

BA 005E/FM54i/01.20

Valid starting from
Hardware V 2.1
Software V 1.29

Flowmax[®] 54i

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:



IMPORTANT!

IMPORTANT! indicates situations or cases which, if not avoided, could result in damage or failure of the Flowmax 42i 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 54i may only be used for measuring the flow of pure, homogeneous liquids.
- The Flowmax 54i is not intended for use in medical applications.
- The volume flowmeter Flowmax 54i 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.

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1. Planning information

1.1 Areas of application

The flow measurement device Flowmax 54i is designed to measure dynamic flow in pipes and tubes. This flowmeter is suitable for liquids only. The Flowmax 54i 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 54i 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
- Constant pipe cross-section over the entire measurement channel

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.

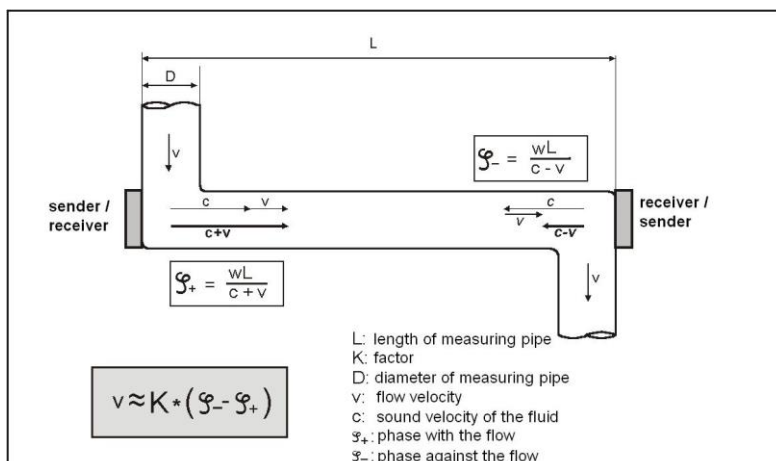


Figure 1: Presentation of the principle of ultrasonic flow measuring

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 65.

Flowmax 54i 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 54i meets the safety requirements concerning the Protective Extra Low Voltage directive according to EN 50178, SELV, PELV

2. Assembly an installation

2.1 Installation instructions

The arrow on the nameplate of the Flowmax 54i shows the positive flow direction. The flowmeter has to be installed in a way so that the flow-through is in the same direction as the arrow symbol.

NOTICE!

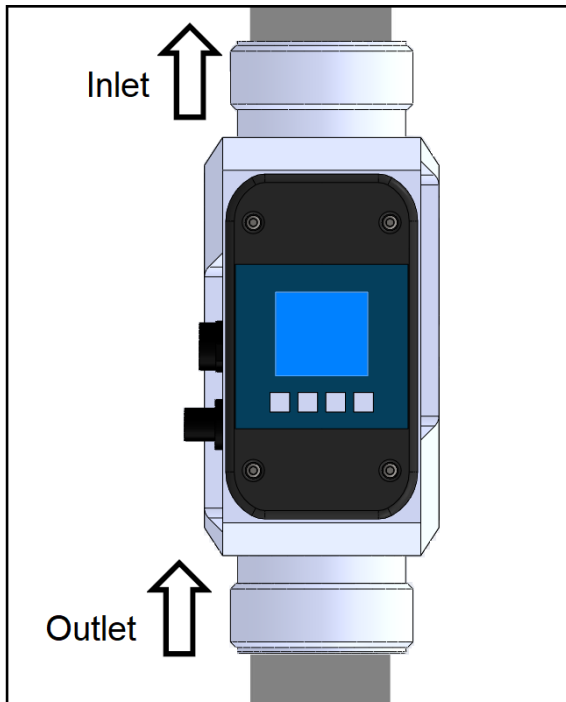


Figure 1: ideal installation position of Flowmax 54i

For fastest possible bubble detection it is important to keep the pipe distance from tank to Flowmax 54i 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 54i 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 54i 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 54i must be installed in flow direction on the pressure side, in order to ensure sufficient pressure. The maximum pressure rating of Flowmax 54i has to be considered.

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:

	DN25	DN 32	DN 40	DN50
Inflow distance	30cm	40cm	45cm	60cm
Outflow distance	20cm	20cm	20cm	20cm

2.2 Assembly of the flowmeter

The flowmeter is mounted into a pipe system by using the mechanical connection. Flowmax 54i 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 54i should be installed on the pressure side of the pump.

It is recommended to place the pump in the same plane as the container. Thus, the pump runs independently full and there is caused no vacuum when promoting.

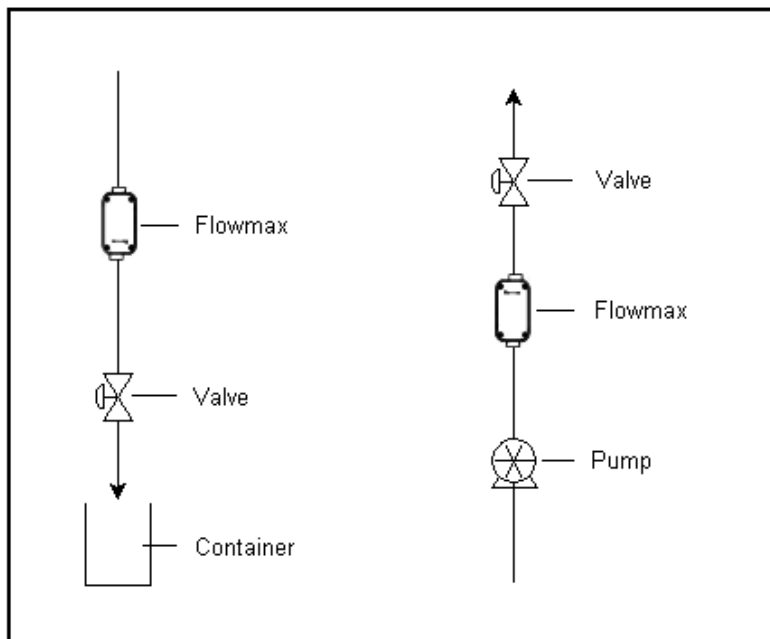
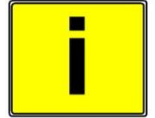


Figure 2: Mounting examples for Flowmax 54i

If it is not possible to mount the flowmeter vertically, then mount the flowmeter 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 54i.

Important!

The Flowmax 54i 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.



IMPORTANT!

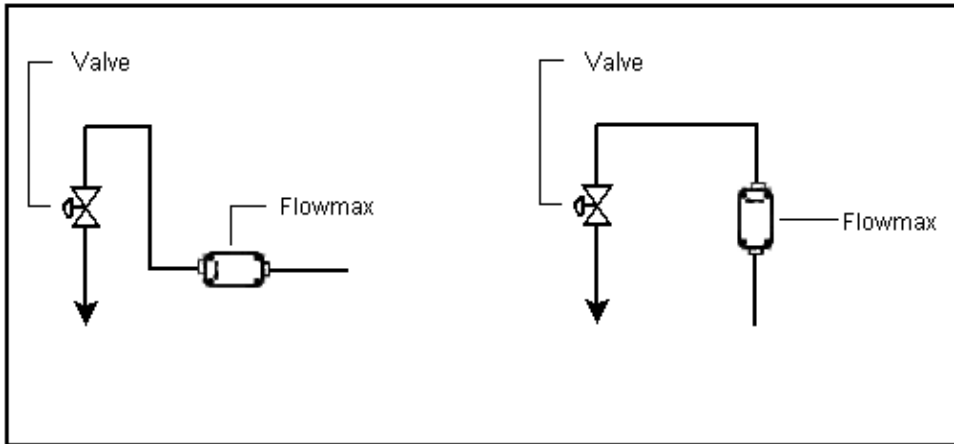


Figure 3: Mounting possibilities

Vibrations or mechanical forces may decrease measuring accuracy.

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 54i is not assembled and installed.

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



WARNING!



Figure 4: Pin code: Connection plug / socket for 5-pin version

Connector cable 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 300l/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 300l/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 5: Pin code: Connection plug / socket for 8-pin version

Connector cable 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 1. Pulse output 2. Empty pipe output 3. Dosing output 4. Upper or Lower Limit output 5. Negative flow	Digital output Q1 Configurable npn-or pnp transistor, max. load 100mA*. Max. voltage must be less than the supply voltage Freely adjustable ranging from 0.1 to 3000 ml/pulse in 0.1 ml/pulse steps, 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	Digital output Q2 Functions: 1. Empty pipe output 2. Dosing output 3. Pulse output 4. Upper or Lower Limit output 5. Negative flow	Digital output Q2 Configurable 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 Freely adjustable ranging from 0.1 to 3000 ml/pulse in 0.1 ml/pulse steps. Configurable output of 0V or 24V when flow reaches upper or lower limit. Configurable output of 0V or 24V when liquid flows in negative direction.
5	Analog output QA	4....20mA; 0....20mA Example: 0l/min => 4mA 300l/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 6: Pin code: Connection plug / socket for 8-pin version

Connector cable 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 1. Pulse output 2. Empty pipe output 3. Dosing output 4. Upper or Lower Limit output 5. Negative flow	Digital output Q1 Configurable npn-or pnp transistor, max. load 100mA. Max. voltage must be less than the supply voltage Freely adjustable ranging from 0.1 to 3000 ml/pulse in 0.1 ml/pulse steps, 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	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 300l/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 Flowmax54i within the operating limits stipulated on the product label and the operating manual / data sheet. Use of the Flowmax 54i outside these conditions will lead to overloads which cause permanent damage.



IMPORTANT!

3. Commissioning

NOTE:

After 30 minutes with power running the measuring device reaches the maximum accuracy.

NOTICE!**NOTE:**

If Flowmax 54i is used for a fluid other than water the "basic trim" has to be carried out during commissioning. Therefore the device has absolutely been filled with medium.

NOTICE!

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.

3.1 Operating

If Flowmax 54i 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 54i may also be ordered with customized settings, but customized settings must be requested when Flowmax 54i is ordered.

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. It is always necessary to adjust the manufacturer pre-set parameters when using the Flowmax 54i as a dosing device according to section 3.2.2 (Flowmax 54i as a dosing device). Adjusting the manufacturer pre-set parameters requires a display or FlowCon.

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
- 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
- Pulse value
- Creeping suppression
- Optimization of measurement curve with up to 8 interpolation values (medium matrix)

3.1.1 Display and user menu

Flowmax 54i 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.

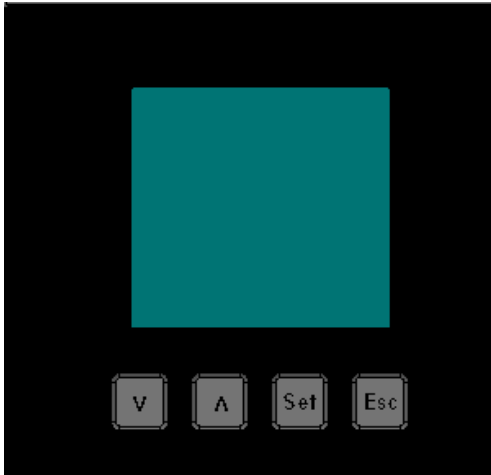


Figure 7: Operating with the key pad

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 54i 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.

Operating examples see appendix.

The Password should only be shared with personnel authorized to make changes to setting.

Note:

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

Note:

In the menu all the possible functions of the instrument are visible.

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 54i without display has the same features as the display version, but you can change parameters only via the display or programming unit FlowCon.



IMPORTANT!

NOTICE!

NOTICE!

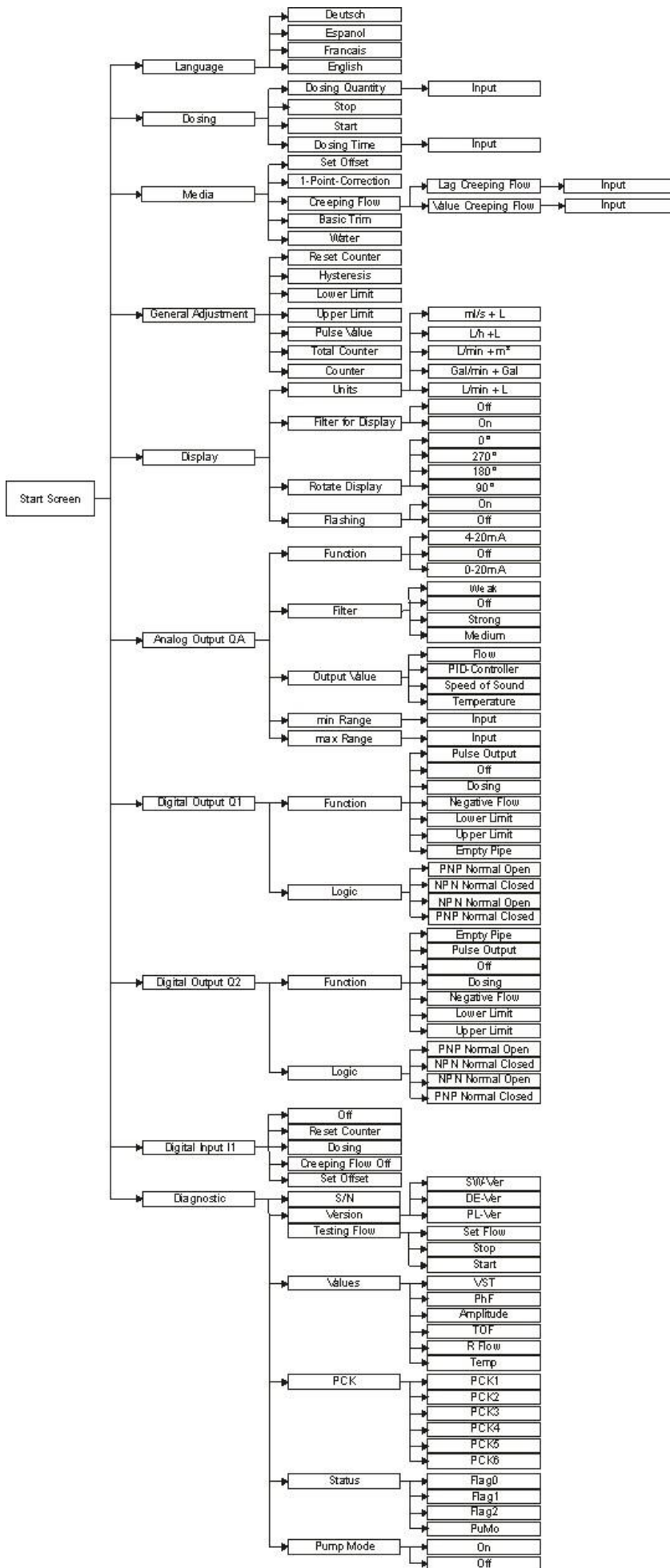


Figure 8: Menu structure Flowmax 54i
M I B

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 54i 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.

Warning!

The customer has to provide a technical solution for overflow 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

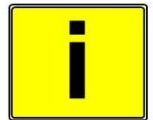
In the sub menu “Set Offset” it is possible to set the actual offset of the flowmeter. Use this function only when Flowmax 54i is completely filled with liquid, and there is no flow. If the offset is set while flow is present or when the pipe is empty it will cause an offset drift what results in a faulty 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.



IMPORTANT!



WARNING!

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%.

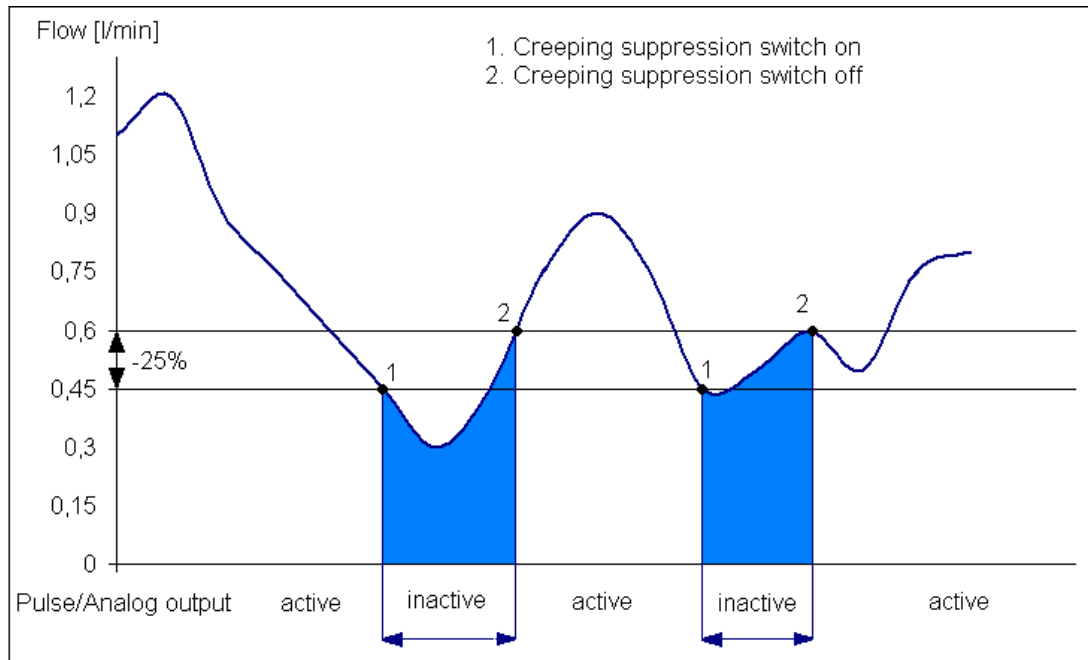


Figure 9: Function of creeping suppression illustrated with 0.6 l/min

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...36 l/min, in 0.006 l/min steps

Default settings:

DN25:	5 l/min
DN32:	9 l/min
DN40:	18 l/min
DN50:	36 l/min

Lag Creeping Flow

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

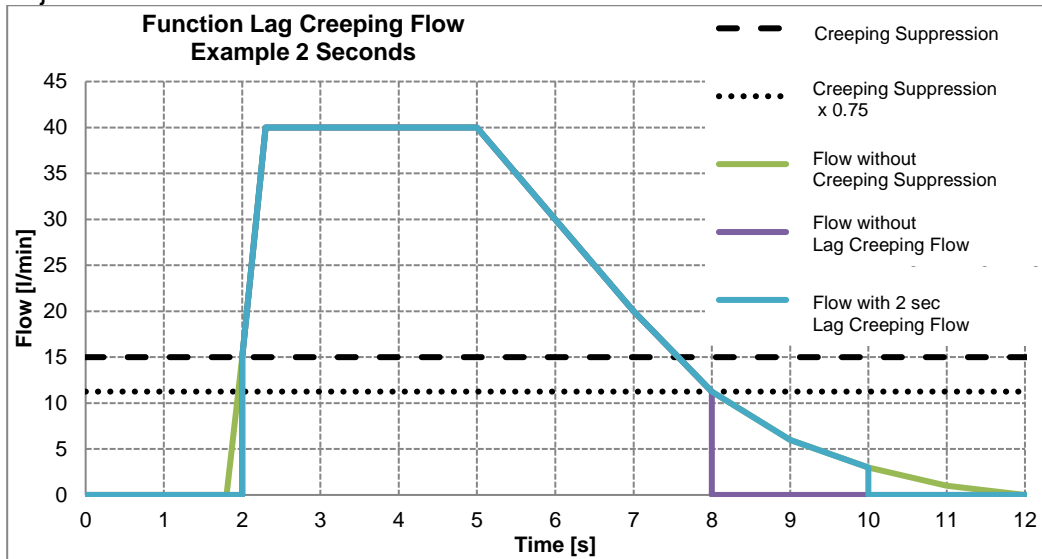


Figure 10: Function Lag Creeping Flow at 15l/min

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

3.2.3.4 Basic Time

The “Basic Trim” function insures that the flowmeter is conforming to the media specific characteristics. To execute this function, Flowmax 54i runs a self-diagnostic function which optimizes all important parameters. This process lasts approximately 1 minute.

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”.

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 54i 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.

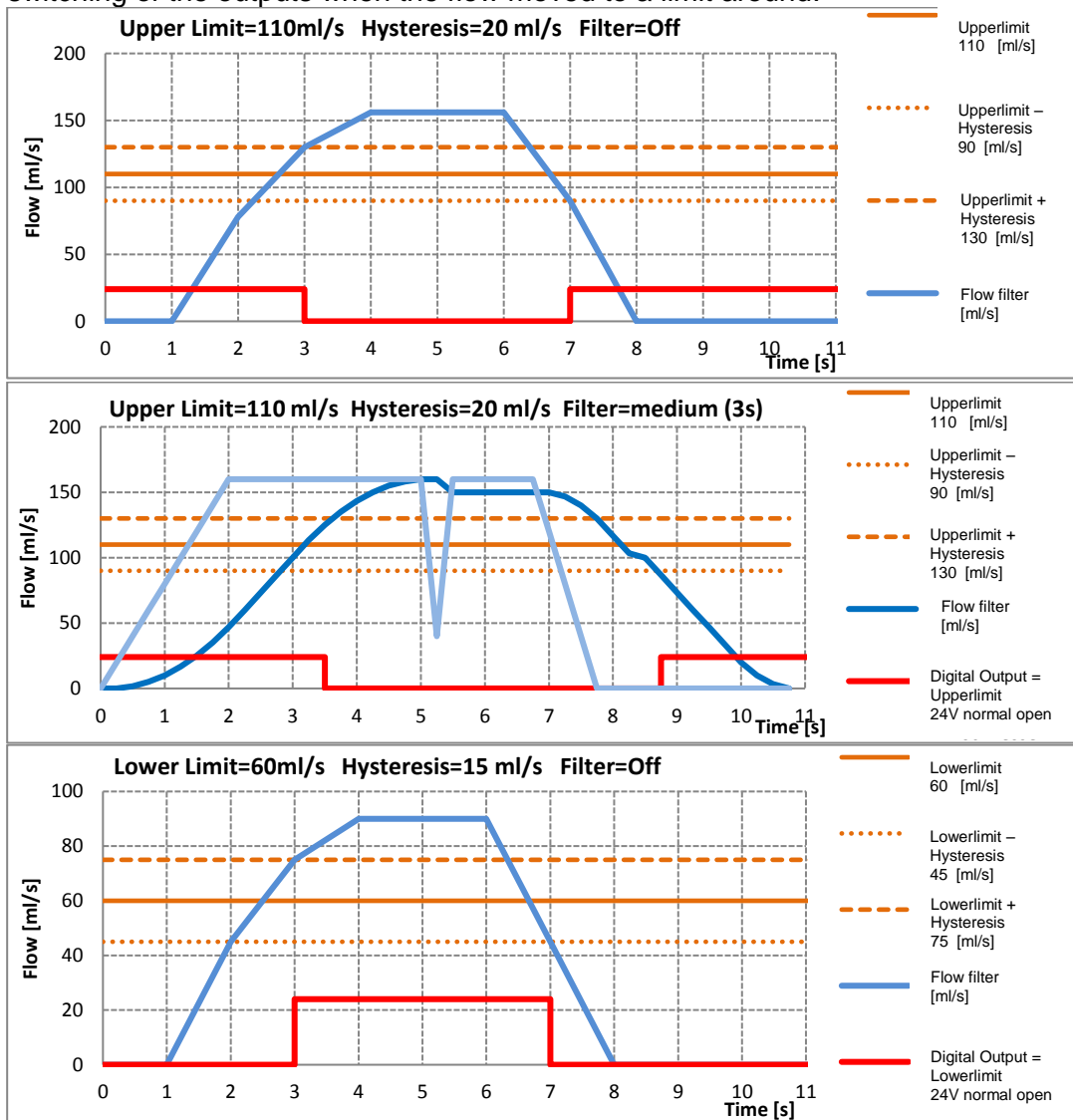


Figure 11: Function Hysteresis at limit

Setting range: 0 to 900 l/min in steps of 0.01 l/min.
Default settings: 0

3.2.4.3 Lower Limit

Here, the lower limit for the digital output is set.

Setting range: 0 to 900 l/min in steps of 0.01 l/min.

Default settings: 0

3.2.4.4 Upper Limit

Here, the lower limit for the digital output is set.

Setting range: 0 to 900ml/s in steps of 0.01 l/min.

Default settings: max. Flow of the flowmeter

DN25 = 180 l/min

DN32 = 300 l/min

DN40 = 480 l/min

DN50 = 900 l/min

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 54i (10kHz) nor the maximum input frequency of the control. If the maximum frequency is exceeded the Flowmax 54i 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: 10.0 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.

3.2.4.6 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 counter 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 1000000 liters, it automatically begins to count up from zero. Total counter runs without resetting on.

b) at daily amount in [m³]

from [m ³]	to [m ³]	reolution display [m ³]	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 461204 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 1000000 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 54i 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: On

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 the display menu or FlowCon.

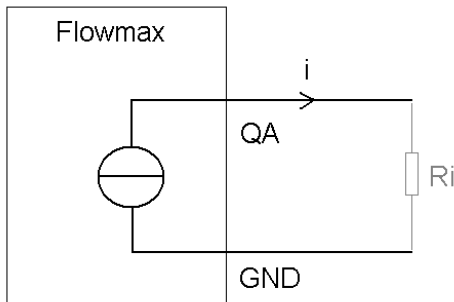


Figure 12: The current output is active

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.

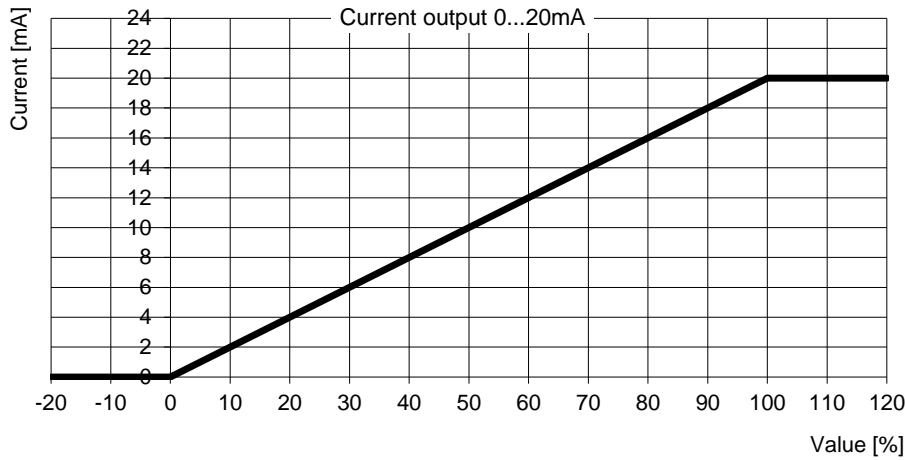


IMPORTANT!

Characteristic curves analog output

- **0 - 20mA**

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

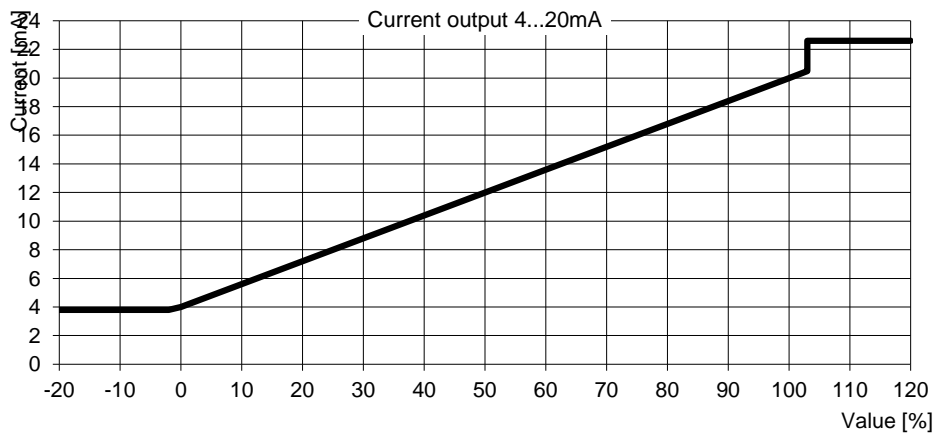


Value	Current [mA]
Smaller 0%	0
0% (min Range)	0
Between 0% and 100%	Linear interpolation from 0 to 20 mA
100% (max Range)	20
Bigger 100%	20

Figure 13: 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

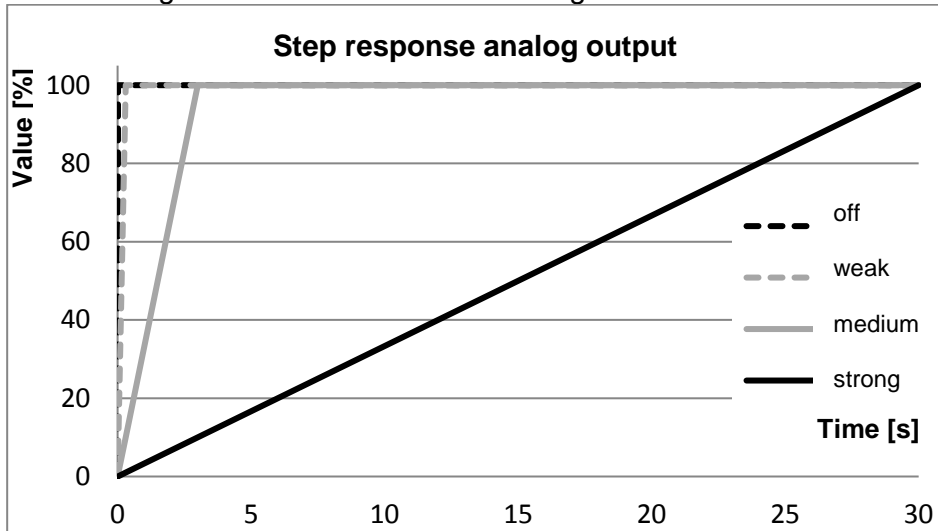
Figure 14: Characteristic curve 4 to 20mA

3.2.6.2 Filter

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

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

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 15: 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 (see Section 3.1.1 Fig 9. Menu structure Flowmax 54i with analog output QA - Output value) 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 (see Section 3.1.1 Fig 9. Menu structure Flowmax 54i with analog output QA - Output value) 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 900 l/min (or °C or m/s) in steps of 0.01

Default setting: 0 l/min

Max Range

Here, the value is set at the 20 mA to be output.

Setting range: 0 to 900 l/min (or °C or m/s) in steps of 0.01

Default setting: max Flow of the flowmeter:

DN25 = 180 l/min

DN32 = 300 l/min

DN40 = 480 l/min

DN50 = 900 l/min

3.2.7 Digital Output Q1 and Q2 (Q2 only with 8-pol 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. All outputs become high resistant if voltage falls below 16V. The digital outputs become high resistant after about 100µs for 2s when short circuit or overload. Then it will retry 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	Between 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 54i electronics.



IMPORTANT!

Example 1: Flowmax 54i via NPN, external relay

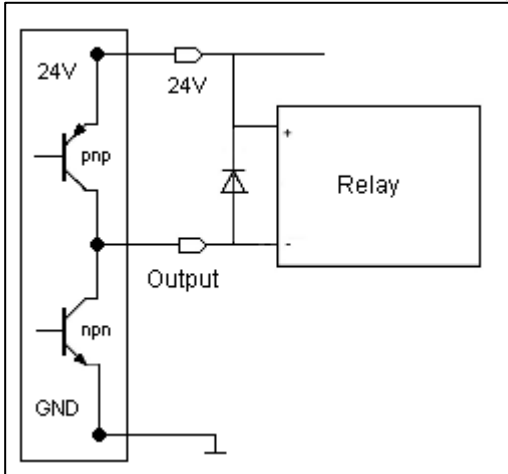


Figure 16: Connecting Digital Output to relay

Example 2: Flowmax 54i via PNP, external counter e.g. PLC

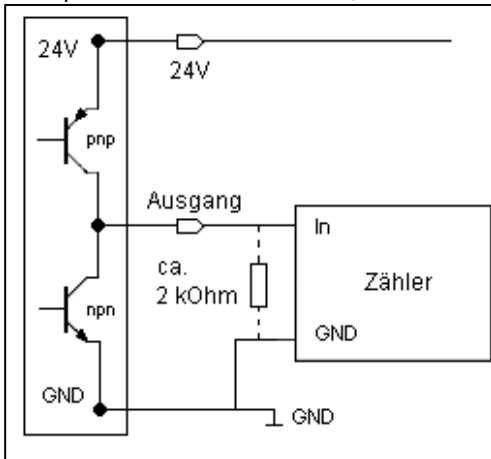


Figure 17: Connecting Digital Output to counter

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-pol pin plug)


Flowmax 54i 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.

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...1920 l/min in steps of 0.06 l/min

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	10 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 DN25 = 180 l/min DN32 = 300 l/min DN40 = 480 l/min DN50 = 900 l/min
Creeping suppression	DN25 = 5 l/min DN32 = 9 l/min DN40 = 18 l/min DN50 = 36 l/min

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.

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

Flowmax 54i is operational!



IMPORTANT!

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**
- 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



WARNING!

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 54i 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).**

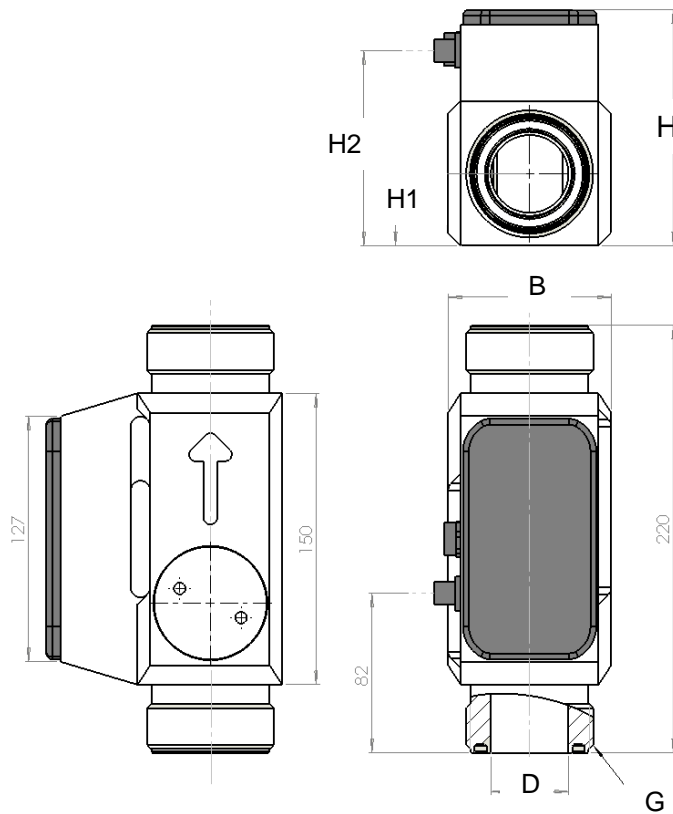


WARNING!

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 of the compact version



	G	D	B	H1	H2	H	weight [kg]
DN25	G1 ½	23	73	33	95	116	1
DN32	G2	32	80	35	99	120	1,1
DN40	G2 ¼	40	84	37	101	122	1,1
DN50	G2 ¾	52	95	43	110	131	1,3

5.2 Technical specifications

Housing

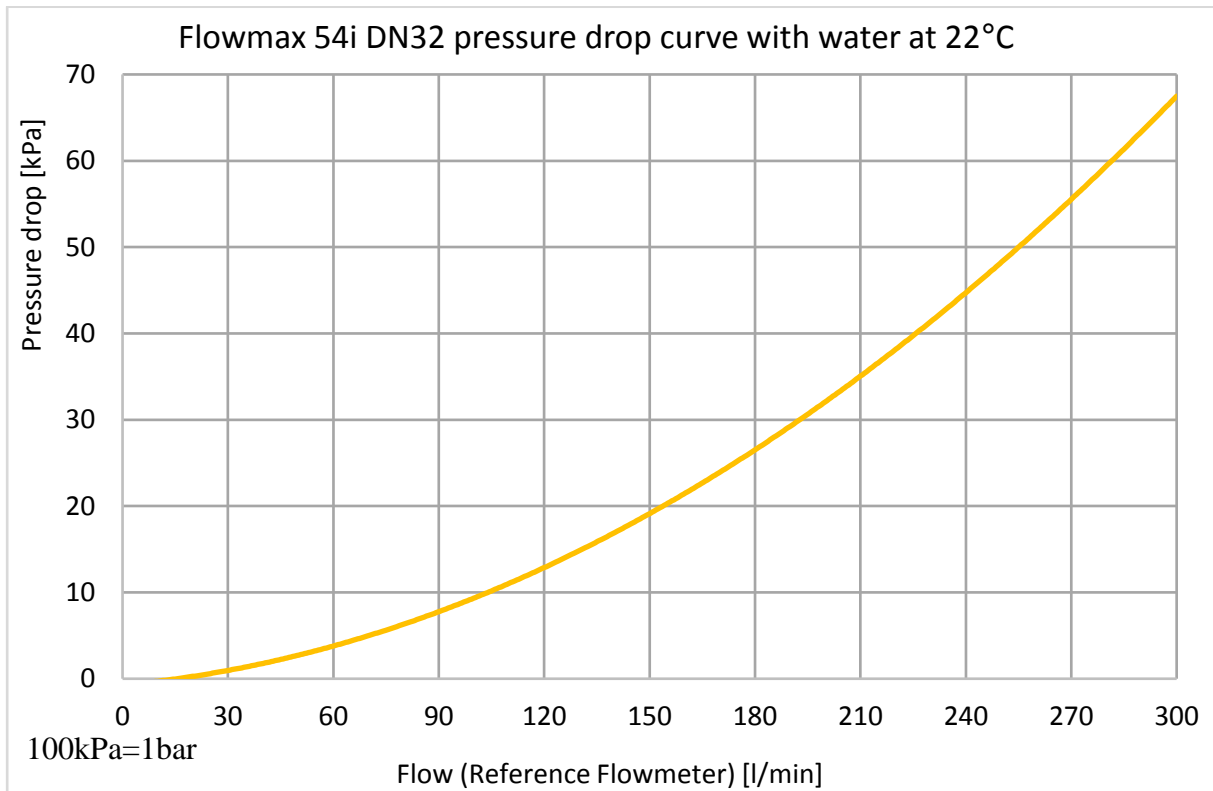
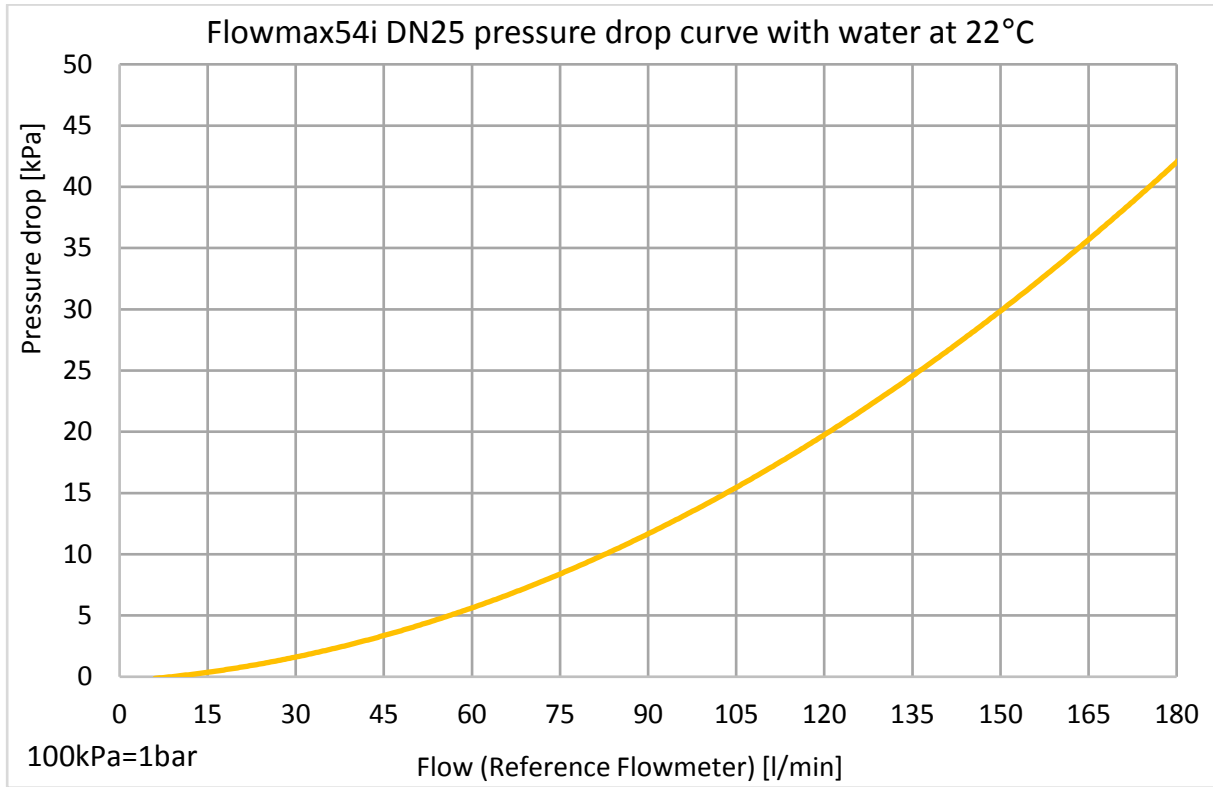
Nominal diameters	DN25, 32, 40, 50
Connection inner thread	G1 ½, G2; G2 ¼, G2 ¾
Medium temperature	0...+50°C
Protection class	IP 65
Pressure nominal	PN10
Material	PE-HD (Polyethylene)

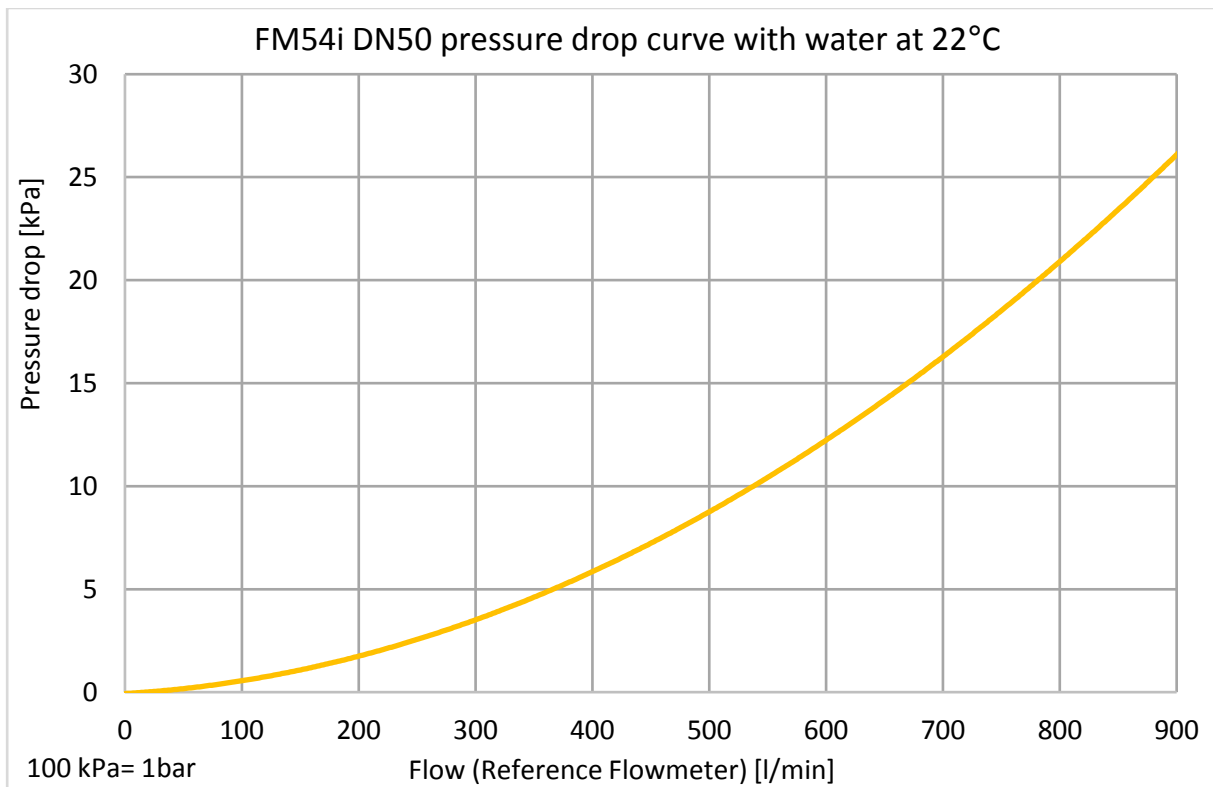
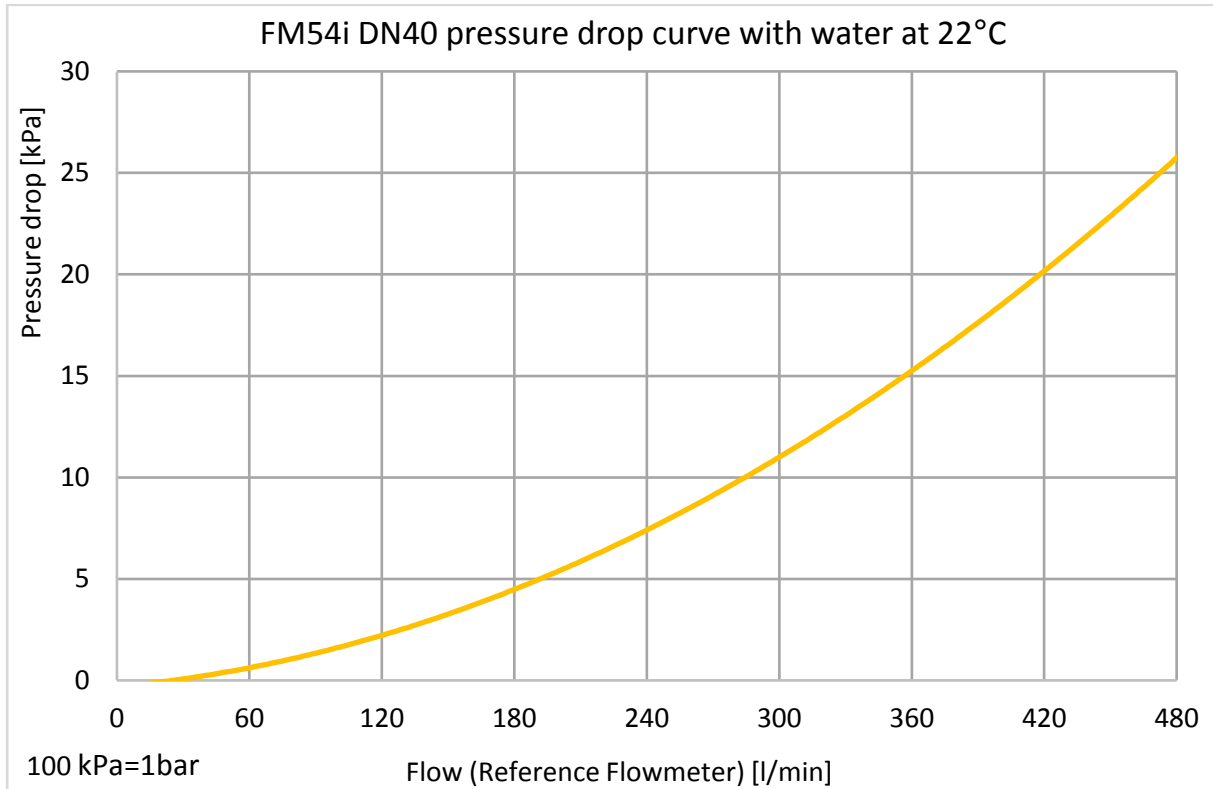
Electronics

Power supply	18...30VDC
Power input	at 24VDC = 3.6W
Connection	Plug 5 pins, option plug 8 pins
Ambient temperature	-15....+50°C
Storage temperature	-15....+50°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...20mA
Digital output Q1/2	via transistor npn- and pnp-logic, max. 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
Measuring deviation	± 2% o.r. ± 0,3% f.s. (o.r. = of reading , f.s. = fullscale), option ± 1% o.r. ± 0,3% f.s. Reference conditions (VDE/VDI 2642)
Measuring range	DN25: 5 – 180 l/min DN32: 9 – 300 l/min DN40: 18 – 480 l/min DN50: 36 – 900 l/min
Repeatability:	0,5%

The measuring system Flowmax 54i 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





Possible error text Flowmax 54i

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**Flowmax connection socket**

Flowmax connection socket is used to power and connect Flowmax 54i to an external control unit.

Ordercode 507321 (Socket 5 pins)

Ordercode 800845 (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 54i
- 2 gaskets for Hydraulic connection

Appendix

Examples of operation:

Enter Password

Key	Display picture
Set	Password
4 x Λ	40000
Set	X0000
Λ	X1000
Set	XX000
4 x Λ	XX400
Set	XXX00
Λ	XXX10
Set	XXXX0
4 x Λ	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 54i 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°.

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