN Nr	Function	Description
1	24 V DC	Power supply 18 ... 30 VDC
2	Pulses	Digital output Q1 Adjustable from 0.1 up to 3000 ml/pulse
	Alternatives:	Per step of 0.1 ml/pulse; NPN (open collector); Max. load 30 V / 100 mA The maximum voltage must be lower than the supply voltage
	1. "Empty tube" output	To set as 0 V or as 24 V signal for empty tube event.
	2. Dosing output	To set as 0 V or as 24 V signal
	3. Min. or Max. output	To set as 0 V or as 24 V signal to reach the upper or lower limit
4. Reverse flow	To set as 0 V or as 24 V signal when the liquid flows in the negative direction	
3	GND	Earth 0 V
4	Communication	Communication interface
5	Analogue output QA	4 ... 20 mA; 0 ... 20 mA Example: 0 l/min => 4 mA 36 l/min => 20 mA (according the Ø) Empty tube/ alarm => 3.5 mA => Self-powered loop between terminals 5 (+) and 3 (GND)



Fig. 3: 5-pin connections

6.2 Option: M12 - 8-pin connector

PIN Nr	Function	Description
1	24 V DC	Power supply 18 ... 30 V DC
2	Output Q1	Digital output Q1 Adjustable from 0.1 to 3000 ml/pulse
	Alternatives:	Per step of 0.1 ml/pulse; NPN (open collector); Max. load 30 V / 100 mA The maximum voltage must be lower than the supply voltage.
	1. "Empty tube" output	To set as 0 V or as 24 V signal for empty tube event.
	2. Dosing output	To set as 0 V or as 24 V signal
3	3. Min. or Max. output	To set as 0 V or as 24 V signal to reach the upper or lower limit
	4. Reverse flow	To set as 0 V or as 24 V signal when the liquid flows in the negative direction
3	GND	Earth 0 V
4	Output Q2	Digital output Q2 To set as PNP (closed collector) or NPN (open collector); Max. load 30 V / 100 mA
	1. "Empty tube" output	To set as 0 V or as 24 V signal when the tube is empty
	2. Dosing output	Configurable To set via software interface or to 0 V or to 24 V
	3. Pulse output	Adjustable from 0.1 to 3000 ml/pulse
	4. Min. or Max. output	To set as 0 V or as 24 V signal to reach the upper or lower limit
5	5. Reverse flow	To set as 0 V or as 24 V signal when the liquid flows in the negative direction
	Analogue output QA	4 ... 20 mA; 0 ... 20 mA Example: 0 l/min => 4 mA 36 l/min => 20 mA (according the Ø) Empty tube / alarm => 3.5 mA
6	Communication	Communication interface
7	Input I1	Digital input I1
	1. Dosing output	Dosing start with 24 V supply
	2. Offset adjustment	The offset is defined with the 24 V supply.
	3. Reset / counter	Reset the counter to zero with the 24 V supply
8	4. Elimination of low flow-rates	The filter is deactivated by maintaining 24 V at the input.
	Shielding	EMC directives



Fig. 4: 8-pin connections

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7. COMMISSIONING

7.1 Operations

The BAMOFLONIC PFA used as a volume flowmeter with a liquid such as water, does not require on-site calibration. Measuring parameters for water are factory-calibrated.

Settings for a liquid with significantly different viscosity and sound velocity (from water) can be set via the keypad menu of the remote display (option) or via the software interface. This is necessary when using the BAMOFLONIC PFA as a dosing device. Under certain conditions, the following parameters can be changed:

- Function and comportement of digital output Q1
- Function and comportement of the digital output Q2 * (function available with 8-pin connector)
- Function and comportement of the analogue output QA
- Flow range for which 4-20 mA will apply
- Pulse value
- Signal correction, "Minimum flow" function
- Dosing input * (function available with 8-pin connector)
- Optimization of the measurement curve with up to 8 values

7.2 Digital output Q1 (see specification on page 12)

Output Q1 can be assigned to pulse output, "empty pipe" detection, dosing valve switching or remote control output. The end-user can switch between NPN and PNP modes. In the presence of inductive load a diode must be connected in parallel with the load.

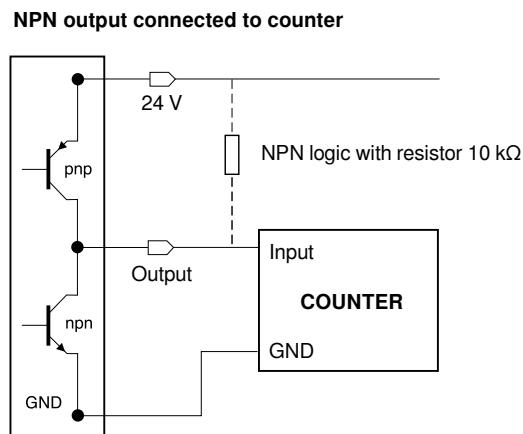


Fig. 5: Connecting output Q1 to external counter

7.3 Digital output Q2* (see specifications on page 12)

A PNP or NPN logic function can be selected. For an inductive load, e.g. an external relay, an additional diode must be installed in parallel with the load.

The digital output Q2 can be used either as a pulse output, or empty tube detection, or to control a dosing valve, or to check the flow direction.

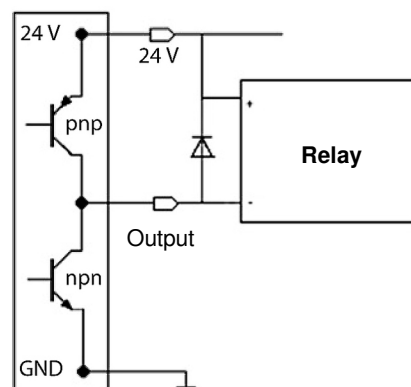


Fig. 6: Connecting output Q2 to a relay

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7.4 Minimum flow rate

This function excludes measurements in a narrow band around zero where the inaccuracy becomes too great. At the factory, the suppression is set to a reference value in relation to the flowmeter cross section.

This function works with a hysteresis of -25%

Example: "Minimum flow rate" = 0.6 l/min

When the flow rate is less than 0.45 l/min, the analogue output will become inactive.

When the flow rate exceeds 0.6 l/min, the analogue output and totalizer will become active again.

Adjustment range	0.0 ... 20 l/min per step of 0.006 l/min
Default settings	0.3 l/min for DN10, 3/8"
	0.9 l/min for DN15, 1/2"
	3.5 l/min for DN20, 3/4"
	5.0 l/min for DN25, 1"

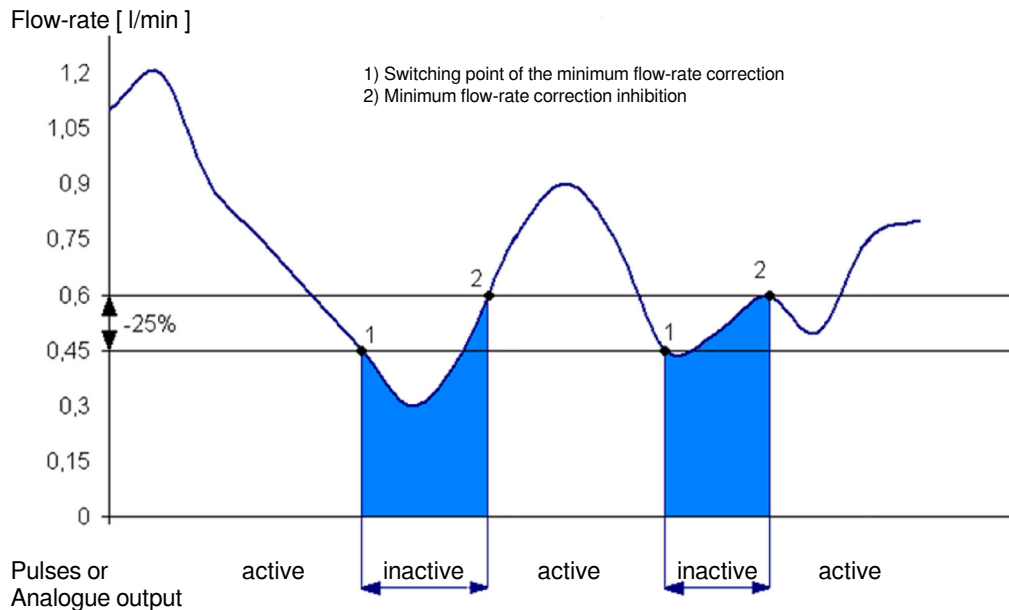


Fig. 7: Action of the "Minimum flow-rate" correction

7.5 Diagnostic

This function shows the software and hardware versions as well as help on the data.

7.6 Analog output QA

The BAMOFLONIC PFA is supplied as standard with a 4-20 mA output.

This output can be switched to 0-20 mA, via the keypad menu of the remote display (Optional), or via the software interface.

The current varies from 0 to 22.6 mA depending on the flow-rate and measurement conditions.

Default values with 4-20 mA output:

20 mA	for the maximum flow-rate
4 mA	for the minimum flow-rate
3.5 mA	Occurs with condition: "Empty pipe"

When operating the current output, the load must not be higher than 500 Ohm.
Higher load prevents the device from providing the maximum current of 22 mA.

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7.7 Pulse value

This function inform about the settings of the pulse output. The pulse value must not exceed the maximum output frequency (10 kHz) of the BAMOFLONIC PFA, nor the maximum input frequency of the control unit.

Example: 2.0 ml/Pulse (1 pulse every 2.0 ml)

Adjustment range 0.1 ... 3000.0 ml/Pulse, per step of 0.1 ml/Pulse
Default setting 1.0 ml/Pulse

7.8 Dosing

The dosing function can be accessed via the keypad menu of the remote display, or via the software interface .

Filling can be started and stopped with the "Start" and "Stop" function keys.

"Dosing Batch" adjustment range 0 to 3,500 litres
Setting range "Dosing Time". 0 to 30,000 seconds
Default setting "Dosing batch" 0 litres
Default setting "Dosing Time" 3 seconds

Dosing function possibilities:

a) BAMOFLONIC PFA is used as a dosing device (dosing control by the BAMOFLONIC PFA)

The BAMOFLONIC PFA fully controls the dosing function, a dosing volume (e.g. 400 ml) is declared via the serial interface (RS 485) and the user menu accessible via the keypad of the remote display. Dosing starts as soon as the line input is connected to 24 V. The BAMOFLONIC PFA opens the dosing valve via the output set for this purpose. When the preset quantity is reached, the dosing valve closes. The dosing procedure is started and stopped via the user menu.

b) BAMOFLONIC PFA is used as a dosing device (dosing control via software interface)

The BAMOFLONIC PFA fully controls the dosing function; A volume (e.g. 400 ml) is declared via the serial interface (RS485) and the operating software. Dosing is started via the software. The BAMOFLONIC PFA opens the dosing valve via the set output. When the preset dosing quantity is reached, the dosing valve is closed.

c) BAMOFLONIC PFA is used as a flowmeter (dosing control by a dosing process)

The dosing process fully controls the function; A dosing volume is configured when the process is put into operation by preselecting the pulse counter. Dosing is started when the key assigned to the dosing equipment is pressed. The control opens the dosing valve. From then on, the BAMOFLONIC PFA will send a voltage pulse to control each unit of volume (e.g. each 1 ml). When the preselected quantity is reached, the controller closes the dosing valve.

WARNING

To prevent dangerous situations, the user must have an emergency stop device, as well as an overflow protection device. These two devices must perform the safety shutdown of the pumps and the closing of the valves.

7.9 "Media"

Different liquids can be managed through the sub menu "Media". By using the sub-menu "1-point- Correction" it is possible to correct in % the flow-rate measurement.

7.10 Overview of default settings

Functions	Default settings
Digital output Q1	Pulse output
Digital output Q2*	Empty tube detection
Digital input I1*	Unassigned function
QA output	4-20 mA
Measuring range	6 l/min ND 7
	24 l/min ND 10
	60 l/min ND 15
	120 l/min ND 20
Pulse value	1 ml/Pulse
Minimum flow-rate	0.09 l/min ND 7
	0.3 l/min ND 10
	0.9 l/min ND 15
	1.2 l/min ND 20

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7.11 Digital input I1

The digital input I1 is only available on the model with the 8-pole connector.

The flowmeter has a programmable digital input for the following functions:
Reset counter, Start dosing, Minimum flow-rate correction disabled, Offset adjustment.

To start a dosing process, a 24 V DC power supply is required. Settings of dosing parameters or modifications can be made via the user control keypad or via the PC software interface.

When operating, the dosing input is blocked so that a restart is not possible during a dosing operation.

7.12 General information

Check the following points before switching on the BAMOFLONIC PFA for the first time:

- Check the connection status and cable assignments.
- Check the installation position of the BAMOFLONIC PFA.
(Direction of flow is indicated by an arrow engraved on the measuring tube of the BAMOFLONIC PFA).
- Make sure that the pipe is indeed full.
- Check the back pressure in the system.

Once checks are compliant, switch the device on; it will reach its maximum accuracy after 15 minutes.

8. Replacement of the BAMOFLONIC PFA

WARNING

Switch off the power supply before disconnecting the instrument.

After replacing the flowmeter, the (saved) programming of the old device can be copied to the new one. When using the dosing function, set a quantity

8.1 Repairs, dangerous substances

Before returning the BAMOFLONIC PFA :

- 1) Clean and rinse the flow path thoroughly, paying particular attention to the fittings and seals.
This is very important, especially if the device has been in contact with a liquid that is hazardous to health.
- 2) Attach a detailed report describing the application and the problem that occurred, as well as the decontamination certificate (contact us before shipment).
→ **The decontamination declaration is available for download at www.bamo.eu under "After sales service".**

9. FLOW RANGES AND Kv

Fittings	ND	Range [ml/s]	Range [l/min]	Kv [m ³ /h]	Cv [Gal/min]
3/8"	7	1.5 ... 100	0.09 ... 6	0.70	0.82
1/2"	10	5.0 ... 400	0.30 ... 24	1.65	1.93
3/4"	15	15 ... 1000	0.90 ... 60	4.34	5.07
1"	20	20 ... 2000	1.20 ... 120	8.80	10.30
		Low flow-rate [ml/s]	Low flow-rate [l/min]		
3/8"	7	0.5 ... 100	0.03 ... 6	0.70	0.82

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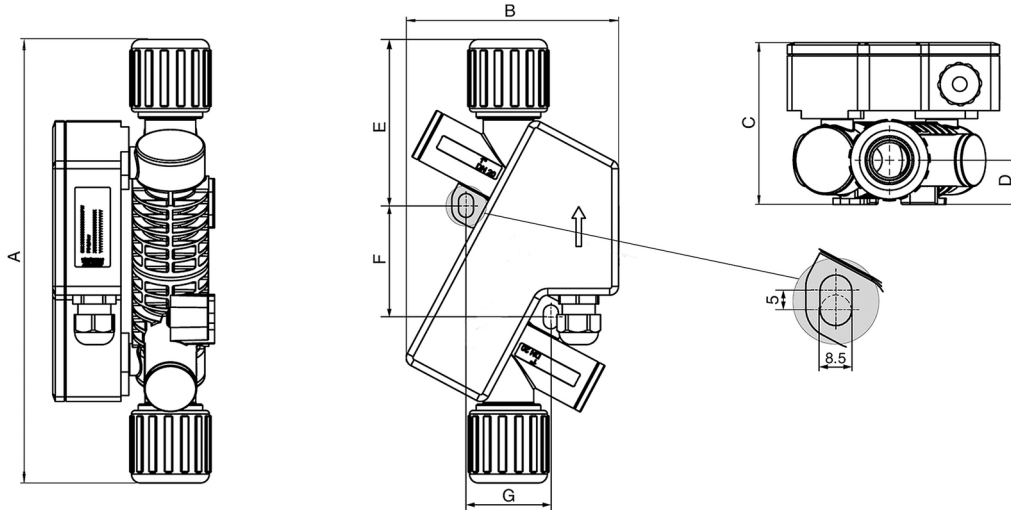
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10. DIMENSIONS



ND	Fittings	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	Mass [kg]
7	3/8"	218	120	79	16	77	63	48	1.3
10	1/2"	219.5				78.5			
15	3/4"	227				82			
20	1"	251				91.5			

11. TECHNICAL FEATURES

Power supply:	24 V DC / 3.6 W
Outputs	1 configurable digital output (pulse, empty tube alarm, anti-backflow, dosing or Min./ Max. alarm) Via NPN and PNP logic transistor, output current 30 V / 100 mA max.; According to DIN 19240: ≤ 5 V for low limit, ≥ 12 V for high limit 1 analog output 0/4-20 mA; Signal error according to NAMUR NE43
Communication interface	For setting and/ or to display on the indicator
Electrical connection	M12 connector, 5-pole (supplied)
Measuring accuracy	±2 % of reading and ±0.3 mm/s; According to VDI/VDE 2642
Repeatability:	≤ 0.5 %
Liquid temperature	0... +60 °C
Pressure limit	6 bar at 20 °C
Protection	IP 65
Fittings	PFA Flare couplings, ND 7; 3/8" ND 10; 1/2" ND 15; 3/4" ND 20; 1"

Measuring ranges

ND 7	0.09 ... 6 l/min (Option, low flow-rate: 0.03 ... 6 l/min)
ND 10	0.3 ... 24 l/min
ND 15	0.9 ... 60 l/min
ND 20	1.2 ... 120 l/min

Materials

Body (measuring tube)	PFA (Perfluoralkoxy)
Housing	PP

Options

Digital input	Dosing start (8-pole M12 connector)
Accuracy	± 1% of reading and ±3 mm/s

EC Conformity: The instrument meets the legal requirements of the current European Directives.

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12. SPECIFICATIONS

12.1 Digital outputs Q1 and Q2

The digital output Q2 is only available on the model equipped with the 8-pole connector.

The output is activated when the power supply is less than 18 V. In the event of an overload or short circuit, the output is deactivated within 100 µs and then becomes active again within 2 s.

Functions:

- Pulses
- Disabled
- Dosing
- Negative flow-rate
- Low limit
- High Limit
- Empty tube

(Default setting on output Q1 = Pulses)

(Default setting on output Q2 = Empty tube)

NPN or PNP logic function setting:

- PNP opener
- NPN shutter
- NPN opener
- PNP shutter

(Default settings on outputs Q1 and Q2 = PNP opener)

"Empty pipe"	Empty measuring tube	Filled measuring tube	
NPN opener	High resistance	0V	
NPN shutter	0V	High resistance	
PNP opener	High resistance	24 V	
PNP shutter	24 V	High resistance	

"Pulse"	Empty measuring tube	Filled measuring tube, no flow	Filled measuring tube, with flow
NPN opener	0V	0V	High resistance
NPN shutter	0V	0V	High resistance
PNP opener	High resistance	High resistance	24 V / Pulse
PNP shutter	High resistance	High resistance	24 V / Pulse

"High limit"	Below low limit	Between the limits	Above high limit
NPN opener	High resistance	High resistance	0V
NPN shutter	0V	0V	High resistance
PNP opener	High resistance	High resistance	24 V
PNP shutter	24 V	24 V	High resistance

"Low limit"	Below low limit	Between the limits	Above high limit
NPN opener	0V	High resistance	High resistance
NPN shutter	High resistance	0V	0V
PNP opener	24 V	High resistance	High resistance
PNP shutter	High resistance	24 V	24 V

"Dosing"	Starting dosing	While dosing	Before/ After dosing
NPN opener	High resistance	High resistance	0V
NPN shutter	High resistance	0V	High resistance
PNP opener	High resistance	High resistance	24 V
PNP shutter	High resistance	24 V	High resistance

Warning

When using the dosing function, the output should not be set as opener.

After re-start and till the end of a dosing process the valve would stay open.

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12.2 Features of the analog output

For the following diagram "Min. Range" is used for 0% and "Max. Range" is used for 100%

0...20 mA

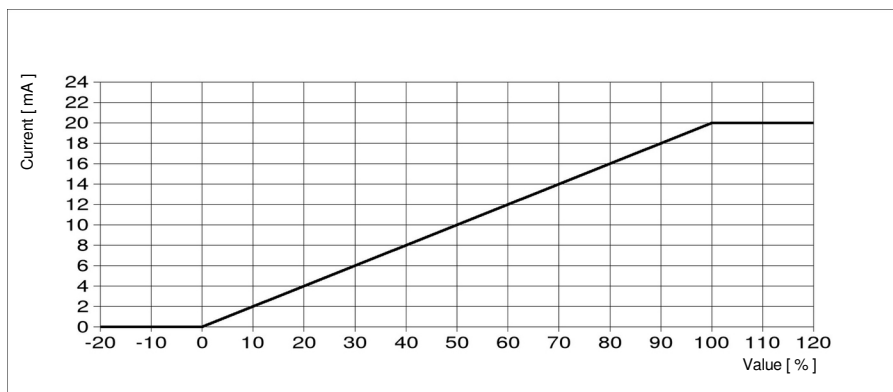


Fig. 8: Current output 0...20 mA

Values	Current [mA]
Lowest (< 0 %)	0
0% (Min. Range)	0
Between 0% and 100%	linear interpolation from 0 to 20 mA
100 % (Max. Range)	20
Highest (> 100 %)	20

For the following diagram "Min. Range" is used for 0% and "Max. Range" is used for 100%

4-20 mA signal

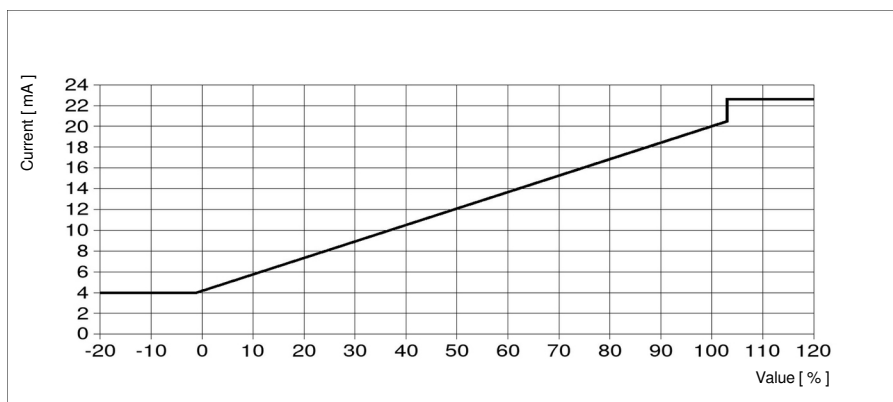


Fig 9: Analogue output 4-20 mA

Values	Current [mA]
Empty pipe	3.5
Lowest (< 1.2 %)	3.8
Between Min. and Max.	Linear interpolation from 3.8 to 4 mA
0% (Min. Range)	4 mA
Between 0% and 100%	Linear interpolation from 4 to 20 mA
100% (Max. Range)	20 mA
Between 100% and 103%	Linear interpolation from 20 to 20.5 mA
Highest (> 103 %)	22.6 mA

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Ultrasonic flowmeter
BAMOFLONIC PFA

18-03-2021

M-776.02-EN-AB

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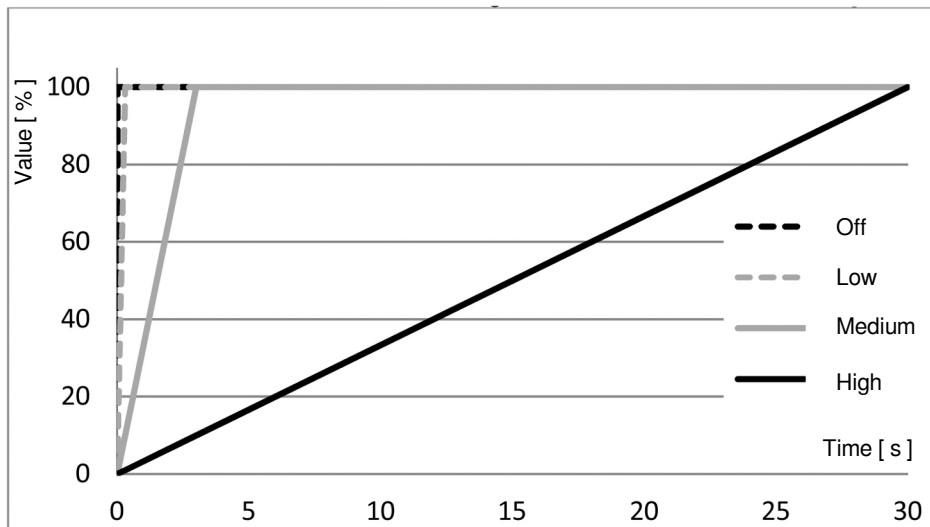
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"Filter"

This function averages the analog output signal.

Possible settings: Low, Medium, High, Off (default = Low)

The analog output signal reacts faster to signal changes when the setting is "Low", while the output signal reacts slower when the setting is "High".



Pic. 10: Response time with filter

Filter	100 %
Off	16ms
Low	0,3s
Medium	1 s
High	30s

Digital input I1

When input setting is modified, a complete start-up of instrument is necessary for validation of modified parameters.

Available input functions:

	Offset setting	Creeping flow off	Starting dosing	Counter reset to 0	Deactivated
0V	-	-	-	-	-
24V	Clipping: 0->24V Setting the Offset *	Status: Deactivating of "Creeping flow"	Clipping: 0->24V Starting dosing	Status: 0->24V Conuter reset	-

* The "Offset setting" function can only be used when there is no flow in the meter. If the flow-meter shows an offset drift caused by an incorrect offset setting, carry out the "Offset setting" or "Basic Setting" function again with the flow-meter full-filled and without flow.