Operating instructions

Clamp-on ultrasonic flow meter
with display

SUCxxx

Table of contents

1 Preliminary note

You will find instructions, technical data, approvals and further information using the QR code on the unit / packaging or at documentation.ifm.com.

1.1 Symbols used

✓	Requirement
▶	Instruction
▷	Reaction, result
bold	Designation of keys, buttons or indications
	Cross-reference without link
	Cross-reference with link
	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:

WARNING

Warning of serious personal injury

▷ If the warning is not observed, fatal and serious injuries are possible.

CAUTION

Warning of minor to moderate personal injury

▷ If the warning is not observed, minor to moderate injuries are possible.

ATTENTION

Warning of damage to property

▷ If the warning is not observed, damage to property is possible.

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 authorised 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.
- Only use the product for permissible pipe materials.
- 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 authorised by the machine operator.
- Protect units and cables against damage.

2.1 Cybersecurity

Installation

The device is suitable for operation in a secure environment according to IEC 62443-1-1.

The device was designed for operation behind a firewall.

▶ Carry out a risk assessment of the system according to IEC 62443-1-1.

▶ Take measures to ensure physical security.

Operation

▶ Observe the security functions described in the product documentation and the recommendations for their use.

Maintenance

▶ Back up system configuration and system data in accordance with your company's change management processes.

Decommissioning

▶ Ensure that no sensitive information can fall into unauthorised hands.

▶ Always reset the system settings to the factory settings before decommissioning the device.

3 Transport, handling and storage

- Store the device in its original packaging.
- When the device is to be stored again, use the original packaging.
- Otherwise, provide unused connections with either a mating connector or a protective cap and pack the device in suitable packaging.
- Observe the permissible ambient conditions for the device during storage (➔ Technical data).

4 Intended use

The device monitors the flow rate and temperature of liquid media non-invasively.

For this purpose, the device is attached to the outside of a pipe.

The SUCxxx series includes types for different pipe outside diameters. The pipe outside diameters are specified in the data sheets available at ifm.com.

4.1 Application area

Liquids with the following properties:

- Conductive water-based media with 90% water content
- Non-conductive water

5 Items supplied

- 1 SUCxxx device with pre-mounted clamp
- 2 captive screws
- 1 rubber couplant
- 1 pipe tape measure

6 Function

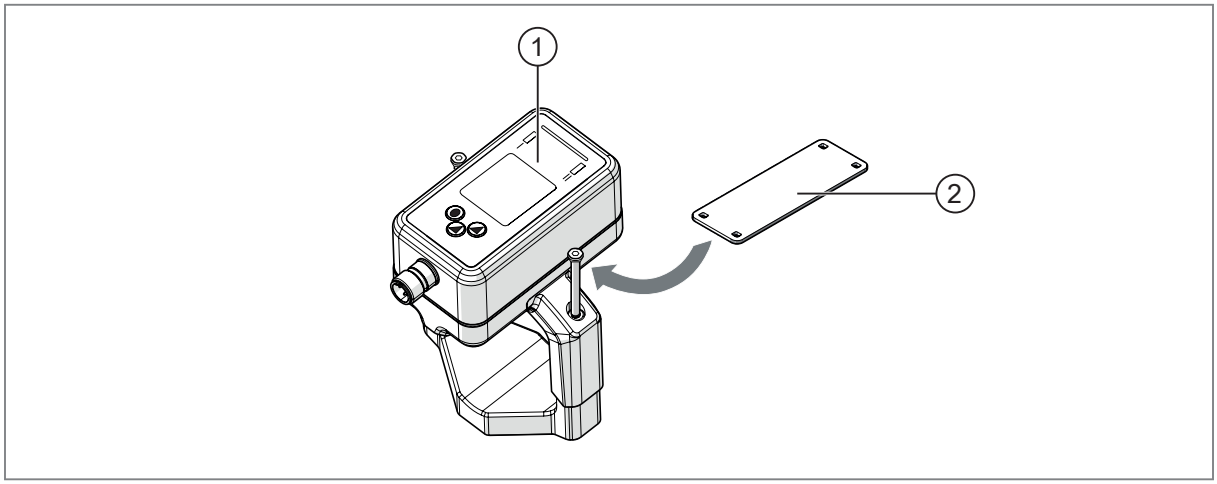


Fig. 1: SUCxxx: Installation

1: SUCxxx device (pipe length, display, fixed clamp including screws)
2: Exxxxx rubber couplant (pre-mounted), can be ordered separately from www.ifm.com

- The unit detects the volumetric flow based on the measuring principle of ultrasonic transit time difference.
- As additional process value the unit detects the medium temperature.
- The unit displays the current process values.
- The unit can be operated in SIO mode (standard input-output) or in IO-Link mode.
- The device generates two output signals according to the parameter setting:
  - Options for output OUT1 10
  - Options for output OUT2 10
- The device has many self-diagnostic options.
  - Automatic detection of pipe wall thickness during initial installation 42.
  - Monitoring of the flow direction 33.
  - Monitoring of the signal quality 33.
  - Indication of warnings and error messages
- The device indicates all self-diagnostic options through the colour signals of an operating status LED 54.
- A guided installation 53 and a simulation mode 56 enable simplified set-up of the sensor.
- Automatic zero-point calibration allows adaptation to the application and increases measurement accuracy 44.

Further functions:

- Application configuration 41:
  Standard unit of measurement, pipe properties, process values for OUT1 and OUT2, damping, output polarity of the switching outputs, low flow cut-off, medium, flow direction, calibration of the measurement characteristic, totaliser reset, counting method of the totalisers, locking/unlocking of the keys, device reset.
- Diagnostic and service functions 53:
  Device information, visual localisation, reading of totaliser values and of the memory for minimum and maximum process values, operating hours counter, internal temperature.
- Display settings 50

6.1 Options for output OUT1

- Switching signal flow
- Switching signal temperature
- Switching signal diagnosis
  - Direction of flow
  - Signal quality
- Switching signal totaliser
- Pulse signal totaliser
- Frequency signal flow
- Frequency signal temperature
- IO-Link
- OFF (output switched to high impedance)

6.2 Options for output OUT2

- Switching signal flow
- Switching signal temperature
- Switching signal diagnosis
  - Direction of flow
  - Signal quality
- Switching signal totaliser
- Pulse signal totaliser
- Analogue signal flow
- Analogue signal temperature
- Input for external totaliser reset
- OFF (output switched to high impedance)

6.3 IO-Link

IO-Link is a communication system for connecting intelligent sensors and actuators to automation systems. IO-Link is standardised in the IEC 61131-9 standard.

General information on IO-Link at io-link.ifm

Input Output Device Description (IODD) with all parameters, process data and detailed descriptions of the device at documentation.ifm.com

IO-Link offers the following advantages:

- Interference-free transmission of all data and process values
- Parameter setting in the running process or presetting outside the application
- Parameters for identifying the connected devices in the system
- Additional parameters and diagnostic functions
- Automatic backup and restore of parameter sets in case of device replacement (data storage)
- Logging of parameter sets, process values and events
- Device description file (IODD - Input Output Device Description) for easy project planning

- Standardised electrical connection
- Remote maintenance

7 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.

ATTENTION

No functional earthing when installed in an ungrounded pipe system (e.g. plastic pipes).

▷ Deficient operating function.

▶ Ground the device. Ground brackets for the M12 connector are available as accessories, see documentation.ifm.com.

The device must only be attached to rigid plastic pipes, not to soft, flexible plastic pipes or hoses.

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

▶ Rinse the system after installation for ventilation.

7.1 Installation position

If the device is installed on a plastic pipe, the pipe must be completely filled so that its wall thickness can be determined automatically.

If the pipe is only partially filled, this may result in measuring inaccuracies or even measured values of zero.

▶ Ensure that there is sufficient counter-pressure in the pipe.

If air bubbles can form in the pipe system:

▶ In case of horizontal installation, mount the sensor with the display on the side of the pipe (A).

▶ Install in front of or in a rising pipe.

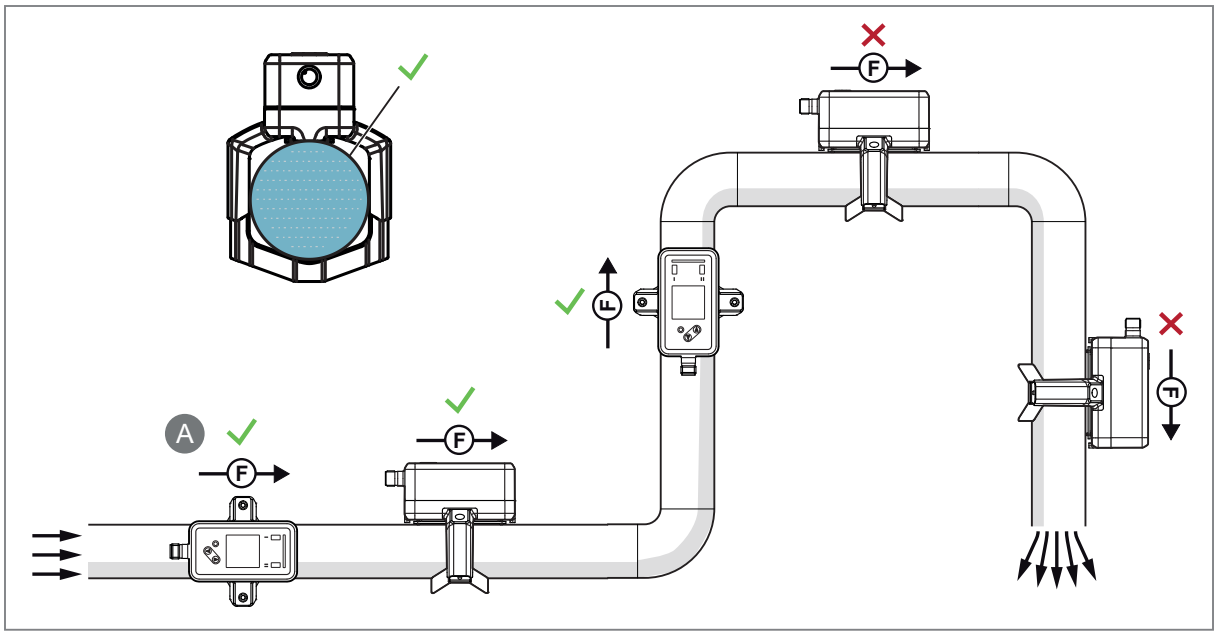


Fig. 2: Installation position

Non-recommended installation position:

- Directly in front of a falling pipe.
- In a falling pipe.
- Directly in front of the spout of a pipe.
- Directly in front of a valve.
- On the suction side of a pump.
- At the highest point of 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.

7.2 Process connection

The device is secured to the pipe via its clamp.

Article	Suitable pipe diameter	
	Nominal widths	Diameter in mm
SUC30x	• DN40 (1.5") • DN50 (2")	44…64 mm

Tab. 1: Device types and pipe diameters

Avoid the following process connections:
- on frozen pipes
- on pipes with condensation
- on corroded pipes
- on weld seams
- on hoses

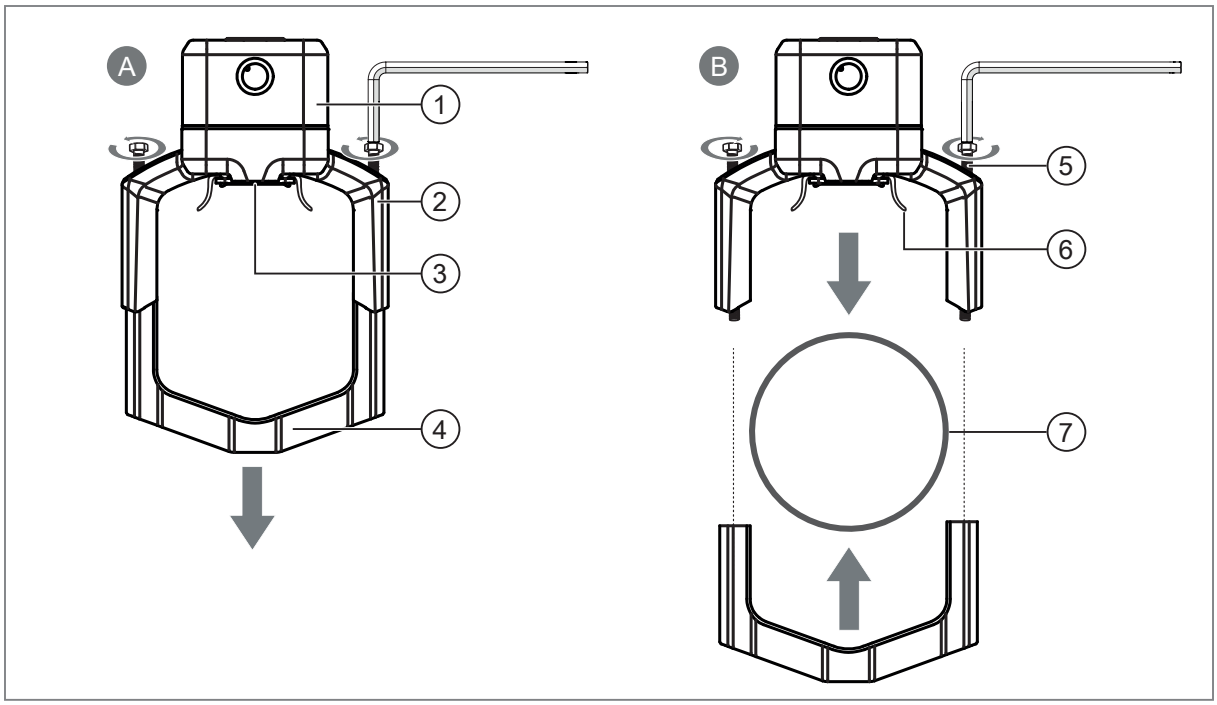


Fig. 3: Installation on a pipe

1: SUCxxx device
2: Upper part of the clamp
3: Rubber couplant (pre-mounted)
4: Lower part of the clamp
5: Captive screws
6: Clamping bracket for self-centering the device
7: Pipe

Installation on the pipe

- ▶ Prepare the contact surface of the pipe so that it is free of grease, clean and smooth.
- ▶ Pull the clamp apart to detach the lower part (B).
- ▶ Place the device onto the pipe using the upper and lower parts of the clamp.
  - ▷ The two clamping brackets on the underside of the device ensure that it centres itself on the pipe.
- ▶ Tighten the clamp to the pipe using the two screws. To do this, tighten the screw heads evenly in three stages. Maximum tightening torque: 2 Nm.
- Step 1: approx. 50% of the specified maximum tightening torque.
- Step 2: approx. 80% of the specified maximum tightening torque.
- Step 3: 100% of the specified maximum tightening torque.

The rubber couplant is required to ensure an optimum fit of the clamp to the pipe diameter and to prevent slipping. Tightening the screws to the specified tightening torque ensures a reliable connection between the sensor and the pipe. Good signal quality can only be ensured if the rubber couplant is correctly fitted. The rubber couplant can be reordered as an accessory from ifm.com.

7.3 Interference

Structures in the pipe, bends, valves, reducing pieces and the like affect the function of the unit.

▶ Adhere to the distances between sensor and interference.

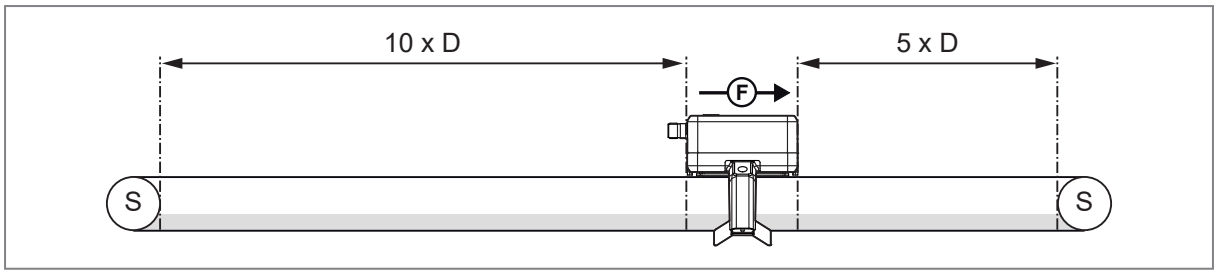


Fig. 4: Interference

D: Outside diameter of the pipe S: Interference

8 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:

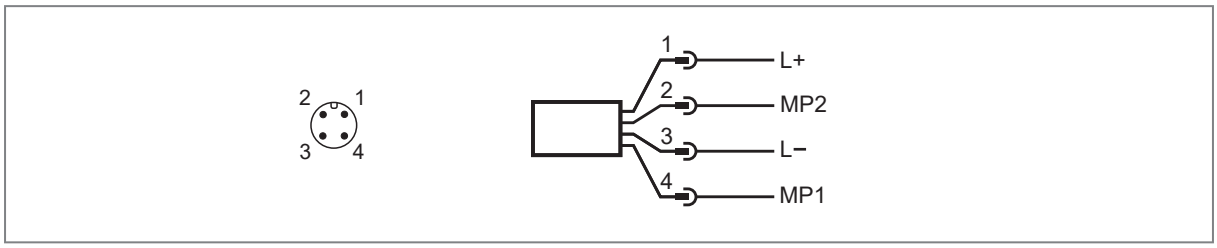


Fig. 5: Wiring

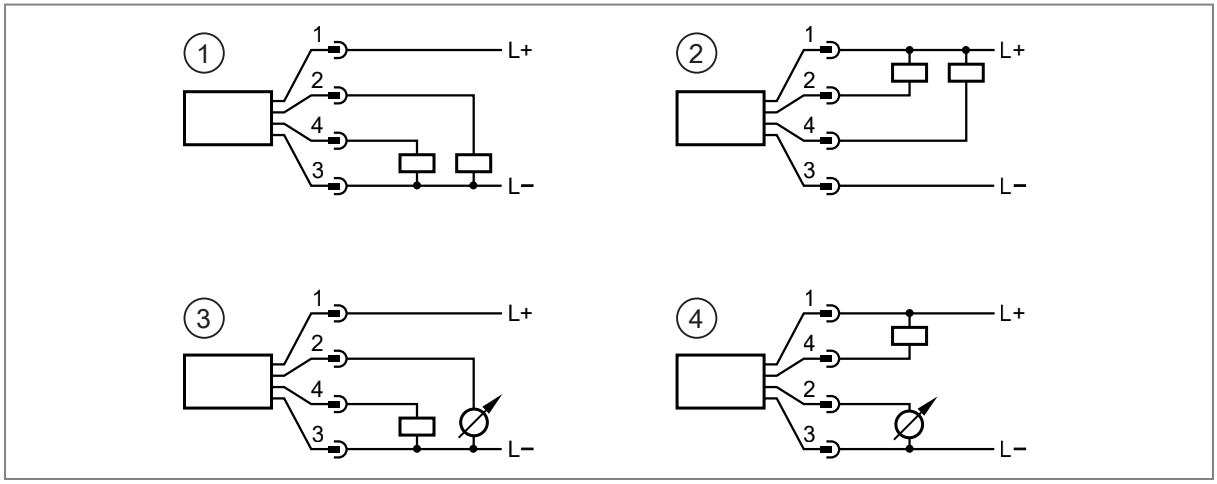
1: L+ Voltage supply
2: MP2 Multi-function connection 2:
- OUT2: Digital output 2 or analogue output
- IN: Digital input

3: L- Voltage supply
4: MP1 Multi-function connection 1:
- OUT1: Digital output 1 or frequency output
- IO-Link

See also:

- Options for output OUT1 10
- Options for output OUT2 10

Circuit examples:



1: 2 x positive switching
2: 2 x negative switching
3: 1 x positive switching / 1 x analogue
4: 1 x negative switching / 1 x analogue

9 Operating and display elements

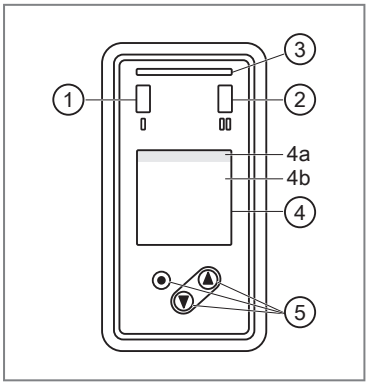


Fig. 6: Operating and display elements

1: Switching status LED for OUT1
(lights yellow if output 1 is switched)
2: Switching status LED for OUT2
(lights yellow if output 2 is switched)
3: Operating status LED (green / blue / red).
See also: Operating status LED ➔ 54.
4: PFA display
See also: Display layout ➔ 51.
4a: Title line
4b: Process value line
5: Keys for changing views and parameter setting

If the unit measures a high internal temperature, the display brightness is automatically adjusted:
Internal temperature of the unit > 64 °C: brightness is reduced to 25%.
Internal temperature of the unit ≥ 90 °C: display is automatically switched off.

Switching between display screens:

The device keys can be used to switch between different process value displays during operation:

- ▶ Press ▼ or ▲.
- ▷ The display switches between the three process value displays, as shown in the figure below.
- ▷ After 30 seconds, the device returns to the user-defined display layout.

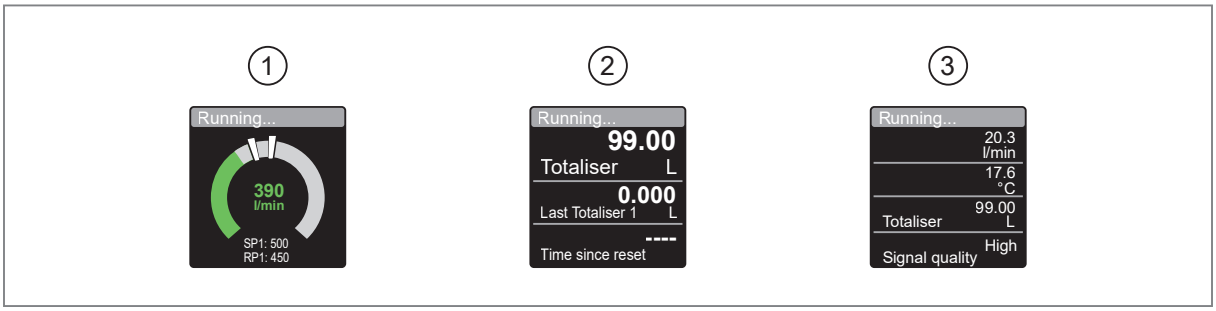


Fig. 7: Switching between the process value displays

1: Display layout, as set under **diS.L**.
See also: Display layout ➔ 51. In this example **diS.L** = **L1.G**.
2: Totaliser (current consumend quantity vol.1), Last Totaliser (consumend quantity vol.1 before the last reset), Time since reset.
3: Display layout **diS.L** = **L4**:
flow rate, temperature, totaliser vol.1, signal quality ➔ 55

10 Menu

The figures in which the menus are displayed show the parameters that can be set on the unit by key input. These parameters and other functions are also available via the IO-Link interface.

Parameter setting via the device keys can also be carried out as a guided installation using a wizard ➔ 28.

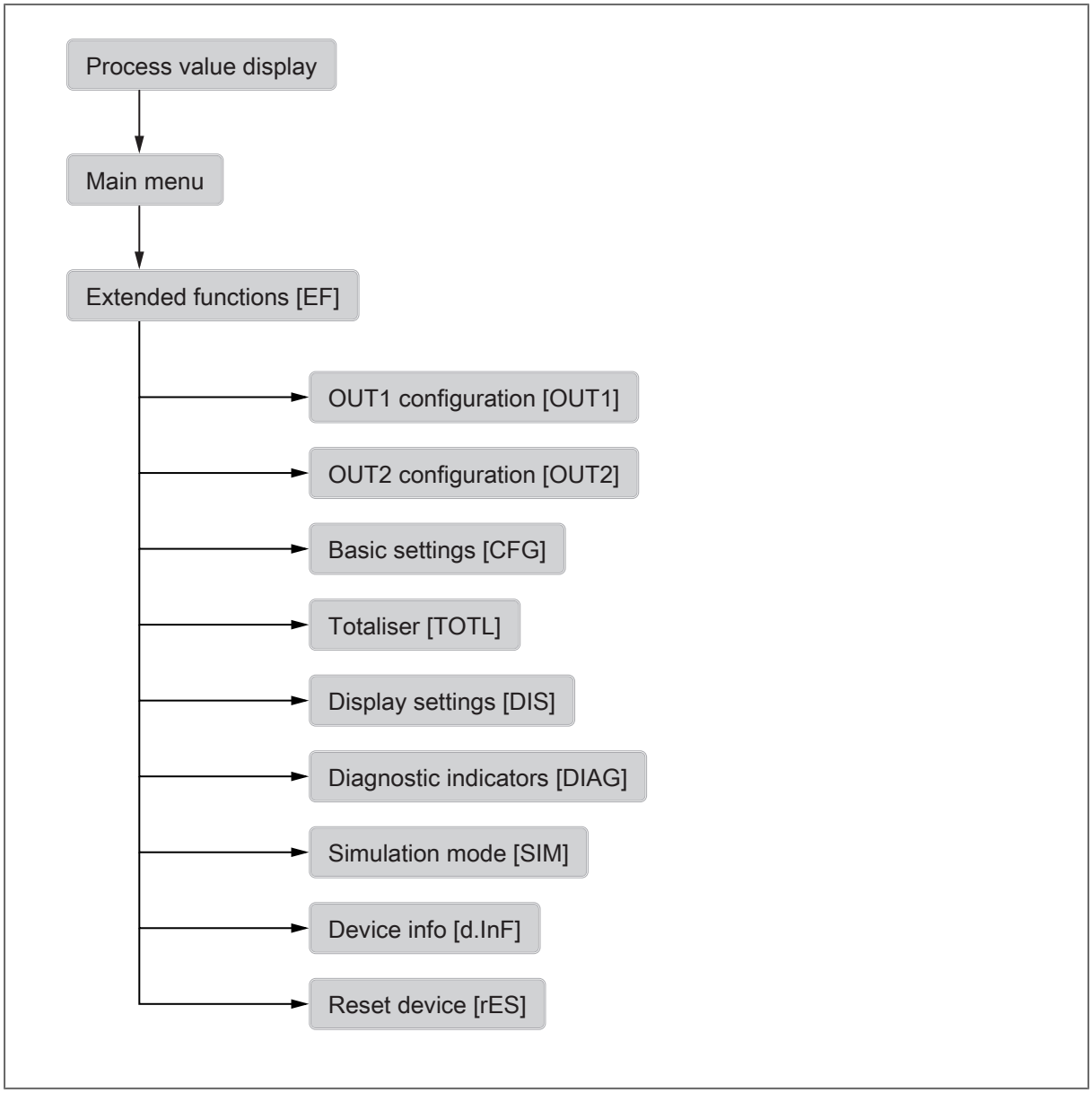


Fig. 8: Menu overview

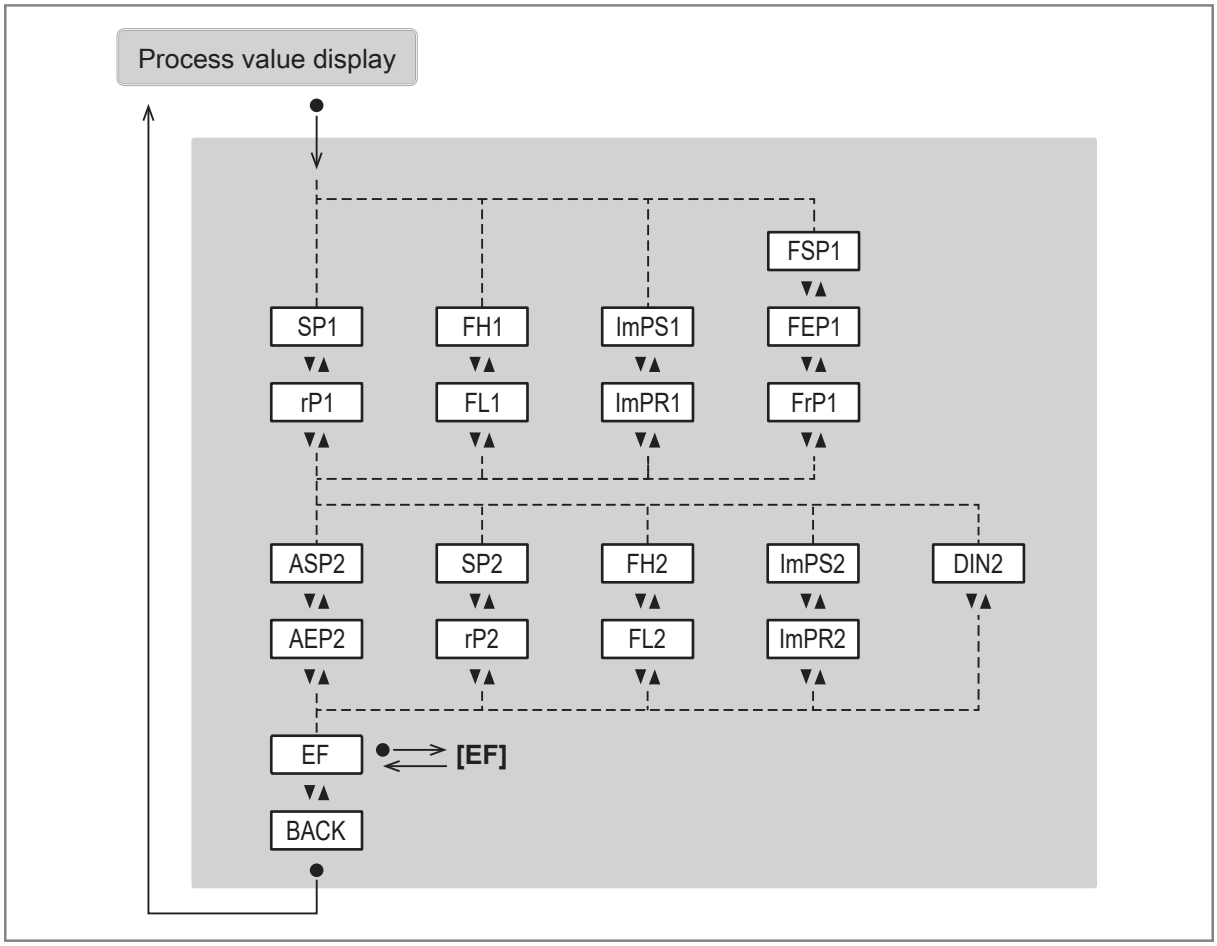
10.1 Main menu and submenus

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

The designation of the parameters in the parameter setting software may differ from the designations in the device display.

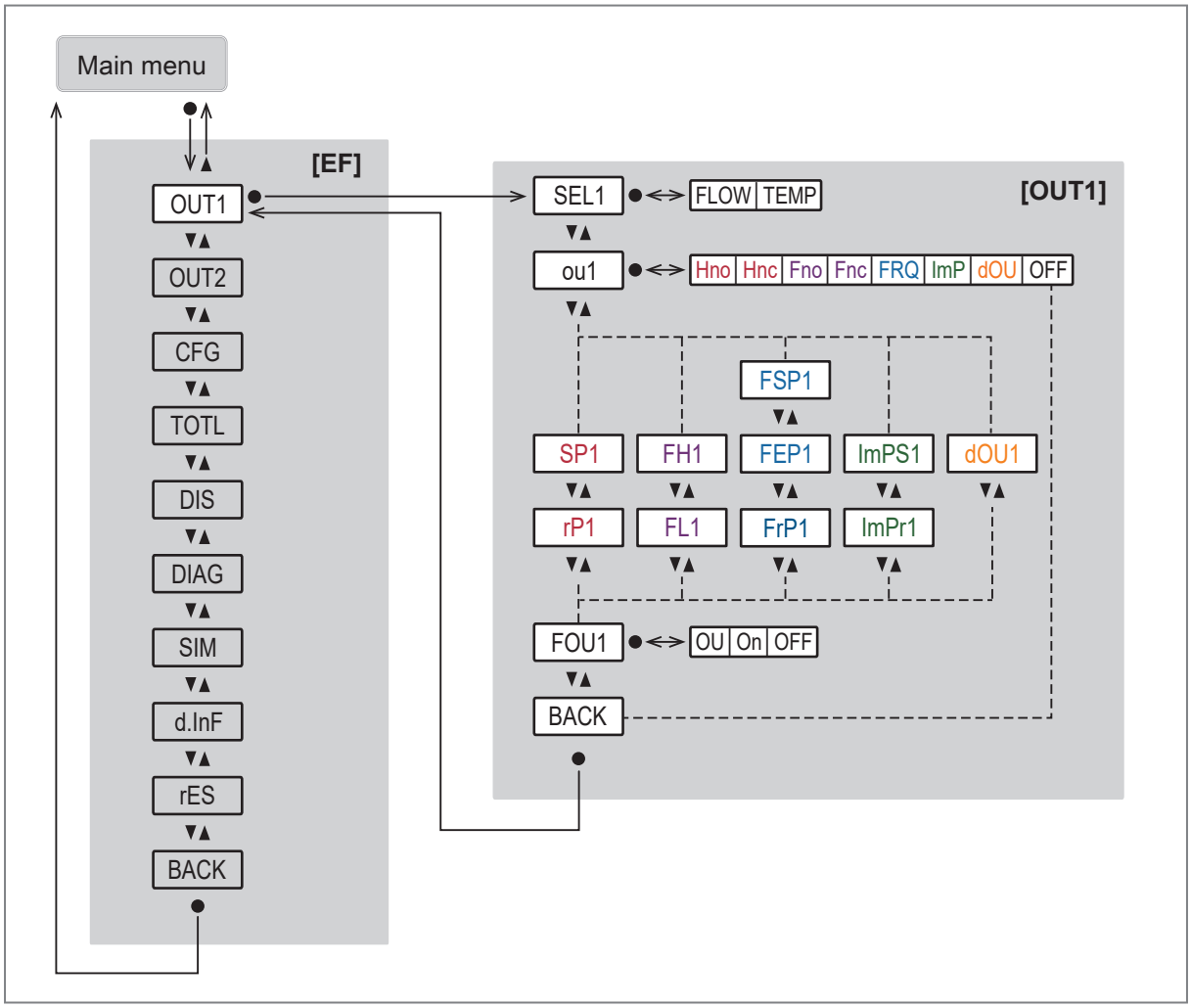
Main menu:

The main menu displays parameter settings that can be changed either here or in the **OUx** submenu.



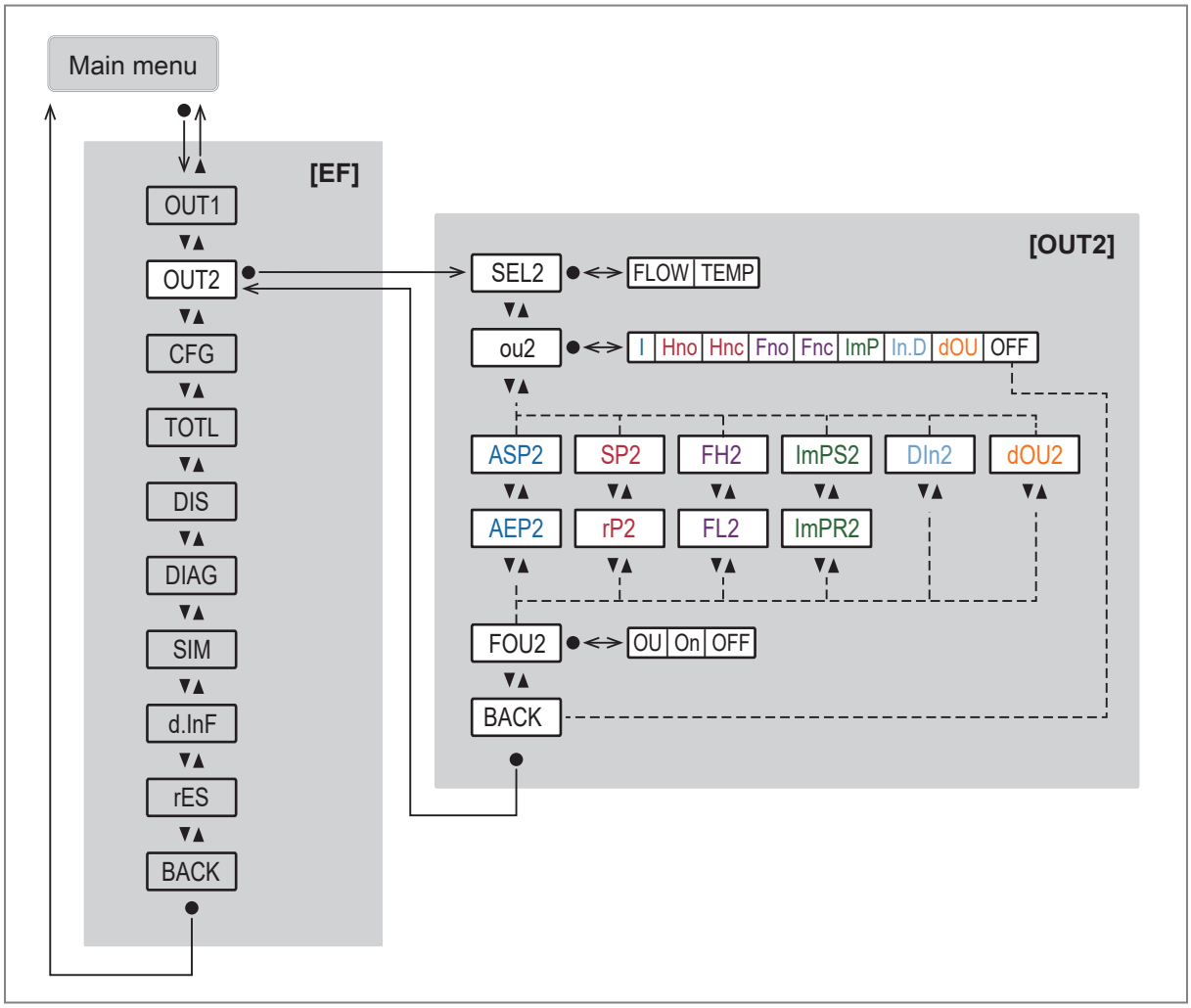
Parameter	Explanation
SPx	Switch point for switching output OUTx
rPx	Reset point for switching output OUTx
FHx	Upper limit for switching signal OUTx with window function
FLx	Lower limit for switching signal OUTx with window function
ImPSx	Pulse value (= flow value at which 1 pulse is provided)
ImPRx	Totaliser function: pulse signal (ImPR = YES) or switching signal (ImPR = NO)
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.
ASP2	Analogue start point for OUT2 = process value at which the output signal is 4 mA.
AEP2	Analogue end point for OUT2 = process value at which the output signal is 20 mA.
DIn2	Reset signal for external totaliser reset

Output 1 menu **OUT1**:



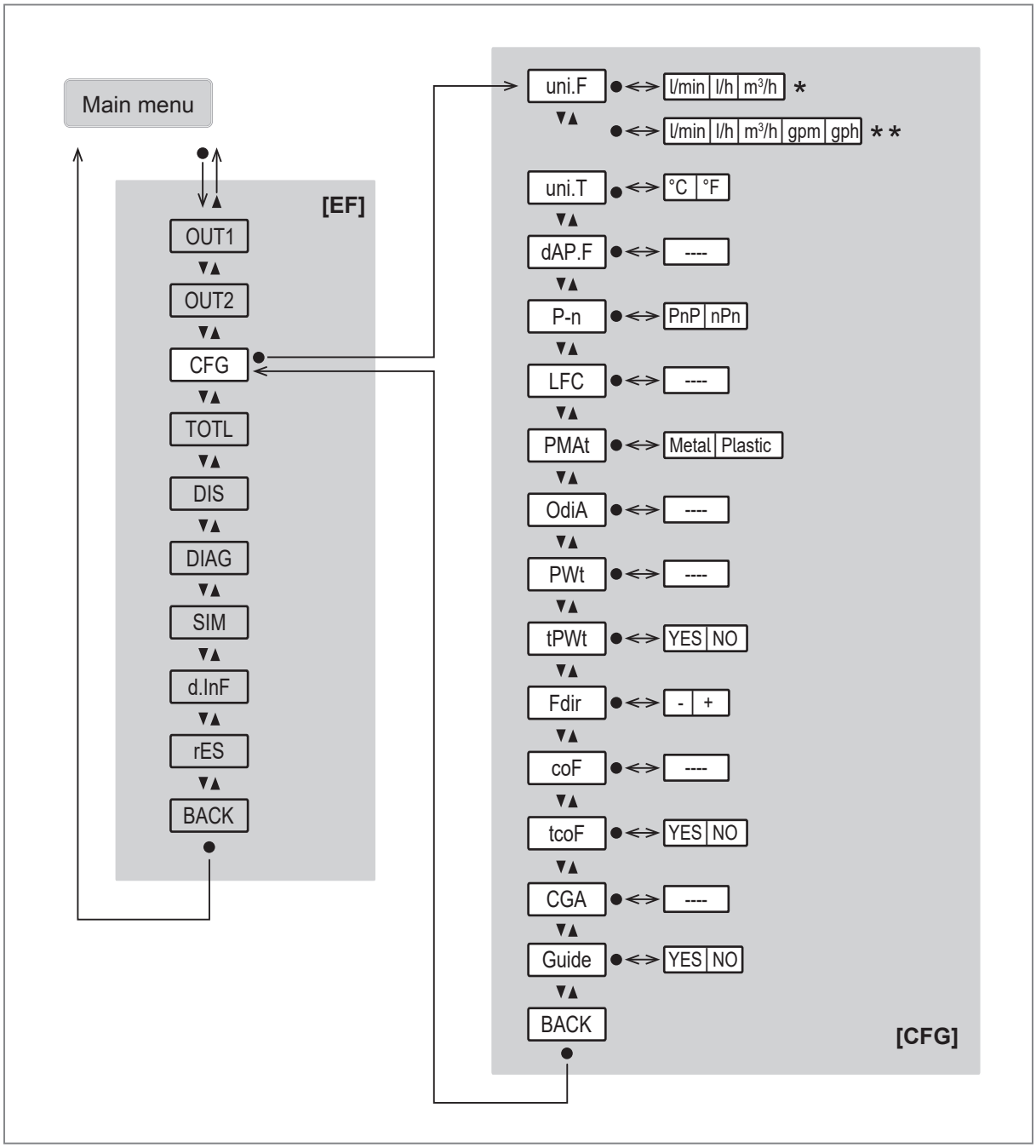
Parameter	Explanation
SEL1	Process value for output OUT1
ou1	Output function for output OUT1
SP1	Setpoint for switching output OUT1 with hysteresis function
rP1	Reset point for switching output OUT1 with hysteresis function
FH1	Upper limit value for switching signal OUT1 with window function
FL1	Lower limit value for switching signal OUT1 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.
ImPS1	Pulse value (= flow value at which 1 pulse is provided)
ImPR1	Totaliser function: pulse signal (ImPR1 = YES) or switching signal (ImPR1 = NO)
dOUx	Switching signal diagnosis: direction of flow (Fdir) or signal quality (Sig.Q)
FOU1	Behaviour of output OUT1 in case of an error

Output 2 menu **OUT2**:



Parameter	Explanation
SEL2	Process value for output OUT2
ou2	Output function for output OUT2
ASP2	Analogue start point for OUT2 = process value at which the output signal is 4 mA.
AEP2	Analogue end point for OUT2 = process value at which the output signal is 20 mA.
SP2	Setpoint for switching output OUT2 with hysteresis function
rP2	Reset point for switching output OUT2 with hysteresis function
FH2	Upper limit value for switching signal OUT2 with window function
FL2	Lower limit value for switching signal OUT2 with window function
ImPS2	Pulse value (= flow value at which 1 pulse is provided)
ImPR2	Totaliser function: pulse signal (ImPR2 = YES) or switching signal (ImPR2 = NO)
DIn2	Reset signal for external totaliser reset
dOUx	Switching signal diagnosis: direction of flow (Fdir) or signal quality (Sig.Q)
FOU2	Behaviour of output OUT2 in case of error

Basic settings menu **CFG**:

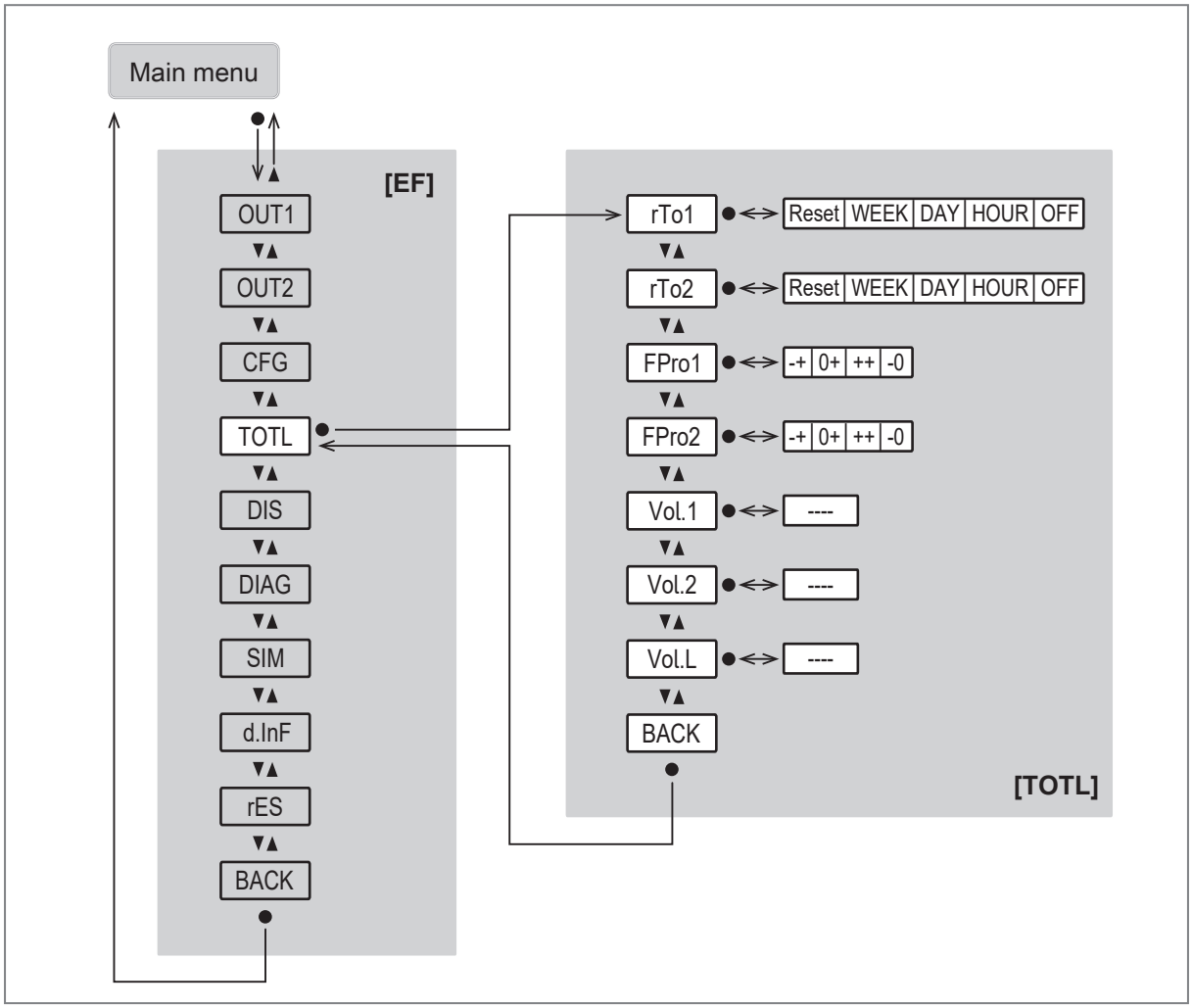


*Device types SUCxx0; **Device types SUCxx1

Parameter	Explanation
uni.F	Standard unit of measurement for flow
uni.T	Standard unit of measurement for temperature
dAP.F	Damping constant in seconds for flow (63 % rise time τ)
P-n	Output polarity for the switching outputs
LFC	Low flow cut-off (= flow value below which flow is evaluated as standstill)
PMAt	Material of the pipe
OdiA	Outer diameter of the pipe
PWt	Wall thickness of the pipe
tPWt	Detecting the wall thickness of the pipe automatically

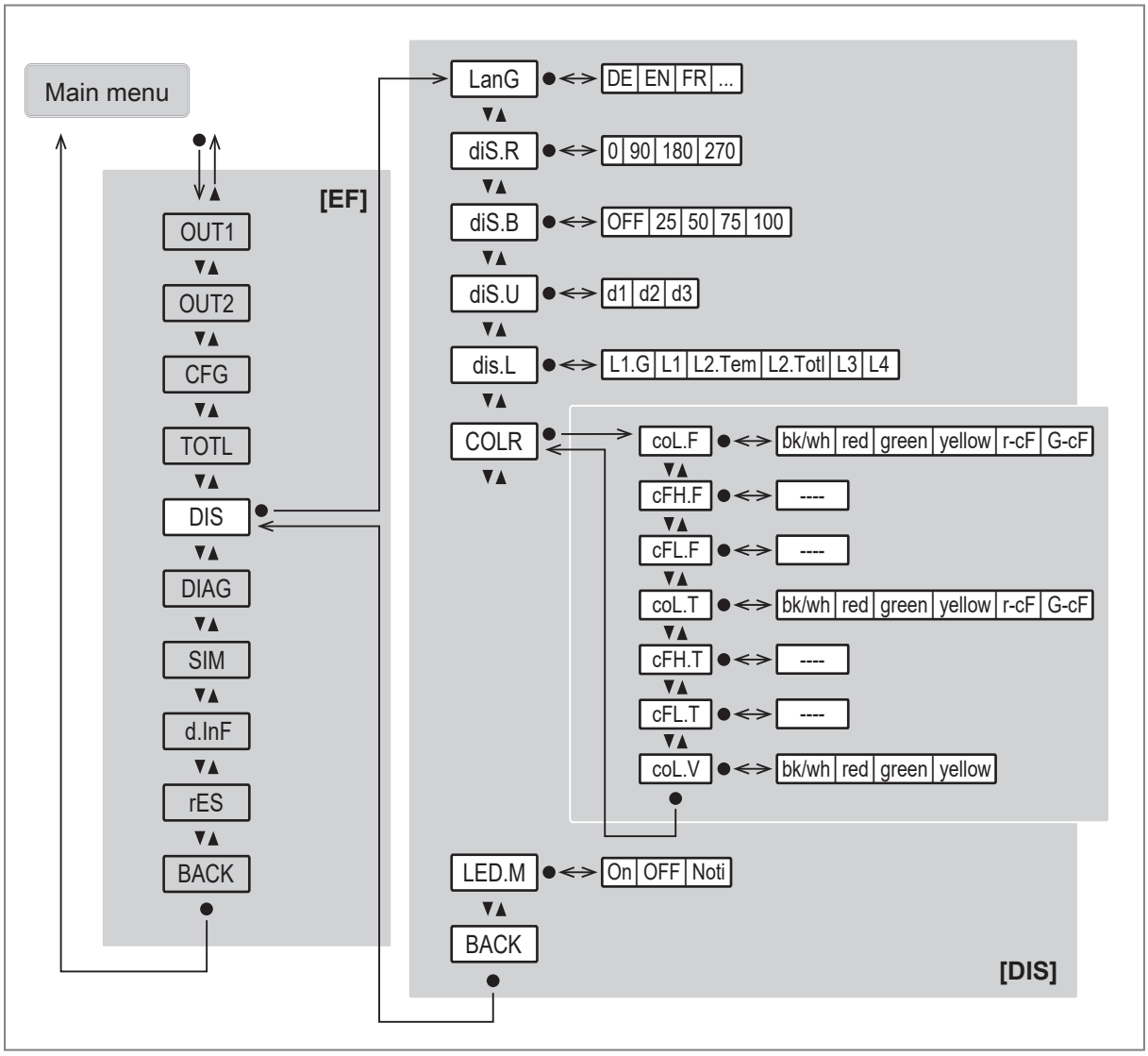
Parameter	Explanation
Fdir	Direction of flow
coF	Correction factor for zero point calibration
tcOF	Teach correction factor for zero point calibration
CGA	Calibration factor in % for adapting the measured value curve to the application
Guide	Activation of the guided installation (wizard)

Totaliser menu **TOTL**:



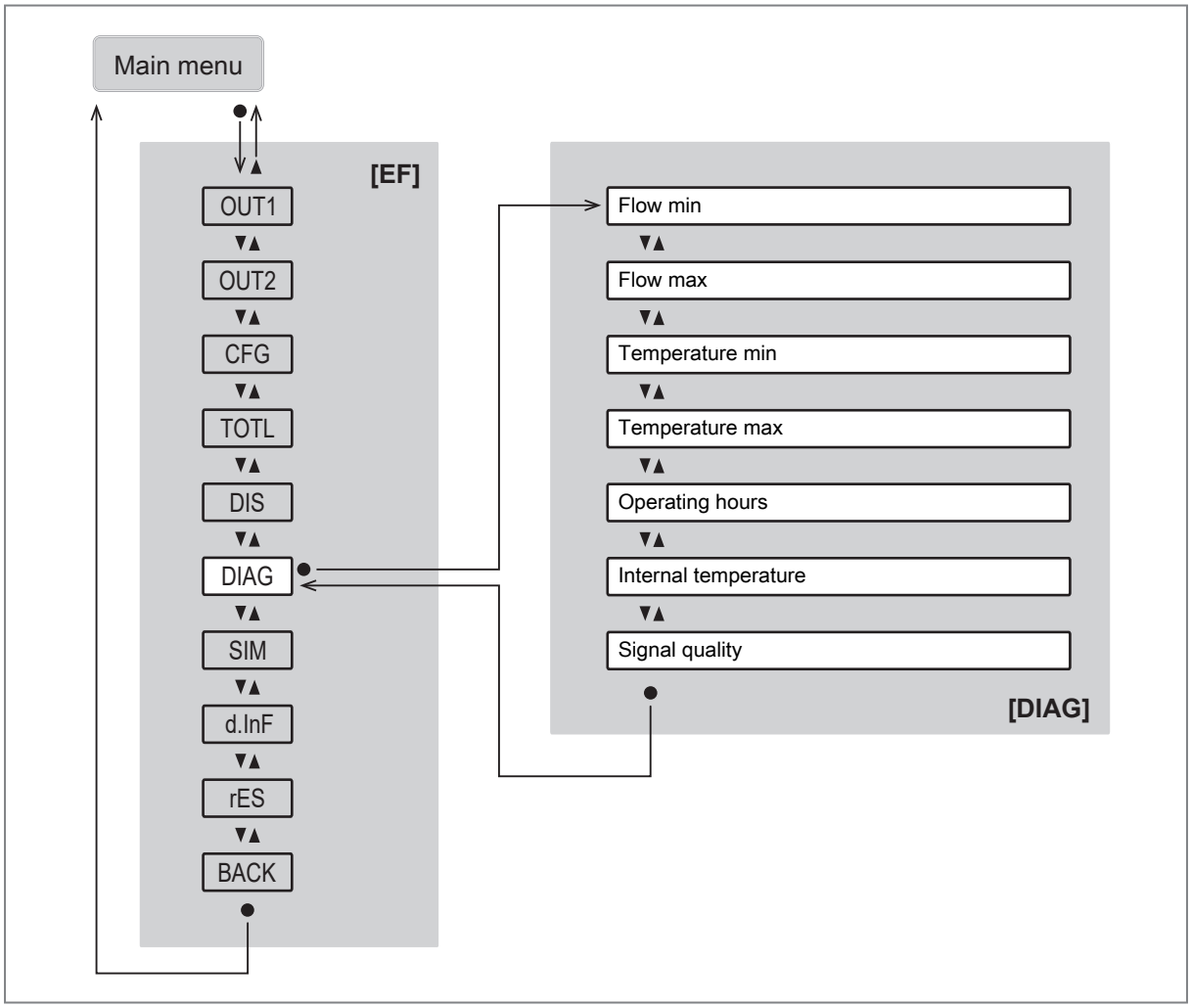
Parameter	Explanation
rTox	Setting for the totaliser reset (manually or time-controlled)
FProx	Counting method of the totaliser: consideration of the direction of flow
Vol.x	Current counter reading for totaliser Vol.x
Vol.L	Current counter reading for totaliser Vol.L over the whole lifetime

Display menu **DIS**:

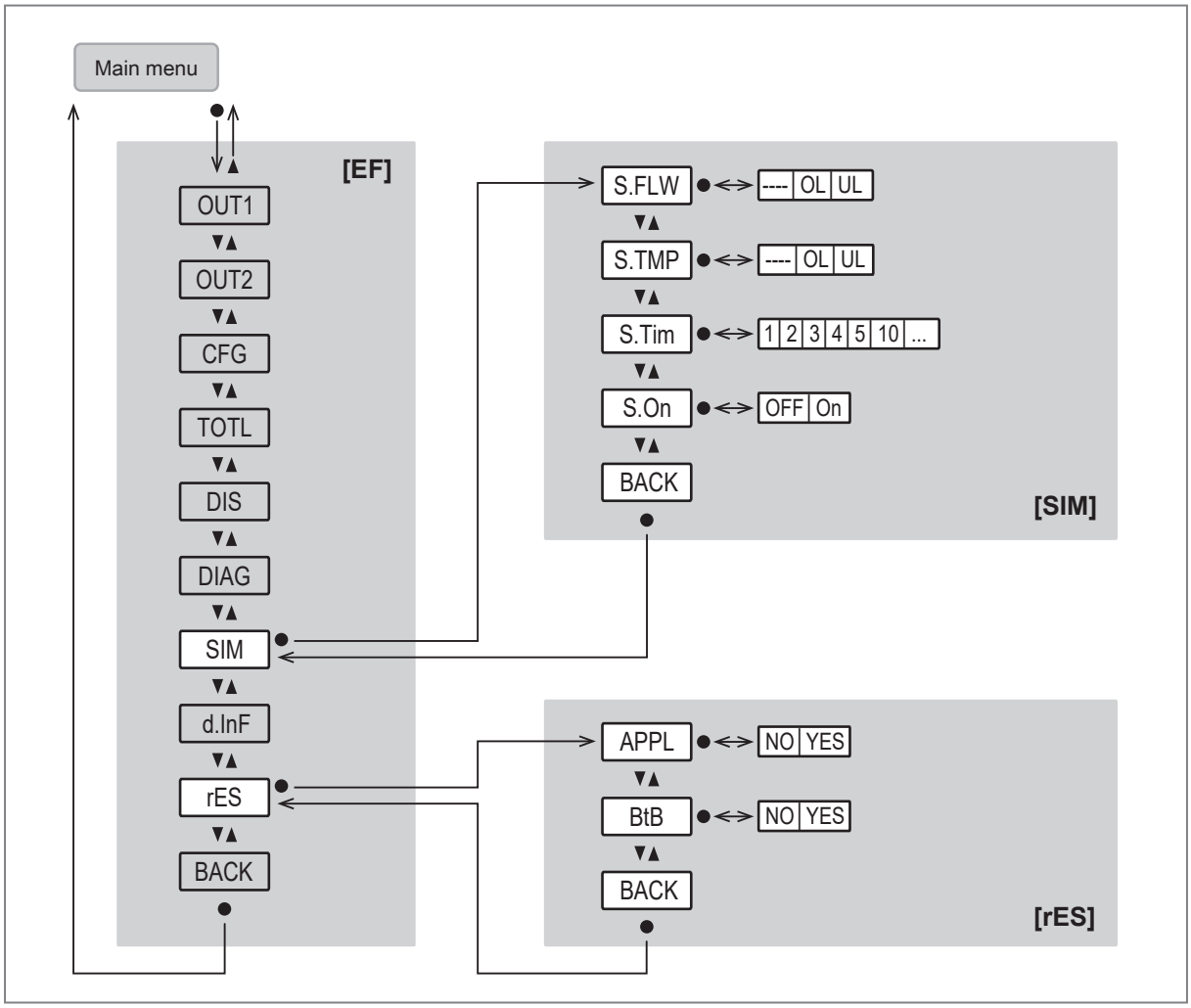


Parameter	Explanation
LanG	Language selection for the display
diS.R	Orientation of the display
diS.B	Brightness of the display
diS.U	Update rate of the display
diS.L	Standard process value of the display
COLR	Change to the submenu COLR (colour settings)
coL.F	Font colour for flow
cFH.F	Upper limit value for colour change (flow)
cFL.F	Lower limit value for colour change (flow)
col.T	Font colour for temperature
cFH.T	Upper limit value for colour change (temperature)
cFL.T	Lower limit value for colour change (temperature)
col.V	Font colour for totaliser indication
LED.M	Setting of the operating status LED

Diagnostics menu **DIAG**:

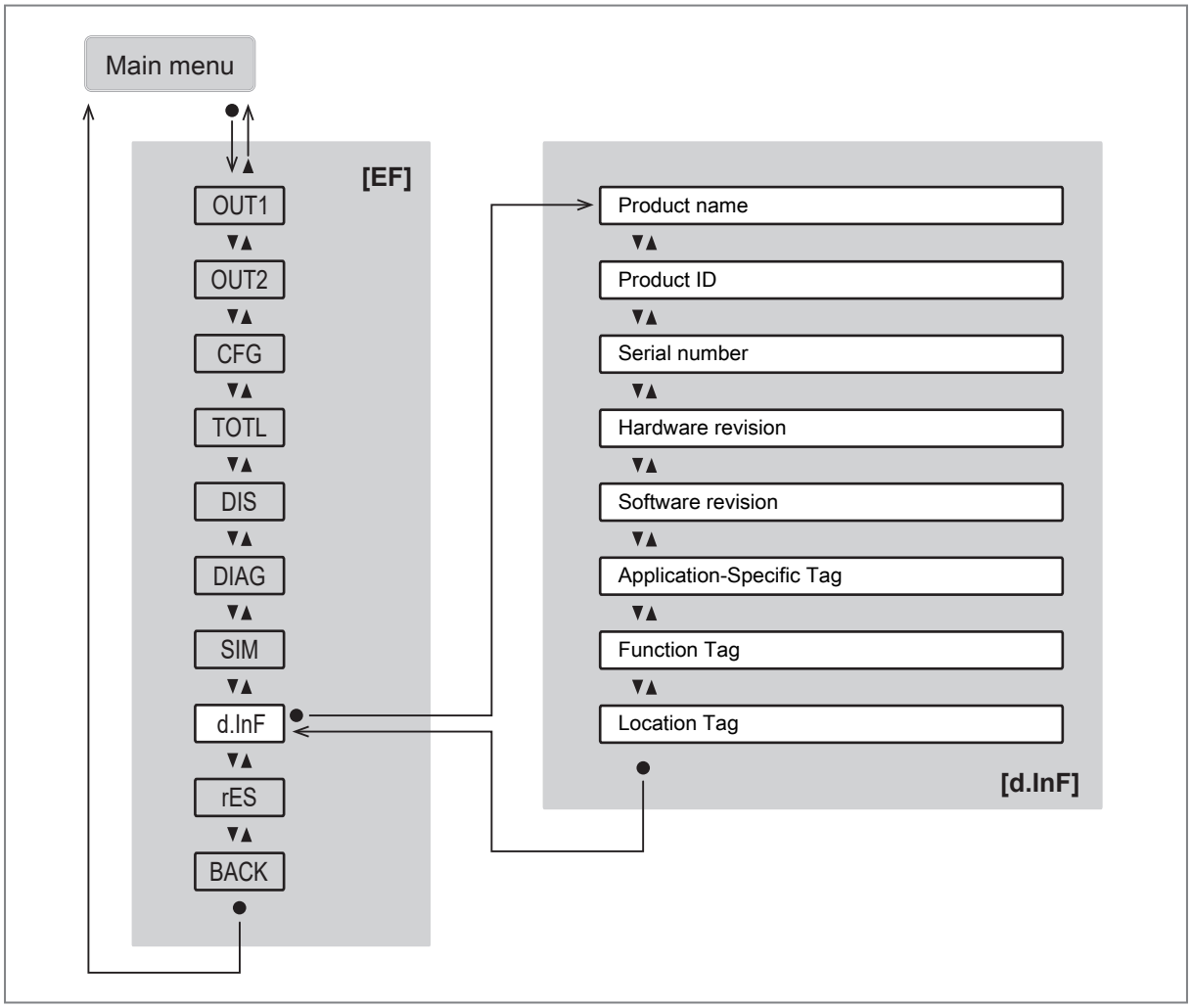


Simulation menu **SIM** and 'reset device' menu **rES**:



Parameter	Explanation
S.FLW	Simulated flow value in simulation mode
S.TMP	Simulated temperature value in simulation mode
S.Tim	Duration of the simulation in minutes
S.On	Starts the simulation mode
APPL	Application reset (reset of application-specific parameter settings)
BtB	Back-to-Box reset (reset to factory settings)

Device information menu **d.InF**:



11 Set-up

During initial set-up of the device, the installation wizard is launched to set the necessary parameters 28.

Each time the device is started up, it behaves as follows, depending on its configuration:

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 in the following status according to the set parameters:

- ON with normally open function (Hno / Fno)
- OFF with normally closed function (Hnc / Fnc)
- ON for detection of direction (dir.F)
- OFF for frequency output (FRQ)
- OFF for consumed quantity monitoring (ImP)
- 20 mA for current output (I)

When an IO-Link master is connected, the device automatically goes from SIO mode (standard input-output) into IO-Link mode if the port of the master is set to IO-Link mode.

11.1 Guided installation via an installation wizard

When the device is set up for the first time or after a reset (**APPL** or **BtB**), the display starts with a guided installation: Parameters, questions and instructions appear on the display in succession.

▶ Use the ▲ and ▼ keys to choose from the available options and the ◉ key to confirm the selection.

During guided installation, the following setting options appear in succession:

1. **diS.R**: display rotation
2. **LanG**: display language
3. **PMAt**: material of the pipe
4. **OdiA**: outer diameter of the pipe
5. **tPWt**: The wall thickness of the pipe is determined automatically. If the automatic measurement fails, the **PWt** parameter will prompt you to enter the value manually.
6. **Fdir**: direction of flow

The next question is whether a switching signal is required.

If **No** is selected:

▶ **diS.L**: setting the display layout.

▷ The installation is completed 29.

If **Yes** is selected:

▶ Continue with the parameter setting to set the switching signal for limit value monitoring (see also 31).

The configuration of the OUTx outputs as a diagnostic switching output 32, as a switching output for consumed quantity monitoring (totaliser), as a frequency output 38 or as an analogue output 36 is not possible via the wizard and must be carried out manually.

1. Output OUT1:
   – **SEL1**: process value (flow rate or temperature)

- **uni.F**:/ **uni.T**: standard unit of measurement (flow rate or temperature)
- **ou1**: switching signal (**Hno**, **Hnc**, **Fno**, **Fnc**)
- **SP1**, **rP1**, **FH1**, **FL1**: limit values (hysteresis or window function)
- **FOU1**: error behaviour of the output OUT1

2. Output OUT2:
   - **SEL2**: process value (flow rate or temperature)
   - **ou2**: switching signal (**Hno**, **Hnc**, **Fno**, **Fnc**)
   - **SP2**, **rP2**, **FH2**, **FL2**: limit values (hysteresis or window function)
   - **FOU2**: error behaviour of the output OUT2

▶ **diS.L**: setting the display layout.

▷ The installation is completed.

After the message that the guided installation is completed, you are asked whether you want to start the measurement.

▶ Select **Yes** or **No** or **Device info**.

▷ If **Yes** is selected, the installation process is completed and the device changes to the process value display.

▷ If **No** is selected, the parameters for the flow direction, OUT1/OUT2 and the display layout can be modified again, or the guided installation can be restarted from the beginning using the **Restart** command.

▷ If **Device info** is selected, the device displays the previously set device configuration.

The guided installation can be called up again at any time via the parameter **EF** > **CFG** > **Guide**.

12 Parameter setting

Parameter setting can be carried out via the IO-Link interface or via the operating elements on the unit.

Parameters can be set before installation or during operation.

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

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

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.

12.1 Parameter setting via the unit keys

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.
- ▶ If necessary, use a blunt object to make settings on the device.

Intention	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 ◉
Select the required parameter	▲ or ▼
Change to the setting mode	◉
Modify the parameter value	▲ or ▼
Apply the set parameter	◉
Exit parameter setting without saving	▲ + ▼
Return to the next higher menu level (repeat several times to reach process value display)	▲ + ▼ - or - Use ▲ or ▼ to navigate to **Back**, then ◉
Return to the process value display	> 30 seconds (timeout)

When changing from the process value display to the main menu or after resetting the unit, the guided installation option is automatically displayed. You are asked whether you want a guided installation.

See also: Guided installation using an installation wizard → 28.

12.2 Parameter setting via IO-Link

The device parameters can be set via the IO-Link interface in the following ways, for example:

- Parameter setting via a suitable parameter setting software, e.g. ifm moneo|configure
- Parameter setting via a PLC
- Parameter setting via an IIoT application

Requirements for parameter setting via the IO-Link interface:

- ✓ The Input Output Device Description (IODD) for the device in case of parameter setting via a parameter setting software, see documentation.ifm.com
- ✓ The IO-Link interface description (PDF) for the device in case of parameter setting via a PLC or IIoT application, see documentation.ifm.com
- ✓ An IO-Link master
- ▶ Connect the IO-Link master to the parameter setting software, the PLC or the IIoT application.
- ▶ Connect the device to a suitable free port of the IO-Link master.
- ▶ Set the port of the IO-Link master to the IO-Link operating mode.
- ▷ The device changes to the IO-Link mode.
- ▶ Change the parameter settings in the software.
- ▶ Write the parameter settings to the device.

Support for system integration and parameter setting via IO-Link:
→ Manual of the parameter setting software (e.g. moneo)
→ Explanations and startup packages at ifm.com/cnt/io-link-system-integration.

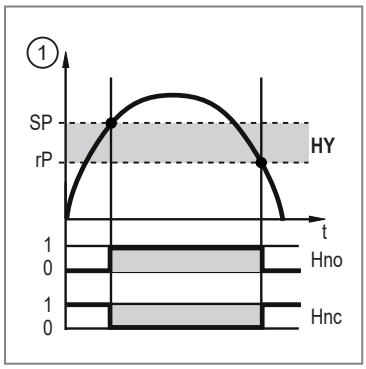
12.3 Output configuration

This chapter describes the options for the output signals at OUT1 and OUT2.

12.3.1 Switching signal for limit value monitoring

A switching signal can be output for process value monitoring. OUTx changes its switching state when the set switching limits are exceeded or not reached. You can choose between hysteresis and window function.

Hysteresis function:

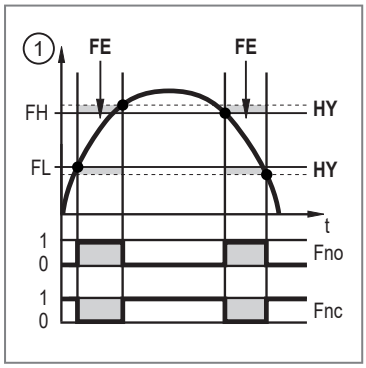


1:	Process value
t:	Time
SP:	Set point
rP:	Reset point
HY:	Hysteresis
Hno:	Hysteresis function NO (normally open)
Hnc:	Hysteresis function NC (normally closed)

Fig. 9: Hysteresis function

When the hysteresis function is set, the set point **SP** and the reset point **rP** are set. The rP value must be lower than the SP value. The difference between SP and rP is at least 0.5 % 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.

Window function:



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. 10: Window function

When set to the window function, the window high **FH** and the window low **FL** are set. The difference between FH and FL is at least 0.5% 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.

Parameter setting via unit keys: Switching signal

- ✓ Standard unit of measurement is selected: **EF** > **CFG** > **uni.x**.
- ▶ Go to **EF** > **OUTx** to configure output OUTx.
- ▶ Select **SELx** and set the process value: **FLOW** or **TEMP**.

Hysteresis function:

- ▶ Select **ou** and set the switching signal: **Hno** or **Hnc**.
- ▶ Select **SPx** and set the measured value at which the output switches.
- ▶ Select **rPx** and set the measured value at which the output switches back.

Window function:

- ▶ Select **ou** and set the switching signal: **Fno** or **Fnc**.
- ▶ Select **FHx** and set the upper limit of the window.
- ▶ Select **FLx** and set the lower limit of the window.

The parameter settings for **SP**, **rP**, **FH** and **FL** can be changed subsequently in the main menu.

12.3.2 Switching signal Diagnosis

The unit features an integrated diagnostic function. When using the diagnostic function, the output is used exclusively for diagnostic message output, which it indicates by a switched signal.

The switching output is switched on in normal operation (normally closed) and the switching status LED lights yellow.

If the unit detects a diagnostic case, the output is switched off and the switching status LED goes out.

Diagnostic cases include:

- Reversal of the direction of flow 33.
- Low signal quality / no signal 33.

12.3.2.1 Switching signal for flow direction

A flow direction change can be monitored by providing a switching signal.

The output is switched on until the flow rate falls below the set minimum flow rate in negative flow direction (- LFC)(1).

Then the following applies:

- The output switches ON when **+ LFC** is exceeded (2).
- The output switches OFF when **- LFC** is not reached (3).

LFC = Low flow cut-off**:** Low flow cut-off 43**.** The unit of the minimum flow rate corresponds to the selection under **uni.F**.

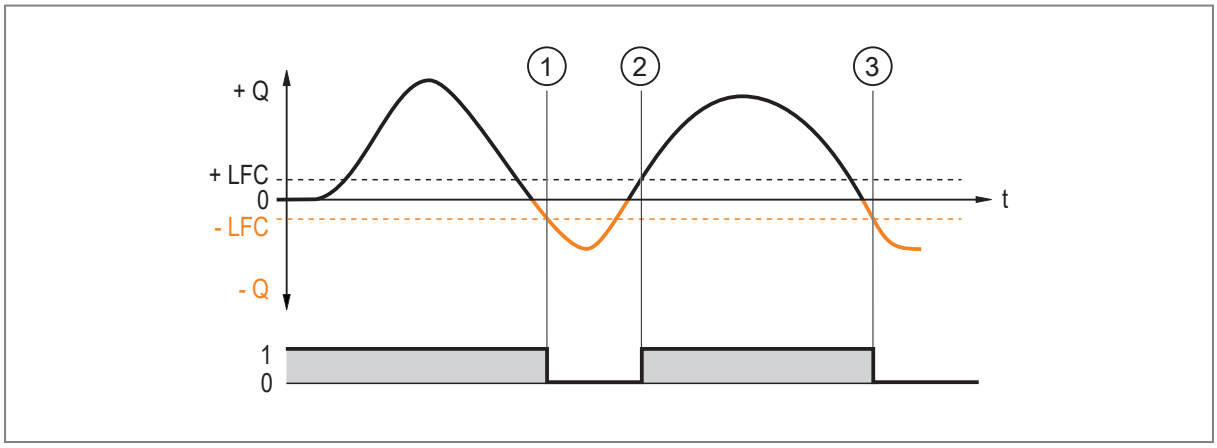


Fig. 11: Monitoring of the flow direction by switching signals

+Q: Flow in positive flow direction
-Q: Flow in negative flow direction
+LFC: Minimum flow in positive flow direction
-LFC: Minimum flow in negative flow direction

An arrow with the text “flow direction” on the device indicates the positive flow direction. The direction of the flow measurement can be reversed using the parameter **Fdir**.

Flow direction 44.

Parameter setting via unit keys: switching signal for flow direction

- Go to the **EF** > **OUTx** menu.
- Select **oux** and set **dOU**.
- Select **dOUx** and set **Fdir**.

12.3.2.2 Switching signal for signal quality

The unit can provide a switching signal when the signal quality deviates from normal operation.

The signal quality of the sensor can be affected by irregularities in the medium (e.g. strong turbulences, air bubbles, particles or build-up).

The unit detects the signal quality in three stages:

Signal quality	Explanation	Operating status LED	Switching output
Normal	The device operates without restrictions (normal operation).	Lights green	On
Low	The signal quality is disturbed, but the device is still working within its specifications.	Lights blue	OFF

Signal quality	Explanation	Operating status LED	Switching output
No signal	No medium is present, or no pipe detected, or no signal can be established.	Flashes red	OFF

Parameter setting via unit keys: switching signal for signal quality

- Go to the **EF** > **OUTx** menu.
- Select **oux** and set **dOU**.
- Select **dOUx** and set **Sig.Q**.

12.3.3 Consumed quantity monitoring (totaliser function)

The unit has 3 internal quantity meters (totalisers Vol.1, Vol.2 and Vol.L). The totalisers continuously sum up the consumed quantity and provide this process value both on the display and via the IO-Link interface.

Totaliser	Process value	Read access via IO-Link
Vol.1	Consumed quantity 1 (This value is used for consumed quantity monitoring by switching or pulse signals)	Cyclic
Vol.2	Consumed quantity 2	Acyclic
Vol.L	Consumed quantity over the whole lifetime (lifetime totaliser)	Acyclic

- The totalisers Vol.1 and Vol.2 can be reset. Totaliser Vol.L cannot be reset.

Totaliser reset 46.

- The totalisers Vol.1 and Vol.2 take account of the following parameter settings when totalising the consumed quantity:

1. Flow direction 44.
2. Counting method of the totalisers 47.
3. Low flow cut-off 43.

- The Life Time Totalisator Vol.L totals all flow quantities regardless of the flow direction and counting method.
- When the detection range is exceeded, the totalisers use the last valid flow rate value (final value of the measuring range) and continue counting with this value.
- In addition to the current consumed quantity, the value before the last reset is saved. This value and the time since the last reset can also be displayed.

Read totaliser values 54.

The totaliser saves the totalled consumed quantity at regular intervals. 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. This means that the possible data loss can amount to one minute.

- The accuracy of the consumed quantity measurement depends on the accuracy of the flow measurement.
- A switching signal or pulse signals can be provided for consumed quantity monitoring:

Switching signal totaliser 35.
Pulse signal totaliser 35.

OUT1 and OUT2 cannot be used simultaneously for the consumed quantity monitoring.

12.3.3.1 Switching signal totaliser

A switching signal can be provided for consumed quantity monitoring.

When totaliser Vol.1 has totalled the flow quantity (pulse value) set under **ImPS**, the output provides a switching signal.

The flow direction is taken into account when totalling the flow quantity 47.

The output remains switched until a totaliser reset is carried out. When the totaliser has been reset, metering starts again.

The totaliser is reset automatically or manually.

The conditions for the totaliser reset and the switching signal can be set via the parameter **rTo**:

- **rTo** = **OFF**:
  - The totaliser is only reset with a manual reset or after overflow.
  - The output is switched when the totaliser has reached the flow quantity **ImPS**.
- **rTo** = …**h** / **d** / **w** (hours / days / weeks):
  - The totaliser is automatically reset after the set time.
  - The output is only switched when the totaliser reaches the flow quantity **ImPS** by the set time.

The totalisers can be reset manually at any time via the **rTox** parameter. Totaliser Vol.1 can additionally be reset via an external signal at pin 2.

Totaliser reset 46.

Parameter setting via unit keys: Switching signal totaliser

✓ Standard unit of measurement is selected: **EF** > **CFG** > **uni.x**.
✓ **rTox** is set: **EF** > **TOTL** > **rTox**.
▶ Go to **EF** > **OUTx** to configure output OUTx.
▶ Select **SELx** and set the process value: **FLOW**.
▶ Select **ou1** or **ou2** and set **ImP**.
▶ Select **ImPSx** and set the volumetric flow quantity at which the output switches.
• Press ▲ or ▼ to select the setting range.
• Briefly press ● to confirm the setting range.
• Press ▲ or ▼ to set the requested numeric value.
• Briefly press ● to apply the value.
▶ Select **ImPRx** and set **No**.

The parameter settings for **ImPS** and **ImPR** can be changed subsequently in the main menu.

12.3.3.2 Pulse signal totaliser

Pulse signals can be provided for consumed quantity monitoring.

Pulse signals are not available via the IO-Link interface.

The output provides a pulse signal each time totaliser Vol.1 has totalled the flow quantity (pulse value) set under **ImPS**.

The flow direction is taken into account when totalling the flow quantity 47.

The pulse signal consists of a short switching on and off of the output.

The switching status LEDs do not display the switching operation.

Parameter setting via unit keys: Pulse signal totaliser

✓ Standard unit of measurement is selected: **EF** > **CFG** > **uni.x**.

▶ Go to **EF** > **OUTx** to configure output OUTx.

▶ Select **SELx** and set the process value: **FLOW**.

▶ Select **ou1** or **ou2** and set **ImP**.

▶ Select **ImPSx** and set the volumetric flow quantity at which 1 pulse is provided (pulse value).

- Press ▲ or ▼ to select the setting range.
- Briefly press ● to confirm the setting range.
- Press ▲ or ▼ to set the requested numeric value.
- Briefly press ● to apply the value.

▶ Select **ImPRx** and set **Yes**.

The parameter settings for **ImPS** and **ImPR** can be changed subsequently in the main menu.

12.3.4 Analogue signal

The device provides an analogue signal proportional to the process value.

Within the measuring range the analogue signal is between 4...20 mA.

The measuring range can be scaled between -100% and 100% of the final value of the measuring range.

A negative flow value means flow against the flow direction set under [Fdir] 44.

- **ASP2** determines at which measured value the output signal is 4 mA.
- **AEP2** determines at which measured value the output signal is 20 mA.

Minimum distance between **ASP2** and **AEP2** = 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 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).

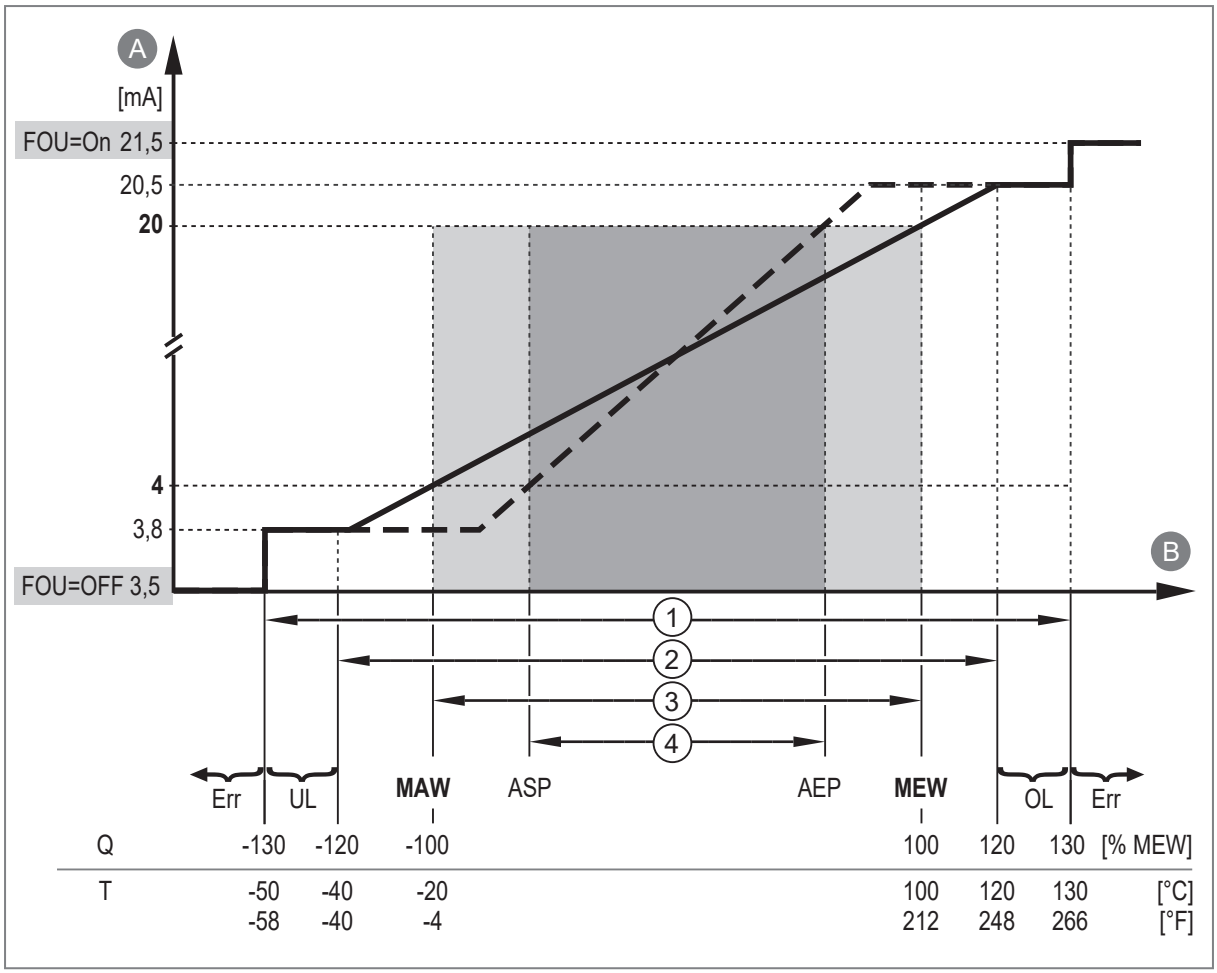


Fig. 12: Characteristics of the analogue output according to the standard IEC 60947-5-7

A:	Analogue signal	MAW:	Initial value of the measuring range
B:	Process value	MEW:	Final value of the measuring range
1:	Detection range	ASP:	Analogue start point
2:	Display range	AEP:	Analogue end point
3:	Measuring range	UL:	Below the display range
4:	Scaled measuring range	OL:	Above the display range
Q:	Flow	Err:	Error
T:	Temperature		

The analogue signal in case of a fault can be set via the parameter **FOU**: Error behaviour of the outputs 40.

Parameter setting via unit keys: Analogue signal

- ✓ Standard unit of measurement is selected: **EF** > **CFG** > **uni.x**.
- ▶ Go to **EF** > **OUT2** to configure output OUT2.
- ▶ Select **SEL2** and set the process value. **FLOW** or **TEMP**.
- ▶ Select **ou2** and set the function: **I** (analogue signal 4...20 mA.).
- ▶ Select **ASP2** and set the measurement value at which the output signal is 4 mA.
- ▶ Select **AEP2** and set the measurement value at which the output signal is 20 mA.

The parameter settings **ASP** and **AEP** can be changed subsequently in the main menu.

12.3.5 Frequency signal

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

The frequency signal is adjustable:

- **FrP1** defines the frequency signal in Hz that is provided when the upper measured value is reached.

Setting range: 1 Hz…10 kHz.

The measuring range is scalable:

- **FSP1** defines the lower measured value from which a frequency signal is provided.
- **FEP1** defines the upper measured value at which the output signal has the frequency set under **FrP1**.

FSP1 is only available for temperature measurement. Minimum difference between **FSP1** and **FEP1** = 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.

Frequency signal for flow:

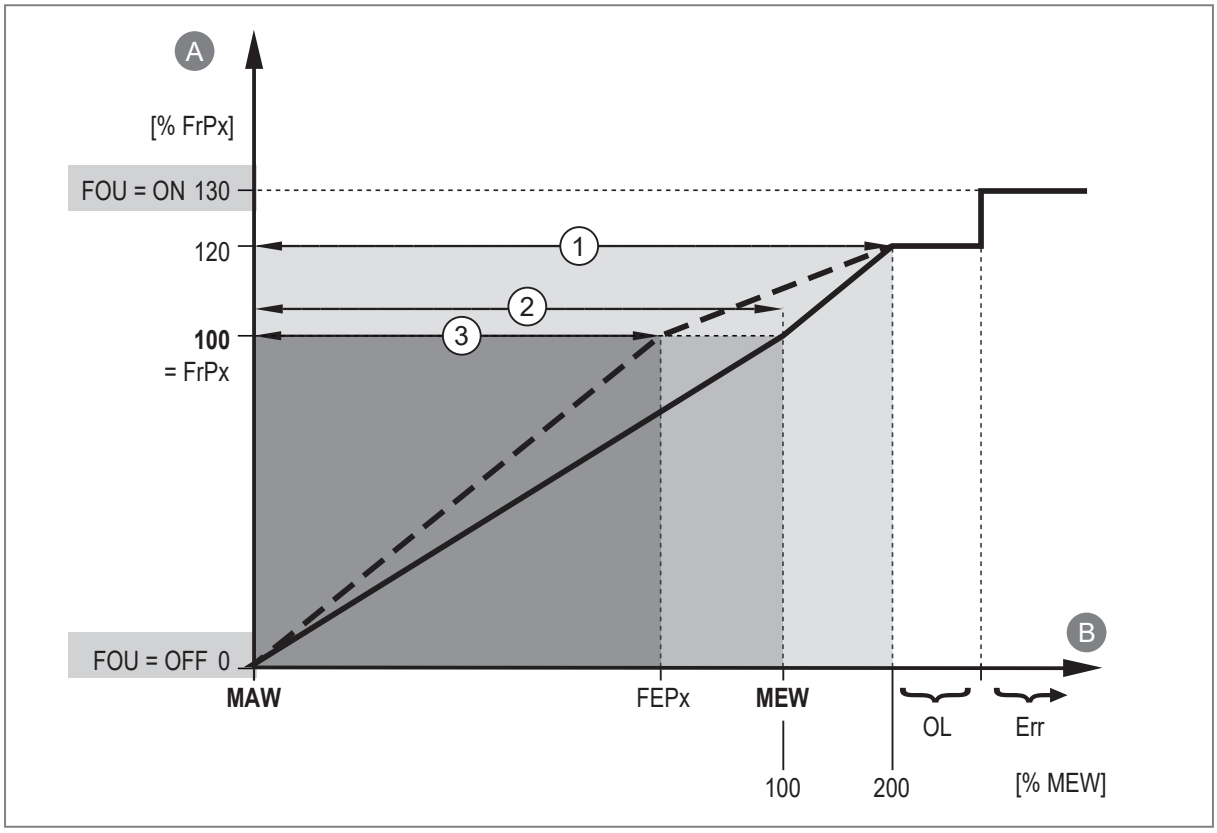


Fig. 13: Output characteristic of the frequency output, flow

A:	Frequency signal	MAW:	Initial value of the measuring range
B:	Flow	MEW:	Final value of the measuring range
1:	Display range	FEPx:	Frequency end point
2:	Measuring range	FrPx:	Frequency signal (Hz) for upper measured value
3:	Scaled measuring range	OL:	Above the display range
		Err:	Error

Frequency signal temperature:

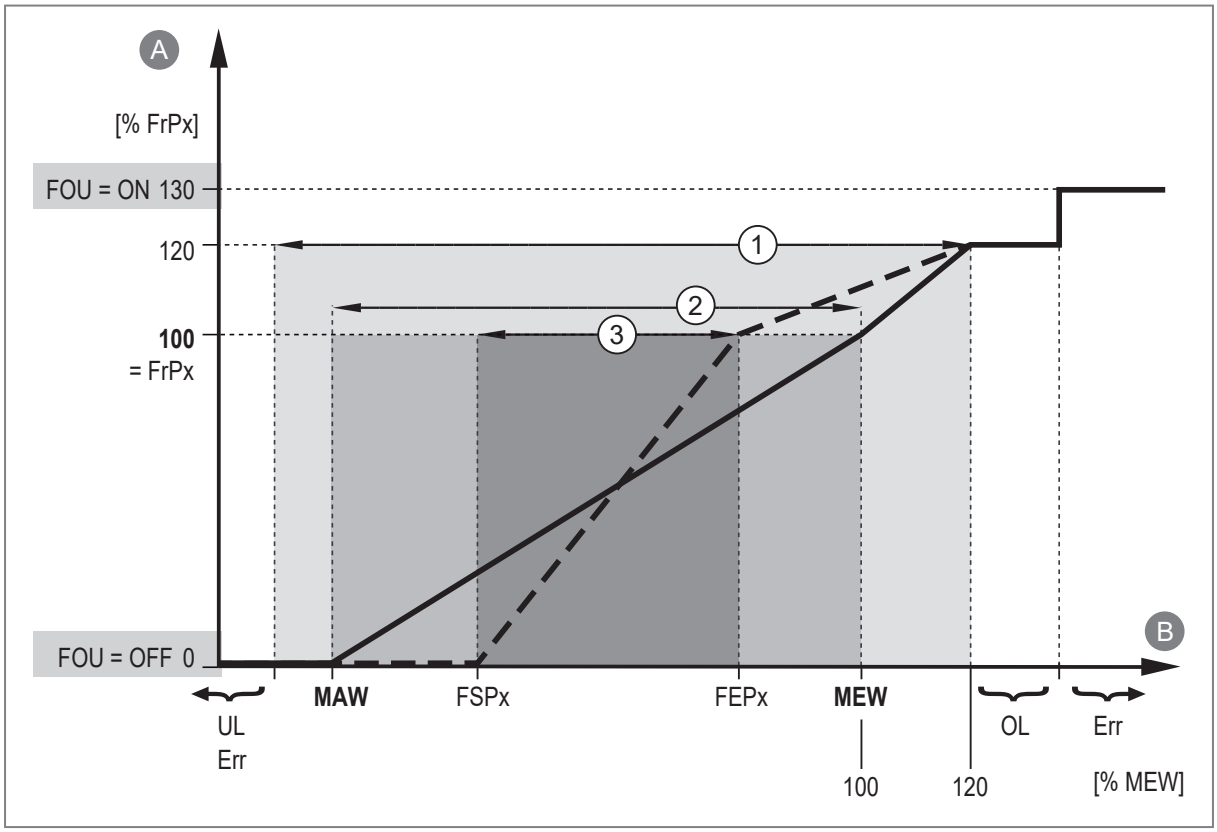


Fig. 14: Output characteristics frequency output, temperature

A:	Frequency signal	MAW:	Initial value of the measuring range
B:	Temperature	MEW:	Final value of the measuring range
1:	Display range	FSPx:	Frequency start point
2:	Measuring range	FEPx:	Frequency end point
3:	Scaled measuring range	FrPx:	Frequency signal (Hz) for upper measured value
Err:	Error	OL:	Above the display range
		UL:	Below the display range

Parameter setting via unit keys: Frequency signal

✓ Standard unit of measurement is selected: **EF** > **CFG** > **uni.x**.

▶ Go to **EF** > **OUT1** to configure output OUT1.

▶ Select **SEL1** and set the process value: **FLOW** or **TEMP**.

▶ Select **ou1** and set **FRQ**.

▶ Select **FSP1** and set the lower measured value at which 0 Hz is output.

FSP1 is only available for temperature measurement.

▶ Select **FEP1** and set the upper measured value at which the frequency set at **FrP1** (= 100 %) is output.

▶ Select **FrP1** and set the frequency for the upper measured value in Hz.

The parameter settings for **FSP**, **FEP** and **FrP** can be changed subsequently in the main menu.

12.3.6 Error behaviour of the outputs

The response of the OUTx output in case of a fault can be set via the parameter **FOUx**. Depending on the selected output function, the following signals are provided in case of a fault:

- Switching signal:

FOUx	Process values SELx	Output signal	Explanation
On	All process values	The output switches ON in case of a fault.	As soon as a defective process value is present, the device sets all process values to invalid.
OFF	All process values	The output switches OFF in case of a fault.	
OU	Flow	The output switches OFF in case of a fault.	If the process value “Flow” is defective, the device continues to provide the process value “Temperature”.
	Temperature	The output switches ON in case of a fault.	If the process value “Temperature” is defective, the device continues to provide the process value “Flow”.

- Analogue signal:

FOUx	Process values SELx	Output signal	Explanation
On	All process values	In case of an error the output goes to 21.5 mA.	As soon as a defective process value is present, the unit sets all process values to invalid.
OFF	All process values	In case of an error the output goes to 3.5 mA.	
OU	Flow	In case of an error the output goes to 3.5 mA.	If the process value “Flow” is defective, the unit continues to provide the process value “Temperature”.
	Temperature	In case of an error the output goes to 21.5 mA.	If the process value “Temperature” is defective, the unit continues to provide the process value “Flow”.

- Frequency signal:

FOUx	Process values SELx	Output signal	Explanation
On	All process values	In case of an error the output goes to 130% of **FrPx**.	As soon as a defective process value is present, the device sets all process values to invalid.
OFF	All process values	In case of an error the output goes to 0 Hz.	
OU	Flow	In case of an error the output goes to 0 Hz.	If the process value “Flow” is defective, the device continues to provide the process value “Temperature”.
	Temperature	In case of an error the output goes to 130% of **FrPx**.	If the process value “Temperature” is defective, the device continues to provide the process value “Flow”.

The parameter **FOU** has no influence on the pulse signal, the diagnostic signals for flow direction and signal quality and the IO-Link process data transmission.

Parameter setting via unit keys: Error behaviour of the outputs

▶ Go to the **EF** > **OUTx** menu.

▶ Select **FOUx** and set the error behaviour for OUTx: **On**, **OFF**, **OU**.

12.3.7 Output off

The output signal can be deactivated. The output then goes to high impedance.

Communication via the IO-Link interface on OUT1 remains active.

Parameter setting via unit keys: output off

- Go to the **EF** > **OUTx** menu.
- Select **SELx** and set **OFF**.

12.4 Application configuration

The chapter describes the setting options for adaptation to your specific application.

12.4.1 Standard unit of measurement

A unit of measurement can be selected with which the process value is shown in the display by default. All further parameter settings are based on this unit.

Selectable values:

- Flow **uni.F**:
  - SUCxx0: l/min; l/h; m^3/h
  - SUCxx1: l/min; l/h; m^3/h; gpm; gph
- Temperature **uni.T**:
  - SUCxx0: °C
  - SUCxx1: °C or °F

Parameter setting via unit keys: Standard unit of measurement

- Call up the menu **EF** > **CFG**.
- Select **uni.F** and set the unit of measurement.
- Select **uni.T** and set the unit of measurement.

12.4.2 Pipe properties

The pipe's material, outer diameter and wall thickness are crucial for the non-invasive determination of the measured value.

The pipe properties are set in the **EF** > **CFG** menu.

Incorrectly set pipe properties may cause the device to display the warning message "No pipe detected" 59.

12.4.2.1 Material of the pipe

The pipe material is set via the **PMAt** parameter.

Selectable values:

- **Metal** = metal pipe (stainless steel, carbon steel, copper)

- **Plastic** = plastic pipe (PVC)

The device must only be attached to rigid plastic pipes, not to soft, flexible plastic pipes or hoses.

12.4.2.2 Outer diameter of the pipe

The outer diameter of the pipe is set via the **OdiA** parameter.

Default outer diameter: Factory Settings 63.

Device	Setting range
SUC3xx	44…64 mm

Tab. 2: Adjustable outer diameters depending on the device type

12.4.2.3 Wall thickness of the pipe

The wall thickness of the pipe is set via the **PWt** parameter.

The wall thickness can be determined automatically via the **tPWt** parameter.

Default wall thickness: Factory Settings 63.

Device	Adjustable wall thickness	
	…manually via **PWt**	... automatically via **tPWt**
SUC3xx	0.1…11.1 mm	1.4…11.1 mm

Tab. 3: Adjustable wall thickness depending on the device type

Level for automatic wall thickness measurement:

- ▷ When installed on a plastic pipe, the pipe must be completely filled.
- ▷ When installed on a metal pipe, the pipe may be partially filled or empty.

If automatic wall thickness measurement fails (for example, if the wall thickness is < 1.4 mm), the value can be set manually.

12.4.3 Process value for OUT1 and OUT2

For both outputs, you can select which process value is to be monitored. All further parameter settings are based on this selection.

Selectable values:

- **FLOW**: Flow
- **TEMP**: Temperature

Parameter setting via unit keys: process values OUT1 and OUT2

- ▶ Go to the **EF** > **OUTx** menu.
- ▶ Select **SELx** and set the process value for output OUTx.

12.4.4 Damping

The set damping constant stabilises the output signals. Abrupt changes in the physical process values are smoothed out.

This concerns the outputs, the display and the process value transmission via the IO-Link interface.

The damping constant **dAP** is used to set after how many seconds the output signal reaches 63 % of the final value if the measured value changes suddenly.

The damping constant is added to the response time of the sensor (⇒ Technical data).

The UL and OL signals are defined under consideration of the damping time.

Measured value damping only has an effect on the process value flow.

Parameter setting via unit keys: measured value damping

- Call up the menu **EF** > **CFG**.
- Select **dAP** and set the damping time in seconds (τ-value 63 %).

12.4.5 Output polarity of the switching outputs

The output polarity is set via the parameter **P-n**.

The setting affects both switching outputs.

- **PnP**: The switching output is positive switching.
- **nPn**: The switching output is negative switching.

Parameter setting via unit keys: Output polarity

- Call up the menu **EF** > **CFG**.
- Select **P-n** and set **PnP** or **nPn**.

12.4.6 Low flow cut-off

Low flow quantities can be ignored using the parameter **LFC** (Low flow cut-off). Flow below the LFC value is evaluated by the sensor as standstill (Q = 0).

The LFC value influences:

- the process value for flow shown on the display
- The switching signal for flow
- the analogue signal for flow
- The frequency signal for flow
- the consumed quantity monitoring (switching or pulse signal for flow)
- The totalisation of the consumed quantity by the totaliser.
- the memory values for minimum and maximum flow

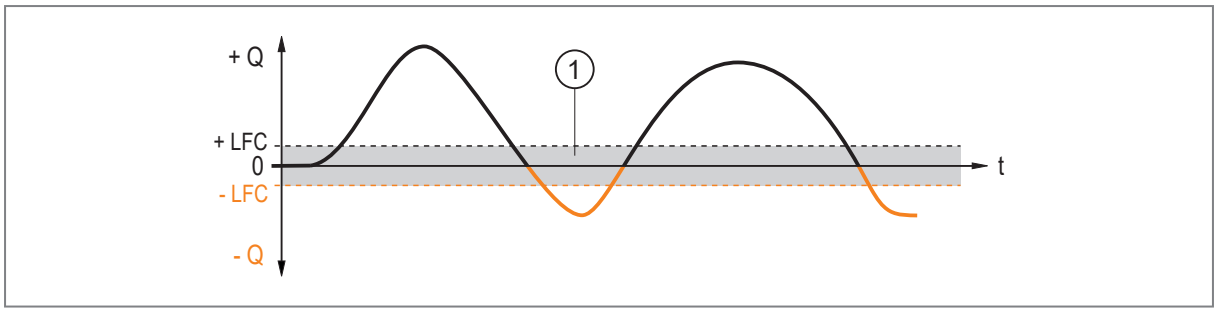


Fig. 15: Low flow cut-off

+LFC: Minimum flow in positive flow direction
-LFC: Minimum flow in negative flow direction
1: Flow which is evaluated as standstill

Parameter setting via unit keys: low flow cut-off

- Call up the menu **EF** > **CFG**.
- Select **LFC** and set the limit below which a flow is evaluated as standstill.

12.4.7 Flow direction

The positive flow direction can be defined by the user. This setting affects the following functions:

- Consumed quantity monitoring (totaliser function).
- Switching signal for flow direction 33.

An arrow with the text “flow direction” on the device indicates the positive flow direction (factory setting). The direction of the flow rate measurement can be reversed using the parameter **Fdir**:

Fdir	Direction of flow
+	Flow direction in case of factory setting
-	Flow direction contrary to the factory setting

Parameter setting via unit keys: flow direction

- Call up the menu **EF** > **CFG**.
- Select **Fdir** and set the direction of media flow.

12.4.8 Zero-point calibration

If there is a systematic deviation between the measured value and the actual process value, this measurement inaccuracy can be corrected using the correction factor **cOF** or **tcOF**.

- **cOF**: correction factor for zero point calibration (Calibration offset)
- **tcOF**: teach of the correction factor for zero point calibration

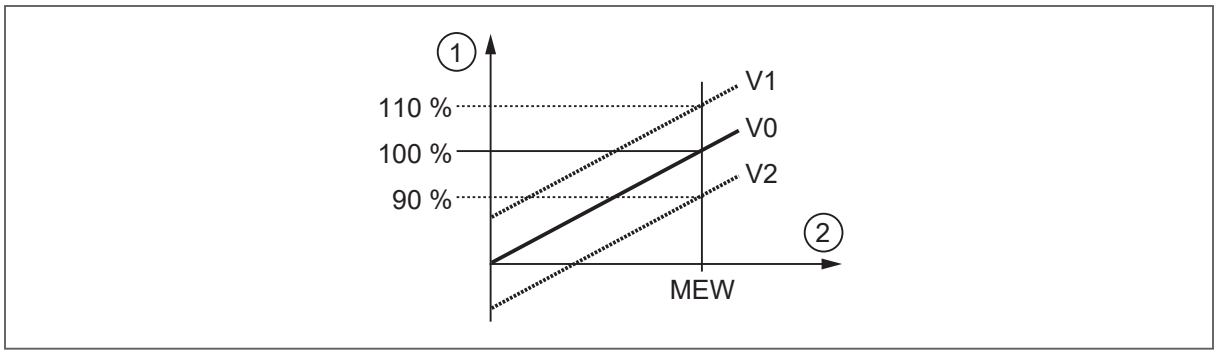


Fig. 16: Zero point calibration (calibration offset)

1: Output signal
2: Process value
MEW: Final value of the measuring range
V0: Measurement characteristic at factory setting
V1: Measurement characteristic after offset by +10 % of the final value of the measuring range
V2: Measurement characteristic after offset by -10 % of the final value of the measuring range

Parameter setting via unit keys: Zero-point calibration

- ▶ Call up the menu **EF** > **CFG**.
- ▶ Select **cOF** and set the value.
- ▷ The internal zero point is shifted by the set value.

Teach zero-point calibration:

- ▶ Ensure that the pipe is completely filled with the medium and that the flow rate remains at zero.
- ▶ Call up the menu **EF** > **CFG**.
- ▶ Select **tcOF** and set **Yes**.
- ▷ The current measured value is taken as internal zero point if the deviation lies within a range of ±10 % of the final value of the measuring range.

12.4.9 Calibration of the measurement characteristic

The calibration factor **CGA** is used to adjust the temperature-viscosity compensation of the sensor to the characteristics of the medium used. The calibration factor influences the slope of the measurement characteristic of the flow measurement.

The slope modification of the measurement characteristic is indicated in percent. The factory setting is **CGA** = 100%. After a change the calibration can be reset to factory setting.

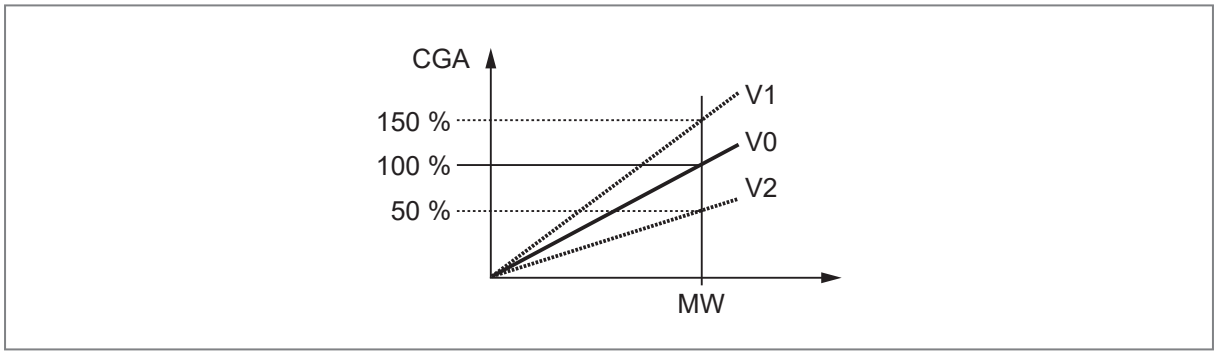


Fig. 17: Calibration of the measurement characteristic

MW: Measured value

V0: Measurement characteristic at factory setting
V1: Measurement characteristic after offset by +50%
V2: Measurement characteristic after offset by -50%

Parameter setting via unit keys: Calibration

- ▶ Call up the menu **EF** > **CFG**.
- ▶ Select **CGA** and set the slope of the measuring characteristic in percent.

12.4.10 Totaliser reset

The totalisers Vol.1 and Vol.2 can be reset in different ways:

Type of reset		Parameter
1.	Manual reset	• **rTox** = **rES.T**
2.	Time-controlled reset	• **rTox** = – **... h** = hours – **... d** = days – **... w** = weeks
3.	Reset via external signal	• **ou2** = **In.D** • **DIn2**: – **+EDG** = reset for rising edge – **-EDG** = reset for falling edge – **HIGH** = reset for high signal – **LOW** = reset for low signal
4.	Reset via overflow (maximum display range is reached)	• **rTox** = **OFF**

Totaliser Vol.L cannot be reset.

If totaliser Vol.1 is reset in one of the above ways, the output is also reset in the case of consumed quantity monitoring.

Switching signal totaliser 35.

Parameter setting via unit keys: Totaliser reset

1. Manual reset:

- ▶ Go to the **EF** > **TOTL** menu.
- ▶ Select **rTox** > **Reset** and set **Yes**.
- ▷ The totaliser is reset.

2. Time-controlled reset:

- ▶ Go to the **EF** > **TOTL** menu.
- ▶ Select **rTox**, then set time in weeks (w), days (d) or hours (h).
- ▷ The totaliser is automatically reset after the set time.

3. Reset via external signal:

- ▶ Go to the **EF** > **OUT2** menu.
- ▶ Select **ou2** and set digital input: **In.D**.
- ▶ 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

> The totaliser Vol.1 is reset when receiving the reset signal via pin 2.

An external reset is only possible for totaliser Vol.1.

The parameter setting for **DIn2** can be changed subsequently in the main menu.

4. Reset via overflow:

▶ Go to the **EF** > **TOTL** menu.

▶ Select **rTox** and set **OFF**.

▷ The totaliser is reset as soon as the maximum display range is exceeded.

12.4.11 Counting method of the totalisers

The totalisers Vol.1 and Vol.2 take account of the flow direction when totalising the consumed quantity. The following counting methods can be defined via the parameter **FProx**:

FProx	Counting method
0+	Negative volumetric flow values (against the marked flow direction) are not taken into account for totalling.
-0	Positive volumetric flow values (corresponding to the marked flow direction) are not taken into account for totalling.
-+	Negative flow values are subtracted from the consumed quantity.
++	All volumetric flow values are totalled irrespective of the volumetric flow direction.

Tab. 4: Counting method of the totalisers

The counting method of Vol.L cannot be set. The lifetime totaliser totals all volumetric flow quantities irrespective of the flow direction.

The counting method affects the output signals for consumed quantity monitoring.

→ Consumed quantity monitoring (totaliser function).

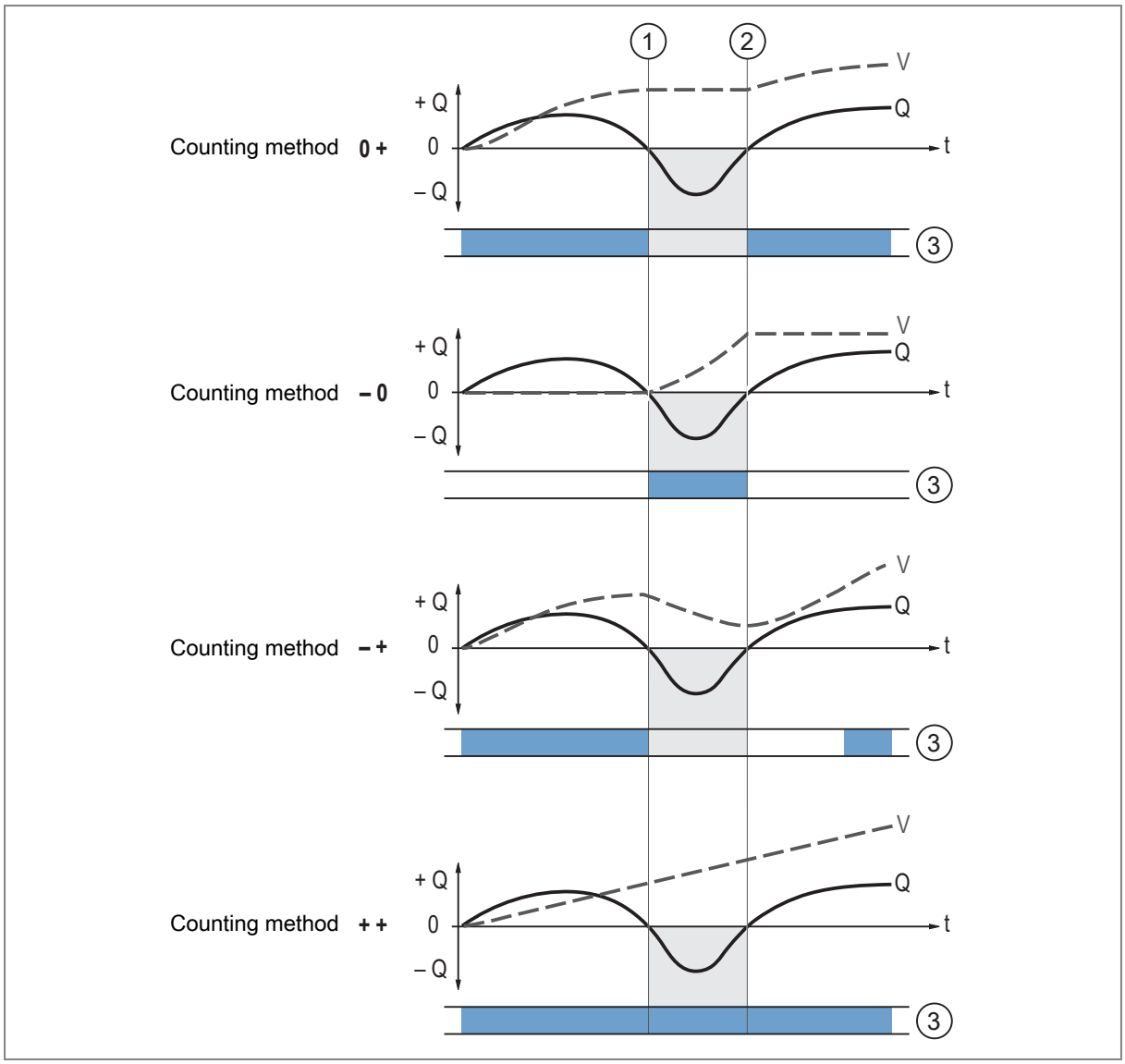


Fig. 18: Taking into account the flow direction when totalling the consumed quantity

+Q: Flow quantity in positive direction
-Q: Flow quantity in negative direction
V: Flow quantity absolute (= sum of negative and positive flow)
1: Flow changes to negative direction
2: Flow changes to positive direction
3: Flow taken into account for totalisation

When the direction of flow is changed, the minimum flow quantity **LFC** is taken into account: Low flow cut-off 43.

Parameter setting via unit keys: counting method of the totalisers

- Go to the **EF** > **TOTL** menu.
- Select **FPro1** and set the counting method for totaliser Vol.1.
- Select **FPro2** and set the counting method for totaliser Vol.2.

12.4.12 Lock / unlock

The unit can be locked electronically to prevent unauthorised setting.

This lock prevents the settings from being changed via the keys on the unit.

Factory setting: not locked.

Parameter setting via unit keys: lock / unlock

Locking:

- ▶ Make sure that the unit is in the normal operating mode.
- ▶ Press ⊙ + ⊙ simultaneously for 10 s until **Loc** is displayed.
- ▷ The device is locked for parameter setting via the device keys. When trying to change a parameter value, **Loc** appears in the digital display.

Unlocking:

- ▶ Make sure that the unit is in the normal operating mode.
- ▶ Press ⊙ + ⊙ simultaneously for 10 s until **uLoc** is displayed.
- ▷ The locking of the device keys is removed.

12.4.13 Reset the unit

The unit can be reset in 2 ways:

- **APPL** (application reset): reset of the parameter settings. The following is reset:
  - All changed application-specific parameters

If IO-Link data storage is activated, this triggers a parameter update in the master. This writes the parameters configured in the master to the device again. An application reset may therefore be ineffective.

- **BtB** (Back to Box): reset to factory settings. The following is reset:
  - All changed application-specific parameters
  - All writeable unit identification parameters such as **Application Specific Tag**, **Function Tag** or **Location Tag**.
  - Diagnostic parameters, status parameters, events.

After the Back to Box reset, the sensor suspends communication and measurement operation until the voltage is interrupted. The IO-Link data storage is not triggered.

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

Parameter setting via unit keys: reset the unit

- ▶ Select **EF** > **rES**.
- ▶ Select **APPL** or **BtB** and set **Yes**.

Only if **BtB** is selected:

- ▶ Disconnect and reconnect the voltage supply.
- ▷ The device carries out a reboot.

12.5 Display settings

The presentation in the display can be adjusted via various parameters. The parameters described below are set as follows:

▶ Call up the menu **EF** > **DIS**.

Colour setting:

▶ Go to **EF** > **DIS** > **COLR**.

12.5.1 Display language

The display language can be set via the parameter **LanG**.

Selectable languages:

- **DE**: German
- **EN**: English
- **ES**: Spanish
- **FR**: French
- **IT**: Italian
- **JP**: Japanese
- **KOR**: Korean
- **PT**: Portuguese
- **ZH**: Chinese

12.5.2 Display rotation

Use the parameter **diS.R** to rotate the text in the display clockwise for better readability.

Selectable values:

- **0°** (not rotated)
- **90°**
- **180°**
- **270°**

12.5.3 Display brightness

The display brightness can be set via the parameter **diS.B**.

Selectable values:

- **25 %**
- **50 %**
- **75 %**
- **100 %**
- **OFF**: energy-saving mode. The display is switched off in the operating mode.
  - The setting takes effect after a delay of 30 seconds.
  - Display activation by pressing any key. After 30 s of inactivity, the display is switched off again.

Error messages are displayed via IO-Link and the operating status LED when the display is switched off.

If the unit measures a high internal temperature, the display brightness is automatically adjusted:
Internal temperature of the unit > 64 °C: brightness is reduced to 25%.
Internal temperature of the unit ≥ 90 °C: display is automatically switched off.

12.5.4 Display update rate

The update rate of the display can be set via the parameter **diS.U**.

Selectable values:

- **d1**: fast
- **d2**: medium
- **d3**: slow

12.5.5 Display layout

Use the **diS.L** parameter to choose which process values are shown in the display by default.

Selectable values:

- **L1**: current process value for flow
- **L2**: current process value for flow rate and temperature
- **L3**: current process value for flow, temperature and totaliser Vol.1
- **L4**: current process value for flow and temperature and totaliser Vol.1 and signal quality
- **L1.G**: current process value for flow rate in a graphical display (Gauge Display).

L1.G* only if **ou1** = **Hno**, **Hnc**, **Fno** or **Fnc**. Otherwise **L1.G****.

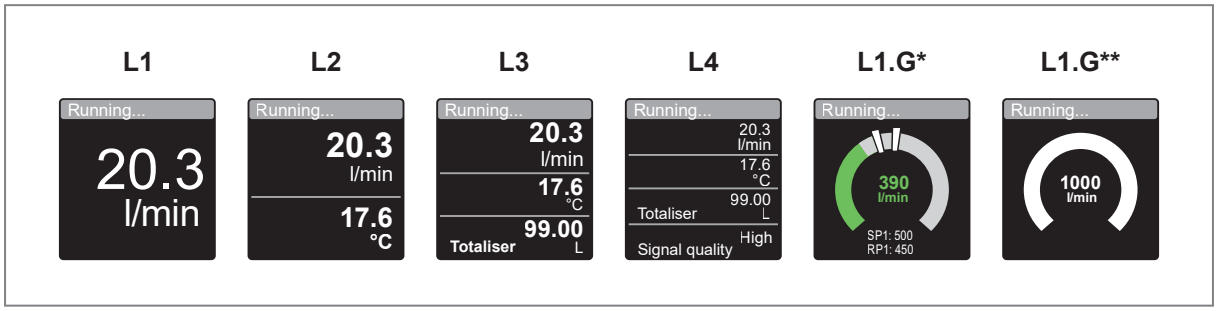


Fig. 19: Selectable layouts

12.5.6 Display colour setting

The font colour in the display can be set via the parameter **coL.x**.

- **coL.F**: font colour for flow
- **coL.T**: font colour for temperature
- **coL.V**: font colour for totaliser Vol.1

12.5.6.1 Permanent colour selection

The font colour is permanently set to one colour:

- **coL.x** = **bk/wh**: font colour white

- **coL.x** = **red**: font colour red
- **coL.x** = **green**: font colour green
- **coL.x** = **yellow**: font colour yellow

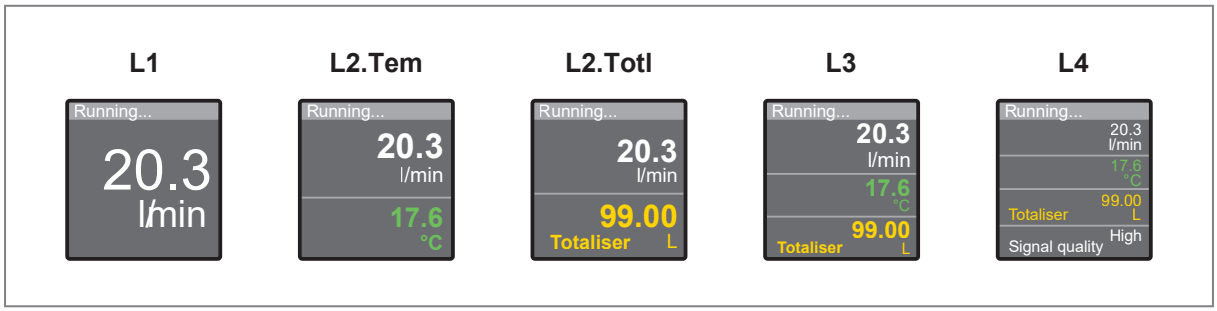


Fig. 20: Permanent colour setting. Example: **coL.F** = **bk/wh**; **coL.T** = **green**; **coL.V** = **yellow**, overview of all display layouts ➔ 51

If **diS.L** = **L1.G** (Gauge Display) is set, the font colour is not adjustable: ➔ 51.

12.5.6.2 Colour change depending on freely definable limit values

If the measured value is within the limits of **cFL.x**…**cFH.x**, the following applies depending on the parameter selection:

- **coL.x** = **r-cF**: font colour red
- **coL.x** = **G-cF**: font colour green

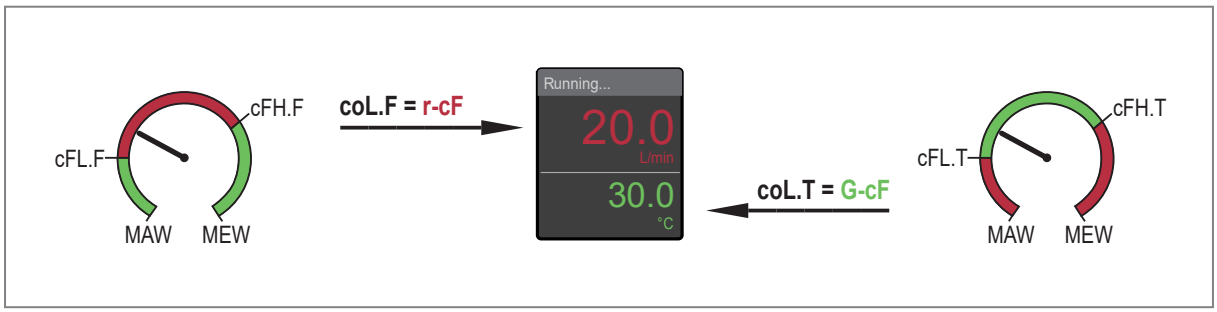


Fig. 21: Colour change. Example: **coL.F** = **r-cF**; **coL.T** = **G-cF**; current measured values between the limit values.

A colour change is not available for the totaliser display.

The limit values of the window range can be freely selected within the measuring range and are independent of the output function:

- Flow: **cFL.F** = lower limit value; **cFH.F** = upper limit value
- Temperature: **cFL.T** = lower limit value; **cFH.T** = upper limit value

The **cFL.x** and **cFH.x** parameters will only appear in the menu if the **r-cF** or **G-cF** setting has been selected for **coL.x**.

12.6 Diagnostics and service functions

12.6.1 Guided installation

An installation wizard can be used for fast and easy parameter setting of the unit. On-screen instructions guide users through the entire parameter setting process.

See also: Guided installation via an installation wizard.

Parameter setting via unit keys: guided installation

- ▶ Call up the menu **EF** > **CFG**.
- ▶ Select **Guide** and set **Yes**.

12.6.2 Device information

Unalterable device information is stored on the unit. This includes:

- Product name
- Product ID
- Serial number
- Hardware revision
- Software revision

In addition, further freely definable tags with a maximum length of 32 characters can be assigned to the unit via the IO-Link interface using suitable parameter setting software. This includes:

- application-specific tag
- function tag
- location tag

Reading via the unit keys: device information

- ▶ Go to the **EF** > **d.InF** menu.
- ▶ Read the unit information.

12.6.3 Optical localisation

The sensor can be located remotely in the system via the IO-Link interface.

This function is only available via the IO-Link interface.

When the command is executed via the IO-Link interface, the switching status LEDs flash and the “IO-Link” indication flashes in the display.

- ▶ Deactivate the function via IO-Link or by pressing any button on the device.

12.6.4 Operating status LED

The device has an operating status LED that indicates deviations from normal operation (= diagnostic cases) by a colour signal.

The function of the operating status LED is adjustable:

LED.M	Operating status LED
On	The LED is permanently on: green in normal operation, blue or red to indicate diagnostic cases.
OFF	The LED is permanently off.
Noti	The LED only lights/flashes blue or red to indicate diagnostic cases.

Diagnostic cases include:

- Low or no signal quality. See also:
  - Signal quality 55
- Warnings or error messages. See also:
  - Warning messages 59
  - Error messages 61

Parameter setting via unit keys: operating status LED

- Call up the menu **EF** > **DIS**.
- Select **LED.M** and set operating status LED.

12.6.5 Read totaliser values

For the totalisers Vol.1 and Vol.2, the following values can be read at any time:

- current volumetric flow quantity (= consumed quantity since the last reset).
- consumed quantity before the last reset.
- time in minutes since the last reset.

For the totaliser Vol.L, the following values determined during the entire operating time can be read at any time:

- volumetric flow quantity in preferred direction (= positive flow direction).
- volumetric flow quantity in non-preferred direction (= negative flow direction).

Reading via unit keys: totaliser values

- Go to the **EF** > **TOTL** menu.
- Select **Vol.x** and read consumption values.

12.6.6 Memory

The unit stores the maximum and minimum measured process values.

The current value can be read from the unit's display or via the IO-Link interface.

Selectable values:

- **Lo.F**: Minimum value memory for volumetric flow
- **Hi.F**: Maximum value memory for volumetric flow

- **Lo.T**: Minimum value memory for temperature
- **Hi.T**: Maximum value memory for temperature

The stored values can only be reset via the IO-Link interface.

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

Reading via unit keys: memory

- ▶ Go to the **EF** > **DIAG** menu.
- ▶ Read the value for the minimum and maximum stored process value.

12.6.7 Operating hours counter

The operating hours since the first set-up are stored by the unit.

The current value can be read from the unit's display or via the IO-Link interface.

The counter cannot be reset.

Reading via unit keys: operating hours

- ▶ Go to the **EF** > **DIAG** menu.
- ▶ Select **Operating hours** and read value.

12.6.8 Internal temperature

The sensor measures the internal temperature.

The current value can be read from the unit's display or via the IO-Link interface.

A high internal temperature is signalled by the unit as follows:

- warning via operating status LED.
- reduced brightness or deactivation of display.

If the unit measures a high internal temperature, the display brightness is automatically adjusted:
Internal temperature of the unit > 64 °C: brightness is reduced to 25%.
Internal temperature of the unit ≥ 90 °C: display is automatically switched off.

Reading via unit keys: internal temperature

- ▶ Go to the **EF** > **DIAG** menu.
- ▶ Select **Internal temperature** and read value.

12.6.9 Signal quality

The signal quality of the sensor can be affected by irregularities in the medium (e.g. strong turbulences, air bubbles, particles or build-up).

The unit detects the signal quality in three stages:

Signal quality	Explanation	Operating status LED
Normal	The device operates without restrictions (normal operation).	Lights green
Low	The signal quality is disturbed, but the device is still working within its specifications.	Lights blue
No signal	No medium is present, or no pipe detected, or no signal can be established.	Flashes red

The current value can be read from the unit's display or via the IO-Link interface.

In addition, the signal quality can be indicated via a switching signal and/or an LED colour signal. See also:

- Switching signal for signal quality 33
- Operating status LED 54

Reading via unit keys: signal quality

- ▶ Go to the **EF** > **DIAG** menu.
- ▶ Select **Signal quality** and read value.

12.6.10 Simulation

This function is used to simulate process values or error states and check the sensor behaviour.

The simulation time is adjustable: 1...60 minutes.

The following values can be simulated:

- process values for flow and temperature
- process values outside the measuring range (UL, OL).
- The consumed quantity of totaliser Vol.1, taking into account the set counting method

During the simulation:

- The title line of the display shows that the simulation is active.
- The simulated values are shown on the display:
  - Simulated process values or events (e.g. UL) for flow and temperature.
  - Simulated totaliser Vol.1. The totaliser starts at 0.
- The operating status LED lights according to the simulated values: green for normal operation, flashing red for measured values outside the measuring range.
- The switching status LEDs are on according to the simulated values and the set output configuration.
- The original totaliser values remain saved without any changes. A real flow during the simulation is not counted.
- The display does not show warning or error messages of the current real application.

If the simulation is started via IO-Link, it can also only be finished via IO-Link. If you try to stop the simulation using the device keys, 🔒 will be displayed.

Parameter setting via unit keys: simulation

- ▶ Select **EF** > **SIM**.
- ▶ 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 under **S.Tim**. Abort by pressing any key.
- **OFF**: The simulation is not active.

13 Operation

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.

The device keys can be used to switch between different process value displays during operation (↪ Operating and display elements).

14 Troubleshooting

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

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

The status signals are classified according to NAMUR recommendation NE107.

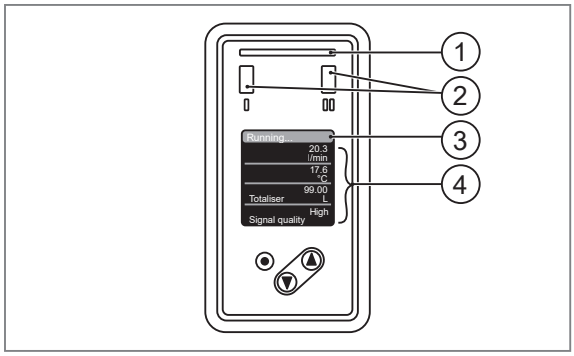
If several diagnostic events occur simultaneously, only the diagnostic message of the event with the highest priority is displayed.

In addition, warning and error messages are displayed by the device as follows:

- switching signal when using OUT1 or OUT2 as diagnostic output.
  See also: Switching signal Diagnosis 32.
- colour signal of the operating status LED.
  See also: Operating status LED 54.

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

Additional diagnostic functions are available via IO-Link IO-Link interface description at documentation.ifm.com.



1: Operating status LED
2: Switching status LEDs
3: Title line
4: Process value display

Fig. 22: Device display and indicators (warning and error messages)

14.1 Warning messages

Title line	Process value display	LED indicators	Problem / remedy
Off	Off	• Operating status LED: off • Switching status LEDs: off	• Supply voltage too low. ▶ Check the supply voltage. • Display switched off. ▶ Check whether **diS.B** = **OFF** is set and change setting if necessary. • Operating status LED switched off. Check whether **LED.M** = **OFF** is set and change setting if necessary.
Off	Off	• Operating status LED: flashes red	Internal device temperature too high. ▶ Allow the device to cool down.
Short circuit OUT1/ OUT2	----	• Operating status LED: flashes red • Switching status LEDs: flash yellow rapidly	Short circuit in both outputs. ▶ Check OUT1 and OUT2 for short circuit or excessive current.

Title line	Process value display	LED indicators	Problem / remedy
Short circuit OUT1	----	• Operating status LED: flashes red • Switching status LED1: flashes yellow rapidly	Short circuit in output 1. ▶ Check OUT1 for short circuit or excessive current.
Short circuit OUT2	----	• Operating status LED: flashes red • Switching status LED2: flashes yellow rapidly	Short circuit in output 2. ▶ Check OUT2 for short circuit or excessive current.
No media detected	0 l/min	• Operating status LED: flashes red	There is no medium in the pipe, or the medium is not detected. ▶ Check whether medium is present in the sensor tube. ▶ Check whether there is the wrong medium in the sensor tube. ▶ Remove the device and check for deposits. ▶ Check application for interference (air bubbles/particles).
Under limit	UL	• Operating status LED: flashes red	Below the display range. ▶ Check the measuring range.
Over limit	OL	• Operating status LED: flashes red	Above the display range. ▶ Check the measuring range.
Override active	---	• Operating status LED: flashes red	A process value differs from the measured value. PV is set to “0” while override bit is set in PDOut. ▶ Deactivate PDOut override.
No pipe detected	No Data	• Operating status LED: lights blue	The pipe on which the device is installed is not being detected. ▶ Check that the pipe has the correct diameter. ▶ Check that the device is fitted tightly enough against the pipe. Tighten the screws if necessary.
Signal quality low	LOW	• Operating status LED: lights blue	Signal quality low. ▶ Remove the device and check for deposits. ▶ Check application for interference (air bubbles/particles).
⚠	IO-Link	• Switching status LEDs: flash yellow rapidly	IO-Link function for optical identification of the active unit. ▶ Deactivate IO-Link function.
Simulation	---	• Operating status LED: lights green	Simulation active. ▶ End simulation.
Lock via key	---		Setting keys on the device locked, parameter change rejected. ▶ Unlock the device using the keys.
Lock via system	---		Setting keys locked via parameter setting software, parameter change rejected. ▶ Unlock the device via IO-Link interface using the parameter setting software.

Title line	Process value display	LED indicators	Problem / remedy
Lock via communication	---		Parameter setting via keys locked, parameter setting is active via IO-Link communication. ▶ Finish parameter setting via IO-Link communication.

In the event of a warning, the outputs react according to the setting under **FOU** = OU. Exception: Short circuit.

14.2 Error messages

Title line	Process value display	LED indicators	Problem / remedy
Hardware error	ERROR	• Operating status LED: lights red	Device faulty / malfunction. ▶ Replace the device.
Parameter error	PARA	• Operating status LED: lights red	Parameter setting outside the valid range. ▶ Check parameter setting.

In the event of an error, the outputs react according to the setting under **FOU**.

15 Maintenance, repair and disposal

The operation of the unit is maintenance-free.

Only the manufacturer is allowed to repair the unit.

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

16 Factory Settings

Overall settings

Parameter	SUC300	SUC301
CFG:		
uni.F	l/min	gal/min
uni.T	°C	°F
dAP.F	0.6 s	0.6 s
P-n	PnP	PnP
LFC	20 l/min	5.28 gal/min
MEdI	H2O	H2O
PMAt	--- (not set)	--- (not set)
OdiA	--- (not set)	--- (not set)
PWt	3.7 mm	3.7 mm
Fdir	+	+
cOF	0%	0%
CGA	100%	100%
TOTL:		
rTo1	OFF	OFF
rTo2	OFF	OFF
FPro1	0+	0+
FPro2	0+	0+
DIS:		
LanG	EN	EN
diS.L	L1.G	L1.G
diS.U	d2	d2
diS.R	0°	0°
diS.B	50%	50%
coL.F	bk/wh	bk/wh
coL.T	bk/wh	bk/wh
coL.V	bk/wh	bk/wh
LED.M	On	On
SIM:		
S.FLW	500 l/min	132.1 gal/min
S.TMP	40 °C	104 °F
S.Tim	3 min	3 min
S.On	OFF	OFF
Loc	uLoc	uLoc

Settings for OUT1

Parameter	SUC300	SUC301
SP1 / FH1	200 l/min	52.83 gal/min
rP1 / FL1	189.6 l/min	50.09 gal/min
FSP1	-20 °C	-4 °F

Parameter	SUC300	SUC301
FEP1	1000 l/min	264.17 gal/min
FrP1	1000 Hz	1000 Hz
ImPS1	0.1 L	0.1 gal
ImPR1	YES	YES
SEL1	FLOW	FLOW
ou1	HNO	HNO
dOU1	Fdir	Fdir
FOU1	OFF	OFF

Settings for OUT2

Parameter	SUC300	SUC301
SP2 / FH2	400 l/min	105.67 gal/min
rP2 / FL2	389.6 l/min	102.92 gal/min
ImPS2	0.1 L	0.1 gal
ImPR2	YES	YES
ASP2	0 l/min	0 gal/min
AEP2	1000 l/min	264.17 gal/min
DIn2	+EDG	+EDG
SEL2	FLOW	FLOW
ou2	I	I
dOU2	Fdir	Fdir
FOU2	OFF	OFF

