Compressed air counter probe

Instruction manual

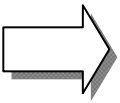
1 Contents

2 Safety and the environment

2.1. About this document

Symbols and writing standards

The following characters and symbols are used in this instruction manual to emphasise text passages that need special attention.

Symbol	Explanation
	Notes This arrow points out specifics that must be observed during operation.
	Warning This symbol indicates text passages which, if not complied with or not followed specifically, may lead to the damage or destruction of system parts.
	Caution! This symbol is placed in front of text passages which may be hazardous to one's health or life if not complied with.
	Reference The symbol points out further information in other manuals, chapters or sections.
Menu	Elements of the instrument, the instrument display or the program interface.
[OK]	Control keys of the instrument or buttons of the program interface.

2.2. Safety

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

As the user, you are responsible for the 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.

The instruments are factory-tested and were delivered in a safe condition.

These operating instructions contain information and warnings that must be followed by the user in order to ensure safe operation.

- Assembly, 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 these operating instructions, and must comply with the directions contained herein.
- Check that all connections are correct before commissioning the complete measuring point.
- Do not commission damaged products and keep these from being inadvertently commissioned. Mark the damaged products as defective.
- Faults at the measuring point may only be corrected by authorised and specially trained personnel.
- If faults cannot be corrected, the products must be taken out of operation and secured from inadvertent commissioning.
- Repairs that are not described in these operating instructions may only be carried out directly by the manufacturer or by the service organisation.

Exclusion of liability

Liability of the manufacturer and its assistants exists only in the event of deliberate acts or gross negligence. The extent of liability is limited to the value of the respective order placed with the manufacturer.

The manufacturer accepts 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.

Use

- Please read this documentation through carefully and familiarize yourself with the product before putting it to use. Pay particular attention to the safety instructions and warning advice in order to prevent injuries and damage to the products.
- Keep this document to hand so that you can refer to it when necessary.
- Hand this documentation on to any subsequent users of the product.

2.3. Protecting the environment

- Dispose of faulty rechargeable batteries/spent batteries in accordance with the valid legal specifications.
- At the end of its useful life, send the product to the separate collection for electric and electronic devices (observe local regulations) or return the product to Testo for disposal.

3 Specifications

3.1. Use

The compressed air counter 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.

Thanks to the design, operation in systems that are under pressure up to PN16 is possible.

Use which deviates from that described endangers the safety of people and of all the measuring equipment and is thus not permissible.

The manufacturer accepts no liability for damages that occur as a result of improper or inappropriate use or installation.

To avoid damage to the instrument or health hazards, no manipulation using tools may occur on the measuring units unless expressly defined in this operating manual.

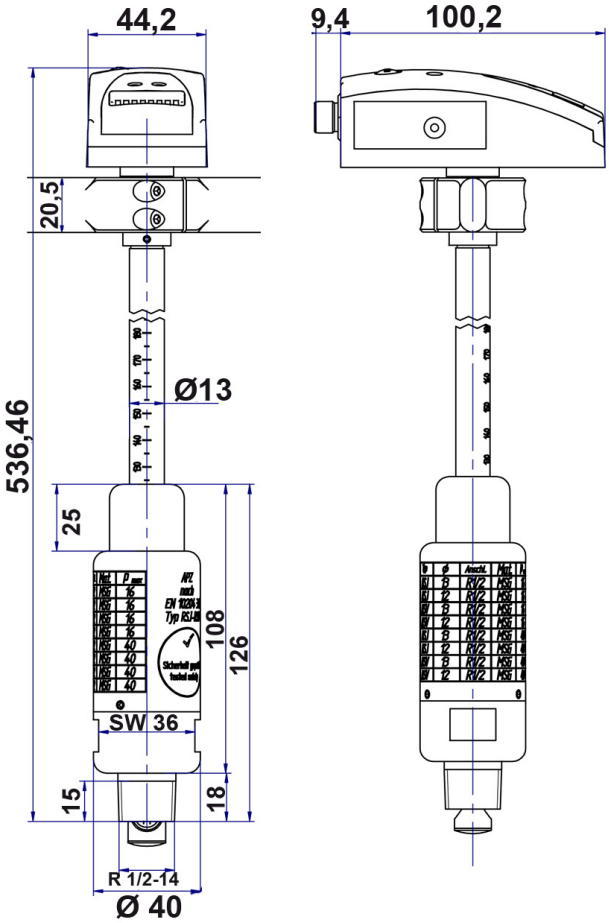
Changing the sensors while in operation is possible.

Use authorised personnel when changing the sensors during operation. Further details ☞ Assembly under pressure, page 21.

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.

3.2. Technical data

3.2.1. Dimensions (mm)



3.2.2. Thermal mass flow sensor

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

Feature	Values
Sensor	Thermal, glass-coated ceramic sensor
Media	Compressed air (CO_2, N_2 also possible with special calibration)
Accuracy	For compressed air quality classes (ISO 8573: particles to humidity to oil) 1-4-1: ±3 % of reading, ±0.3 % of final value for compressed air quality classes (ISO 8573: particles to humidity to oil) 3-4-4: ±6 % of reading, ±0,6 % of final value
Display, operation	Four-digit alphanumeric display, two operating buttons, operation menu, LEDs (6x green for physical units, 2x yellow for switch statuses)
Display units[1]	m³/min, m³/h, m/s, m³, °C
Measurement dynamics	1:150 or 1:300
Measuring range (1:300)	0.25 to 75 Nm³/h
Response time	< 0.1 s
Pressure-tight	Up to 16 bar overpressure
Protection class	IP65 / III
Media contact	V2A (1.4301), glass-coated ceramic, PEEK, polyester, Viton, anodised aluminium
Housing materials	PBT-GF 20, PC (APEC), Makrolon, V2A (1.4301), Viton
Protection class	IP65 / III
Electrical connection	M12 x 1 connector, can be loaded to 250 mA, short-circuit-proof

[1] The measurement, display and adjustment ranges are related to the standard volume flow according to DIN ISO 2533 (15 °C, 1013 mbar and 0 % rel. humidity) if not otherwise stated in the calibration protocol of the sensor

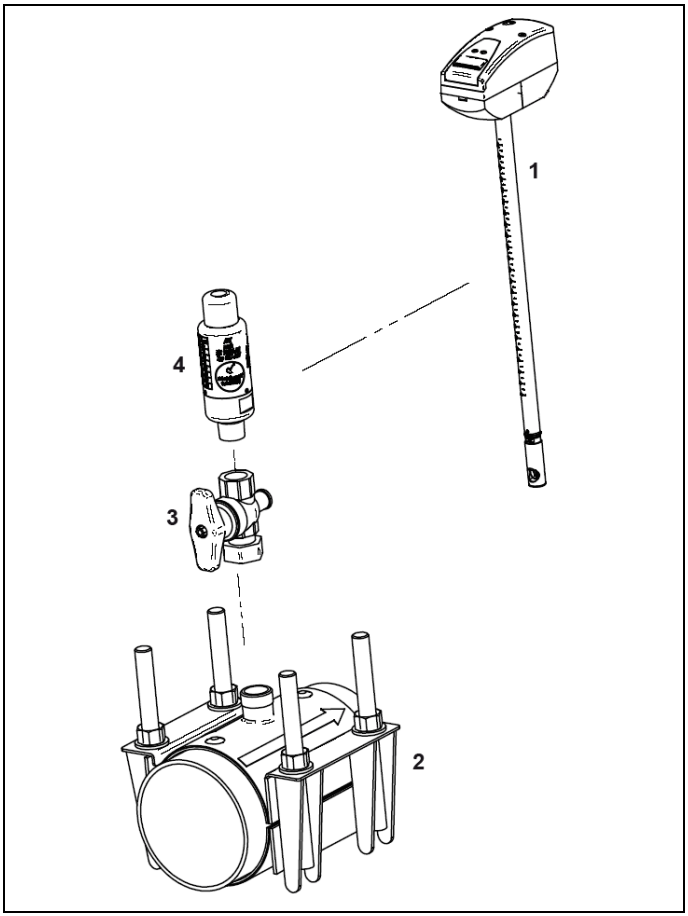
Feature	Values
Voltage supply	19 to 30 V DC, power consumption < 100 mA
Readiness delay	0.5 s
Analogue output	4 to 20 mA, measuring range scalable for m³/min, m³/h, m/s and °C max. load = 500 Ohm
Pulse output	Pulse speed adjustable in increments of 1 m³ (recommended increments are 1 m³, 10 m³, 100 m³ and 1,000 m³, or preset counter up to 1,000,000 m³)
Current carrying capacity	2 x 250 mA, short-circuit-proof, protected against polarity reversal, overload-proof
Medium temperature	0 to +60 °C (rel. humidity max. 90 %)
Ambient temperature	0 to +60 °C
Storage temperature	-25 to +85 °C
EMC	EN 6126-1:2006 class B/EN 6126-1:2006 table 2
IEC 1000/4/2 ESD	4/8 kV
IEC 1000/4/3 HF radiated	10 V/m
IEC 1000/4/4 burst	2 kV
IEC 1000/4/6 HF grid-bound	10 V
Warranty	2 years, for warranty conditions see www.testo.com/warranty

3.2.3. Accessories

- Sensor parameterisation for CO_2 and N_2: Six measuring points are paramaterised 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.
- ISO calibration points: For the purpose of basic characteristics and accuracy, six measuring points are paramaterised with specified nominal widths, standard temperatures and pressures, then moved to the test stand where the standard volume is tested.
- ISO certificate: An ISO certificate from the manufacturer indicates six measuring points with m³/min (incl. standard conditions). The six ISO calibration points are required for this.
- Measurement fitting: The measurement fitting is nickel-plated brass and has a DN 20 female pipe clamp connection, plus a DN 15 quick-release connection for additional measuring points (e.g. pressure or pressure dew point).
- Tap: The tap is nickel-plated brass and has a DN 20 female pipe clamp connection.
- Tapping clamp: Material: Stainless steel tapping clamp (304/A2), Perbunan (NBR) insert, stainless steel screws and nuts. The tapping clamp allows the sensor to be installed precisely using the drill unit without the need for welding. The corresponding supply line may be under pressure (normal operating conditions) when installing the tapping clamp or when repairing/replacing the sensor.
- Connecting cable with electrical isolator (item no. 0699 3393): A connecting cable with an electrical isolator integrated into the connector is available as an accessory. The cable is 5 metres long and is used for the galvanic isolation of the sensor output to the electronics to which it is attached. 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.

4 Product description

4.1. Overview



1 Electronic sensor

2 Tapping clamp (optional)

3 Measurement fitting with quick-release coupling (optional, ☞ Accessories, page 11)

4 PBCOver reverse running protection unit

PBCOver reverse running protection unit

The PBCOver combines three functions in one instrument:

- Reverse running protection, meaning the sensor can only be moved in one direction during assembly.
- Process seal, meaning compressed air cannot escape during assembly thanks to an enclosed O-ring.
- Adjustable fixation, so that a precise immersion depth and alignment is possible (similar to the pressure point on a car clutch). 360° alignment is possible at any time (rotation of the sensor).

The PBCOver reverse running protection unit must not be disassembled (loss of functionality) and can be used at an overpressure up to 16 bar.

Tapping clamp

The tapping clamp allows the sensor to be installed precisely using the drill unit without the need for welding. The corresponding supply line may be under pressure (normal operating conditions) when installing the tapping clamp or when repairing/replacing the sensor.

Assembly of the tapping clamp under pressure should only be made by trained personnel, and is permitted for a maximum pressure of 16 bar (up to DN 200) and 10 bar (DN 250 and DN 300, ☞ Assembly under pressure, page 21).

Tolerance range for outer diameter of the pipeline when using tapping clamps:

Nominal width	Tolerance range
DN 40	52 – 58 mm
DN 50	59 – 67 mm
DN 65	73 – 80 mm
DN 80	86 – 106 mm
DN 100	107 – 127 mm
DN 125	128 – 148 mm
DN 150	149 – 171 mm
DN 200	216 – 238 mm
DN 250	260 – 280 mm
DN 300	315 – 335 mm

Electronic sensor

The sensor records the standard volume flow rate of the working compressed air according to the calorimetric measurement principle. The measurement value of the standard volume flow rate is calculated based on DIN ISO 2533 (1013 hPa, 15 °C and 0 % relative humidity).

The electronic sensor may only be used for measuring the volume flow of working compressed air up to an overpressure of 16 bar.

Set the pipeline diameter on the instrument and any deviating standard temperatures and pressures (☞ Programming, page 30). Read out and set the analogue end point (20 mA).

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

Quality class acc. to ISO 8573-1 **Particles to humidity to oil**	**Measurement inaccuracy**
1-4-1	± (3 % of reading, + 0.3 % of end measurement value)
3-4-4	± (6 % of reading, + 0.6 % of end measurement value)

Score

- Current flow rate
- Current consumption quantity (pulse output and totaliser)

Display

- Current volume flow in m³/min (l/min = LED 1 and 10³ = LED 6 both light up) and m³/h (LED 2).
- Current average flow speed in m/s (LED 3).
- Current consumption quantity in Nm³ (LED 4 = four-digit display between 0.001 Nm³ and 4294 x 10³ Nm³). For values > 9999 Nm³, 1/1000 of the measurement value is displayed and the 10³ (LED 6) display indicates that the value must be multiplied by a factor of 1000.
- Consumption quantity before the last reset in Nm³. During the display of this value, Nm³ (LED 4) flashes.

- The °C display (LED 5) indicates the gas temperature in °C.

Switch output 1

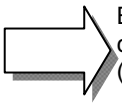
- Switch signal as the limit value for volume flow, hysteresis or window function as NO or NC contact.
- Pulse sequence for adjustable consumption quantity, e.g. 1 pulse/m³ (pulse length 100 ms) or quantity monitoring via preset counter (☞ Setting the preset counter / pulse value (ImPS), page 36).

Switch output 2

- Switch signal as the limit value for volume flow, hysteresis or window function as NO or NC contact.
- Analogue signal (4 to 20 mA) for corresponding volume flow.

Sensor type	Measuring range[2]	Recording/display range[2]
Sensor up to 80 m/s	0.33 % – 50 %	0 % – 60 %
Sensor up to 160 m/s	0.33 % – 100 %	0 % – 120 %

Nominal width	Measuring range (80 m/s)[3]	Measuring range* (160 m/s)[3]
DN 40	0.03 – 5.2 m³/min	0.03 – 10.4 m³/min
DN 50	0.06 – 8.3 m³/min	0.06 – 16.7 m³/min
DN 65	0.11 – 16.7 m³/min	0.11 – 33.3 m³/min
DN 80	0.15 – 22.9 m³/min	0.15 – 45.8 m³/min
DN 100	0.24 – 36.7 m³/min	0.24 – 73.3 m³/min
DN 125	0.39 – 58.3 m³/min	0.39 – 116.7 m³/min
DN 150	0.55 – 83.3 m³/min	0.55 – 166.7 m³/min
DN 200	0.9(7) – 145.8 m³/min	0.9(7) – 291.7 m³/min
DN 250	1.5(3) – 229.2 m³/min	1.5(3) – 458.3 m³/min



Based on the small size, the sensor only has a small contact surface. The pressure loss is thus negligible (typically 1 mbar).

[2] Absolute measuring range depends on the nominal width (see following table)

[3] Specifications acc. to DIN ISO 2533 (15 °C, 1013 hPa and 0 % rel. humidity). Initial measuring range is different to display resolution

5 Initial operation

5.1. Mechanical assembly

5.1.1. Preparation

Determining the installation point

The installation point should be easily accessible and experience only low vibrations. The ambient temperature must not exceed the values specified in the technical data (pay attention to possible heat radiation).

Please note that a clearance of at least 400 mm is required for de-installation of the sensor. When planning the measuring point, this is in addition to the space required for the measurement fitting or tap of at least 95 mm, or the space for the existing fittings (also including possible reductions to DN 15).

During assembly, consider the flow direction and required inflow/outflow routes.

Also consider the installation point with regard to the specified technical data. The medium may not be in a condensed state at the installation point. For this reason, the location in a working compressed air network can only be behind a suitable compressed air dryer which provides a suitable pressure dew point; otherwise the specified measurement accuracy is not guaranteed.

Required measurement route

Bear in mind the required inflow and outflow routes in order to achieve the specified measurement accuracy. The inflow route refers to the pipeline length in front of the mass flow sensor and the outflow route to the pipeline length behind the mass flow sensor, as seen in the direction of flow for the medium.

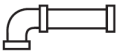
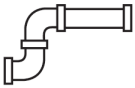
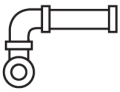
Total measurement route = inflow route + outflow route

Outflow route = 5 x D

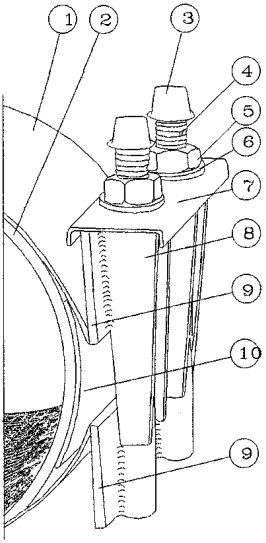
Inflow route = 5 x D + B

D = pipe diameter [mm]

B = additional cushioning route

	Changes to the pipe diameter	B = 15x pipe diameter
	90° manifold	B = 15x pipe diameter
	Two 90° manifolds, one level	B = 20x pipe diameter
	Two 90° manifolds, two levels	B = 25x pipe diameter
	Valve, slider	B = 45x pipe diameter

Assembly of the tapping clamp



1 Clamp
2 Seal
3 Cap
4 Threaded bolt
5 Nut
6 Delrin® washer
7 Retaining bracket
8 Screw yoke
9 Side bracket
10 Slide plate

On-site preparations

The installation point must be freely accessible and there must be enough space to work around the pipes.

A stable stepladder is required for all assembly work carried out up to 3.5 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.

Any cladding or insulation covering the pipes must be removed around the measuring point (clearance of at least 0.6 metres). Any grinding work required in the event of corroded pipes must be carried out carefully so that the surface curvature is not destroyed.

5.1.2. Assembly of the clamp

Assembly recommendations

- Compare the pipe diameters and check the correct size of the clamp.
- Eliminate all traces of dirt, rust and grease from the assembly point of the clamp so that the surface is smooth and clean. The seals and slide plate should be wetted to achieve better adhesion. Seals, nuts and bolts must not be greased!
- Before assembly, mark the position of the clamp to ensure a correct fit.
- During assembly, ensure that the seals and holder lips remain clean and that no foreign bodies are found between the seal and pipe.
- The correct tools (long wrench and/or torque wrench) make assembly easier.
- The bolt threads must not be contaminated.
- If a torque wrench is not used, then the nuts must not be tightened excessively. Always pay attention to the shape of the Delrin® washer.
- Always carry out a pressure test before closing the clamp. In the event of leaks, adjust the torque and check again after 20 minutes.

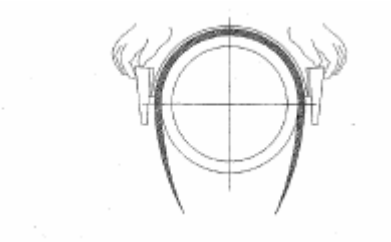
Installation

The pipe must be completely free of any dirt, rust or grease at the assembly point of the clamp. Cleaning with soapy water is best for this, as it also improves the functionality of the clamp.

Seals, nuts and bolts must not be greased!

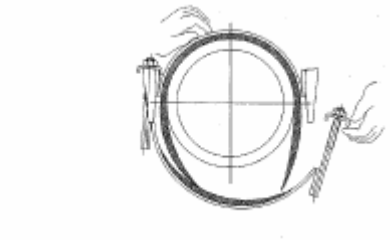
Remove the caps on the threaded bolts and unscrew the nuts up to the end of the threaded bolt (do not remove them).

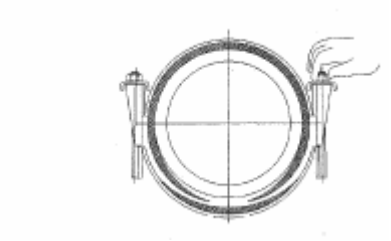
Unfold the pipe clamp and place the upper clamp part around the pipe.



Hang the retaining bracket correctly over the screw yoke on one side.

Feed the loose bottom clamp part underneath the pipe and hang it loosely on the other screw yoke using the free retaining bracket.

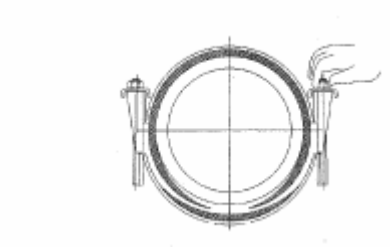




When doing this, ensure that both holder lips are inserted smoothly under the seals.

The clamp must no longer be moved radially from this position.

Check that the seals and holder lips are positioned on the pipe and that the sharp ends are positioned smoothly over the seals. Tighten the nuts by hand on the retaining bracket attached loosely to the screw yoke until the bracket is under tension.



Using the wrench, rotate further until the retaining bracket slips over the screw yoke and clicks into place.

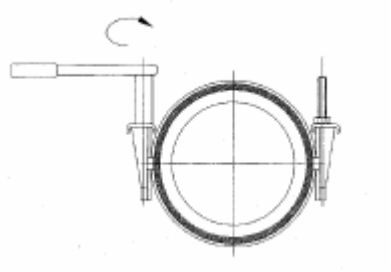
Tighten the nuts uniformly using a wrench (min. 300 mm long) until the Delrin® washers curve slightly around the nuts. The shape of the Delrin® washer does not affect the clamp functionality.

The following torques are set when using a torque wrench:

M12: 65 Nm

M14: 85 Nm

M16: 110 Nm



The Delrin® washers must also curve slightly around the nuts in this case.

Check the torque after 20 minutes and adjust if necessary.

The attached clamp must be checked for leaks before it is pressurised!

To do this, apply a test pressure from the outside through the tap or measurement fitting and check for leaks using leak spray.

5.1.3. Assembly under pressure

Assembly of the tapping clamp under pressure should only be made by trained personnel.

A pressure test is made to check the clamp for leaks after the clamp has been installed and before drilling. This is made using a pressurised cylinder that has been filled from the compressed air supply.

Drilling of the pipe is not started until the pressure test has been made successfully. The bore diameter measures 14.5 mm.

After the bore is drilled, the drill is removed and the measurement fitting (tap) can then be closed. After the drill is removed, any residual chippings outside the tap are removed by opening the tap briefly.

5.1.4. Assembly of the PBCOver reverse running protection unit

1 Work surface for 36 mm wrench

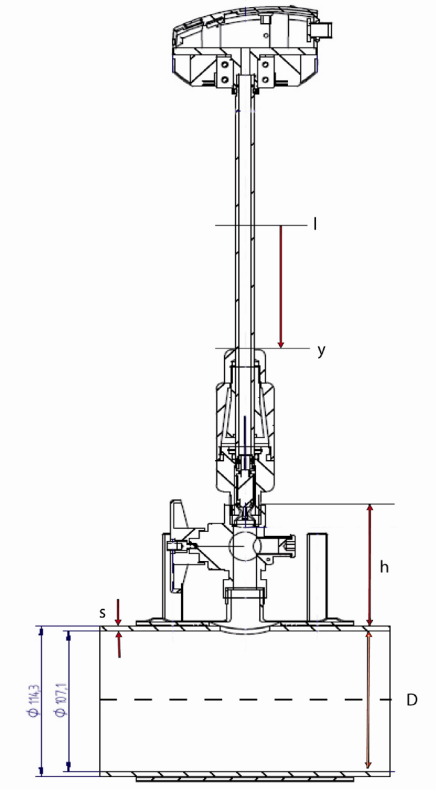
2 ½" thread

1. Seal the PBCOver reverse running protection unit on the ½" thread.
2. Screw into the measurement fitting or tap (use a 36 mm wrench above the thread).
3. Insert the sensor according to the nominal width determined from the scale (see following table or own calculations).

4. Align to the pipeline and note the flow direction (see arrow). Alignment is not made on PBCOver units with alignment protection.
5. After adjusting the sensor, tighten the adjustment screw clockwise by hand.

If the sensor is inserted too deep (points 1 to 3 only), or has to be removed for cleaning, inspection or recalibration:

1. Unscrew the sensor adjustment screw (anti-clockwise).
2. Hold the sensor in place.
3. Press the sensor adjustment screw downwards lightly against the spring force until the reverse running protection yields.
4. Pull the sensor back to the end stop.
5. Close the measurement fitting or tap, loosen the PBCOver using the 36 mm wrench and counterlock the fitting.



Sample formula for DN 100 / stainless steel:

y = top edge of reverse running protection when closed

h = height of edge of measurement fitting or existing tap up to outer wall of pipe (e.g. 95 mm fitting)

s = 3.6 mm

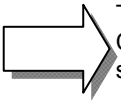
l = D/2 + h [mm] + s [mm] + 120 mm

54 + 95 + 3.6 + 120 mm

≈ 275 mm

The sensor is positioned in the centre of the pipe.

Inch	DN	Wall thickness [mm]	Outer diameter [mm]	Immersion depth [mm]
1 ½"	40	2.60	48.30	241
2"	50	2.90	60.30	247
2 ½"	65	2.90	76.10	255
3"	80	3.20	88.90	261
4"	100	3.60	114.30	275
5"	125	4.00	139.70	289
6"	150	4.50	168.30	303
8"	200	6.30	219.10	328
10"	250	6.30	273.00	355

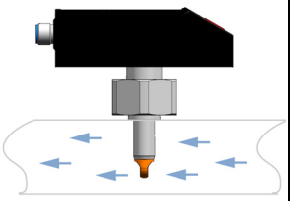
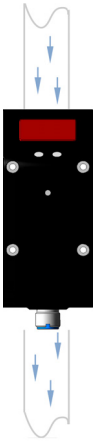
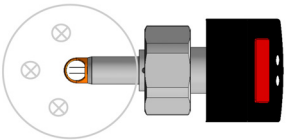


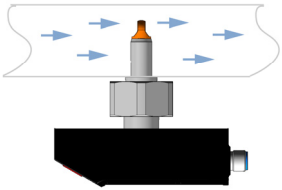
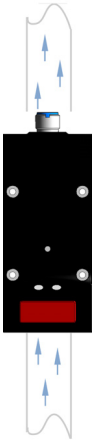
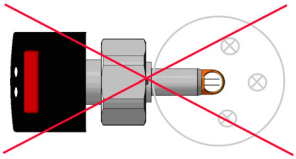
This table applies only to tapping clamps on steel pipes. Check for any deviations in wall thickness when using stainless steel pipes and use the formula accordingly.

5.1.5. Installation position of the sensor

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

Schematic diagram (the arrow shows the direction of flow for the medium):

		
Vertical installation position, direction of flow horizontally to the left, sensor downwards	Horizontal installation position, direction of flow vertically downwards, sensor to the rear	Horizontal installation position, direction of flow horizontally to the rear, sensor to the left (heated sensor element upwards)

		
Vertical installation position, direction of flow horizontally to the right, sensor upwards	Horizontal installation position, direction of flow vertically upwards, sensor to the rear	Horizontal installation position, direction of flow horizontally to the rear, sensor to the right (heated sensor element downwards, problems possible at low flow rates)

Direction of flow

The direction of flow must be taken into account when installing the measurement fitting. This is shown on the tapping clamp by means of an arrow (Compac-Air system). The arrow points in the direction in which the medium in the pipeline flows.

If only the electronic sensor with PBCOver reverse running protection is used, then make sure the sensor display points against the direction of flow.

The sensor must be parallel to the direction of flow. Angular displacement leads to severe measurement errors.

5.2. Electrical connection

The instrument may only be installed by a qualified electrician. Follow the national and international regulations regarding the installation of electro-technical systems. The voltage supply is to be laid out in accordance with EN50178, SELV, PELV. To meet the "limited voltage" requirements according to UL 508, the instrument must be supplied from a galvanically isolated source and protected against short-circuits by means of an overcurrent device.

Four-wire pin assignment (not an accessory)

If the optional connecting cable for electrical isolation is not used, then the following assignments apply.

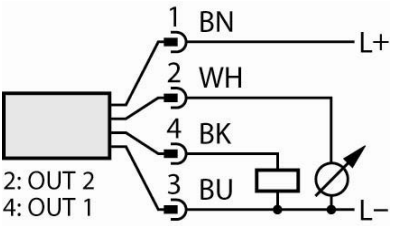
Pin assignment on the connector (M12x1)

Pin no.	Wire colour	Assignment
1	Brown	+L (19 to 30 V DC)
2	White	OUT2
3	Blue	0 V DC (GND)
4	Black	OUT1

1 x pulse output, 1 x analogue output (condition on delivery)

The **OUT1** output is used as a PNP signal output (pulse) and the **OUT2** output is used as an analogue output. This is the configuration in which the sensors are delivered.

Pin assignment on the instrument



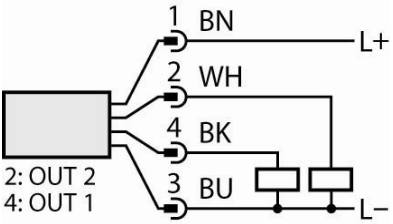
Pin assignment on the cable connector

Pin no.	Wire colour
1	BN (brown)
2	WH (white)
3	BU (blue)
4	BK (black)

2 x pulse output

Both of the available **OUT1**and **OUT2** outputs are each used as a PNP signal output (pulse).

Pin assignment on the instrument



Five-wire pin assignment (accessory)

If the optional connecting cable for electrical isolation is used (☞ Accessories, page 11), then the following assignments apply.

Wire colour	Assignment
Brown	+L (19 to 30 V DC) sensor supply
Pink	+ potential-free pulse output (collector) OUT1
White	- potential-free pulse output (emitter) OUT1
Green	OUT2
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 Ohm
Insulation voltage	5.3 kV
Protected against polarity reversal	Yes

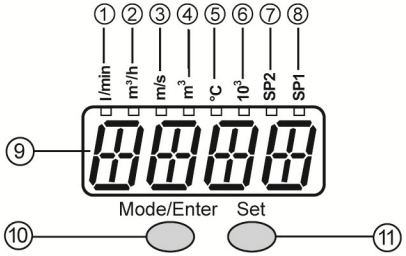
6 Operation

Thermal mass flow sensor

Familiarise yourself with the operation and programming of the sensor. The sensor is calibrated ex factory and provided with default settings for each nominal width. Do not inadvertently change these.

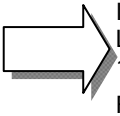
6.1. Operation and display elements

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



Number	Type	Description
1	Green LED	Flow rate [**l/min**]
2	Green LED	Flow rate [**m³/h**]
3	Green LED	Average speed [**m/s**]
4	Green LED	Quantity counter [**m³**]
5	Green LED	Gas temperature [**°C**]
6	Green LED	**10³** = the displayed value must be multiplied by 1000
7	Yellow LED	**SP2** = display of the switch status: LED illuminates when the respective output is switched through
8	Yellow LED	**SP1** = display of the switch status: LED illuminates when the respective output is switched through
9	Four-digit alpha-numeric display	Display of the current volume flow Display of the average speed Display of the current consumption quantity

		Display of the parameters and parameter values
10	MODE / ENTER programming button **[Mode/Enter]**	Selection of the parameters and confirmation of the parameter values
11	SET programming button **[Set]**	Setting the parameter values Changing the display unit in run mode



In general, the following applies as the display value: LED 1 (l/min) x 1000 (LED 6 = 10^3 also illuminated) = 1 m^3/min

From DN 150 upwards, the following applies: LED 2 (m^3/h) display value x 1000 (LED 6 = 10^3 also illuminated) = 10.0 (display value), corresponds to 10,000 m^3/h

6.1.1. Types of operation

Run mode

After switching on the supply voltage, the instrument is in run mode. It carries out its measurement and evaluation functions and provides output signals according to the set parameters.

The display shows the current measurement values and the yellow LEDs show the switch status of the outputs.

The display unit can be temporarily changed (press the **[Set]** button briefly). After 15 seconds, the instrument returns to the display unit that was set in the **UNI** menu item.

The totaliser (consumption quantity counter) periodically (every 10 minutes) stores interim values as well as the amount of time elapsed of the automatic reset. After a drop in voltage, this value is available as the current status of the totaliser (the possible loss of data can amount to a maximum of 10 minutes).

Display mode

Display of the parameters and set parameter values

The instrument is switched to display mode by pressing **[Mode/Enter]** briefly. Internally, it remains operational.

The set parameter values can be read independent of this:

- The parameters are read through by pressing **[Mode/Enter]** briefly.

- The corresponding parameter value is displayed for approximately 15 seconds by pressing **[Set]** briefly. After a further 15 seconds, the instrument returns to run mode.

Programming mode

Setting the parameter values

The instrument is switched to programming mode if a parameter is selected and the **[Set]** button is pressed for longer than 5 seconds (the parameter value flashes, then is continuously increased).

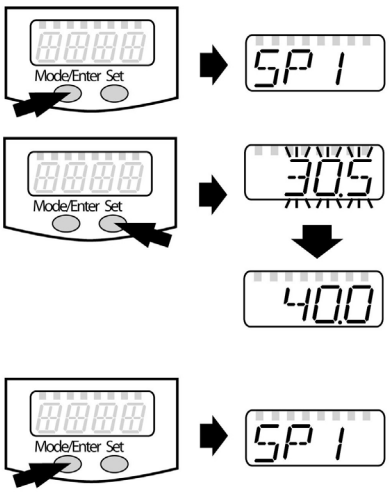
Internally, the instrument also remains operational here.

It continues to carry out its monitoring functions with the existing parameters until the alteration is completed.

You can change the parameter value using **[Set]** and confirm by pressing **[Mode/Enter]**.

The instrument returns to measurement mode if no buttons are pressed for 15 seconds afterwards.

6.1.2. Programming



Press **[Mode/Enter]** until the desired parameter appears in the display.

Press and hold **[Set]**. The current parameter value **flashes** for 5 seconds.

It is then increased[4] (in steps by pressing once or continuously by pressing and holding the button).

Press **[Mode/Enter]** briefly (confirmation). The parameter is displayed again and the new parameter value applies.

[4] Lowering the value: Allow the display to run through to the maximum setting value. After this, the run-through starts again from the minimum setting value.

Changing further parameters:	Start again with step 1.
Ending programming:	Wait for 15 seconds or press **[Mode/Enter]** until the current measurement value appears again.

Set the display unit (**Uni**) before you set the values for the **SPx**, **rPx**, **ASP** and **AEP** parameters. In this way, rounding up/down errors are avoided during the internal conversion into other units and the exact values required are provided. Condition at delivery: **Uni = nm3h**.

If no button is pressed for 15 seconds during the setting process, the instrument returns to the run mode with unchanged values.

The instrument can be electronically locked so that unintentional false entries are avoided: Press both programming buttons in run mode until Loc is displayed.

To unlock, press the buttons until uLoc is displayed.

Condition at delivery: Not locked.

When the instrument is locked, Loc is shown briefly in the display if an attempt is made to change the parameter values.

6.1.3. Adjustable parameters

Representation in display	Description
SP1 **SP2**	Switch point 1/2 Upper limit value at which the output changes its switch status. **SP 2** is only active when **OU2** = **Hno**, **Hnc**, **Fno** or **Fnc.**
rP1 **rP2**	Return switch point 1/2 Lower limit value at which the output changes its switch status. **rPx** is always smaller than **SPx**. Values can only be entered which are lower than **SPx**. When the switch point is changed, the return switch point changes with it (the interval between **SPx** and **rPx** remains constant). If the interval is larger than the new switch point, then it is reduced automatically (**rPx** is set to the minimum setting value). **rP2** is only active when **OU2** = **Hno**, **Hnc**, **Fno** or **Fnc**.

ImPS	Output 1 as pulse output **ImPS** is only active when **OU1** = **ImP**.
ImPR	Configuring quantity monitoring through pulse output Select **ImPR** and set to **YES**. Pulse repetition is active. Output 1 emits a counting pulse each time the value set in **ImPS** is reached. Configure the quantity monitoring using the preset counter. Select **ImPR** and set to **NO**. Pulse repetition is not active. The output switches ON when the value set in **ImPS** is reached. It remains switched until the counter is reset. For further details ☞ Setting the preset counter / pulse value (ImPS), page 36.
OU1	Configuration for output 1 5 functions can be set: **Hno** = Hysteresis function / normally open (NO) **Hnc** = Hysteresis function / normally closed (NC) **Fno** = Window function / normally open (NO) **Fnc** = Window function / normally closed (NC) Output signal for consumption quantity: **ImP** = Pulse output
OU2	Configuration for output 2 6 functions can be set: Output signals for flow measurement: **Hno** = Hysteresis function / normally open (NO) **Hnc** = Hysteresis function / normally closed (NC) **Fno** = Window function / normally open (NO) **Fnc** = Window function / normally closed (NC) **I** = Analogue signal (4 to 20 mA)
	Alternatively: Configure output 2 (pin 2) as an input for an external reset signal. Setting: **OU2** = **InD**
ASP	Analogue starting point Measurement value at which 4 mA is output. **ASP** is only active when **OU2** = **I**.

AEP	Analogue end point Measurement value at which 20 mA is output. Minimum distance between **ASP** and **AEP** = 25 % of the final measuring range value. **AEP** is only active when **OU2** = **I**.
EF	Extended functions This menu point contains a submenu with further parameters. To access these parameters, briefly press the **[Set]** button.
HI **LO**	Min/max flow memory **HI**: Display of the highest flow value measured **LO**: Display of the lowest flow value measured Clearing the memory: Press **[Mode/Enter]** until **HI** or **LO** appears. Press **[Set]** and hold it until **- - - -** appears. Now press **[Mode/Enter]** briefly. It is a good idea to clear the memory as soon as the instrument is used for the first time under normal working conditions.
diA	Display of the inner pipeline diameter Setting is only possible in the **EF2** submenu. This may be locked in the event of parameterised (non-manipulable) sensors.
FOU1 **FOU2**	Behaviour of output 1 in the event of an internal error Behaviour of output 2 in the event of an internal error
dAP	Measurement value damping / damping constant in seconds
rTo	Resetting the quantity counter After a set period of time, the counter is automatically cleared and a new counting interval begins. The following time spans can be set: 1h to 23h (reset after 1 to 23 hours) 1d to 6d (reset after 1 to 6 days) 1w to 8w (reset after 1 to 8 weeks) Additionally: **OFF** = reset after counter overflow (32 bit number overflow, i.e. overflow at 4,294,967.295 Nm³).

	rES.T = manual reset: The counter is manually cleared and a new counting interval begins: Press **[Set]** until **rES.T** appears. Now press **[Mode/Enter]** briefly. A manual reset can also be carried out when a time period for an automatic reset has been set.
diS	Setting the display 7 settings can be selected: **d1** = update of measurement value every 50 ms **d2** = update of measurement value every 200 ms **d3** = update of measurement value every 600 ms The measurement value update affects only the display. It has no effect on the outputs. **rd1**, **rd2**, **rd3** = display as with d1, d2, d3, but rotated by 180° **OFF** = display of the measurement value switched off in run mode. By pressing one of the buttons, the current measurement value is displayed for 15 seconds. Pressing the **[Mode/Enter]** button again opens the display mode. The LEDs also remain active when the display is switched off.
Uni	Display unit 3 settings can be selected: **nm3m** = flow in m³/min **nm3h** = flow in Nm³/h or Nm³/h x 1000 **nm3** = quantity counter in standard cubic metres Set the display unit before you set the values for the **SPx**, **rPx**, **ASP** and **AEP** parameters. In this way, rounding up/down errors are avoided during the internal conversion into other units and the exact values required are provided.
SELd	Standard measurement parameter on display Flow value, counter reading or medium temperature

SEL2	Standard measurement parameter for evaluation using output 2: • Limit value signal or analogue signal for flow • Limit value signal or analogue signal for temperature
rEF.P	Standard pressure; measurement and display values for flow correspond to this value. Select **rEF.P** and set the desired standard pressure: Adjustment range: 500 to 1500 hPa in 1 hPa increments
rEF.T	Standard temperature; measurement and display values for flow correspond to this value. Select **rEF.T** and set the desired standard temperature: Adjustment range: 0 to 50 °C in 1 °C increments
LFC	Low flow cut-off Select **LFC** and set the limit value: Adjustment range: 2 to 13 m³/min in 1 m³/min increments
rES	Reset to factory settings It is recommended to note down the individual settings before carrying out this function. Select **rES**. Press **[Set]** and hold it down until **----** is displayed. Press **[Mode/Enter]** briefly.
CGA	Setting a scale factor Select **CGA** and set the desired scale (proportional) factor: Adjustment range: 50 to 150 % in 1 % increments
CAr	Reset to factory settings for the scale factor It is recommended to note down the individual settings before carrying out this function. Select **CAr**. Press **[Set]** and hold it down until **----** is displayed. Press **[Mode/Enter]** briefly.
diA	Setting the inner pipe diameter Select **dIA** and set the desired inner diameter for the nominal width. Adjustment range: 32 to 250 mm in 2 mm increments

6.1.4. Setting the preset counter / pulse value (ImPS)

The instrument has seven adjustment ranges:

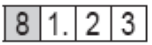
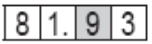
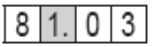
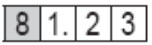
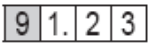
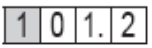
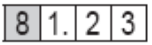
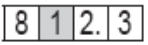
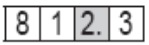
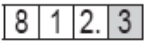
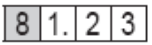
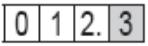
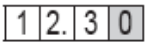
	LED	Display	Value	Resolution
1	④	0.001 ... 9.999	0.001 to 9999 Nm³	0.001 Nm³
2	④	10.00 ... 99.99	10.00 to 99.99 Nm³	0.01 Nm³
3	④	100.0 ... 999.9	100.0 to 999.9 Nm³	0.1 Nm³
4	④	1000 ... 9999	1000 to 9999 Nm³	1 Nm³
5	④	10.00 ... 99.99	10000 to 99990 Nm³	10 Nm³
6	④	100.0 ... 999.9	100000 to 999900 Nm³	100 Nm³
7	④	1000	1000000 Nm³	

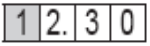
Setting procedure: ④ Set **OU1** to **ImP**.

- Press **[Mode/Enter]** until **ImPS** is displayed.
- Press and hold **[Set]**.
- The current numerical value flashes for 5 seconds, then the first digit is active (digit flashes, can be changed).
- Set the desired value as specified in the following table.
- First select the desired adjustment range (1, 2, 3 etc.).
- Enter the number from left (first digit) to right (fourth digit).
- Press **[Mode/ Enter]** briefly when all four digits are set.

As soon as the first digit flashes, there are three options (flashes on grey background):

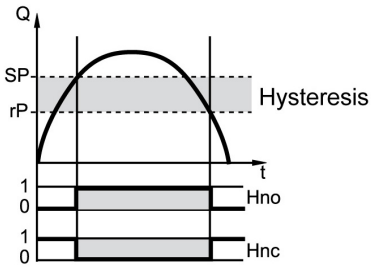
Press **[Set]** briefly once each time.	The flashing digit is increased. 0 is displayed after 9.
	8 1.2 3
[Set] pressed once	9 1.2 3
[Set] pressed once	0 1.2 3
[Set] pressed once	1 1.2 3

Press and hold **[Set]**.	The flashing digit is increased. 0 is displayed after 9 and the next digit to the left is active.  **[Set]** held down  **[Set]** still held down 
	If digit 1 is changed in this way, then the display changes to the next highest adjustment range. 10 is displayed after 9, the decimal point is moved one space to the right or the LED display changes.  **[Set]** held down  **[Set]** still held down 
Wait for 3 seconds (no buttons pressed).	The next digit to the right flashes (now active).  No button pressed, after 3 seconds  After 3 seconds  After 3 seconds 
	If the fourth digit flashes for 3 seconds without changing, then digit 1 is active when it is > 0. After 3 seconds 
	If digit 1 is "0", then the display changes to the next lowest adjustment range. The decimal point is moved one space to the left or the LED display changes.  After 3 seconds 

	Continue: Change digit 4 or wait for 3 seconds and set digit 1. After 3 seconds 

If **[Set]** is pressed down continuously, the display runs through all ranges and goes back to the start value when it reaches the end. Release **[Set]** briefly and start the setting again.

Hysteresis function (marked in grey in the figure)



The hysteresis keeps the switch status of the output stable if the flow fluctuates around the nominal value.

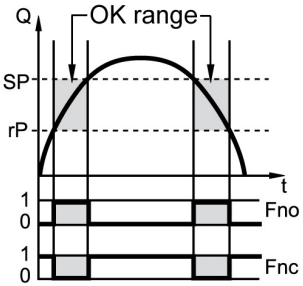
With increasing flow, the output switches upon reaching the switch point (**SPx**).

If the flow decreases again, the output only switches back when the return switch point (**rPx**) is reached.

The hysteresis is adjustable:

First the switch point is determined, then the return switch point at the desired distance.

Window function



The window function allows a defined OK range to be monitored.

If the flow fluctuates between switch point (**SPx**) and return switch point (**rPx**), the output is switched through (window function/NO contact) or opened (window function/NC contact).

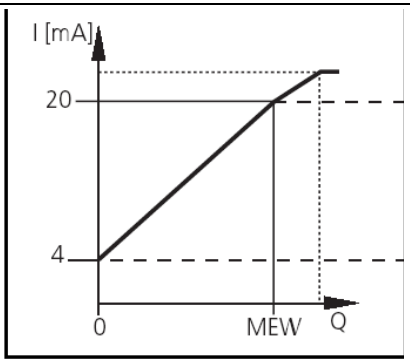
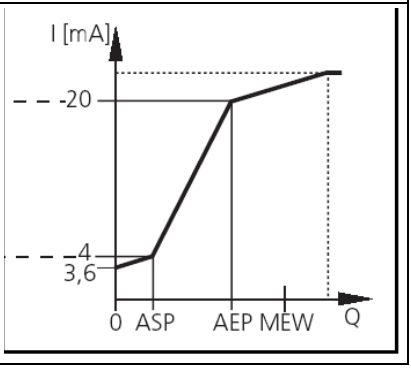
The size of the window is adjustable by the distance between **SPx** and rPx.

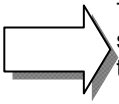
SPx = upper value; **rPx** = lower value.

Scaling the measuring range

- With the analogue starting point parameter (**ASP**), you determine at which measurement value the output signal is 4 mA.
- With the analogue end point parameter (**AEP**), you determine at which measurement value the output signal is 20 mA.

Minimum distance between **ASP** and **AEP** = 25 % of the final measuring range value (**MEW**).

Factory setting	Scaled measuring range
	

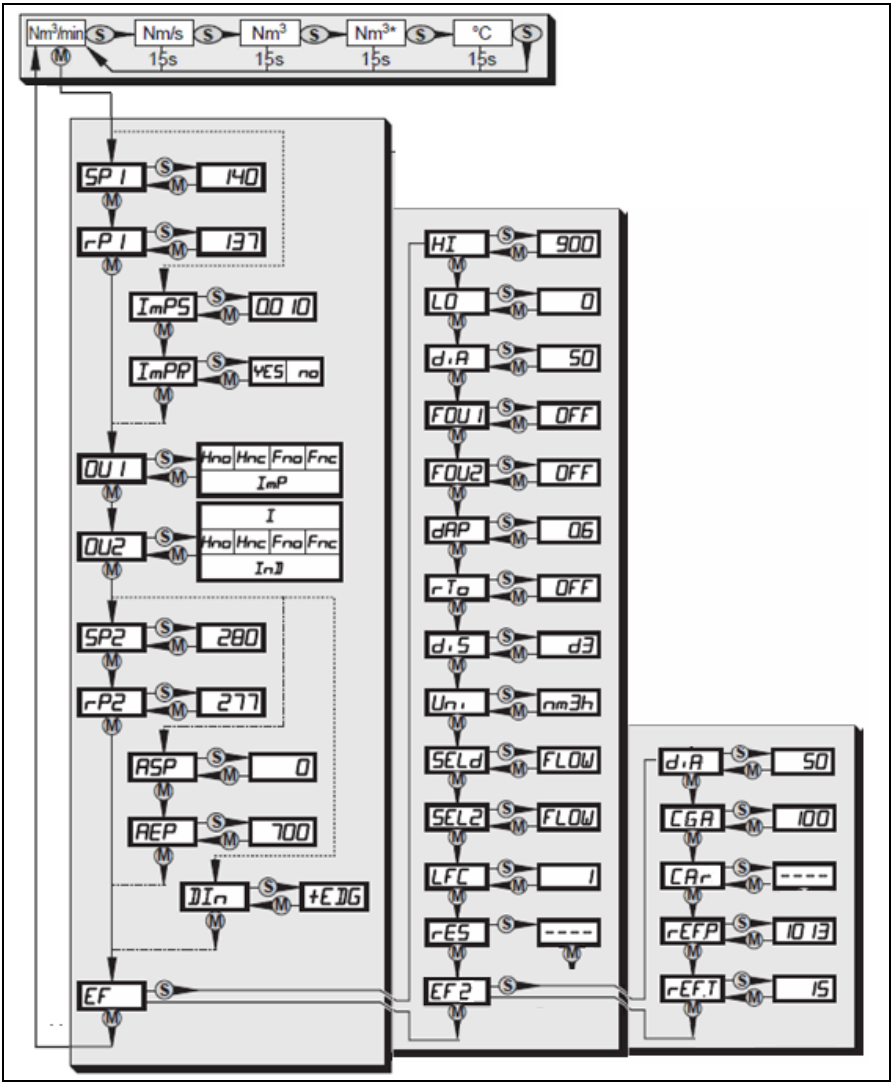


The analogue end point (AEP) varies according to the selected parameters (inner diameter, standard temperature, standard pressure and scale factor).

The output signal is between 4 and 20 mA in the set measuring range. Further signals are:

- Flow above the measuring range: Output signal > 20 mA
- Flow below the measuring range: Output signal between 3.6 and 4 mA.

6.1.5. Menu overview



7 Cleaning the sensor

You must clean the sensor:

- Before each calibration/inspection
- Regularly during operation

You can remove the sensor and clean it manually.

- Only clean the sensor with approved cleaning agents.
- Do not use any abrasive cleaning agents. These can lead to irreparable damages to the sensor.
- Carry out a new inspection after cleaning, as required.

7.1. Cleaning agents

For cleaning the sensor, use agents containing surfactants (alkaline) or water-soluble organic solvents (e.g. ethanol).

Isopropanol is recommended for cleaning various contamination, especially greases and oils.

7.2. Calibration

Because of contamination (e.g. oil, water, particles), an annual recalibration of the sensor is recommended, and one must take place at least every 24 months. This is mandatory for accounting purposes.

8 Troubleshooting

8.1. Replacing damaged parts

Damages to the compressed air counter that affect the pressure integrity may only be remedied by authorised personnel.

After each repair, the technical data of the specifications must be checked by authorised personal, e.g. pressure test.

Replace all other damaged parts immediately. Contact your supplier for more details on ordering.

8.2. Replacing O-rings and seal rings

- Keep the sealing surfaces clean
- Remove any encrusted residues from time to time
- In the event of leakage, contact your supplier

Danger of the medium escaping!

Replacement of the seals may only be performed by authorised personnel.

8.3. Error messages

These error messages are shown even when the display is switched off.

Display	Explanation
OL	**Recording range exceeded** (Flow > 120 % of the final measuring range value)
SC 1	**Flashing**: Short-circuit in switch output 1[5]
SC 2	**Flashing**: Short-circuit in switch output 2[5]
SC	**Flashing**: Short-circuit in both switch outputs[5]
Err	**Flashing**: Malfunction in probe

[5] The affected output is switched off as long as the short-circuit lasts.