

## Instruction and operation manual

# S 430

## Pitot tube flow sensor



Dear Customer,

thank you for choosing our product.

The operating instructions must be read in full and carefully observed before starting up the device. The manufacturer cannot be held liable for any damage which occurs as a result of non-observance or non-compliance with this manual.

Should the device be tampered with in any manner other than a procedure which is described and specified in the manual, the warranty is cancelled and the manufacturer is exempt from liability.

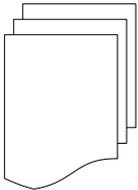
The device is destined exclusively for the described application.

CS-iTEC offers no guarantee for the suitability for any other purpose. CS-iTEC is also not liable for consequential damage resulting from the delivery, capability or use of this device.

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## 1. Safety instructions



**Please check if this instruction manual accords to the product type.**

Please observe all notes and instructions indicated in this manual. It contains essential information which have to be observed before and during installation, operation and maintenance. Therefore this instruction manual has to be read carefully by the technician as well as by the responsible user / qualified personnel.

This instruction manual has to be available at the operation site of the flow sensor at any time. In case of any obscurities or questions, regarding this manual or the product, please contact the manufacturer.

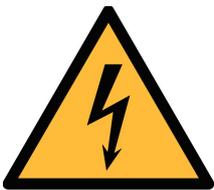


### **WARNING!**

#### **Compressed air!**

**Any contact with quickly escaping air or bursting parts of the compressed air system can lead to serious injuries or even death!**

- Do not exceed the maximum permitted pressure range (see sensors label).
- Only use pressure tight installation material.
- Avoid that persons get hit escaping air or bursting parts of the instrument.
- The system must be pressureless during maintenance work.



### **WARNING!**

#### **Voltage used for supply!**

**Any contact with energized parts of the product, may lead to a electrical shock which can lead to serious injuries or even death!**

- Consider all regulations for electrical installations.
- The system must be disconnected from any power supply during maintenance work.
- Any electrical work on the system is only allowed by authorized qualified personal.

**WARNING!****Permitted operating parameters!**

**Observe the permitted operating parameters, any operation exceeding this parameters can lead to malfunctions and may lead to damage on the instrument or the system.**

- Do not exceed the permitted operating parameters.
- Make sure the product is operated in its permitted limitations.
- Do not exceed or undercut the permitted storage and operation temperature and pressure.
- The product should be maintained and calibrated frequently, at least annually.

**General safety instructions**

- It is not allowed to use the product in explosive areas.
- Please observe the national regulations before/during installation and operation.

**Remarks**

- It is not allowed to disassemble the product.
- Always use spanner to mount the product properly.

**ATTENTION!****Measurement values can be affected by malfunction!**

**The product must be installed properly and frequently maintained, otherwise it may lead to wrong measurement values, which can lead to wrong results.**

- Always observe the direction of the flow when installing the sensor. The direction is indicated on the housing.
- Do not exceed the maximum operation temperature at the sensors tip.
- Avoid condensation on the sensor element as this will affect the accuracy enormously.

**Storage and transportation**

- Make sure that the transportation temperature of the sensor without display is between -30°C... 70°C and with display between

-10°C... 60°C.

- For transportation it is recommended to use the packaging which comes with the sensor.
- Please make sure that the storage temperature of the sensor is between -10°C... 50°C.
- Avoid direct UV and solar radiation during storage.
- For the storage the humidity has to be <90%, no condensation.

## 2. Application

The S 430 is a flow sensor which is designed to measure the consumption of compressed air and gases in wet air or high mass flow / velocity applications. The sensor can measure in wet and dirty gases as occurring, for example, at the outlet of a compressor.

The S 430 can measure the following values:

- Velocity of the compressed air or gas.
- Volume flow of the compressed air or gas.
- Total consumption of the compressed air or gas.
- Pressure and Temperature of the compressed air or gas.

The default factory settings are: Velocity in m/s, Volume flow in m<sup>3</sup>/h and Total Consumption in m<sup>3</sup>, pressure in bar, temperature in °C. Other units can be programmed by the optional display or the service kit.

The S 430 flow sensor is not developed to be used in explosive areas. For the use in explosive areas please contact the manufacturer.

The S 430 flow sensor is mainly used in compressed air systems in industrial environment.

## 3. Features

- Flow and consumption measurement in wet air or high mass flow / velocity applications.
- Measurement at compressor outlet possible.
- Insertion type flow sensor for easy installations under pressure through a ball valve.
- High temperature application up to 200°C.
- Tube diameters from 1" up to 10", larger diameters on request.
- No mechanical wear parts.
- All parts which are in contact with the medium are made of stainless steel.
- Optional display directly on the sensor, showing velocity, volume flow and consumption, temperature, pressure.

## 4. Technical Data

### 4.1 General

<b>CE</b>	
Parameters	Standard unit flow: m <sup>3</sup> /h other units: m <sup>3</sup> /min, l/min, cfm, kg/h, kg/min, kg/s Standard unit velocity: m/s Standard unit temperature: °C Standard unit pressure: bar
Reference conditions	ISO1217 20°C 1000 mbar (Standard-Unit) DIN1343 0°C 1013,25 mbar (Norm-Unit)
Principle of measurement	Pitot tube
Sensor	Differential pressure sensor
Measuring medium	Air, gas (non corrosive gas), steam
Operating temperature	-40... 200°C probe tube -30... 70°C housing 0... 50°C display (optional)
Humidity of the meas. medium	< 90%, no condensation
Operating pressure	0... 1.6 MPa
Housing material	PC + ABS
Material of the probe tube, sensor head and the screwing	Stainless steel 1.4404
Protection class	IP65
Dimensions	See dimensional drawing on chapter 5
Display (optional)	2.4" colour graphics display with keypad (optional)
Tube diameter	1" to 10" (bigger diameters on request)
Screwing thread	G1/2" (ISO 228/1)
Weight	1.10 kg

## 4.2 Electrical Data

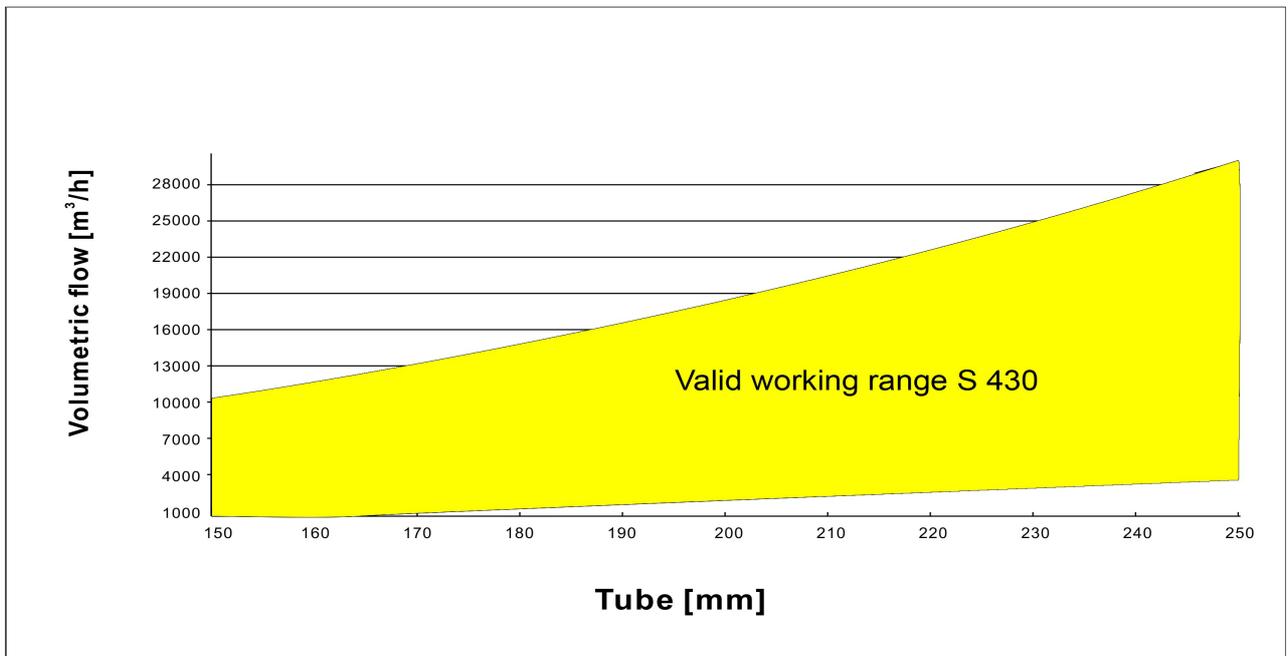
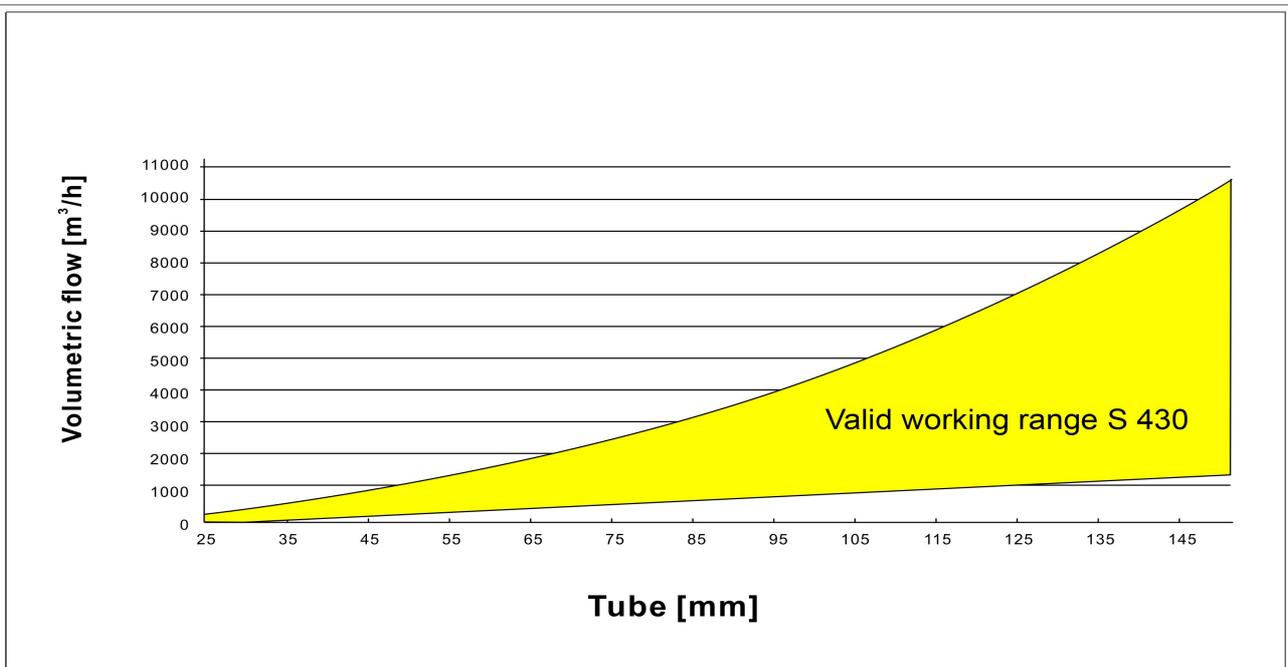
Power supply	24 VDC, 150 mA
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## 4.3 Output-Signals

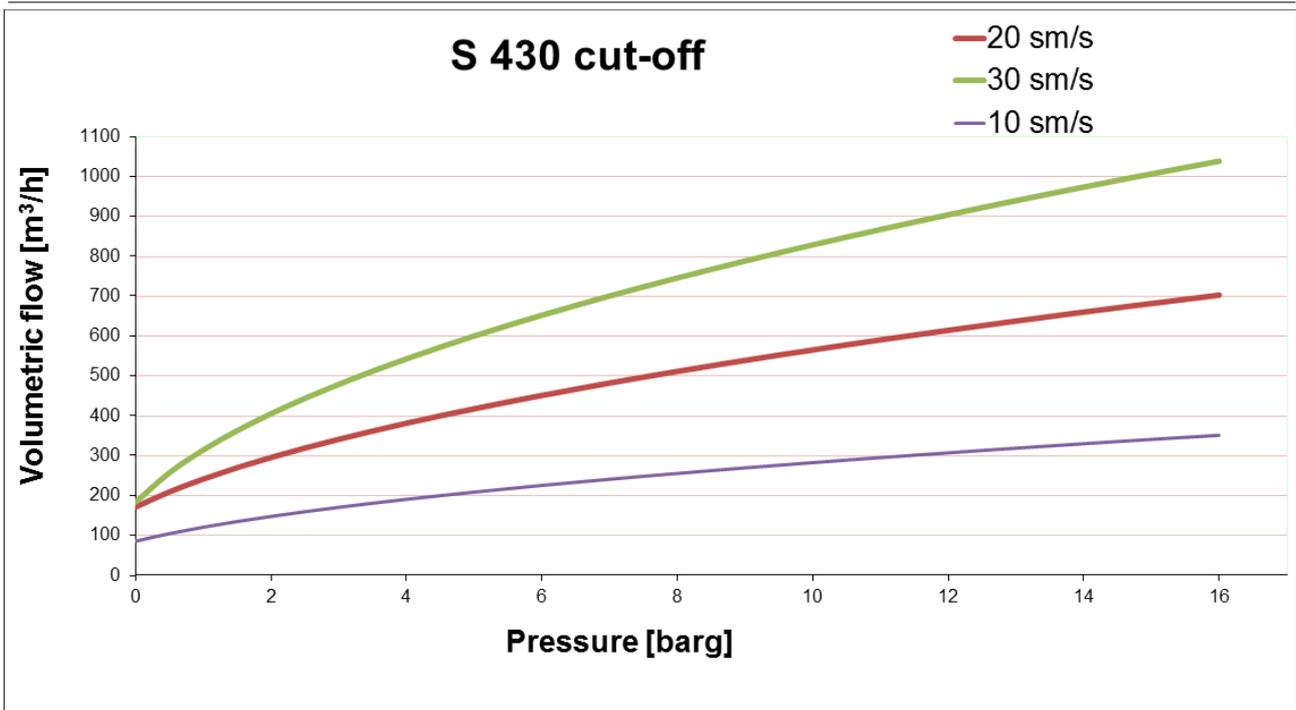
Analog output	Signal: 4... 20 mA Scaling: 0 to max. volume flow / velocity Accuracy: 0.06 mA
Pulse output	1 pulse per m <sup>3</sup> , isolated switch, max. 30 VDC, 200 mA (active signal) (pulse length: 30... 120 ms, depends on flow rate)
Modbus output (default setting)	See chapter 9.4
M-Bus output (default setting)	See chapter 9.5

## 4.4 Accuracy

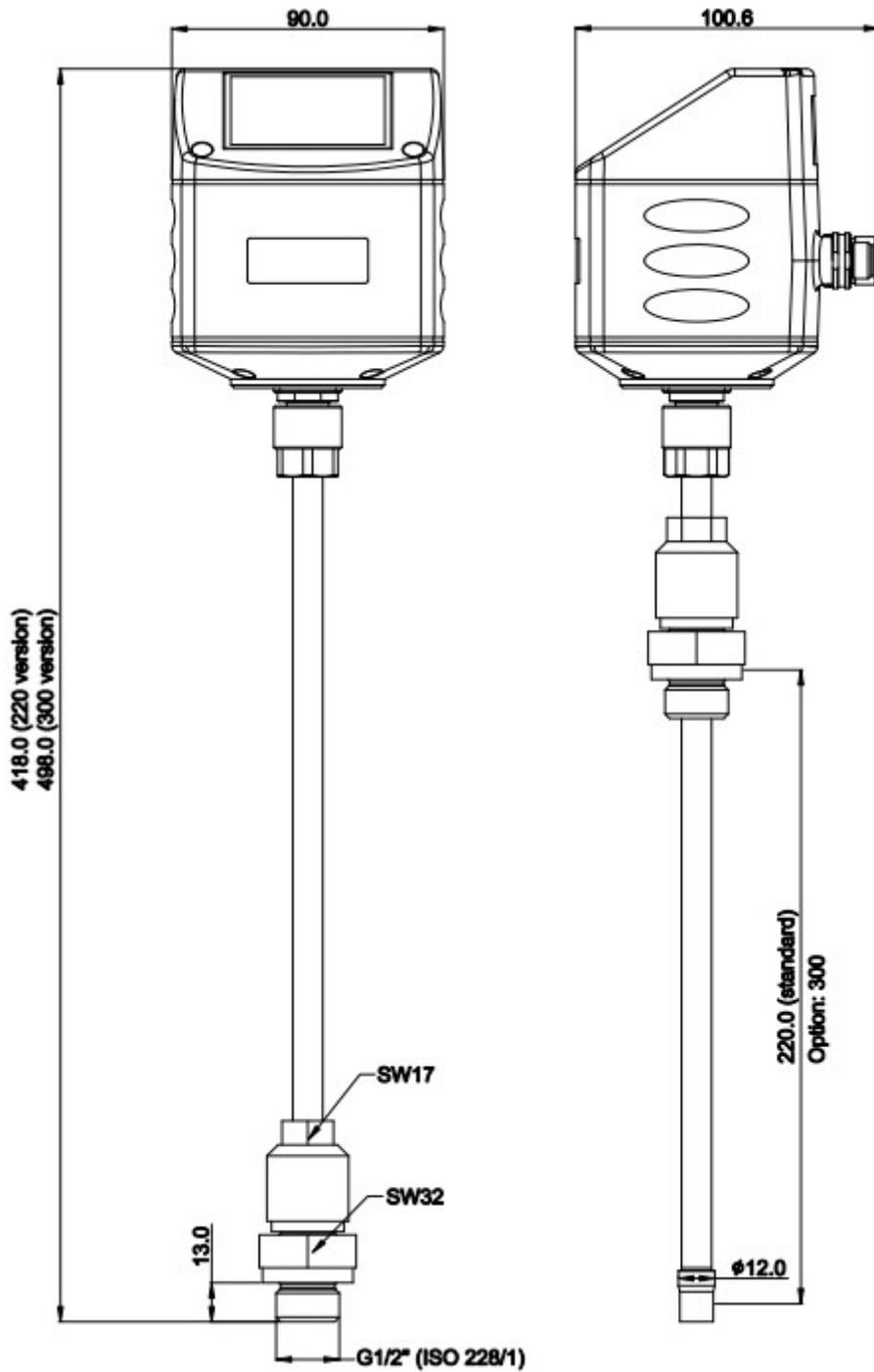
Accuracy	Flow: $\pm(1.5\%$ of reading+0.3% full scale) Pressure: 0.5% FS Temperature: 0.5°C
Stated accuracy at	Ambient/process temperature 23°C $\pm$ 3°C Ambient/process humidity <90% Process pressure at 0.6 MPa
<p>Working range: Flow range for air at 6 barg, 50°C and 90% humidity. For other gas and condition please see appendix or download flow range software from the homepage of the manufacturer.</p>	



Cut-off flow of S 430 is pressure depending. Following chart shows the relationship at tube of 100 mm, 50°C and 90% humidity. For other tube and conditions please download "Flow range" software from the homepage of the manufacturer.



### 5. Dimensional drawing



## 6. Determination of the installation point

In order to maintain the accuracy stated in the technical data, the sensor must be inserted in the centre of a straight pipe section with unhindered flow characteristics.

### Remark

If the pipe diameter is higher than the maximum shaft length, it is possible to install the sensor out of centre of the pipe. For this please contact the manufacturer.

Unhindered flow characteristics are achieved if the section in front of the sensor (inlet) and behind the sensor (outlet) are sufficiently long, absolutely straight and free of obstructions such as edges, seams, curves etc..

Please consider that enough space exists at your site for an adequate installation as described in this manual.



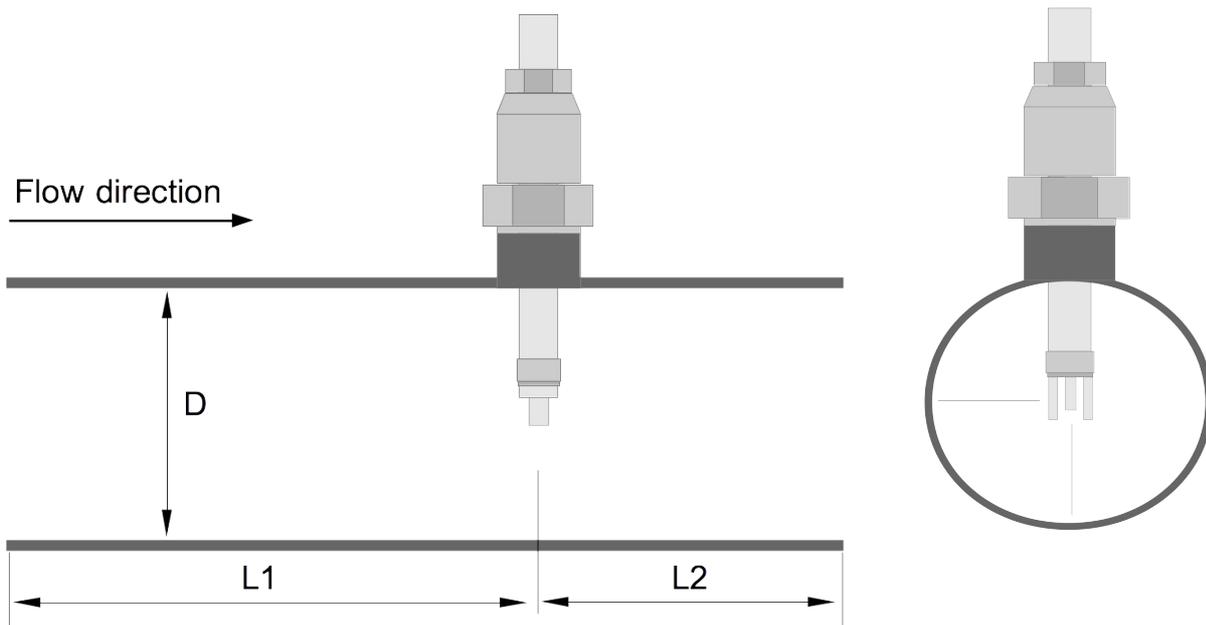
### ATTENTION!

**Wrong measurement is possible, if the sensor is not installed correctly.**

- Careful attention must be paid to the design of the inlet and outlet section. Obstructions can cause counter-flow turbulence as well as turbulence in the direction of the flow.
- The sensor is for indoor use only! At an outdoor installation, the sensor must be protected from solar radiation and rain.

<p>Tube</p> <p>recommended</p> <p>recommended</p> <p>10°</p> <p>not recommended</p>	<p>Please install the sensor only in the recommended area like you can see in the picture. A horizontal installation is not permitted. Please consider that the distance to the horizontal level must be <math>&gt;10^\circ</math>.</p>
<p>20°</p>	<p>Sideling install with 20 degree, use 3/4" nipple and ball valve.</p>

## 7. Inlet and Outlet section



L1 : Length of inlet section

L2 : Length of outlet section

D : Diameter of tube

The following table shows the necessary equalizing sections in relation to existing obstructions. It gives the respective values which are required. It must consider that if its not possible to observe the indicated equalizing sections deviations in measuring results must be expected.

Flow obstructions before the measurement section	Min. length inlet (L1)	Min. length outlet (L2)
Slight curve (bend <math><90^{\circ}</math>)	12 x D	5 x D
Reduction (Tube narrows towards measurement section)	15 x D	5 x D
Expansion (Tube expands towards measurement section)	15 x D	5 x D
90° bend or T piece	15 x D	5 x D
2 x 90° bends on one level	20 x D	5 x D
2 x 90° bends 3 dimensional change of direction	35 X D	5 x D

Shut-off valve	45 x D	5 x D
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## 8. Sensor Installation

Before installing the sensor, please make sure that all components listed below are included in your package.

Qty	Description	Item No.
1	S 430 Sensor	S695 4300
1	Sealing ring	No P/N
1	Alignment key	No P/N
2	M12 plug	C219 0059
1	Instruction manual	No P/N
1	Calibration certificate	No P/N

### 8.1 Installation Requirements

To install the sensor a ball valve or a nozzle is needed.

- The inner thread has to be G 1/2".
- The diameter of the hole must be  $\geq 13\text{mm}$ , otherwise the shaft can not be inserted.

### 8.2 Installation Procedure

The following steps explain the procedure of an appropriate installation.

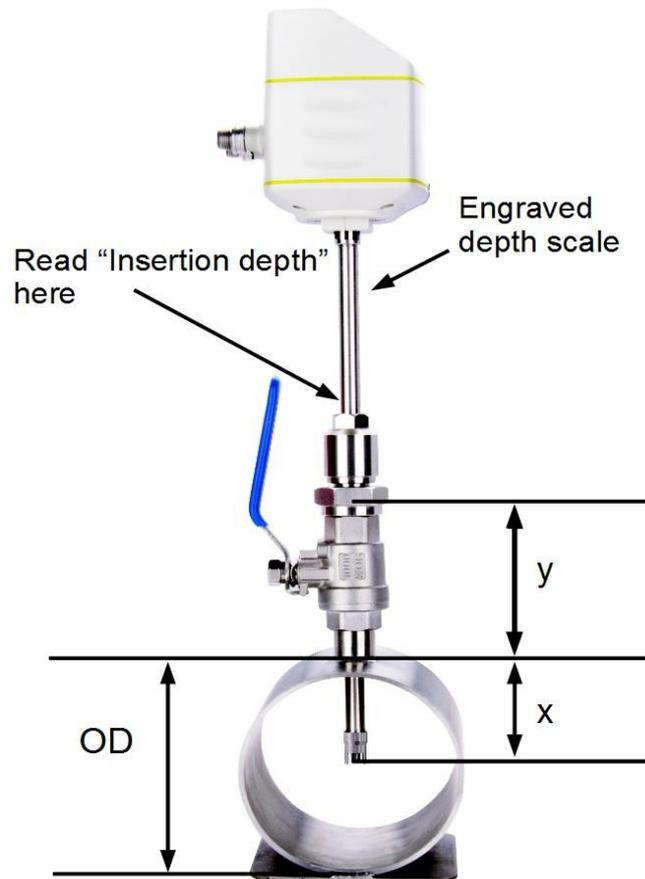
#### Determination of the insertion depth of the sensor

The sensor tip has to be placed in the centre of the pipe. For this the probe shaft has a scale. To determine the right position please calculate the insertion depth like described below.

#### Remark

If the pipe diameter is higher than the maximum shaft length, it is possible to install the sensor out of centre of the pipe. For this please contact the manufacturer.

## Center installation



**Insertion depth** =  $x + y$

$x = \frac{OD}{2}$ ;  $OD$  = Outer diameter of pipe

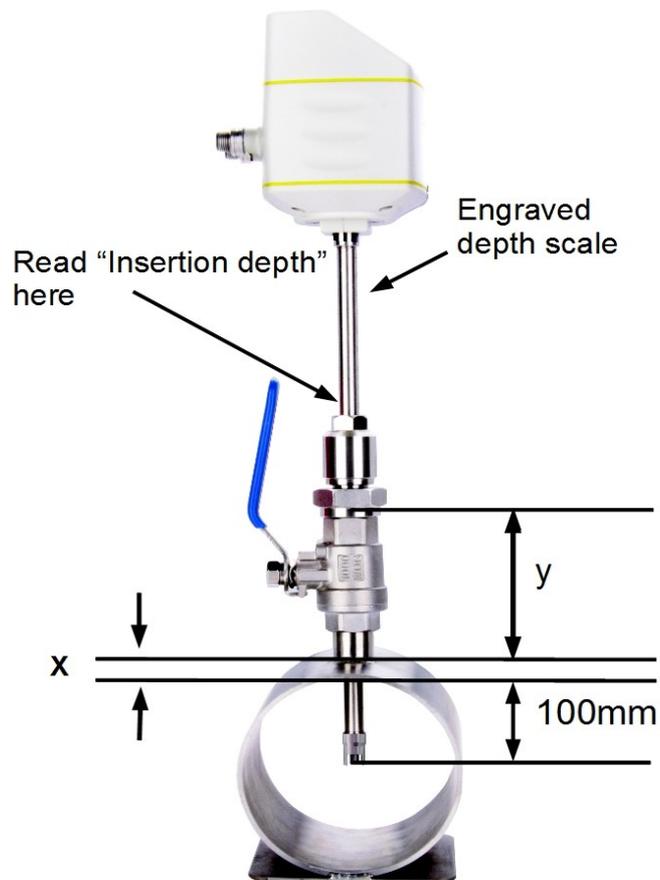
Example for a 2" pipe and a 87 mm ball valve:

$y = 87 \text{ mm}$ ;  $OD = 60.3 \text{ mm}$

$x = \frac{OD}{2} = \frac{60.3 \text{ mm}}{2} = 30.15 \text{ mm}$

**Insertion depth** =  $30.15 \text{ mm} + 87 \text{ mm} = 117.15 \text{ mm}$

## Non-center installation



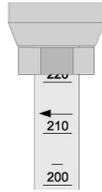
**Insertion depth** =  $x + y + 100$   
 $x$  is the wall thickness of pipes

Example for a 12" pipe, the wall thickness of pipes 9 mm and a 87 mm ball valve:

$x = 9 \text{ mm}$  ;  $y = 87 \text{ mm}$

**Insertion depth** =  $9 \text{ mm} + 87 \text{ mm} + 100 \text{ mm} = 196 \text{ mm}$

## Installation of the sensor



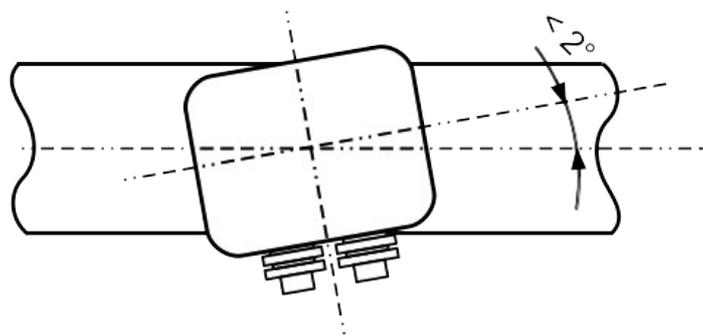
First please observe the flow direction indicated on the housing or on the shaft. It must match the flow direction of the compressed air or gas.

1. Ball valve has to be closed.
2. The sensor head has to be completely covered by the connection thread (see photo on the left).
3. Underlay the "O-ring" at the thread of the ball valve before screwing the flow sensor.
4. Screw the connection thread tightly to the ball valve and align flow sensor to flow direction.
5. Open ball valve and tighten clamp sleeve manually by hand.
6. Perform **zero flow calibration** (see picture on P21).
7. Move flow sensor slightly to the determined insertion depth by means of the scale.
8. Tighten the clamp sleeve at the connection thread so that the flow sensor can not longer be moved by the pressure in the pipe, however it should be possible to move the sensor shaft manually.
9. With the aid of the alignment key make sure that the actual flow direction is same as the arrow shows (the angle deviation should not be larger than  $\pm 2^\circ$  to the perfect position, please see picture on the next page).

10. Tighten clamp sleeve with clamping torque 20...30 Nm.

11. During the final check control the installation depth again because sometimes the shaft is moved from its original position due the compressed air.

Maximum angle deviation of a proper installation:



### Removal of the flow sensor

1. Hold the flow sensor.
2. Release the clamp sleeve at the connection thread.
3. Pull out the shaft slowly until the value "10" can be read at the scale.
4. Close the ball valve.
5. Release the connection thread and unscrew the flow sensor.

### Zero flow calibration:

**⚠ ATTENTION!**  
To achieve the best accuracy, we recommend to perform a zero calibration of the sensor before every installation. Please follow these steps:

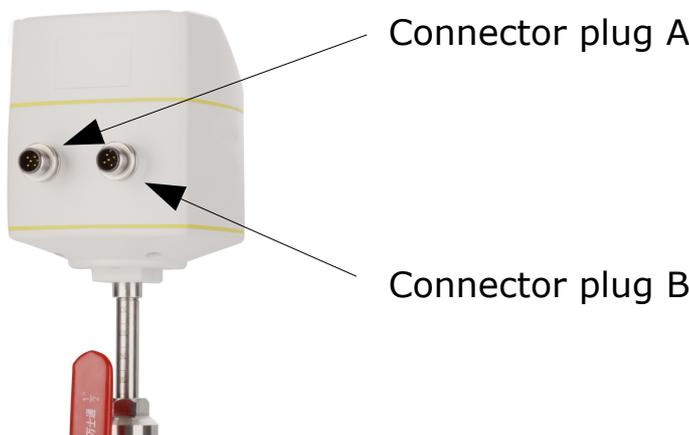
1. Mount the sensor **onto the ball valve and align the sensor** parallel to the pipe and the green arrow must point to the flow direction
2. Open the ball valve, but **do not insert** the sensor into the pipe
3. The calibration can be done using the **mobile app**, the **service kit** or by using the **integrated display**. If you are using the integrated display, please proceed as follows:

Read more on back side →

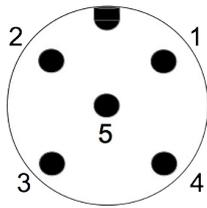
4. Press key for 3 seconds and enter unlock code "12"
5. Select **"Zero Flow Calibration"** in the menu and follow the instructions
6. After these steps the sensor is ready to be inserted into the pipe

### 8.3 Electrical connection

The flow sensor is equipped with two connector plugs "A" and "B". The cables are connected to the sensor through the M12 connector.



**Connection pins connector plug M12**



Connection pins  
(view from the clamping side)

**Pin assignment connector plug M12**

Output Version	Connector	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
Modbus	A	SDI	-VB	+VB	NC	NC
	B	GND	-VB	+VB	+D	-D
Pulse and analog	A	SDI	-VB	+VB	NC	NC
	B	NC	SW	SW	+I	-I
M-Bus	A	SDI	-VB	+VB	NC	NC
	B	NC	-VB	+VB	M	M
Wire colour		brown	white	blue	black	grey

**Legend to pin assignment**

- GND: Ground for Modbus
- SDI: Digital signal (internal use)
- VB: Negative supply voltage
- +VB: Positive supply voltage
- +I: Positive 4...20 mA signal
- I: Negative 4... 20 mA signal
- SW: Isolated pulse switch input/output
- D+: Modbus data +
- D-: Modbus data -
- M: M-Bus data
- NC: Not connected



**ATTENTION!**

**Do not screw the M12 plug using force. Otherwise, it may damage the connecting pins.**

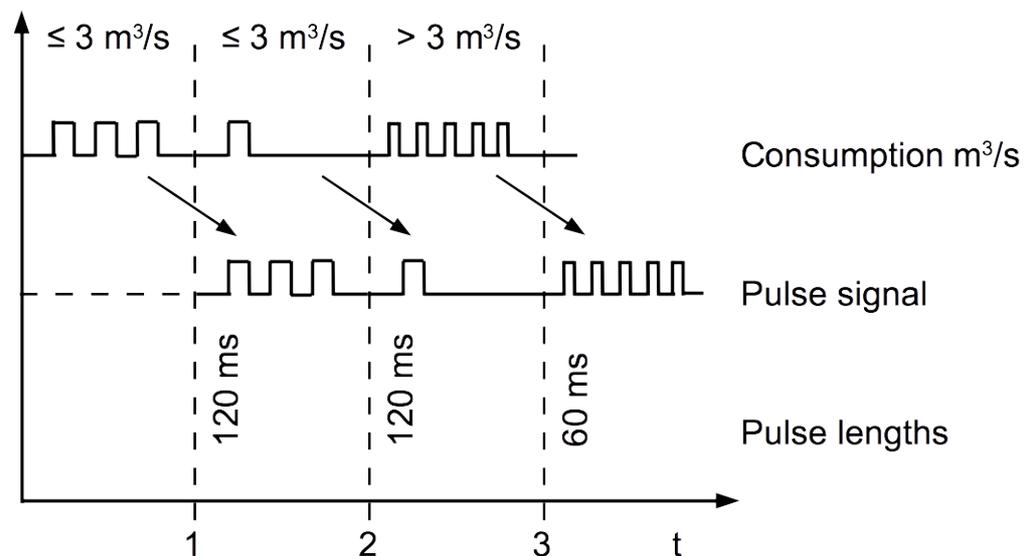
## 9. Sensor signal outputs

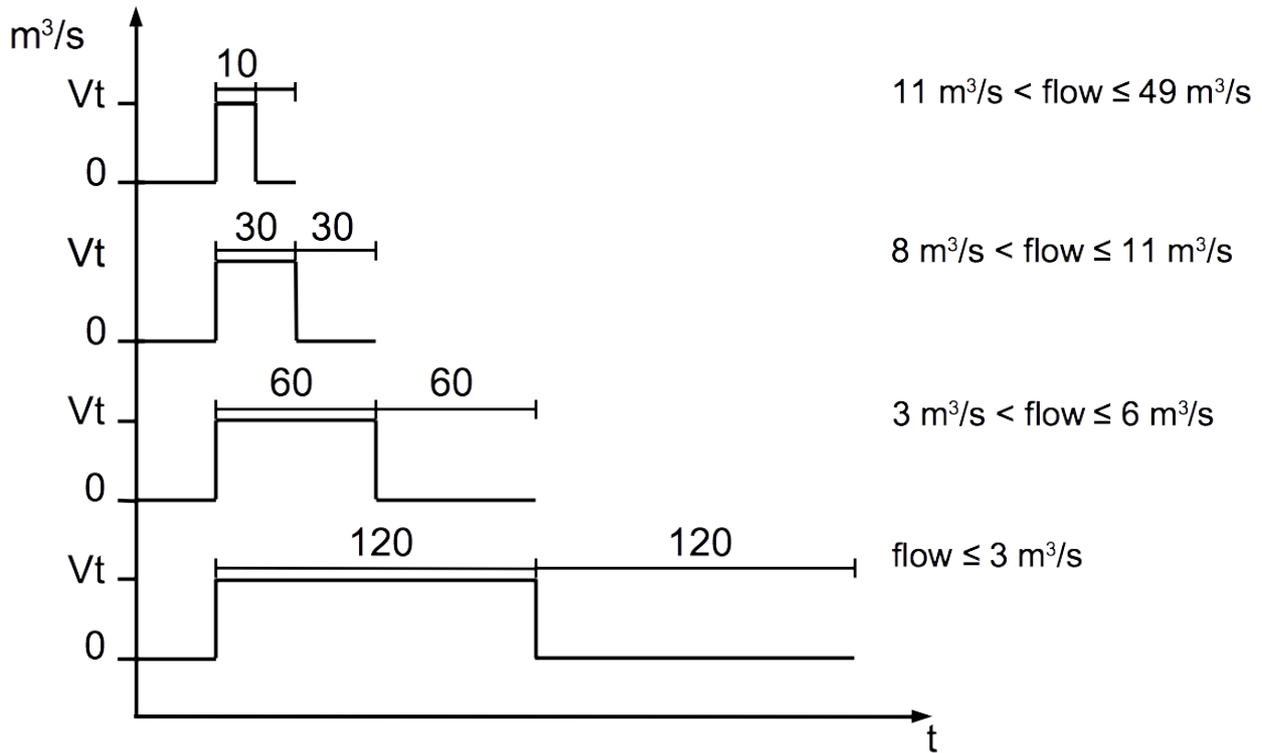
### 9.1 Analog output

The sensor has an analogue output range of 4...20 mA. This output can be scaled to match a desired measuring range. Standard is the range from 0 to max. flow depending on the pipe diameter. The corresponding flow in different pipe sizes can be found in the Appendix section. For other ranges, please contact the manufacturer.

### 9.2 Pulse output

The sensor will send out one pulse per consumption unit. This pulse output can be connected to an external pulse counter to count the total consumption. The number of  $\text{m}^3$  per second are summed up and indicated after one second. Pulse length depends on consumption rate.





In case the flow rate is higher than 50 m<sup>3</sup>/s, l/s of ft<sup>3</sup>/s, the S 430 can not output the pulses with default settings (one pulse per consumption unit). For this the pulse can be set by our service software or a connected display to 1 pulse per 10 consumption units or 1 pulse per 100 consumption units. For example, if set to 1 pulse per 10 m<sup>3</sup>, the sensor will send one pulse each 10 m<sup>3</sup>.

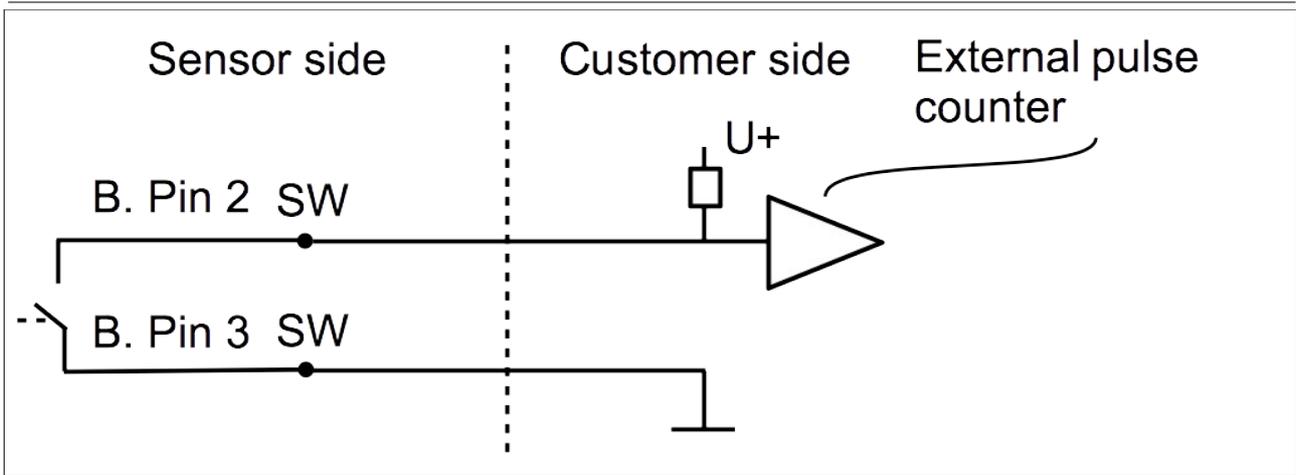
Example:

Volume flow [m <sup>3</sup> /h]	Pulse length [ms]	Max. consumption [m <sup>3</sup> ]
≤ 10800	120	10800
> 10800	60	28800
> 28800	30	57600

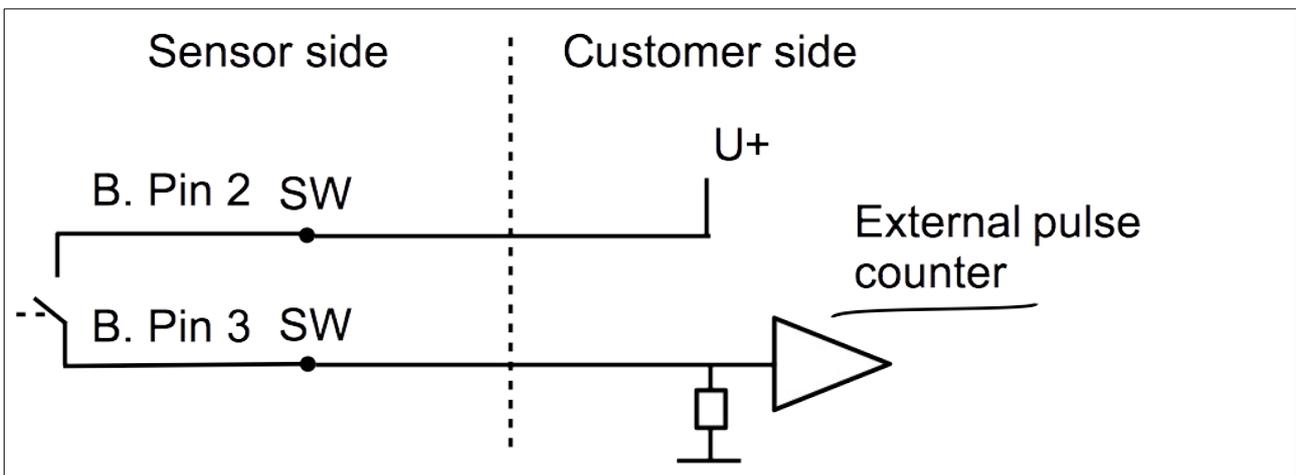
### 9.3 Pulse Connection Diagram

#### Using the isolated pulse switch (Connector B Pin 2 and 3)

Variant 1:



Variant 2:



### 9.4 Modbus output

Mode	: RTU
Baud rate	: 19200
Device address	: 1
Framing / parity / stop bit	: 8, N, 1
Response time	: 1 second
Response delay	: 0 ms
Inter-frame spacing	: 7 char

#### Remarks

- Modbus communication settings can be changed by the service software.

Index	Channel description	Unit	Resolution	Format	Length	Modbus address
0	Gas temperature	°C	0.1	FLOAT	4 Byte	0
1	Pressure	bar	0.001	FLOAT	4 Byte	2
2	Velocity	m/s	0.1	FLOAT	4 Byte	4
3	Flow	m <sup>3</sup> /h	0.1	FLOAT	4 Byte	6
4	Consumption	m <sup>3</sup>	1.0	UNIT32	4 Byte	8
5	Reverse velocity	m/s	0.1	FLOAT	4 Byte	10
6	Reverse flow	m <sup>3</sup> /h	0.1	FLOAT	4 Byte	12
7	Reverse consumption	m <sup>3</sup>	1.0	UNIT32	4 Byte	14
8	System status		1.0	UNIT32	4 Byte	24

**Remark**

- all numbers are in little-endian format.

**9.5 M-Bus output**

Manufacturer code / : 0x15C4 / serial number  
Fabrication No.

Baud rate / parity : 2400 bps / even

Device address : primary address: 1; secondary address: serial number

Response delay / : 7ms / 500ms  
timeout

Channel	Data information Field (DIF)	Unit	Range coding
Counter	04	m <sup>3</sup>	1
Flow	04	m <sup>3</sup> /h	10

**10. Sensor display (option)**

With the Sensor display it is possible to show the value of the velocity, the flow and the consumption. Moreover it shows error messages and it is possible to change the configuration setting of the sensor.

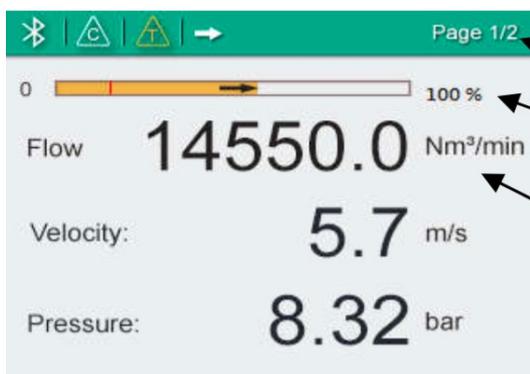
“Enter key” = 

“Up key” = 

“Down key” = 

## 10.1 Starting process

After power up, the display starts automatically with a initialisation procedure. During the next eight seconds the display will show the current software version and starts the connection to the sensor. Now the display goes to the standard mode, showing the online values, flow, velocity and pressure, alternately.



Home page:

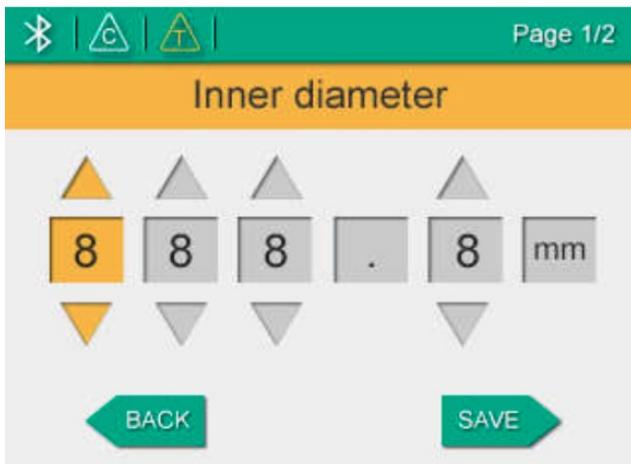
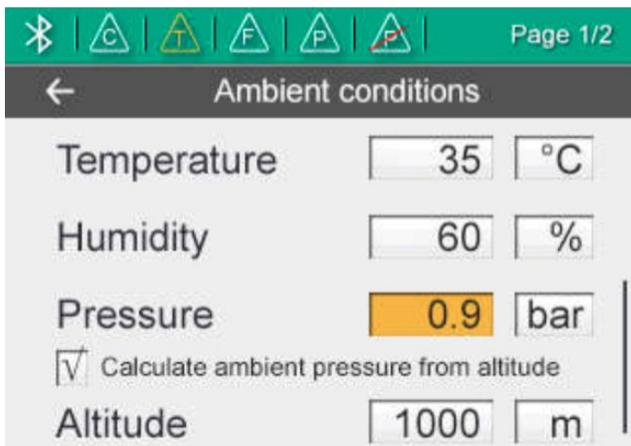
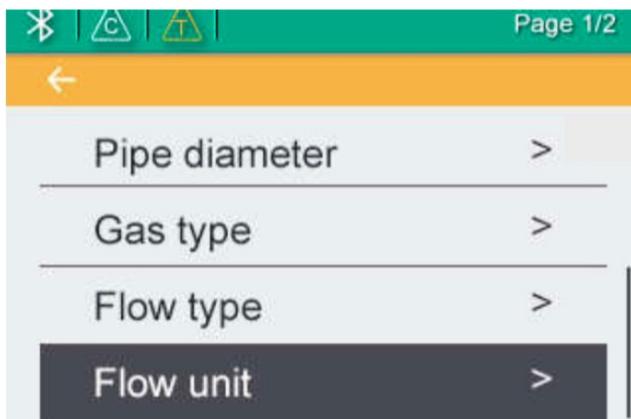
- Status bar
- Moving bar to indicate flow and cutoff value
- Measuring values

## 10.2 Configuration using the display

The following settings can be changed via display or service software.

- Pipe diameter – for flow calculation.
- Gas type – select the gas to be measured.
- Flow type – selection of flow, dry air flow, FAD and actual flow
- Flow unit – select unit for flow value.

For this please observe the following steps:



1. Please press "Enter" (>3s) key to check and change settings (unlock code:12).
2. Use the "Up" and "Down" key on the keyboard to choose the setting which should be changed.
3. Also use these two buttons to select desired entry box or adjust the values.
4. Please press "Enter" button to confirm the changes.

## 11. Calibration

The sensor is calibrated ex work. The exact calibration date is printed on the certificate which is supplied together with the sensor. The accuracy of the sensor is regulated by the on site conditions, parameters like oil, high humidity or other impurities can affect the calibration and furthermore the accuracy. However we recommend to calibrate the instrument at least once per year. The calibration is excluded from the instruments warranty. For this please contact the manufacturer.

## 12. Maintenance

To clean the sensor it is recommended to use distilled water or isopropyl alcohol only. If the contamination can not be removed the sensor has to be inspected and maintained by the manufacturer.

## 13. Disposal or waste

Electronic devices are recyclable material and do not belong in the household waste.

The sensor, the accessories and its packings must be disposed according to your local statutory requirements. The dispose can also be carried by the manufacturer of the product, for this please contact the manufacturer.

## 14. Warranty

CS-iTEC provides a warranty for this product of 24 months covering the material and workmanship under the stated operating conditions from the date of delivery. Please report any findings immediately and within the warranty time. If faults occurring during the warranty time CS-iTEC will repair or replace the defective unit, without charge for labour and material costs but there is a charge for other service such as transport and packing costs.

Excluded from this warranty is:

- Damage caused by:
  - Improper use and non-adherence to the instruction manual.
  - Use of unsuitable accessories.
  - External influences (e.g. damage caused by vibration, damage during transportation, excess heat or moisture).

The warranty is cancelled:

- If the user opens the measurement instrument without a direct request written in this instruction manual.
- If repairs or modifications are undertaken by third parties or unauthorised persons.
- If the serial number has been changed, damaged or removed.

Other claims, especially those for damage occurring outside the instrument are not included unless responsibility is legally binding.

Warranty repairs do not extend the period of warranty.



**ATTENTION!**

**Batteries have a reduced warranty time of 12 month.**

## Appendix

Scaling table analogue output (standard range):

Medium: Air at ISO 1217; 20°C; 1000mbar

Tube			Flow							
inch	PLF	mm	m <sup>3</sup> /h	m <sup>3</sup> /min	l/min	l/s	cfm	kg/h	kg/min	kg/s
1/2"	0.671	<b>16.10</b>	98.36	1.64	1639.3	27.32	57.9	116.8	1.95	0.03
3/4"	0.722	<b>21.70</b>	192.26	3.20	3204.3	53.40	113.2	228.4	3.81	0.06
1"	0.746	<b>25.00</b>	263.66	4.39	4394.3	73.24	155.2	313.2	5.22	0.09
	0.750	<b>26.00</b>	286.70	4.78	4778.4	79.64	168.7	340.5	5.68	0.09
	0.756	<b>27.30</b>	318.62	5.31	5310.3	88.50	187.5	378.4	6.31	0.11
	0.761	<b>28.50</b>	349.54	5.83	5825.7	97.09	205.7	415.2	6.92	0.12
	0.767	<b>30.00</b>	390.36	6.51	6505.9	108.43	229.8	463.7	7.73	0.13
1 1/4"	0.776	<b>32.80</b>	472.10	7.87	7868.3	131.14	277.9	560.7	9.35	0.16
	0.784	<b>36.00</b>	574.57	9.58	9576.2	159.60	338.2	682.5	11.37	0.19
	0.785	<b>36.30</b>	584.93	9.75	9748.9	162.48	344.3	694.8	11.58	0.19
1 1/2"	0.792	<b>39.30</b>	691.72	11.53	11528.7	192.15	407.1	821.6	13.69	0.23
	0.793	<b>40.00</b>	717.49	11.96	11958.2	199.30	422.3	852.2	14.20	0.24
	0.797	<b>41.80</b>	787.47	13.12	13124.5	218.74	463.5	935.3	15.59	0.26
	0.800	<b>43.10</b>	840.36	14.01	14006.0	233.43	494.6	998.2	16.64	0.28
	0.804	<b>45.80</b>	953.69	15.89	15894.9	264.92	561.3	1132.8	18.88	0.31
2"	0.810	<b>50.00</b>	1145.11	19.09	19085.2	318.09	674.0	1360.1	22.67	0.38
	0.811	<b>51.20</b>	1202.22	20.04	20037.0	333.95	707.6	1428.0	23.80	0.40
	0.812	<b>53.10</b>	1294.69	21.58	21578.2	359.64	762.0	1537.8	25.63	0.43
	0.813	<b>54.50</b>	1365.54	22.76	22759.1	379.32	803.7	1622.0	27.03	0.45
	0.818	<b>57.50</b>	1529.37	25.49	25489.4	424.82	900.2	1816.5	30.28	0.50
	0.820	<b>60.00</b>	1669.32	27.82	27821.9	463.70	982.5	1982.8	33.05	0.55
	0.823	<b>64.20</b>	1918.19	31.97	31969.9	532.83	1129.0	2278.4	37.97	0.63
2 1/2"	0.824	<b>65.00</b>	1968.69	32.81	32811.4	546.86	1158.7	2338.3	38.97	0.65
	0.825	<b>68.90</b>	2214.70	36.91	36911.7	615.19	1303.5	2630.6	43.84	0.73
	0.827	<b>70.30</b>	2311.21	38.52	38520.1	642.00	1360.3	2745.2	45.75	0.76
	0.827	<b>71.10</b>	2364.11	39.40	39401.8	656.70	1391.5	2808.0	46.80	0.78
	0.829	<b>76.10</b>	2714.85	45.25	45247.5	754.13	1597.9	3224.6	53.74	0.90
3"	0.830	<b>80.00</b>	3003.87	50.06	50064.4	834.41	1768.0	3567.9	59.46	0.99
	0.831	<b>82.50</b>	3198.39	53.31	53306.5	888.44	1882.5	3798.9	63.32	1.06
	0.831	<b>84.90</b>	3387.18	56.45	56453.1	940.88	1993.6	4023.2	67.05	1.12
	0.832	<b>90.00</b>	3810.93	63.52	63515.5	1058.59	2243.0	4526.5	75.44	1.26
4"	0.833	<b>100.00</b>	4710.50	78.51	78508.4	1308.47	2772.5	5595.0	93.25	1.55
	0.834	<b>107.10</b>	5409.63	90.16	90160.5	1502.67	3184.0	6425.4	107.09	1.78
	0.834	<b>110.00</b>	5706.55	95.11	95109.2	1585.15	3358.8	6778.1	112.97	1.88
5"	0.835	<b>125.00</b>	7377.83	122.96	122963.9	2049.40	4342.4	8763.2	146.05	2.43
	0.835	<b>133.70</b>	8440.57	140.68	140676.1	2344.60	4967.9	10025.4	167.09	2.78
6"	0.836	<b>150.00</b>	10636.80	177.28	177280.1	2954.67	6260.6	12634.1	210.57	3.51
	0.836	<b>159.30</b>	11996.66	199.94	199944.3	3332.40	7061.0	14249.3	237.49	3.96
	0.837	<b>182.50</b>	15764.26	262.74	262737.7	4378.96	9278.5	18724.3	312.07	5.20
	0.837	<b>190.00</b>	17086.58	284.78	284776.3	4746.27	10056.8	20294.9	338.25	5.64
8"	0.838	<b>200.00</b>	18955.11	315.92	315918.6	5265.31	11156.6	22514.3	375.24	6.25
	0.838	<b>206.50</b>	20207.22	336.79	336787.0	5613.12	11893.5	24001.5	400.03	6.67
10"	0.839	<b>250.00</b>	29652.71	494.21	494211.8	8236.86	17452.9	35220.6	587.01	9.78
	0.840	<b>260.40</b>	32209.47	536.82	536824.6	8947.08	18957.8	38257.4	637.62	10.63
12"	0.840	<b>300.00</b>	42750.79	712.51	712513.2	11875.22	25162.2	50778.1	846.30	14.11
	0.840	<b>309.70</b>	45560.04	759.33	759334.0	12655.57	26815.6	54114.8	901.91	15.03
	0.840	<b>339.60</b>	54781.89	913.03	913031.5	15217.19	32243.4	65068.2	1084.47	18.07
	0.840	<b>400.00</b>	76001.41	1266.69	1266690.2	21111.50	44732.8	90272.1	1504.54	25.08
	0.840	<b>500.00</b>	118752.20	1979.20	1979203.4	32986.72	69894.9	141050.2	2350.84	39.18
	0.840	<b>600.00</b>	171003.17	2850.05	2850052.9	47500.88	100648.7	203112.3	3385.20	56.42
	0.840	<b>700.00</b>	232754.32	3879.24	3879238.6	64653.98	136994.1	276458.4	4607.64	76.79
	0.840	<b>800.00</b>	304005.64	5066.76	5066760.6	84446.01	178931.0	361088.5	6018.14	100.30
	0.840	<b>900.00</b>	384757.14	6412.62	6412618.9	106876.98	226459.6	457002.6	7616.71	126.95
	0.840	<b>1000.00</b>	475008.81	7916.81	7916813.5	131946.89	279579.7	564200.8	9403.35	156.72

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