



Operating instructions
Mechatronic flow sensor

FSC75-00-42-6H

FSC75-00-42-10H

FSC1-00-42-27H

FSC15-00-42-50H

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1 Preliminary note

1.1 Symbols used

- ✓ Requirement
- ▶ Instructions
- ▷ Reaction, result
- [...] Designation of keys, buttons or indications
- Cross-reference
-  Important note
Non-compliance may result in malfunction or interference.
-  Information
Supplementary note

1.2 Warnings

Warnings indicate the possibility of personal injury and damage to property. This enables safe product handling. Warnings are graded as follows:

	<p>WARNING</p> <p>Warning of serious personal injury</p> <p>▷ If the warning is not observed, fatal and serious injuries are possible.</p>
	<p>CAUTION</p> <p>Warning of minor to moderate personal injury</p> <p>▷ If the warning is not observed, minor to moderate injuries are possible.</p>
	<p>ATTENTION</p> <p>Warning of damage to property</p> <p>▷ If the warning is not observed, damage to property is possible.</p>

For the scope of validity cULus:

The device shall be supplied from an isolating transformer having a secondary Listed fuse rated either

- a) max 5 amps for voltages 0~20 Vrms (0~28.3 Vp) or
- b) 100/Vp for voltages of 20~30 Vrms (28.3~42.4 Vp).

The device shall be connected only by using any Listed (CYJV/7) or R/C (CYJV2/8) cord in respect of Condition of Acceptability, having suitable ratings.

Dans le champ d'application cULus :

L'appareil doit être impérativement alimenté par une alimentation isolée galvaniquement disposant au secondaire d'un fusible avec homologation UL et un courant nominal max. de

- a) 5 ampères pour des tensions de 0...20 Veff (0...28.3 Vpic) ou
- b) 100/Vpic pour des tensions de 20...30 Veff (28.3...42.4 Vpic).

Pour le raccordement de l'appareil, veuillez utiliser un connecteur femelle (CYJV/7) ou R/C (CYJV2/8) listé avec les données appropriées selon les "Condition of Acceptability".

2 Safety instructions

- The unit described is a subcomponent for integration into a system.
 - The system architect is responsible for the safety of the system.
 - The system architect undertakes to perform a risk assessment and to create documentation in accordance with legal and normative requirements to be provided to the operator and user of the system. This documentation must contain all necessary information and safety instructions for the operator, the user and, if applicable, for any service personnel authorized by the architect of the system.
- Read this document before setting up the product and keep it during the entire service life.
- The product must be suitable for the corresponding applications and environmental conditions without any restrictions.
- Only use the product for its intended purpose (→ Intended use).
- Only use the product for permissible media.
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property may occur.
- The manufacturer assumes no liability or warranty for any consequences caused by tampering with the product or incorrect use by the operator.
- Installation, electrical connection, set-up, operation and maintenance of the product must be carried out by qualified personnel authorized by the machine operator.
- Protect units and cables against damage.

3 Intended use

The unit monitors liquid media (water, glycol solutions, industrial oils, coolants).

It detects the process categories volume flow (volumetric flow quantity/time) and medium temperature.

ATTENTION

Frost formation of the medium.

▷ The sensor may be damaged.

▶ Ensure that the medium in the sensor does not freeze during operation and transport.

4 Function

- The unit detects the flow rate according to the principle of differential pressure by means of a permanent magnet and a measuring cell.
- As additional process value the unit detects the medium temperature.
- The unit displays the current process values.
- The unit generates two output signals according to the parameter setting.

4.1 Output OUT1 selection options

- Switching signal flow
- Switching signal temperature
- Frequency signal flow
- Frequency signal temperature

4.2 Output OUT2 selection options

- Switching signal flow
- Switching signal temperature
- Analog signal flow
- Analog signal temperature

4.3 Switching output

OUTx changes its switching status if it is above or below the set switching limits. Hysteresis or window function can be selected.

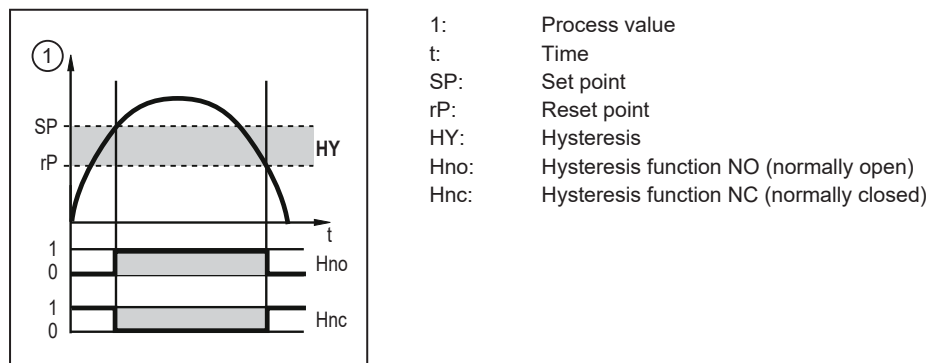
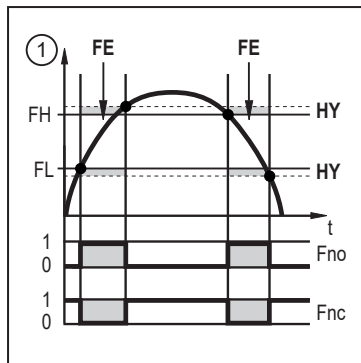


Fig. 1: Hysteresis function



When the hysteresis function is set, the set point [SP] and the reset point [rP] are defined. The rP value must be lower than the SP value. The distance between SP and rP is at least 0.6 % of the final value of the measuring range (= hysteresis). If only the set point is changed, the reset point is changed automatically; the difference remains constant.



- 1: Process value
- t: Time
- FH: Upper limit value
- FL: Lower limit value
- HY: Hysteresis
- FE: Window area
- Fno: Window function NO (normally open)
- Fnc: Window function NC (normally closed)

Fig. 2: Window function



When set to the window function the upper limit value [FH] and the lower limit value [FL] are defined. The distance between FH and FL is at least 0.6 % of the final value of the measuring range. FH and FL have a fixed hysteresis of 0.25 % of the final value of the measuring range. This helps keep the switching status of the output stable if the flow rate varies slightly.

The switching signal in case of a fault can be set via the parameter [FOU].

4.4 Analog output

The unit provides an analog signal of 4...20 mA proportional to the process value.

If the measured value is outside the measuring range or in the event of an internal error, the current signal indicated in the following figure is provided.

For measured values outside the display range or in case of a fault, messages are displayed (UL, OL, Err).

The analog signal in case of a fault can be set via the parameter [FOU].

4.4.1 Volumetric flow monitoring

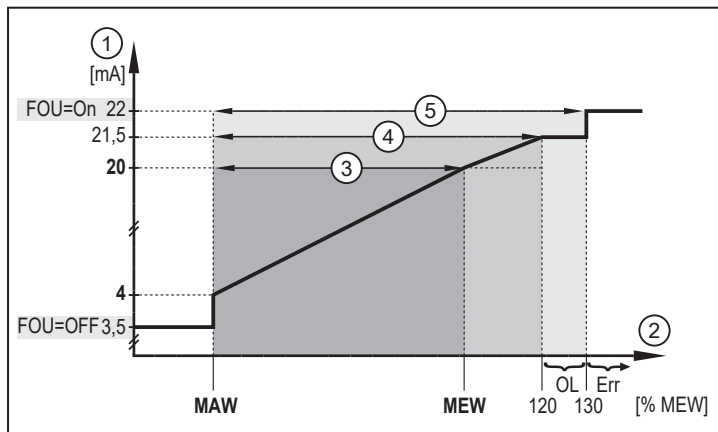


Fig. 3: Characteristics of the analog output according to the standard IEC 60947-5-7, flow rate

- 1: Analog signal
- 2: Flow
- 3: Measuring range
- 4: Display range
- 5: Detection zone
- MAW: Initial value of the measuring range
- MEW: Final value of the measuring range
- OL: Above the display range
- Err: Error state

4.4.2 Temperature monitoring

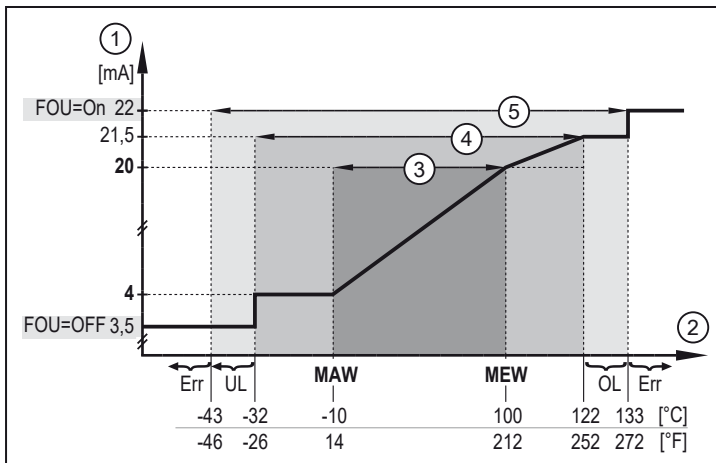


Fig. 4: Characteristics of the analog output according to the standard IEC 6094752, temperature

- | | |
|--------------------|---|
| 1: Analog signal | MAW: Initial value of the measuring range |
| 2: Temperature | MEW: Final value of the measuring range |
| 3: Measuring range | OL: Above the display range |
| 4: Display range | UL: Below the display range |
| 5: Detection zone | Err: Error state |

4.5 Frequency output

The device provides a frequency signal proportional to the process value.

The frequency signal is scalable:

- [FrPx] defines the frequency signal in Hz that is provided when the upper measured value is reached.

The measuring range is scalable:

- [FSPx] defines the lower measured value from which a frequency signal is provided.
- [FEPx] defines the upper measured value at which the output signal has the frequency set under [FrPx].



[FSPx] is only available for temperature measurement. Minimum difference between [FSPx] and [FEPx] = 20 % of the final value of the measuring range.

If the measured value is outside the measuring range or in the event of an internal error, the frequency signal indicated in the following figure is provided.

For measured values outside the display range or in case of a fault, messages are displayed (UL, OL, Err).

The frequency signal in case of a fault can be set via the parameter [FOU].

4.5.1 Volumetric flow monitoring

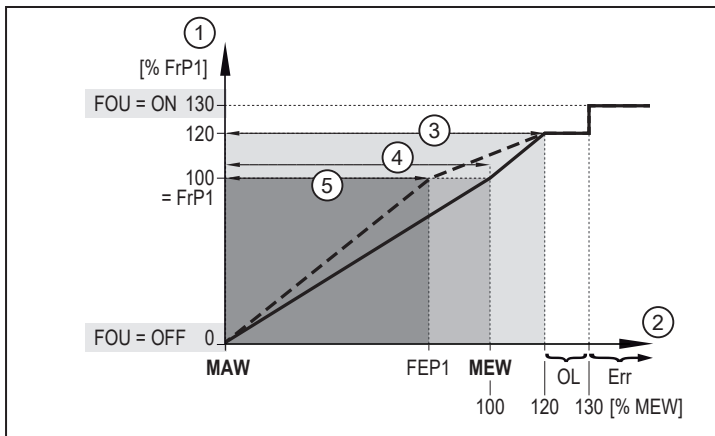


Fig. 5: Output characteristic frequency output, flow rate

- | | |
|---------------------------|--|
| 1: Frequency signal | MAW: Initial value of the measuring range |
| 2: Flow | MEW: Final value of the measuring range |
| 3: Display range | FEP1: Frequency end point |
| 4: Measuring range | FRP1: Frequency signal (Hz) for upper measured value |
| 5: Scaled measuring range | OL: Above the display range |
| | Err: Error |

4.5.2 Temperature monitoring

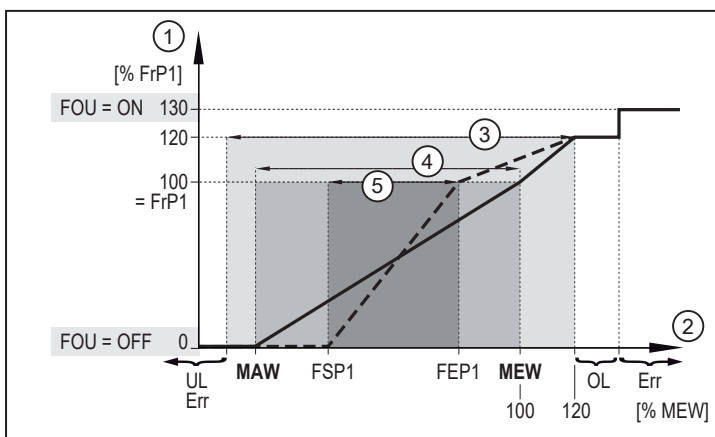


Fig. 6: Output characteristics frequency output, temperature

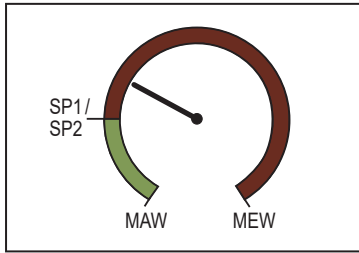
- | | |
|---------------------------|--|
| 1: Frequency signal | FSP1: Frequency start point |
| 2: Temperature | FEP1: Frequency end point |
| 3: Display range | FRP1: Frequency signal (Hz) for upper measured value |
| 4: Measuring range | MAW: Initial value of the measuring range |
| 5: Scaled measuring range | MEW: Final value of the measuring range |
| Err: Error | OL: Above the display range |

4.6 Display color setting

The color of the characters in the display can be set via the parameter [coLr]. With the set parameters rED (red) and GrEn (green), the display is permanently set to one color. If the parameters rxou and Gxou are set, the color of the characters changes depending on the process value:

	OUT1	OUT2	Color change to...
Parameter setting	r1ou	r2ou	Red
	G1ou	G2ou	Green

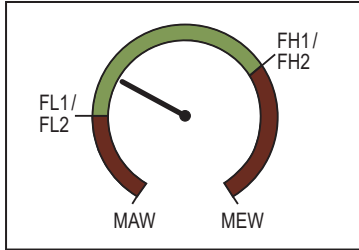
When the hysteresis function is set, the color changes if the process value is above the set point:



MAW: Initial value of the measuring range
 MEW: Final value of the measuring range
 SPx: Switch point

Fig. 7: Hysteresis function, [coLr] = rxou

When the window function is set, the color changes if the process value is within the window section:



MAW: Initial value of the measuring range
 MEW: Final value of the measuring range
 FLx: Lower limit of the window section
 FHx: Upper limit of the window section

Fig. 8: Window function, [coLr] = Gxou

5 Mounting



CAUTION

During installation or in case of a fault (e.g. housing damage) media under high pressure or hot media can leak from the system.

- ▷ Risk of injury caused by pressure or burns.
- ▶ Ensure that the system is free of pressure during installation.
- ▶ Ensure that no media can leak at the mounting location during installation.
- ▶ Equip the unit with suitable protection (e.g. cover) to avoid hazard to personnel from leaking media.

5.1 Process connection

- ▶ Avoid major changes of cross section on the inlet side.
- ▶ Fit the unit in the pipe in accordance with the flow direction (arrow) and tighten at the spanner flats.



Do not clamp the housing in a vice.

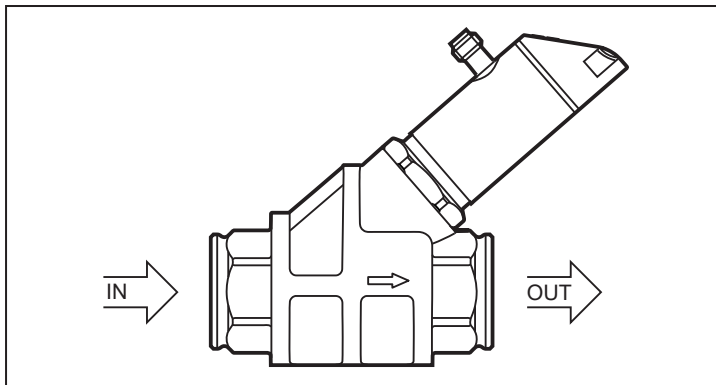


Fig. 9: Process connection

IN: inlet
OUT: outlet



The sensor can also prevent backflow.



The sensor head can be rotated by 360°.

5.2 Interference

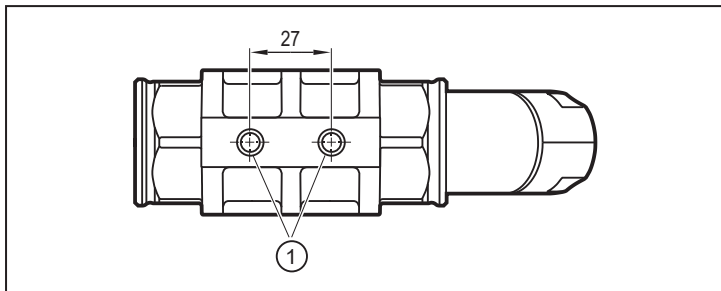
- ▶ The following minimum distances must be adhered to:

Distance between the sensor and ferromagnetic materials	≥ 30 mm *
Distance between the sensor and constant / alternating fields	≥ 500 mm
Distance between the sensor axes for side-by-side installation	≥ 50 mm

* The pipe may consist of ferromagnetic material.

5.3 Mounting options

- Fasten the unit with the threaded holes from underneath.



1: Threaded hole M8 (depth 6 mm) on the bottom side of the unit

5.4 Installation in case of medium containing dirt

- Use a 200-micron filter in front of the inlet (IN).
- Install sensor horizontally.
- Adhere to the inclination angle to the horizontal axis:

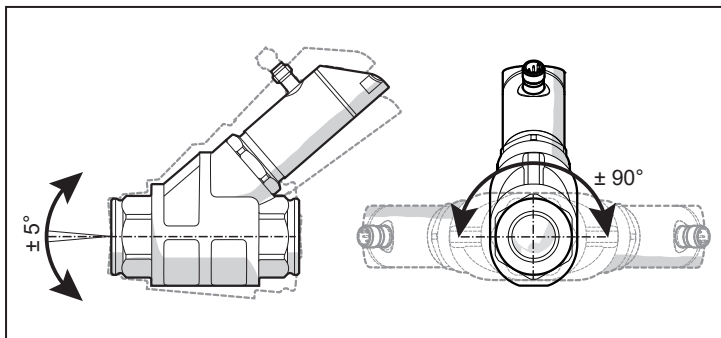


Fig. 10: Alignment in case of medium containing dirt



In clean medium, installation in vertical pipes is also possible.

6 Electrical connection



The unit must be connected by a qualified electrician.

Observe the national and international regulations for the installation of electrical equipment.

Voltage supply according to SELV, PELV.

► Disconnect power.

► Connect the unit as follows:

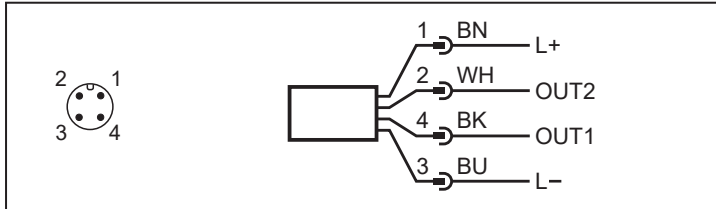


Fig. 11: Wiring diagram (colors to DIN EN 60947-5-2)

BN: Brown
 WH: White
 BK: Black
 BU: Blue

Pin	Assignment
1	L+
3	L-
4 (OUT1)	<ul style="list-style-type: none"> • Switching signal flow • Switching signal temperature • Frequency signal flow • Frequency signal temperature
2 (OUT2)	<ul style="list-style-type: none"> • Switching signal flow • Switching signal temperature • Analog signal flow • Analog signal temperature

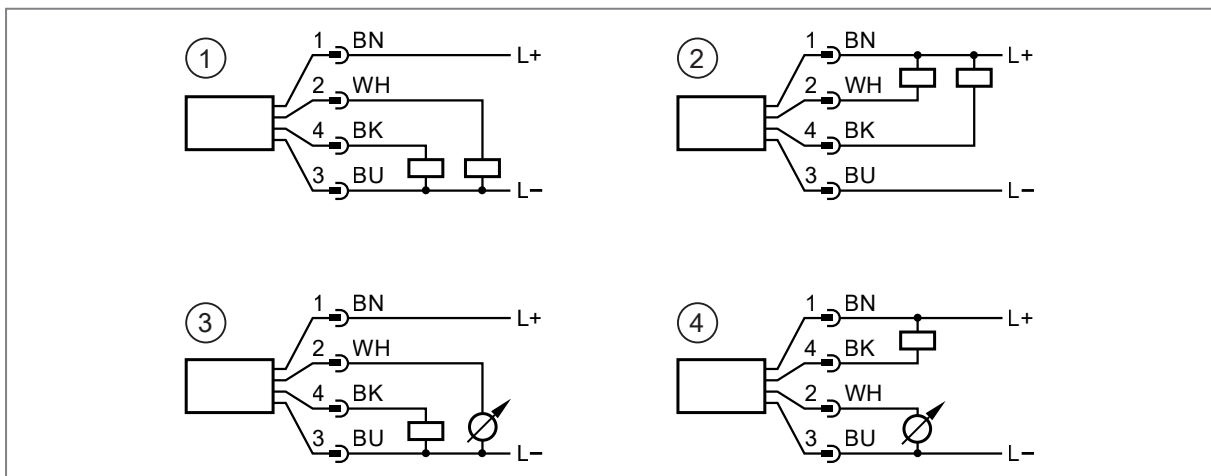
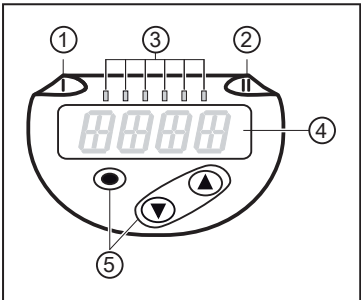


Fig. 12: Circuit examples

- 1: 2 x positive switching
- 2: 2 x negative switching
- 3: 1 x positive switching / 1 x analog
- 4: 1 x negative switching / 1 x analog

7 Operating and display elements



- 1: Switching status LED for OUT1
- 2: Switching status LED for OUT2
- 3: Process value in the indicated unit of measurement *
- 4: 4-digit alphanumeric display
- 5: Keys for changing views and parameter setting

Fig. 13: Operating and display elements

* gpm; gph

8 Menu

8.1 Menu overview

Use the operating keys to navigate from the process value display to the main menu and from there to the submenus.

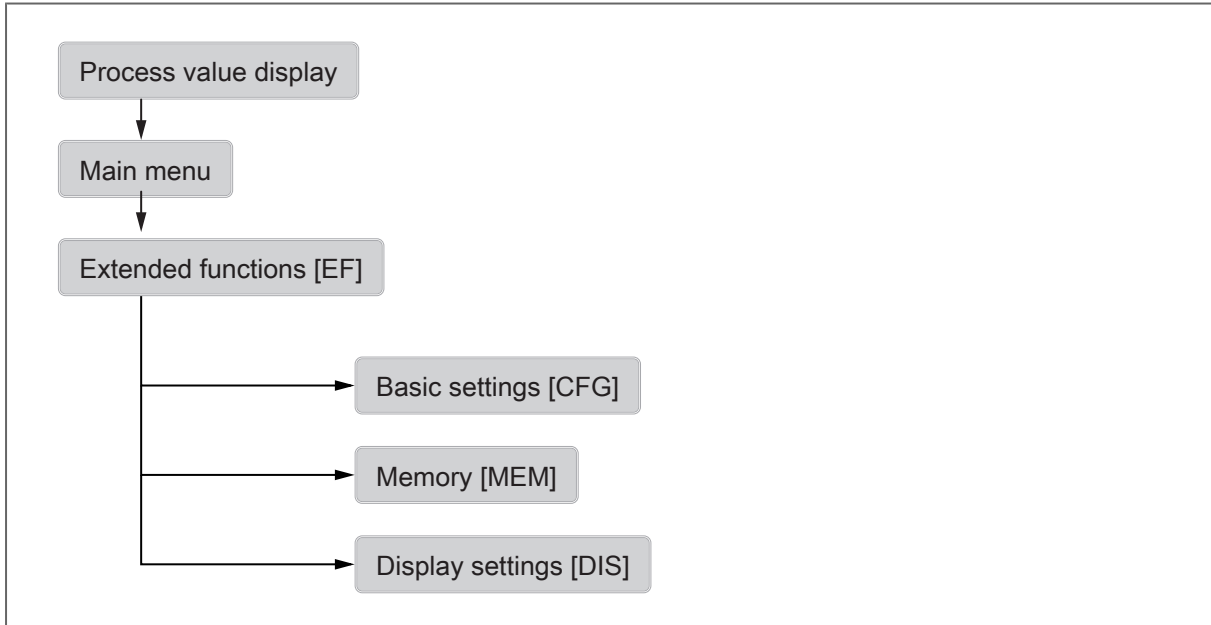


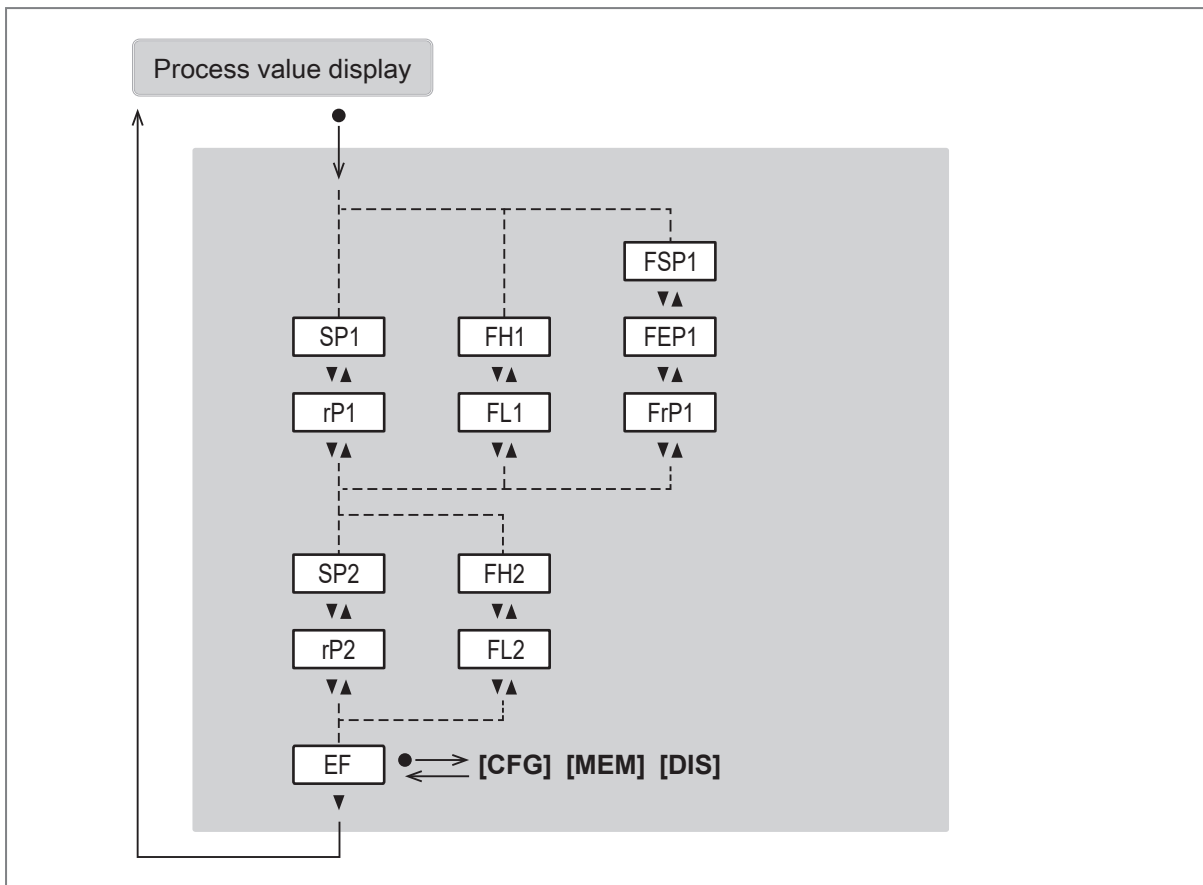
Fig. 14: Menu overview

8.2 Main menu and submenus



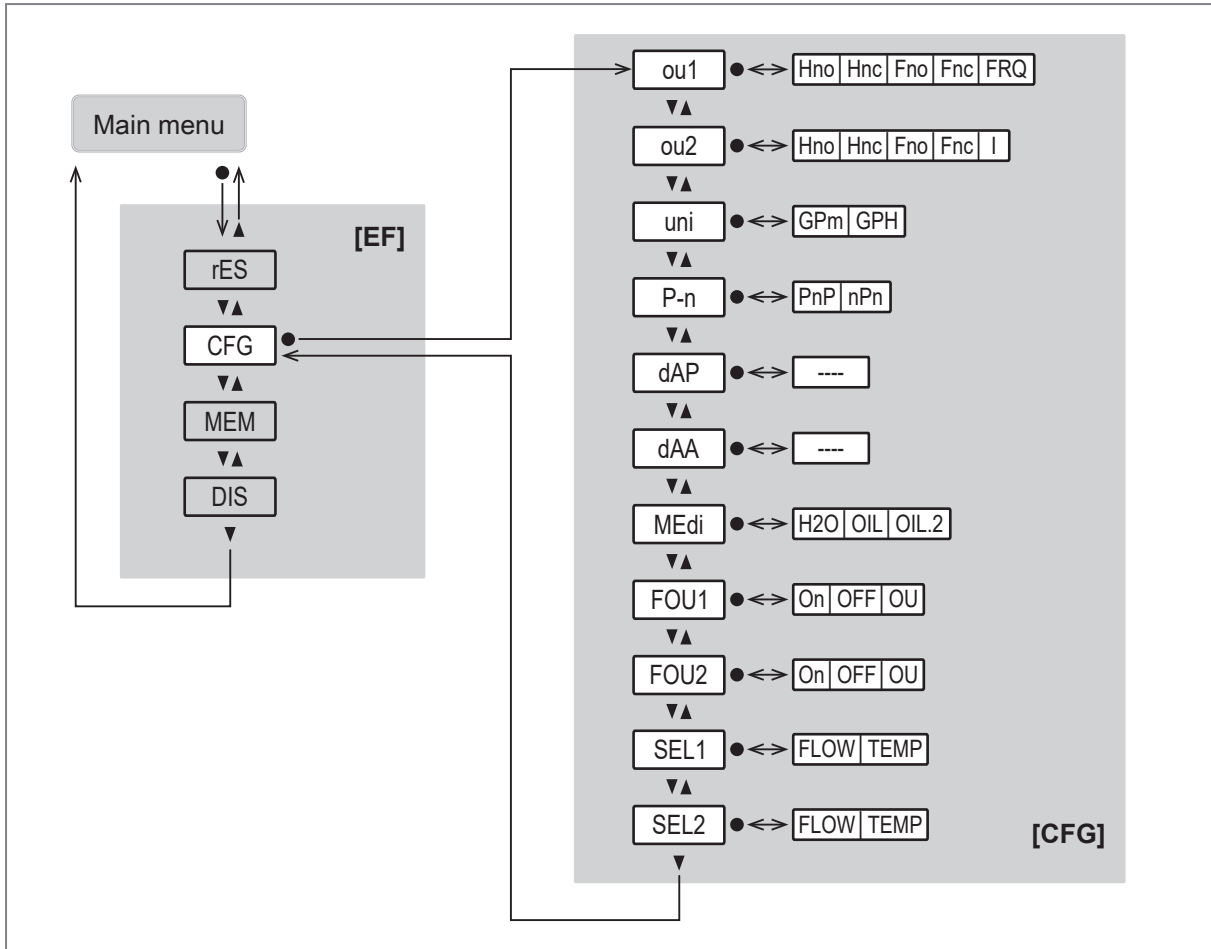
The displayed parameters change when the factory setting is changed. The following menu displays show the maximum available parameters.

Main menu:



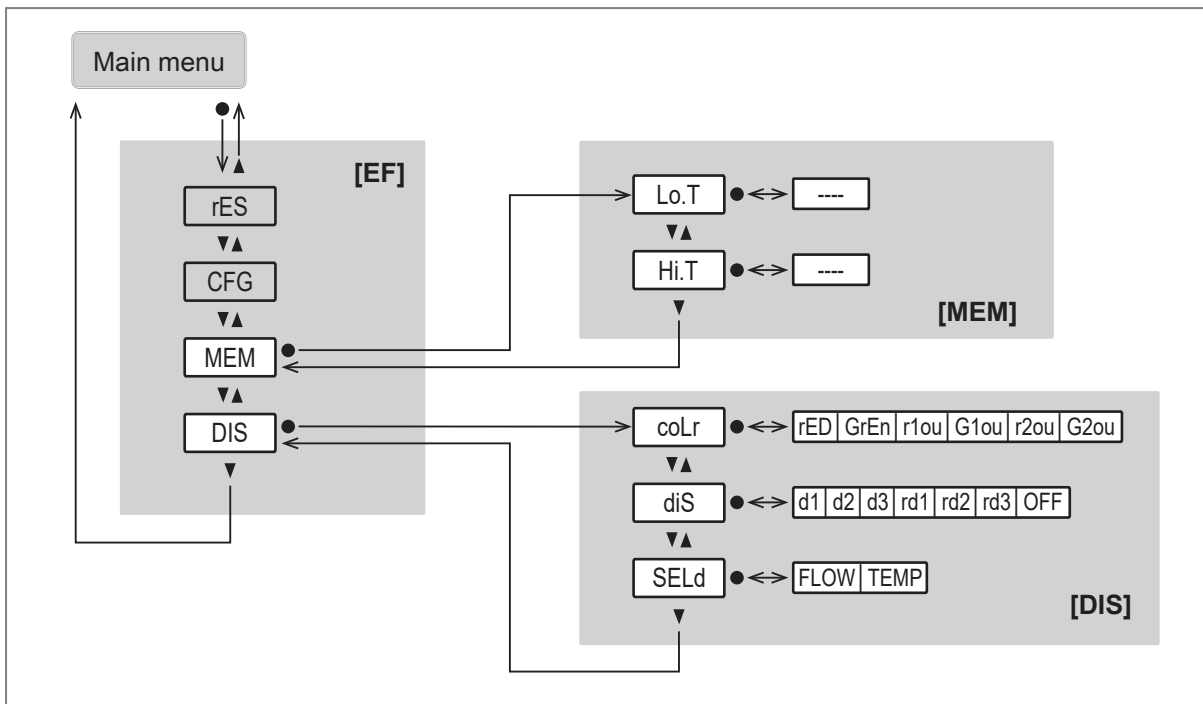
Parameter	Explanation
SPx	Switch point for switching output OUTx with hysteresis function
rPx	Reset point for switching output OUTx with hysteresis function
FHx	Upper limit for switching signal OUTx with window function
FLx	Lower limit for switching signal OUTx with window function
FSP1	Frequency start point for OUT1 = Lower measured value from which a frequency signal is provided (only for temperature measurement).
FEP1	Frequency end point for OUT1 = Upper measured value at which the frequency signal set under FrP1 is provided.
FrP1	Frequency signal which is provided when the upper measured value (MEW or FEP1) is reached.

Configuration [CFG] menu:



Parameter	Explanation
oux	Output function for hardware output OUTx
uni	Standard unit of measurement for flow
P-n	Output polarity for the switching outputs
dAP	Damping time in seconds for switching signal flow
dAA	Damping time in seconds for analog signal flow
MEdi	Selection of the medium to be monitored
FOUx	Behavior of output OUTx in case of an error
SELx	Process value for output OUTx

Memory [MEM] and display [DIS] menus:



Parameter	Explanation
Lo.T	Minimum measured temperature value
Hi.T	Maximum temperature value measured
colr	Color configuration of the display
diS	Update rate and orientation of the display
SELd	Standard process value of the display

9 Set-up

After power on and expiry of the power-on delay time, the unit is in the normal operating mode. It carries out its measurement and evaluation functions and generates output signals according to the set parameters.

During the power-on delay time the outputs are switched as programmed:

- OFF with normally open function (Hno / Fno)
- OFF with normally closed function (Hnc / Fnc)
- OFF for frequency output (FRQ)
- 0 mA for current output (I)

10 Parameter setting

Parameters can be set before installation or during operation.



If you change parameters during operation, this will influence the function of the plant.

- ▶ Ensure that there will be no malfunctions in your plant.

During parameter setting the unit remains in the operating mode. It continues to monitor with the existing parameter until the parameter setting has been completed.



Depending on the parameter setting, the parameters available in the menu may change.

Parameter setting process in general:

Intent	Action
Change from the process value display to the main menu	[●]
Change to the submenu	Use [▼] to navigate to the submenu (e.g. EF), then [●]
Selection of the desired parameter	▲ or [▼]
Change to setting mode	[●]
Changing the parameter value	▲ or [▼] > 1 s
Acceptance of the set parameter	[●]
Exit parameter setting without saving	[▲] + [▼]
Return to next higher menu (Repeat several times to reach process value display)	[▲] + [▼]
Return to the process value display	> 30 seconds (timeout)

10.1 Presets



Before setting the parameters, first check the following default settings and change them if necessary:

- [SEL1]: Process value for OUT1
- [SEL2]: Process value for OUT2
- [uni]: Standard unit of measurement for flow

10.1.1 Process value for OUTx

- ▶ Select the CFG menu.
- ▶ Select [SELx] and set the process value for output x:
 - FLOW: Flow
 - TEMP: Temperature

10.1.2 Standard unit of measurement

- ▶ Call up the menu [EF] > [CFG].
- ▶ Select [Uni] and set the unit of measurement for the flow.

10.2 Setting the output functions



The parameters for flow monitoring and temperature monitoring are set in the same way. The prerequisite is that the process value for OUTx has first been defined via [SELx].

10.2.1 Limit monitoring OUTx / hysteresis function

- ▶ Select the CFG menu.
- ▶ Select [oux] and set the switching signal:
 - Hno: hysteresis function / normally open
 - Hnc: hysteresis function / normally closed
- ▶ Select the main menu.
- ▶ Select [SPx] and set the measured value at which the output switches.
- ▶ Select [rPx] and set the measured value at which the output switches off.

10.2.2 Limit monitoring OUTx / window function

- ▶ Select the CFG menu.
- ▶ Select [oux] and set the switching signal:
 - Fno: window function / normally open
 - Fnc: window function / normally closed
- ▶ Select the main menu.
- ▶ Select [FHx] and set the upper limit of the window section.
- ▶ Select [FLx] and set the lower limit of the window section.

10.2.3 Frequency signal OUT1

- ▶ Select the CFG menu.
- ▶ Select [ou1] and set FRQ.
- ▶ Select the main menu.
- ▶ Select [FSP1] and set the lower temperature value at which 0 Hz is provided.



FSP1 is only available for temperature measurement.

- ▶ Select [FEP1] and set the upper measured value at which the maximum frequency is provided.
- ▶ Select [FrP1] and set the maximum frequency in Hz.

10.2.4 Analog signal OUT2

- ▶ Select the CFG menu.
- ▶ Select [ou2] and set the function:
 - l: flow-proportional current signal 4...20 mA.

10.3 User settings (optional)

10.3.1 Standard display

- ▶ Select the DIS menu.
- ▶ Select [SELd] and set the standard unit of measurement:
 - FLOW: The display shows the current process value for flow rate.
 - TEMP: The display shows the current process value for temperature.
- ▶ Select [diS] and set the update rate and orientation of the display:
 - d1, d2, d3: update of the measured values every 50, 200, 600 ms.
 - rd1, rd2, rd3: display as with d1, d2, d3; rotated by 180°.
 - OFF: The process value display is deactivated in the RUN mode.



The LEDs remain active even if the display is deactivated. Error messages are displayed even if the display is deactivated.

10.3.2 Display color setting

- ▶ Select the DIS menu.
- ▶ Select [coLr] and define the color of the characters in the process value display:
 - rEd: red
 - GrEn: green
 - rxou: color change from green to red
 - Gxou: color change from red to green

10.3.3 Medium

- ▶ Select the CFG menu.
- ▶ Select [MEdi] and set the medium:
 - H2O: Water
 - OIL: viscosity 10 mm²/s (104 °F)
 - OIL2: viscosity 46 mm²/s (104 °F)

10.3.4 Output logic

- ▶ Select the CFG menu.
- ▶ Select [P-n] and set PnP or nPn.

10.3.5 Measured value damping for switching output

- ▶ Select the CFG menu.
- ▶ Select [dAP] and set the damping constant in seconds (τ value 63 %).

10.3.6 Measured value damping for analog output

- ▶ Select the CFG menu.
- ▶ Select [dAA] and set the damping constant in seconds (τ value 63 %).

10.3.7 Error behavior of the outputs

- ▶ Select the CFG menu.
- ▶ Select [FOUx] and set the error behavior for OUTx:
 - Switching output
 - On: Output switches ON in case of a fault.
 - OFF: Output switches OFF in case of a fault.
 - OU: Output switches irrespective of the error as defined with the parameters.
 - Analog output
 - On: The analog signal goes to 22 mA.
 - OFF: The analog signal goes to 3.5 mA.
 - OU: The analog signal still corresponds to the measured value.
 - Frequency output
 - On: The frequency signal goes to 130 % of FrPx.
 - OFF: The frequency signal goes to 0 Hz.
 - OU: The frequency signal still corresponds to the measured value.

10.3.8 Lock / unlock

The unit can be locked electronically to prevent unintentional settings. Factory setting: not locked.

Locking:

- ▶ Make sure that the unit is in the normal operating mode.
- ▶ Press [▲] and [▼] simultaneously for 10 s until [Loc] displayed.

Unlocking:

- ▶ Make sure that the unit is in the normal operating mode.
- ▶ Press [▲] and [▼] simultaneously for 10 s until [uLoc] is displayed.

10.3.9 Factory reset

- ▶ Select the EF menu.
- ▶ Select [rES].
- ▶ Briefly press [●].
- ▶ Keep [▼] or [▲] pressed.
 - ▷ [----] is displayed.
- ▶ Briefly press [●].
- ▷ The unit carries out a reboot.



We recommend documenting your own settings in the chapter Factory setting before carrying out a reset.

10.4 Diagnostic functions

10.4.1 Reading minimum values / maximum values

- ▶ Select the MEM menu.

▶ Select [Lo.T] or [Hi.T] to display the highest or lowest process value measured:

- Lo.T = Minimum temperature value
- Hi.T = Maximum temperature value

Delete memory:

▶ Select [Lo.T] or [Hi.T].

▶ Briefly press [●].

▶ Keep [▲] and [▼] pressed.

▷ [----] is displayed.

▶ Briefly press [●].



It makes sense to delete the memories as soon as the unit operates under normal operating conditions for the first time.

11 Operation

11.1 Process value display

It is possible to switch between different process value indications during operation:

- ▶ Press [▲] or [▼].
- ▷ The display changes between the standard indication with set standard unit of measurement and other views.
- ▷ After 30 s, the unit returns to the standard display.

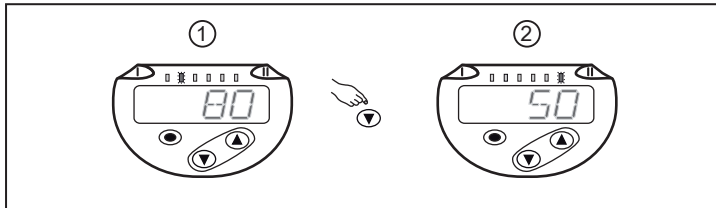


Fig. 15: Process value display

- 1: Standard display as set under [SELD] and [uni].
Example: [SELD] = FLOW and [uni] = m³/h
- 2: Further view. The LED indicates in which unit the current process value is displayed.
Example: temperature in °C.

11.2 Reading the parameter setting

- ▶ Briefly press [●].
- ▶ Press [▼] to select the parameter.
- ▶ Briefly press [●].
- ▷ The currently set value is displayed for 30 s. Then the unit returns to the process value display.

12 Troubleshooting

The device provides self-diagnostic options. It monitors itself automatically during operation.

Warnings and error states are displayed even if the display is switched off.

If several diagnostic events occur simultaneously, only the diagnostic message of the event with the highest priority is displayed.

If the measured temperature value fails, the process value for flow rate is still available.

12.1 Error messages

Display indication	Problem / remedy
Err	Device faulty / malfunction ▶ Replace the device.
No display	<ul style="list-style-type: none"> • Supply voltage too low ▶ Check the supply voltage. • Display switched off ▶ Check whether setting diS = OFF and change setting if necessary.
Loc	Setting keys on the device locked, parameter change rejected. ▶ Unlock the device using the device keys.
UL	<ul style="list-style-type: none"> • Value below the minimum value of the temperature display range: temperature value between -32...-43 °C (-26...-46 °F). ▶ Check the temperature range.
OL	<ul style="list-style-type: none"> • Temperature display range exceeded: temperature value between 122...133 °C (252...272 °F). ▶ Check the temperature range. • Flow display range exceeded: flow value between 120...130 % of the final value of the measuring range. ▶ Adjust the flow range.
SC1	Switching status LED for OUT1 flashing: short circuit OUT1. ▶ Check switching output OUT1 for short circuit or excessive current.
SC2	Switching status LED for OUT2 flashing: short circuit OUT2. ▶ Check switching output OUT2 for short circuit or excessive current.
SC	Switching status LEDs for OUT1 and OUT2 flashing: short circuit OUT1 and OUT2. ▶ Check switching outputs OUT1 and OUT2 for short-circuit or excessive current.

13 Maintenance, repair and disposal

The unit is maintenance-free.

- ▶ After use, dispose of the unit in an environmentally friendly way in accordance with the applicable national regulations.

13.1 Cleaning the device

If measurement errors occur because of an insufficient filtration cleaning may be required:

- ▶ Unscrew sensor head.
- ▶ Remove float and spring.
- ▶ Clean the inside of the float, spring and housing, e.g. by means of compressed air.
- ▶ Before re-assembly check O-ring for damage. If necessary, replace and grease.
- ▶ After cleaning install components again.
- ▶ Tighten sensor head with a tightening torque of 20 Nm.
- ▶ To restore the measurement accuracy, press the float until you feel a mechanical stop using something non-magnetic, e.g. a finger and hold for at least 2 seconds.

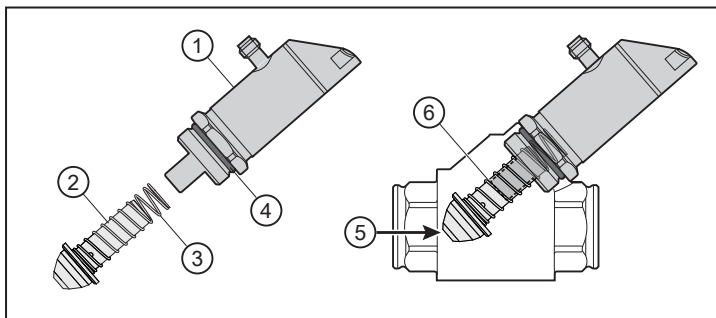


Fig. 16: Cleaning the sensor

- | | |
|----------------------|--------------------|
| 1: sensor head | 2: float |
| 3: spring | 4: O-ring |
| 5: non-magnetic tool | 6: mechanical stop |

14 Factory settings

Parameter	Factory setting	User setting
SP1 / FH1 (FLOW)	20 %	
rP1 / FL1 (FLOW)	19 %	
SP1 / FH1 (TEMP)	54 °F	
rP1 / FL1 (TEMP)	52 °F	
FrP1 (FLOW)	10 %	
FrP1 (TEMP)	10 %	
FSP1 (TEMP)	14 °F	
FEP1 (TEMP)	212 °F	
FEP1 (FLOW)	100 %	
SP2 / FH2 (FLOW)	40 %	
rP2 / FL2 (FLOW)	39 %	
SP2 / FH2 (TEMP)	94 °F	
rP2 / FL2 (TEMP)	92 °F	
ou1	Hno	
ou2	l	
uni	gal/min	
P-n	PnP	
dAP (FLOW)	0.1	
dAA (FLOW)	0	
Medl	H2O	
FOU1	ou	
FOU2	ou	
SEL1	FLOW	
SEL2	FLOW	
coLr	rEd	
diS	d2	
SEld	FLOW	