

BAMOFLONIC 42i

Ultrasonic flow-meter



INSTRUCTIONS MANUAL

BAMO MESURES

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Ultrasonic flow-meter
BAMOFLONIC 42i

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776 M1 04 B

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776-04

General safety instructions

Please pay attention to the safety instructions with the following pictograms and signal words in these operating instructions:



IMPORTANT

Indicates situations or cases which, if not avoided, could result damage or failure on the used equipment.

WARNING

Indicates general hazardous situations or cases which, if not avoided, could result in serious injury.

NOTICE

Used to lead users to helpful information not related to personal injury.

Intended use

- The flow-meter BAMOFLONIC 42i may only be used for measuring the flow of pure, homogeneous liquids.
- The volume flow-meter BAMOFLONIC 42i is manufactured and designed according to the current industry standard EN 61010 (corresponds to VDE 0411 "Safety specifications for electrical measurement, control and laboratory devices").
- BAMO Mesures cannot be held liable for any damage caused by inappropriate or unintended use, by conversions/ changes to the flow-meter.

Personnel for installation, commissioning and operation

- **Assembly, electrical installation, commissioning and maintenance of the flow-meter must be carried out by qualified, trained technicians.**

The qualified personnel must read and take care of these operating instructions. must follow all appropriate instructions.

- **The installer has to ensure that the flow-meter is correctly connected according to the electrical connection diagrams.**



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1. Information

1 1.1 Areas of application

The BAMOFLO NIC 42i is well suited for measuring dynamic flow of liquids in piping such as:

- Chemicals supply for controlling, logistics, monitoring
- Cooling systems, logistics, monitoring
- Process equipment for control and monitoring of formulas
- Valve control for dosage
- Supply of demineralized water
- Dynamic liquid processes with dosing times of below 1 second

BAMOFLO NIC 42i has the following features and benefits:

- No movable parts, therefore no wear
- Compact
- High repeatability
- Easy to clean
- Great reliability
- Protected configuration by key word
- Integrated detection of empty pipe
- Integrated dosing function with pre-set and adjustable amounts
- Chemically resistant to aggressive fluids
- Constant pipe diameter

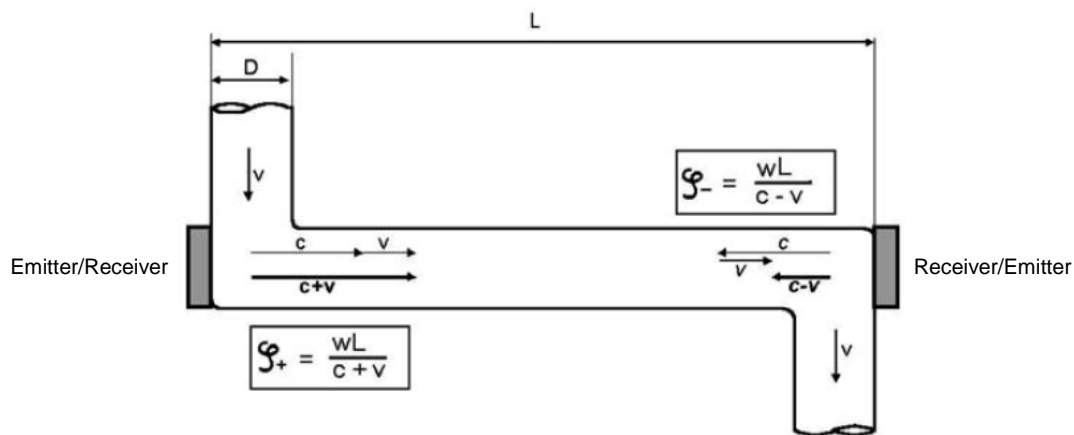
1.2 Measuring principle

The ultrasonic flow measurement is based on the phase difference approach. Two sensors that are located opposite from each other alternatively transmitting and receiving ultrasonic signals.

With medium at standstill, both sensors receive the transmitted ultrasonic signals in the same phase, i.e. without phase difference.

With medium flowing there is a phase shift. It differs when measured in direction of the flow than when measured against the direction of the flow. This phase difference is proportional to the flow rate.

The flow rate and the known diameter of the pipe are used to determine the flow rate.



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

- L: Length of measuring pipe
- K: Factor
- D: Diameter of measuring pipe
- v: Flow velocity
- c: Sound velocity in the fluid
- φ_+ : Phase with the flow
- φ_- : Phase against the flow

Fig. 1: Principle of ultrasonic flow measuring

1.3 Operational safety

Comprehensive self-tests ensure highest possible safety to protection class IP 65.

BAMOFLONIC 42i meets the directives **EN 61000-6-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, and EN 61000-4-6**

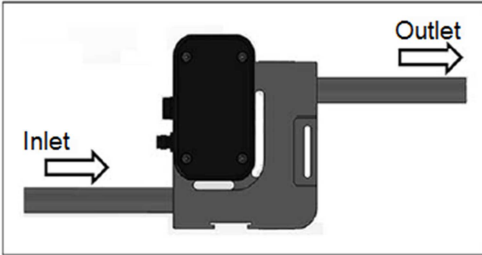
2. Assembly and installation

2.1 Installation instructions

The housing of BAMOFLONIC 42i is labelled with an arrow symbolizing the direction of the flow.
The flow-meter must be installed in direction of the flow.

NOTICE

For fastest detection it is important to keep the pipe distance from tank to BAMOFLONIC 42i as short as possible. Accurate measurement can only be possible, if the pipe is completely filled and the liquid does not outgas.



Notwithstanding it may be advantageous for dosing applications to install the BAMOFLONIC as close as possible to the dosing valve, since soft pipes increases the cross-section depending on the system pressure. This may lead to repeatable differences.

Insure that flow keeps linear and without cavitation. Depending on the measured liquid it can be helpful to have enough back pressure on the outlet of BAMOFLONIC to avoid cavitation. Insure all mechanical connections are tight.

Particles present in the flow stream may result in measuring errors.

Fig. 2: Installation and mounting a BAMOFLONIC 42i

When using pumps, BAMOFLONIC 42i must be installed in flow direction on the pressure side. Note the maximum pressure specification of the flow-meter on § 5.2.



IMPORTANT

For correct measurements **straight and unobstructed distances** before and after the device have to be observed.

Nominal diameter	ND 5	ND 7	ND 10	ND 15
Inlet distance	0 cm	0 cm	5 cm	40 cm
Outlet distance	0 cm	0 cm	0 cm	20 cm

2.2 Assembly of the flow-meter

The flow-meter is mounted into a pipe system by using a proper fitting.

For best measuring performance the BAMOFLONIC 42i should be mounted vertically.

It is not recommended to install the flow-meter after a dosing-valve.

The flow-meter can run empty.

To avoid getting bubbles in the liquid, the BAMOFLONIC 42i should be installed on the pressure side of the pump.

If it is not possible to mount the flowmeter vertically, then mount the instrument in a location where the pipe will be filled at all times. The best measuring result is reached, when bubbles are unable to get into the BAMOFLONIC.

For CIP applications where completely drain the pipe system is necessary, we recommend mounting the flowmeter in the vertical position. If the flowmeter is mounted horizontally the internal geometry of the instrument will result in stagnate liquid.

Vibrations or mechanical forces may decrease measuring accuracy. It is possible to fix the flowmeter additionally with two clamps against vibrations or movements, as seen in the following examples.

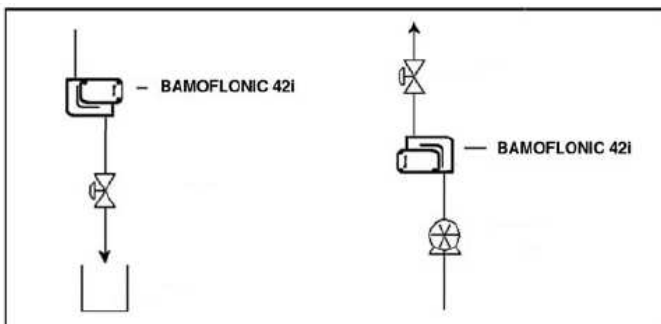


Fig. 3: Mounting examples

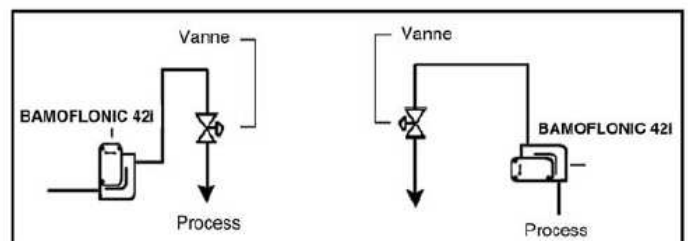


Fig. 4: Possibilities for installation



IMPORTANT

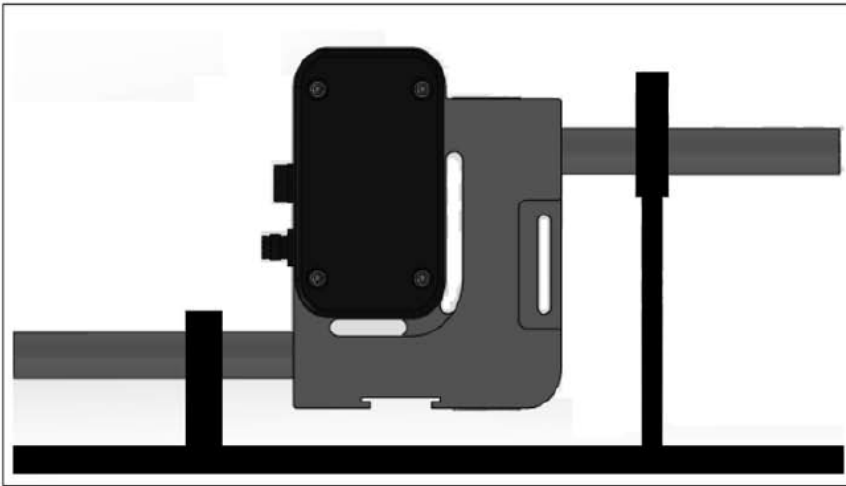


Fig. 5 Mounting a BAMOFLONIC 42i

Flow-meter must be free of mechanical strain from piping or it would be damaged.



WARNING

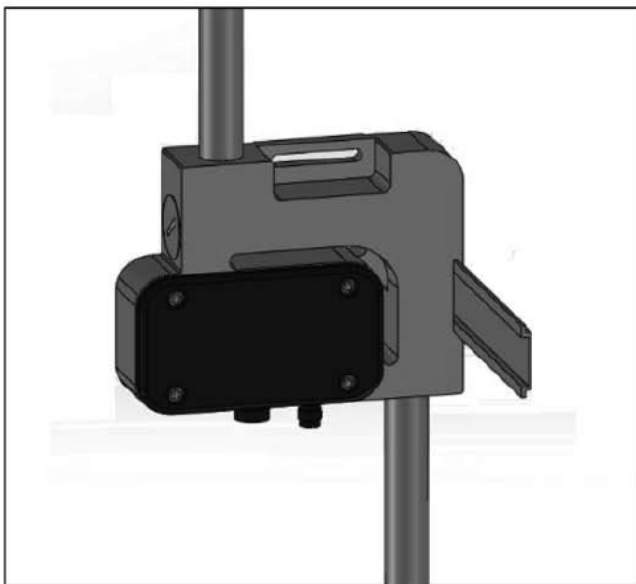


Fig. 6 Mounting the BAMOFLONIC 42i on DIN Rail

No respect of instructions could destroy the instrument and liquid leaks may occur.

2.3 Electrical wiring

The flow-meter must not be installed, wired or disassembled with live power present. Disconnect or shutdown all power before working on the flow-meter.

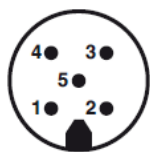


Fig. 7: 5-Pin connection plug
(of the instrument)

Socket for 5-pin
(cable)

Connector cable pin configuration

The outputs may be re-programmed for specific applications.

Pin	Function	Description
1	L+	Voltage supply 18...30 V DC
2	Pulse output (options): 1. Empty-pipe output 2. Dosing output 3. Limit-control output 4. Negative flow	Digital output Q1 Freely adjustable from 0.1 to 3000 ml/pulse By 0.1 ml/pulse steps, NPN-Transistor, max. load 30 V / 100 mA Configurable output of 0 V or 24 V when pipe is empty. Configurable output of 0 V or 24 V via dosing- menu (with FlowSoft.) Configurable output of 0 V or 24 V when reaching upper or lower limit Configurable output of 0 V or 24 V when liquid flows in reverse direction
3	GND Ground:	0 V
4	Communication	Communication interface
5	Analogue output QA	4...20 mA or 0...20 mA Loop is self-powered (between pin 5+ and 3 ground) Example: 0 L/min → 4 mA 36 L/min → 20 mA Alarm → 3.5 mA (4-20mA, depending of min. & max. limits)

Only operate the flow-meter BAMOFLONIC 42i within the operating limits stipulated on the product label and the operating manual / data sheet. Use outside these conditions lead to overloads which cause permanent damages.



3. Commissioning

3.1 Operation

If the BAMOFLONIC 42i is used as volume flow-meter for water or water-like liquids it will not require on-site calibration. Parameters for water are calibrated at the factory.

For liquids with specific viscosity and/or specific sonic speed, the BAMOFLONIC 42i may also be customized with the help of the hardware interface and the FlowSoft service software. This is always necessary when using BAMOFLONIC as a dosing device according to section Dosing function.

The following parameters may be changed to settings suitable for the individual conditions:

- Digital output Q1, function and behaviour
- Analogue output QA, function and behaviour
- Flow range, for which shall apply 4...20 mA; Pulse weight
- Creeping suppression
- Optimization of measurement curve with up to 8 interpolated values

3.2 Functions and default settings

Display and user interface:

The BAMOFLONIC 42i is equipped with a display to visualize actual measurement values and change parameters of the flowmeter. Navigation and changes are done by the four keys on the keypad.

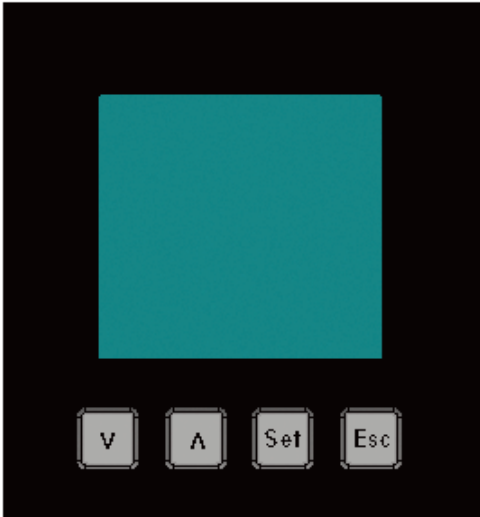


Fig. 8: Operating with the key pad

When the “Set” key is pressed the device switches into the Main Menu. Different menu options can be selected by using the two arrow keys.

To enter e.g. analogue limits

“Analogue output – Upper limit” use the arrow keys to change values and press “Set” to confirm.

To switch back to the last menu level, press the “Esc” key.

Password protection is used to ensure just authorized personal is able to change values or configurations.

Default password is: 41414.

The password can be changed with *FlowSoft*.

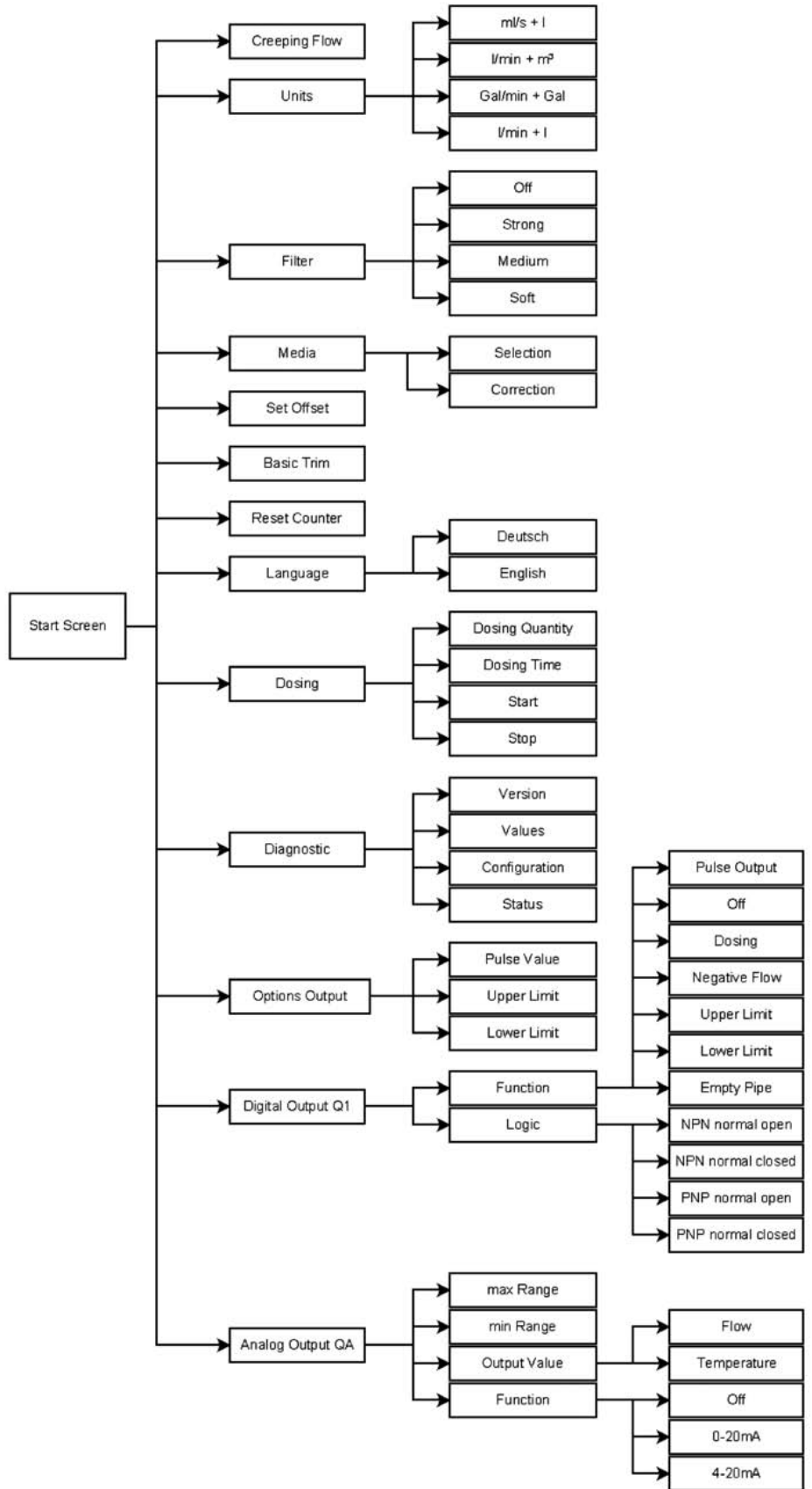


Fig. 9: MENU BAMOFLONIC 42i – User interface

Notice

NOTICE

Not all functions of BAMOFLONIC can be changed in the user menu display. To configure more parameters FlowSoft and an “USBtoRS485-Converter Sonic” are necessary.

Set Offset

In the sub menu "Set Offset" it is possible to set the actual offset of the flowmeter. This function should just be used when the BAMOFLONIC is completely filled with liquid and there is no flow. A small offset change e.g. caused by variable temperatures is automatically done by the flow. Offset may be adjusted through the digital inputs (software).

Language

To choose between English and German.

Filter

The function "Filter" averages the analogue output signal.

Possible settings: Soft, Medium, Strong or Off

The analogue output signal reacts faster when average determination is soft; Whereas the output signal reacts slower when filter is strong.

Units

The BAMOFLONIC is able to show flow-rate & volume in different units: ml/s & l, Gal/min & Gal, l/min & l, l/min & m³.

The first unit corresponds to the flow-rate & the second to the volume.

Reset Counter

The volume counter can be reset.

Note: Accidentally erased counter values are permanently lost.

Basic Trim

This function runs a self-diagnostic to optimize all parameters; it lasts approximately one minute.

Basic trim is necessarily done with filled flow-meter with the liquid, and, without flow.

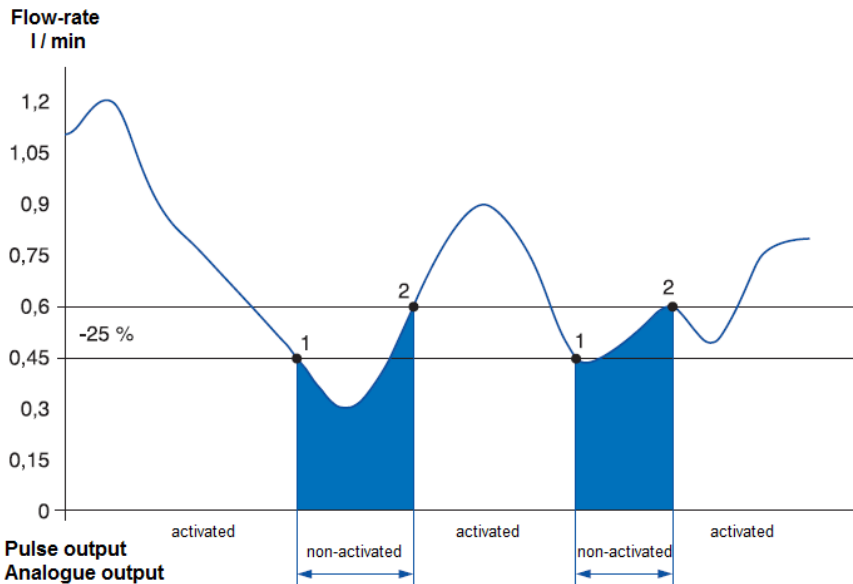
After successfully finishing the basic trim, the display shows "Done". When an error is detected the display shows "Error".

Creeping suppression

The creeping suppression excludes flow measurements around zero where the non-accuracy is consequent (even with a closed valve).

At the factory, the creeping suppression is set at a standard value in relation with the tube cross-section of the flow-meter.

The creeping suppression works with a hysteresis of - 25%



Example:

Creeping suppression = 0.6 l/min

If the flow rate is lower than 0.45 l/min the pulse output or the analogue output becomes inactive.

If the flow rate exceeds 0.6 l/min pulse output is active and added to the totalizer. Similarly, a value is transmitted through the analogue output again.

Available values:

0.0 ... 20 l/min : by steps 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"

Diagnosis

The sub menu "Diagnostic" shows the software/hardware version and other helpful values for analysis.

NOTICE

Analogue output

The analogue output is available as current output 4-20 mA. It can also be switched as a 0-20 mA signal through the keyboard or with *FlowSoft*. The current output ranges from 0 to 22.6mA according the flow rate and operating conditions.

Default values for 4-20mA configuration::

- 20 mA → Upper limit of the relevant measurement
- 4 mA → Lower limit of the relevant measurement
- 3.5 mA → "empty pipe"

For detailed information see § 5.2.

When current output is used, the load must not be higher than 500 Ohm.
A higher load does not allow the device from providing the maximum current of 22mA.



Pulse value

This section determines the output settings for pulsed outputs.
Choose configuration such as to neither exceed the maximum output frequency (10 kHz of the BAMOFLONIC 42i, nor the maximum input frequency of the control.

Example: 2.0 ml/pulse (This means: a pulse is emitted every 2.0 ml).

Setting range: 0.1 ... 3000.0 ml/Pulse, by steps of 0.1 ml/pulse

Default setting: 1.0 ml/Pulse

Dosing

By choosing the dosing function via the menu, end-user can manually set up the parameters.
A dosage can be started and stopped with the menu function keys "Start" and "Stop".

- | | |
|---------------------------------|--------------------|
| Setting range "Dosing Batch": | 0 ... 3 500 litres |
| Setting range "Dosing Time" | 0 ... 30 000 s |
| Default setting "Dosing Batch": | 0 litre |
| Default setting "Dosing Time": | 3 s |

Digital output Q1

Digital output Q1 may be used as pulse output, empty pipe detection, for switching dosing valve or limit control.
Through the menu, end-user can switch between NPN and PNP transistor logic.
In case of inductive load a diode has to be connected parallel to the coil. For detailed information see § 5.2.

NPN output connected to a counter

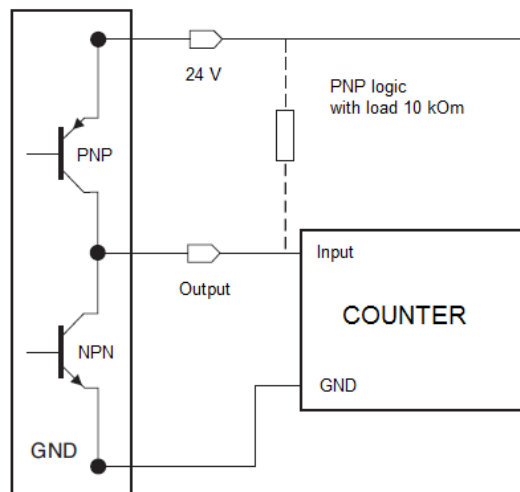


Fig.11: Example Q1 output connected to a counter

Dosing function

3 possibilities for dosing function:

a) BAMOFLONIC 42i as a dosing device

BAMOFLONIC controls the complete dosing function. The dosing quantity (e.g. 400 ml) is pre-set in the BAMOFLONIC via the digital interface (RS485) with the operating software or by using the menu of the display unit.

Dosing starts, as soon as line digital input is wired to 24 V, e.g. via a pushbutton.

BAMOFLONIC will open the dosing valve via the output configured for it.

When the pre-set dosing quantity is reached, the dosing valve is closed via the above output.

The dosing procedure can also be started and stopped by using the dosing menu sequence.

b) BAMOFLONIC 42i as a dosing device with control through software *FlowSoft*

BAMOFLONIC controls the complete dosing function. The dosing quantity (e.g. 400 ml) is pre-set via the digital interface (RS485) with the operating software "FlowSoft".

Dosing starts via the dosing-menu in the operating software.

BAMOFLONIC will now open the dosing valve via the output configured for it.

When the pre-set dosing quantity is reached, the dosing valve is closed via the above output.

c) BAMOFLONIC 42i as a flowmeter (dosing control via external dosing equipment – pulse signal)

The dosing equipment controls the entire dosing function. The dosing quantity is fixed in the dosing equipment control during commissioning by pre-selecting the meter pulses.

Dosing starts, when the relevant pushbutton of the dosing equipment is pushed.

This control will open the dosing valve.

From now on BAMOFLONIC will send a pulse to the dosing equipment for each volume unit that has flown through (e.g. per 1ml).

When the pre-selected pulse quantity is reached, the dosing equipment closes the dosing valve.

In this case, output 1 of BAMOFLONIC is used to send out pulses.

**The end-user has to provide an emergency stop and an overfilling stop to prevent hazardous situations.
Both functions must perform safety shut down of pumps and closing of valves.**



Media

Various media can be managed in the sub menu "Media".

With the sub menu "Correction" it is possible to correct the measures flow in percent.

3.3 Overview of default settings

Function	Default settings
Digital output Q1	Pulse output
Current output QA	Flow as 4-20mA signal
Pulse value	1 ml/pulse
Creeping suppression	0.024 l/min ND 5
	0.09 l/min ND 7
	0.3 l/min ND10
	0.9 l/min ND15

3.4 General Information

Please check the following before powering the flowmeter for the first time:

- Check the electrical connections and cable allocations.
- Check the installation position of the flowmeter (arrow on the body shows the correct flow direction).
- Is the measurement pipe completely filled with fluid ?
- Check the back pressure in the system.

When everything has been checked, switch on power.

After 15 minutes with power running the measuring device reaches the maximum accuracy.



4. Exchange of measuring device BAMOFLONIC 42i

- Switch off power before disconnecting the connectors
- After replacing the flowmeter
 - a) Settings (saved) of previous flowmeter may be copied in the new flowmeter
 - b) when using the dosing function, set a quantity



Repair, hazardous substances

Before sending the BAMOFLONIC 42i

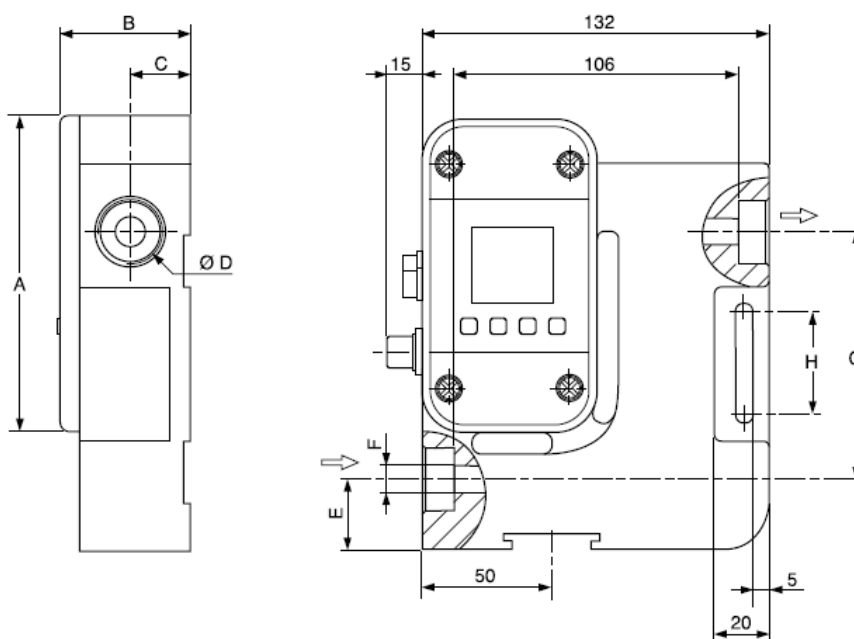
- Clean all process chemicals from the device.
 - Fully rinse the flow path. Pay close attention to the process fittings and areas of retention.
 - All media must be removed before returning.

This is particularly important, if the medium to be measured is health hazardous. Devices judged to be insufficiently cleaned will be returned to sender. No inspection of device will be done until proper cleaning is completed by user.
- Join a detailed report describing the application and the failure.
 - Fill the declaration of decontamination (see last page), dated and stamped.



5. Technical specifications

5.1 Dimensions and weight



DN	A /mm	B /mm	C /mm	D	E /mm	F /mm	G /mm	H /mm	PE-HD /g	PVDF /g
DN 5	167,5	50	23	1/2" G	25	7	98	40	670	1100
DN 7	167,5	50	23	1/2" G	25	7	98	40	670	1100
DN 10	170,5	50	23	3/4" G	26,5	10	95	40	720	1190
DN 15	175,5	55	25	1" G	29	15	90	30	895	1470

5.2 Specifications

Nominal diameters:	DN 5 – 1/2" ; DN 7 - 1/2" ; DN 10 - 3/4" ; DN 15 - 1"
Fittings:	G or NPT thread, Clamp connection DIN 11864-3, Tube nozzle
Medium temperature:	0...+50 °C
Protection class:	IP 65
Pressure:	Max. 7 bar at 20 °C
Materials:	All parts in contact with medium made of PSU (Polysulfone), Electronics housing made of PSU (Polysulfone)
Power supply:	18...30V DC
Power input:	at 24V DC = 3.6W
Connector:	M12, Plug 5 pins
Display:	Back-lighted
Ambient temperature:	0...+60 °C
Analogue output:	0/4...20 mA, Lower and upper limit adjustable, Ground connected to supply ground Error Signal according to NAMUR NE43
Digital output	Via transistor NPN or PNP logic; max. 30V / 100 mA;; According DIN 19240: ≤5V means LOW, ≥12V means HIGH Short cut resistant, Frequency 0...10kHz Short circuit protected; Frequency 0 ... 10 kHz
User interface:	Keyboard 4 touch buttons, or through adaptor USB/RS485 to use with software <i>FlowSoft</i>
Measurement Accuracy:	± 2 % of reading and ± 3mm/s // <i>Option: ± 1 % and ± 3 mm/s ; ± 6mm/s for DN10 – 3/8"</i>
Measuring range:	(According VDE/VDI 2642) ND 5 → 0.024... 3 l/min ND 7 → 0.09 ... 6 l/min ND 10 → 0.3 ...24 l/min ND 15 → 0.9... 60 l/min
Repeatability:	0.5%
EC Conformity:	Instrument meets the directives EN 61000-6-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6

Digital output

Switch over to high resistance when the supply is lower than 18V. When overload or short circuit is detected the digital output is switched off within 100µs for a period of 2s.

Empty pipe output	Empty pipe	Device filled
NPN opener	High resistant	0 V
NPN shutter	0 V	High resistant
PNP opener	High resistant	24 V
PNP shutter	24 V	High resistant

Pulse output	Empty pipe	Filled, no flow	Filled, flow
NPN opener	0 V	0 V	0 V Pulse
NPN shutter	0 V	0 V	0 V Pulse
PNP opener	High resistant	High resistant	24 V Pulse
PNP shutter	High resistant	High resistant	24 V Pulse

Lower limit output	Below lower limit	Between the limits	Above upper limit
NPN opener	High resistant	High resistant	0 V
NPN shutter	0 V	0 V	High resistant
PNP opener	High resistant	High resistant	24 V
PNP shutter	24 V	24 V	High resistant

Higher limit output	Below lower limit	Between the limits	Above upper limit
NPN opener	0 V	High resistant	High resistant
NPN shutter	High resistant	0 V	0 V
PNP opener	24 V	High resistant	High resistant
PNP shutter	High resistant	24 V	24 V

Dosing output	Startup of device	While dosing	Before/after dosing
NPN opener	High resistant	High resistant	0 V
NPN shutter	High resistant	0 V	High resistant
PNP opener	High resistant	High resistant	24 V
PNP shutter	High resistant	24 V	High resistant

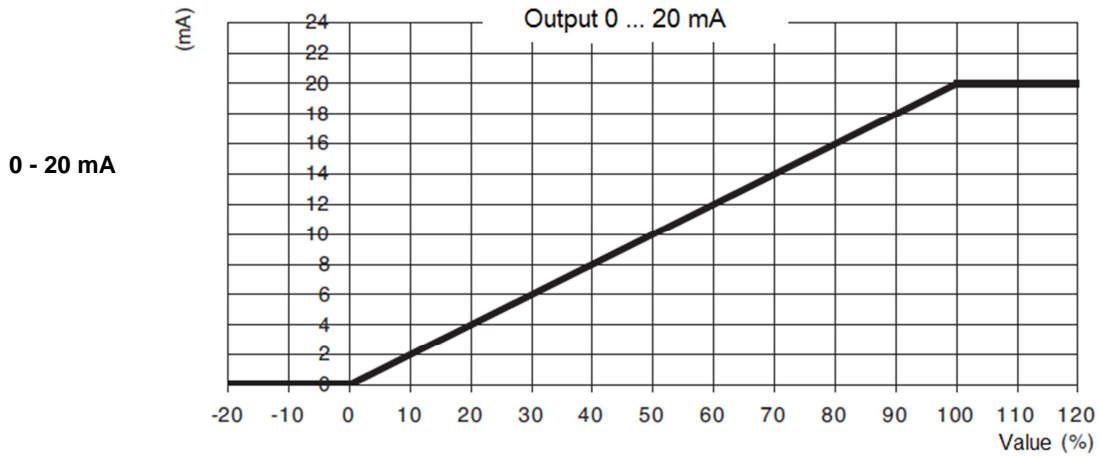
When using the dosing function the output should not be configured as opener.

After restart and till the end of a dosing process the valve would be open.

NOTICE

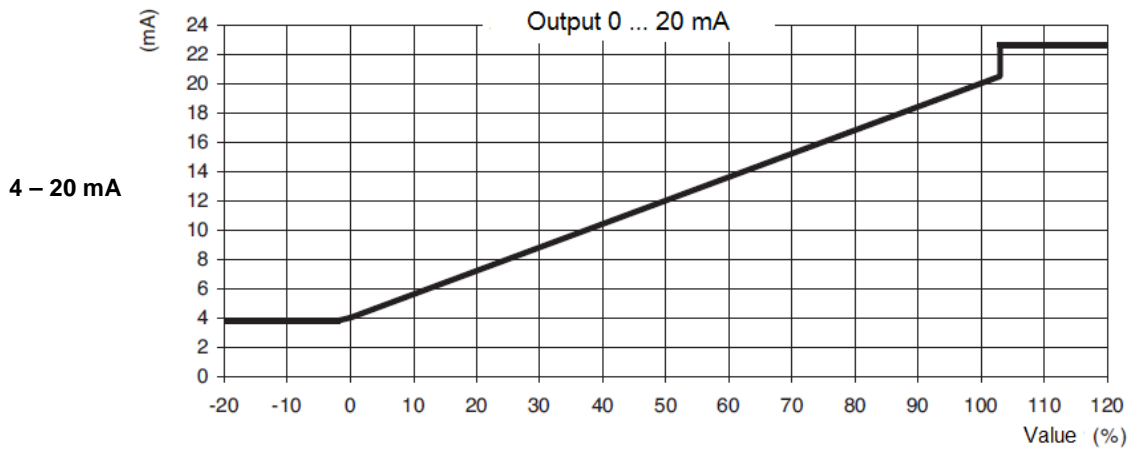
Features of analogue output response

For the following graphic "min Range" is used for 0% and "max Range" is used for 100%.



Value	Current [mA]
Smaller 0%	0
0% (min Range)	0
Between 0% and 100%	Linear interpolation from 0 to 20mA
100% (max Range)	20
Higher 100%	20

For the following graphic "min Range" is used for 0% and "max Range" is used for 100%

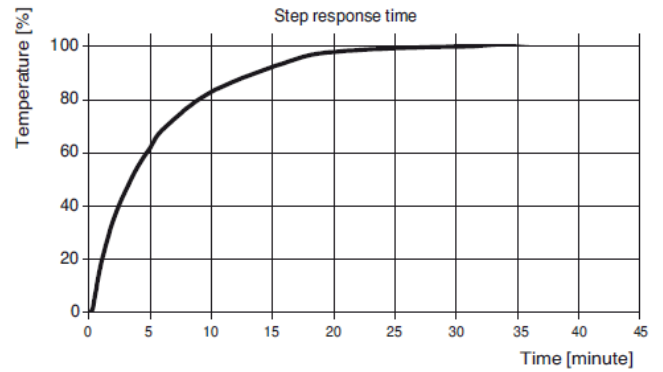


Value	Current [mA]
Empty pipe	3.5
Smaller -1.2%	3.8
Between	Linear interpolation from 3.8 to 4mA
0 % (min Range)	4
Between 0% and 100%	Linear interpolation from 4 to 20mA
100% (max range)	20
Between 100% and 103%	Linear interpolation from 20 to 20.5mA
Higher 103%	22.6

Thermocouple features

The integrated thermocouple has no direct contact to the liquid and is used to calculate the expansion of the housing. The environment temperature greatly influences the actual temperature of the thermocouple. The response time of temperature changes relates to the mounting position of the thermocouple inside the housing.

Step-response time after a significant temperature change (Filter „Off“) —>



Influence of the environment temperature

Some examples:

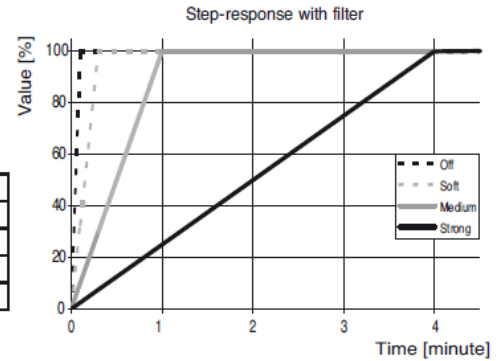
Liquid T°x 0.7	+ ambient T°x 0.3	= measured T°
40°C x 0.7	+ 20 °C x 0.3	= 34°C
40°C x 0.7	+ 30 °C x 0.3	= 37°C
40°C x 0.7	+ 40 °C x 0.3	= 40°C
60°C x 0.7	+ 20 °C x 0.3	= 48°C

In case of an error:

- For a short circuit of thermocouple "- 50°C" is shown.
- For broken cable "- 30°C" is shown.

Filter configurations for thermocouple

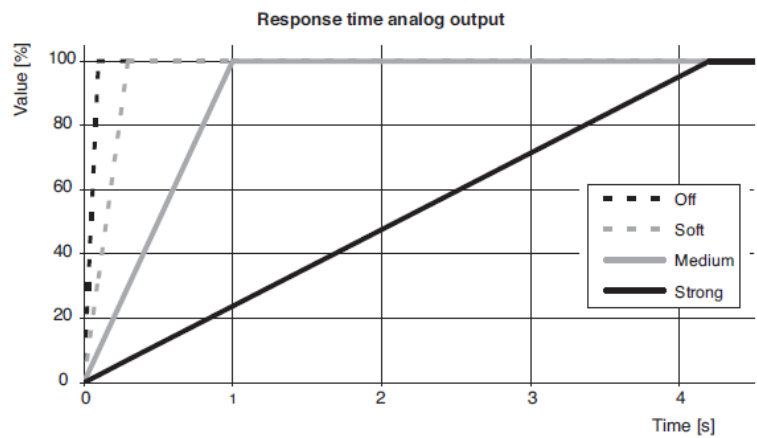
Filter	100 %
Off	1s
Soft	16s
Medium	1min
Strong	4min



Filter options for analogue output

Settings

Filter	100%
Off	16ms
Soft	0.3s
Medium	1s
Strong	4.2s



Error message displays for BAMOFLONIC 42i

Text	Description	Display
Empty pipe	"Empty Pipe" is detected	Flashing + text
Low Voltage	Supply voltage is less than 18V; Outputs are inactive	Flashing + text
Short circuit	Over load of digital output is detected (>100mA); Outputs are inactive	Text only
Lower limit	Flow is less than low limit set for min. limit control	Text only
Upper limit	Flow is greater than high limit set for max. limit control	Text only
Sonic Speed	Sonic speed out of specified value; Run "Basic trim"	Text only

RETURNED EQUIPMENT HANDLING FORM







SENDER	DESTINATION
Contact person:	Please, return your equipment to: BAMO MESURES SAS 22, rue de la Voie des bans Z.I de la gare 95100 ARGENTEUIL FRANCE Phone: +33 130 258 320 Contact: Mr Corbe
Company:	
Your reference:	
Date:	

EQUIPMENT DESCRIPTION, OPERATING CONDITIONS / MALFUNCTION DESCRIPTION

Device: Serial number:	
EQUIPMENT HISTORY <input type="checkbox"/> The equipment operates correctly <input type="checkbox"/> Was delivered damaged <input type="checkbox"/> Malfunction during the start up <input type="checkbox"/> Damaged during installation <input type="checkbox"/> Operating since: (period/time) <input type="checkbox"/> Previous maintenance already done by BAMO	INFORMATION FROM BAMO (DO NOT FILL THE BLANK) <i>Customer Account:</i> <i>SAV Ref.:</i> <i>P.O. Nr.:</i> <i>Date:</i> <i>Delivery note:</i> <i>Delivery date:</i> <i>Invoice Nr.:</i>

REASON OF RETURN, OBSERVATIONS / DESCRIPTION OF FAULT / MALFUNCTION:

DECLARATION OF DECONTAMINATION

	Denomination							Harmless
		Corrosive	Flammable materials	Irritant Harmful	Toxic	Biological hazard	Other *	
Process medium:		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cleaning tool / chemical:		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

* Please describe the risk:

Legal directives :
 According to legal obligations and for our staff safety and workshop protection, it is necessary to send with the equipment this certificate to declare the decontaminating procedures have been applied before shipment.
 Your responsibility will apply in case of non-respect of proper operations.

DECLARATION: I hereby declare that the returned equipment has been carefully cleaned and disinfected. It remains free of residues, harmful / toxic substances.

Name, Dept.:	Signature:
STAMP:	Date: