testo 6456 COMPRESSED AIR METER

Instruction manual



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1 GENERAL INFORMATION

1.1 Incoming goods inspection, transportation and storage

- **Make sure that the packaging is undamaged!**
  Inform your supplier of any damage to the packaging. Retain the damaged packaging until the matter is settled.

- **Make sure that the contents are not damaged!**
  Inform your supplier of any damage to the contents. Retain the damaged goods until the matter is settled.

- **Check the scope of delivery** for completeness by referring to the shipping documents and your order.

- **The instrument is to be packaged for storage and transport in a way that protects it from impacts and moisture.** The original packaging offers optimum protection. The permissible ambient conditions must also be observed (☞ see 4 Technical data).

- **If you have any questions, please contact your supplier or their sales office.**

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2 SAFETY PRECAUTIONS

Read this instruction manual before commissioning the compressed air meter. Store this instruction manual in a location that is accessible for all users at all times.

2.1 Intended use

The compressed air meter is intended exclusively for use in pipe systems for working compressed air, provided that the calibration certificate does not explicitly allow use with other gases.

WARNING



The structural design allows for operation in pressurized systems up to PN 16 (DN 200 14 bar)



ATTENTION

Any use other than that described will compromise the safety of persons and the entire measuring system and is therefore not permitted.
The manufacturer shall accept no liability for damages that occur as a result of improper or inappropriate use or installation.
To prevent damage to the instruments or health risks occurring the measuring units **must never be manipulated with tools** unless expressly defined in this instruction manual.

The compressed air meter may only be operated under the ambient conditions specified in the technical data. Otherwise, inaccurate measurements will occur and instrument malfunctions cannot be ruled out.

To ensure the safety of the user and the functionality of the instruments, the commissioning steps, checks and maintenance work recommended by the manufacturer are to be complied with and carried out.

These instructions do not contain complete detailed information for the sake of transparency. Should you require further information or should a specific problem occur that is not comprehensively handled in the instructions, you can request the required information directly from the manufacturer.

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2.2 Installation, commissioning and operation

The compressed air meter was built and tested reliably according to state-of-the-art technology and left the factory in an appropriately safe condition.

As the user, you are responsible for compliance with all valid safety regulations, including:

- **Installation specifications**
- **Local standards and regulations.**

  The manufacturer has undertaken all necessary measures to ensure safe operation. The user must ensure that the instruments are set up and installed in such a way that their safe use is not affected.
  This instruction manual contains information and warnings that must be followed by the user in order to ensure safe operation.

- Installation, commissioning, operation and maintenance of the measuring unit may **only be performed by trained, authorised personnel**.
  The personnel must be authorised for the specified tasks by the system operator.

- **The authorised personnel must have read and understood this instruction manual and comply with the instructions set out in it.**

- Check all connections for correctness before commissioning the complete measuring station.

- **Do not commission damaged products and keep these from being inadvertently commissioned.** Mark the damaged products as defective.

- Faults at the measuring point are only to be corrected by authorised and specially trained personnel.

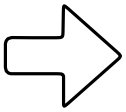
- If faults cannot be corrected, the products must be taken out of operation and be safeguarded from inadvertent commissioning.

- Repairs that are not described in this instruction manual may only be carried out directly by the manufacturer or by the service organisation.

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2.3 Exclusion of liability

Liability of the manufacturer and its vicarious agents shall exist only in the event of deliberate acts or gross negligence. The extent of liability shall be limited to the value of the respective order placed with the manufacturer. The manufacturer shall accept no liability for damages that occur due to non-observance of the safety instructions or non-compliance with the instruction manual or the operating conditions. Consequential damages are excluded from the liability.



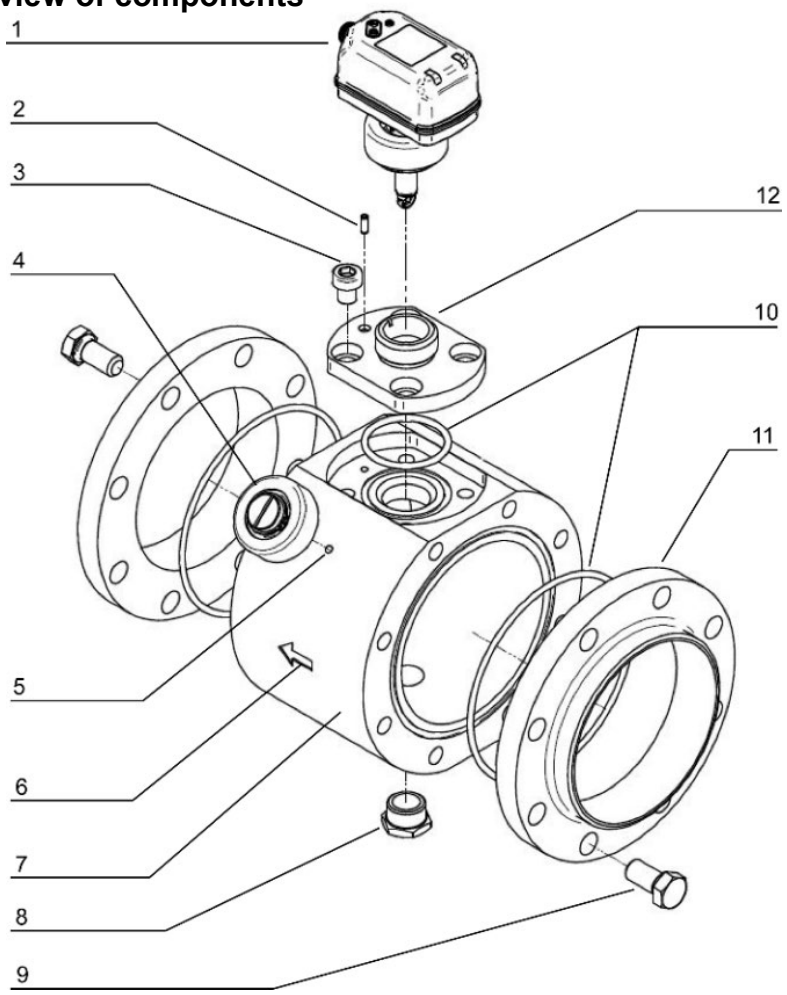
Note

Use the components only in the supplied combination. Due to the design, they are not necessarily compatible with older compressed air meters.

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3 DESIGN AND FUNCTION / SCOPE OF DELIVERY

Overview of components



1	Sensor unit	2	Straight pin as alignment aid
3	Hexagon socket head screw M 10	4	Dummy plug
5	Dummy plug holder both sides	6	Direction of flow arrow
7	Measuring station	8	Brass sealing plug
9	Hexagon screw depending on DN	10	Viton O-rings
11	Compac steel welding neck flange	12	Compac stainless steel sealing cone

The equipment is supplied loosely pre-assembled in 2 parts: sensor and station. Also included in the scope of delivery:

- Calibration certificate

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3.1 Electric sensor unit

The sensor records the standard volumetric flow of working compressed air based on the calorimetric measuring principle.

This compressed air meter is available with two different output options. In the instruction manual as well as in the configuration code, these two options are marked "F01" and "F02".

Order option F01 indicates that the compressed air meter is equipped with one analog output and one pulse output. With this option, it is not possible to measure the pressure. The process parameters flow rate, consumption quantity and temperature are recorded.

Order option F02 indicates that the compressed air meter is equipped with two analog outputs (dual analog). With this option, it is possible to measure the operating pressure as well. The process parameters flow rate, consumption quantity, temperature and pressure are recorded.

All specifications apply to standard volumetric flow according to DIN ISO 2533 (1013 mbar, 15 °C, 0% relative air humidity).

Observe the general operating conditions for compressed air systems. The air quality of the working compressed air influences the measuring accuracy as follows:

Quality classes according to ISO 8573-1	Measurement errors
1-5-1	± (3% of measured value, + 0.3% of full scale value)
3-4-4	± (6% of measured value + 0.6% of full scale value)

Absolute measuring range



WARNING

The compressed air meter may be used to measure the volume flow of **working compressed air with up to 16 bar (> DN 200 14 bar) overpressure.**

Nominal width	Measuring range	Recording/ display range
DN 65	9 - 2011 m³/h	0 - 2413 m³/h

DN 80	12 - 2769 m³/h	0 - 3323 m³/h
DN 100	20 - 4667 m³/h	0 - 5600 m³/h
DN 125	30 - 7057 m³/h	0 - 8468 m³/h
DN 150	43.05 - 10320 m³/h	0 - 12390 m³/h
DN 200	73 - 17480 m³/h	0 - 20980 m³/h
DN 250	115 - 27590 m³/h	0 - 33110 m³/h

Specifications according to DIN ISO 2533 (15 °C, 1013.25 mbar and 0% rel. humidity).

3.2 Compac sealing cone

The Compac sealing cone makes up the intersection between the measuring station and sensor. The straight pin of the measuring station engages in the one-sided bore of the Compac sealing cone.
This is designed with a slot that receives the sensor pin in the downstream direction of flow.

3.3 Compac steel welding neck flange

The connection between the measuring point interface and the pipe system is made via the Compac welding neck flanges.

Note

To avoid a mixed seam in the welded joint to the pipeline, make sure that the Compac flanges are made of steel or stainless steel according to the pipeline.

An alternative to the welding neck flange (V flange) is to fit a Compac threaded flange (G flange).

Abb. 1

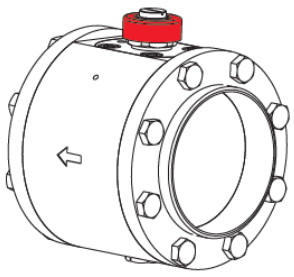
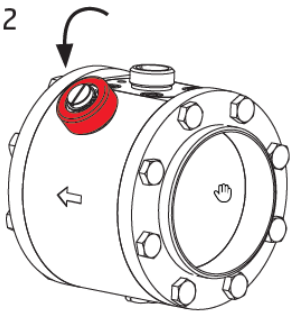


Abb. 2



3.4 Measuring station

The measuring station with Compac welding neck flanges is used to precision-mount the electronic volume flow sensor. The measuring station is welded into pipelines with the Compac welding neck flanges in line with the flow direction (see engraved direction arrow). **The nominal width of the measuring station and welding neck flanges must match the nominal pipe width** (☞ see 3). To prevent a mixed seam during welding, the material of the parts must also be the same. The compressed air meter is designed for **nominal pipe widths from DN 65 to DN 250**.

3.5 Factory certificate

The sensor is adjusted to the measuring station over its entire measuring range and calibrated at multiple measuring points. The calibration certificate is included in the delivery.

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4 TECHNICAL DATA

4.1 Thermal mass flow sensor

The thermal mass flow sensor for compressed air volume flow measurement works independently of the process pressure and media temperature.

Sensor	Thermal glass-coated ceramic sensor
Media	Compressed air, with special calibration also CO2, N2 Argon
Accuracy	Class 1-5-1: ± (3% of measured value + 0.3% of full scale value) Class 3-4-4: ± (6% of measured value + 0.6% of full scale value) Air quality according to ISO 8573 – 1.2010; at media temperature 23 °C
Temperature monitoring	± 0.5°C (for media flow within the limits of the flow measuring range)
Repeat accuracy	±1.5% of measured value
Display, operation	Colour display 1.44", 128x128 pixels, 2x LED, yellow
Response time	0.1 s
Pressure-tight	Up to 16 bar overpressure (> DN 200 up to 14 bar overpressure)
Media temperature	-10 °C to + 60 °C
Perm. ambient temp.	0 °C to 60 °C
Maximum permissible relative humidity	< 90% relative humidity
Perm. storage temperature	-20 °C to + 85 °C
Media contact	V2A (1.4301), glass-coated ceramic, FKM, PPS GF40, acrylate
Measuring range pressure**	-1 … 16 bar
Accuracy pressure**	0,05 bar
Housing materials	PBT + PC-GF 30, PPS GF40
Protection class	IP65, IP 67 / III
Electrical connection	M12 x 1 connector, can be loaded to 150 mA, short-circuit-proof
Power supply	18 to 30 VDC, current consumption < 80 mA*
Readiness delay	1 s

* according to EN 80178 SELV/PELV

** only with order option F02

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Output signals	
Analog output	4-20 mA, measuring range scaleable max. load 500 Ω
Current carrying capacity	2 x 150 mA, short-circuit-proof, protected against polarity reversal,
EMC	DIN EN 60947-5-9

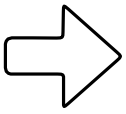
4.2 Accessories

4.2.1 Connecting cable with electric isolation (opt. with electrical isolation)

A suitable connection cable is available as an accessory. The cable is 5 m long and is used for the electrical connection of the transmitter to the customer's control system. The cable is delivered with an appropriate connector for the mass flow sensor on one side and with open cable ends on the other side.
Optionally, a cable with additional electrical isolation is also available; with this cable, the electrical isolation is built into the instrument connector and is used for the galvanic electrical isolation of the sensor output from the electronics connected to it.

4.2.2 Replacement sensor

The replacement sensor serves as a replacement in case of damage to or loss of the original mass flow sensor.



Note

When ordering a new sensor, please indicate the certificate number of the old sensor in order to take account of customer-specific measuring conditions directly during calibration.

4.2.3 Calibration options

- **ISO certificate**
  An ISO certificate from the manufacturer documents six measuring points including the measuring conditions.

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- **Sensor parameter setting for CO2 and N2**
  Six measuring points are parametrised with specified nominal widths, standard temperatures and pressures for nitrogen or carbon dioxide, then moved to the test stand where the standard volume is tested.

4.2.4 Dummy plug

The dummy plug is made of stainless steel and has a bright red plastic protective cap to stop it unintentionally loosening.
It secures the measuring point interface while the sensor is uninstalled, e.g. when changing the sensor for recalibration. For this purpose, it is screwed onto the sealing cone (Fig. 1) when the **line is depressurized**.



Fig. 1

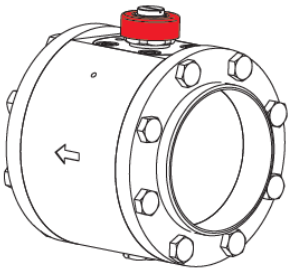
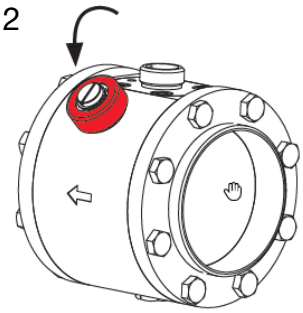


Fig. 2



4.3 Function

- The flow is monitored by a calorimetric measuring system, the measuring signals are evaluated by the electronics.
  The instrument records the media temperature during flow as an additional process value(F01).
- As an additional process value, the instrument records the pressure during flow (F02).
- The instrument displays the current process values.
- The instrument has extensive self-diagnostic capabilities.
- A simulation mode enables simple commissioning of the sensor.

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4.3.1 Processing the measuring signals

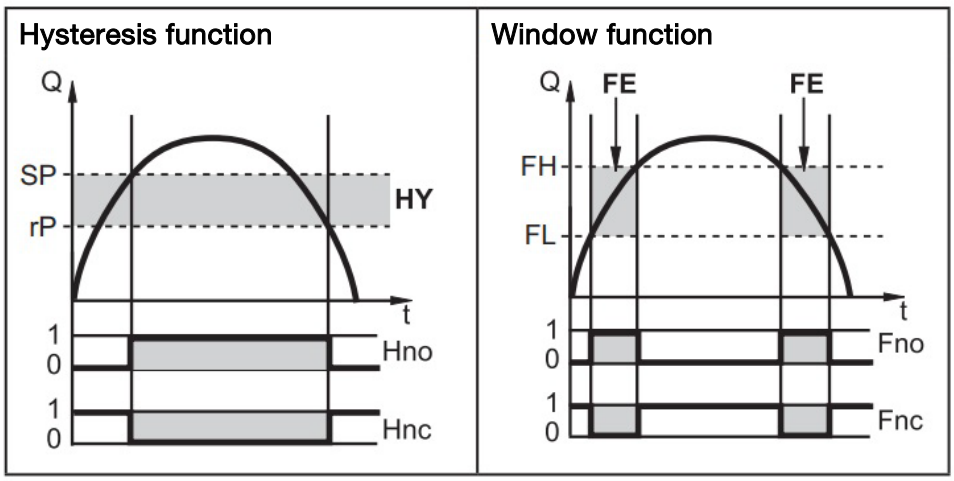
The instrument generates 2 output signals according to the parameter settings:

Order option F01	Order option F02
OUT1	**OUT1**
- Switching signal for flow quantity limit value - Switching signal for temperature limit value - Switching signal for preset counter - Pulse signal for quantity counter - OFF (output switched to high impedance)	- Analog signal for flow quantity - Analog signal for temperature - Analog signal for pressure - OFF (output switched to high impedance)
OUT2	**OUT2**
- Switching signal for flow quantity limit value - Switching signal for temperature limit value - Switching signal for preset counter - Pulse signal for quantity counter - Analog signal for flow quantity - Analog signal for temperature - Input for external counter reset signal (InD) - OFF (output switched to high impedance)	- Analog signal for flow quantity - Analog signal for temperature - Analog signal for pressure - OFF (output switched to high impedance)

4.3.2 Switching output (only with order option F01)

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 flow monitoring:



SP = Switching point
rP = Reset point
HY = Hysteresis

FH = Upper limit value
FL = Lower limit value
FE = Window

Hno / Fno = NO (normally open) Hnc / Fnc = NC (normally closed)

Note

When the hysteresis function is set, the switching point (SP) is defined first, then the reset point (rP), which must be a lower value. If only the switching point is changed, the reset point is changed automatically, the previously set gap remains constant.

Note

When set to the window function, the upper limit value (FH) and lower limit value (FL) have a fixed hysteresis of 0.25% of the full scale value. This keeps the switching status of the output stable if the flow fluctuates very slightly.

4.3.3 Analog output

The instrument provides an analog signal that is proportional to the flow quantity or the media temperature.

Within the measuring range, the analog signal is between 4 and 20 mA.

The measuring range is scalable:

- **[ASPx]** determines at which measured value the output signal is 4 mA.
- **[AEPx]** determines at which measured value the output signal is 20 mA.

Note

Minimum distance between **[ASPx]** and **[AEPx]** = 20% of the FS value.

If the measured value is outside the measuring range or if there is an internal error, the current signal indicated in Figure 1 | p. 19 is output.

For measured values outside the display range or in the event of an error, messages are displayed (**cr.UL, UL, OL, cr.OL, Err**; ☞ 11).

The analog signal in the event of an error is adjustable (☞ 9.5.10):

- **[FOU] = On** determines that the analog signal goes to the upper end value (21.5 mA) in the event of an error.
- **[FOU] = OFF** determines that the analog signal goes to the lower end value (3.5 mA) in the event of an error.
- **[FOU] = OU** determines that the analog signal behaves as specified by the current parameters in the event of an error.

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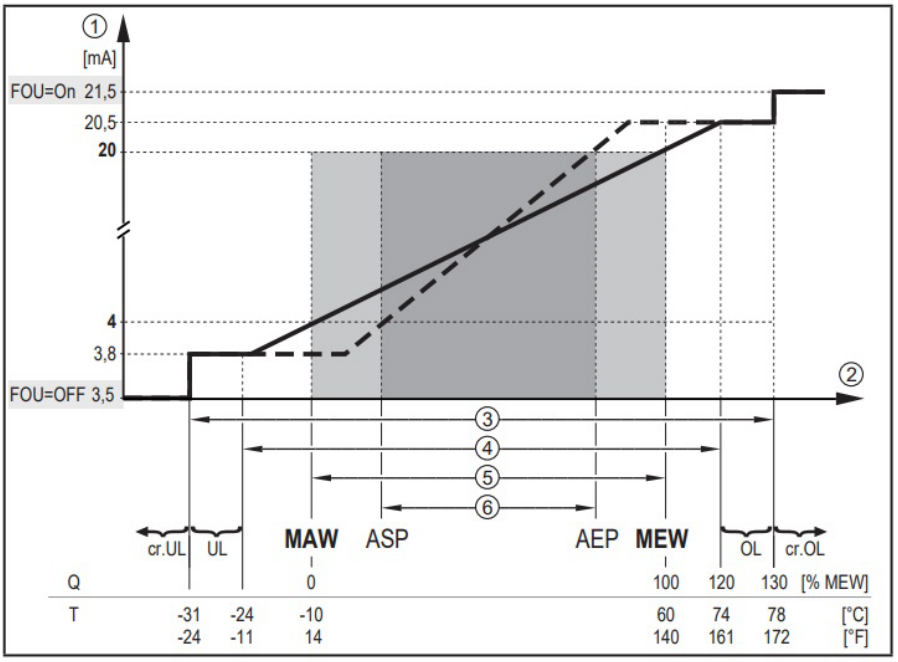


Fig. 1	Analog output characteristic according to standard IEC 60947-5-7.
①	Analog signal
②	Measured value (flow or temperature)
③	Detection range
④	Display range
⑤	Measuring range
⑥	Scaled measuring range
Q:	Flow
T:	Temperature
MAW:	Zero/lower range value for non-scaled measuring range. (When a low flow cut-off is set for Q: Signal output starting at MAW + LFC, ☞ 4.3.6)
MEW:	Full scale value/upper range value for non-scaled measuring
ASP:	Analog starting point with scaled measuring range
AEP:	Analog end point with scaled measuring range
UL:	Below the display range
OL:	Above the display range
cr.UL:	Below the detection range (error)
cr.OL:	Above the detection range (error)

4.3.4 Consumption quantity monitoring [ImP] (with order option F01)

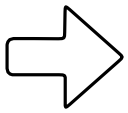
The instrument has an internal quantity counter (= totaliser). It continuously totals up the consumption quantity and provides this process value on the display

Pulse signals or a switching signal (preset counter) can be used to monitor the consumption quantity.

☞ 4.3.4.3 **Consumption quantity monitoring via pulse signals**
☞ 4.3.4.4 **Consumption quantity monitoring via preset counter**

4.3.4.1 Meter reading

The current status of the quantity counter can be displayed (☞ 7.1).
In addition, the value before the last reset is stored. This value and the time since the last reset can also be displayed (☞ 7.1).



Note

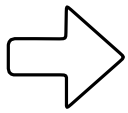
The counter stores the totalled flow quantity every 10 minutes. After a power failure, this value is available as the current meter reading. If a time-controlled reset is set, the elapsed time of the set reset interval is also stored. So the possible loss of data can be a maximum of 10 minutes.

4.3.4.2 Counter reset

The quantity counter can be reset in various ways:

- Manual counter reset (☞ 9.3.3)
- Time-controlled counter reset (☞ 9.3.4)
- Counter reset using an external signal (☞ 9.3.6)

If the quantity counter is not reset by applying one of the above procedures, an automatic reset takes place when the maximum flow quantity that can be displayed is exceeded (overflow).



Note

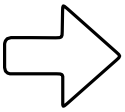
OUT1 and **OUT2** cannot be used simultaneously for the consumption quantity monitoring

The accuracy of the consumption quantity measurement depends on the accuracy of the flow measurement

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4.3.4.3 Consumption quantity monitoring via pulse signals

The output emits a pulse signal each time the flow quantity (pulse value) set under **[ImPS]** is reached.



Note

OUT1 and **OUT2** cannot be used simultaneously for the pulse output.

4.3.4.4 Consumption quantity monitoring via preset counter

The output emits a switching signal when the flow quantity set under **[ImPS]** is reached.
Setting the parameter **[rTo]** determines whether the flow quantity must be reached irrespective of the time **(1)** or within a set time **(2)** for the output to switch

(1)	OFF (☞ 9.3.5)	▪ The output switches when the flow quantity set under [ImPS] is reached. ▪ The output remains switched until the counter reset.	▪ The preset counter is only reset - when a manual reset is performed or - when the maximum display range has been exceeded (overflow)
(2)	1,2,…h 1,2,…d 1,2,…w (☞ 9.3.4)	▪ The output only switches when the flow quantity set under [ImPS] is reached within the set time. ▪ The output remains switched until the counter reset.	▪ If the output is not switched, the preset counter is automatically reset when the time period has elapsed and the count starts again (☞ 9.3.4 Time-controlled counter reset). ▪ If the output is switched, the preset counter is only reset - when a manual reset is performed (☞ 9.3.3) or - when the maximum display range is exceeded (overflow).

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4.3.5 Measuring value damping

The damping time **[dAP.F]** can be used to set after how many seconds the output signal reaches 63% of the final value in the event of a sudden change in the flow value. The set damping time stabilizes the switching outputs, the analog outputs and the display.

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

The signals **[UL]** and **[OL]** (☞ 11) are defined taking the damping time into account.

4.3.6 Low flow cut-off

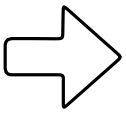
With the Low flow cut-off **[LFC]** function, it is possible to suppress small flow quantities. Flows below the LFC value are evaluated by the sensor as a standstill (Q = 0).

4.3.7 Simulation

This function simulates the process values flow, temperature and meter reading of the totaliser and reviews their signal chain.

The parameter settings **cr.UL, UL, OL** and **cr.OL** can also be used to simulate process values that lead to an error message or warning (☞ 11).

When the simulation is started, the totaliser values are frozen and the simulated totaliser is set to 0. The simulated flow value then has an effect on the simulated totaliser. When the simulation is ended, the initial totaliser values are restored.



Note

The simulation does not have any effect on the currently existing process values. The outputs behave as previously set.

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

During the simulation operation, no error messages of the current real application are available. They are suppressed by the simulation.

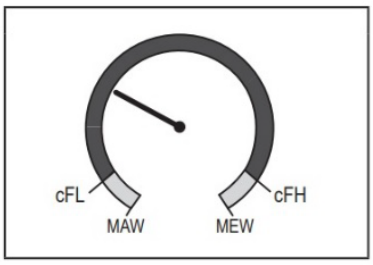
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4.3.8 Colour of the characters in the display

The colour of the characters in the display can be set via the parameter **[coL.x]**:

- Permanent definition of the display colour:
  - **bk/wh (black/white)**
  - **yellow**
  - **green**
  - **red**

- Colour change from red to green or vice versa:
  - **r-cF** (red display colour between the limit values cFL...cFH)
  - **G-cF** (green display colour between the limit values cFL...cFH)



cFL = lower limit value
cFH = upper limit value

MAW = zero/lower range value
MEW = full scale value/
upper range value

Note

The limit values can be freely selected within the measuring range and are independent of the output function set for **OUT1** and **OUT2**.

5 INSTALLATION



WARNING

Installation may only be carried out by authorised, qualified staff, e.g. pipeline engineers. Please observe the relevant national regulations.
The electrical connections are to be performed by a qualified electrician.



WARNING

To install and remove the sensor the line must be depressurized. Ensure that the line section cannot be inadvertently used (lockout-tagout).

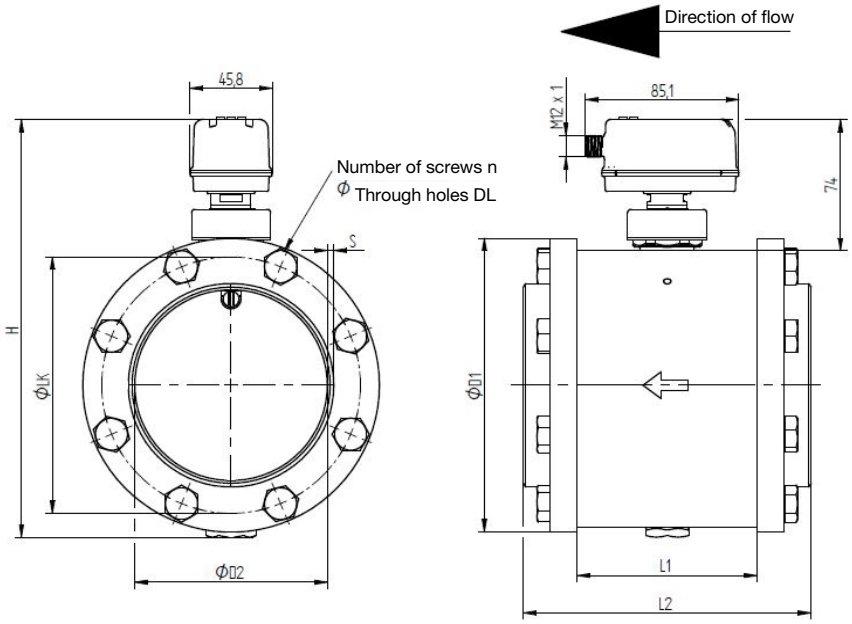
5.1 Determining the installation point

Please always observe the technical data (☞ see 4.1). The place of installation is to meet the following criteria:

- **Medium does not condense at the place of installation, i.e. measuring location only behind a suitable compressed air dryer**, which ensures an appropriate pressure dew point. Otherwise the specified measuring accuracy cannot be guaranteed.
- **Ambient temperature of maximum +60 °C** (note any potential thermal radiation).
- **Take account of the inflow and outflow section** (☞ see 5.4).
- **Take account of the direction of flow** (☞ see 5.5).
- **Well accessible with low vibration.**
- **A min. 200 mm space is needed** to remove the sensor.

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5.2 Length measurements of the compressed air meter

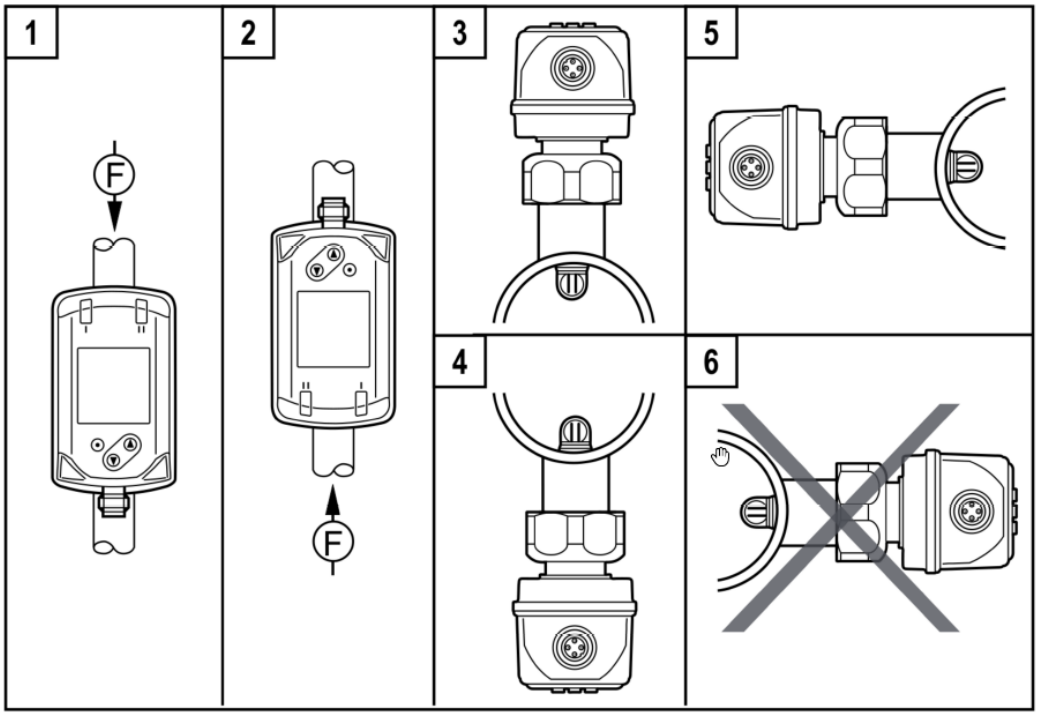


Part no.	KMAT Ø D0x (steel) / D1x (stainless steel)	Inch	DN	L1 mm	L2 mm	Ø D1 mm	Ø D2 mm	S mm	H1 mm	N	ØDL mm	ØLK mm
0555 6456	D01 / D11	2½ "	65	104	148	125	70,3	2,9	195	16xM12	13	106
0555 6456	D02 / D12	3 "	80	100	160	141	82,5	3,2	210	16xM12	13	118
0555 6456	D03 / D13	4 "	100	100	160	165	107,1	3,6	235	16xM12	13	144
0555 6456	D04 / D14	5 "	125	100	172	205	131,7	4	267	16xM12	13	168
0555 6456	D05 / D15	6 "	150	100	180	235	159,3	4,5	296	16xM12	17	200
0555 6456	D06 / D16	8 "	200	100	180	290	207,3	5,9	348	24xM12	17	252
0555 6456	D07 / D17	10 "	250	100	196	355	260,4	6,3	408	24xM12	21	315

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5.3 Installation position

Do not install the sensor in the crossed-out installation positions shown in the following graphic in point 6. Otherwise, in the event of limited flow, the specified accuracy cannot be maintained.



The arrow shows the direction of flow for the medium.

1, 2: Vertical installation position, any instrument
3, 4: Horizontal installation position, any instrument
5: Left installation position, instrument lying sideways
6: Avoid: Right installation position, instrument lying sideways

5.4

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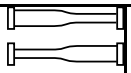
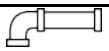
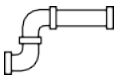
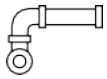
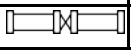
Required measuring section

Note

Take account of the required **inflow and outflow section** in order to achieve the specified measuring accuracy. The inflow section refers to the pipeline length **upstream** of the compressed air meter and the outflow section to the pipeline length **downstream** of the compressed air meter, as seen in the direction of flow for the medium.

Total measurement section = inflow section + outflow section
Inflow route = 15 x D + B

D = pipe diameter [mm]
B = additional calming section

	Changes to the pipe diameter	B = 5 x pipe diameter
	90° elbow	B = 5 x pipe diameter
	Two 90° elbows, one level	B = 10 x pipe diameter
	Two 90° elbows, two levels	B = 15 x pipe diameter
	Valve, slider	B = 35 x pipe diameter

5.5 Direction of flow

Note

Take the direction of flow into account when installing the measuring station. This is indicated by the arrow engraved on the side of the measuring station. The arrow points in the direction in which the medium flows in the pipeline.

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5.6 Installation of the compressed air meter

Note

To avoid a mixed seam in the welded joint to the pipeline, make sure that the Compac flanges are made of steel or stainless steel according to the pipeline.

WARNING

To install and remove the sensor the line must be depressurized. Ensure that the line section cannot be inadvertently used (lockout-tagout).

WARNING

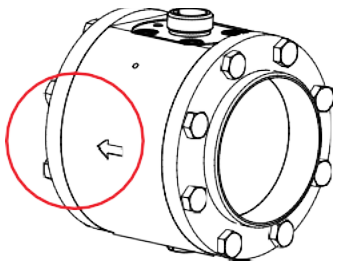
A stable stepladder is required for all assembly work carried out up to 2.5 metres off the floor (height of the pipe). A working platform must be provided for work at greater heights. If the measuring point cannot be accessed by a platform, then scaffolding or other equipment must be used to provide a safe working platform.

5.6.1 Installation of the measuring station

1. Depressurize the pipe section at the installation point and secure it against accidental reconnection (lockout-tagout).
2. Weld the Compac welding neck flanges to the existing pipeline **with no torsion, taking national regulations into account,** to achieve optimal tightness.

Note

Make sure that the measuring station is installed in the direction of flow – see arrow. Otherwise, there may be sensor measuring inaccuracies.



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3. Screw the measuring station between the flanges according to the direction of flow. Fix the screws in diagonal order for even force distribution.

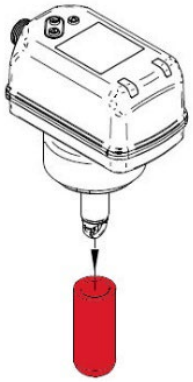
5.6.2 Installing the sensor in the measuring station



WARNING

Make sure that the pipeline is depressurized before installing the sensor. Make sure that the Compac sealing cone is always closed either with a sensor or a dummy plug.

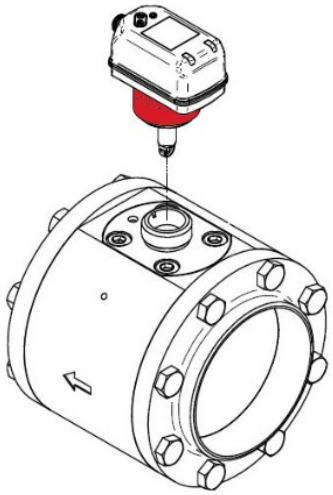
1. To install the sensor unscrew the dummy plug from the sealing cone and temporarily store it in the holder on the side of the measuring station.
2. Remove the red protective transportation cap from the tip of the sensor and keep it for the next time you remove the sensor.



3. Install the sensor in the Compac sealing cone of the measuring station. **Take notice of the correct installation position of the sensor.**

   Due to the design, the sensor can only be screwed onto the sealing cone in one direction (bolt/groove principle).
   The M12 connector of the sensor points in the direction of flow. If this is not the case, the measuring station has to be turned between the flanges.

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4. Fix the sensor to the measuring station with the union nut **and without tools**.
5. The mechanical installation of the compressed air meter is now complete.

5.7 Sensor replacement

The removal of the mounted sensor may be necessary for maintenance, cleaning and calibration purposes.

WARNING

Never remove the sensor or the dummy plug from the sealing cone when the line is under pressure – this may be life-threatening.

1. Remove the electrical connecting cable by unscrewing the connector from the sensor by hand. Protect the connector from contamination and moisture.

2. Remove the sensor **without tools** from the measuring station pulling it up and out vertically.

3. Mount the dummy plug (☞ see 3.4) on the Compac sealing cone.

4. **Protect the sensor tip with the red protective transportation cap.**

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5.8 Electrical connection

Disconnect the system from the power supply when connecting.

WARNING

The instrument may only be installed by a qualified electrician. Follow the national and international regulations regarding the installation of electrical engineering systems.
The voltage supply is to be laid out in accordance with EN50178, SELV, and PELV.

Note

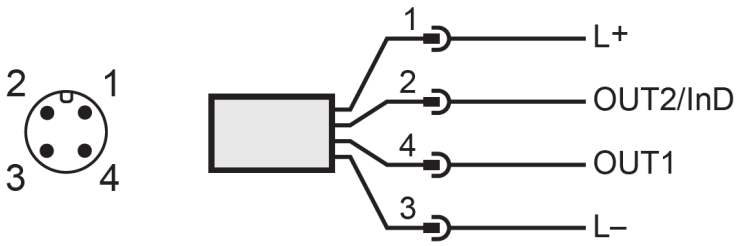
If you are connecting the sensor directly or using a **4-wire connecting cable**, **proceed as set out in 5.8.1**.
If you have a potential-free **5-wire connection cable**, **proceed as set out in 5.8.2.**

5.8.1 4-wire pin assignment

If you are using the standard connection, the following pin assignment applies to the connection cable or the pin assignment directly on the sens or.

Pin assignment with specification F01

Pin Nr.	Wire colour	Assignment
1	Brown	+L (18…30 V DC)
2	Green	OUT2 – Analog signal, pulse, switching signal
3	Yellow	0 V DC (GND)
4	White	OUT1 – Pulse, switching signal



Pin assignment with specification F02

Pin no.	Wire colour	Assignment
1	Brown	+L (18…30 V DC)
2	Green	OUT2 – Analog signal
3	Yellow	0 V DC (GND)
4	White	OUT1 – Analog signal

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5.8.2 5-wire pin assignment (accessory) (with order option F01)

If the optional connecting cable for electrical isolation is used (☞ see 4.2.2), then the following assignments apply.

Pin no.	Wire colour	Assignment
1	Brown	+ L (19 to 30 V DC) sensor supply
2	Pink	+ potential-free pulse output (collector) OUT1
3	White	- potential-free pulse output (emitter) OUT1
4	Green	OUT2
5	Black	0 V DC (GND)

The potential-free pulse output OUT1 is specified for this connecting cable as follows:

Line type	LiYCY
Length	5 m
Switching capacity	500 mA
Max. switching voltage	36 V
Min. switching voltage	5 V
Switch contact resistance	0.21 Ω
Insulation voltage	5.3 kV
Protected against polarity	Yes

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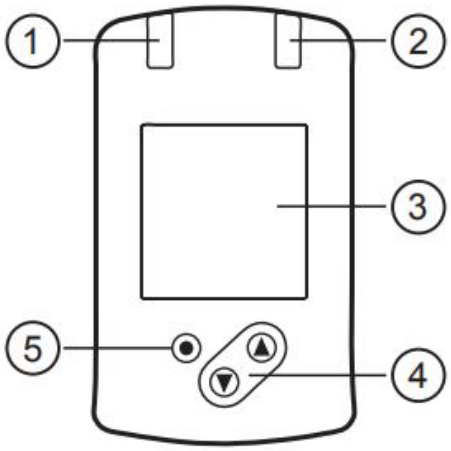
6 OPERATION

Thermal mass flow sensor

Familiarize yourself with the operation and programming of the sensor. The sensor is calibrated ex factory and provided with default settings for each nominal width.

6.1 Operation and display elements

The following illustration shows the operating and display unit of the sensor from above.



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1 and 2: Switching status LEDs

- LED ① = switching status OUT1 (lights up if output 1 is switched)
- LED ② = switching status OUT2 (lights up if output 2 is switched)

3: TFT display

- Display of current process values (flow quantity, temperature, totaliser)
- Display of the parameters and parameter values

4: [▲] and [▼] key

- Select parameter
- Change parameter value (press and hold key)
- Change process value display in normal operating mode (RUN mode)
- Lock / Unlock (keys pressed simultaneously > 10 seconds)

5: [●] key = Enter

- Change from RUN mode to the main menu
- Change to setting mode
- Acknowledge the set parameter value

Note

Display illumination:

- Instrument temperature > 70 °C: Brightness automatically reduced
- Instrument temperature ≥ 100 °C: Display automatically switched off

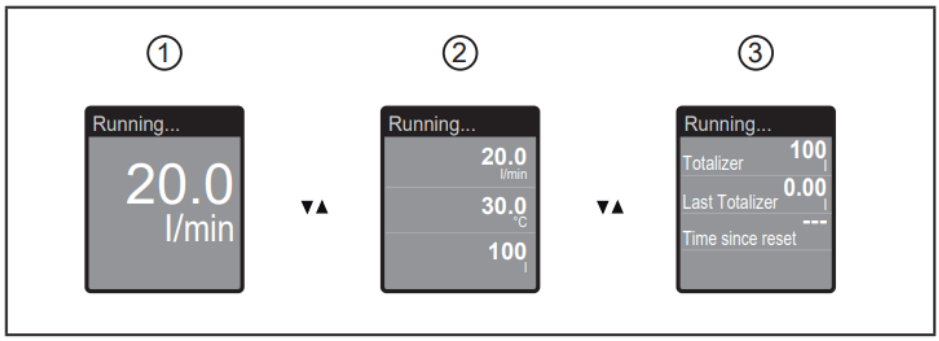
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7 MENU

7.1 Process value display (RUN)

It is possible to switch between three process value displays during operation.

- Press the [▲] or [▼] key
- The display switches between the standard indication and two other views.
- After 30 seconds, the instrument switches back to the standard display.

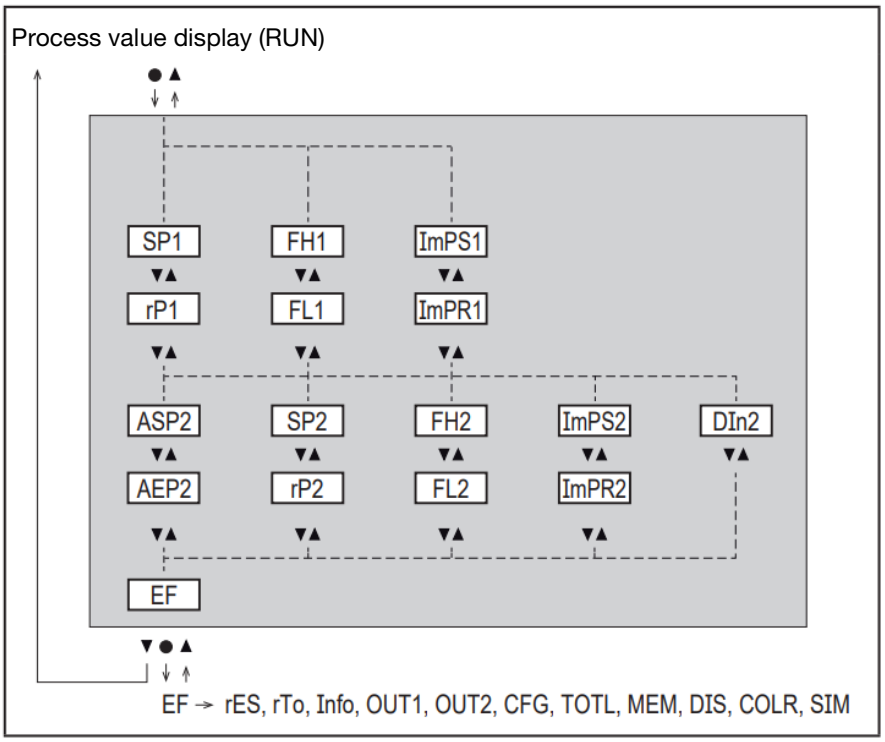


1: Standard display as set under [diS.L]
2: Complete overview of all process values
3: Overview of totaliser values

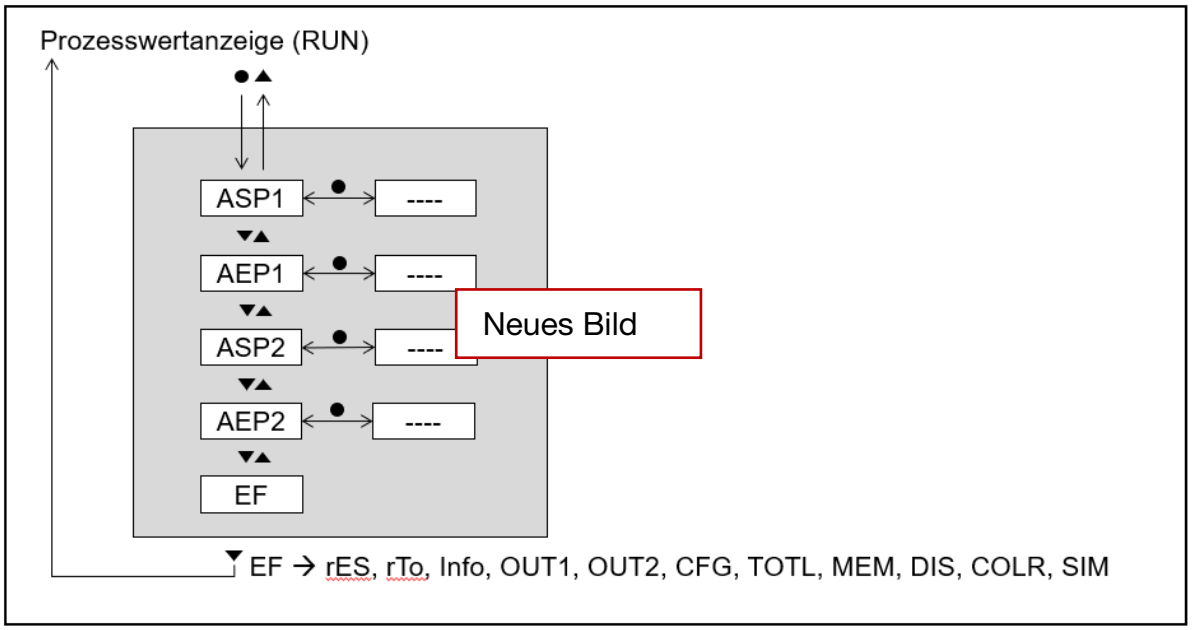
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7.2 Main menu

With specification F01:



With specification F01:

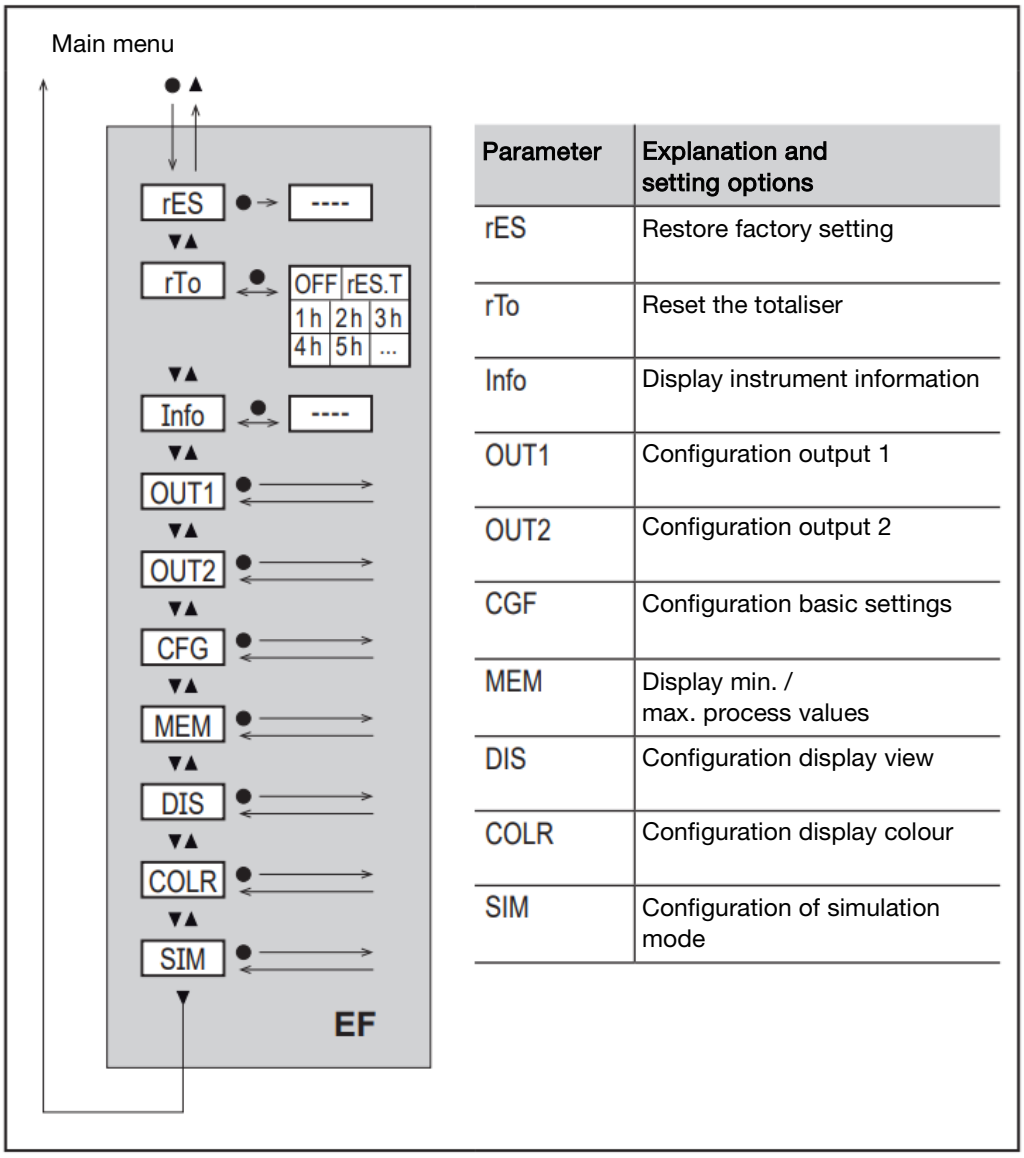


Explanation of the parameters ☞ 7.4 Submenu **OUT1** and ☞ 7.5 Submenu **OUT2**

The displayed parameters change when the factory setting in submenu **OUT1** and **OUT2** is changed.

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7.3 Extended functions EF

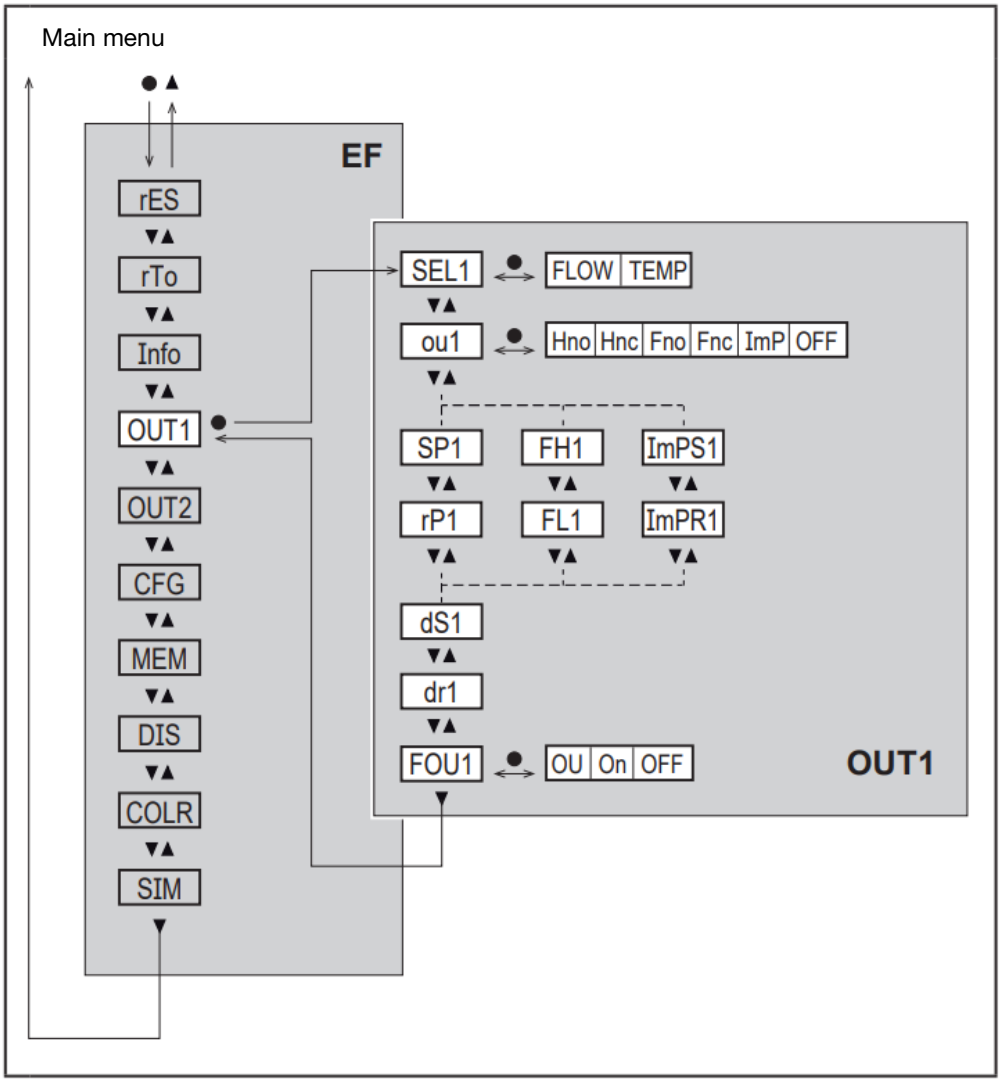


Parameter	Explanation and setting options
rES	Restore factory setting
rTo	Reset the totaliser
Info	Display instrument information
OUT1	Configuration output 1
OUT2	Configuration output 2
CGF	Configuration basic settings
MEM	Display min. / max. process values
DIS	Configuration display view
COLR	Configuration display colour
SIM	Configuration of simulation mode

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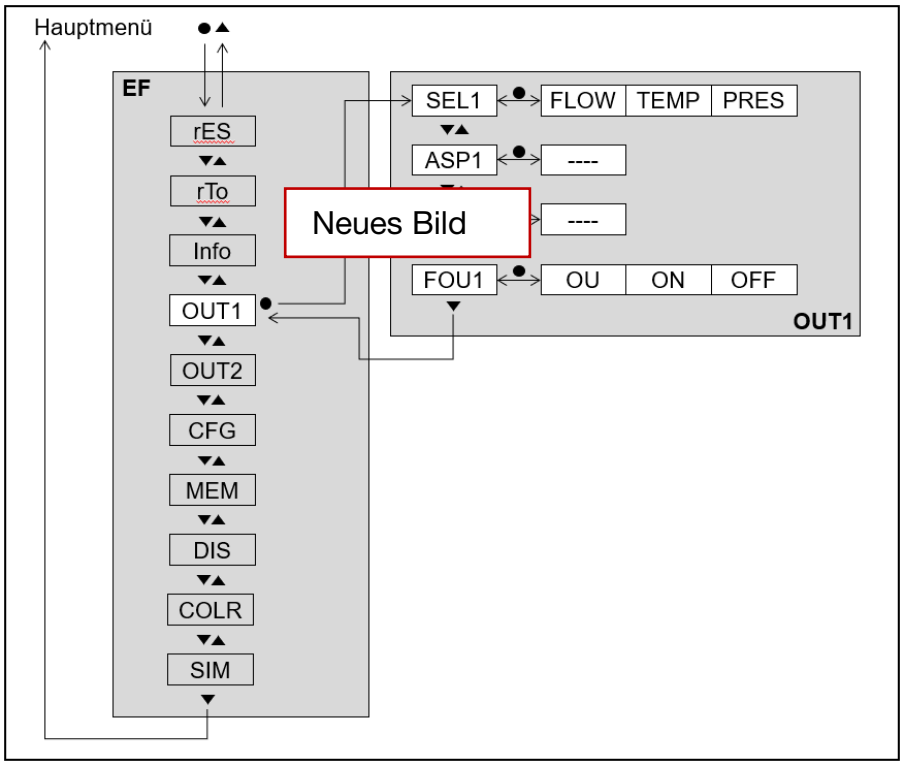
7.4 Submenu OUT1

Specification F01:



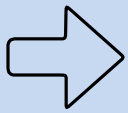
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Specification F02:



Parameter	Explanation and setting options
SEL 1	Standard measurement parameter for evaluation by OUT1: FLOW or TEMP
ou1	Output function for OUT1: ▪ Flow: Hno, Hnc, Fno, Fnc, ImP ▪ Temperature: Hno, Hnc, Fno, Fnc Hno = Switching signal with hysteresis function normally open Hnc = Switching signal with hysteresis function normally closed Fno = Switching signal with window function normally open Fnc = Switching signal with window function normally closed Imp = Consumption quantity monitoring (totaliser function) OFF = Output OFF (high impedance)
SP1	Switching point for OUT1
rP1	Reset point for OUT1
FH1	Upper limit value for OUT1
FL1	Lower limit value for OUT1
ImPS1	Pulse value = flow quantity at which 1 pulse is delivered.

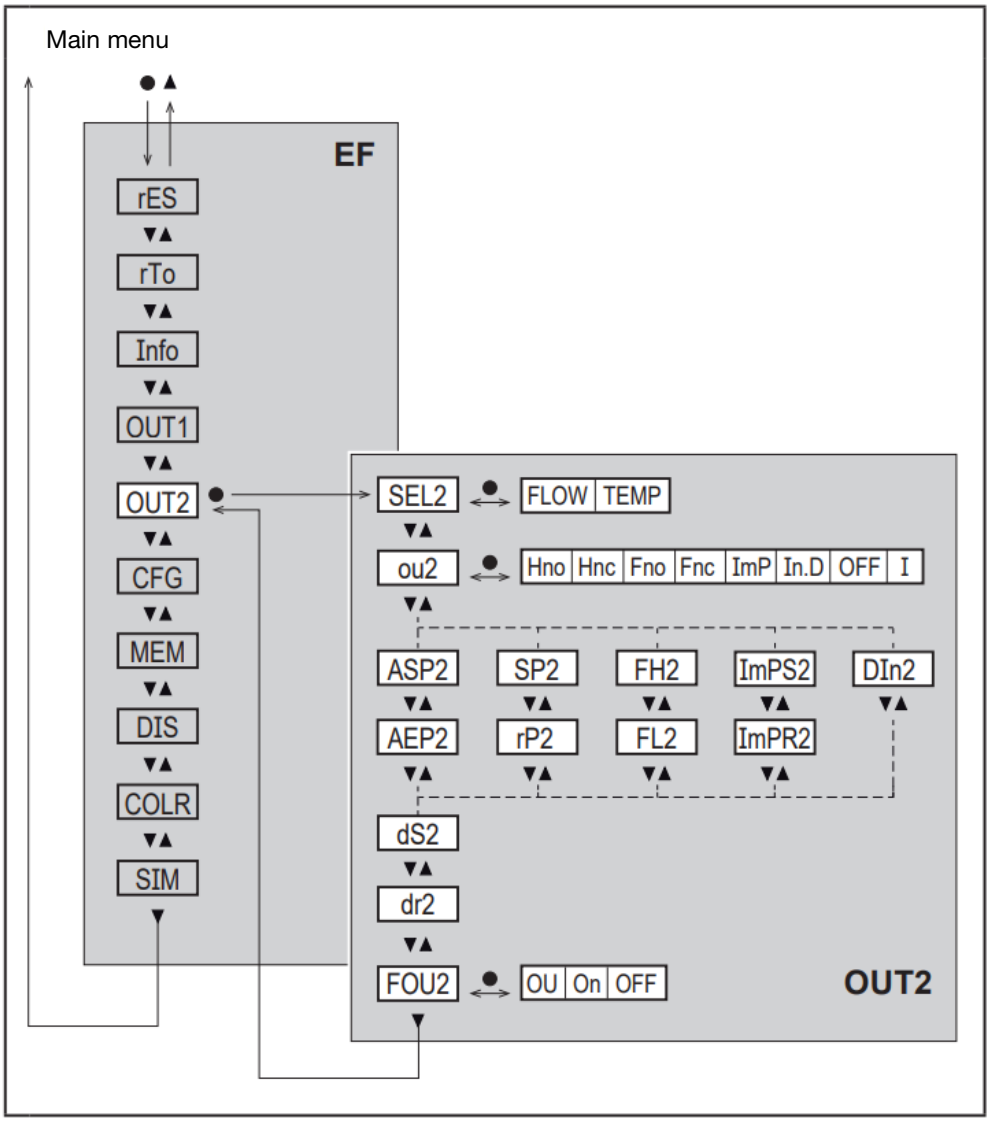
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ImPR1	Configuration of OUT1 for consumption quantity monitoring: YES (pulse signal), no (switching signal).
dS1	Switching delay on OUT1.
dr1	Reset delay on OUT1.
FOU1  **Note**	Response of OUT1 in the event of an internal error: OU = output reacts as normal On = output switches ON / analog signal goes to 21.5 mA OFF = output switches OFF / analog signal goes to 3.5 mA **FOU1 is not available if ou1 = ImP was selected.**
Parameter	**Explanation and setting options (F02)**
SEL1	Standard measurement parameter for evaluation by OUT1: Flow or TEMP (temperature) or PRES (pressure)
ASP1	Analog starting point for OUT1
AEP1	Analog end point for OUT1
FOU1	Response of OUT1 in the event of an internal error: OU = analog signal goes to 21.5 mA in the event of an error in pressure measurement and to 3.5 mA in the event of an error in flow measurement or temperature measurement On = analog signal goes to 21.5 mA OFF= analog signal goes to 3.5 mA

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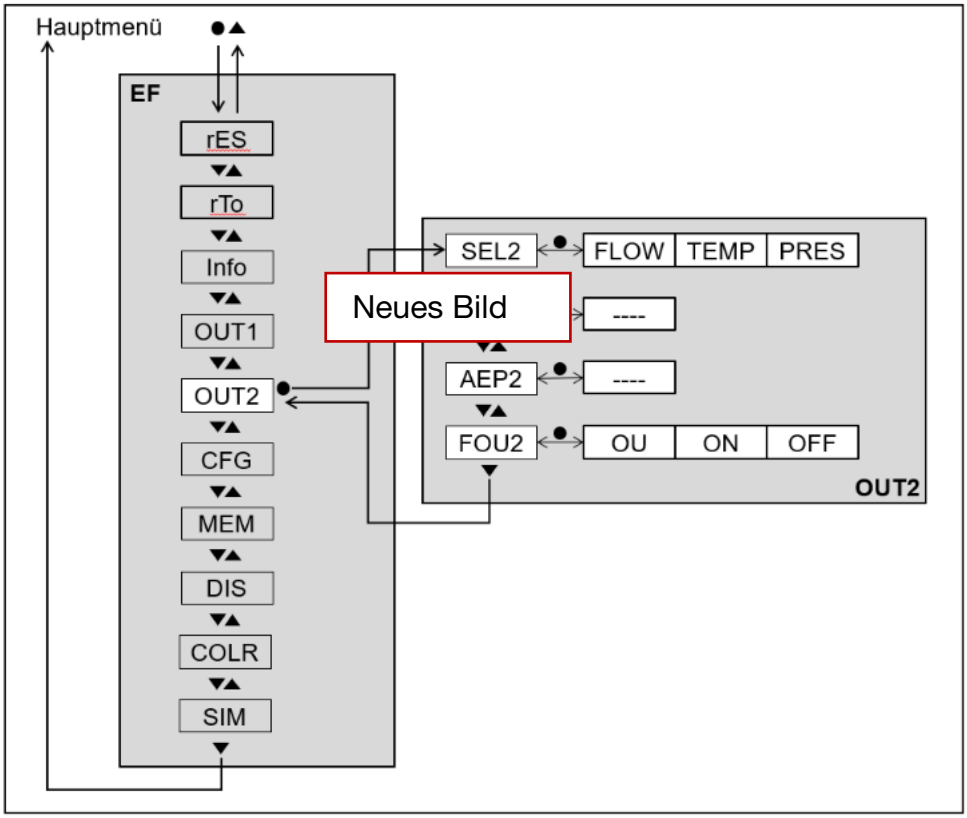
7.5 Submenu OUT2

Specification F01:



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Specification F02:

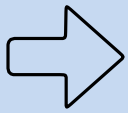


Note

The displayed parameters change when the factory settings are changed in the **OUT2** submenu.

Parameter	Explanation and setting options
SEL 2	Standard measurement parameter for evaluation by OUT2: FLOW or TEMP
ou2	Output function for OUT1: ▪ Flow: Hno, Hnc, Fno, Fnc, I, ImP ▪ Temperature: Hno, Hnc, Fno, Fnc, I Hno = Switching signal with hysteresis function normally open Hnc = Switching signal with hysteresis function normally closed Fno = Switching signal with window function normally open Fnc = Switching signal with window function normally closed I = Analog signal 4 to 20 mA In.D = Input for external counter reset signal Imp = Consumption quantity monitoring (totaliser function) OFF = Output OFF (high impedance)
ASP1	Analog starting point for OUT2

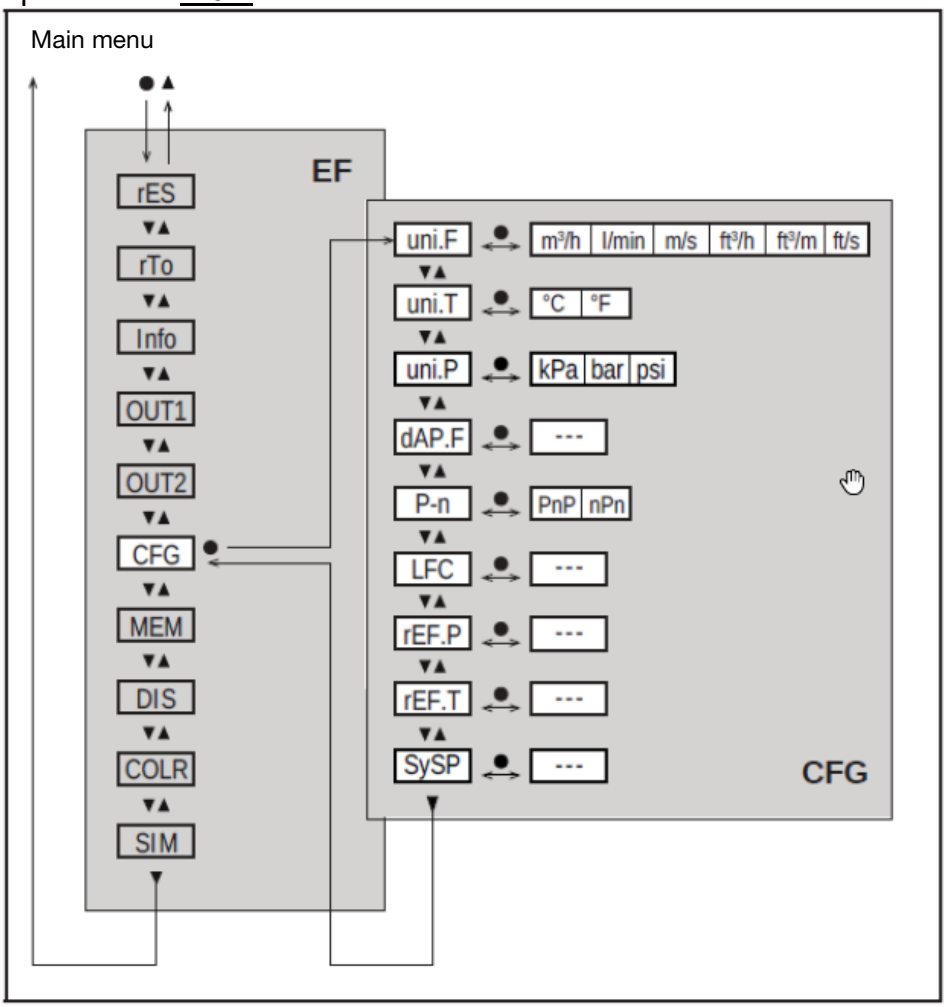
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AEP1	Analog end point for OUT2
SP2	Switching point for OUT2
rP2	Reset point for OUT2
FH2	Upper limit value for OUT2
FL2	Lower limit value for OUT2
ImPS2	Pulse value = flow quantity at which 1 pulse is delivered.
ImPR2	Configuration of OUT2 for consumption quantity monitoring: YES (pulse signal), no (switching signal).
dS1	Switching delay on OUT1.
dr1	Reset delay on OUT1.
FOU2  **Note**	Response of OUT2 in the event of an internal error: OU = output reacts as normal On = output switches ON / analog signal goes to 21.5 mA OFF = output switches OFF / analog signal goes to 3.5 mA **FOU2 is not available if ou2 = ImP was selected.**
Parameter	**Explanation and setting options (F02)**
SEL2	Standard measurement parameter for evaluation by OUT2: Flow or TEMP (temperature) or PRES (pressure)
ASP2	Analog starting point for OUT2
AEP2	Analog end point for OUT2
FOU2	Response of OUT2 in the event of an internal error: OU = analog signal goes to 21.5 mA in the event of an error in pressure measurement and to 3.5 mA in the event of an error in flow measurement or temperature measurement On = analog signal goes to 21.5 mA OFF= analog signal goes to 3.5 mA

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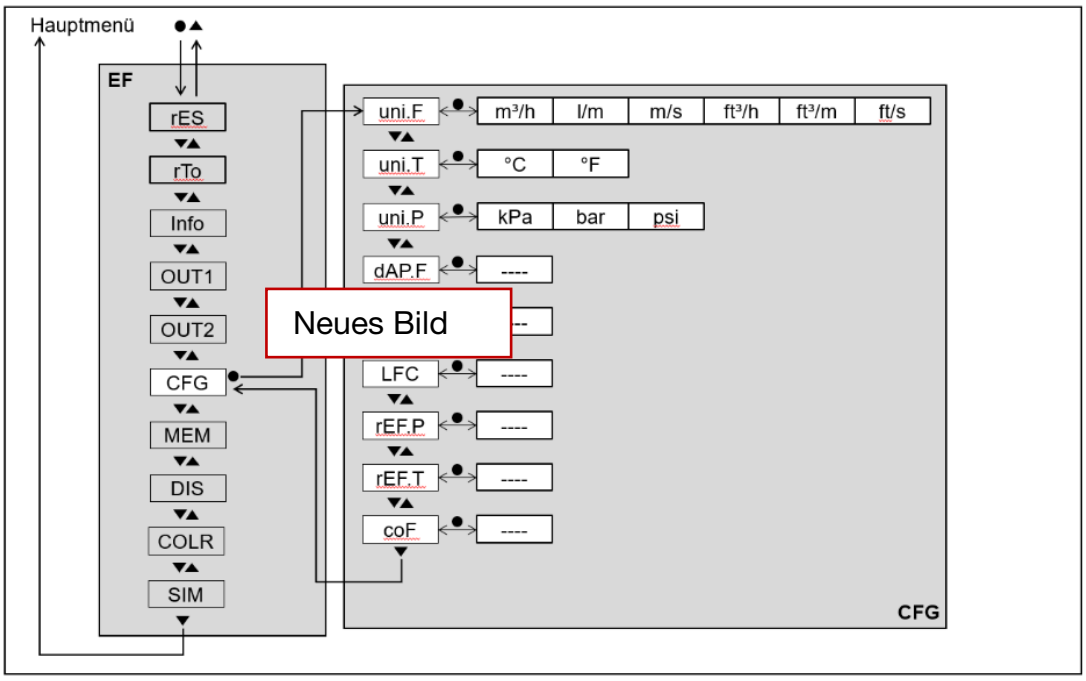
7.6 Submenu CFG

Specification F01:



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Specification F02:

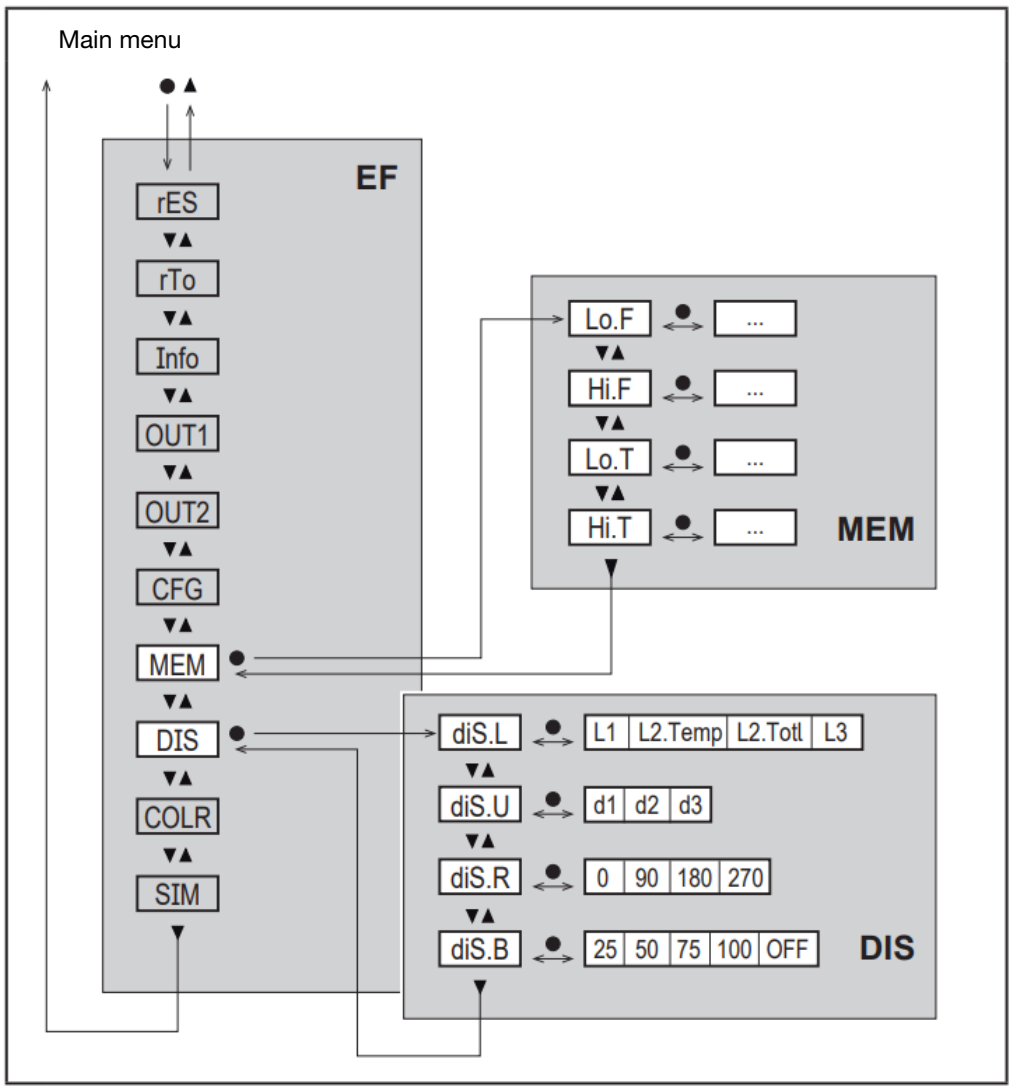


Parameter	Explanation and setting options
uni.F	Standard unit of measurement for flow
uni.T	Standard unit of measurement for temperature
uni.P	Standard unit of measurement for pressure (F02)
dAP.F	Measured value damping for flow
dAP.P	Measured value damping for pressure (F02)
P-n	Switching logic for outputs (F01)
LFC	Low flow cut-off
rEF.P	Standard pressure to which measured and display values for flow refer.
rEF.T	Standard temperature to which the measured and display values for flow refer.
SySP	Process pressure setting for the pressure compensation (F01)
coF	Zero point calibration for pressure measurement. The internal measured value 0 is shifted by this amount (F02) Specification

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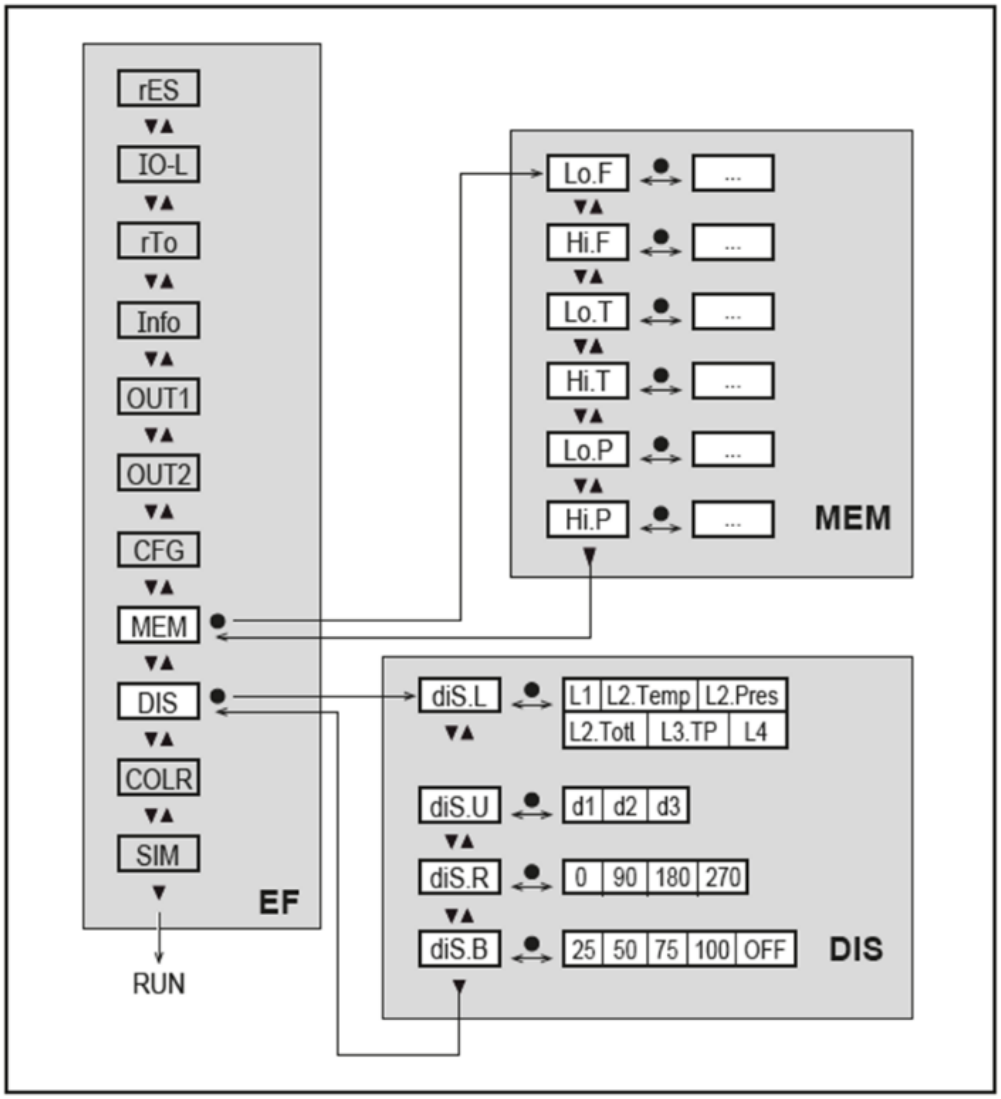
7.7 Submenu MEM, DIS

Specification F01:



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Specification F02:



Explanation submenu MEM

Parameter	Explanation and setting options
Lo.F	Minimum value of the flow volume measured in the process
Hi.F	Maximum value of the flow volume measured in the process
Lo.T	Minimum value of the temperature measured in the process
Hi.T	Maximum value of the temperature measured in the process
Lo.P	Minimum value of the pressure measured in the process (F02)
Hi.P	Maximum value of the pressure measured in the process (F02)

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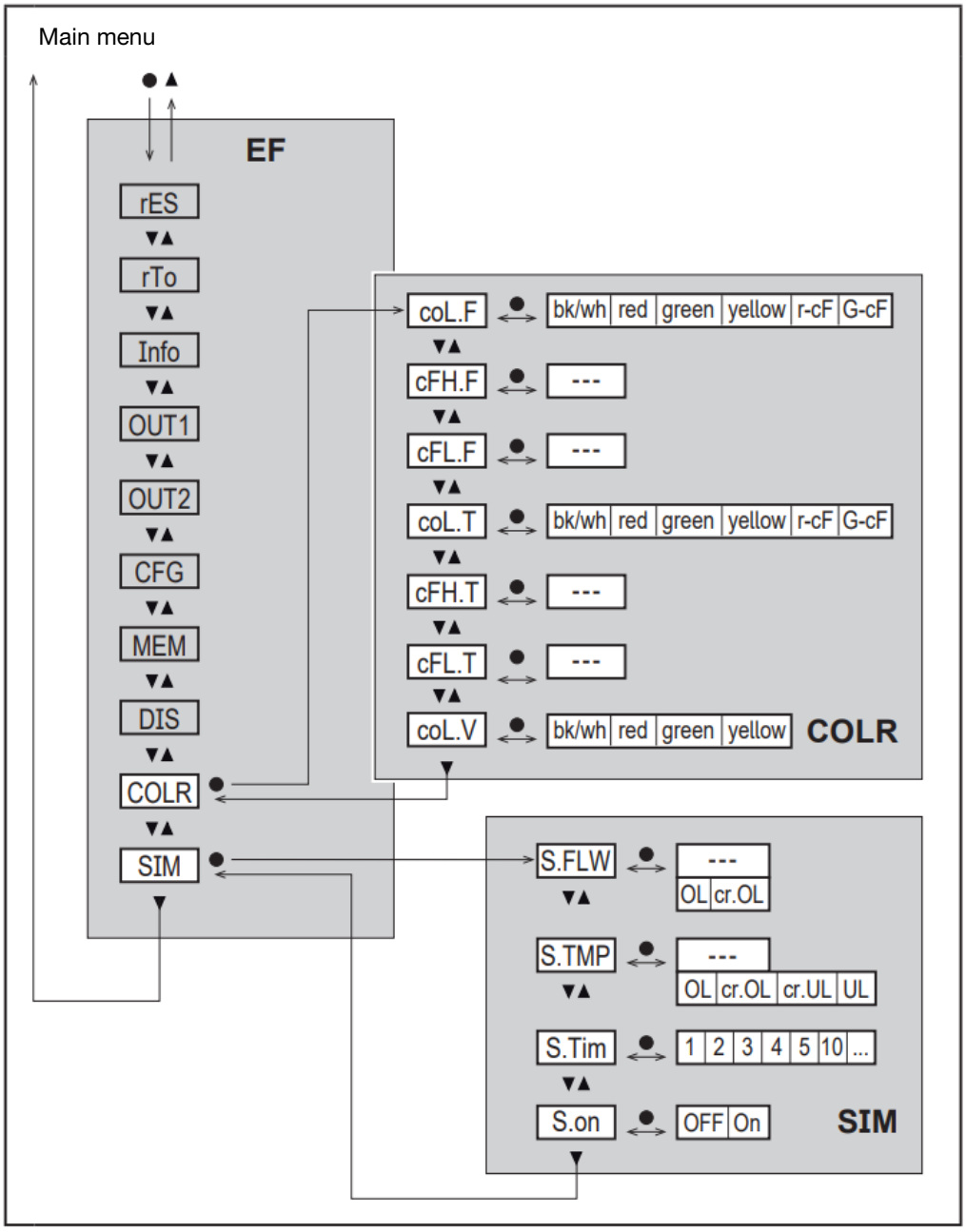
Explanation submenu DIS

Parameter	Explanation and setting options
diS.L (F01)	Standard process value display
	L1 = current process value for flow L2.Temp = current process value for flow and temperature L2.Totl. = current process value for flow and totaliser L3 = current process value for flow and temperature and totaliser
diS.L (F02)	Standard process value display
	L1 = current process value for flow L2.Temp = current process value for flow and temperature L2.Press = current process value for flow and pressure L2.Totl. = current process value for flow and totaliser L3.TP = current process value for flow, temperature and pressure L4 = current process value for flow, temperature, pressure and totaliser value
diS.U	Display refresh rate d1 = High d2 = Medium d3 = Low
diS.R	Display rotation: 0°, 90°, 180°, 270°
diS.B	Display brightness: 25%, 50%, 75%, 100%, OFF Measurement display in RUN mode switched off

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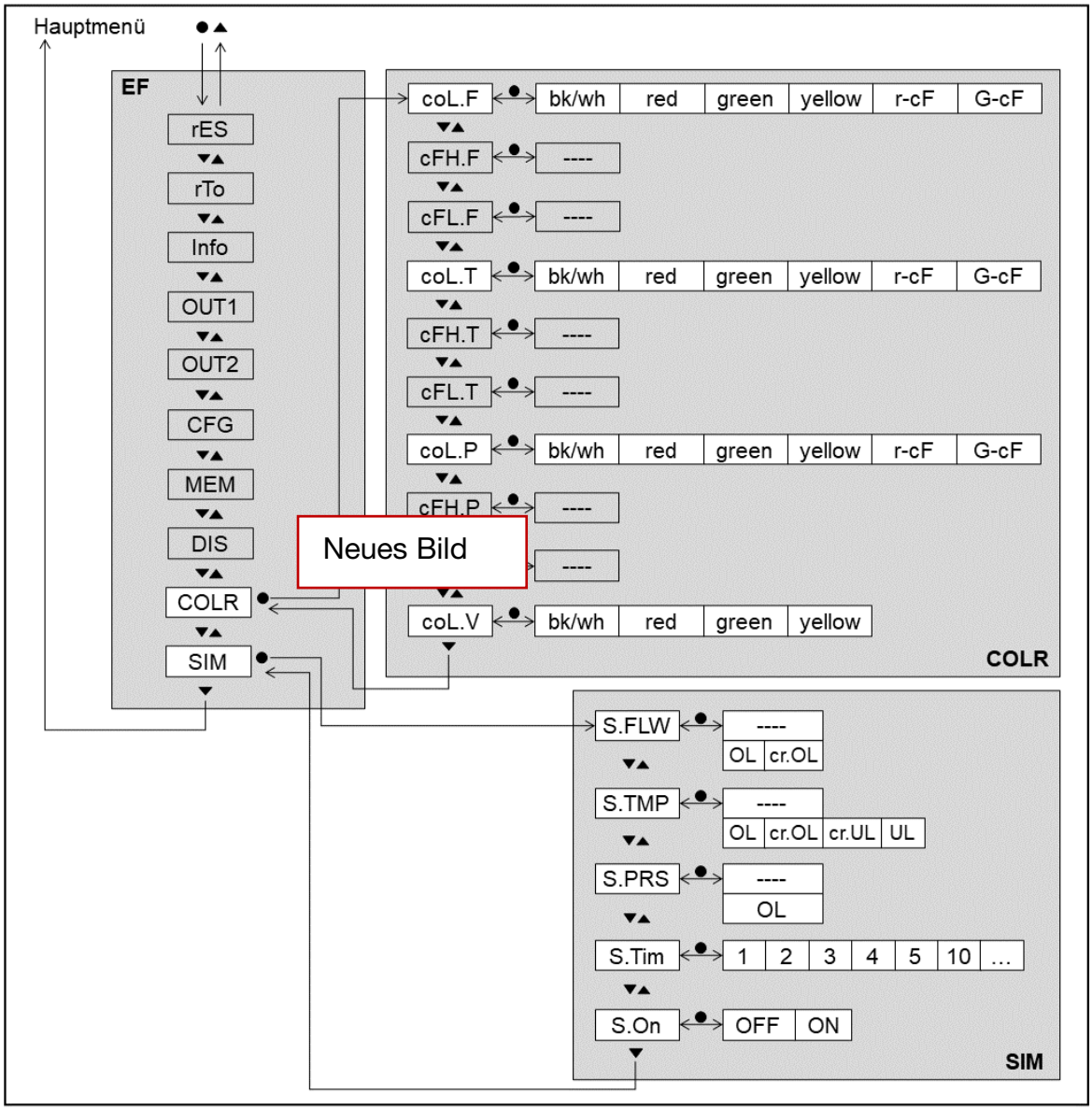
7.8 Submenu COLR, SIM

Specification F02:



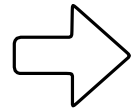
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Specification F02:



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Explanation submenu COLR



Note

The displayed parameters change when the factory settings in submenu **OUT1** and **OUT2** are changed.

Parameter	Explanation and setting options
coL.F	Colour of the characters in the display for the flow value
cFH.F	Upper limit value for the colour change for flow measurement
dFL.F	Lower limit value for the colour change for flow measurement
coL.T	Colour of the characters in the display for the temperature value
cFH.T	Upper limit value for the colour change for temperature
cFL.T	Lower limit value for the colour change for temperature
coL.P	Colour of the characters on the display for the pressure value
coL.P	Upper limit value for the colour change for pressure measurement
cFL.P	Lower limit value for the colour change for pressure measurement
coL.V	Colour of the characters in the display for the totaliser value
bk/wh	Permanently black/white
yellow	Permanently yellow
green	Permanently green
red	Permanently red
r-cF	Display colour between limit values cFL...cFH red, outside green
G-cF	Display colour between limit values cFL...cFH green, outside red

Explanation submenu SIM

Parameter	Explanation and setting options
S.FLW	Simulated flow value
S.TMP	Simulated temperature value
S.PRS	Simulated pressure value (F02)
cr.UL	Measured value below the detection range → error message
UL	Measured value below the display range → warning
OL	Measured value above the display range → warning

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cr.OL	Measured value above the detection range → error message
S.Tim	Simulation duration in minutes
S.On	Simulation duration_ OFF,On

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8 COMMISSIONING

After power-on and expiry of the readiness delay time of approx. 1 second, the instrument is in RUN mode (=normal operating mode). It carries out its measurement and evaluation functions and generates output signals according to the set parameters.

- During the readiness delay time, the outputs are switched as programmed:
  - ON with normally open function (Hno / Fno)
  - OFF with normally closed function (Hnc / Fnc)
  - OFF for consumption quantity monitoring (ImP)

- If output 2 is configured as an analog output, the output signal is at 20 mA during the readiness delay time.

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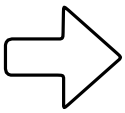
9 PARAMETER SETTING

WARNING



CAUTION!
The housing can become very hot
- Risk of burns
- Do not touch the instrument with your hands
- Use another object (e.g. a ballpoint pen) to implement settings on the instrument.

Parameters can be set before installation and commissioning of the instrument or during operation. If you change parameters during operation, this will affect the functioning of the system.



- Make sure that there are no malfunctions in the system

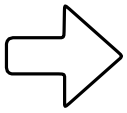
Note

During parameter setting, the instrument remains in the operating mode. It continues to carry out its monitoring functions with the existing parameters until the parameter setting has been completed.

9.1 General parameter setting

1. Change from RUN mode to the main menu	[●]
2. Select the required parameter	[▲] or [▼]
3. Change to setting mode	[●]
4. Change the parameter value	[▲] or [▼] > 1s
5. Acknowledge the set parameter value	[●]
6. Return to RUN mode	>30 seconds (timeout)

Note



If [🔒 Lock via system] is displayed, the sensor is permanently locked via software. This lock can only be removed with service software.

9.1.1 Select submenu

1. Press [●] to switch from the process value display to the main menu.
2. Press [▼] to select the menu EF and press [●].
3. Press [▼] to select the submenu and press [●].

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9.1.2 Change to the process value display (RUN mode)

There are 2 options:

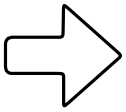
1. Wait 30 seconds (☞ 9.1.4 Timeout).
2. Press [▲] or [▼] to go to the end of the menu and switch to the next higher menu.

9.1.3 Lock / unlock

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

Locking:

- Make sure that the instrument is in normal operating mode.
- Press [▲] and [▼] simultaneously for 10 seconds until [🔒 Reset menu lock] is displayed.



Note

During operation: [🔒 Lock via key] is displayed if you try to change parameter values.

Unlocking:

- Make sure that the instrument is in normal operating mode.
- Press [▲] and [▼] simultaneously for 10 seconds until [🔒 Reset menu lock] is displayed

9.1.4 Timeout

If no key is pressed for 30 seconds while setting a parameter, the instrument returns to the operating mode with the value unchanged.

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9.2 Settings for flow monitoring

9.2.1 Limit value monitoring OUT1 or OUT2 / hysteresis function (with order option F01)

	Menu OUTx:
▪ Select **[SELx]** and set FLOW	[SELx]
▪ Select **[oux]** and adjust the switching signal: - Hno = hysteresis function / normally open - Hnc = hysteresis function / normally closed	[oux]
▪ Select **[SPx]** and set the value at which the output switches.	[SPx]
▪ Select **[rPx]** and set the value at which the output resets.	[rPx]

9.2.2 Limit value monitoring OUT1 or OUT2 / window function (with order option F01)

	Menu OUTx:
▪ Select **[SELx]** and set FLOW	[SELx]
▪ Select **[oux]** and adjust the switching signal: - Fno = window function / normally open - Fnc = window function / normally closed	[oux]
▪ Select **[FHx]** and set the value at which the output switches.	[FHx]
▪ Select **[FLx]** and set the value at which the output resets.	[FLx]

9.2.3 Analog signal flow OUTx*

	Menu OUTx:
▪ Select **[SELx]** and set FLOW	[SELx]
▪ Select **[oux]** and set analog signal: I (4 to 20 mA)	[oux]
▪ Select **[ASPx]** and set the value at which 4 mA is provided.	[ASPx]
▪ Select **[AEPx]** and set the value at which 20 mA is provided.	[AEPx]

*With order option F01 - OUT2 With order option F02- OUT 1 & OUT 2

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9.3 Settings for consumption quantity monitoring

9.3.1 Quantity monitoring by pulse signal OUT1 and OUT2 (with order option F01)

	Menu OUTx:
▪ Select **[SELx]** and set FLOW	[SELx]
▪ Select **[oux]** and adjust the pulse output: ImP	[oux]
▪ Select **[ImPSx]** and set the pulse value (= flow quantity at which a pulse is provided): 1. Press [▲] or [▼] to select the setting range. 2. Press [●] briefly to confirm the setting range. 3. Press [▲] or [▼] to set the required numerical value. 4. Press [●] briefly to apply the value.	[ImPSx]
▪ Select **[ImPRx]** and set YES.	[ImPRx]

9.3.2 Quantity monitoring by preset counter OUT1 or OUT2 (with order option F01)

	Menu OUTx:
▪ Select **[SELx]** and set FLOW	[SELx]
▪ Select **[oux]** and adjust the pulse output: ImP	[oux]
▪ Select **[ImPSx]** and set the flow quantity at which output x switches.	[ImPSx]
▪ Select **[ImPRx]** and set NO.	[ImPRx]

9.3.3 Manual counter reset

	Menu EF:
▪ Select **[rTo]** and set rES.T. → The totaliser is reset to zero	[rTo]

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9.3.4 Time-controlled counter reset

	Menu EF:
▪ Select **[rTo]** and set the required value (intervals of hours, days or weeks). → The totaliser is automatically reset with the value now set.	[rTo]

9.3.5 Deactivating counter reset

	Menu EF:
▪ Select **[rTo]** and set OFF. → The totaliser is only reset after the overflow.	[rTo]

9.3.6 Counter reset using an external signal (with order option F01)

	Menu OUT2:
▪ Select **[rTo]** and set In.D.	[ou2]
▪ Select **[Din2]** and set counter reset signal: **HIGH** = reset for high signal **LOW** = reset for low signal **+EDG** = reset for rising edge **-EDG** = reset for falling edge → Totaliser is reset to zero.	[Din2]

9.4 Settings for temperature monitoring

9.4.1 Limit value monitoring OUT1 or OUT2 / hysteresis function (with order option F01)

	Menu OUTx:
▪ Select **[SELx]** and set TEMP	[SELx]
▪ Select **[oux]** and adjust the switching signal: - Hno = hysteresis function / normally open - Hnc = hysteresis function / normally closed	[oux]
▪ Select **[SPx]** and set the value at which the output switches.	[SPx]
▪ Select **[rPx]** and set the value at which the output resets.	[rPx]

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9.4.2 Limit value monitoring OUT1 or OUT2 / window function (with order option F01)

	Menu OUTx:
▪ Select **[SELx]** and set TEMP	[SELx]
▪ Select **[oux]** and adjust the switching signal: - Fno = window function / normally open - Fnc = window function / normally closed	[oux]
▪ Select **[FHx]** and set the value at which the output switches.	[FHx]
▪ Select **[FLx]** and set the value at which the output resets.	[FLx]

9.4.3 Analog signal temperature OUT2

	Menu OUTx:
▪ Select **[SELx]** and set Temp	[SELx]
▪ Select **[oux]** and select analog signal: I (4 to 20 mA)	[oux]
▪ Select **[ASPx]** and set the value at which 4 mA is provided.	[ASPx]
▪ Select **[AEPx]** and set the value at which 20 mA is provided.	[AEPx]

9.5 Settings for pressure monitoring

9.5.1 Analog signal pressure OUTx (with order option F02)

	Menü OUTx:
▶ [SELx] wählen und PRES einstellen. ▶ [ASPx] wählen und Wert einstellen, bei dem 4 mA ausgegeben werden. ▶ [AEPx] wählen und Wert einstellen, bei dem 20 mA ausgegeben werden.	[SELx] [ASPx] [AEPx]

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9.6 User settings (optional)

9.6.1 Standard display (with order option F01)

	Menu DIS:
▪ Select **[diS.L]** and set process value display: **L1** = current process value for flow **L2.Temp** = current process value for flow and temperature **L2.Totl** = current process value for flow and totaliser **L3** = current process value for flow and temperature and totaliser	[diS.L]
▪ Select **[diS.U]** and set the display refresh rate: d1 = High d2 = Medium d3 = Low	[diS.U]
▪ Select **[diS.R]** and set the orientation of the display: 0°, 90°, 180°, 270°	[diS.R]
▪ Select **[diS.B]** and set the brightness of the display: 25%, 50%, 75%, 100% or OFF (= energy-saving mode. The display is switched off in the operating mode. Error messages are shown even if the display is deactivated. Activate the display by pressing any key.)	[diS.B]

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9.6.2 Standard display (with order option F02)

▶ [diS.L] wählen und Prozesswertanzeige einstellen: - L1 = aktueller Prozesswert für Durchfluss - L2.Temp = aktueller Prozesswert für Durchfluss und Temperatur - L2.Pres = aktueller Prozesswert für Durchfluss und Druck - L2.Totl = aktueller Prozesswert für Durchfluss und Totalisator - L3.TP = aktueller Prozesswert für Durchfluss und Temperatur und Druck - L4 = aktueller Prozesswert für Durchfluss und Temperatur und Druck und aktueller Totalisatorwert ▶ [diS.U] wählen und Aktualisierungsrate des Displays einstellen: - d1 = High - d2 = Medium - d3 = Low ▶ [diS.R] wählen und Ausrichtung des Displays einstellen: 0°, 90°, 180°, 270° ▶ [diS.B] wählen und Helligkeit des Displays einstellen: 25 %, 50 %, 75 %, 100 % oder OFF (= Energiesparmodus. Die Anzeige ist im Arbeitsbetrieb ausgeschaltet. Fehlermeldungen werden auch bei ausgeschaltetem Display angezeigt. Displayaktivierung über beliebigen Tastendruck.)	Menü DIS: [diS.L] [diS.U] [diS.R] [diS.B]

9.6.3 Standard unit of measurement for flow

	Menu CFG
▪ Select **[uni.F]** and set the unit of measurement for standard display (☞ 7.1): l/min, m^3/h, m/s, ft^3/m,ft^3/h, ft/s The consumption quantity (meter reading) is automatically displayed with the unit of measurement that provides the highest accuracy.	[uni.F]

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9.6.4 Standard unit of measurement for temperature

	Menu CFG
▪ Select **[uni.T]** and set the unit of measurement for standard display (☞ **7.1**): °C and °F	[uni.T]

9.6.5 Standard unit of measurement for pressure

▶ [uni.P] wählen und Maßeinheit für Standard-Anzeige (→ 7.1) einstellen: kPa, bar, psi.	Menü CFG: [uni.P]

9.6.6 Measuring value damping

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

9.6.7 Switching logic for outputs

	Menu CFG
▪ Select **[P-N]** and set PnP or nPn.	[P-N]

9.6.8 Low flow cut-off

	Menu CFG
▪ Select **[LFC]** and set the limit value below which a flow is evaluated as a standstill.	[LCF]

9.6.9 Zero point calibration pressur

▶ [coF] wählen und Wert in bar einstellen. > Der interne Messwert 0 wird um diesen Betrag verschoben.	Menü CFG: [coF]

9.6.10 Standard conditions

	Menu CFG
▪ Select **[rEF.P]** and set standard pressure.	[rEF.P]
▪ Select **[rEF.T]** and set standard temperature.	[rEF.T]

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9.6.11 Colour of the characters in the display

▶ [coL.F] für Durchfluss oder [coL.T] für Temperatur oder [col.P] für Druck wählen und Schriftfarbe des Prozesswerts in der Standard-Anzeige einstellen: - bk/wh = dauerhaft schwarz/weiß - yellow = dauerhaft gelb - green = dauerhaft grün - red = dauerhaft rot - r-cF = Display-Farbe rot zwischen Grenzwerten cFL...cFH, außerhalb Farbwechsel nach grün. - G-cF = Display-Farbe grün zwischen Grenzwerten cFL...cFH, außerhalb Farbwechsel nach rot. ▶ [cFH.x] und [cFL.x] wählen und Grenzwerte für Farbfenster einstellen: - cFH.F = oberer Grenzwert für Durchfluss - cFL.F = unterer Grenzwert für Durchfluss - cFH.T = oberer Grenzwert für Temperatur - cFL.T = unterer Grenzwert für Temperatur - cFH.P = oberer Grenzwert für Druck * - cFL.P = unterer Grenzwert für Druck * ▶ [coL.V] wählen und Schriftfarbe für Totalisator einstellen: - bk/wh = dauerhaft schwarz/weiß - yellow = dauerhaft gelb - green = dauerhaft grün - red = dauerhaft rot	Menü COLR: [coL.x] [cFH.x] [cFL.x] [coL.V]

* only with order option F02

9.6.12 Switching/reset delay

	Menu OUTx:
▪ Select **[dSx]** and set the delay for switching Outx in seconds.	[dSx]
▪ Select **[drx]** and set the delay for resetting OUTx in seconds.	[drx]

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9.6.13 Error behaviour of the outputs (F02)

▶ [FOUx] wählen und Fehlerverhalten einstellen: - On = Das Analogsignal geht auf den oberen Fehlerwert (→ 3.2). - OFF = Das Analogsignal geht auf den unteren Fehlerwert (→ 3.2). - OU = Das Analogsignal geht im Fehlerfall bei der Druckmessung auf 21,5 mA und im Fehlerfall bei der Durchflussmessung oder Temperaturmessung auf 3,5 mA (→ 3.2).	Menü OUTx: [FOUx]

9.6.14 Error behaviour of the outputs (F01)

	Menu OUT1:
▪ Select **[FOU1]** and set error behaviour for output 1: **On** = Output 1 switches ON in the event of an error. **OFF** = Output 1 switches OFF in the event of an error. **OU** = Output 1 switches irrespective of the error as defined with the parameters	[FOU1]
	Menu OUT2:
▪ Select **[FOU2]** and set error behaviour for output 2: Switching output: **On** = Output 2 switches ON in the event of an error. **OFF** = Output 2 switches OFF in the event of an error. **OU** = Output 2 switches irrespective of the error as defined with the parameters Analog output: **On** = The analog signal goes to the upper error value (☞ 4.3.3). **OFF** = The analog signal goes to the lower error value (☞ 4.3.3). **OU** = The analog signal corresponds to the measured value.	[FOU2]

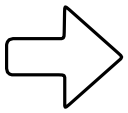
Note

If **[ou]** = Imp (consumption quantity monitoring) was selected, the parameter **[FOUx]** is not available. The pulses are provided irrespective of the error.

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9.6.15 Restore factory settings

	Menu EF:
▪ Select **[rES]** ▪ Briefly press [●] ▪ Press and hold [▲] or [▼]. → **[----]** is displayed. ▪ Briefly press [●]. → The instrument carries out a reboot.	[rES]



Note

☞ **13 Factory settings**. We recommend noting down your own individual settings in this table before implementing this function.

9.7 Diagnostic functions

9.7.1 Read min/max values

▶ [Lo.x] oder [Hi.x] wählen um den jeweils höchsten oder niedrigsten gemessenen Prozesswert anzuzeigen: - [Lo.F] = Minimal-Wert des im Prozess gemessenen Durchflussvolumens - [Hi.F] = Maximal-Wert des im Prozess gemessenen Durchflussvolumens - [Lo.T] = Minimal-Wert der im Prozess gemessenen Temperatur - [Hi.T] = Maximal-Wert der im Prozess gemessenen Temperatur - [Lo.P] = Minimal-Wert des im Prozess gemessenen Drucks - [Hi.P] = Maximal-Wert des im Prozess gemessenen Drucks Speicher löschen: ▶ [Lo.x] oder [Hi.x] wählen. ▶ [▲] und [▼] gedrückt halten. > [----] wird angezeigt. ▶ Kurz [●] drücken. Es ist sinnvoll, die Speicher zu löschen, sobald das Gerät erstmals unter normalen Betriebsbedingungen arbeitet.	Menü MEM: [Lo.x] [Hi.x]

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10 OPERATION

The process values to be permanently displayed can be preset (☞ 9.5.1 Standard display). A standard unit of measurement can be defined for the flow measurement and the temperature measurement (☞ 9.5.2 and ☞ 9.5.3).

In addition to the preset standard display, the display can be changed by pressing [▲] or [▼] ☞ 7.1 Process value display (RUN).

11 TROUBLESHOOTING

The instrument has extensive self-diagnostic capabilities. It monitors itself automatically during operation.

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

The status signals are classified according to Namur recommendation NE107.

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

If one process value fails, the other process values continue to be available.

ERROR	ERROR	**---**	⊗	Instrument faulty / malfunction	**FOU**	Replace instrument
Aus	Off	---	⊗	Supply voltage too low	**FOU**	Check supply voltage. Change [diS.B] setting (☞ 9.5.1)
PArA	Parameter Error	---	⊗	Parameter setting outside the valid range.	**FOU**	Repeat parameter setting.
ERROR	Flow Error	---	⊗	Error in flow measurement	**FOU**	Check flow measurement. Replace instrument.

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Process value line	Title line	Status LED	Type	Description	Output response	Troubleshooting
ERROR	Temp. Error	---	⊗	Error in temperature measurement	**FOU**	Check temperature measurement. Replace instrument
cr.OL	Critical over limit	---	⊗	Critical exceeding of the detection range	**FOU**	Check flow range / temperature range
cr.UL	Critical under limit	---	⊗	Critical undershooting of the detection range*	**FOU**	Check temperature range
---	Short circuit OUT1/ OUT2	OUT1 ✱ OUT2 ✱	⚠	Short circuit OUT1 and OUT2	---	Check switching output OUT1 and OUT2 for short circuit or excessive current
---	Short circuit OUT1	OUT1 ✱	⚠	Short circuit OUT1	---	Check switching output OUT1 for short-circuit or excessive
---	Short circuit OUT2	OUT2 ✱	⚠	Short circuit OUT2	---	Check switching output OUT2 for short-circuit or excessive
OL	Over limit	---	⚠	Detection range* exceeded	**OU**	Check flow range / temperature range
UL	Under limit	---	⚠	Detection range* not reached	**OU**	Check flow range / temperature range
Lock via key	---	---	⚠	Setting button on instrument locked, parameter change rejected.	**OU**	Unlock instrument ☞ 9.1.3

*Detection range ☞ 4.3.3 Fig. 1

⊗ Error — In the event of an error, the outputs react according to the setting under [FOU1] and [FOU2] (☞ 9.5.10)

⚠ Warning

✱ LED flashes

✱ LED flashes rapidly

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12 MAINTENANCE, REPAIR AND DISPOSAL

As a rule, no maintenance measures are necessary.

- Define regular calibration intervals according to process requirements. Recommendation: every 12 months.

The instrument may only be repaired by the manufacturer.

- After use, dispose of the instrument in an environmentally friendly manner in accordance with the applicable national regulations.

13 CONFIGURATION AND FACTORY SETTINGS

13.1 Configuration of OUx on delivery

Menu	Parameter	Configuration	User setting
OUT1	SEL1	FLOW	
	OU1	ImP	
OUT2	SEL2	FLOW	
	OU2	I	

Nominal width	ImPS1	ASP2 … AEP
DN65	1 m^3	0 … 2000 m^3/h
DN80	1 m^3	0 … 2750 m^3/h
DN100	10 m^3	0 … 4400 m^3/h
DN125	10 m^3	0 … 7000 m^3/h
DN150	10 m^3	0 … 10000 m^3/h
DN200	10 m^3	0 … 17400 m^3/h
DN250	10 m^3	0 … 27500 m^3/h

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13.2 Factory setting

Menu	Parameter	Factory setting	User setting
EF	rTo	OFF	
OUT1	SEL1	FLOW	
	ou1	Hno	
	SP1/FH1	20%	
	rP1/FL1	19%	
	ImPS1	0.0001 m^3	
	ImPR1	YES	
	dS1	0	
	Dr1	0	
	FOU1	OFF	
OUT2	SEL2	FLOW	
	ou2	1	
	ASP2	0%	
	AEP2	100%	
	SP1/FH1	40%	
	rP1/FL1	39%	
	ImPS2	0.0001 m^3	
	ImPR2	YES	
	Dln2	+EDG	
	dS1	0	
	dr1	0	
	FOU2	OFF	
CFG	uni.F	m^3/h	
	uni.T	°C	
	dAP.F	0,6 s	
	P-n	PnP	
	LFC	0,13%	
	rEF.T	15 °C	
	rEF.P	1013 mbar	

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Menu	Parameter	Factory setting	User setting
DUS	diS/L	L3	
	diS/U	d3	
	diS/R	0	
	diS/B	75	
COLR	coL.F	bk/wh	
	coL.T	bk/wh	
	coL.V	bk/wh	

The process values refer to the final value of the measuring range (the full scale value, MEW).

Note

The parameter settings for the sensor may deviate from the factory settings on delivery depending on the nominal width and the order.

Specification F02:

Menü	Parameter	Werkseinstellung	Benutzer-Einstellung
EF	**rTo**	OFF	
OUT1	**SEL1**	TEMP	
	ASP1	0 %	
	AEP1	100 %	
	FOU1	OFF	
OUT2	**SEL2**	FLOW	
	ASP2	0 %	
	AEP2	100 %	
	FOU2	OFF	

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Menü	Parameter	Werkseinstellung	Benutzer-Einstellung
CFG	uni.F	m^3/h	
	uni.T	°C	
	uni.P	bar	
	dAP.F	0,6 s	
	dAP.P	0,06 s	
	LFC	0555 6451 0,1 m^3/h 0555 6452 0,3 m^3/h 0555 6453 0,5 m^3/h 0555 6454 2,0 m^3/h	
	rEF.P	1013 mbar	
	rEF.T	15 °C	
	coF	0	
DIS	diS.L	L3.TP	
	diS.U	d3	
	diS.R	0	
	diS.B	75	
COLR	coL.F	bk/wh	
	coL.T	bk/wh	
	coL.P *	bk/wh	
	coL.V	bk/wh	

* only with order option F02

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