Flowmax® 44i

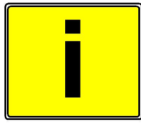# Ultrasonic flow metering / dosing device

Operating manual
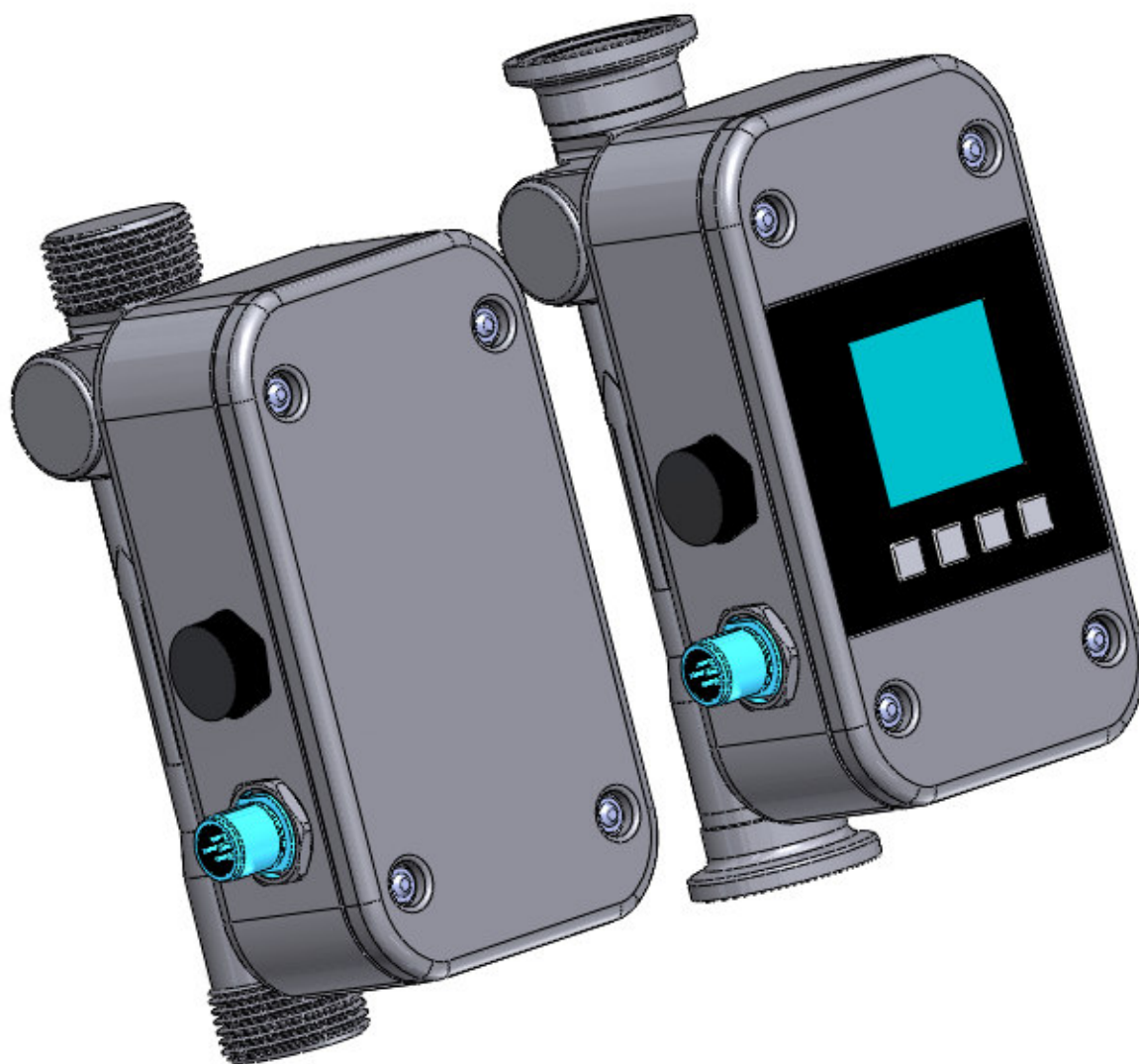
General safety instructions

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 44i 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 44i may only be used for measuring the flow of pure, homogeneous liquids.
- The Flowmax 44i is not intended for use in medical applications.
- The volume flowmeter Flowmax 44i 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 flow meter 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.

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1. Planning information

1.1 Areas of application

The flow measurement device Flowmax 44i is designed to measure dynamic flow in pipes and tubes. This flowmeter is suitable for liquids only. The Flowmax 44i is used in

- Chemicals supply for controlling, logistics, monitoring
- Cooling systems, 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

Flowmax 44i 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 pre-set and adjustable amounts
- 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 ultrasonic-sensors located opposite from each other alternatively transmitting and receiving ultrasonic signals. If there is no liquid flow both sensors receive the transmitted ultrasonic signals in the same phase, i.e. without phase difference. If liquid is 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.

$$\varphi_- = \frac{wL}{c - v}$$

$$\varphi_+ = \frac{wL}{c + v}$$

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

L: length of measuring pipe
K: factor
D: diameter of measuring pipe
v: flow velocity
c: sound velocity of the fluid
φ_+: phase with the flow
φ_-: phase against the flow
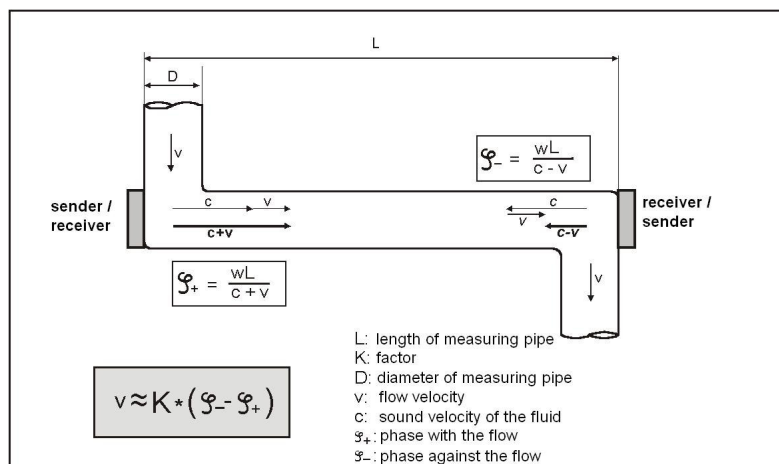
Figure 1: Presentation of the principle of ultrasonic flow measuring

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 44i 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 44i meets the safety requirements concerning the Protective Extra Low Voltage
directive according to EN 50178, SELV, PELV.

2. Assembly and installation

2.1 Installation instructions

The housing of Flowmax 44i is labeled with an arrow symbolizing the direction of the flow measurement. The flow meter has to be installed in a way so that the flow-through is in the same direction as the arrow symbol.

TOP -> outlet

DOWN -> inlet
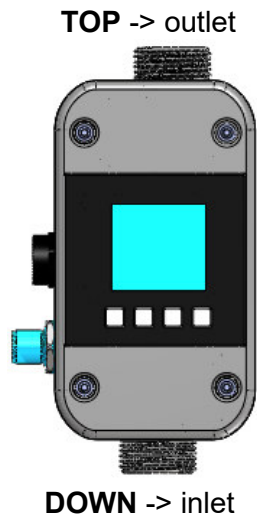
Figure 2: Installation position of Flowmax 44i

For fastest possible bubble detection it is important to keep the pipe distance from tank to Flowmax 44i 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 44i as close as possible to the dosing valve, as soft pipes change 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 44i to avoid cavitations. Insure all mechanical connections are tight. Absolutely do not use Teflon tape for sealing!

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

When using pumps, Flowmax 44i must be installed in flow direction on the pressure side, on order to ensure sufficient pressure.

WARNING!
Do not exceed the maximum pressure allowance for of the Flowmax 44i (see section 5.2 Technical specifications). Exceed the maximum pressure or the maximum torque can lead to destruction or rupture of the Flowmax 44i.

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

Nominal diameter	DN10 3/8"	DN15 1/2"	DN20 3/4"	DN25 1"
Inflow distance	10cm 3,94"	30cm 11,81"	40cm 15,75"	40cm 15,75"
Outflow distance	0cm 0"	5cm 1,97"	10cm 3,94"	20cm 7,87"

Always make sure that the maximum torque of the nuts for the hydraulic connections is not exceeded. Use the delivered seals and the maximum torque depending on the diameter:

Nominal diameter	DN10 3/8"	DN15 1/2"	DN20 3/4"	DN25 1"
Inch thread, torque:	2Nm 1.5 ft-lbs	3Nm 2.2 ft-lbs	4Nm 3.0 ft-lbs	6Nm 4.4 ft-lbs

i
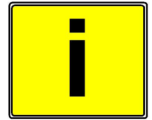
IMPORTANT!

2.2 Assembly of the flowmeter

The flowmeter is mounted into a pipe system by using the mechanical connection. Flowmax 44i should be mounted vertically into the pipe for the best measuring performance. Do not install the flowmeter after a dosing valve where the flowmeter can run empty. Placing the flowmeter after a dosing valve and allowing it to run empty will cause a measuring deviation at the next measurement. To avoid bubbles in the liquid, Flowmax 44i should be installed on the pressure side of the pump.

NOTICE!
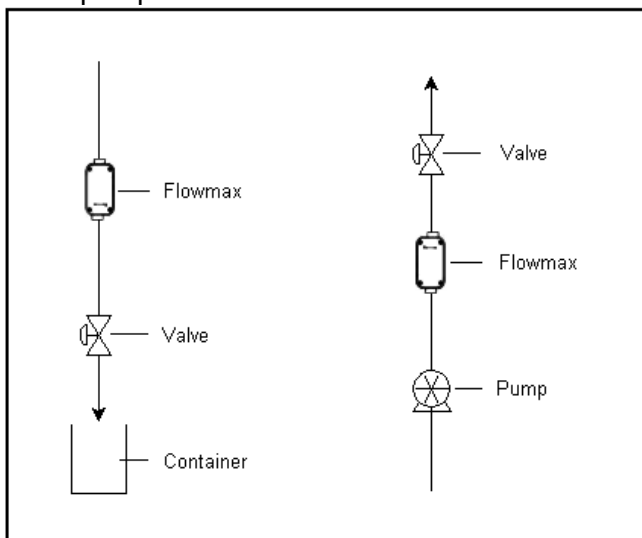
Figure 3: Mounting examples for Flowmax 44i

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 achieved if bubbles do not pass through Flowmax 44i.
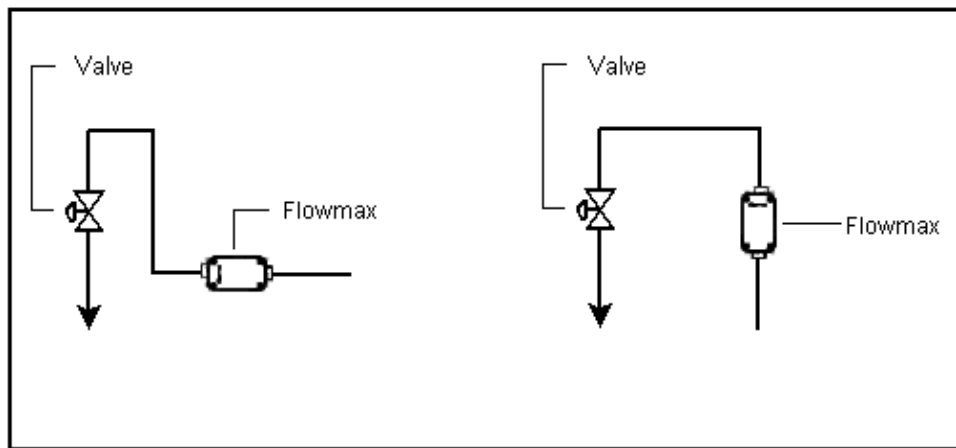
Figure 4: Mounting possibilities

For applications with a "clean design" for which it is necessary to completely drain the pipe system, we recommend mounting the flowmeter in the vertical position. Residual liquid may remain inside the device if flowmeter is mounted horizontally.

Vibrations or mechanical forces may decrease measuring accuracy.
Mounting the flowmeter using two clamps will reduce vibrations or movements. Use the clamps as seen in the figure below at the inlet and outlet connections of Flowmax 44i.
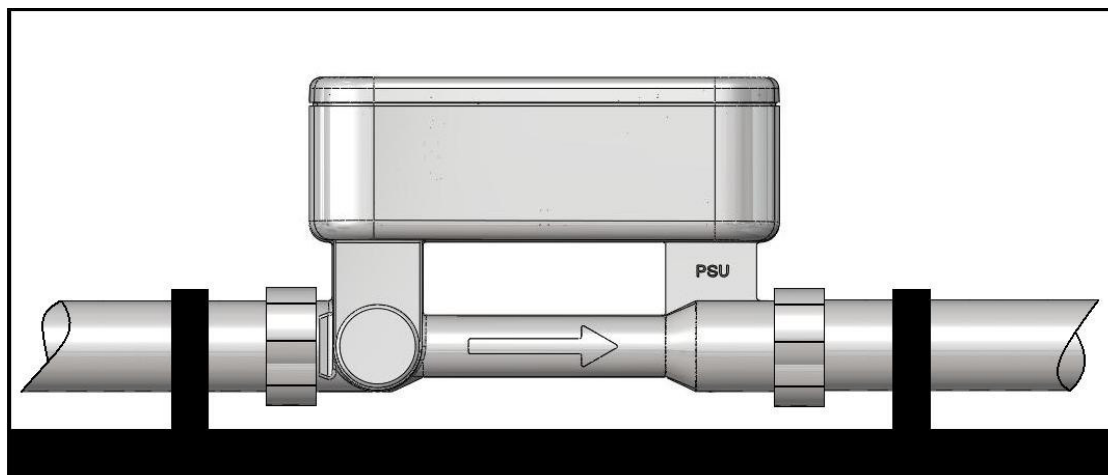
Figure 5: Fixing Flowmax 44i

IMPORTANT!
Flowmax 44i must be installed without mechanical tensions on the existing pipe system. The flowmeter may be damaged if there is tension on the existing pipe system. Set the axial channel offset to 5mm when mounting the flowmeter (For details see section 5.1 Dimensions and weight).

WARNING!
Non-compliance of the installation instructions may result in tearing of the housing, liquid may leak out.

Applications with hot liquids:

If Flowmax 44i is used in applications with liquid temperatures hotter than 60°C and mounted horizontally then the flow meter should be mounted with the electronic housing on the underside to reduce exposure to rising heat. If Flowmax 44i is mounted vertically, heat damage is not an issue.

IMPORTANT!
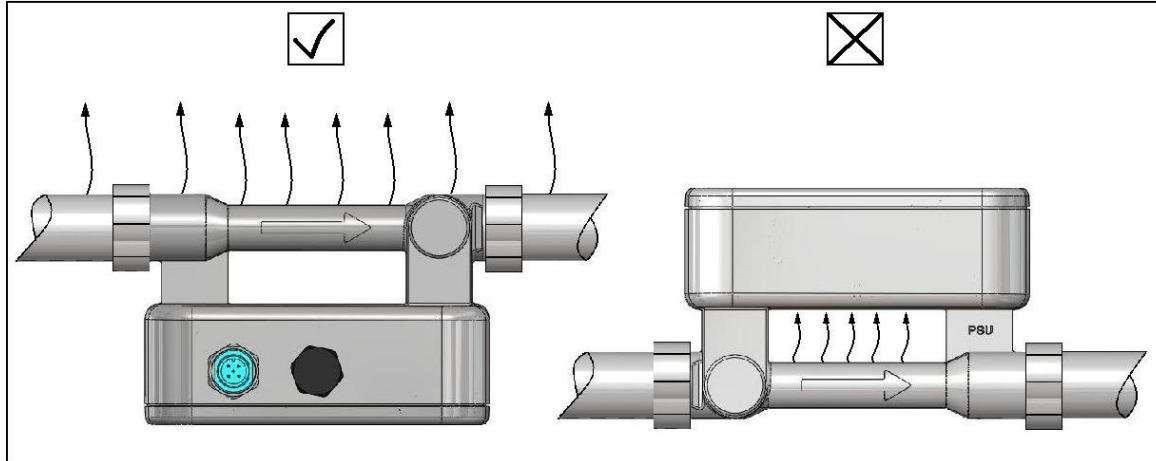
Figure 6: Flowmax 44i with hot liquids

WARNING!
Installation with metal screw connections in combination with high medium temperatures
Note that the metal tube, or the metal union nut and the plastic housing of the measuring device have a different expansion behavior! The resultant force acting on the meter forces can cause the plastic housing of Flowmax 44i warps and the process connection breaks off.
To ensure the mechanical stress-free mounting of Flowmax 44i, is on site to ensure by appropriate measures that no forces can act on the plastic housing, for example, a flexible metal hose or a strain curve.

WARNING!

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 44i is not assembled and installed.

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

Figure 7: Pin code: Connection plug   /   socket for 5-pin version

8-pin plug assignment with factory-assigned outputs
The inputs and outputs can be reprogramed for specific applications.

5-pin plug with 1-wire communication:

Pin	Function	Description
1	24 VDC	Voltage supply: 18 ... 30 VDC
2	Pulse / Frequency 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
		        36l/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 36l/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 / Frequency 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 8: Pin code: Connection plug   /   socket for 8-pin version

8-pin plug assignment with factory-assigned outputs
The inputs and outputs can be reprogrammed 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 / Frequency 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 / Frequency 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 36l/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 9: Pin code: Connection plug   /   socket for 8-pin version

8-pin plug assignment with factory-assigned outputs
The inputs and outputs can be reprogrammed 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 / Frequency 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 36l/min => 20mA (depending on diameter Empty pipe Alert => 3.5mA
6	Communication	RS 485 A
7	Communication	RS 485 B
8	Shielding	EMC safety

ATTENTION:
Only operate the flowmeter Flowmax44i within the operating limits stipulated on the product label and the operating manual / data sheet. Use of the Flowmax 44i outside these conditions will lead to overloads which cause permanent damage.

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IMPORTANT!

3. Commissioning

NOTE:
After starting up the electronics, the unit is ready for use, but it reaches its optimum operating state after 30 minutes. It makes sense to carry out a basic trim or zero point adjustment only after this warm-up phase.

NOTICE!

NOTE:
If Flowmax 44i is used for a fluid other than water the "basic trim" has to be carried out during commissioning. Therefore the device has absolutely be filled with medium.
The basic trim can be done on the device display (alternatively FlowCon 200i). During the adjustment, the medium may not flow, as this can lead to a measurement deviation. If there is a possible flow, it will be stored as "zero point".

NOTICE!

3.1 Operation

If Flowmax 44i is used as a volume flowmeter for water or water-like liquids it will not require on-site calibration. Parameters for water are calibrated at the factory. The Flowmax 44i may also be ordered with customized settings, but customized settings must be requested when Flowmax 44i is ordered.

NOTE: If necessary, e.g. if viscosity and/or speed of sound deviate significantly from water, the pre-set parameters can be adjusted via the display or FlowCon 200i.

NOTICE!

The following parameters may be changed to settings suitable for the individual conditions: for 5-pin version
- Digital output Q1, function and behavior
- Analog output QA, function and behavior
- Flow range, for which shall apply 4 ... 20 mA resp. 0 … 20mA
- Pulse value
- Creeping suppression
- Optimization of measurement curve with up to 8 interpolation values (medium matrix)

The following parameters may be changed to settings suitable for the individual conditions: for 8-pin version
- Digital output Q1, function and behavior
- Digital output Q2, function and behavior
- Digital input I1, function and behavior
- Analog output QA, function and behavior
- Flow range, for which shall apply 4 ... 20 mA resp. 0 … 20mA
- Pulse value
- Creeping suppression
- Optimization of measurement curve with up to 8 interpolation values (medium matrix)

3.1.1 Display and user menu

Flowmax 44i is equipped with a display to visualize actual measurement values and to change parameters of the flowmeter. Menu navigation and parameter changes are controlled by the four keys on the keypad.
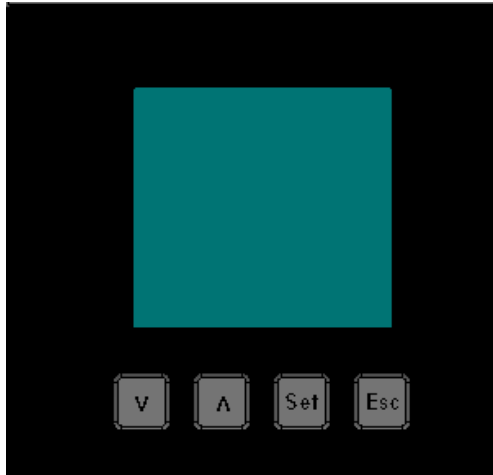

Figure 10: Operating with the key pad

Press the "Set" key to display the main menu. Different menu options can be selected by using the two arrow keys.
To enter e.g. analog limits "Analog 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. As soon as the operator tries to change values the user will be prompted to enter a password. Password protection is used to ensure changes to values or configurations are done by authorized personnel. The default password for Flowmax 44i is **41414**. The user level will remain active for 30 minutes after the last press on any button. 200 seconds after the last key press, the device skips the menu and returns to the display mode, which does not apply to the menu items diagnostic and dosing. Here, the unit remains in the submenu until the operator exits the submenu again with the ESC key.
Operating examples see appendix.

NOTE:
Always the actual set-activated menu parameters are shown in the display. The activated parameter is displayed inverted.

NOTICE!

NOTE:
In the menu all the possible functions of the instrument are visible

NOTICE!

The functions of Digital Output Q2 and Digital Input I1 are only available on the Flowmax version with 8-pin plug.

In the menu Analog Output there are displayed the output value functions PID - Controller and Speed of Sound. They are provided only with functionality, if they were considered in the order (optional).
Flowmax 44i without display has the same features as the display version, but you can change parameters only via the display or programming unit FlowCon 200i.

		Reset Counter
		Empty Pipe delay
		Hysteresis
		Lower Limit
General Settings		Upper Limit
		Pulse Value
		Total Counter
		Counter

	Units	ml/s + L
		L/h + L
		L/min + m³
		Gal/min + Gal
		L/min + L
	Display Filter	Off
		On
Display		0°
		270°
		180°
	Rotate Display	90°
		On
	Flashing	Off

	Function	4-20mA
		Off
		0-20mA
		Soft
	Filter	Off
		Strong
		Medium
Analog Output QA		Flow
	Output Value	PID-Controler
		Speed Of Sound
		Temperatur
	min Range	Input
	max Range	Input

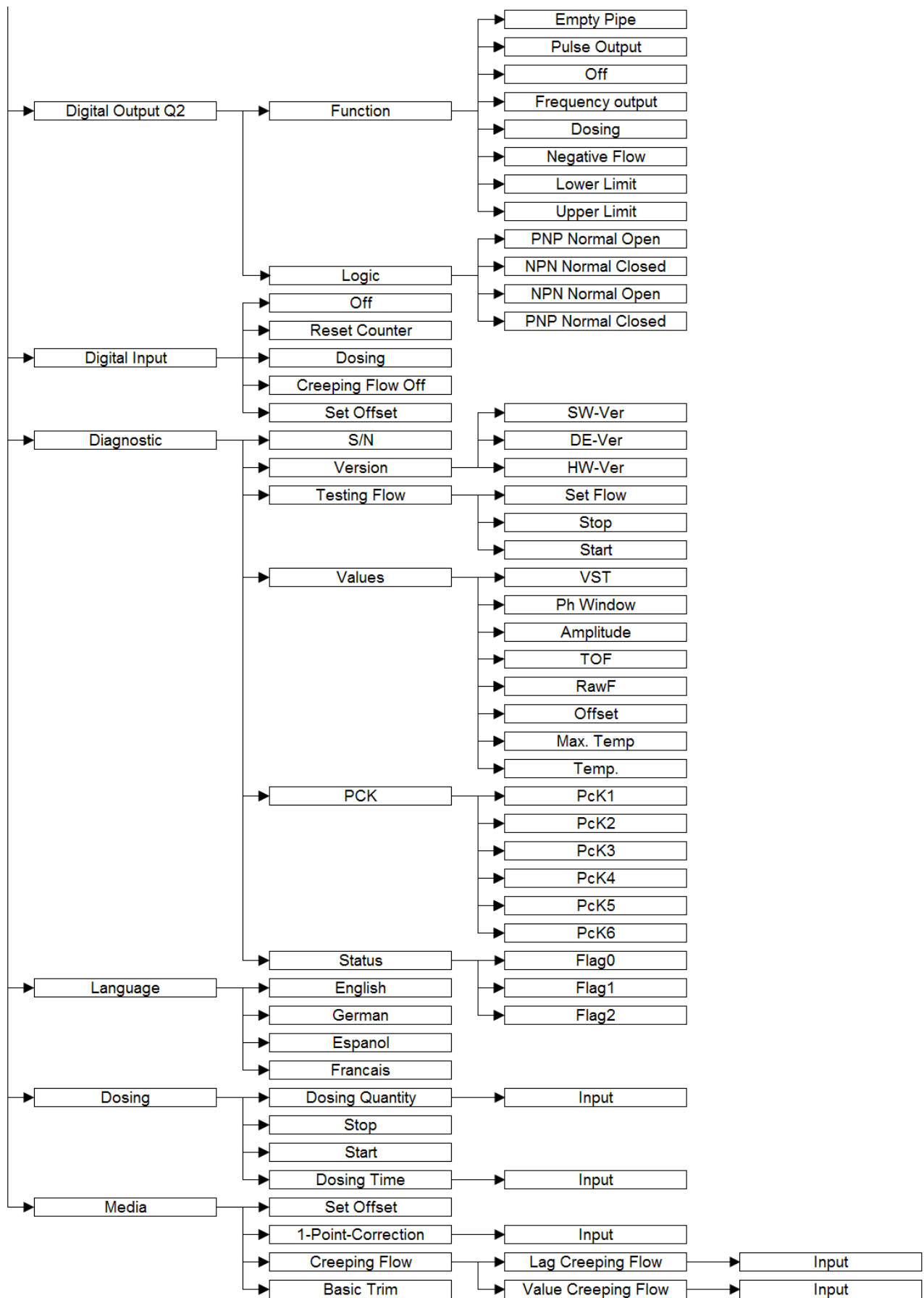|		
		Pulse Output
		Off
		Frequency output
	Function	Dosing
Digital Output Q1		Negative Flow
		Lower Limit
		Upper Limit
		Empty Pipe
		PNP Normal Open
	Logic	NPN Normal Closed
		NPN Normal Open
		PNP Normal Closed

Start screen

Figure 11: Menu structure Flowmax 44i

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 44i 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. After the set time has passed, the output switches regardless of the measured quantity. 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 1 sec,
                                      having an accuracy of +0/-1 sec
Default setting "Dosing Time":   3 Seconds

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 intended as a safety function and should be selected insignificantly longer than the actual time required for dosing. This ensures that possible malfunctions/leakages in the structure/system are detected at an early stage. An exact dosage purely on the dosing time is not useful.

IMPORTANT!
If Dosing Time = 0 the time switch-off is inactive.
To be able to activate dosing, a digital output must be parameterised for dosing. Dosing can be started both via the menu and via the digital input.

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.

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 44i is completely filled with liquid, and there is no flow, as this condition is the new "zero" value.
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.

IMPORTANT!
In contrast to the basic trim, the Set Offset is not stored in the device. When the unit is restarted, the original, last stored value is active

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IMPORTANT!

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 0% to - 25%.
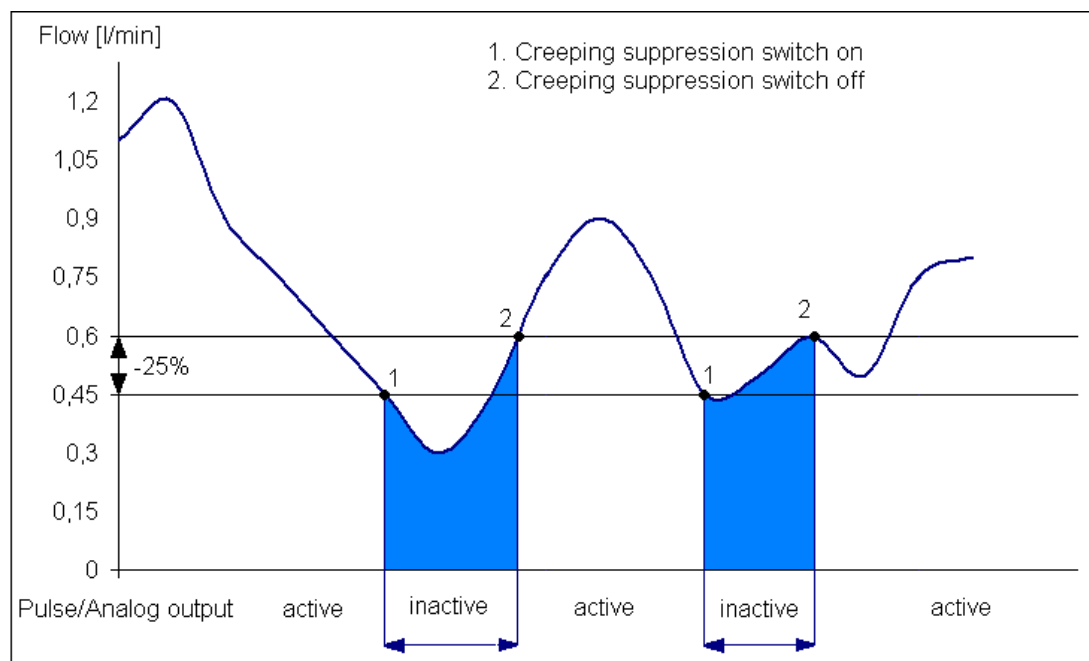

Figure 12: Function of creeping suppression illustrated with 0.6 l/min

Example: Creeping suppression = 0.6 l/min
            If the flow rate is lower than 0.45 l/min the creeping suppression
            becomes active. 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 ... 19.2 l/min, in 0.0006 l/min steps
Default settings: DN10:   0.3 l/min
                        DN15:   0.9 l/min
                        DN20:   3.5 l/min
                        DN25   5.0 l/min

Lag Creeping Flow

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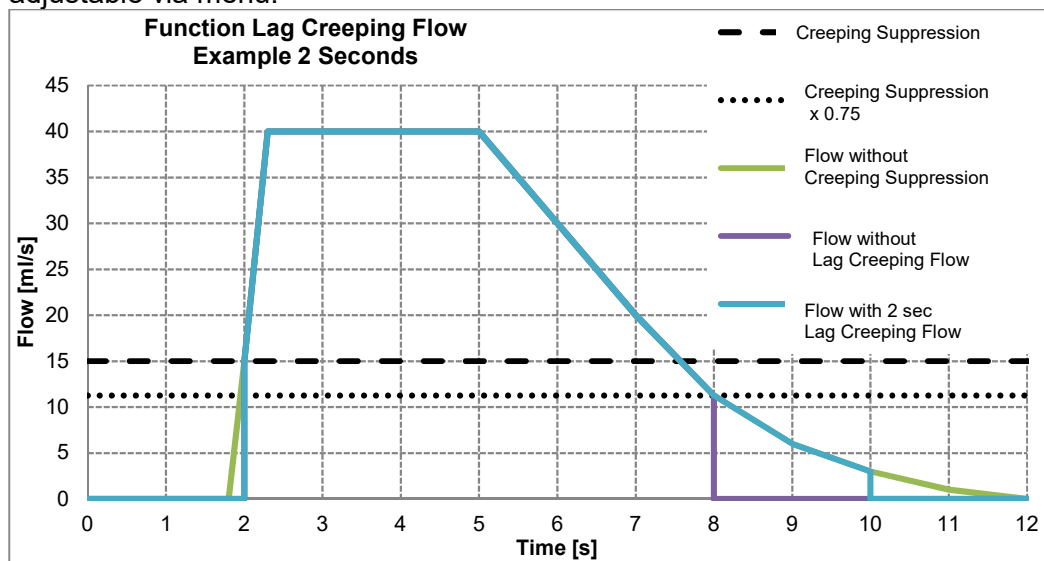adjustable via menu.

Figure 13: Function Lag Creeping Flow

Setting range: 0 ... 99.0 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 44i 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
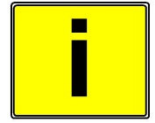display will show "Done".

IMPORTANT!

3.2.4 General Settings

3.2.4.1 Reset Counter

The volume counter of Flowmax 44i 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 Empty pipe delay
Small air bubbles or particles, which are carried with the liquid, disturb the sound
transmission in the measuring channel.
During the set time, but for max. 3 sec, the last undisturbed flow value will be
output, afterwards the flowmeter behaves as if there is no flow and only after the
preset delay time the flowmeter will go into alarm.

Setting range: 0.0 … 3000.0 s
Default settings: 0.5 s for all DN

3.2.4.3 Hysteresis
The limit values can be provided with a hysteresis. This is to avoid frequent
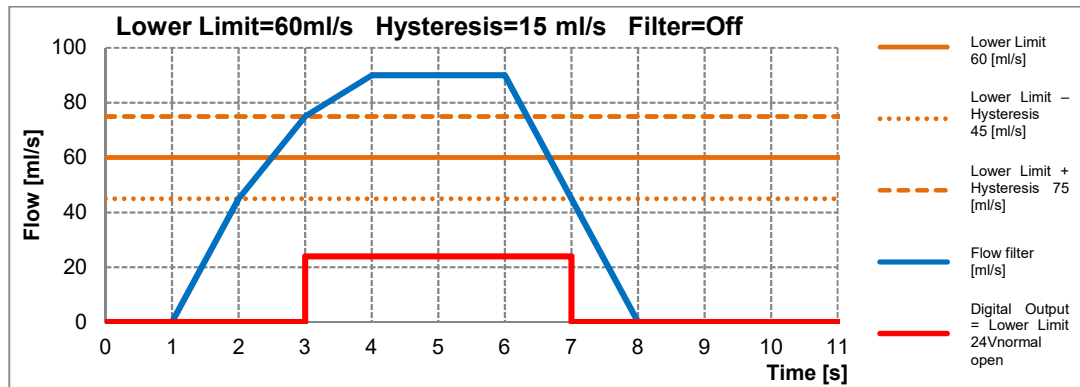switching of the outputs when the flow moved to a limit around.
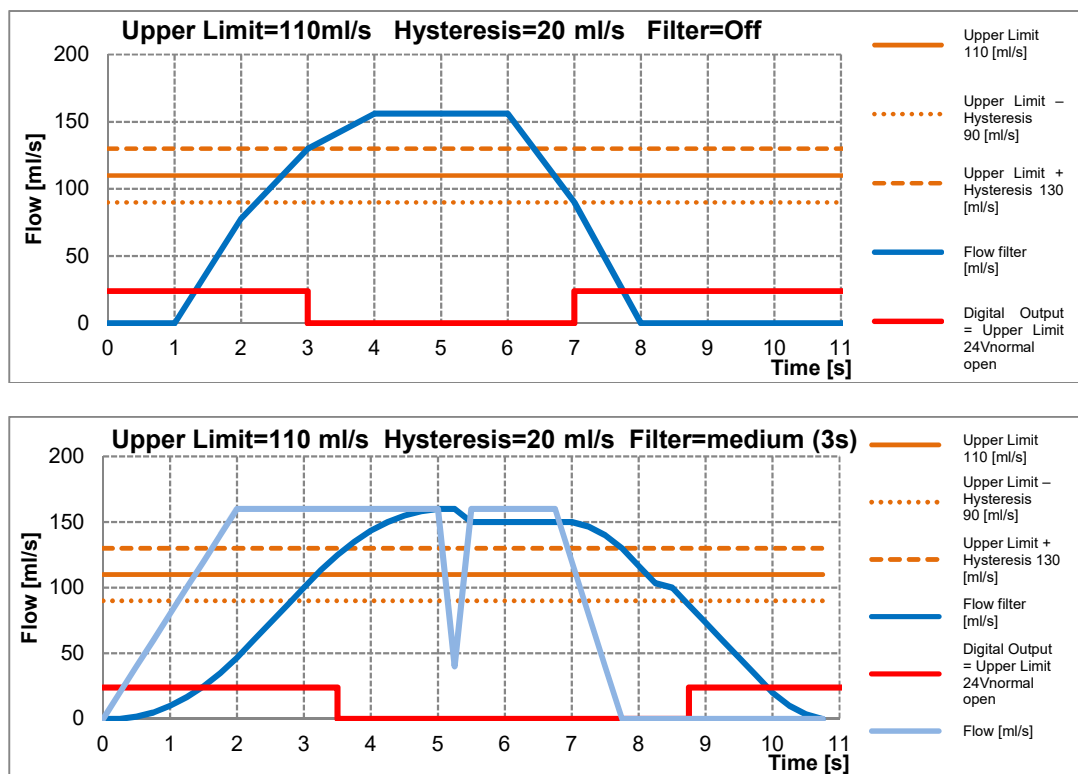
Figure 14: Function Hysteresis at limit

Setting range: 0 … 8000 ml/s in steps of 0.01 ml/s.
Default settings: 0 for all DN

3.2.4.4 Lower Limit
Here, the lower limit for the digital output is set.
Setting range: 0 … 20000 ml/s in steps of 0.01 ml/s.
Default settings: 0 for all DN

3.2.4.5 Upper Limit

Here, the upper limit for the digital output is set.
Setting range: 0 … 20000 ml/s in steps of 0.01 ml/s.
Default settings: max. Flow of the flowmeter (depending on the diameter)
                        DN10 =   350 ml/s
                        DN15 =   600 ml/s
                        DN20 = 1000 ml/s
                        DN25 = 4000 ml/s

3.2.4.6 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 44i (10kHz) nor the maximum input frequency of the control. If the maximum frequency is exceeded the Flowmax 44i 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

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.

3.2.4.7 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!

3.2.4.8 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

Flowmax 44i 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.
When activating the alarm flashing, the backlight first flashes after 150s. The time is extended by the set empty pipe delay time, when the empty pipe delay is active.
Setting range: On, Off
Default setting: On

The alarm flashing can be muted for 150 seconds by pressing the ESC key.

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 the display menu or FlowCon 200i.
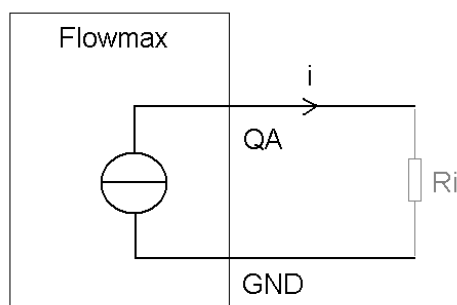

Figure 15: The current output is active

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 max range of the relevant measurement
➢ 4 mA the min range of the relevant measurement
➢ 3.5 mA empty pipe

Max range and min range parameters can be set within the type-specific measurement of the device. The value of the max range must be greater than the value of the min range, so that the values are stored. By default, the min range 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

IMPORTANT!
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.
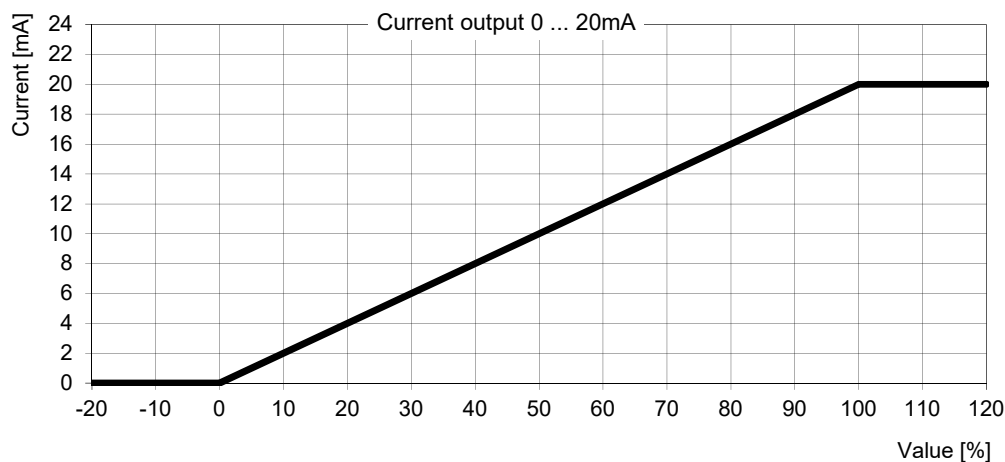
i

IMPORTANT!

Characteristic curves analog output

- **0 … 20mA**

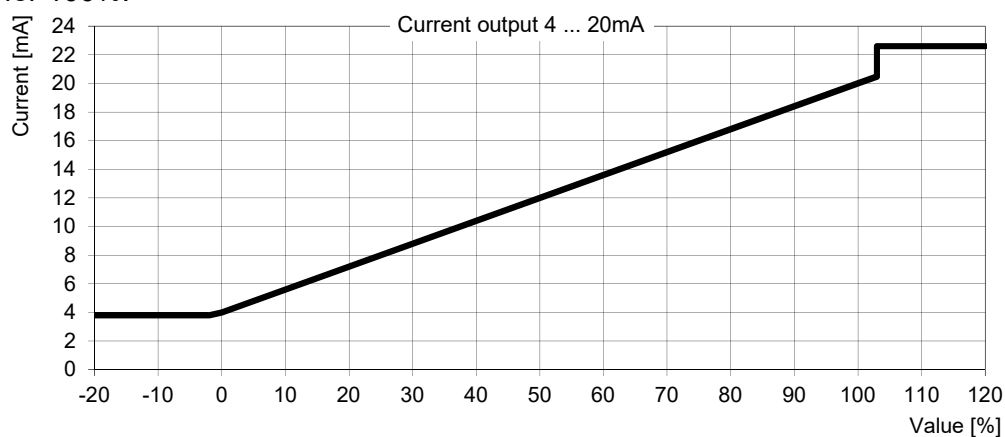For the following graphic "min Range" is used for 0% and "max Range" is used for 100%.

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

Figure 16: Characteristic curve 0 … 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 ... 4mA
0% (min Range)	4
Between 0% and 100%	Linear interpolation from 4 ... 20mA
100% (max Range)	20
Between 100% and 103%	Linear interpolation from 20 ... 20.5mA
Bigger 103%	22.6

Figure 17: Characteristic curve 4 … 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".
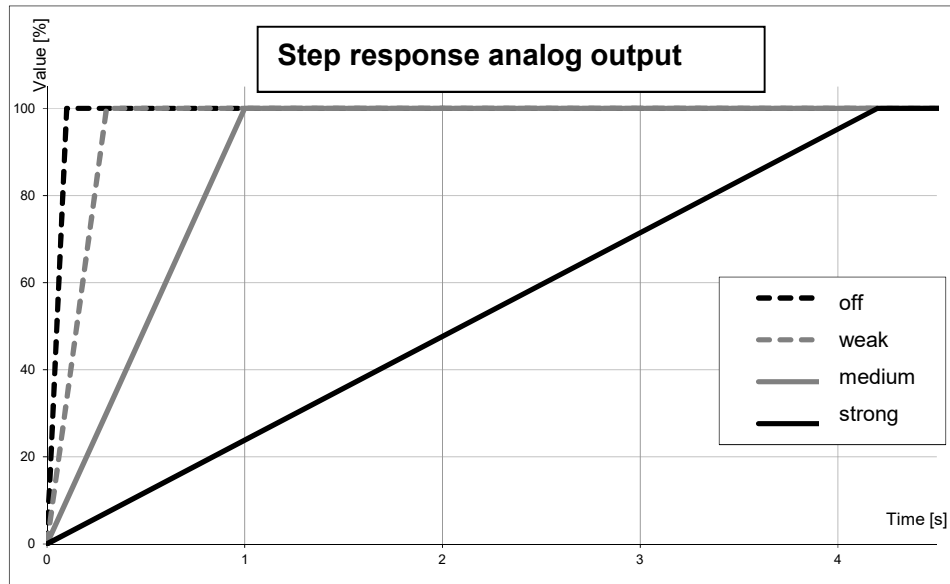
Filter	100%
off	16ms
weak	0,3s
medium	3s
strong	30s

Figure 18: 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 will be set on flow.

NOTICE!

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 (see Section 3.1.1 Fig 11. Menu structure Flowmax 44i with analog output QA - Output value) is selected and the function PID controller was not ordered, the output will be set on "flow".

NOTICE!

Speed of Sound for the analog output (Option)
When this function via the menu (see Section 3.1.1 Fig 11. Menu structure Flowmax 44i with analog output QA - Output value) is selected and the function Speed of sound was not ordered, the output will be set on "flow".

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.
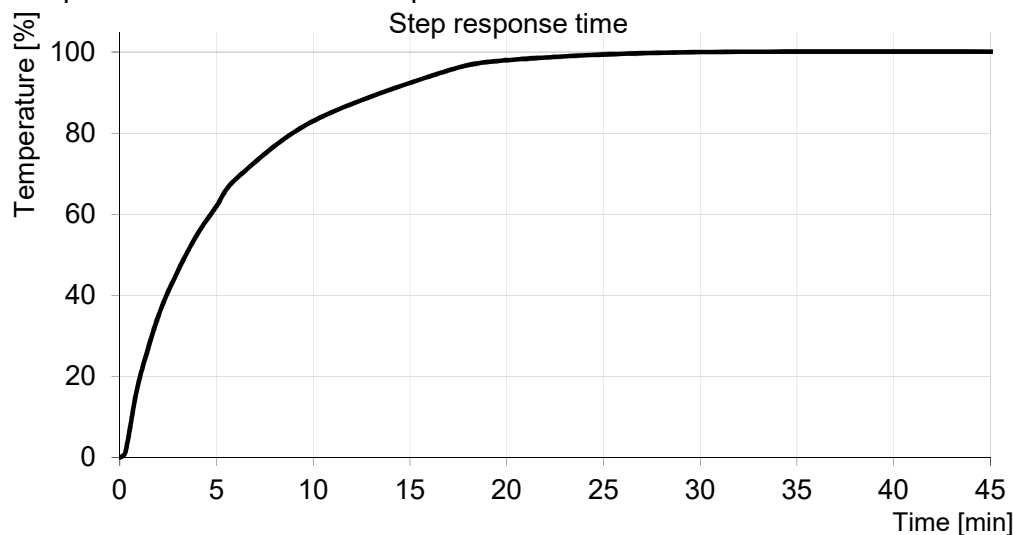

Figure 19: Step response time of the temperature measurement

Ambient temperature influence
Example of influences of the room temperature to the measured value.

Medium Temp. °C	x	0.7	+	ambient Temp. °C	x	0.3	=	measured Temp. °C
40	x	0.7	+	20	x	0.3	=	34
40	x	0.7	+	30	x	0.3	=	37
40	x	0.7	+	40	x	0.3	=	40
60	x	0.7	+	20	x	0.3	=	48

Min Range
Here, the value is set at the 0 or 4 mA to be output.
Setting range: 0.00 to 20000.00 ml/s in steps of 0.01 ml/s
Default setting: 0 ml/s

Max Range
Here, the value is set at the 20 mA to be output.
Setting range: 0.01 to 20000.00 ml/s in steps of 0.01ml/s
Default setting: max Flow of the flowmeter (depending on diameter)
                                    DN10:   350 ml/s
                                    DN15:   600 ml/s
                                    DN20:   1000 ml/s
                                    DN25:   4000 ml/s

NOTE!
The value "Range min" cannot be set bigger than or equal to the "Range max".

3.2.7 Digital Outputs Q1 and Q2 (Q2 only available with 8-pin plug)

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.

If "Pulse Output" is selected at one of the two digital outputs, the setting "Frequency output" cannot be selected at the other digital output and vice versa.

All outputs become high resistant if voltage falls below 16V. The digital outputs become high resistant after about 100 µs for 2 s when short circuit or overload. Then it will retrying to actuate the output.

Setting range: Off, Pulse Output, Frequency 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 / Frequency 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 44i electronics.

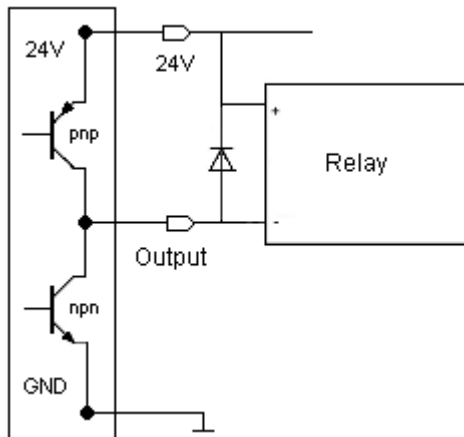Example 1: Flowmax 44i via npn, external relay

Figure 20: Connecting Digital Output to relay
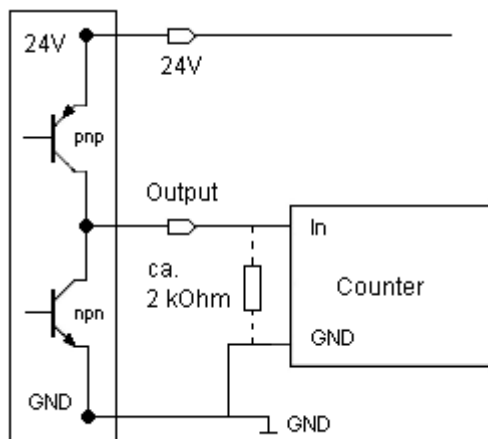
Example 2: Flowmax 44i via pnp, external counter e.g. PLC

Figure 21: 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)

Flowmax 44i 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 user display or FlowCon 200i.

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.

NOTE!
Before contacting MIB, please note the values "Fab. no.", "Versions", "Values".

NOTICE!

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 ... 3200 ml/s in steps of 0.1 ml/s

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 -> 21 l/min at DN10 36 l/min at DN15 60 l/min at DN20 240 l/min at DN25
Creeping suppression	0.3 l/min at DN10 0.9 l/min at DN15 3.5 l/min at DN20 5.0 l/min at DN25

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.

i
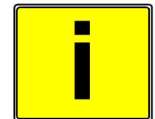
IMPORTANT!

When everything has been checked, switch on power. After 30 minutes with power running the measuring device reaches the maximum accuracy.
The meter reaches the optimum operating state after 30 minutes. See 3.Commissioning.

Flowmax 44i 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 44i 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
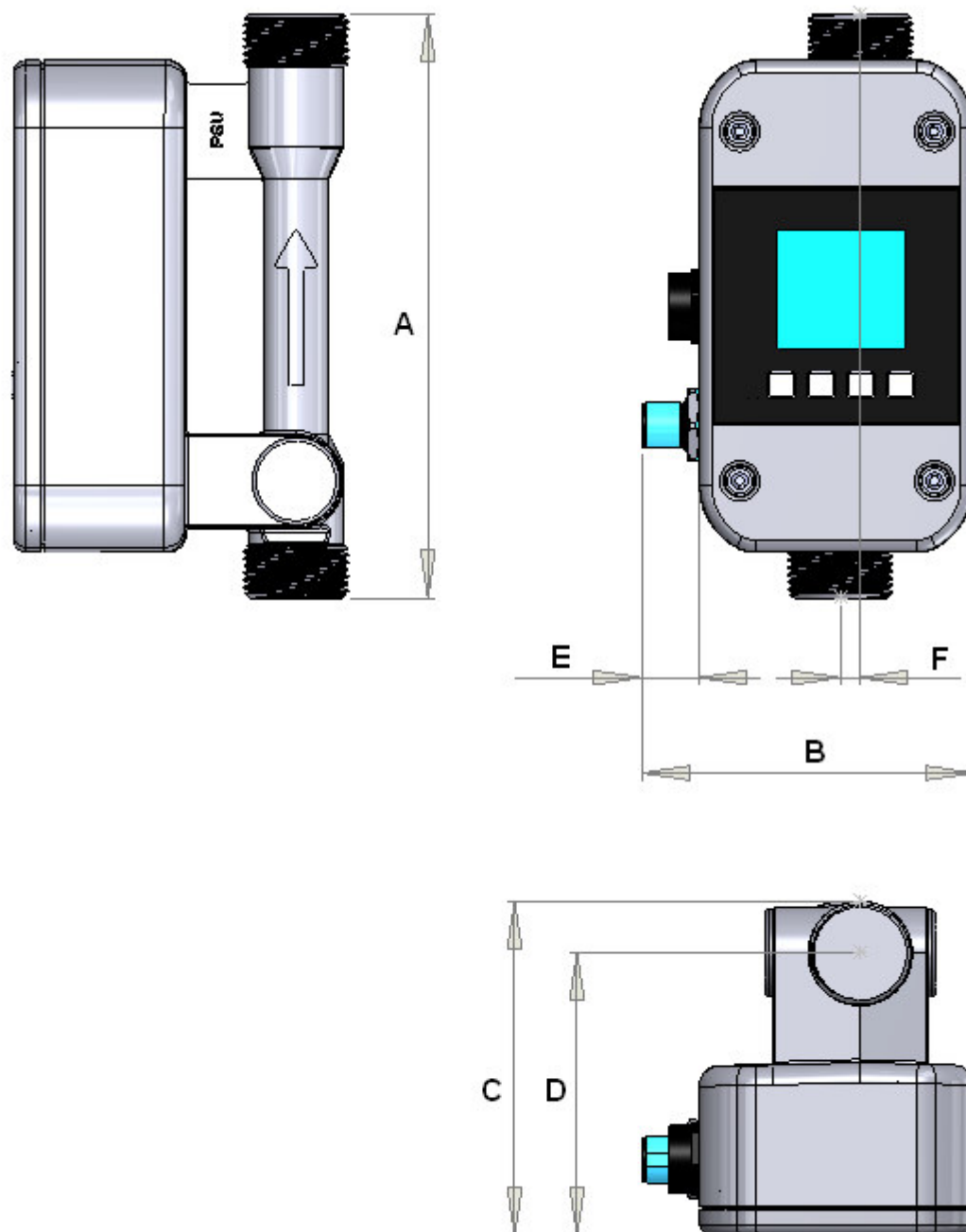
Nominal diameter	Connection	Length A [mm]	Width B [mm]	Height C [mm]	Height axis D [mm]	Plug E [mm]	Channel offset F [mm]	Weight [g]
DN10 ⅜"	½ G,NPT	147.0	84.0	83.0	70.5	15.0	5.0	332
DN15 ½"	¾ G,NPT	147.0	84.0	84.5	71.1	15.0	5.0	344
DN20 ¾"	1 G,NPT	160.0	84.0	94.2	77.6	15.0	5.0	414
DN25 1"	1 ¼ G,NPT	168.0	84.0	98.5	77.6	15.0	5.0	454
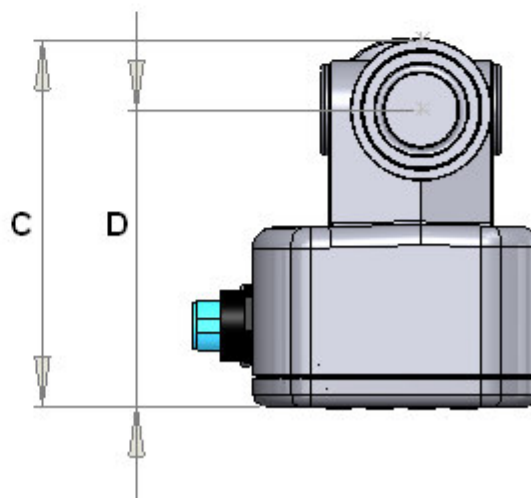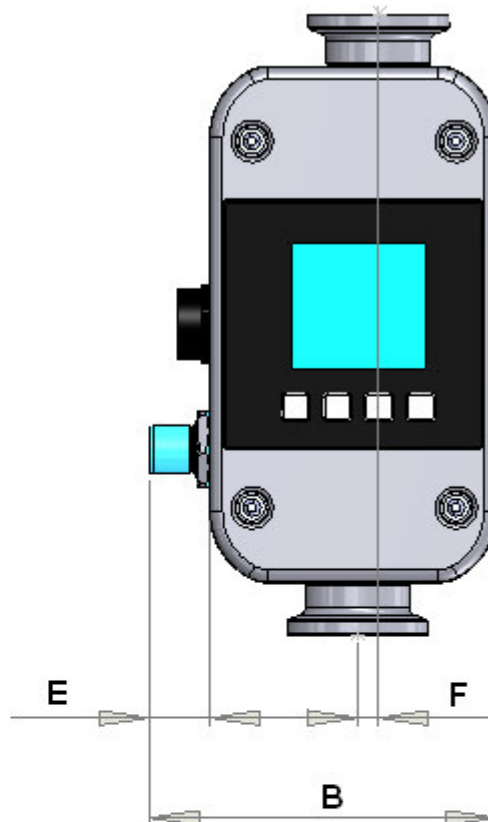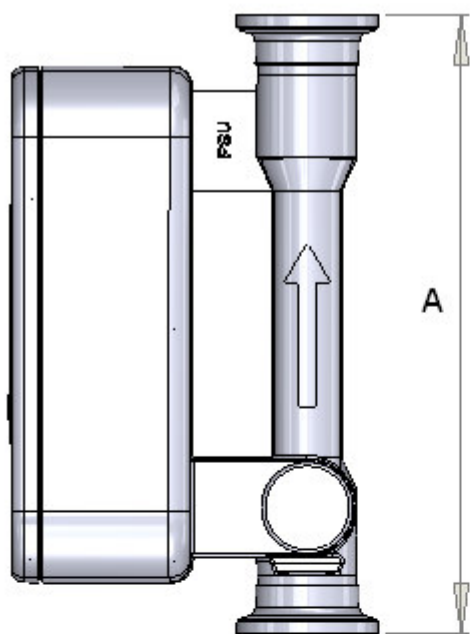
Nominal diameter	Connection	Length A [mm]	Width B [mm]	Height C [mm]	Height axis D [mm]	Plug E [mm]	Channel offset F [mm]	Weight [g]
DN10 ⅜"	11864-Clamp	149.0	84.0	83.0	70.5	15.0	5.0	339
DN15 ½"	11864-Clamp	149.0	84.0	84.5	71.1	15.0	5.0	347
DN20 ¾"	11864-Clamp	162.0	84.0	94.2	77.6	15.0	5.0	429
DN25 1"	11864-Clamp	170.0	84.0	98.5	77.6	150	5.0	469

5.2 Technical specifications

Housing

Nominal diameters	DN10, DN15, DN20, DN25
Connection inner thread	inch thread G, inch threat NPT, clamp connection DIN11864-3 BKS-Clamp Form A
Medium temperature	0 ... +80°C (Optionally up to 95°C, respectively up to 140°C)
Protection class	IP 67
Nominal pressure	PN16 for DN10 and DN15 PN10 for DN20 and DN25
Material	all wetted parts made of PPSU (Polyphenylsulfone) Electronics housing made of PPSU (Polyphenylsulfone)

Electronics

Power supply	18 ... 30 VDC
Power input	at 24 VDC = 3.6 W
Connection	Plug 5 pins, option plug 8 pins
Ambient temperature	0 ... +60°C
Storage temperature	0 ... +70°C
Current output QA	0/4 ... 20 mA, Lower- and upper limit adjustable, Ground connected to supply ground Error Signal according to NAMUR NE43 with 4 … 20 mA
Digital output Q1/2	via transistor npn- and pnp-logic, max. 100 mA output voltage according to DIN 19240: ≤5 V means LOW ≥12 V means HIGH Short cut resistant Frequency 0 ... 10 kHz
Data interface	Data interface for parameterize
Measuring deviation	± 2% o.r. ± 0.15% f.s. (o.r. = of reading, f.s. = full scale), option ± 1% o.r. ± 0.15% f.s. Reference conditions (VDE/VDI 2642)
Measuring range	DN10: 0.3 … 21 l/min DN15: 0.9 … 36 l/min DN20: 3.5 … 60 l/min DN25: 5.0 … 240 l/min
Repeatability:	0.5%

The measuring system Flowmax 44i 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.

Pressure drop

FM44i DN10 pressure drop curve with water at 22°C

100kPa = 1bar

FM44i DN15 pressure drop curve with water at 22°C

100kPa = 1bar

FM44i DN20 pressure drop curve with water at 22°C

100kPa = 1bar

FM44i DN25 pressure drop curve with water at 22°C

100kPa = 1bar
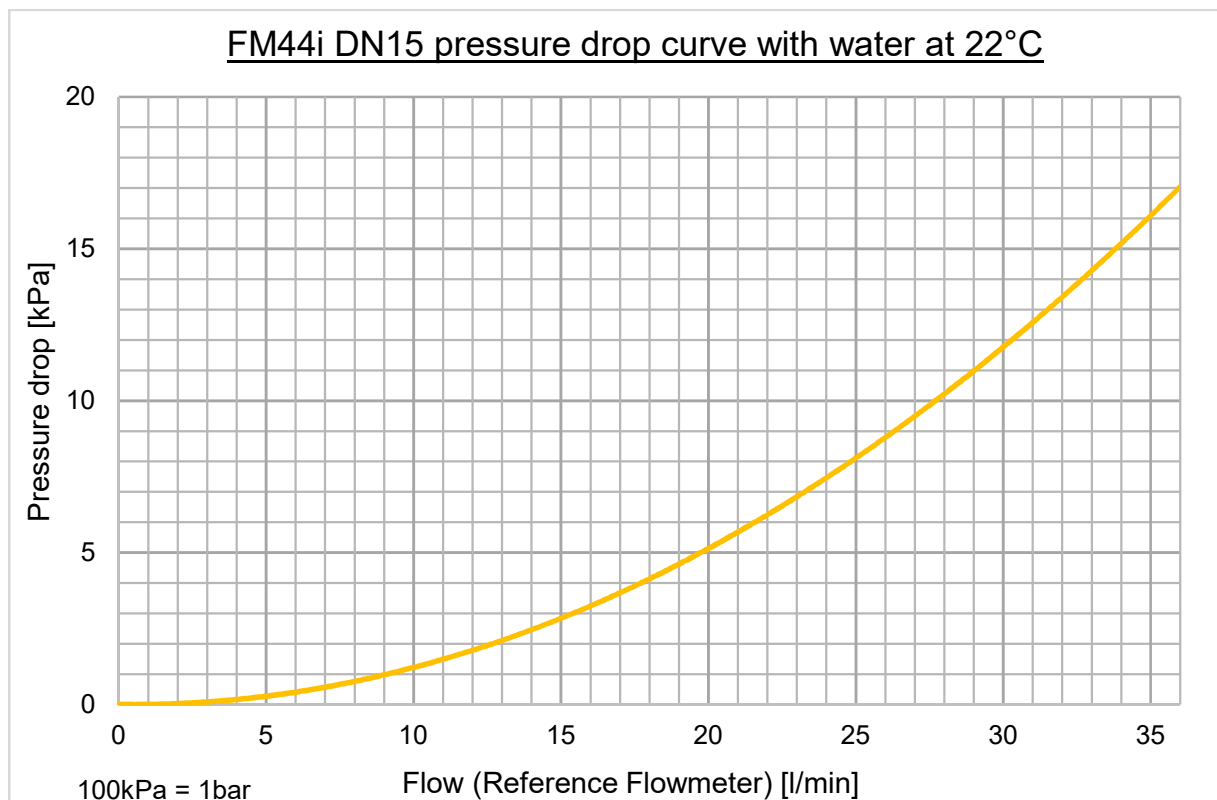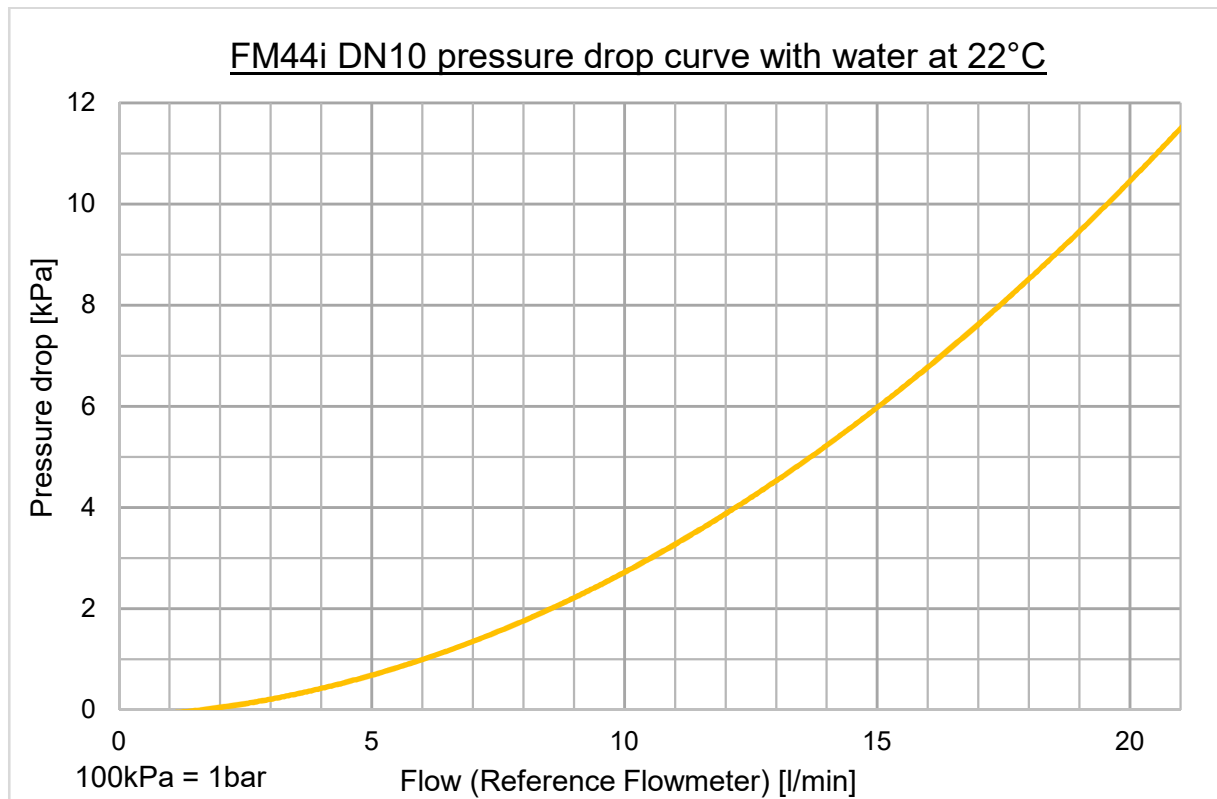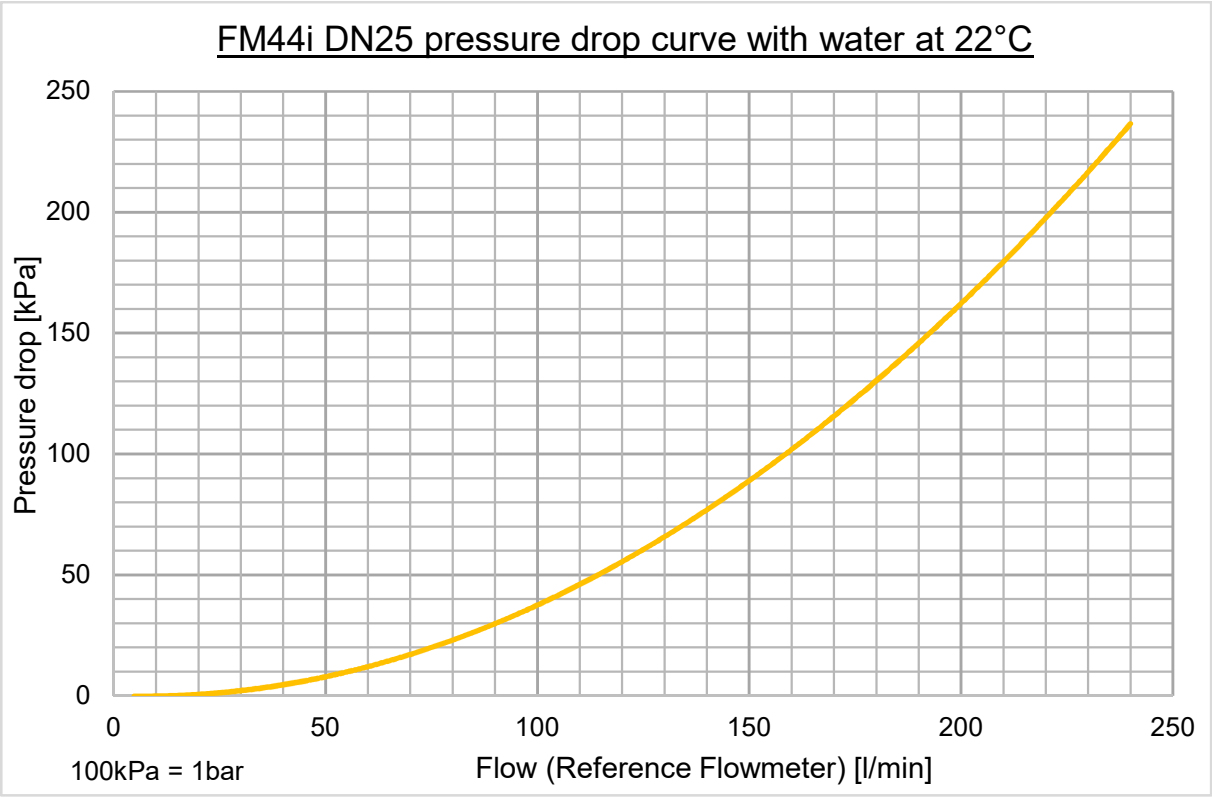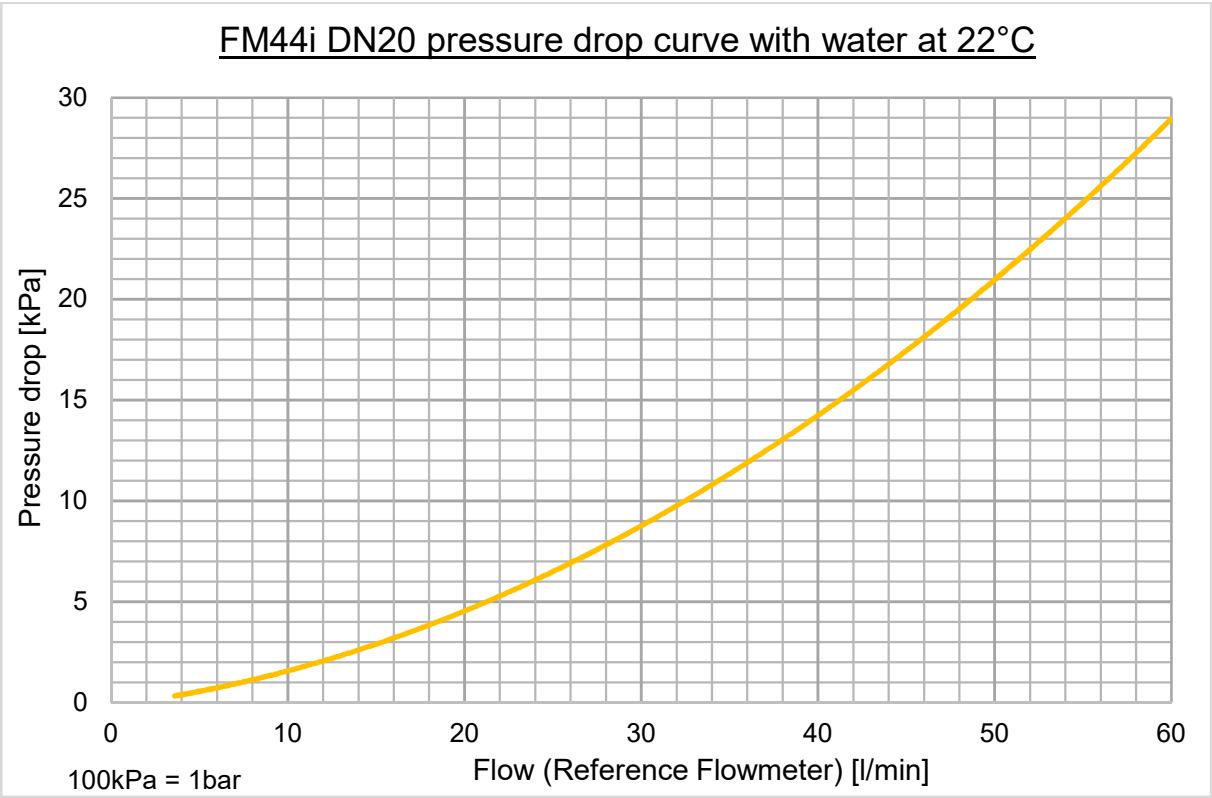
Possible error text Flowmax 44i

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. Can occur with media with the speed of sound outside the measurement window or with very small air bubbles.	only text
Overflow	Message appears if the measuring range is exceeded. This may also occur during start-up or when there are air bubbles. The message is 30 seconds visible even when the flow is within the allowable range. However, the measurement still works.	only text, message is displayed 30 sec

6. Accessories

Flowmax connection socket
Flowmax connection socket is used to power and connect Flowmax 44i to an external control unit.
Ordercode   507321 (Socket 5 pins)
Ordercode   507084 (Socket 8 pins)

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)

7. Shipment

- Flowmax 44i
- 2x EPDM O-Ring (only for inch thread G)

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 44i 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. For this purpose, a typical volume for the application is filled into a container and the weight is determined with a scale. 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 setting, choose Rotate Display 0°.

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