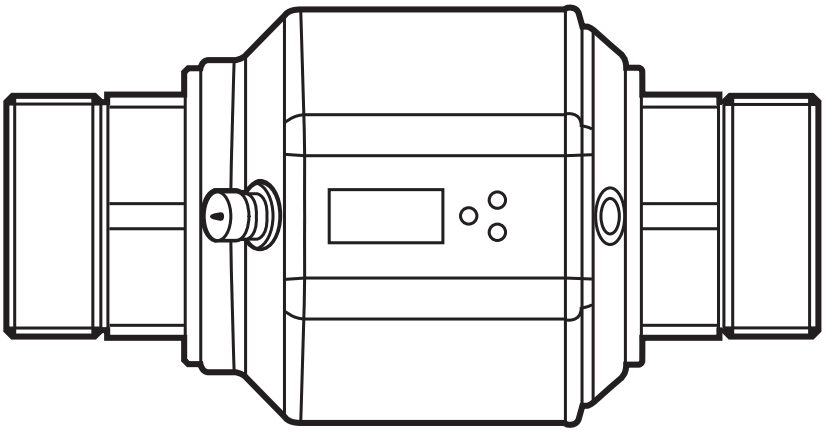
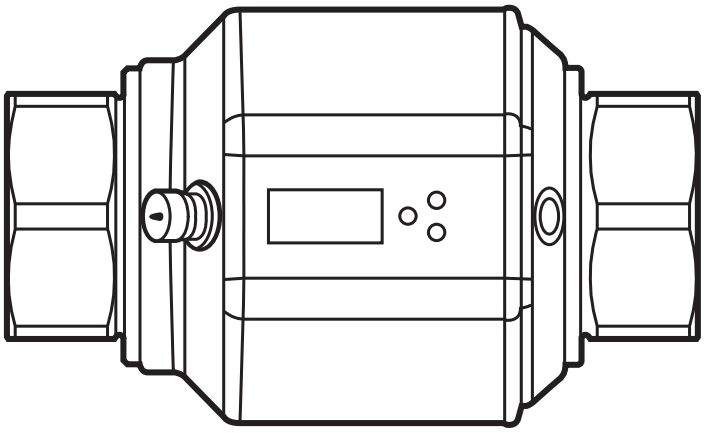
CE

Operating instructions
Magnetic-inductive flow meter

SM0510
SM2x00
SM2130
SM9x00
SM2x01
SM9x01

UK





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Contents

1 Preliminary note

1.1 Symbols used

▶ 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 used

CAUTION

Warning of personal injury.
Slight reversible injuries may result.

2 Safety instructions

- The device described is a subcomponent for integration into a system.
  - The manufacturer of the system is responsible for the safety of the system.
  - The system manufacturer undertakes to perform a risk assessment and to create a 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 authorised by the manufacturer 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 (→ Functions and features).
- Only use the product for permissible media (→ Technical data).
- 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 unit must be carried out by qualified personnel authorised by the machine operator.
- Protect units and cables against damage.

3 Functions and features

The unit monitors liquid media. It detects the 3 process variables volumetric flow quantity, consumed quantity, medium temperature.

3.1 Pressure Equipment Directive (PED)

The units comply with the Pressure Equipment Directive and are designed and manufactured for group 2 fluids in accordance with the sound engineering practice. Use of group 1 fluids on request.

3.2 Applications

Conductive liquids with the following properties:

- Conductivity: ≥ 20 µS/cm
- Viscosity: < 70 mm2/s at 40 °C; < 70 cSt at 104°F

This is a class A product.
The unit may cause radio interference in domestic areas.

▶ If required, take appropriate EMC screening measures.

3.3 Note regarding SM0510 and SM2130

Operation in overload conditions can cause cavitation. Operation with cavitation can damage the pressure-carrying parts.

▶ Consider the cavitation limits (→ Technical data).

4 Function

- The unit detects the flow based on the magnetic-inductive volumetric flow measuring principle.
- The unit also detects the medium temperature.
- It features an IO-Link interface.
- The unit displays the current process value.

4.1 Process measured signals

The unit generates 2 output signals according to the parameter settings:

OUT1/IO-Link: 5 selection options	Parameter setting
- Switching signal for volumetric flow limit value	→ 10.2.1
- Frequency signal for volumetric flow quantity	→ 10.2.4

- Pulse signal for quantity meter → 10.3.1
- Switching signal for preset counter → 10.3.2
- Switching signal for empty pipe detection → 10.5.8

OUT2: 6 selection options Parameter setting

- Switching signal for volumetric flow limit value → 10.2.2
- Switching signal for temperature limit value → 10.4.1
- Analogue signal for volumetric flow quantity → 10.2.3
- Analogue signal for temperature → 10.4.2
- Switching signal for empty pipe detection → 10.5.8
- Input for external reset signal (InD) → 10.3.7

4.2 Direction of flow

In addition to the flow velocity and the volumetric flow quantity, the unit also detects the direction of flow.

4.2.1 Determining the direction of flow (Fdir)

An arrow with the text "flow direction" on the unit indicates the positive flow direction. The flow direction can be inversed (→ 10.5.3).

▶ Use the supplied label to mark the changed flow direction (new positive direction of flow).

Flow...	Process value display
corresponds to the marked flow direction	+ (positive)
against the marked flow direction	- (negative)

4.3 Consumed quantity monitoring (ImP)

The unit has an internal mass flow meter (totaliser). It continuously totals the consumed quantity after the last reset. Pulse signals or a switching signal can be used to monitor the consumed quantity.
→ 10.3.1 Quantity monitoring by pulse output (OUT1)
→ 10.3.2 Quantity monitoring by preset counter (OUT1)

4.3.1 Display and counting method of the quantity meter

Meter reading:

- The current quantity meter reading can be indicated (→ 11.2).
- In addition, the value before the last reset is saved. This value can also be displayed (→ 11.2).

The meter saves the totalled volumetric flow quantity every 10 minutes. After a power failure this value is available as the current meter reading. If a time-controlled reset is set, the elapsed time of the set reset interval is also saved. So the possible data loss can be at most 10 minutes.

Counter reset:

- There are different ways to reset the quantity meter.
  → 10.3.4 Manual counter reset
  → 10.3.5 Time-controlled counter-reset
  → 10.3.7 Counter reset using an external signal
- If the quantity meter is not reset by applying one of the above-mentioned methods, an automatic reset takes place when the maximum volumetric flow quantity that can be displayed is exceeded (overflow).

Consideration of the direction of flow:

- The quantity meter takes account of the flow direction when totalising the consumed quantity. The following counting methods can be defined via the parameter [FPro] (→ 10.5.12):

[FPro]	Counting method
0+	Negative flow values (against the marked direction of flow) are not taken into consideration for totalling.
– +	Negative flow values are subtracted from the consumed quantity.

Depending on the setting of the counting method [FPro] totalling of the volumetric flow quantity takes into account the flow in negative direction of flow (– +) or does not take it into account (0+).

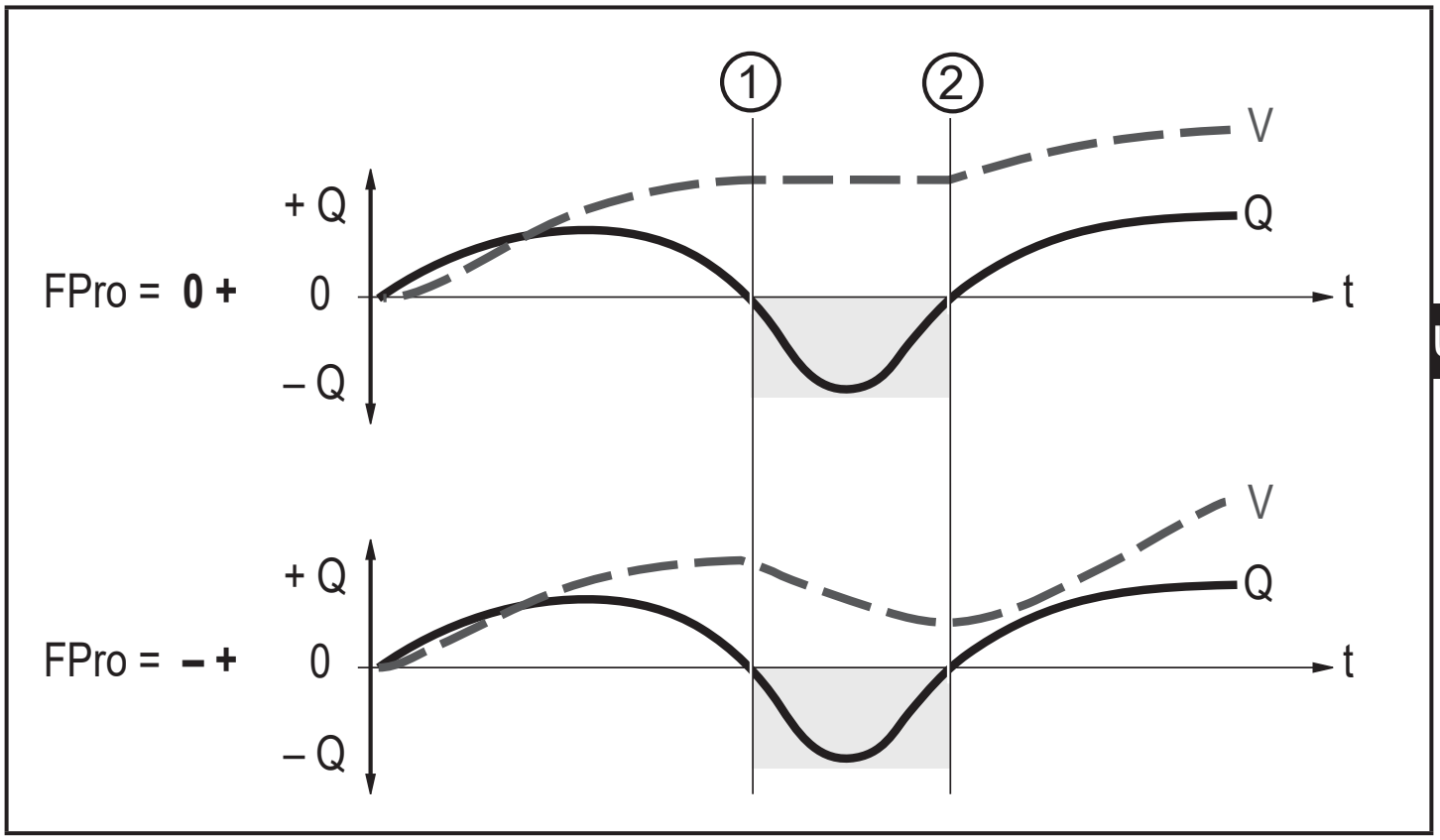


Fig. 1: Taking account of the volumetric flow direction when totalling the consumed quantity

+ Q = volumetric flow quantity in positive direction
- Q = volumetric flow quantity in negative direction
V = volumetric flow quantity absolute (= sum of negative and positive volumetric flow)
① Volumetric flow changes to negative direction
② Volumetric flow changes to positive direction

When the volumetric flow direction is changed a minimum volumetric flow quantity is taken into account: - LFC in negative direction; + LFC in positive direction.

4.3.2 Consumed quantity monitoring via pulse output

OUT 1 issues a pulse signal each time the set volumetric flow quantity has been reached (→ 10.3.3 Pulse value).

4.3.3 Consumed quantity monitoring via preset counter

2 kinds of monitoring are possible which can be set via the parameter [rTo].

[rTo]	Output	Meter reset
OFF (→ 10.3.6)	OUT1 switches when the volumetric flow quantity set with [ImPS] has been reached.	The preset counter is only reset - when a manual reset is made (→ 10.3.4) or - when the maximum display range has been exceeded.
1, 2,... h 1, 2,... d 1, 2,... w (→ 10.3.5)	OUT1 switches when the volumetric flow quantity set with [ImPS] is reached within the set time.	The preset counter is reset automatically when the time has elapsed and counting starts again.

4.4 Empty pipe detection

The unit detects when the two electrodes are not wetted by the medium.

The empty pipe detection can be activated or deactivated (→ 10.5.8). If it is active and the pipe is empty, the unit reacts as follows:

> [SEnS] is indicated in the display.

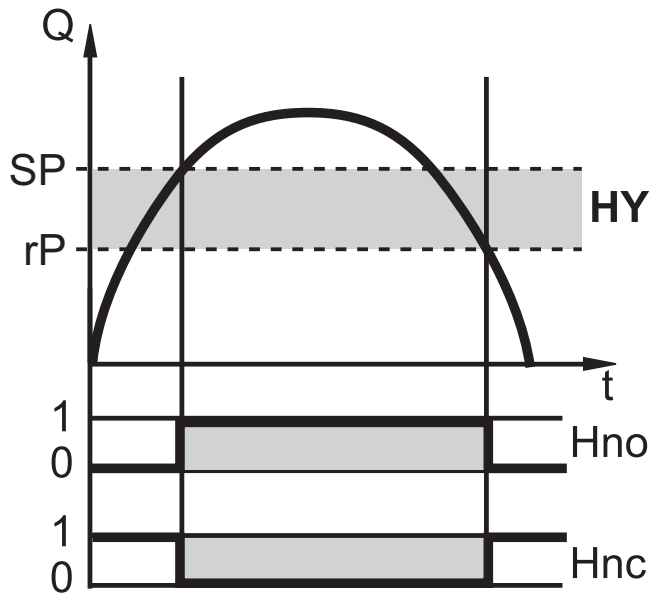
> The flow is set to zero.

The empty pipe detection can be set as time-depending or not time depending) (→ 10.5.10).

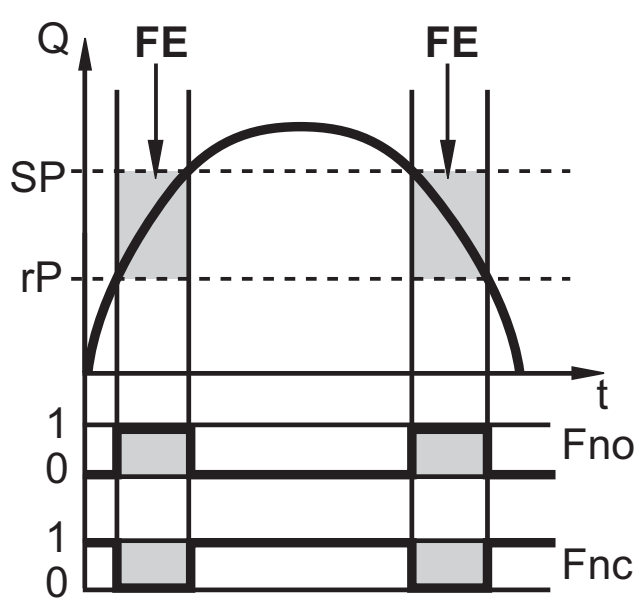
4.5 Switching function

OUTx changes its switching status if it is above or below the set switching limits (flow or temperature). Hysteresis or window function can be selected. Example of volumetric flow monitoring:

Hysteresis function



Window function



SP = set point
rP = reset point
HY = hysteresis
Hno = hysteresis NO (normally open)
Hnc = hysteresis NC (normally closed)

SP = upper limit
rP = lower limit
FE = window
Fno = window NO (normally open)
Fnc = window NC (normally closed)

When the hysteresis function is set, the set point [SP] is defined first and then the reset point [rP] which must have a lower value. If only the set point is changed, the reset point is changed automatically; the difference remains constant.

When set to the window function, the upper limit [SP] and the lower limit [rP] have a fixed hysteresis of 0.25 % of the final value of the measuring range. This keeps the switching status of the output stable if the flow rate varies slightly.

4.6 Analogue function

- The unit provides an analogue signal that is proportional to the flow quantity and the medium temperature.
- The analogue signal can be provided as current or voltage signal.
- Within the measuring range, the analogue signal is 4...20 mA (current output) or 0...10 V (voltage output).
- If the measured value is outside the measuring range or in the event of an internal error, the current or voltage signals indicated in Figure 1 are provided.
- The measuring range is scalable:
  Analogue start point [ASP2] determines at which measured value the output signal is 4 mA or 0 V.
  Analogue end point [AEP2] determines at which measured value the output signal is 20 mA or 10 V.

  Minimum distance between [ASP2] and [AEP2] = 20 % of the final value of the measuring range.

MAW	Initial value of the measuring range	For non-scaled measuring range (= factory setting)
VMR	Final value of the measuring range	
ASP2	Analogue start point	For scaled measuring range
AEP2	Analogue end point	

Table 1: Definitions

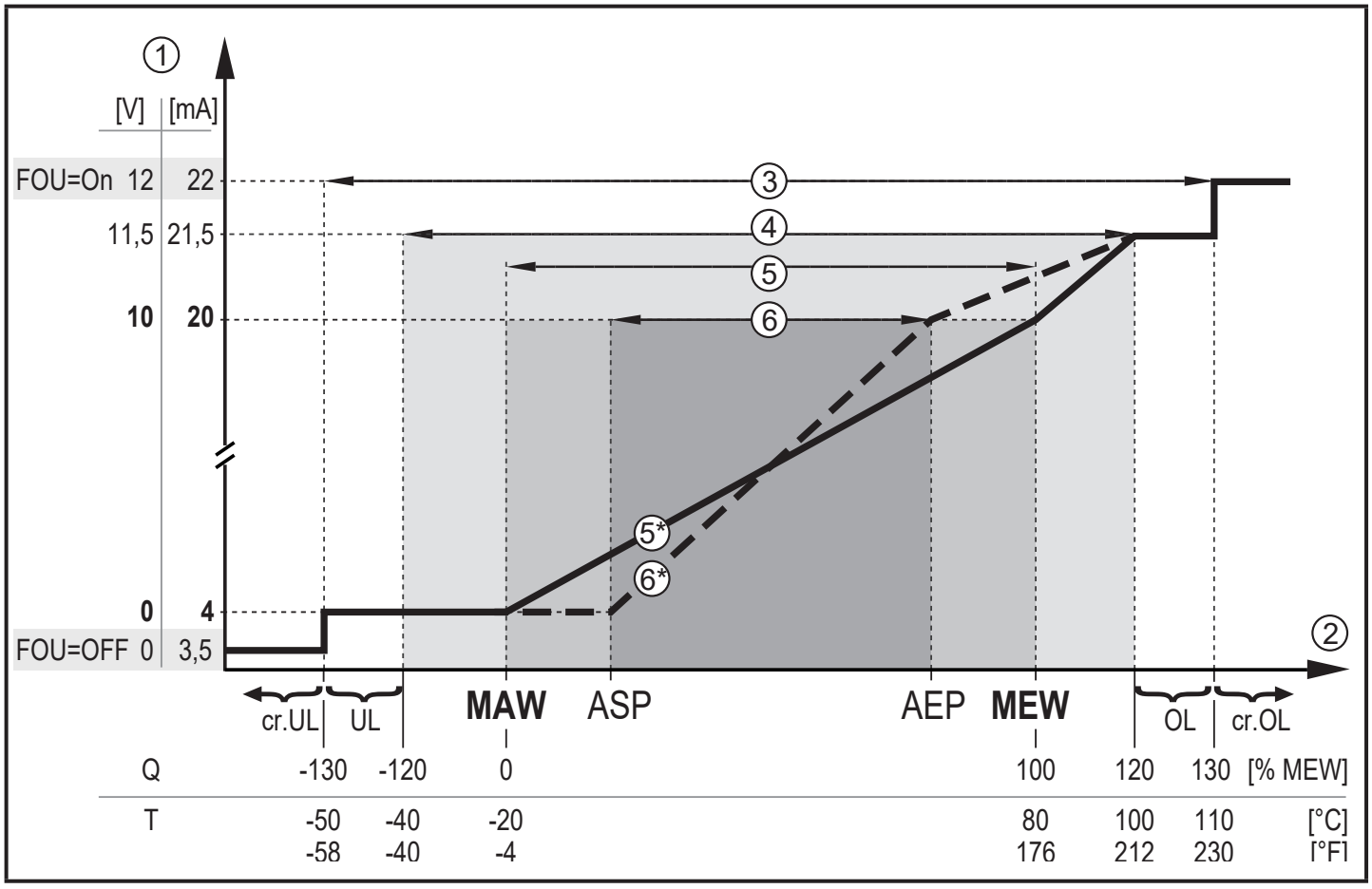


Figure 1: Characteristics of the analogue output according to the standard IEC 60947-5-7.

Q: Flow (a negative flow value means flow against the marked flow direction).
T: Temperature
UL: Below the display range
OL: Above the display range
cr.UL: Below the detection zone (error)
cr.OL: Above the detection zone (error)
FOU=On: Default setting at which the analogue signal goes to the upper final value in case of an error.*
FOU=OFF: Default setting at which the analogue signal goes to the lower final value in case of an error.

* The type of error is displayed: cr.UL, cr.OL, Err (→ 12).

① Analogue signal (voltage or current)
② Measured value (flow or temperature)
③ Detection zone
④ Display range
⑤ Measuring range
⑤* Analogue signal in the measuring range with factory setting
⑥ Scaled measuring range
⑥* Analogue signal with scaled measuring range

4.7 Frequency output

The unit provides a frequency signal that is proportional to the volumetric flow.

Within the measuring range the frequency signal is between 0 and 1 kHz for the factory setting.

The frequency signal is scalable:

FrEP = Frequency signal in Hz which is provided at OUT1 when the upper measured value FEP is reached.

Factory setting: FrEP = 1 kHz = 100 %.

The measuring range is scalable:

FEP = Upper measured value at which OUT1 provides the frequency signal FrEP.

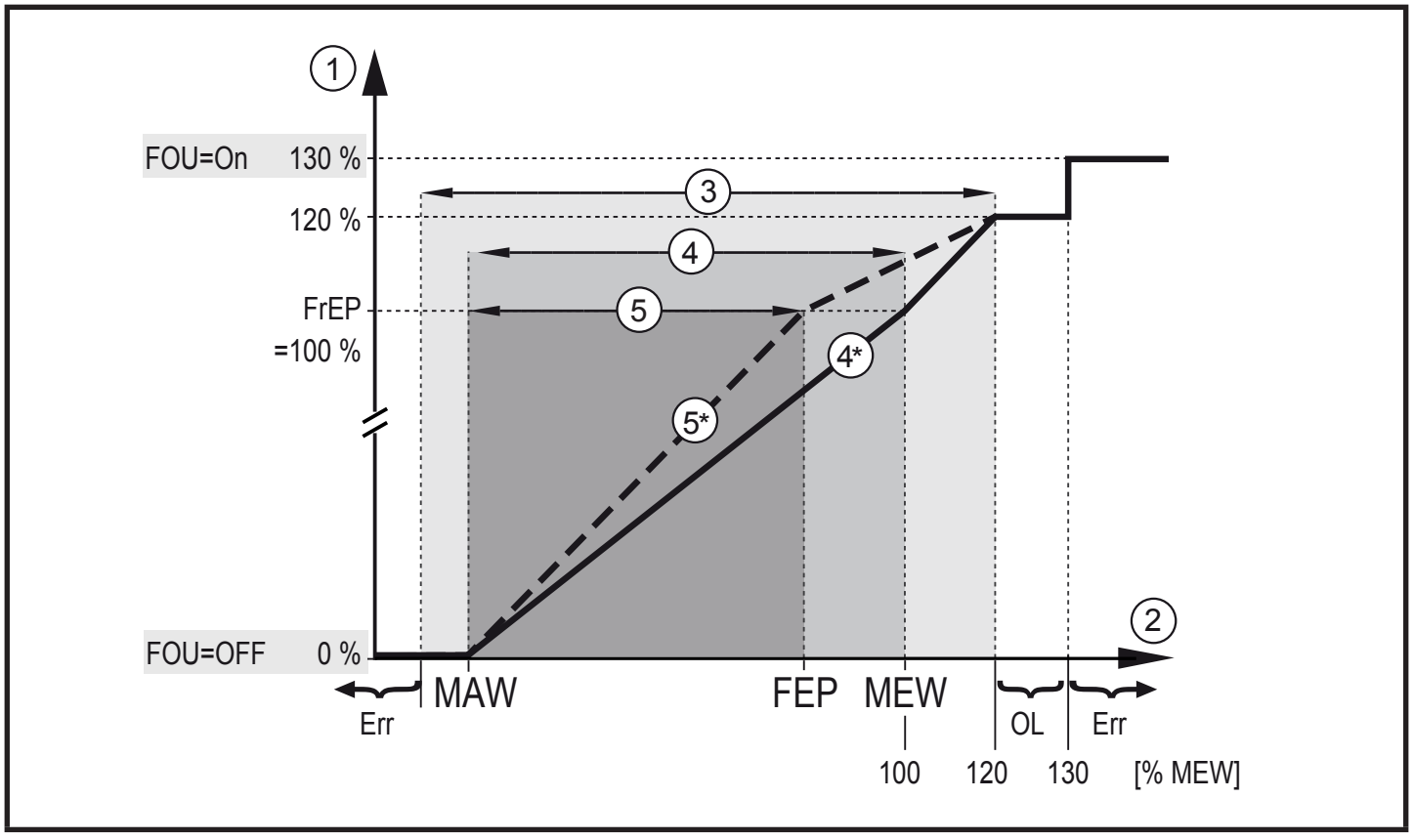


Figure 1: Output curve frequency output
MAW = initial value of the measuring range; MEW = final value of the measuring range

① Frequency signal
② Volumetric flow quantity
③ Display range
④ Measuring range
④* Frequency signal in the measuring range with factory setting
⑤ Scaled measuring range
⑤* Frequency signal with scaled measuring range

4.8 Measured value damping (dAP)

The damping time enables to set after how many seconds the output signal has reached 63 % of the final value if the flow value changes suddenly. The set damping time stabilises the outputs, the display and the process value transfer via the IO-Link interface. The signals [UL] and [OL] (→ 12) are defined under consideration of the damping time.

4.9 Start-up delay (dSt)

The start-up delay dST influences the switching outputs of the volumetric flow monitoring.

If the start-up delay is active (dST > 0), note: As soon as the volumetric flow quantity exceeds the LFC (LFC = Low flow cut-off → 4.10), the following processes are carried out:

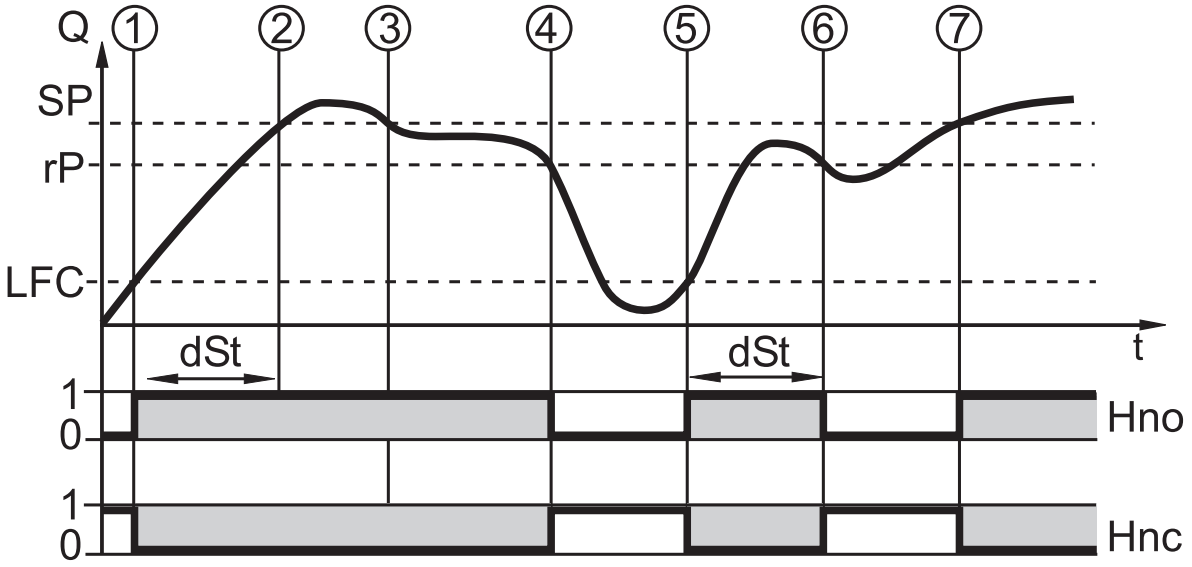
> The start-up delay is activated.

> The outputs switch as programmed:ON for NO function, OFF for NC function.

After the start of the start-up delay there are 3 options:

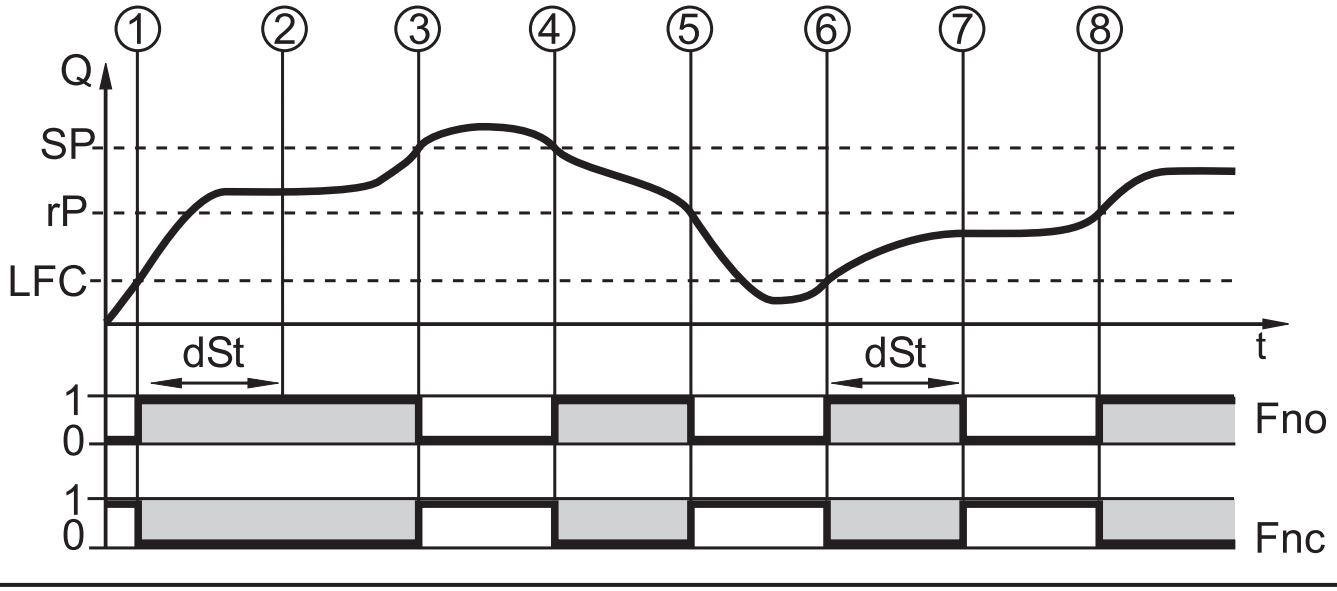
1. The volumetric flow increases quickly and reaches the set point / good range within dST.
   > Outputs remain active.
2. The volumetric flow increases slowly and does not reach the set point /good range within dST.
   > Outputs are reset.
3. Volumetric flow quantity falls below LFC within dST.
   > Outputs are reset at once; dST is stopped.

Example: dST for hysteresis function



	Condition	Reaction
1	Volumetric flow quantity Q reaches LFC	dST starts, output becomes active
2	dST elapsed, Q reached SP	Output remains active
3	Q below SP but above rP	Output remains active
4	Q below rP	Output is reset
5	Q reaches again LFC	dST starts, output becomes active
6	dST elapsed, Q has not reached SP	Output is reset
7	Q reaches SP	Output becomes active

Example: dST for window function



	Condition	Reaction
1	Volumetric flow quantity Q reaches LFC	dST starts, output becomes active
2	dST elapsed, Q reached good range	Output remains active
3	Q above SP (leaves good range)	Output is reset
4	Q again below SP	Output becomes active again
5	Q below rP (leaves good range)	Output is reset again
6	Q reaches again LFC	dST starts, output becomes active
7	dST elapsed, Q has not reached good range	Output is reset
8	Q reaches good range	Output becomes active

4.10 Low flow cut-off (LFC)

With this function small volumetric flow quantities can be suppressed (→ 10.5.13). Flows below the LFC value are evaluated by the sensor as standstill (Q = 0).

4.11 Simulation

With this function flow and temperature values can be simulated (→ 10.6.2).
The simulation does not have any effect on the totaliser or the current flow. The outputs operate as previously set.
When the simulation starts, the value of the totaliser is saved and then the simulated totaliser is set to 0. The simulated flow value then has an effect on the simulated totaliser. When the simulation is finished, the original totaliser value is restored.

During the simulation the original totaliser value remains saved without any changes even if there is a real flow.

4.12 IO-Link

This unit has an IO-Link communication interface which enables direct access to process and diagnostic data. In addition it is possible to set the parameters of the unit during operation. Operation of the unit via IO-Link interface requires an IO-Link capable module (IO-Link master).

With a PC, suitable IO-Link software and an IO-Link adapter cable communication is possible when the system is not in operation.

The IODDs necessary for the configuration of the unit, detailed information about process data structure, diagnostic information, parameter addresses and the

necessary information about the required IO-Link hardware and software can be found at www.ifm.com.

5 Installation

CAUTION

If the medium temperature is above 50 °C (122 °F) parts of the housing can increase in temperature to over 65 °C (149 °F).

> Risk of burns.

▶ Protect the housing against contact with flammable substances and unintentional contact.

▶ Apply the supplied warning label to the sensor cable.

▶ Ensure that the system is free of pressure during installation.
▶ Ensure that no media can leak at the mounting location during installation.
▶ Avoid deposits, accumulated gas and air in the pipe system.

The unit can be installed independently of the orientation if the following is ensured:

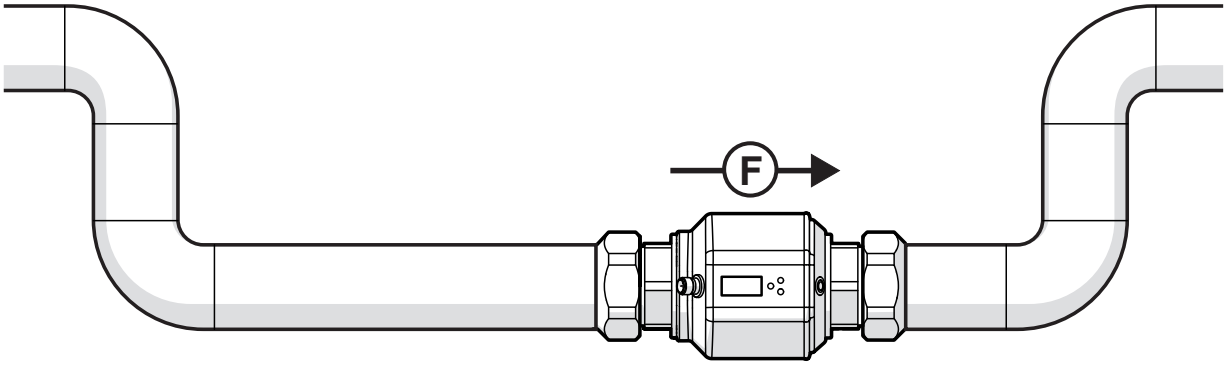
- No air bubbles can form in the pipe system.
- The pipes are always completely filled.

5.1 Recommended mounting position

▶ To ensure best possible empty pipe detection, install the unit according to Figure 1.

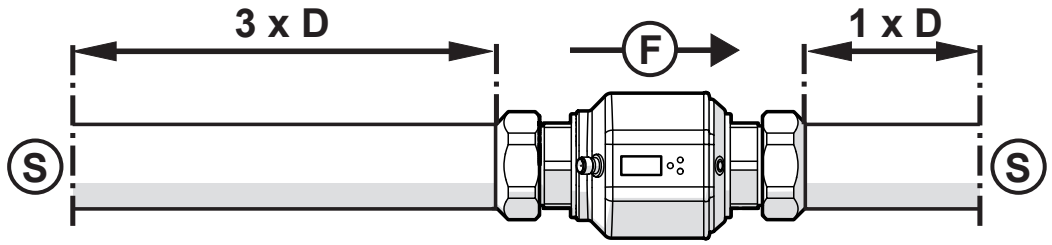
Example of an optimised installation:

1



- ▶ Install the unit so that the measuring pipe is always completely filled.
- ▶ Allow for laminar flow for inlet and outlet pipe lengths. Disturbances caused by bends, valves or pipe reductions, etc. are then eliminated This applies in particular to: Shut-off valves and control devices are not allowed directly in front of the unit.

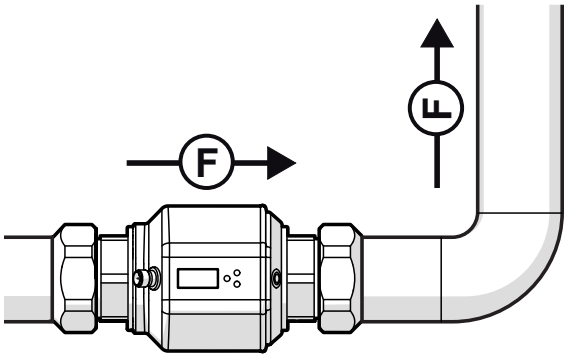
2



S = disturbance; D = pipe diameter; F = flow direction

- ▶ Install in front of or in a rising pipe:

3



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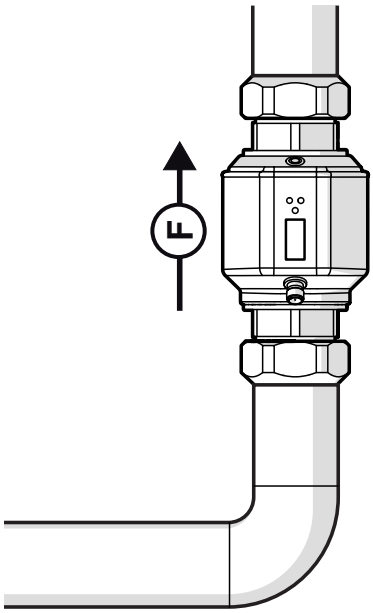
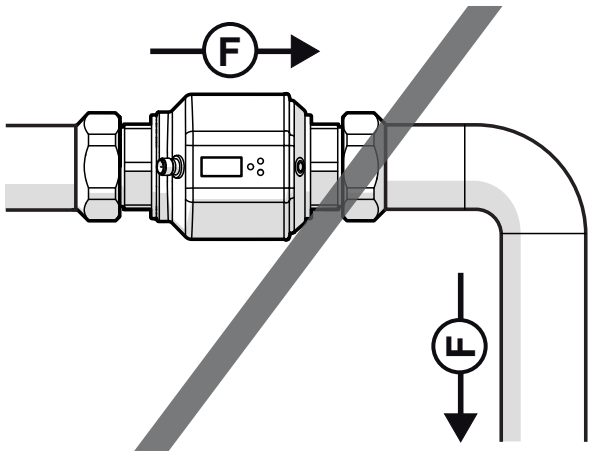


F = flow direction

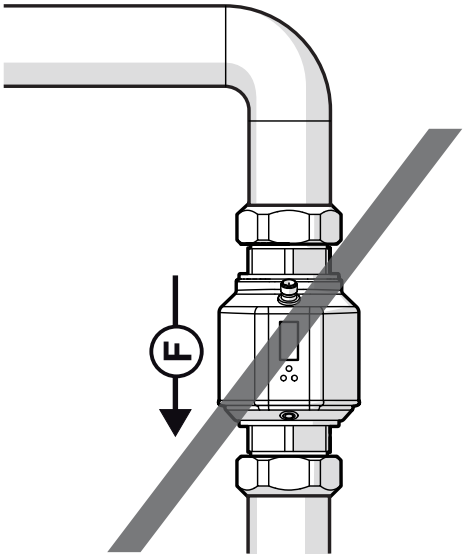
UK

5.2 Non recommended installation position

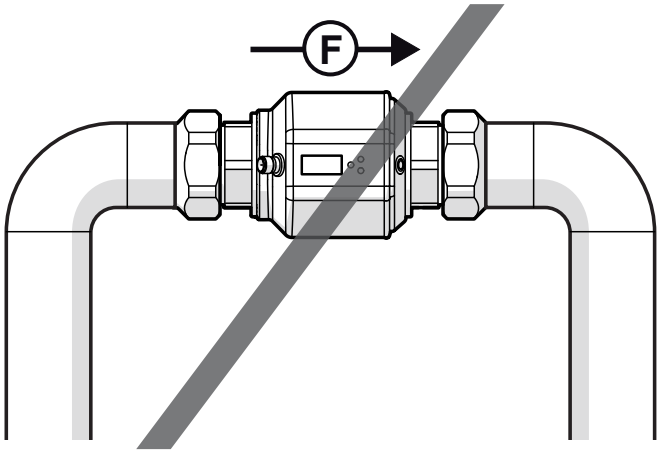
▶ Avoid the following installation positions:



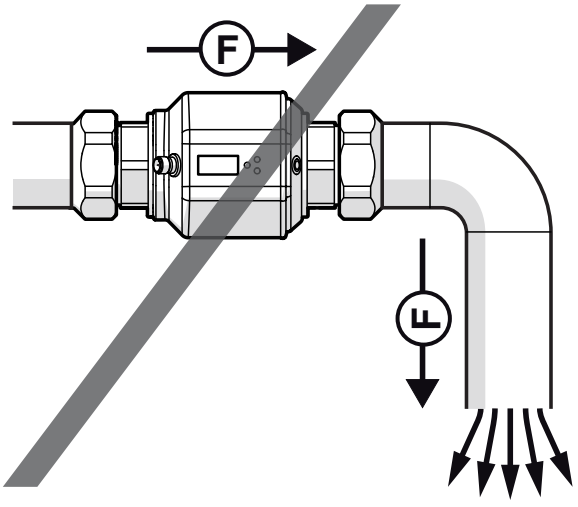
Directly in front of a falling pipe.



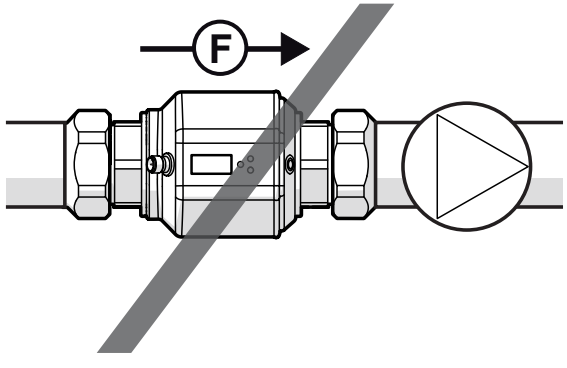
In a falling pipe.



At the highest point of the pipe system.



Directly in front of the spout of the pipe.



On the suction side of a pump.

F = flow direction

5.3 Grounding

If installed in an ungrounded pipe system (e.g. plastic pipes), the unit must be grounded (functional earth).

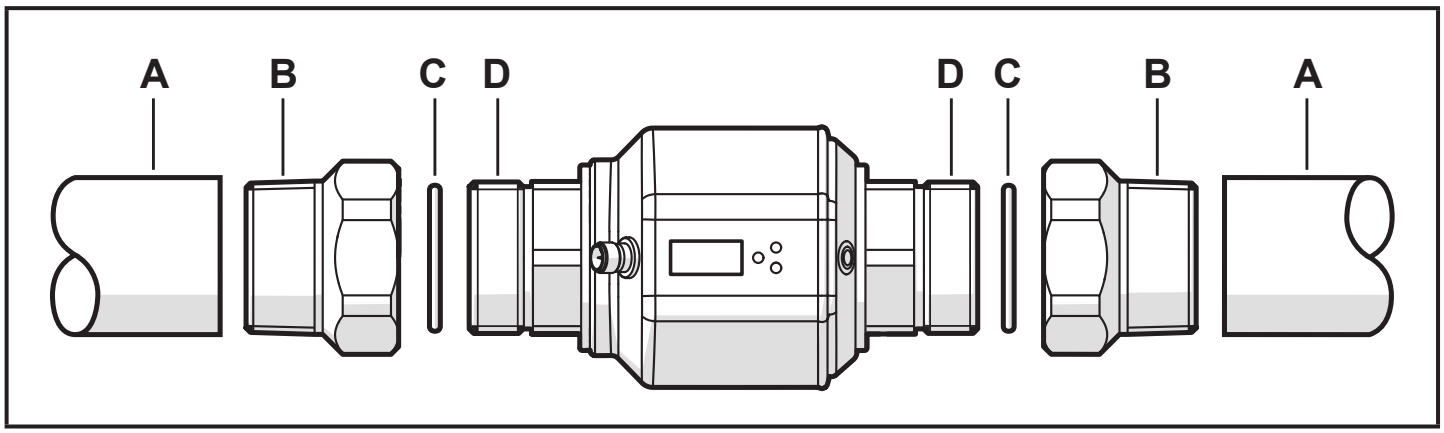
Ground brackets for the M12 connector are available as accessories (→ www.ifm.com).

5.4 Installation in pipes

The units with a G thread can be installed in the pipes using adapters.

Information about the available mounting accessories at

A correct fit of the unit and ingress resistance of the connection are only ensured using ifm adapters.



1. Screw the adapter (B) into the pipe (A).
2. Place the seals (C) and install the unit according to the marked flow direction.
   ▶ To mount the adapters on the process connection of the sensor use suitable lubricants.
3. Screw the adapter (B) with the threads (D) until it is hand-tight.
4. Tighten the two adapters in opposite direction (tightening torque: 30 Nm).

After installation, air bubbles in the system can affect the measurement.
Corrective measures:

▶ Rinse the system after installation for ventilation (rinsing quantity > 15 l/min, 4 gpm).

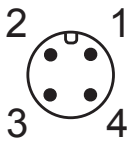
In case of horizontal installation:
As a result of horizontal mounting a small quantity of the medium always remains in the measuring channel, even after switching off the pump.

6 Electrical connection

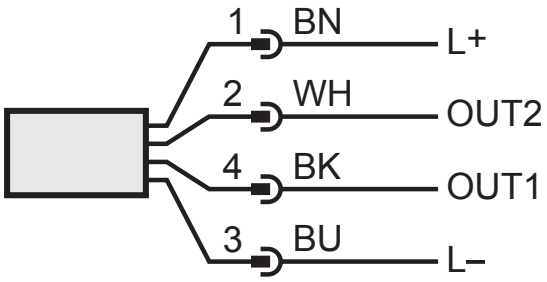
The unit must be connected by a qualified electrician.
The national and international regulations for the installation of electrical equipment must be adhered to.
Voltage supply according to EN 50178, SELV, PELV.

▶ Disconnect power.

▶ Connect the unit as follows:



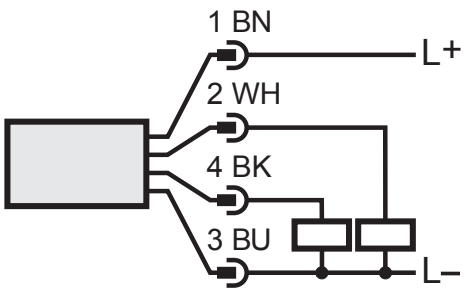
BK: black
BN: brown
BU: blue
WH: white



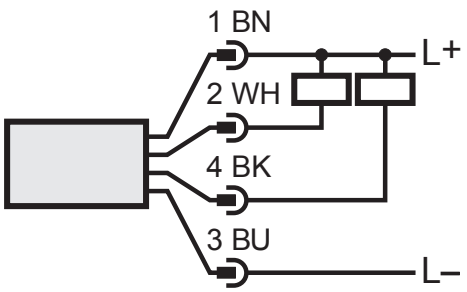
Colours to DIN EN 60947-5-2

Sample circuits:

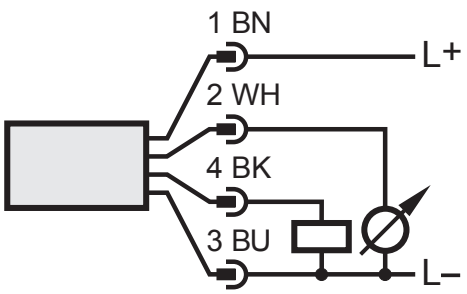
2 x positive switching



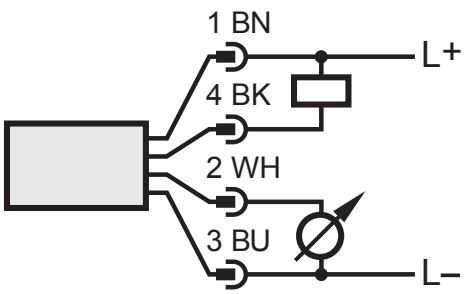
2 x negative switching



1 x positive switching / 1 x analogue



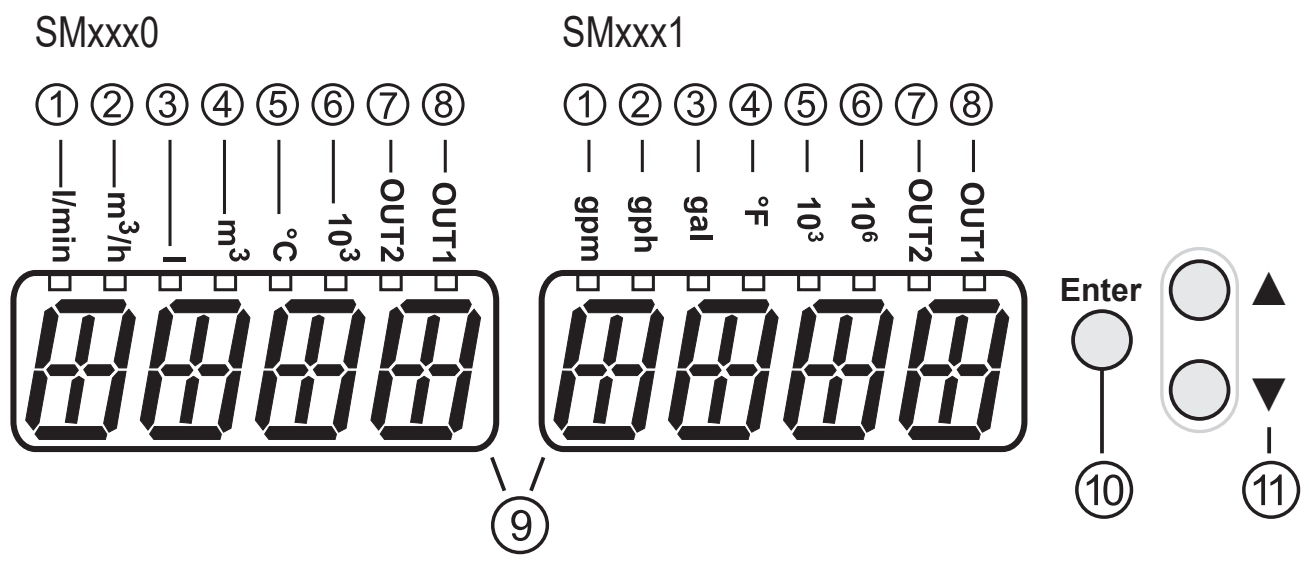
1 x negative switching / 1 x analogue



Pin 1	L+
Pin 3	L-

Pin 4 (OUT1)	• Switching signal: limit values for volumetric flow quantity • Pulse signal: 1 pulse every time the defined volumetric flow quantity is reached • Switching signal: quantity meter has reached preset value • Frequency signal for volumetric flow quantity • Switching signal: empty pipe detection • IO-Link
Pin 2 (OUT2/InD)	• Switching signal: limit values for volumetric flow quantity • Switching signal: limit values for temperature • Analogue signal for volumetric flow quantity • Analogue signal for temperature • Switching signal: empty pipe detection • Input for external reset signal (InD)

7 Operating and display elements



1-6: Indicator LEDs

SMxxx0:

LED		Process value display		Unit
1	□	Current flow volume per minute		l/min
2	□	Current flow volume per hour		m^3/h
3	□	Current consumed quantity (= meter reading) since the last reset	Totaliser *	l
4	□			m^3
4 + 6	□			$m^3 \times 10^3$
3	⌘	Consumed quantity (= meter reading) before the last reset		l
4	⌘			m^3
4 + 6	⌘			$m^3 \times 10^3$
5	□	Current medium temperature		°C

SMxxx1:

LED		Process value display		Unit
1	□	Current flow volume per minute		gpm
2	□	Current flow volume per hour		gph
3	□	Current consumed quantity (= meter reading) since the last reset	Totaliser *	gal
3 + 5	□			gal x 10^3
3 + 6	□			gal x 10^6
3	⌘	Consumed quantity (= meter reading) before the last reset		gal
3 + 5	⌘			gal x 10^3
3 + 6	⌘			gal x 10^6
4	□	Current medium temperature		°F

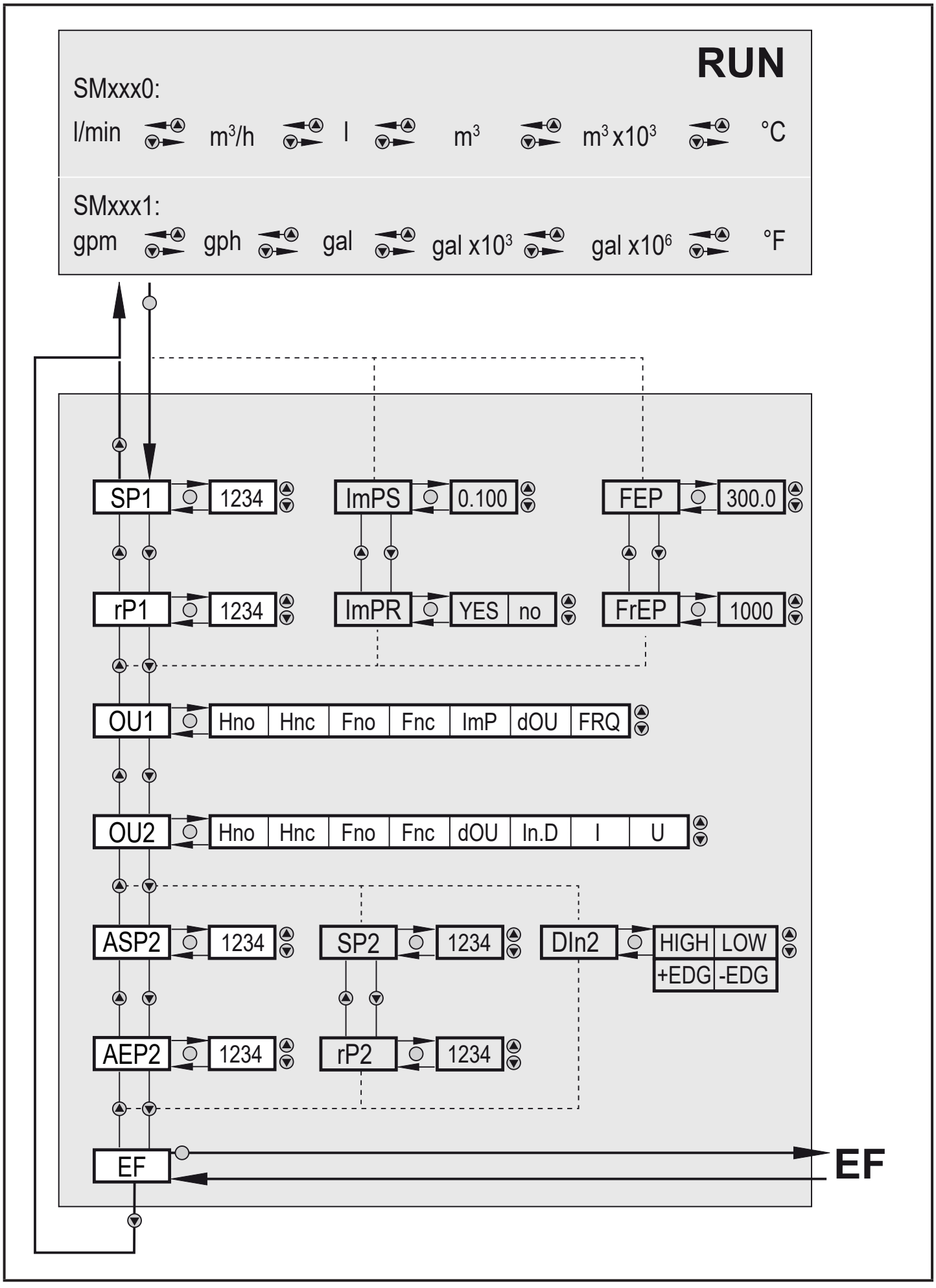
▭ LED is lit; ⌸ LED flashes * The consumed quantity is automatically displayed in the unit of measurement providing the highest accuracy.
7-8: Indicator LEDs for switching output
LED 7: Switching status OUT2 (lights when output 2 is switched) LED 8: Switching status OUT1 (lights when output 1 is switched)
9: Alphanumeric display, 4 digits
• Current volumetric flow quantity with [SELd] setting = FLOW • Meter reading of the totaliser with [SELd] setting = TOTL • Current medium temperature with [SELd] setting = TEMP • Parameters and parameter values
10: [Enter] button
• Selection of the parameters • Reading the set values • Confirmation of the parameter values Symbol used in → 8 Menu: ○
11: Buttons up [▲] and down **[▼]**
• Selection of the parameters • Activation of the setting functions • Changing the parameter values • Change of the display unit in the normal operating mode (RUN mode) • Locking / unlocking Symbol used in → 8 Menu: ⏶ and ⏷

8 Menu

Parameters with white background are indicated in case of factory setting (→ 14).

Parameters with grey background are available if OU1 or OU2 have been selected as Pulse or Frequency.

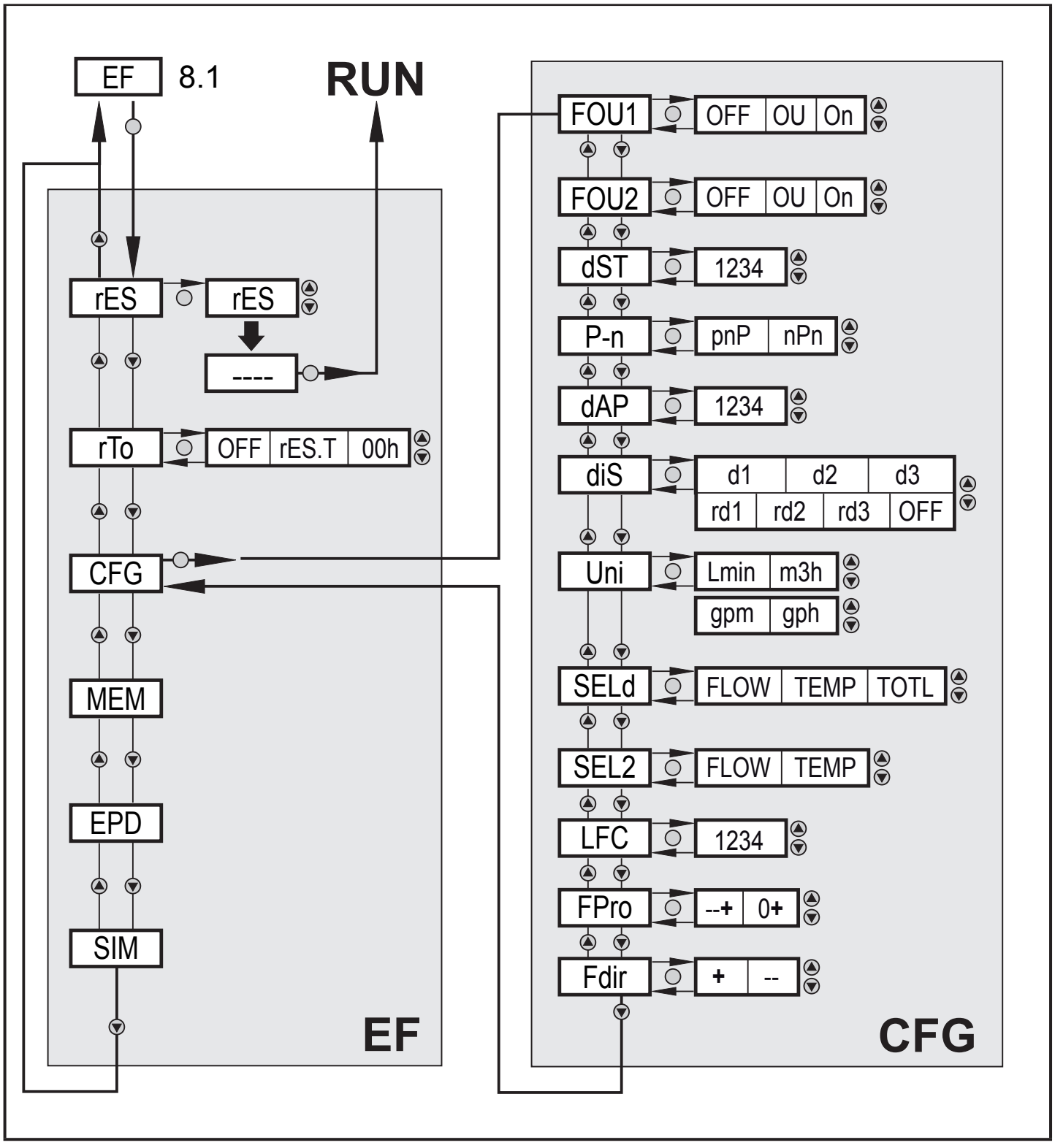
8.1 Main menu


RUN
SMxxx0:
l/min
m³/h
l
m³
m³ x10³
°C
SMxxx1:
gpm
gph
gal
gal x10³
gal x10⁶
°F
SP1
1234
ImPS
0.100
FEP
300.0
rP1
1234
ImPR
YES
no
FrEP
1000
OU1
Hno
Hnc
Fno
Fnc
ImP
dOU
FRQ
OU2
Hno
Hnc
Fno
Fnc
dOU
In.D
I
U
ASP2
1234
SP2
1234
DIn2
HIGH
LOW
+EDG
-EDG
AEP2
1234
rP2
1234
EF
EF

8.1.1 Explanation of the main menu

Parameters	Explanation and setting options
SP1	Switch Point value for volumetric flow on OUT1.
rP1	Reset Switch Point value for volumetric flow on OUT1.
ImPS	Pulse value = volumetric flow quantity at which 1 pulse is provided.
ImPR	Configuration of the output for consumed quantity monitoring:YES (pulse signal), no (switching signal).
FEP	Upper flow value at which OUT1 provides the frequency signal FrEP.
FrEP	Frequency signal that is provided at OUT1 when FEP is reached.
OU1	Output function for OUT1 (volumetric flow): - Hno, Hnc, Fno, Fnc: Switching signal for the limit values - ImP: Consumed quantity monitoring (totaliser function) - dOU: Switching signal for empty pipe detection - FRQ: Frequency output
OU2	Output function for OUT2 (volumetric flow or temperature): - Hno, Hnc, Fno, Fnc: Switching signal for the limit values - dOU: Switching signal for empty pipe detection - I (current signal 4...20 mA), U (voltage signal 0...10 V) Input function for OUT2: - In.D: input for external meter reset signal
ASP2	Analogue start point for volumetric flow or temperature on OUT2.
AEP2	Analogue end point for volumetric flow or temperature on OUT2.
SP2	Switch Point value for volumetric flow or temperature on OUT2.
rP2	Reset Switch Point value for volumetric flow or temperature on OUT2.
DIn2	Configuration of the input for external meter reset signal.
EF	Extended functions: Opening of the lower menu level.

8.2 Extended functions – Basic settings



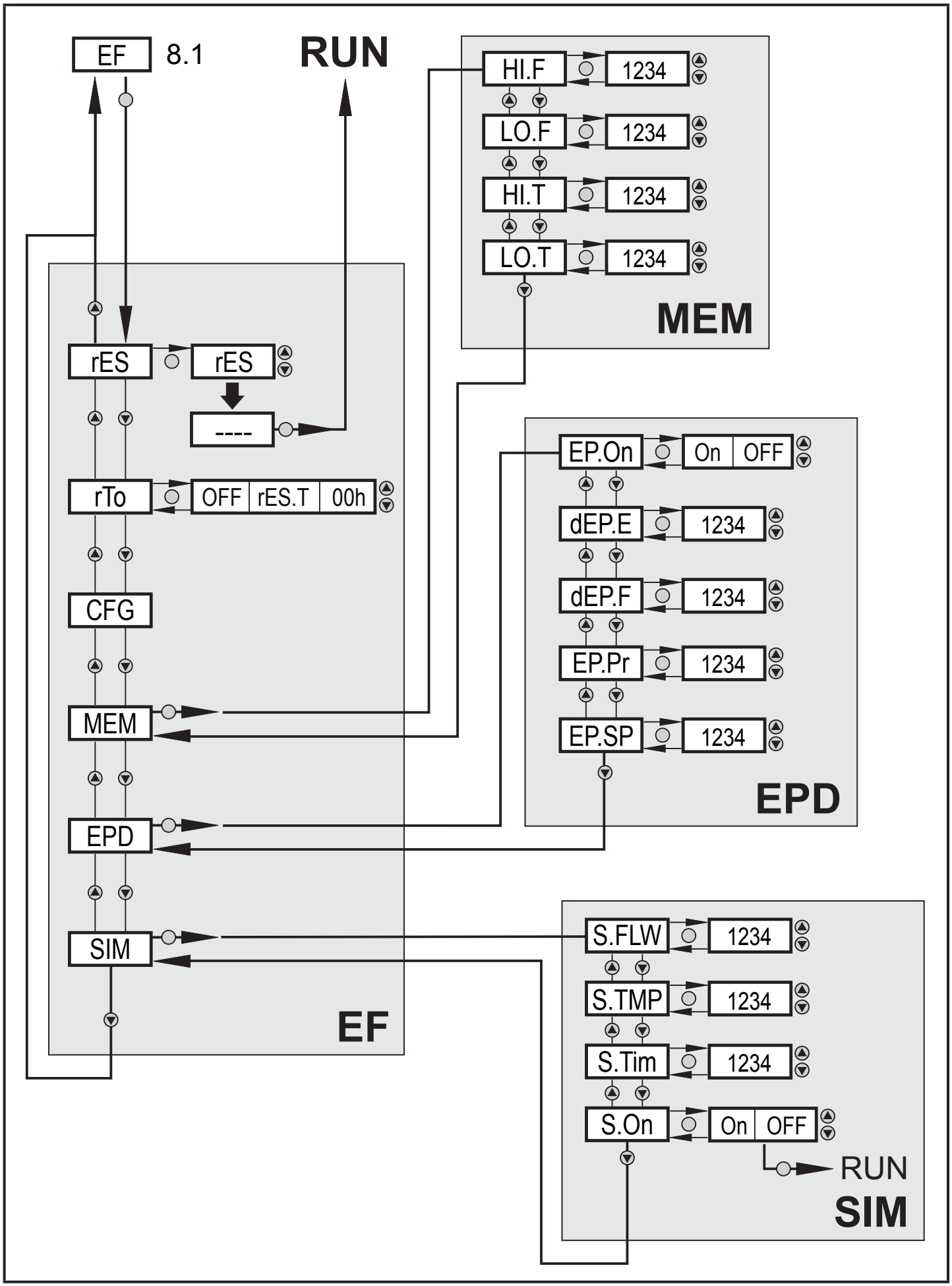
8.2.1 Explanation extended functions (EF)

rES	Restore factory settings
rTo	Reset the consumed quantity meter (totaliser)
CFG	Submenu basic settings
MEM	Submenu min/max memory
EPD	Submenu empty pipe
SIM	Submenu simulation

8.2.2 Submenu basic settings (CFG)

FOU1	Behaviour of OUT 1 in case of a fault
FOU2	Behaviour of OUT 2 in case of a fault
dST	Start-up delay for volumetric flow monitoring
P-n	Output logic: pnp / npn
dAP	Measured value damping: damping constant in seconds
diS	Update rate and orientation of the display
Uni	Standard unit of measurement for volumetric flow
SELd	Standard measuring unit of the display: FLOW (volumetric flow value), TEMP (medium temperature), TOTL (meter reading)
SEL2	Standard measured variable for evaluation by OUT2: FLOW (volumetric flow) or TEMP (temperature)
LFC	Low flow cut-off
FPro	Counting method of the totaliser
Fdir	Direction of flow

8.3 Extended functions – Min/max memory – Empty pipe – Simulation



8.3.1 Explanation extended functions (EF)

rES	Restoring the factory settings
rTo	Reset the consumed quantity meter (totaliser)
CFG	Submenu basic settings
MEM	Submenu min/max memory
EPD	Submenu empty pipe
SIM	Submenu simulation

8.3.2 Submenu min/max memory (MEM)

HI.F	Max. value of the flow measured in the process
LO.F	Min. value of the flow measured in the process
HI.T	Max. value of the temperature measured in the process
LO.T	Min. value of the temperature measured in the process

8.3.3 Submenu empty pipe (EPD)

EP.On	Empty pipe detection on / off
dEP.E.	Empty signal delay time
dEP.F	Full signal delay time
EP.Pr	Current measured value of empty pipe detection
EP.SP	Switch point of empty pipe detection

8.3.4 Submenu simulation (SIM)

S.FLW	Simulation flow value
S.TMP	Simulation temperature value
S.Tim	Simulation time
S.On	Simulation start

9 Set-up

After power up and expiry of the start up delay time (approx. 5 s) the unit is in the RUN mode (= normal operating mode). It carries out its measurement and evaluation functions and generates output signals according to the set parameters.

- During the start up delay time the outputs are switched as programmed:
  - ON with normally open function (Hno / Fno)
  - OFF with normally closed function (Hnc / Fnc).
- If output 2 is configured as analogue output, the output signal is at 20 mA (current output) or 10 V (voltage output) during the start up delay time.

10 Parameter setting

Parameters can be set before installation and set-up of the unit 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.

The parameters can also be set via the IO-Link interface (→ 4.12).

CAUTION

If the medium temperature is above 50 °C (122 °F) parts of the housing can increase in temperature to over 65 °C (149 °F).

> Risk of burns.

▶ Do not touch the device with your hands.

▶ Use another object (e.g. a ballpoint pen) to carry out settings on the unit.

10.1 Parameter setting in general

1. Change from the RUN mode to the main menu	[Enter]
2. Select the requested parameter	[▲] or [▼]
3. Display of the set parameter value	[Enter]
4. Change to the setting mode	[▲] or [▼] > 1 s (Display flashes, then permanent)
5. Modification of the parameter value - incremental by pressing once - continuous by keeping the button pressed	[▲] or [▼]
6. Acknowledge the set parameter value	[Enter]
7. Return to the RUN mode	> 30 seconds (timeout) or navigate through the menu levels using [▲] or [▼] until the RUN mode is reached.

10.1.1 Parameter setting in submenus

1. Change from the RUN mode to the main menu	[Enter]
2. Change to the sumenus	[▼] till EF [Enter]
3. Select the requested submenu	[▼] till CFG, MEM, EPD or SIM [Enter]
4. Select the requested parameter	[▲] or [▼]
5. Display of the set parameter value	[Enter]
6. Changing the parameter value	→ 10.1 Parameter setting in general, steps 4-7

10.1.2 Locking / unlocking

The unit can be locked electronically to prevent unintentional settings. On delivery: not locked.

Locking is also possible via an IO-Link capable parameter setting tool.

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

10.1.3 Timeout

If no button is pressed for 30 s during parameter setting, the unit returns to the operating mode with unchanged parameter.

10.2 Settings for volumetric flow monitoring

10.2.1 Switch Point monitoring of volumetric flow (OUT1)

▶ Select [OU1] and set the switching function: Hno, Hnc, Fno or Fnc. ▶ Select [SP1] and set the Switch Point limit value of the volumetric flow. ▶ Select [rP1] and set the Reset Switch Point limit value of the volumetric flow.	Main menu: [OU1] [SP1] [rP1]

10.2.2 Switch Point monitoring of volumetric flow (OUT2)

▶ Select [SEL2] and set FLOW. ▶ Select [OU2] and set the switching function: Hno, Hnc, Fno or Fnc. ▶ Select [SP2] and set the Switch Point limit value of the volumetric flow. ▶ Select [rP2] and Reset Switch Point lower limit of the volumetric flow.	Menu CFG: [SEL2] Main menu: [OU2] [SP2] [rP2]

10.2.3 Analogue output flow rate (OUT2)

▶ Select [SEL2] and set FLOW. ▶ Select [OU2] and set the analogue function: I (4...20 mA) or U (0...10 V). ▶ Select [ASP2] and set the volumetric flow value at which the minimum current or voltage value is provided. ▶ Select [AEP2] and set the volumetric flow value at which the maximum current or voltage value is provided	Menu CFG: [SEL2] Main menu: [OU2] [ASP2] [AEP2]

10.2.4 Frequency signal for flow (OUT1)

▶ Select [OU1] and set FRQ. ▶ Select [FEP] and set the flow value at which the frequency set in FrEP is provided. ▶ Select [FrEP] and set the frequency.	Main menu: [OU1] [FEP] [FrEP]

10.3 Settings for consumed quantity monitoring

10.3.1 Quantity monitoring by pulse output (OUT1)

▶ Select [OU1] and set ImP. ▶ Select [ImPS] and set the volumetric flow quantity at which 1 pulse is provided (→ 10.3.3). ▶ Select [ImPR] and set [YES]. > Pulse repetition is active. Output 1 provides a counting pulse each time the value set in [ImPS] is reached.	Main menu: [OU1] [ImPS] [ImPR]

10.3.2 Quantity monitoring by preset counter (OUT1)

▶ Select [OU1] and set ImP. ▶ Select [ImPS] and set the volumetric flow quantity at which output 1 switches (→ 10.3.3). ▶ Select [ImPR] and set no. > Pulse repetition is not active. The output switches ON if the value set in [ImPS] is reached. It remains switched until the counter is reset.	Main menu: [OU1] [ImPS] [ImPR]

10.3.3 Pulse value

▶ Select [OU1] and set the consumed quantity to be monitored: → 10.3.1 or → 10.3.2. ▶ Select [ImPS]. ▶ Briefly press [Enter]. > The currently set value is displayed. ▶ keep [▲] or [▼] pressed until "⊏⊏⊏⊏ ▶ Press [▲] or [▼] > With each press of the pushbutton the display changes to the next setting range (decimal point shifts and / or LED* changes). ▶ Press [Enter] to confirm the setting range. ▶ Press [▲] or [▼] until the requested numerical value is displayed. ▶ Briefly press [Enter]. * → 7 Operating and display elements	Main menu: [OU1] [ImPS]

10.3.4 Manual counter reset

▶ Select [rTo] and set rES.T. > The counter is reset to zero.	Menu EF: [rTo]

10.3.5 Time-controlled counter-reset

▶ Select [rTo] and set the requested value:intervals of hours (h), days (d) or weeks (w). > The counter is reset automatically with the value now set.	Menu EF: [rTo]

10.3.6 Deactivation of the counter reset

▶ Select [rTo] and set OFF. > The meter is only reset after overflow (= factory setting).	Menu EF: [rTo]

10.3.7 Counter reset using an external signal

▶ Select [OU2] and set InD. ▶ Select [DIn2] and set the reset signal: - HIGH = reset for high signal - LOW = reset for low signal - +EDG = reset for rising edge - -EDG = reset for falling edge	Main menu: [OU2] [DIn2]

10.4 Settings for temperature monitoring

10.4.1 Switch Point monitoring for temperature (OUT2)

▶ Select [SEL2] and set TEMP. ▶ Select [OU2] and set the switching function: Hno, Hnc, Fno or Fnc. ▶ Select [SP2] and set the Switch Point temperature limit ▶ Select [rP2] and Reset the Switch Point temperature limit.	Menu CFG: [SEL2] Main menu: [OU2] [SP2] [rP2]

10.4.2 Analogue output temperature (OUT2)

▶ Select [SEL2] and set TEMP. ▶ Select [OU2] and set the analogue function: I (4...20 mA) or U (0...10 V). ▶ Select [ASP2] and set the temperature value at which the minimum current or voltage value is provided. ▶ Select [AEP2] and set the temperature value at which the maximum current or voltage value is provided.	Menu CFG: [SEL2] Main menu: [OU2] [ASP2] [AEP2]

10.5 User settings (optional)

10.5.1 Standard unit of measurement for volumetric flow

▶ Select [Uni] and set the unit of measurement. The setting only has an effect on the volumetric flow value. The consumed quantity (meter reading) is automatically displayed in the unit of measurement providing the highest accuracy.	Menu CFG: [Uni]

10.5.2 Standard display

▶ Select [SELd] and define the standard unit of measurement FLOW = display shows the current volumetric flow value in the standard unit of measurement.TOTL = display shows the current meter reading in the unit providing the highest accuracy. TEMP = the display shows the current medium temperature in °C / F°. ▶ Select [diS] and set the update rate and orientation of the display: d1 = update of the measured values every 50 ms. d2 = update of the measured values every 200 ms. d3 = update of the measured values every 600 ms. rd1, rd2, rd3 = display like d1, d2, d3; rotated by 180°. OFF = the display is switched off in the operating mode. The LEDs remain active even if the display is deactivated. Error messages are displayed even if the display is deactivated.	Menu CFG: [SELd] [diS]

10.5.3 Direction of flow

▶ Select [Fdir] and set the direction of flow: + = flow in the direction of the flow arrow (= factory setting) – = flow against the flow arrow ▶ label over the arrow	Menu CFG: [Fdir]

10.5.4 Output logic

▶ Select [P-n] and set PnP or nPn.	Menu CFG: [P-n]

10.5.5 Start-up delay

▶ Select [dST] and set the numerical value in seconds.	Menu CFG: [dST]

10.5.6 Measured value damping

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

10.5.7 Error behaviour of the outputs

▶ Select [FOU1] and set the value: 1. Switching output: - On = Output 1 switches ON in case of a fault. - OFF = Output 1 switches OFF in case of an error. - OU = Output 1 switches irrespective of the fault as defined with the parameters. 2. Frequency output: - On = 130% of FrEP. - OFF = 0 Hz - OU = continues running ▶ Select [FOU2] and set the value: 1. Switching output: - On = Output 2 switches ON in case of a fault. - OFF = Output 2 switches OFF in case of a fault. - OU = Output 2 switches irrespective of the fault as defined with the parameters. 2. Analogue output: - On = The analogue signal goes to the upper fault value (→ 4.6). - OFF = The analogue value goes to the lower fault value (→ 4.6). - OU = The analogue signal corresponds to the measured value.	Menu CFG: [FOU1] [FOU2]

10.5.8 Activating / deactivating empty pipe detection

▶ Select [OU1] or [OU2] and set dOU. ▶ Select [EP.On] and set the function: - OFF = empty pipe detection deactivated. - On = empty pipe detection activated.	Main menu: [OU1] [OU2] Menu EPD: [EP.On]

10.5.9 Empty pipe detection switching logic

▶ Select [P-n] and set PnP or nPn.	Menu CFG: [P-n]

10.5.10 Time-delay empty pipe detection

▶ Select [dEP.E] and set the delay time from 0…30 s, at which the signal should be provided when the pipe is empty. ▶ Select [dEP.F] and set the delay time from 0…30 s, at which the signal should be provided when the pipe is full.	Menu EPD: [dEP.E] [dEP.F]

10.5.11 Empty pipe detection limit value

▶ Select [EP.Pr] to display the current value of the empty pipe detection in percent. ▶ Select [EP.SP] and set the switch point of empty pipe detection.	Menu EPD: [EP.Pr] [EP.SP]

10.5.12 Counting method of the totaliser

▶ Select [FPro] and set the value: –+ = totalling the volumetric flow values with the correct sign. 0+ = totalling only positive volumetric flow values.	Menu CFG: [FPro]

10.5.13 Low flow cut-off

▶ Select [LFC] and set the limit value.	Menu CFG: [LFC]

10.6 Service functions

10.6.1 Read min/max values

▶ Select [HI.x] or [LO.x] and read the value. HI.F = maximum volumetric flow, LO.F = minimum volumetric flow HI.T = maximum temperature, LO.T = minimum temperature Delete memory: ▶ Select [HI.x] or [LO.x]. ▶ Briefly press [Enter]. ▶ keep [▲] or [▼] pressed until [----] is displayed. ▶ Briefly press [Enter]. It makes sense to delete the memories as soon as the unit operates under normal operating conditions for the first time.	Menu MEM: [HI.F] [LO.F] [HI.T] [LO.T]

10.6.2 Simulation menu

▶ Select [S.FLW] and set the flow value to be simulated. ▶ Select [S.TMP] and set the temperature value to be simulated. ▶ Select [S.Tim] and set the time of the simulation in minutes. ▶ Select [S.On] and set the function: - On: The simulation starts. The values are simulated for the time set at [S.Tim]. [SIM] is displayed simultaneously with the process values. Cancel with [Enter]. - OFF: The simulation is not active.	Menu SIM: [S.FLW] [S.TMP] [S.Tim] [S.On]

10.6.3 Reset all parameters to factory setting

▶ Select [rES]. ▶ Briefly press [Enter]. ▶ keep [▲] or [▼] pressed. > [----] is displayed. ▶ Briefly press [Enter]. → 14 Factory setting. We recommend taking down your own settings in that table before carrying out a reset.	Menu EF: [rES]

11 Operation

11.1 Reading the process value

The LEDs 1-6 signal which process value is currently displayed in which unit.

The process value to be displayed as standard (temperature, flow velocity or meter reading of the totaliser) can be preset → 10.5.2.

A standard unit of measurement can be defined for the flow velocity → 10.5.1.

11.2 Changing the process value display in the RUN mode

▶ Briefly press [▼] or [▲] in the RUN mode.

> The unit displays the current measured value in the selected display unit for approx. 30 s, the corresponding indicator LED lights (→ 7)

11.3 Read the set parameters

▶ Press [Enter].

▶ Press [▲] or [▼] until the requested parameter is displayed.
Change to the sub-menu if needed→ 10.1.1.

▶ Press [Enter].

> The unit displays the corresponding parameter value. After approx. 30 s it returns to the RUN mode.

12 Troubleshooting

The unit has many self-diagnostic options. It monitors itself automatically during operation.

Warnings and error states are displayed, even when the display is switched off. Error indications are also available via IO-Link.

Display	Type	Description	Troubleshooting
IOE.n	Error	• Unit faulty / malfunction	▶ Replace the unit.
SEnS	Warning	Sensor signal invalid. • Measuring pipe not sufficiently filled. • Medium with too low a conductivity.	▶ Verifying the installation position → 5 ▶ Verify the conductivity of the medium (≥ 20 µS/cm).
No display	Error	• Supply voltage too low. • Setting [diS] = OFF	▶ Check the supply voltage. ▶ Change the setting [diS] → 10.5.2
Loc	Warning	Setting buttons on the unit locked, parameter change rejected.	▶ Unlock the unit → 10.1.2
C.Loc	Warning	Setting buttons on the unit temporarily locked, parameter setting via IO-Link communication active.	▶ Finish parameter setting via IO-Link communication.
S.Loc	Warning	Setting buttons locked via parameter software, parameter change rejected.	▶ Unlock the unit via IO-Link interface using the parameter setting software.

Display	Type	Description	Troubleshooting
UL	Warning	Below the display range. • Current value between -130 % ... -120 % VMR • Temperature value between -50...-40 °C or -58...40 °F	▶ Check flow range / temperature range.
cr.UL	Error	Below the measuring range. • Flow value < -130 % VMR • Temperature value < - 50 °C or -58 °F	▶ Check flow range / temperature range.
OL	Warning	Display range exceeded. • Current value between 120 % ... 130 % VMR • Temperature value between 100...110 °C or 212...230 °F	▶ Check flow range / temperature range.
cr.OL	Error	Above the measuring range. • Flow value > 130 % VMR • Temperature value > 110 °C or 230 °F	▶ Check flow range / temperature range.
PArA	Error	Parameter setting outside the valid range.	▶ Repeat parameter setting.
SC1	Warning	Switching status LED for OUT1 flashing: OUT1 short circuit.	▶ Check switching output OUT1 for short-circuit or excessive current.
SC2	Warning	Switching status LED for OUT2 flashing: short circuit OUT2.	▶ Check switching output OUT2 for short-circuit or excessive current.
SC	Warning	Switching status LEDs for OUT1 and OUT2 flashing: Short circuit in both outputs.	▶ Check switching outputs OUT1 and OUT2 for short-circuit or excessive current.

MEW = final value of the measuring range

13 Technical data

Further technical data and scale drawing at www.ifm.com

14 Factory setting

Parameter	Factory setting		User setting
	SMxxx0	SMxxx1	
SP1	20 % *	20 % *	
rP1	19.5 % *	19.5 % *	
ImPS	0.1	0.02	
ImPR	YES	YES	
OU1	Hno	Hno	
OU2	I	I	
SP2 (FLOW)	40 % *	40 % *	
rP2 (FLOW)	39.5 % *	39.5 % *	
SP2 (TEMP)	20 °C	68 °F	
rP2 (TEMP)	19,6 °C	67,3 °F	
ASP2 (FLOW)	0 % *	0 % *	
AEP2 (FLOW)	100 % *	100 % *	
ASP2 (TEMP)	-20 °C	-4 °F	
AEP2 (TEMP)	80 °C	176 °F	
FEP	100 % *	100 % *	
FrEP	1 kHz	1 kHz	
FDir	+	+	
FPro	- +	- +	
LFC	5 l/min	1.1 gpm	
DIn2	+EDG	+EDG	
FOU1	OFF	OFF	
FOU2	OFF	OFF	
dSt	0	0	
P-n	PnP	PnP	
dAP	0.6 s	0.6 s	
rTo	OFF	OFF	

Parameter	Factory setting		User setting
	SMxxx0	SMxxx1	
diS	d2	d2	
Uni	Lmin	gpm	
SELd	FLOW	FLOW	
SEL2	FLOW	FLOW	
EP.On	OFF	OFF	
dEP.E	0 s	0 s	
dEP.F	2 s	2 s	
EP.SP	75 %	75 %	
S.FLW	20 %	20 %	
S.TMP	20 °C	68 °F	
S.Tim	3 min	3 min	

* of the final value of the measuring range