Flowmax® 400i

Ultrasonic flow metering / dosing device

Operating manual

MIB GmbH
Messtechnik & Industrieberatung
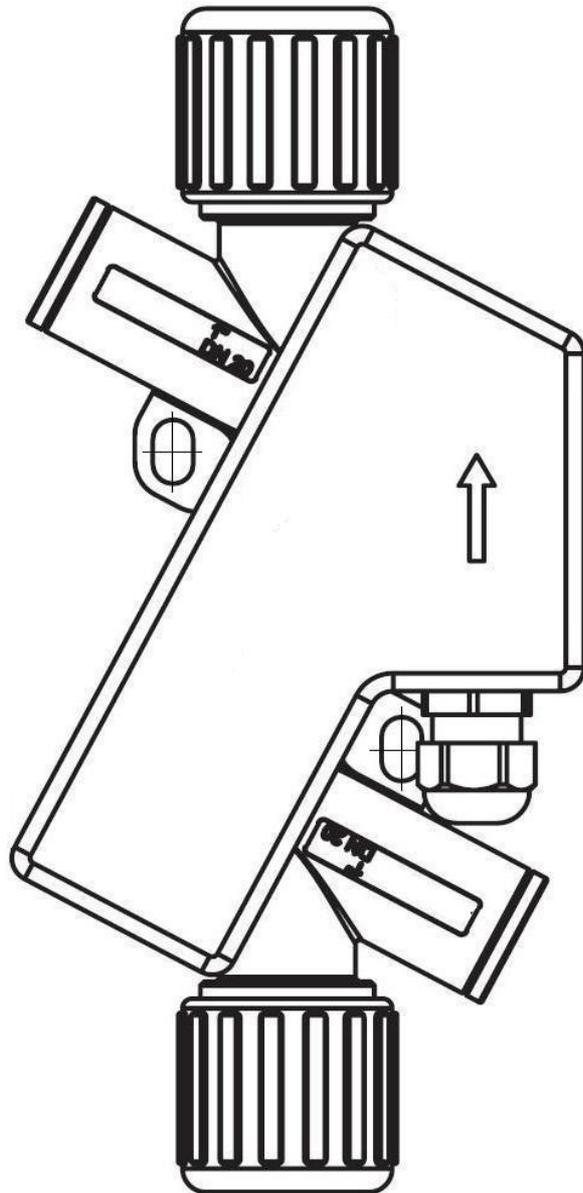
General safety instructions

Please always observe the following safety instructions!
Please pay attention to the safety instructions with the following pictograms and signal words in these operating instructions:
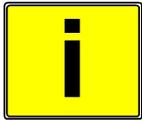
i	**IMPORTANT!**	IMPORTANT! indicates situations or cases which, if not avoided, could result in damage or failure of the Flowmax 400i equipment.
!	**WARNING!**	WARNING! indicates general hazardous situations or cases which, if not avoided, could result in serious injury or death.
	NOTICE!	NOTICE! is used to lead users to helpful information not related to personal injury.

Intended use

- The flowmeter Flowmax 400i may only be used for measuring the flow of pure, homogeneous liquids.
- The Flowmax 400i is not intended for use in medical applications.
- The volume flowmeter Flowmax 400i is built operationally safe in accordance with the latest state of the art technologized developments and industry standard EN 61010 regulations (corresponds to VDE 0411 "Safety specifications for electrical measurement, control and laboratory devices").
- The manufacturer is not liable for any injury, damage or harm due to inappropriate or unintended use or modifications of the flowmeter. Conversions and/or changes to the flowmeter may only be made, if they are expressly performed in accordance with the operating instructions in this operating manual.

Personnel for installation, commissioning and operation

- **Assembly, electrical installation, commissioning and maintenance of the flowmeter must be carried out by qualified, trained personnel. The qualified personnel must have read and understood the operating instructions in this operating manual and must follow the operating instructions in this manual**.
- **The installer has to ensure that the flowmeter is correctly connected according to the electrical connection diagrams in this operating manual.**
- **Serious injury or death from electric shock may occur if wiring, installation, disassembly or remove of wires is performed while electrical power is energized**

!

WARNING!

Technological progress

The manufacturer reserves the right to revise, alter, or modify the flowmeter to the most current technology without special prior notice. Further information about the latest updates and potential additions to these operating instructions are available from the manufacturer.

Table of contents

Table of figures

1. Planning information

1.1 Areas of application

The flow measurement device Flowmax 400i is well suited for measuring dynamic flow in pipes and tubes. This flowmeter is suitable for liquids only. It is used for:

- Chemicals supply for controlling, logistics, monitoring
- Hook-up-boxes for controlling, logistics, monitoring
- Process equipment for control and monitoring of formulas
- Valve control for continuous release of liquid volumes
- Supply with de-ionized water
- Very dynamic liquid processes with dosing times of below 1 second

It has the following features and benefits:

- No movable parts, therefore no wear
- High repeatability
- Easy to clean
- Safe operation
- Compact design
- Integrated detection of empty conduits
- Integrated dosing function with possibility of pre-set and adjustable amounts
- Excellent chemical resistant

1.2 Measuring principle

It usually takes more energy to swim against the flow than with the flow. 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 directly proportional to the flow rate. The flow rate and the known diameter of the pipe are used to determine the flow volume.
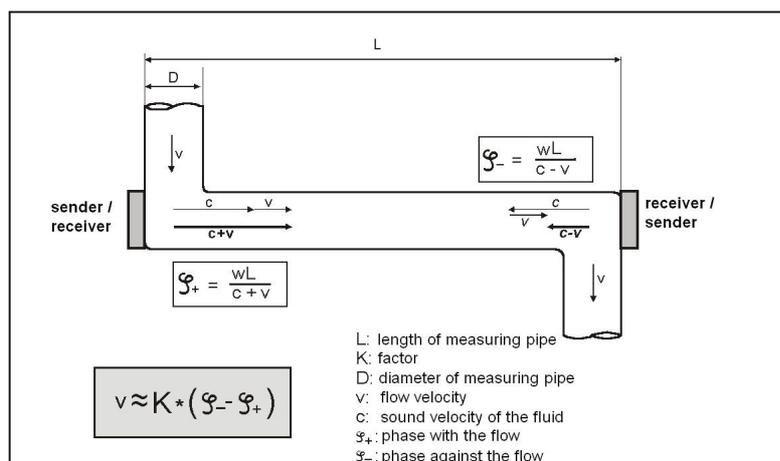
Figure 1: Presentation of the principle of ultrasonic flow measuring

1.3 Operational safety

Comprehensive self-tests ensure highest possible safety.
Faults (process or system errors) are output on a digital output or displayed on the display menu.

The protection class is IP 67.

Flowmax 400i meets the general EMC immunity requirements according to CE, EN 61000-6-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6.

Flowmax 400i meets the safety requirements concerning the Protective Extra Low Voltage directive according to EN 50178, SELV, PELV.

NOTE:
Flowmax 400i is available with different connection versions. There are: M12x1 5-pin plug, M12x1 8-pin plug, on request 10-wire Teflon cable (lengths 5m). Depending on the connection configuration not all functions described in this manual are available. The function volume of every flowmeter is described in the function table, chapter "2.3 Electrical wiring" or on the name plate.

NOTICE!

2. Assembly and installation

2.1 Installation instructions

The housing of Flowmax 400i is labeled with an arrow symbolizing the direction of the flow. The flowmeter must be installed in direction of the flow.

NOTICE!
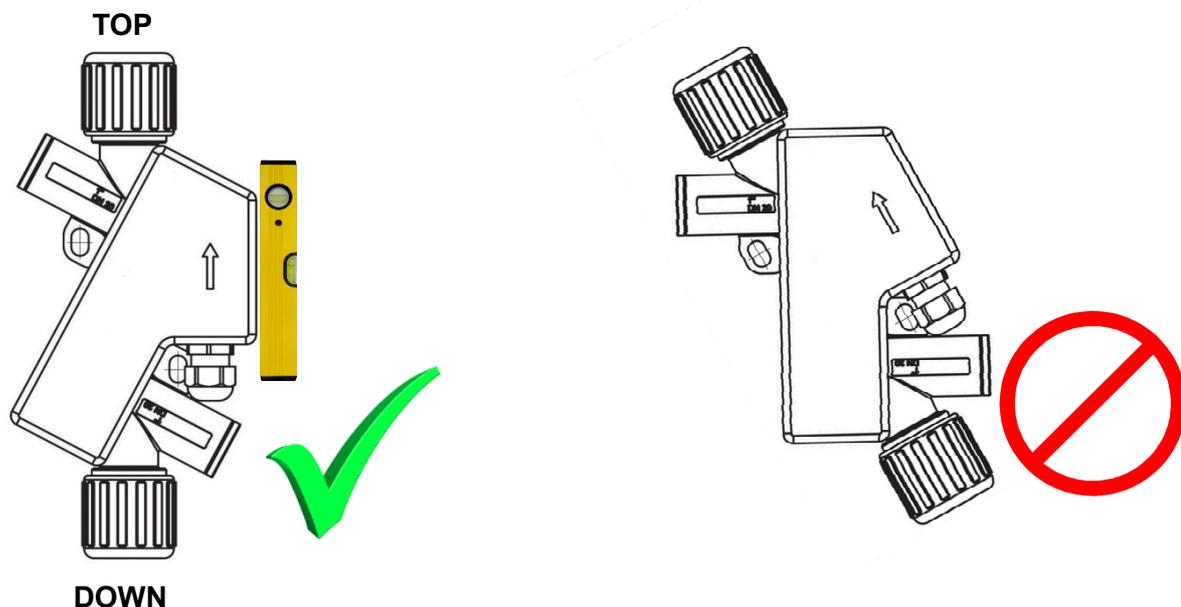
Figure 2: Installation position of Flowmax 400i

For fastest possible bubble detection it is important to keep the pipe distance from tank to Flowmax 400i as short as possible. Accurate measurement can only be assured, if the pipe is completely filled and the liquid does not outgas.

Notwithstanding it may be advantageous for dosing applications to install the Flowmax 400i 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 no cavitations dissolve from the measured liquid. Depending on the measured liquid it can be helpful to have enough back pressure on the outlet of Flowmax 400i to avoid cavitations. Insure all mechanical connections are tight.

NOTICE!

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

When using pumps, Flowmax 400i must be installed in flow direction on the pressure side. The maximum pressure rating of Flowmax 400i has to be considered.

Do not exceed the maximum pressure allowance for of the Flowmax 400i (see section 5.2 Technical specifications). Exceed the maximum pressure can lead to destruction of the Flowmax 400i.

WARNING!

For correct volume flow measurements straight and unobstructed inflow and outflow distances have to be observed. Starting from the connection thread these have to be at least:

Nominal diameter	DN7 3/8"	DN10 1/2"	DN15 3/4"	DN20 1"
Inflow distance	5 cm 2.0"	5 cm 2.0"	40 cm 15.8"	60 cm 23.6"
Outflow distance	0 cm 0.0"	0 cm 0.0"	20 cm 7.9"	20 cm 7.9"

2.2 Assembly of the flowmeter

Flowmax 400i has two ears with 8 mm x 13 mm elongated holes (for dimensions see section 5.1 Dimensions and weight) for attachment to a fixed base. These elongated holes allow attachment to on-site constructions.

2.3 Electrical wiring

Serious injury or death from electric shock may occur if wiring, installation, disassembly or remove of wires is performed while electrical power is energized.

Always shut off or disconnect electrical power at service panel and lock switch or breaker and tag to prevent energizing electrical power during work or while Flowmax 400i is not assembled and installed.

Wiring installation, disassembly and removal must be performed by qualified persons experienced and knowledgeable about electrical work.

Figure 3: Pin code: Connection plug   /   socket for 5-pin version

Connector cable 5-pin configuration defined by manufacturer
The outlets may be re-programmed for specific applications

5-pin plug with 1-wire communication:

Pin	Function	Description
1	24 VDC	Voltage supply: 18...30 VDC
2	Pulse output Q1 alternative: 1. Empty-pipe output 2. Dosing output 3. Upper or Lower Limit-output 4. Negative flow	Digital Output Q1 Freely adjustable ranging from 0.1 to 3000 ml/pulse in 0.1 ml/pulse steps, npn-or pnp-transistor, max. load 100mA. Max. voltage must be less than the supply voltage Configurable output of 0V or 24V when pipe is empty. Configurable output of 0V or 24V Configurable output of 0V or 24V when reaching upper or lower limit Configurable output of 0V or 24V when liquid flows in negative direction
3	GND	Ground: 0 V
4	Communication	Communication interface

5	Analog output QA	4....20mA; 0....20mA
		    Example: 0l/min => 4mA
		        60l/min => 20mA (depending on diameter)
		Empty pipe Alert => 3.5mA

5-pin plug with RS485 communication and current output:

Pin	Function	Description
1	24 VDC	Voltage Supply: 18...30 VDC
2	Communication	RS 485 B
3	GND	Ground: 0 V
4	Communication	RS 485 A
5	Analog output QA	4....20mA; 0....20mA 　　Example: 0l/min => 4mA 　　　　60l/min => 20mA (depending on 　　　　　　diameter) Empty pipe　　Alert => 3.5mA

5-pin plug with RS 485 – communication and digital output Q1:

Pin	Function	Description
1	24 VDC	Voltage supply: 18...30 VDC
2	Pulse output Q1 alternative: 1. Empty-pipe output 2. Dosing output 3. Upper or Lower Limit-output 4. Negative flow	Digital output Q1 Freely adjustable ranging from 0.1 to 3000 ml/pulse in 0.1 ml/pulse steps, npn-or pnp-transistor, max. load 100mA. Max. voltage must be less than the supply voltage Configurable output of 0V or 24V when pipe is empty. Configurable output of 0V or 24V Configurable output of 0V or 24V when reaching upper or lower limit Configurable output of 0V or 24V when liquid flows in negative direction.
3	GND	Ground: 0 V
4	Communication	RS 485 A
5	Communication	RS 485 B

8-pin plug with 1-wire communication:

Figure 4: Pin code: Connection plug   /   socket for 8-pin version

Connector cable 8-pin configuration defined by manufacturer.
The outlets may be re-programmed for specific applications.

Pin	Function	Description
1	24 VDC	Voltage supply: 18...30 VDC
2	Digital output Q1 Functions	Digital output Q1 Configurable npn-or pnp transistor, max. load 100mA*. Max. voltage must be less than the supply voltage
	1. Pulse output	Freely adjustable ranging from 0.1 to 3000 ml/pulse in 0.1 ml/pulse steps,
	2. Empty pipe output	Configurable output of 0V or 24V when pipe is empty.
	3. Dosing output	Configurable output of 0V or 24V
	4. Upper or Lower Limit output	Configurable output of 0V or 24V when reaching upper or lower limit
	5. Negative flow	Configurable output of 0V or 24V when liquid flows in negative direction.
3	GND	Ground: 0 V
4	Digital output Q2 Functions:	Digital output Q2 Configurable npn- or pnp-transistor, max. load 100mA*. Max. voltage must be less than the supply voltage
	1. Empty pipe output	Configurable output of 0V or 24V when pipe is empty.
	2. Dosing output	Configurable output of 0V or 24V
	3. Pulse output	Freely adjustable ranging from 0.1 to 3000 ml/pulse in 0.1 ml/pulse steps.
	4. Upper or Lower Limit output	Configurable output of 0V or 24V when flow reaches upper or lower limit.
	5. Negative flow	Configurable output of 0V or 24V when liquid flows in negative direction.
5	Analog output QA	4....20mA; 0....20mA Example: 0l/min => 4mA 60l/min => 20mA (depending on diameter Empty pipe Alert => 3.5mA
6	Communication	Communication interface
7	Digital input I1 1. Dosing output 2. Set offset 3. Reset counter 4. Creeping flow off	Digital input I1 Starts the dosage by a rising edge of 24V. The Offset is set by a rising edge of 24V. Reset of the counter by a rising edge of 24V. Creeping suppression is deactivated as long as there are 24V at the input.
8	Shielding	EMC safety

*it applies: for Q1 + Q2 ≤ 100mA

8-pin plug with RS 485 communication:

Figure 5: Pin code: Connection plug   /   socket for 8-pin version

Connector cable 8-pin configuration defined by manufacturer.
The outlets may be re-programmed for specific applications.

Pin	Function	Description
1	24 VDC	Voltage supply: 18...30 VDC
2	Digital output Q1 Functions	Digital output Q1 Configurable npn-or pnp transistor, max. load 100mA. Max. voltage must be less than the supply voltage
	1. Pulse output	Freely adjustable ranging from 0.1 to 3000 ml/pulse in 0.1 ml/pulse steps,
	2. Empty pipe output	Configurable output of 0V or 24V when pipe is empty.
	3. Dosing output	Configurable output of 0V or 24V
	4. Upper or Lower Limit output	Configurable output of 0V or 24V when reaching upper or lower limit
	5. Negative flow	Configurable output of 0V or 24V when liquid flows in negative direction.
3	GND	Ground: 0 V
4	Digital input I1 1. Dosing output 2. Set offset 3. Reset counter 4. Creeping flow off	Digital input I1 Starts the dosage by a rising edge of 24V. The Offset is set by a rising edge of 24V. Reset of the counter by a rising edge of 24V. Creeping suppression is deactivated as long as there are 24V at the input.
5	Analog output QA	4....20mA; 0....20mA Example: 0l/min => 4mA 60l/min => 20mA (depending on diameter Empty pipe Alert => 3.5mA
6	Communication	RS 485 A
7	Communication	RS 485 B
8	Shielding	EMC safety

Cable 10-core

Colour	Function	Description
red	24 VDC	Power supply: 18...30 VDC
brown	Digital output Q1 Functions	Digital output Q1 Configurable npn-or pnp transistor, max. load 100mA. Max. voltage must be less than the supply voltage
	1. Pulse output	Freely adjustable ranging from 0.1 to 3000 ml/pulse in 0.1 ml/pulse steps,
	2. Empty pipe output	Configurable output of 0V or 24V when pipe is empty.
	3. Dosing output	Configurable output of 0V or 24V
	4. Upper or Lower Limit output	Configurable output of 0V or 24V when reaching upper or lower limit
	5. Negative flow	Configurable output of 0V or 24V when liquid flows in negative direction.
black	GND	Ground: 0 V
orange	Digital output Q2 Functions:	Digital output Q2 Configurable npn- or pnp-transistor, max. load 100mA*. Max. voltage must be less than the supply voltage
	1. Empty pipe output	Configurable output of 0V or 24V when pipe is empty.
	2. Dosing output	Configurable output of 0V or 24V
	3. Pulse output	Freely adjustable ranging from 0.1 to 3000 ml/pulse in 0.1 ml/pulse steps.
	4. Upper or Lower Limit output	Configurable output of 0V or 24V when flow reaches upper or lower limit.
	5. Negative flow	Configurable output of 0V or 24V when liquid flows in negative direction.
violet	Analog output QA	4....20mA; 0....20mA Example: 0l/min => 4mA 60l/min => 20mA (depending on diameter Empty pipe Alert => 3.5mA
white	Digital input I1 1. Dosing output 2. Set offset 3. Reset counter 4. Creeping flow off	Digital input I1 Starts the dosage by a rising edge of 24V. The Offset is set by a rising edge of 24V. Reset of the counter by a rising edge of 24V. Creeping suppression is deactivated as long as there are 24V at the input..
grey	GND	Ground: 0 V
yellow	Communication	RS 485 A
green	Communication	RS 485 B
blue	GND	Ground: 0 V

*it applies: for Q1 + Q2 ≤ 100mA

ATTENTION:
Only operate the flowmeter Flowmax 400i within the operating limits stipulated on the product label and the operating manual / data sheet. Use of the Flowmax 400i outside these conditions will lead to overloads which cause permanent damage.

i

IMPORTANT!

3. Commissioning

NOTE:
If Flowmax 400i is used for a fluid other than water the "basic trim" has to be carried out during commissioning. Therefor the device has absolutely be filled with medium.
The basic trim can be done on the device display (alternatively FlowCon). During the adjustment the medium may not flow as it affects the function

NOTICE!

3.1 Operation

If Flowmax 400i is used as volume flowmeter for water or water-like liquids, it will not require on-site calibration. Parameters for water are calibrated at the factory. Notwithstanding the Flowmax 400i may also be supplied with customized settings. The coordination must be done at time of purchase order.

If necessary, e.g. if viscosity and/or speed of sound deviate significantly from water, the pre-set parameters can be adjusted via FlowCon 200i. It is always necessary to adjust the manufacturer pre-set parameters when using the Flowmax 400i as a dosing device according to section 3.2. Adjusting the manufacturer pre-set parameters requires FlowCon.

NOTICE!

The following parameters may be changed to settings suitable for the individual conditions:
- Digital output Q1, function and behaviour
- Digital output Q2*, function and behaviour
- Pulse value
- Analog output QA
- Flow range, for which shall apply 4...20 mA
- Creeping suppression
- Dosing input I1*, function and behaviour
- Optimization of measurement curve with up to 8 interpolation values (media matrix)

Described functions that are marked with * are not available for the 5-pin version. The available functions of 5-pin version are described in chapter 2. To change configurations at Flowmax a FlowCon 200i is needed.

3.2 Functionalities of flowmeter and default settings

3.2.1 Language

The language of the display can be changed. Available languages are English, Spanish, French and German.

3.2.2 Dosing

The Flowmax 400i can be configured for manually dosing by choosing the dosing function via the user display. The Volume "Dosing Quantity" and the "Dosing Time" are freely adjustable. The dosing time is intended as a safeguard against unintentional overspill. When "Dosing Time" is set to zero, the timer control is inactive. A dosage can be started and stopped with the menu function keys "Start" and "Stop".

Setting range "Dosing Quantity":   0 – 3500 Liters, in steps of 0.001 L
Default setting "Dosing Quantity":   0 Liters

Setting range "Dosing Time"   0 –30000 Seconds, in steps of 0.1 sec, having an accuracy of +0/-1
Default setting "Dosing Time":   3 Seconds

IMPORTANT!
If Dosing Time =0 the time switch-off is inactive.

Example:
Dosing time = 3 seconds. That is Flowmax is sending the closing signal after 2.1 to 3.0 sec to the valve. The dosing time is designed as a security feature. An exact dosage purely on the dosing time is not useful.

IMPORTANT!

WARNING!
The customer has to provide a technical solution for overfill protection and an emergency stop switch. Both functions must run for safety to valve closure.

WARNING!

3.2.3 Media

3.2.3.1 Set Offset

In the sub menu "Set Offset" it is possible to set the actual offset of the flowmeter. Use this function only when Flowmax 400i is completely filled with liquid, and there is no flow. If the offset is set while flow is present or when the pipe is empty it will cause an offset drift what results in a faulty measurement.
Example of operation see appendix.

A small offset change, e.g. caused by variable temperatures, is automatically done by the flowmeter. It is also possible to set the offset via the configurable digital inputs.

3.2.3.2 1-Pt-Correction

Setting range: -50.0...50.0 % in steps of 0.1%
Default setting: 0 %

Example of operation see appendix.

3.2.3.3 Creeping suppression

The creeping suppression excludes flow measurements that result from convection in a narrow band around zero, even with a closed valve. At the factory, the creeping suppression is set at a standard value in relation to the cross-section of the flowmeter. Changes to a smaller value of the parameter may cause an offset drift what results in a faulty measurement.

There are higher tolerances below the standard default settings, see also section 5.2 measurement errors!

Creeping suppression works with a hysteresis of - 25%.
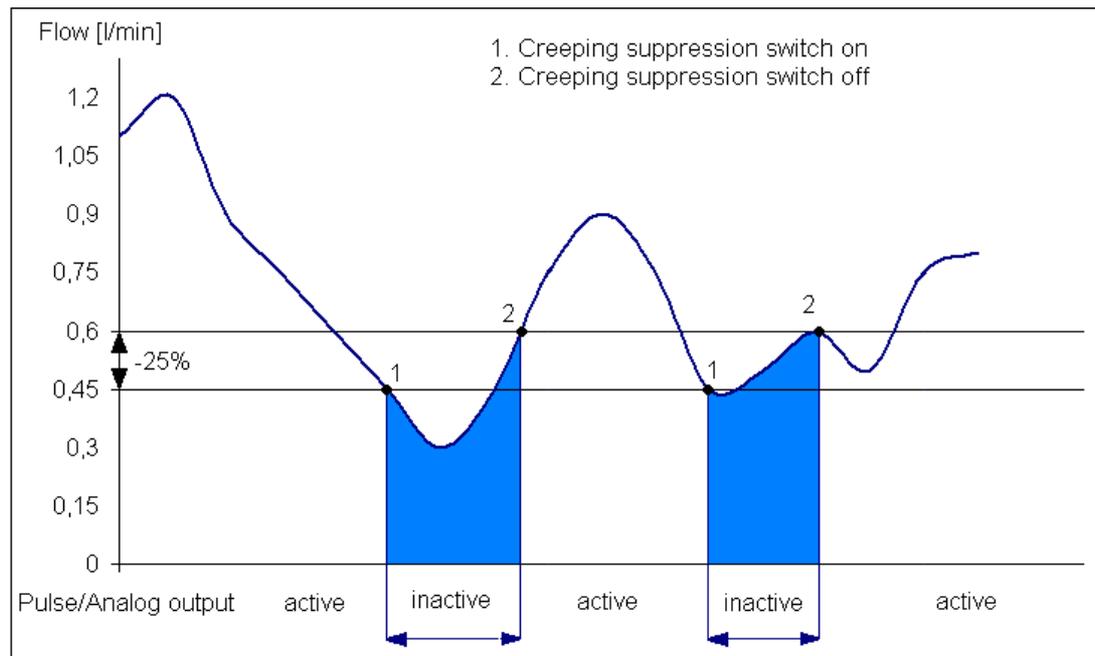
Figure 6: Function of creeping suppression illustrated with 0.6 l/min

Example: Creeping suppression = 0.6 l/min
            If the flow rate is lower than 0.45 l/min the pulse output/analog output becomes inactive. If the flow rate exceeds 0.6 l/min a pulse is output again and added to the totalizer. Similarly, a value is transmitted to the analog output again.

Setting range: 0.0...20 l/min, in steps of 0.006 l/min
Default settings: 0,09 l/min for ⅜"
                      0,3   l/min for ½"
                      0,9   l/min for ¾"
                      1,2   l/min for 1"

Lag Creeping Flow

The activation of the creeping suppression can be delayed. The value is adjustable via menu.
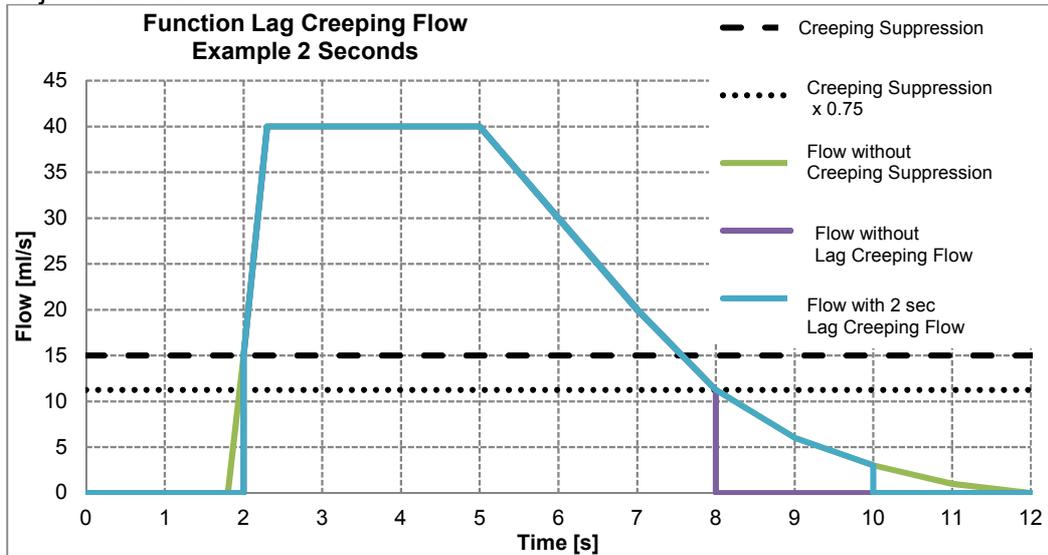

Figure 7: Function Lag Creeping Flow

Setting range: 0...99.9 s in steps of 0.1 s
Default settings: 0.5s

3.2.3.4 Basic Trim

The "Basic Trim" function insures that the flowmeter is conforming to the media specific characteristics. To execute this function, Flowmax 400i runs a self-diagnostic function which optimizes all important parameters. This process lasts approximately 1 minute.

NOTICE!

IMPORTANT!
To make sure the basic trim is correctly done, the flowmeter has to be filled with liquid without a flow.
When there is an error detected while performing the basic trim function, the display shows "Error". After successfully finishing the basic trim function, the display will show "Done".

i

IMPORTANT!

3.2.3.5 Water

In this menu item, the correction values of the media matrix, previously entered with FlowSoft are written back to the water value.
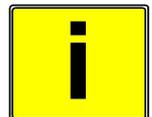
3.2.4 General Adjustment

3.2.4.1 Reset Counter

The volume counter of Flowmax 400i can be reset.
Example of operation see appendix.

IMPORTANT!
Once reset, counter values cannot be restored. After a reset the counter works normally.

IMPORTANT!

3.2.4.2 Hysteresis

The limit values can be provided with a hysteresis. This is to avoid frequent switching of the outputs when the flow moved to a limit around.
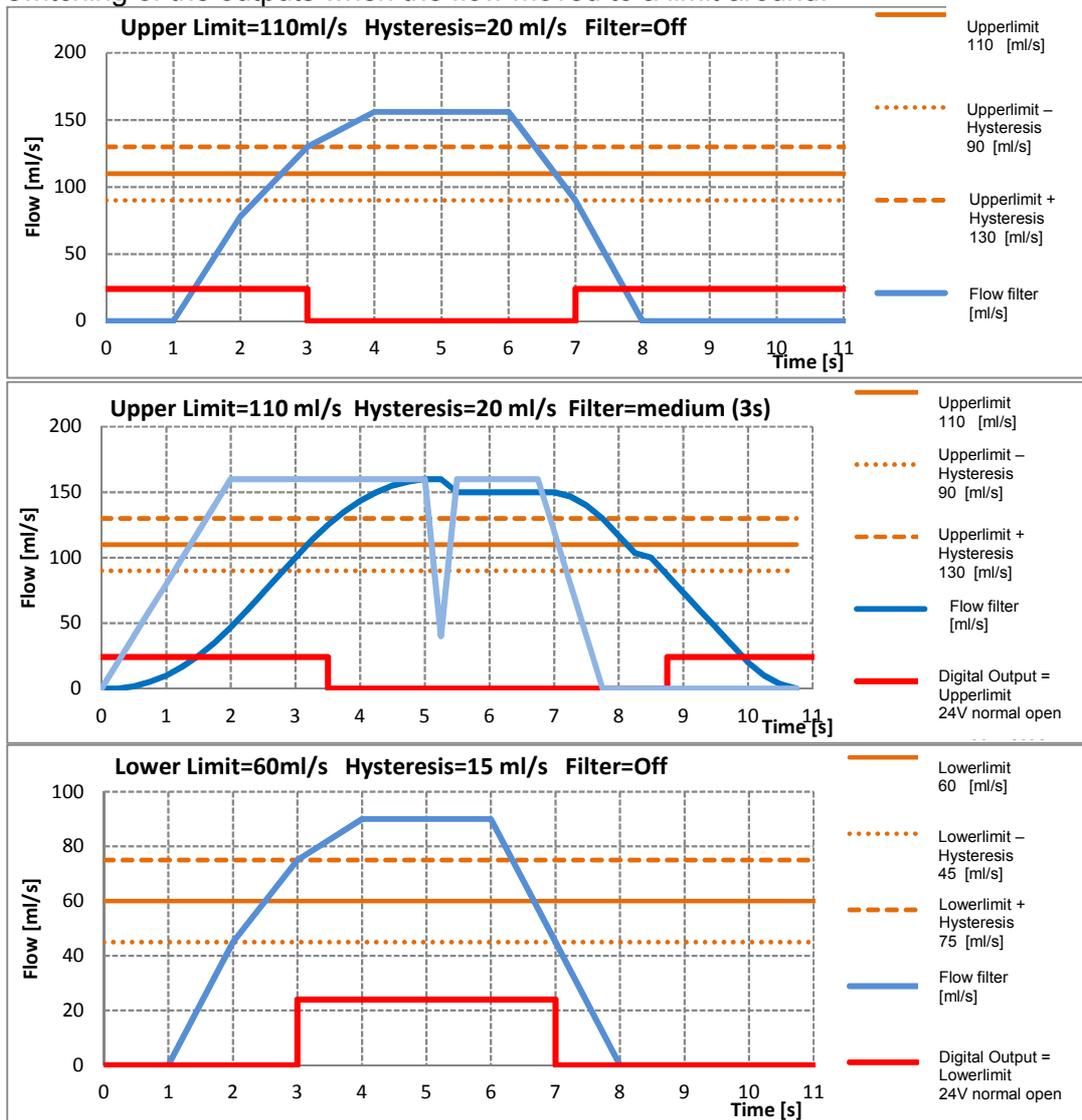
Figure 8: Function Hysteresis at limit

Setting range: 0 to 8000ml/s in steps of 0.01 ml/s.
Default settings: 0

3.2.4.3 Lower Limit

Here, the lower limit for the digital output is set.
Setting range: 0 to 8000ml/s in steps of 0.01 ml/s.
Default settings: 0

3.2.4.4 Upper Limit

Here, the lower limit for the digital output is set.
Setting range: 0 to 8000ml/s in steps of 0.01 ml/s.
Default settings: max. Flow of the flowmeter (depending on the diameter)
                            ⅜" =   100 ml/s
                            ½" =   400 ml/s
                            ¾" = 1000 ml/s
                            1" = 2000 ml/s

3.2.4.5 Pulse value

The pulse value determines the flow volumes for which an output pulse will be emitted.

Choose a configuration which will neither exceed the maximum output frequency of the Flowmax 400i (10kHz) nor the maximum input frequency of the control. If the maximum frequency is exceeded the Flowmax 400i will not output pulses correctly.

Example: 2.0 ml/Pulse

This means: a pulse is emitted every 2.0 ml.
Setting range: 0.1...3000.0 ml/Pulse, in steps of 0.1 ml/Pulse
Default setting: 1.0 ml/Pulse (0,1 ml/pulse at 3/8")

Flow	Pulse value	Frequency	Period	Duration of the pulse	
ml/s	ml/Pulse	Hz	s	s	ms
1	1	1	1	0,5	500
100	1	100	0,01	0,005	5
1000	0,1	10000	0,0001	0,00005	0,05
100	10	10	0,1	0,05	50
0,5	10	0,05	20	1	1000

In the last case every 20 seconds, a pulse of 1 second duration is put out.

3.2.4.6 Total Counter

The Total Counter can be displayed in the menu. The unit is fixed to m³. This counter is unidirectional and can therefore differ from the daily counters.
The Total Counter can not be set to zero!

3.2.4.7 Counter

The daily counters is the one that appears by default in the display. The unit corresponds to each set. The behavior of the daily quantity counter

a) at daily amount in [l]

from [l]	to [l]	resolution display [l]
0,000	14000	0,001
14000	28000	0,002
28000	56000	0,004
56000	112000	0,008
112000	225000	0,016
225000	445000	0,032
445000	1000000	0,064

Once the counter has reached 1.000.000 liters, it automatically begins to count up from zero. Total counter runs without resetting on.

b) at daily amount in [m³]

from [m³]	to [m³]	reolution display [m³]	rounding error -0,05%
0,000	14000	0,001	
14000	28000	0,002	
28000	56000	0,004	
56000	112000	0,008	
112000	225000	0,016	
225000	461204	0,032	

Once the counter has reached 461.204 m³ it automatically begins to count up from zero. Total counter runs without resetting on.

c) at daily amount in [US-Gal]

from [Gal]	to [Gal]	resolution display [Gal]	rounding error +0,12%
0,000	14000	0,001	
14000	28000	0,002	
28000	58000	0,004	
58000	112000	0,008	
112000	225000	0,016	
225000	460000	0,032	
445000	1000000	0,064	

Once the counter has reached 1.000.000 Gal it automatically begins to count up from zero. Total counter runs without resetting on.

3.2.5 Display

3.2.5.1 Units

The Display is able to show actual flow or the volume in different units.

Setting range: ml/s + l , l/h + l, l/min + m³, Gal/min +Gal, l/min + l
Default setting: ml/s + l

Example: ml/s + l
Here, the flow appears in the unit "ml / s" (milliliters per second) and the daily amount in "l" (liters).

Gal are US Gal with 1 Gal = 3,785 l.

3.2.5.2 Filter for Display

The indicated flow can additionally be filtered. This filter is an average over the last 16s. It can be activated and deactivated via the menu.

Setting range: Off, On
Default setting: Off

3.2.5.3 Rotate Display

The display can be rotated in steps of 90°.
Setting range: 0°, 270°, 180°, 90°
Default setting: 0°

3.2.5.4 Flashing

The display flashes in case off an error. This can be switched off
Setting range: On, Off
Default setting: On

3.2.6 Analog Output QA

3.2.6.1 Function

The Analog Output is an active current output with 0-20mA or 4-20mA. It can be adjusted via FlowCon.
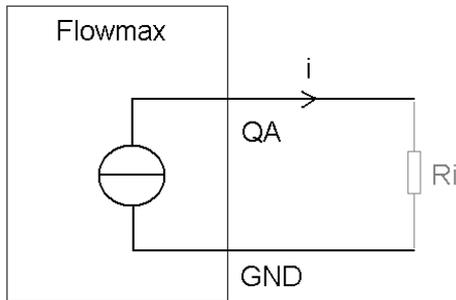

Figure 9: The current output is active

Setting range: 0-20mA, 4-20mA, Off
Default setting: 4-20mA

The current output ranges from 0 to 22.6mA measuring the flow rate or the condition of the flow measurement.

The values here signify for 4-20mA configuration:
  ➢ 20 mA the upper limit of the relevant measurement
  ➢ 4 mA the lower limit of the relevant measurement
  ➢ 3.5 mA empty pipe

Upper and lower limit parameters can be set within the type-specific measurement of the device. The value of the upper limit must be greater than the value of the lower limit, so that the values are stored. By default, the lower limit is 0 mA or 4 mA and the respective end of the measuring range is set to 20 mA.

Setting range: 0-20mA, 4-20mA, off
Default setting: Flow, Temperature

When current output is used, the load must not be higher than 500Ohm. A higher load prevents the device from providing the maximum current of 22.6mA.

i
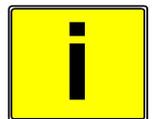
IMPORTANT!

Characteristic curves analog output

- **0 - 20mA**

For the following graphic "min Range" is used for 0% and "max Range" is used for 100%.
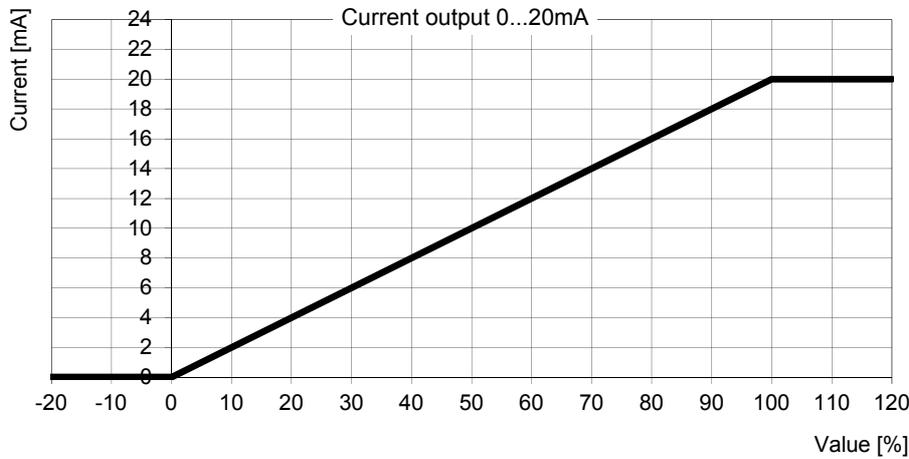
Value	Current [mA]
Smaller 0%	0
0% (min Range)	0
Between 0% and 100%	Linear interpolation from 0 to 20 mA
100% (max Range)	20
Bigger 100%	20

Figure 10: Characteristic curve 0 to 20mA

- **4 - 20mA**

For the following graphic "min Range" is used for 0% and "max Range" is used for 100%.
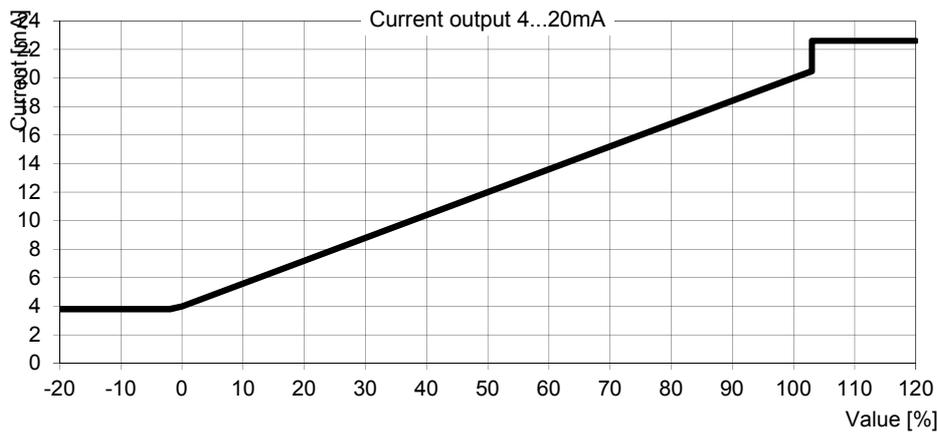
| Value	Current [mA]
Empty pipe	3.5
Smaller -1.2%	3.8
Between -1.2% and 0%	Linear interpolation from 3.8 to 4mA
0% (min Range)	4
Between 0% and 100%	Linear interpolation from 4 to 20mA
100% (max Range)	20
Between 100% and 103%	Linear interpolation from 20 to 20.5mA
Bigger 103%	22.6

Figure 11: Characteristic curve 4 to 20mA

3.2.6.2 Filter

The function "Filter" averages the analog output signal. Possible settings:

Setting range: Weak, Medium, Strong, Off
Default setting: Weak

The analog output signal reacts faster to signal changes when average determination is set to "weak". Whereas the analog output signal reacts slower when average determination is set to "strong".
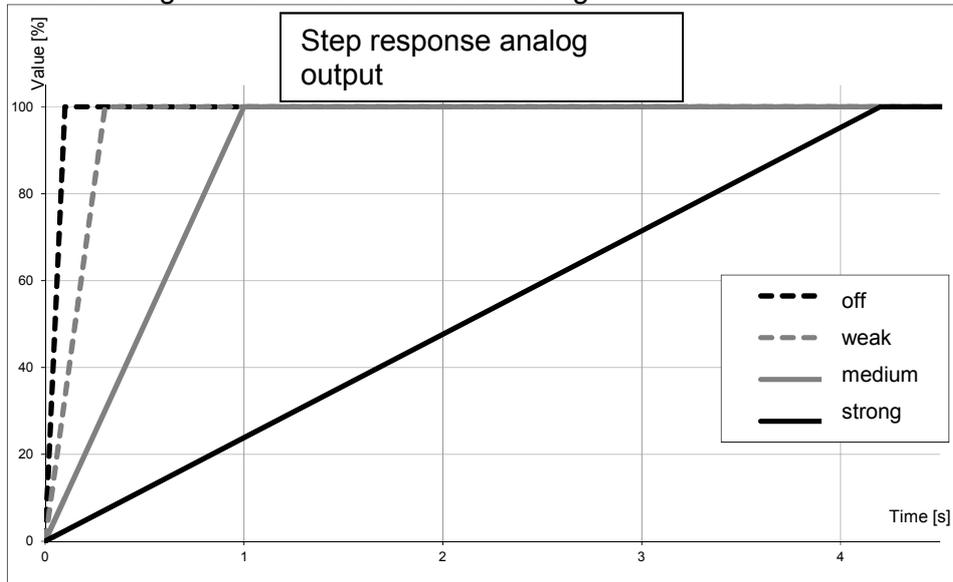
Filter	100%
off	16ms
weak	0,3s
medium	3s
strong	30s

Figure 12: Function Filter of analog output

3.2.6.3 Output Value

In the menu all output values are visible. The optional features are only available when they are ordered. If a not ordered function is selected, the output remains on flow.

Setting range: Flow, PID-Controller, Speed of Sound, Temperature
Default setting: Flow

Flow measurement for the analog output
Via the analog output of the measured flow is output.

PID controller for the analog output (Option)
On the current output, it is possible to realize a flow control. For setting the parameters (target flow, proportional gain, integral gain and differential gain) FlowSoft is necessary.
When this function via the menu is selected and the function PID controller was not ordered, the function flow is output.

Speed of Sound for the analog output (Option)
When this function via the menu is selected and the function Speed of sound was not ordered, the function flow is output.

Temperature measurement for the analog output
Via the analog output the measured temperature is output.

The temperature sensor is not wetted. It is used to calculate the extent of the measuring channel. The sensor is influenced by the ambient temperature. The temperature value will become sluggish, because it measures the plastic - Temperature inside the sensor pocket.

Min Range

Here, the value is set at the 0 or 4 mA to be output.
Setting range: 0 to 8000ml/s (or °C or m/s) in steps of 0.01
Default setting: 0 ml/s

Max Range

Here, the value is set at the 20 mA to be output.
Setting range: 0 to 8000ml/s (or °C or m/s) in steps of 0.01
Default setting: max Flow of the flowmeter (depending on diameter)

⅜":	100 ml/s
½":	400 ml/s
¾":	1000 ml/s
1":	2000 ml/s

3.2.7 Digital Outputs Q1 and Q2
(Q2 only available with 8-pin plug or 10-core cable)

The digital outputs Q1 and Q2 can be used as a pulse output, for signaling the empty pipe message for controlling a dosing valve or to limit monitoring.
All outputs become high resistant if voltage falls below 16V. The digital outputs become high resistant after about 100us for 2s when short circuit or overload. Then it will retrying to actuate the output.

Setting range: Off, Pulse Output, Dosing, Negative Flow,
                        Lower Limit, Upper Limit, Empty Pipe
Default setting Q1:   Pulse Output
Default setting Q2:   Empty Pipe

NPN- or PNP-Logic can be selected.
Setting range: PNP / NPN, normal closed / normal open
Default setting Q1:   PNP normal open
Default setting Q2:   PNP normal open

Empty pipe output

	Empty pipe	Filled, no flow
0V normal closed	High resistance	0V
0V normal open	0V	High resistance
24V normal closed	High resistance	24V
24V normal open	24V	High resistance

Pulse output

	Empty pipe	Filled, no flow	Filled, flow
0V normal closed	0V	0V	High resistance
0V normal open	0V	0V	High resistance
24V normal closed	High resistance	High resistance	24V Pulses
24V normal open	High resistance	High resistance	24V Pulses

Upper limit output

	Below lower limit	Between the limits	Above upper limit
0V normal closed	High resistance	High resistance	0V
0V normal open	0V	0V	High resistance
24V normal closed	High resistance	High resistance	24V
24V normal open	24V	24V	High resistance

Lower limit output

	Below lower limit	Betwenn the limits	Above upper limit
0V normal closed	0V	High resistance	High resistance
0V normal open	High resistance	0V	0V
24V normal closed	24V	High resistance	High resistance
24V normal open	High resistance	24V	24V

Dosing output

	Startup of device	While dosing	Before/after dosing
0V normal closed	High resistance	High resistance	0V
0V normal open	High resistance	0V	High resistance
24V normal closed	High resistance	High resistance	24V
24V normal open	High resistance	24V	High resistance

IMPORTANT!
When using the dosing function the output should not be configured as normal closed!
If the dosing output is configured as normal closed the valve will stay open after the dosing batch.

IMPORTANT!
Inductive load on the digital outputs without an installed diode may cause damage on the Flowmax 400i electronics.

IMPORTANT!

IMPORTANT!

Example 1: Flowmax 400i via npn, external relay
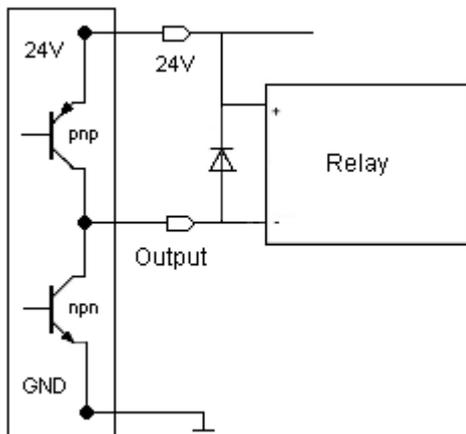
Figure 13: Connecting Digital Output to relay

Example 2: Flowmax 400i via pnp, external counter e.g. PLC
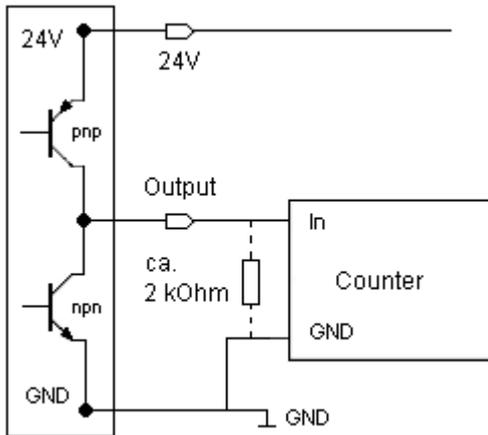
Figure 14: Connecting Digital Output to counter

With high impedance input counters and high speed counting, it may be necessary to include a resistor to have clean edges.

3.2.8 Digital Input I1
(only available with 8-pin plug or 10-core cable)

Flowmax 400i has a digital input that is programmable for the following functions: dosing input, set offset, creeping suppression inactive and reset counter. In order to start a dosing process, 24V DC power is required. The status of the dosing parameters or modifications can be done via FlowCon.

Setting range: Off, Reset Counter, Dosing, Creeping Flow Off, Set Offset
Default setting: Off

The dosing input is locked so that a re-start is not possible during a running dosing process.

Available input functions:

	Set offset	Creeping flow off	Dosing	Reset counter	Off
0V	-	-	-	-	-
24V	Rising edge: 0->24V Set offset	State: deactivating creeping flow	Rising edge: 0->24V start dosing	Rising edge: 0->24V counter is reset	-

� run only in stationary medium

The input function "Set Offset" may only be used when there is no flow through the meter. If an offset trim is done while liquid flow is present an offset drift will cause measurement deviations. If the Flowmax shows an offset drift caused by a wrong offset setting, run the function "Set Offset" or "Basic Trim" again with filled flowmeter and no present flow.

3.2.9 Diagnostic

The sub menu "Diagnostic" shows the software/hardware version and other helpful values for analysis. Actual values and the instrument´s present status are important to analyze the measurement or failure by the manufacturer service.

3.2.9.1 Testing Flow

For commissioning of the process plant, a test flow can be adjusted. In that case the flowmeter will behave as if the test flow is really flowing, even if the flowmeter is empty. To start the simulation "Start" must be selected, "Stop" ends the simulation.
When you restart the flowmeter, the test flow is stopped and the value deleted.

Setting range: 0...3200ml/s in steps of 0.1

3.2.9.2 Pump Mode

This mode can be switched on and off via the menu.
With pulsating flow the flowmeter sets the display and analog filter on strong.
If the pulsating flow stops, the device behaves again as set.

Setting range: On, Off
Default setting: Off

3.3 Overview of default settings

Function	Default settings
Pulse value	1 ml/Pulse
Digital output Q1	Pulse output as PNP (24V) normal open
Digital output Q2 *	Empty pipe output as PNP (24V) normal open
Digital input I1 *	No function assigned

Current output QA	Flow as 4-20mA signal
	20mA -> 6 l/min at ⅜"
	              24 l/min at ½"
	              60 l/min at ¾"
	            120 l/min at 1"

Creeping suppression	0.09 l/min at ⅜" 0.3 l/min at ½" 0.9 l/min at ¾" 1.2 l/min at 1"

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. Is the direction of the arrow on the housing/name plate and the actual flow direction in the pipe congruent?
- Is the measurement pipe completely filled with fluid?
- Check the back pressure in the system.

IMPORTANT!

When everything has been checked, switch on power. After 30 minutes with power running the measuring device reaches the maximum accuracy.

Flowmax® 400i is operational.
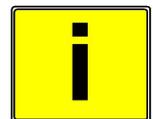
4. Exchange of flowmeter

- **Switch off power before disconnecting the electrical connections!**
- **Wiring installation, disassembly and removal must be performed by qualified persons experienced and knowledgeable about electrical work.**
- **Serious injury or death from electric shock may occur if wiring, installation, disassembly or remove of wires is performed while electrical power is energized**

WARNING!

- Please note that after replacing the flowmeter
    a) Specific programming of the previous flowmeter should be noted and programmed to the new flowmeter
    b) when using the dosing function, set a quantity

If the device requires a configuration change, the display and programming unit FlowCon 200i may be required (see section 6. Accessories).

Repair, hazardous substances

Before sending the flowmeter Flowmax 400i for repair, the following precautions must be taken:

- **Clean all process chemicals from the device. Fully rinse the flow path. Please pay close attention to the process fittings. All media must be removed before returning. This is particularly important, if the medium to be measured is health hazardous.**

WARNING!

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.

Costs due to inadequate cleaning of the instrument for possible disposal or injury (burns, etc.) will be charged to the sender of the flowmeter into account.

- **With the flowmeter send a detailed report describing the failure, the application and the physical-chemical properties of the medium parameters. (e.g. a decontamination declaration).**

WARNING!

In order to be able to process your repair order quickly and smoothly it is important that you provide a technical contact person including phone and fax number as well as e-mail address.

5. Technical specifications

5.1 Dimensions and weight
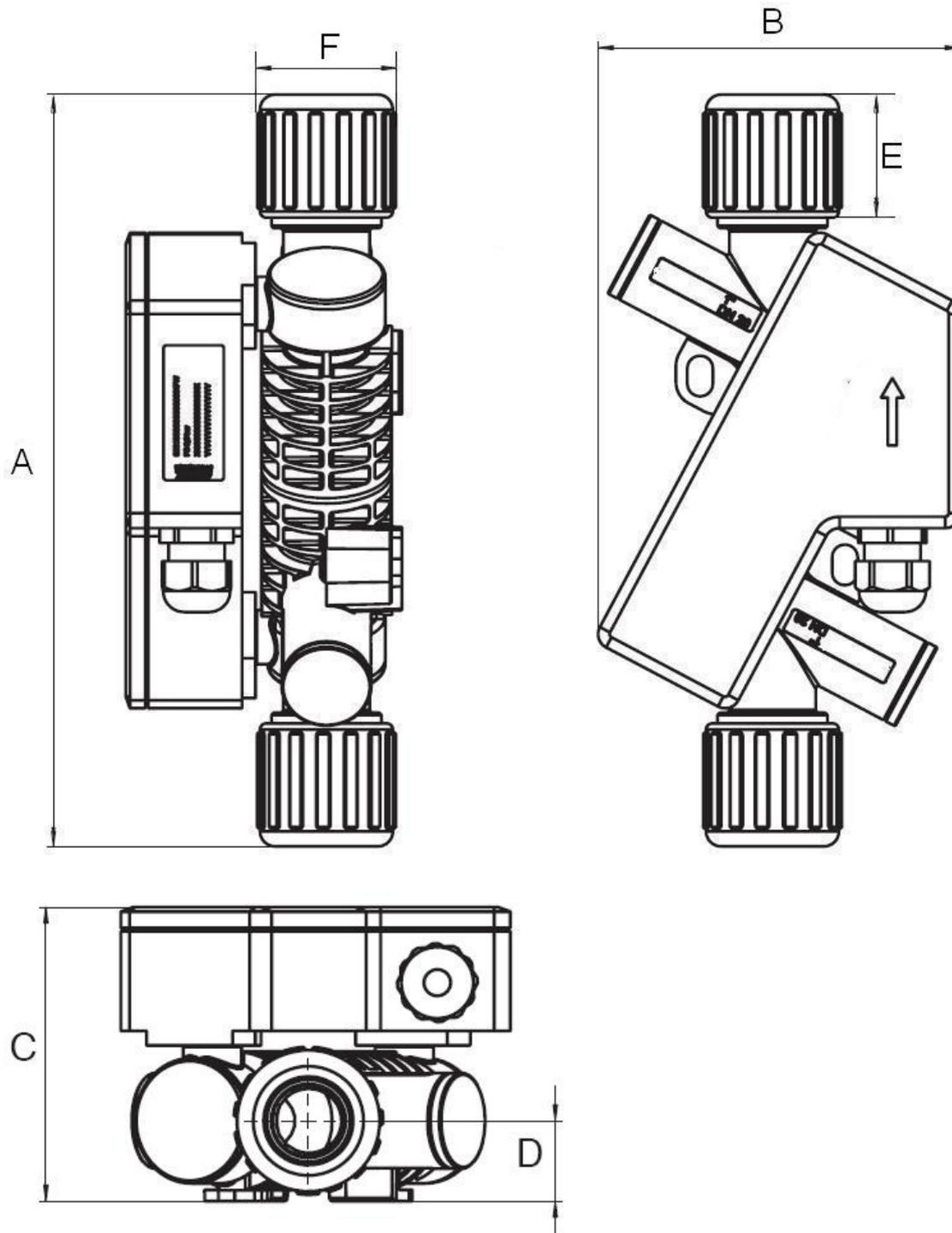
Nominal diameter	Length A [mm]	Width B [mm]	Height C [mm]	Height axis D [mm]	Width nut [mm]	Height nut [mm]	Weight [kg]
3/8"	218,0	120,0	79,0	16	24	28	1,1
1/2"	219,5	120,0	79,0	16	27	31,5	1,1
3/4"	227,0	120,0	82,0	19	35	33	1,1
1"	251,0	120,0	91,5	25	46	41,5	1,3

5.2 Technical specifications

Housing

Nominal diameters	3/8", 1/2", 3/4", 1"
Connection	Flare
Medium temperature	0...+60°C
Protection class	IP 65
Pressure nominal	PN 6
Material	all wetted parts made of PFA Flare nut: PVDF or PFA Electronics-housing: PP

Electronics

Power supply	18...30VDC, 3,6W
Connection	5-pin plug, 8-pin, 10-core teflon cable (5m)
Ambienttemperature	-20....+60°C
Current output QA	0/4...20 mA, Lower- and upper limit adjustable, Ground connected to supply ground Error Signal according to NAMUR NE43
Digital output Q1/2	via transistor, npn- and pnp-logic, max. 30V/100mA output voltage according to DIN 19240: ≤5V means LOW ≥12V means HIGH Short cut resistant Frequency 0....10kHz
Data interface	Data interface for parameterize
Measuement error	± 2% of reading ± 3 mm/s Option: ± 1% of reading ± 3 mm/s Reference conditions (VDE/VDI 2642)
Measuring ranges*	3/8": 0.09…6 l/min, 0.03…6 l/min LowFlow 1/2": 0.3…24 l/min 3/4": 0.9…60 l/min 1" : 1.2…120 l/min
Repeatability:	0.5%

The measuring system Flowmax 400i meets the general EMC immunity requirements according to CE, EN 61000-6-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6. It is in conformity with the requirements of the EC directives and has the CE label.

*The flow range limits correspond to a flow speed of ~3m/s with Flowmax 400i of size 3/8", ~6m/s with Flowmax 400i of sizes ½", ¾" und 1"

Possible error text Flowmax 400i

Display text	Description	Behavior
Empty Pipe	When "Empty Pipe" is detected, no flow measurement.	Display flashing + text
Low Voltage	When power supply is less than 16V the outputs are inactiv.	Display flashing + text
Short Circuit	When over load of the digital outputs is detected (>100mA), outputs are inactive.	only text
Lower Limit	When the flow is less than an adjustable limit and the output is configured for limit control. At the same time the configured output is switched.	only text
Upper limit	When the flow is more than an adjustable limit and the output is configured for limit control. At the same time the configured output is switched.	only text
Sonic Speed	Actual sonic speed out of specified value. Run basic trim!	only text
Overflow	Message appears if the measuring range is exceeded. This may occur when starting up or when air bubbles. The message is 30 seconds visible even when the flow is within the allowable range. The measurement works but then immediately	only text, message is displayed 30 sec

6. Accessories

FlowCon 200i

External display and programming unit for use in combination with ultrasonic flow measuring devices Flowmax. FlowCon 200i can also be installed as separate display for Flowmax.

Ordercode   908873 (FlowCon 200i for 5-pin Flowmax)
Ordercode   908891 (FlowCon 200i for 8-pin Flowmax)

Flowmax-Kupplung

For power supply and connection to external control systems via M12x1 threaded. Note the location of the connector when inserted into the socket!

Ordercode   507321 (Socket 5-pins)
Ordercode   800845 (Socket 8-pins)

7. Shipment

- Flowmax 400i

Appendix

Examples of operation:

Enter Password

Key	Display picture
Set	Password
4 x ∧	40000
Set	X0000
∧	X1000
Set	XX000
4 x ∧	XX400
Set	XXX00
∧	XXX10
Set	XXXX0
4 x ∧	XXXX4
Set	

Reset Counter

Set	Dosing Media **General Adjustment** Display Analog Output QA
Set	**General Adustment** Reset Counter
Set	**General Adjustment** **Reset Counter** Start?
Set	**General Adjustment** **Reset Counter** Done

Set Offset

Use this function only when Flowmax 400i is completely filled with liquid, and there is no flow. If the offset is set while flow is present or when the pipe is empty it will cause an offset drift what results in a faulty measurement.

Set	Dosing Media **General Adjustment** Display Analog Output QA
∧	Language Dosing **Media** General Adjustment Display
Set	**Media** Set Offset
Set	**Media** **Set Offset** Start ?
Set	**Media** **Set Offset** Start ? Done

1-point correction

With the 1-point correction, the meter is calibrated to an operating point. Given an arbitrary amount of volume is filled into a container and measured with a weight. Attention: subtract the weight of the container.
With inclusion of the density of the medium, the volume (volume = mass / density) is obtained. This has to be compared with the meter display.
Shows the meter for instance 2% more than determined by the scale a value of -02.0% must entered for the 1-point correction.

Set	Dosing Media General Adjustment Display Analog Output QA
∧	Language Dosing Media General Adjustment Display
Set	Media Set Offset
V	Media 1-Point-Correction
Set	Media 1-Point-Correction -00.0%

Setting the sign
Setting the value

Set	Media 1-Point-Correction Done

To enable the correction back to delivery, a correction of 00.0% is to be entered.

Display rotate 90°

Set	Dosing Media General Adjustment Display Analog Output QA
V	Media General Adjustment Display Analog Output QA Digital Output Q1
Set	Display Units
2 x V	Display Rotate Display
Set	Display Rotate Display 0°
3 x V	Display Rotate Display 90°
Set	Display Rotate Display 90° Done

To return your display to its delivery, choose Rotate Display 0°.

MIB GmbH
Messtechnik und Industrieberatung
Bahnhofstr. 35
D-79206 Breisach
Tel. 0049 / (0)7667 / 20 777 90
Fax 0049 / (0)7667 / 20 777 99
E-Mail: info@mib-gmbh.com
Internet: www.flowmax.de