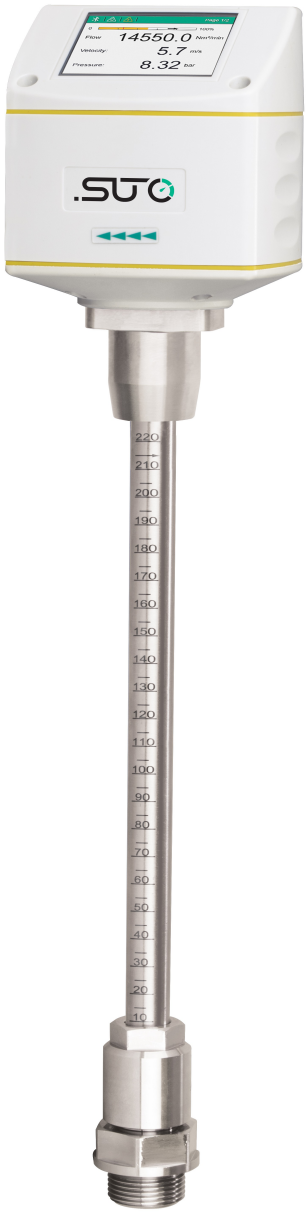
English

Instruction and Operation Manual

S430

Pitot Tube Flow Sensor



Dear Customer,

Thank you for choosing our product.

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

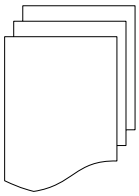
Should the device be tampered with in any manner other than a procedure which is described and specified in the manual, the warranty is void and the manufacturer is exempt from liability.

The device is designed exclusively for the described application.

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

Table of contents

1 Safety instructions



Please check if this instruction manual matches the product type.

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

This instruction manual must 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 by 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 an 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.

ATTENTION!

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 because it 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 ... +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 ... +50°C.
- Avoid direct UV and solar radiation during storage.
- For the storage the humidity must be <90%, no condensation.

2 Registered trademarks

SUTO®

Registered trademark of SUTO iTEC

MODBUS®

Registered trademark of the Modbus Organization, Hopkinton, USA

HART®

Registered trademark of the HART Communication Foundation, Austin, USA

PROFIBUS®

Registered trademark of the PROFIBUS User Organization, Karlsruhe, Germany

Bluetooth® word mark and logos

Registered trademarks of Bluetooth SIG, Inc.

Android™, Google Play

Trademarks of Google LLC

3 RF exposure information and statement

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body.

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user’s authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help
- This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

4 Application

The S430 flow sensor is designed to measure the consumption of compressed air and a variety of other gases in wet air or high mass flow / velocity applications. The sensor can even work in wet and dirty gases such as the outlet of a compressor.

The S430 can measure the following parameters for compressed air or gases:

Parameter	Factory default unit
Velocity	m/s
Volumetric flow	m^3/h
Pressure	bar
Total consumption	m^3
Temperature	°C
Remark: You can change units by means of the service App S4C-FS, the optional local display, or the optional service kit.	

The S430 flow sensor is mainly used in compressed air systems in the industrial environment, and is not designed for explosive areas. To use it in explosive areas, please contact the manufacturer.

5 Features

- Flow and consumption measurement in wet air or high mass flow/ velocity applications.
- Measurement at the compressor outlet applicable.
- Product for bi-directional measurement available based on the advanced auto-direction-detection technology.
- Insertion-type flow sensor facilitating installation under pressure through a ball valve.
- High temperature application up to 230°C.
- Applicable to pipes with diameters from 1.25” up to 10”. Product for greater-diameter pipes available on request.
- No mechanical wear parts.
- Stainless steel used for all parts that are in contact with the medium.
- Mobile service App S4C-FS available for monitoring and configuring the sensor through mobile devices.
- Optional local display available for monitoring and configuring values directly on the sensor.
- Optional Power over Ethernet (PoE).
- Optional M-Bus output.

6 Technical data

6.1 General data

CE FC FCC ID: 2ASK2-SUTO-004		
Parameters	Flow selectable:	Volumetric flow, working condition flow, dry air flow, Free Air Delivery (FAD), mass flow
	Consumption	
	Velocity (working condition)	
	Medium temperature	
	Medium pressure	
Selectable units	Volumetric Flow:	m^3/h, m^3/min, l/min, l/s, cfm
	Mass flow:	kg/h, kg/min, kg/s, t/h, lb/h
	Consumption:	m^3, ft^3, t, lb, l, kg
	Velocity:	m/s, ft/min
	Temperature:	°C, °F
	Pressure:	bar, psi, kPa, MPa
Reference conditions	Selectable by users. Default ex-factory settings:	
	compressed air:	ISO1217 20°C, 1000 hPa
	other gas:	DIN1343 0°C, 1013.25 hPa
Principle of measurement	Differential pressure with Pitot tube	
Sensor	Differential pressure sensor	
Measuring medium	Air, gas (non corrosive gas)	
Operating temperature	-40 … +230°C probe tube -30 … +70°C housing 0 … +50°C local display (Optional) -10 ... +40°C PoE (Optional)	

Turndown ratio	1:10 (min/max flow ratio)
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 in chapter 7.
Display (optional)	2.4” colour graphics display with keypad (optional)
Tube diameter	1.25” to 10” (greater diameters on request)
Screwing thread	G 3/4” (ISO 228/1)
Weight	1.12 kg

6.2 Electrical data

Power supply	24 VDC, 150 mA 48 VDC, 100 mA (PoE)

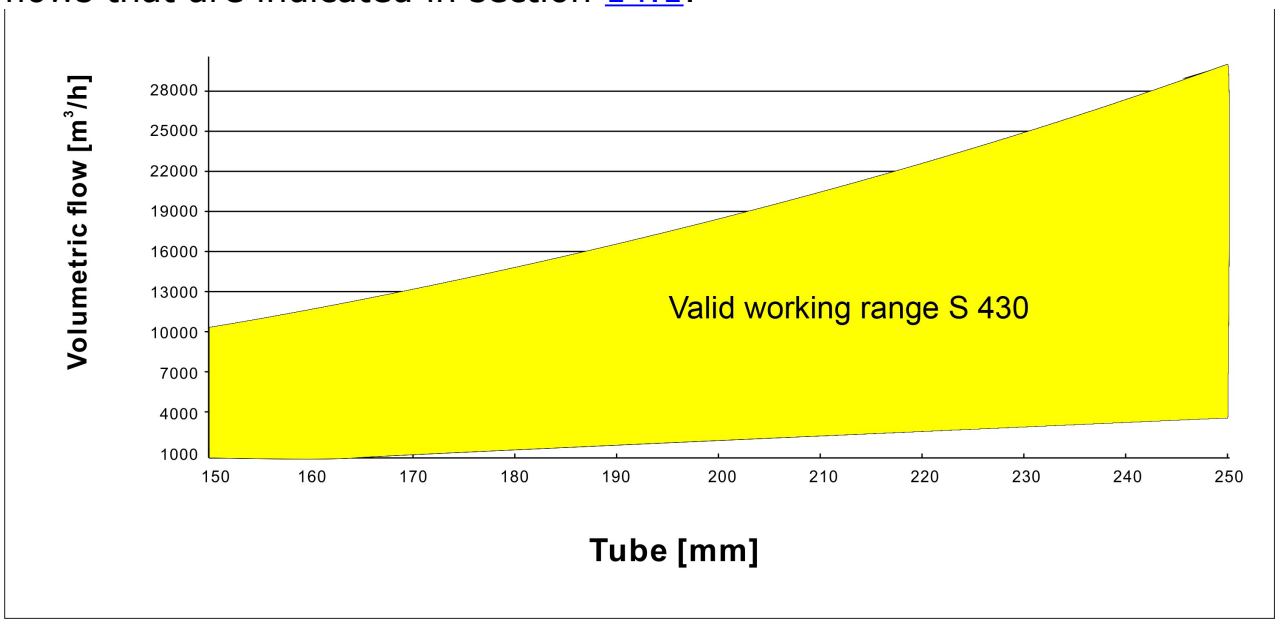
6.3 Output signals

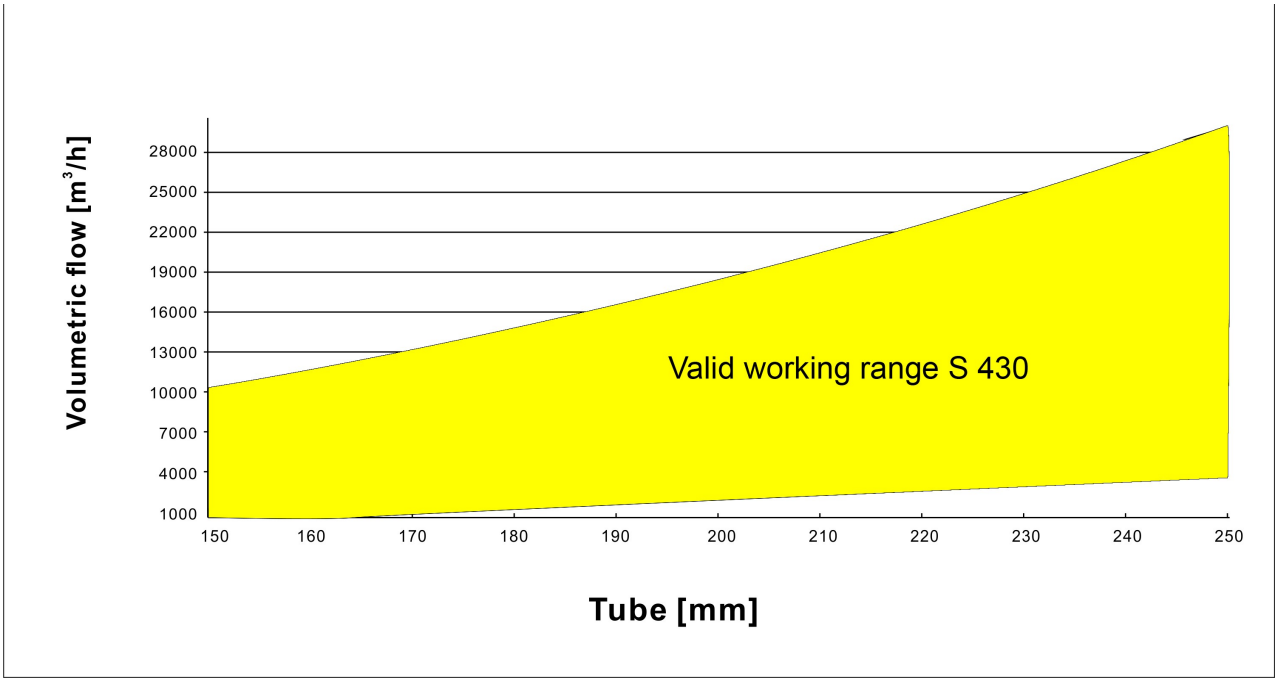
Analogue output	Signal: 4 ... 20 mA Scaling: 0 to maximum volume flow / velocity Accuracy: 0.06 mA
Pulse output	1 pulse per consumption unit Isolated switch: max. 30 VDC / 200 mA Pulse length: 30 … 120 ms depending on the flow rate
Modbus output (default setting)	See section 10.4.
M-Bus output (default setting)	See section 10.5.

6.4 Accuracy

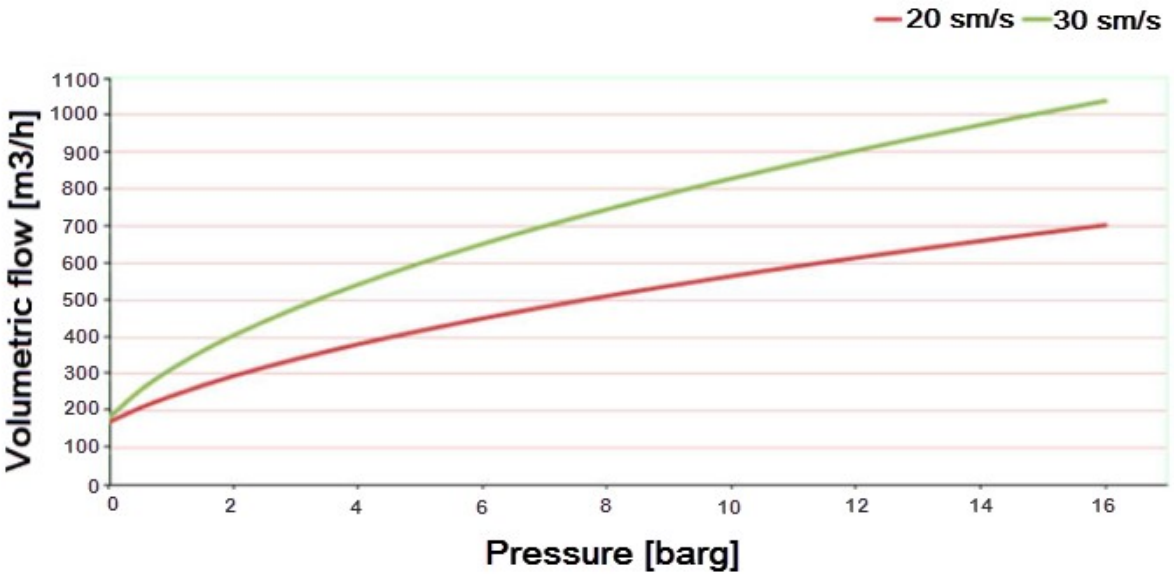
Accuracy*	Flow: ±(1.5% of reading+0.3% full scale) Pressure: 0.5% full scale Temperature: 0.5°C
Stated accuracy at	Ambient/process temperature 23°C ± 3°C Ambient/process humidity <90% Process pressure at 0.6 MPa

* The specified accuracy is valid only within the minimum and maximum flows that are indicated in section 14.1.

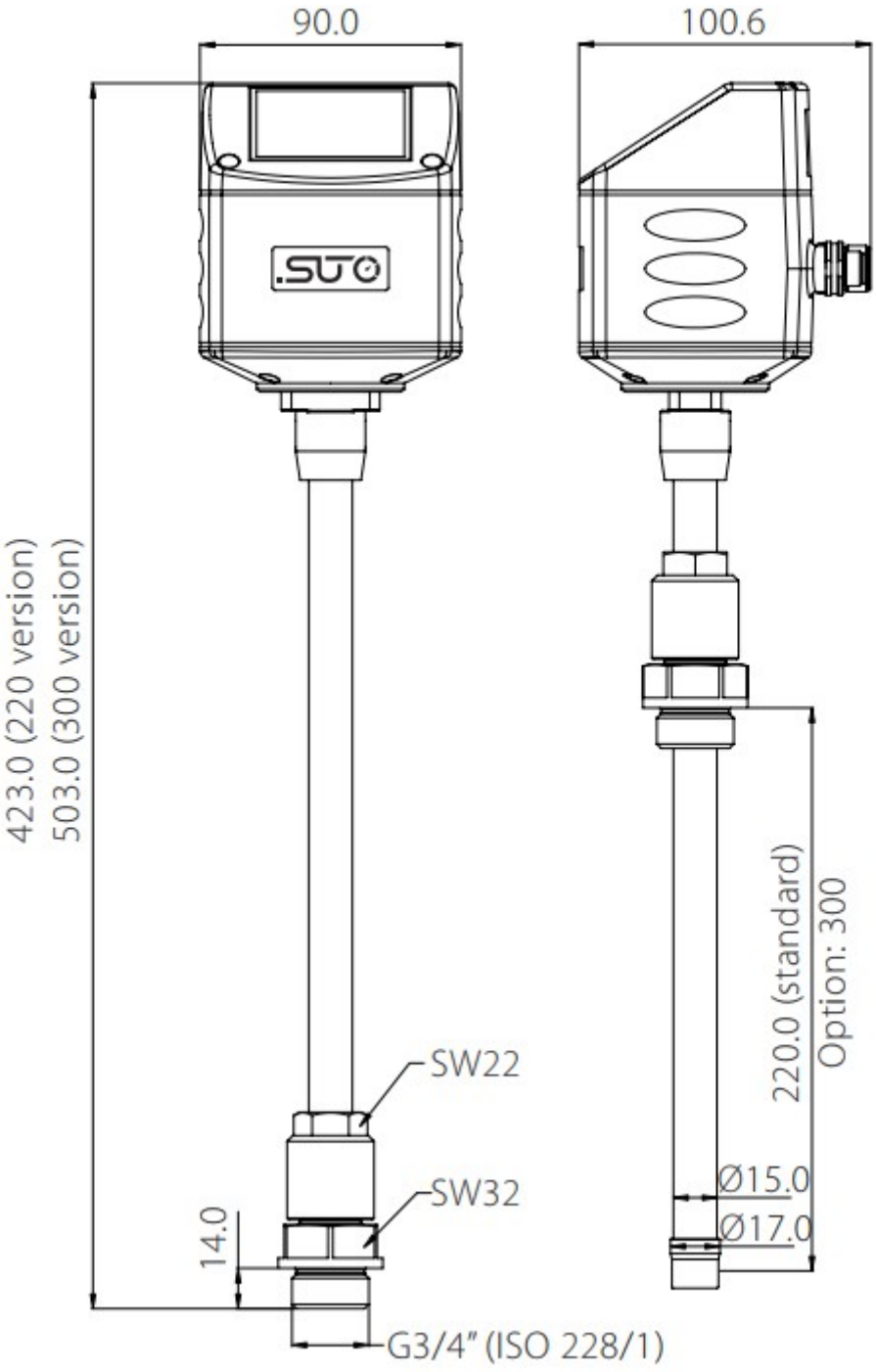




The minimum flow rate depends on the medium pressure and the cut-off setting. Below charts shows the relationship at 20 sm/s cut-off and at 30 sm/s cut-off. The cut-off ex factory is to 20 sm/s.



7 Dimensional drawing



8 Installation

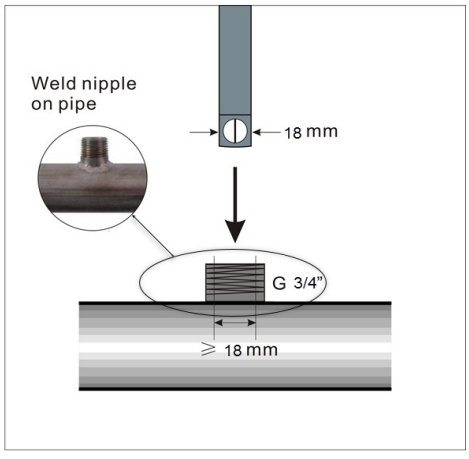
Before you install the sensor, make sure that all components listed below are included in your package.

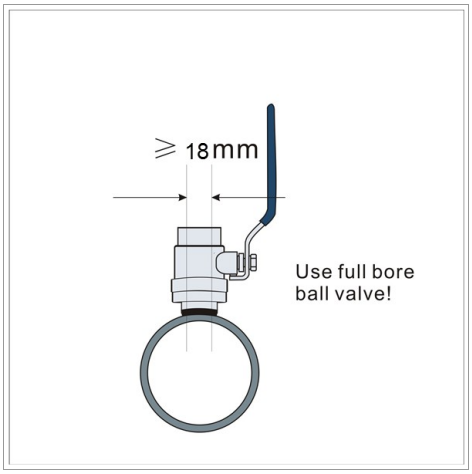
Qty	Description	Item No.
1	S430 sensor	S695 4300 or S695 4302
1	Sealing ring	NA
1	Alignment key	NA
2	Depending on orders: M12 plug or M12 cable	Plug: C219 0059 Cable: A553 0104/A553 0105/A553 0146
1	Instruction manual	NA
1	Calibration certificate	NA

8.1 Installation requirements

To install the sensor, a ball valve or a nozzle with the following specifications is needed:

- The inner thread must be G 3/4”.
- The diameter of the hole must be ≥ 18 mm, otherwise the shaft can not be inserted in.





8.2 Determining the installation point

To achieve and maintain the accuracy stated in the technical data, the sensor must be inserted in a straight pipe section with unhindered flow characteristics.

8.2.1 Inlet and outlet sections

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, and so on.

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

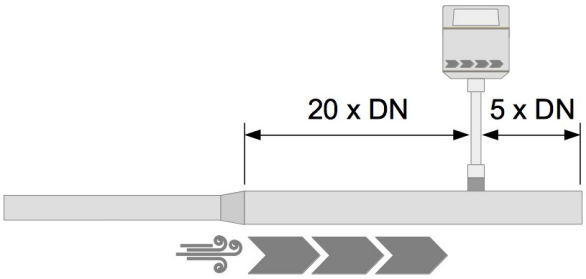
ATTENTION!

Wrong measurement may occur if the sensor is not installed correctly.

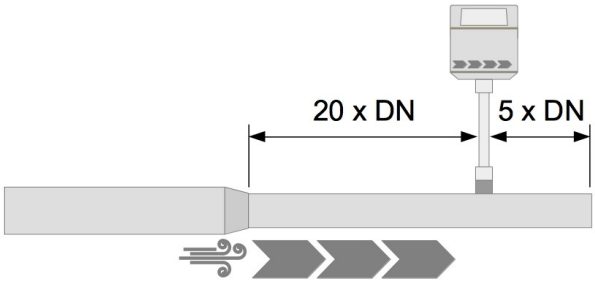
- Pay careful attention to the design of the inlet and outlet sections. Obstructions can cause counter-flow turbulence as well as turbulence in the direction of the flow.
- The sensor is for indoor use only! At an outdoor installation, the sensor must be protected from solar radiation and rain.

NOTE: If there is any combination of the following situations, the longest straight inlet section must be maintained.

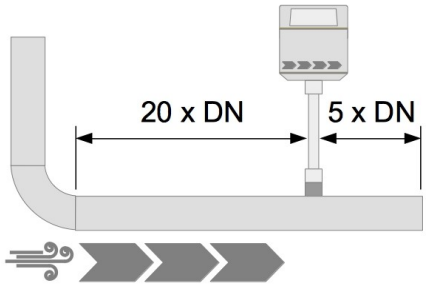
- Expansion



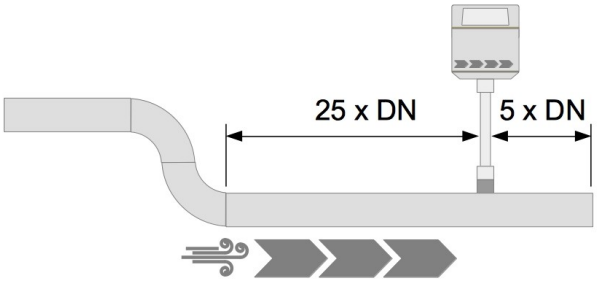
- Reduction



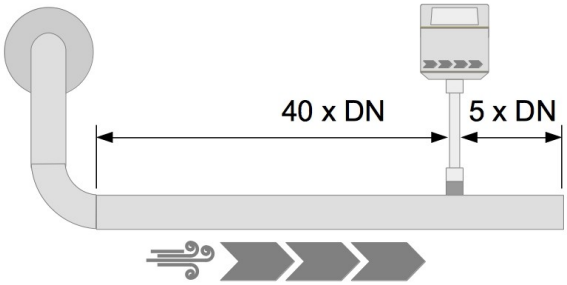
- 90° Bend



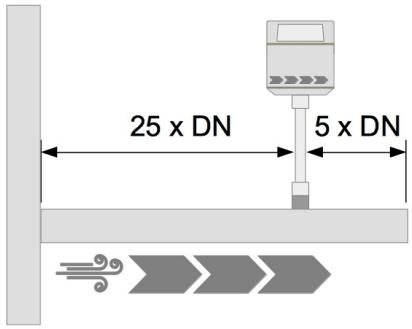
- 2×90° Bend



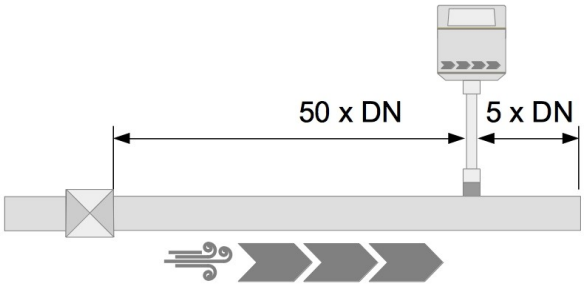
- 3 dimensional Bend

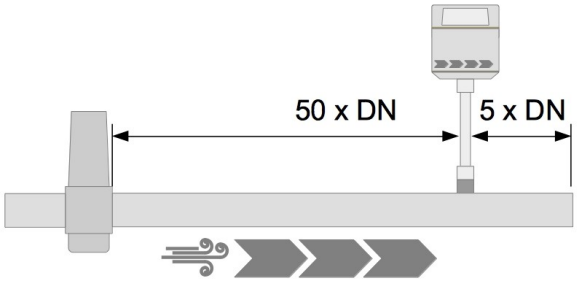


- T-piece



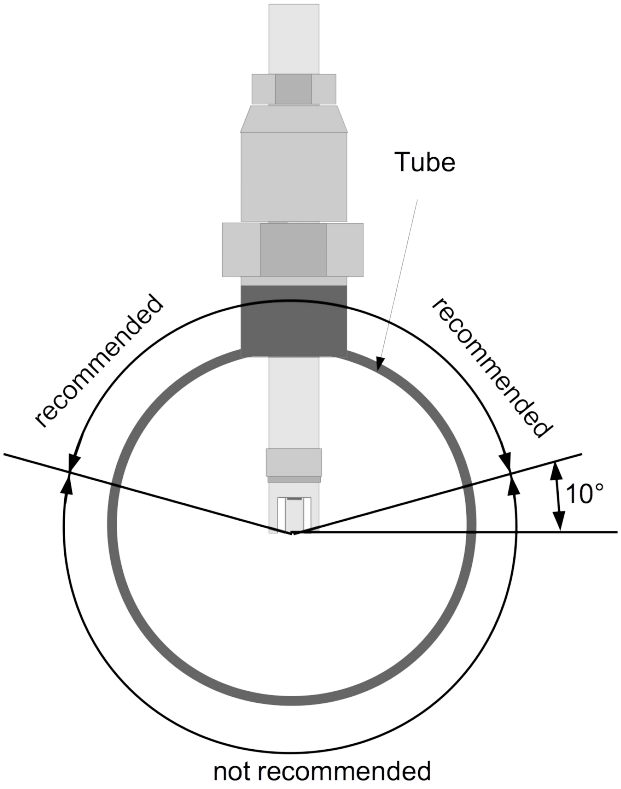
- Shut-off valve
- Filter or similar (unknown objects)





8.2.2 Insertion angles

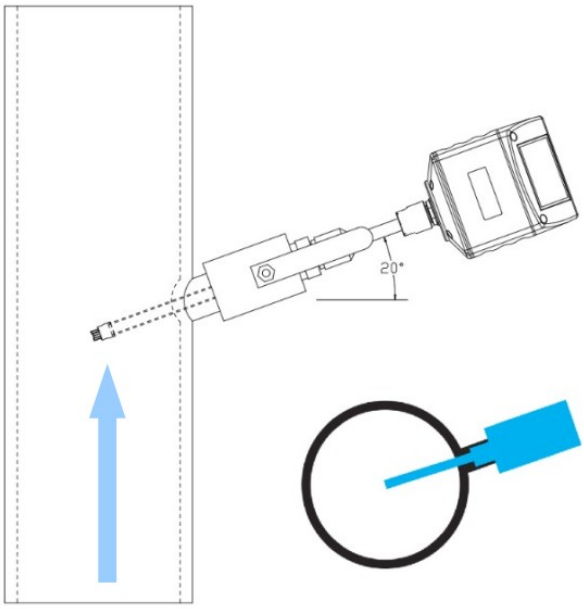
Insertion into a horizontal pipe



As shown in the left figure, the angle to the horizontal level must be >10°. A horizontal installation is NOT permitted.

Please install the sensor only in the recommended area.

Insertion into a vertical pipe



As shown in the left figure, S430 can be used in a vertical pipe when the following two conditions are met:

- The flow direction is from bottom upwards.
- The sensor is installed with an an angle of at least 10-degree. (Recommended angle is 20 degrees).

ATTENTION: Do not install the sensor in vertical pipes where the flow is from top down.

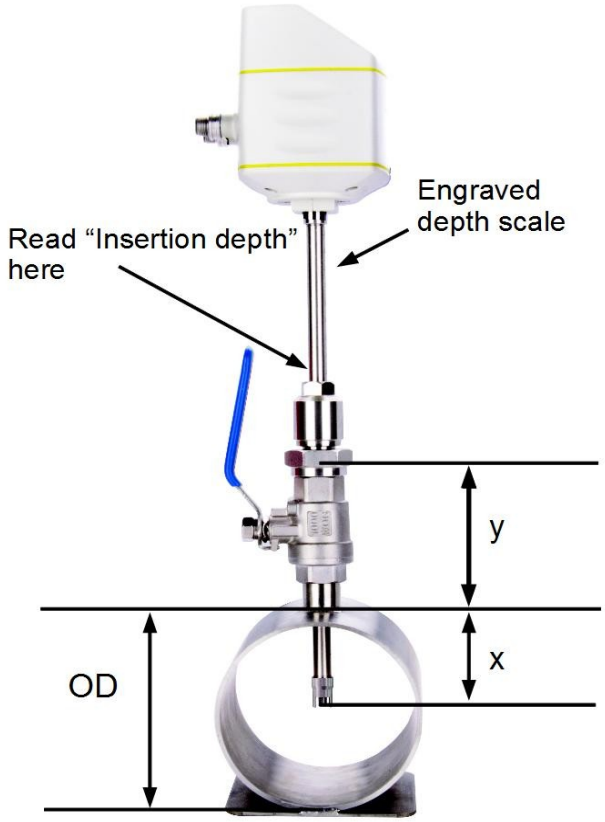
8.3 Calculating the insertion depth

Generally, the sensor tip must be placed in the center of the pipe. To facilitate this, the sensor is designed with a scale engraved on its shaft. To determine the right position, calculate the insertion depth as described below.

Remark: If the pipe diameter is greater than the shaft length, it is feasible to install the sensor out of center of the pipe. For more information, please contact the manufacturer.

8.3.1 Center installation

Center installation is the default and recommended installation type.



Calculation example:

A 2”-diameter pipe and an 87 mm-height ball valve:

$$OD = 60.3\,\text{mm}$$

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

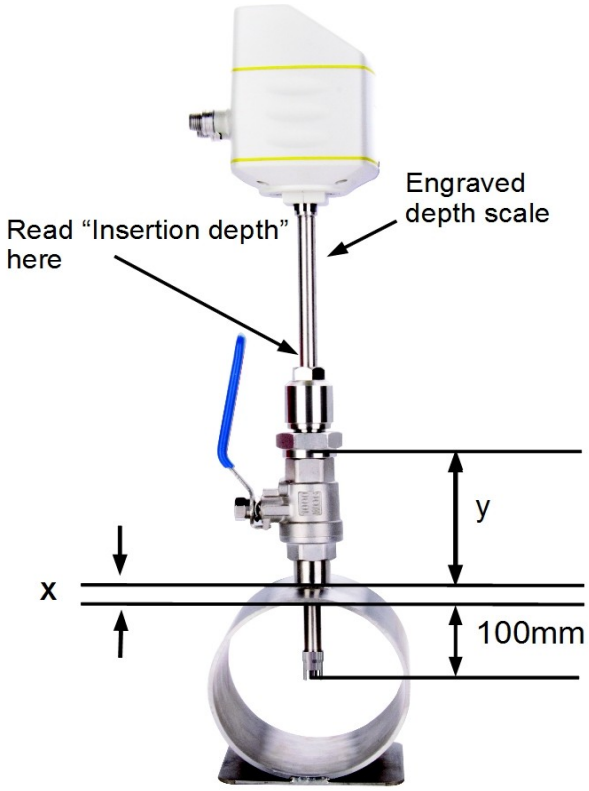
Height of Valve $= 87\,\text{mm}$;

Insertion depth

$= 30.15\,\text{mm} + 87\,\text{mm} = 117.15\,\text{mm}$

8.3.2 100 mm-depth installation

In bigger pipe diameter (> DN150) situations, the 100 mm-depth installation is applicable. In the 100 mm-depth installation, the sensor is inserted to exact 100 mm-depth of pipes.



Insertion depth $= x + y + 100$
x is the wall thickness of pipe
y = Height of the ball valve

Calculation example:

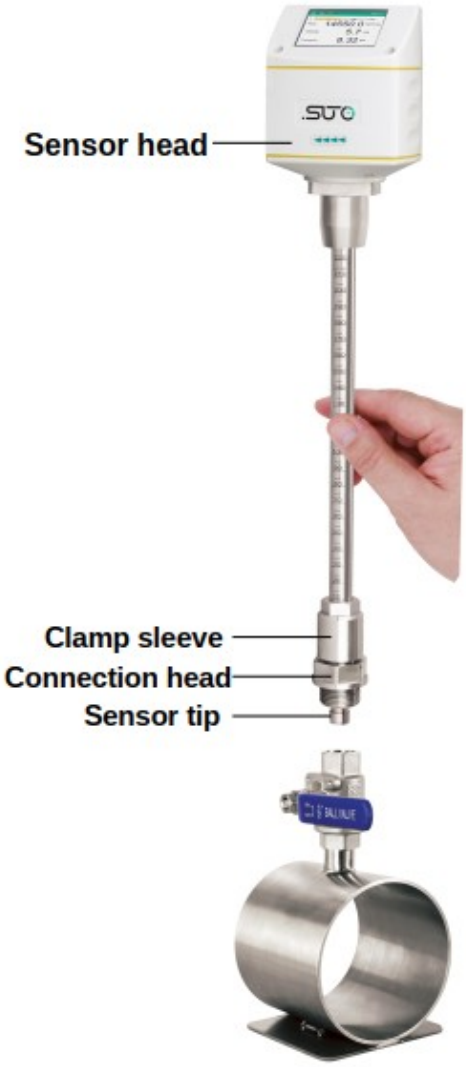
A 12”-diameter pipe with the wall thickness of 9 mm and a 87 mm-height ball valve.

$x = 9\,\text{mm}\,;\ y = 87\,\text{mm}$
Insertion depth
$= 9\,\text{mm} + 87\,\text{mm} + 100\,\text{mm} = 196\,\text{mm}$

8.4 Installing the sensor

This section describes how to install S430.

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



1. Close the ball valve.

2. Move the connection head to keep the sensor tip completely covered by the connection thread (see photo on the left).

3. Embed the O-shaped sealing ring to the groove in the connection head.

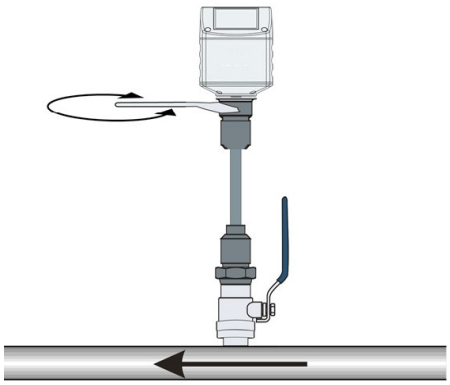
4. Screw the connection head tightly to the ball valve using a spanner. And then move the flow sensor to keep the flow direction sign (on the sensor head) and the flow direction pointing to the same direction.

5. Open the ball valve and tighten the clamp sleeve manually.

6. Perform **zero flow calibration**. For detailed steps, see instructions described on page 24.

7. Move the flow sensor slightly to the determined insertion depth by means of the scale on the sensor shaft.

8. Tighten the clamp sleeve so that the flow sensor cannot be moved by the pressure in the pipe while can be moved by hand.



9. Use the alignment key to keep the sensor align to the pipe and point to the flow direction. See the figure on the left.
NOTE: The angle deviation must be not greater than ± 2° to the perfect position, as shown in Figure 1.

10. Tighten the clamp sleeve using a spanner with clamping torque of 20...30 Nm.

11. Double check the installation depth because the shaft might be moved from its original position by the compressed gas.

Maximum angle deviation of a proper installation:

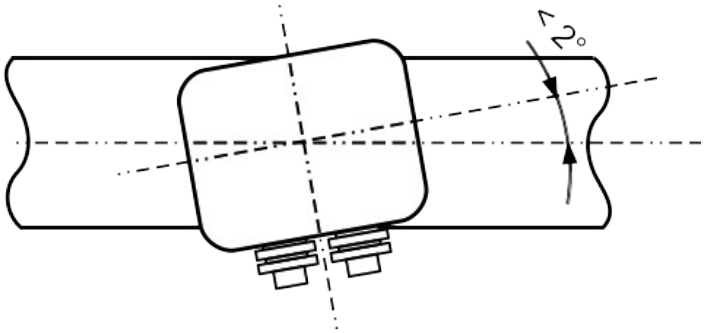


Figure 1: Top view

8.5 Performing the zero flow calibration

The zero flow calibration is a compulsory operation during the installation of the sensor. Use one of the following methods to perform the calibration:

- The service App S4C-FS, available on the Google Play store or our Website for free download
- The optional local display

8.5.1 Prerequisites

Before you start the calibration, make sure the following conditions are met:

- The sensor must have been mounted on top of the G 3/4" ball valve.

- The ball valve must be opened with the sensor tip outside of the pipe. That is, the sensor tip still remain inside the ball valve.

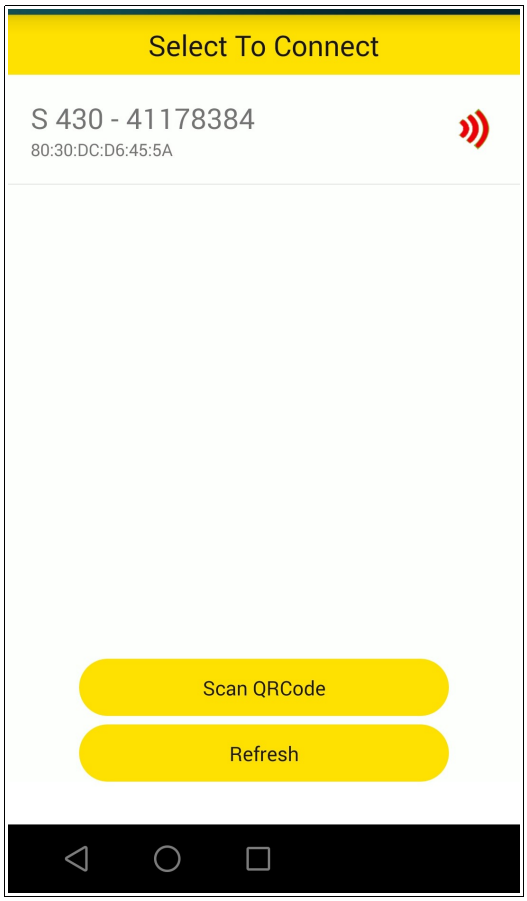
These ensure that the sensor is exposed to the system pressure during calibration.

8.5.2 Using the service App S4C-FS

This is the most convenient way especially when the sensor is not equipped with the optional local display.

1. On your mobile device, download the S4C-FS App from the **SUPPORT** > **Downloads** menu on https://suto-itec.com or from Google Play store as needed.
2. Turn on Bluetooth on your mobile device.
3. Launch the **S4C-FS** App.

   Sensors that are within the reach of the Bluetooth signal while not connected with other S4C-FS Apps are displayed on the home screen.



NOTE: A red Wireless Connection symbol is displayed behind a connected sensor, which indicates that the sensor is successfully

connected but you can only view the online parameter values and existing settings.

4. Click the **Scan QR Code** button, and then scan the QR code attached on the side of the sensor head or on the calibration certification.

   A green Wireless Connection symbol is displayed indicating that the sensor is accessible in the editable mode.

   NOTE: Only through scanning the QR code can you configure system settings and perform calibrations.

5. Click the **Settings** icon.
6. On the **Settings** screen that appears, click **Calibration** and follow the onscreen instructions to perform the zero flow calibration.

8.5.3 Using the local display

See steps 4 and 5 described in Figure 3.

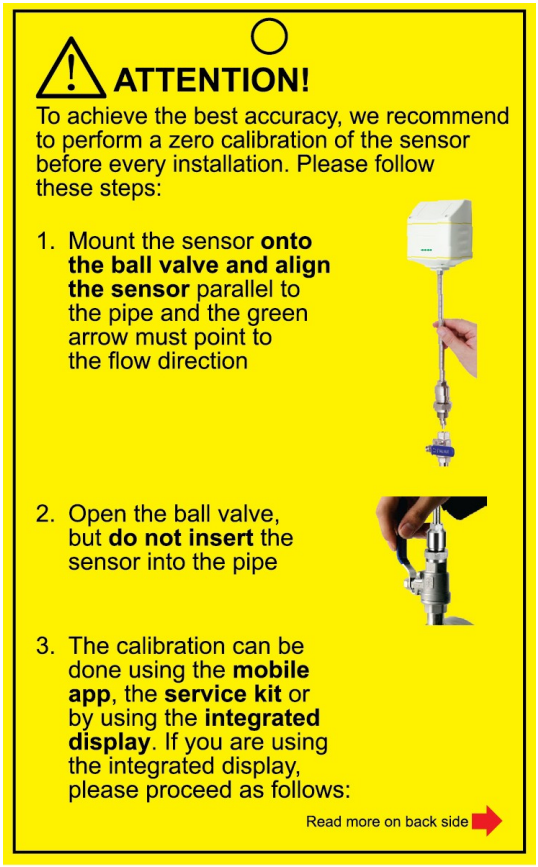


Figure 2: Steps to expose the sensor to the system pressure

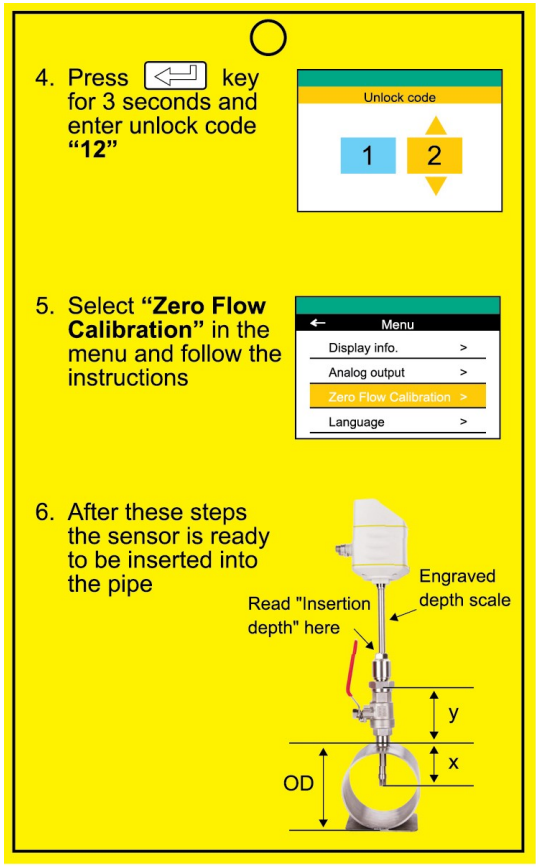


Figure 3: Steps to perform the zero flow calibration

8.6 Removing the sensor

WARNING!

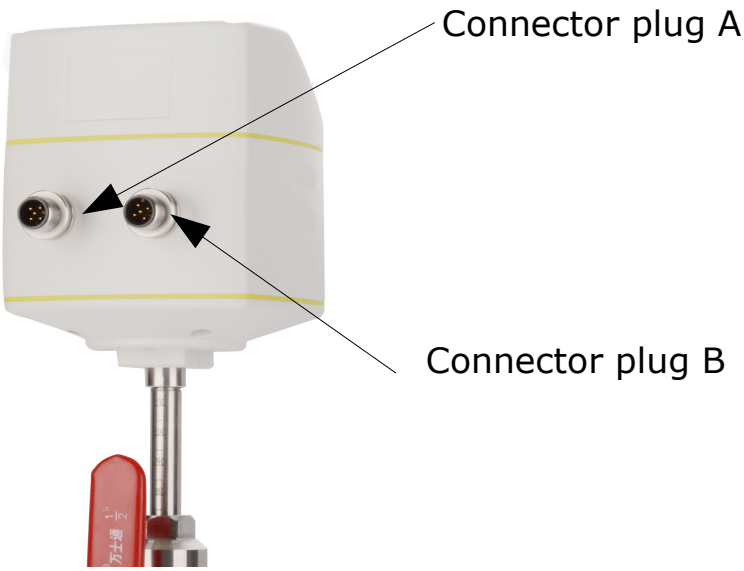
The removal of sensors under pressure can be dangerous! Be aware that the sensor can be shot out of the ball valve if you do not carefully follow the steps described below!

For your information: The sensor is exposed to a force of 18 kg at the 8-barg system pressure; a force of 32 kg at 16-barg system pressure!! Hold the sensor very tight when releasing the clamp sleeve.

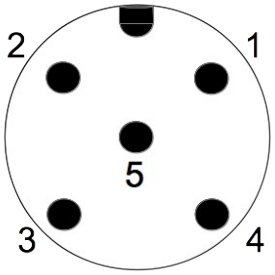
1. Hold the flow sensor firmly.
2. Release the clamp sleeve from the connection head very slowly while keeping your hand on the top of the sensor head.
3. Pull out the shaft slowly until the sensor is fully returned into the value.
4. Close the ball valve.
5. Unscrew the connection head and pull the flow sensor out of the ball valve.

8.7 Making electrical connection

The flow sensor is equipped with two M12 connector plugs - “A” and “B”. Cables are connected to the sensor through the M12 connector plugs.



8.7.1 M12 connector plugs

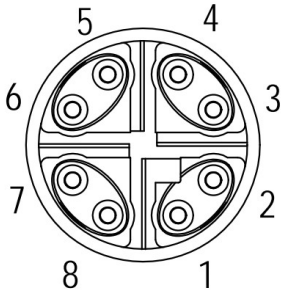


General connection pins, male
(View onto the sensor connector)

For the following output types:

P/N	Output type
A1061	Modbus/RTU
A1062	Pulse and analog
A1063	M-bus

Connector types:
A = M12 5-pin
B = M12 5-pin



Ethernet connection pins, male
(View onto the sensor connector)

For the following output type:

P/N	Output type
A1064	Modbus/TCP

Connector types:
A = M12 5-pin
B = M12 8-pin X-coded

Pin assignment – M12 connector plug

Output Type	Connector	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
Modbus/RTU	A	SDI	-VB	+VB	N/A	N/A
	B	GND	-VB	+VB	+D	-D
Pulse and analog	A	SDI	-VB	+VB	N/A	N/A
	B	N/A	SW	SW	+I	-I
M-Bus	A	SDI	-VB	+VB	N/A	N/A
	B	N/A	-VB	+VB	M-Bus	M-Bus
Modbus/TCP	A	SDI	-VB	+VB	N/A	N/A
	B	See section 8.7.2				
Wire colour		brown	white	blue	black	grey

Legend for pin assignment

GND: Ground for Modbus/RTU
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/RTU data +
D-: Modbus/RTU data -
M-Bus: M-Bus data
N/A: Not applicable

ATTENTION!

Do not screw the M12 connector using force. Otherwise, it may damage the connection pins.

8.7.2 Ethernet connection

The device can be powered by the following ways:

- Using connector A
- Using the PoE function, which is integrated into the Ethernet connection on connector B.

  To power the unit via PoE, a switch that supports PoE is needed.

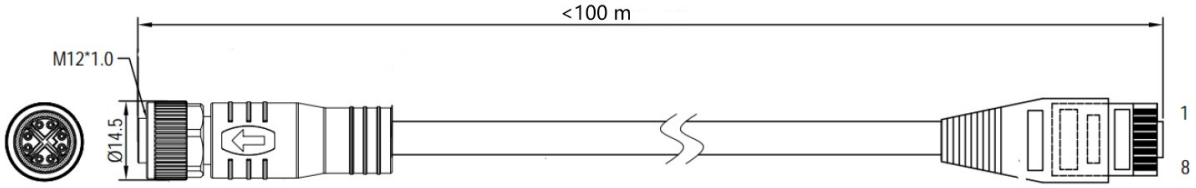
PoE comes into two different standards:

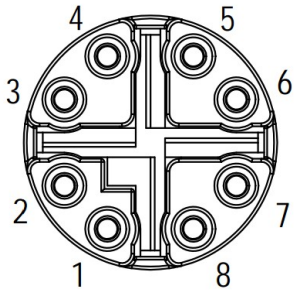
- Type A: PoE switch powers the device via Pair 2 (Pin 1 and Pin 2) and Pair 3 (Pin 3 and Pin 6)
- Type B: PoE switch powers the device via Pair 1 (Pin 4 and Pin 5) and Pair4 (Pin 7 and Pin 8)

This device supports both types.

Connection cable – M12 X-coded to RJ45

When Modbus/TCP is chosen as the sensor output, a 5 m 8-pore cable is supplied in the delivery package, which has the M12 and RJ45 plugs on both ends. RJ45 is used to connect the device to a PoE switch.





Pin front view of M12 connector, female

The 8-position pin/pair assignment on the RJ45 side must comply with T568B wiring method. We do not support T568A wiring method.

M12 X-coded	RJ45	Signal	Color code	Pair designation
1	1	Tx+ / +Vb / -Vb	White-Orange (W-O)	Pair 2
2	2	Tx- / +Vb / -Vb	Orange (O)	
3	3	Rx+ / -Vb / +Vb	White-Green (W-G)	Pair 3
4	6	Rx- / -Vb / +Vb	Green (G)	
5	7	NA / -Vb	White-Brown (W-BR)	Pair 4
6	8	NA / -Vb	Brown (BR)	
7	5	NA/ +Vb	White-Blue (W-BL)	Pair 1
8	4	NA/ +Vb	Blue (BL)	

9 Configuration

After the installation is completed, change the sensor settings of your choice using the mobile App S4C-FS, local display (optional), or service kit (optional).

You can use these tools to view online values and error messages.

9.1 Description of sensor settings

Settings provided on S430 come into the following categories.

9.1.1 Flow settings

Parameter	Description
Pipe diameter	Enter the pipe diameter in the unit of mm.
Gas type	Select the gas type.
Flow type	Make a selection from: • Flow: Total measured volumetric flow (air + moisture) at standard conditions as configured (for example, 20 °C, 1000 hPa) • Dry Air Flow: Measured volumetric flow of air only at standard conditions as configured (for example, 20 °C, 1000 hPa) • FAD: Free Air Delivery calculated based on the total measured volumetric flow at programmed intake conditions (for example, 25 °C, 980 hPa, 30 %rH) • Working Condition Flow: Working volumetric Flow at fluid pressure and temperature.
Installation	Select an installation method • Center Installation • 100mm insertion depth

9.1.2 Unit settings

Configure units for flow, pressure, temperature, and consumption.

9.1.3 Reference conditions

View reference settings at standard condition and norm condition. Configure reference settings at the customer condition as needed.

9.1.4 Factory settings

Configure filter grade at the scale of 0 to 127.

9.1.5 Output settings

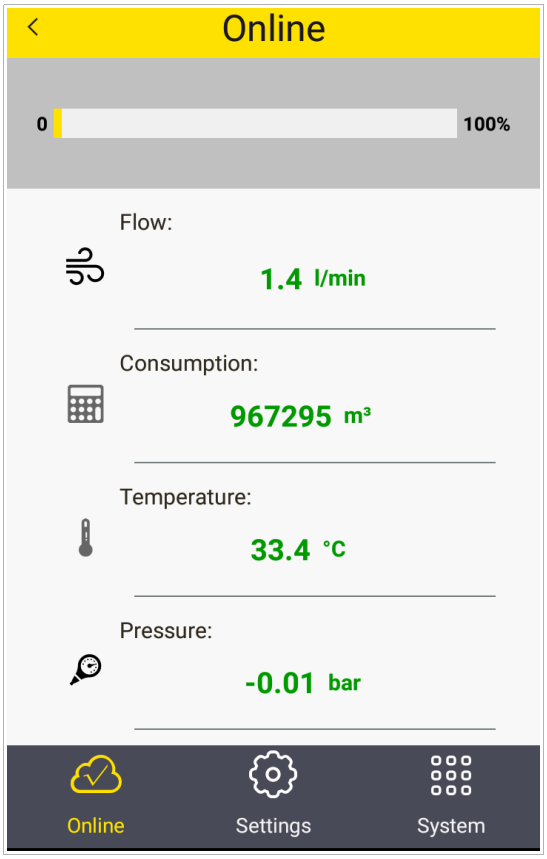
Configure output settings for Modbus such as the device address, Baud rate, Parity, and Stop bit

9.1.6 Language setting

Select the UI language.

9.2 Configuration using the service App S4C-FS

This is the most convenient way especially when the sensor is not equipped with the optional local display.



The App is available for Android systems. You can download the service App from the Google Play store or our Website.

To change settings using the App, you must scan the QR code attached on the side of the sensor head or on the calibration certificate. This ensures that only valid users can change the sensor settings.

For more detailed instructions, refer to steps described on page 25.

9.3 Configuration using the optional sensor display

For sensors equipped with a local display, you can make configurations using the display.

Enter key

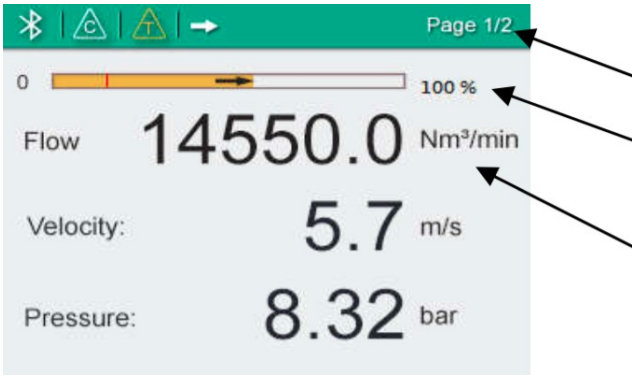
Up key

Down key

9.3.1 Starting process

After powered on, the display automatically starts an initialization procedure. In the next eight seconds the display will show the current software version and build up the connection with the sensor. Now the display goes to the standard mode, showing the online values such as flow, velocity and pressure, alternately.

9.3.2 About the home page



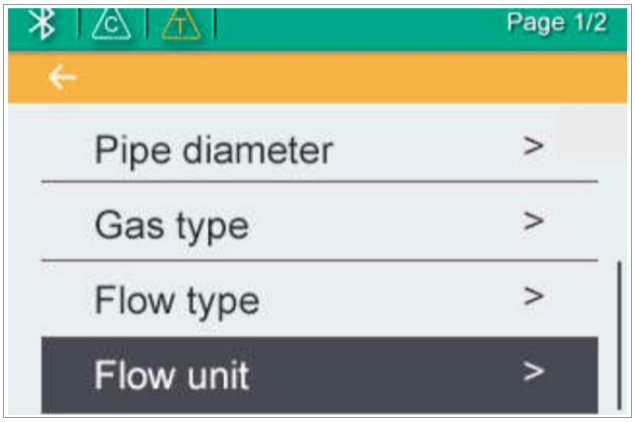
Home page:

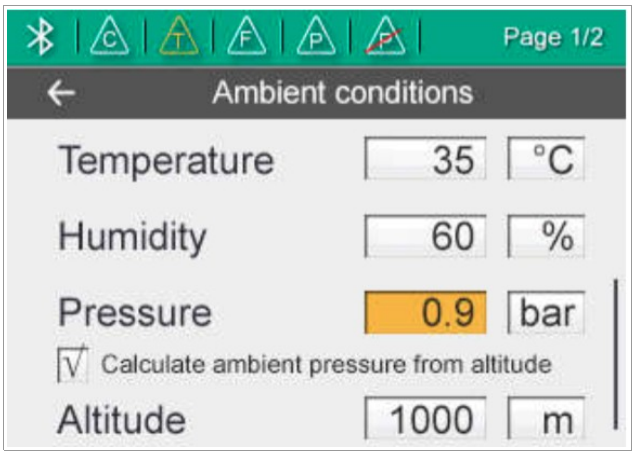
- Status bar
- Moving bar to indicate flow and cut-off value
- Measuring values

Icons are shown in the status bar indicating status or warnings for the sensor in service. The following table provides descriptions for these icons.

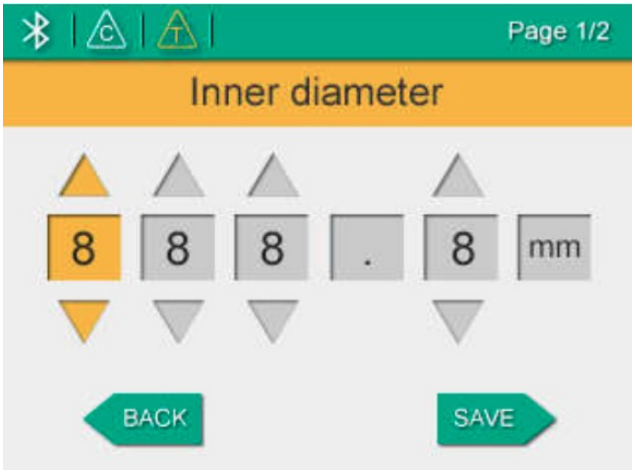
Icon	Description
	Calibration expired
	Temperature over operating range
	Flows over measuring range
	Pressure over operating range
	Pressure sensor damaged
	Temperature sensor damaged
	Flow direction

9.3.3 Configuration instructions





1. Press the **Enter** key (>3s).
2. Enter the unlock code:12 using the **Up** and **Down** keys, and then enter **Enter** key.
3. Use the **Up** and **Down** keys to choose the parameter that you want to change.
4. Use the **Up** and **Down** keys to select desired entry box or adjust the values.
5. Press the **Enter** key to confirm the changes.



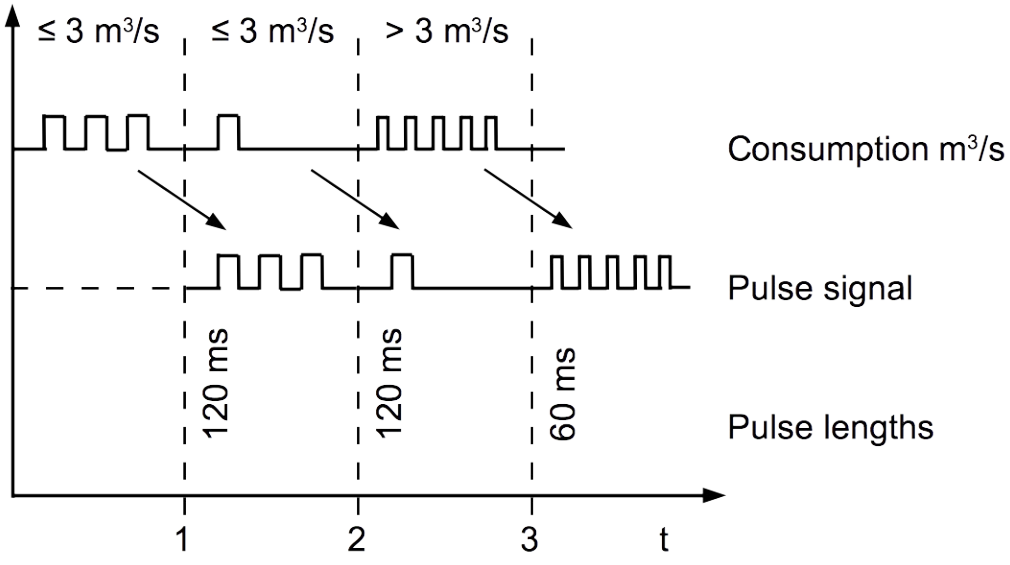
10 Sensor signal outputs

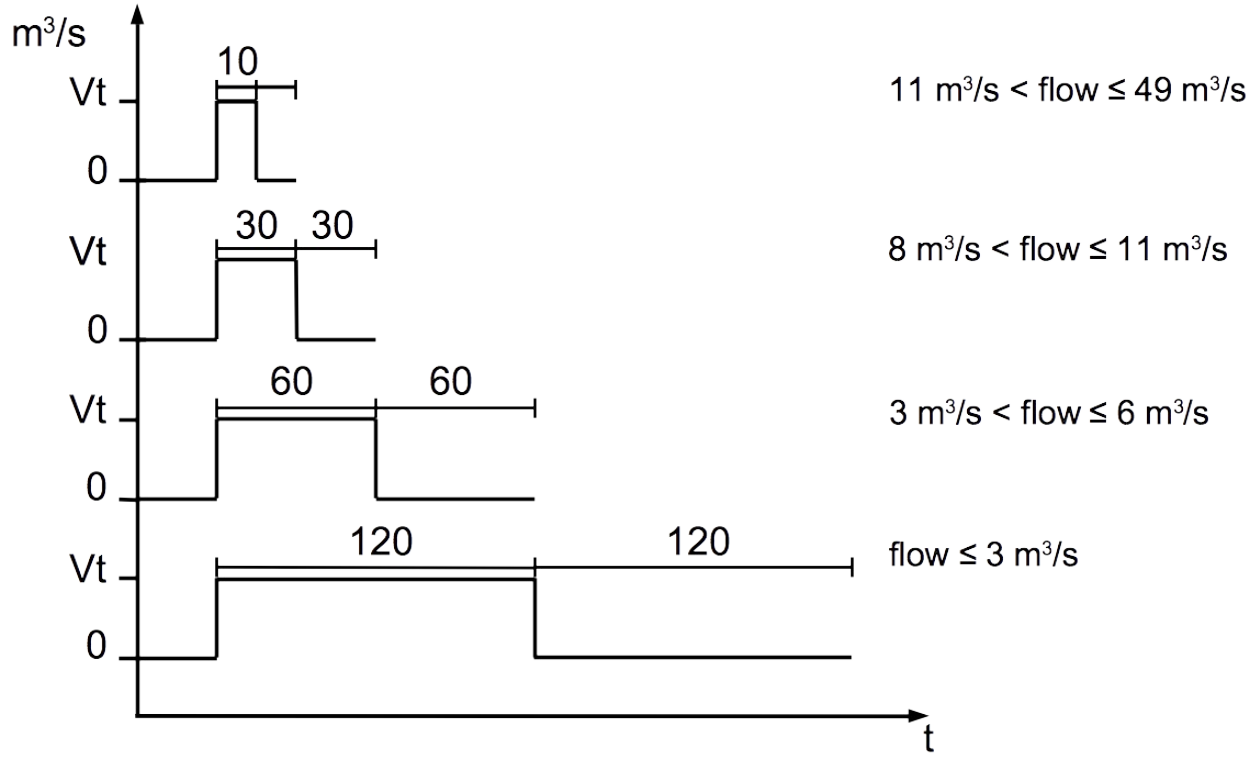
10.1 Analog output

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.

10.2 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 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^3/s, l/s of ft^3/s, the S430 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^3, the sensor will send one pulse each 10 m^3.

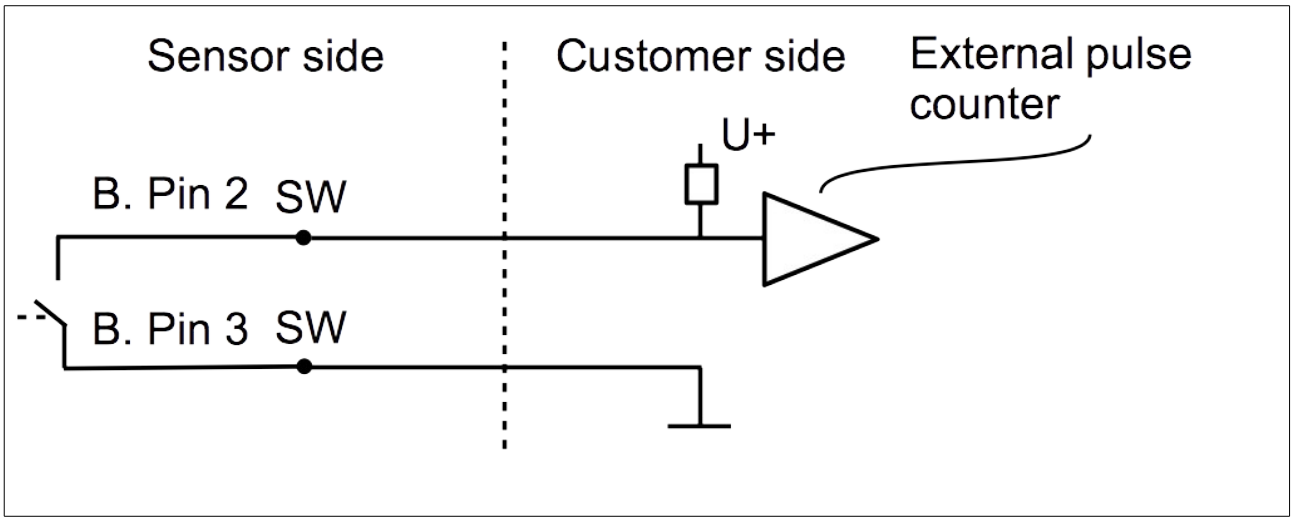
Example:

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

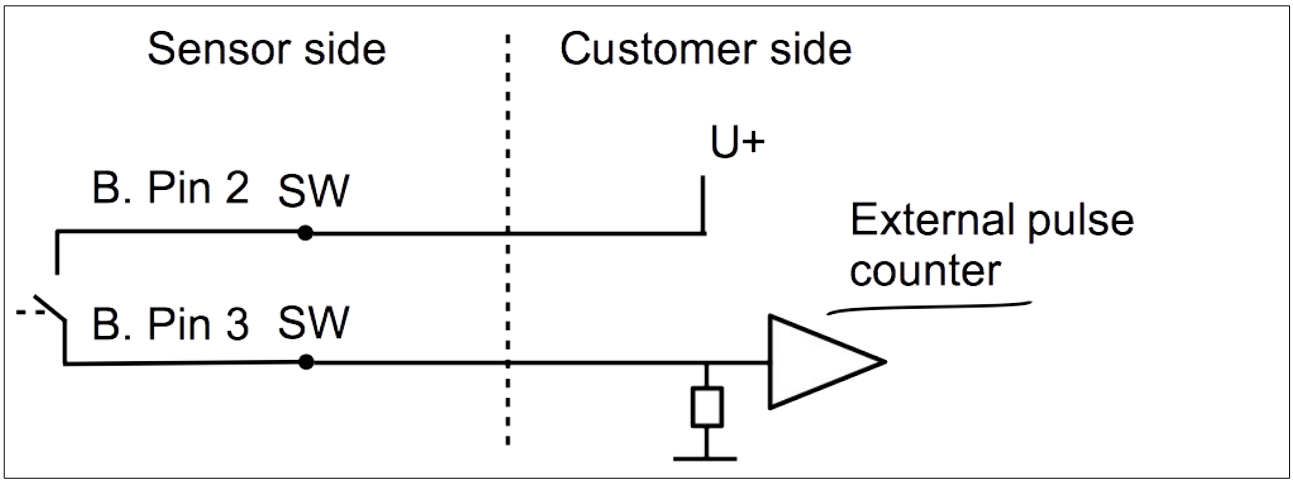
10.3 Pulse connection diagram

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

Variant 1:



Variant 2:



10.4 Modbus output

Mode	:	RTU	TCP
Baud rate	:	19200	
Device address	:	Last two digits of serial number	
Framing / parity / stop bit	:	8, N, 1	N/A
Response time	:	1 second	
Response delay	:	0 ms	
Inter-frame spacing	:	7 char	
DHCP	:		Yes
MAC	:		Set ex-factory
IP address	:	N/A	Dynamic or Static
Subnet	:		User configuration
Gateway	:		User configuration

Remark: Modbus communication settings can be changed by the service App S4C-FS.

Modbus holding register (Modbus/RTU and Modbus/TCP)

Channel description	Resolution	Format	Length	Modbus register address
Gas temperature	0.1	FLOAT	4-Byte	0
Pressure	0.001	FLOAT	4-Byte	2
Velocity	0.1	FLOAT	4-Byte	4
Flow	0.1	FLOAT	4-Byte	6
Consumption	1.0	UNIT32	4-Byte	8
Reverse velocity	0.1	FLOAT	4-Byte	10
Reverse flow	0.1	FLOAT	4-Byte	12
Reverse consumption	1.0	UNIT32	4-Byte	14
System status	1.0	UNIT32	4-Byte	24

Remark: The physical units are configurable using the service App S4C-FS.

Byte order

In the response message that the device returns to the master:

- Function code: 03
- Byte order (32-bit data): MID-LITTLE-ENDIAN.
- To properly decode the 4-byte float and unsigned integer data in the response message, the master must change the byte order from MID-LITTLE-ENDIAN to the order that it is using (LITTLE-ENDIAN or BIG-ENDIAN).

Byte sequencing

Byte order	Byte sequencing (HEX)	Example
MID-LITTLE-ENDIAN (Read from the device)	A B C D	0x 0A 11 42 C5
LITTLE-ENDIAN	B A D C	0x 11 0A C5 42
BIG-ENDIAN	C D A B	0x 42 C5 0A 11

Interpretation of system status

The device provides the device statuses via Modbus as well. The 32-bit data information is read as single bits. The meanings of these bits are described as follows.

Bit	Description	Bit	Description
2	Measurement over range	9	Pressure sensor broken
3	Temperature over range	10	Temperature sensor broken
4	Pressure over range	11	NTC broken
5	Pulse over range	15	Flow direction: 0: standard 1: reverse
6	Calibration overdue	16	BT module connected
8	Differential pressure sensor broken		

10.5 M-Bus output

Value register:

M-Bus Addr.	Description	Data bytes
1	Total consumption	4-byte
2	Flow	4-byte
3	Temperature	4-byte
4	Pressure	4-byte
5	M-Bus status	4-byte

Communication parameters

Primary Address : 1
Secondary Address : 8-digit serial number of the sensor
Manufacturer Code : 0x15C4
M-Bus version : 1
Baud rate : 2400
Response delay (ms) : 7
Response timeout (ms) : 100
Receive timeout (ms) : 500

11 Calibration

The sensor is calibrated before delivery. The calibration date is printed on the certificate which is shipped with the sensor. The accuracy of the sensor is regulated by the on-site conditions. Parameters such as oil, high humidity or other impurities can affect the calibration and furthermore the accuracy. We recommend you calibrate the sensor at least once a year. The calibration is excluded from the product warranty. For more information, 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 must 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 device, 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. Please contact the manufacturer for details.

14 Appendix A – Flow measurement ranges

14.1 Volumetric flow ranges

Stated measuring ranges under following conditions:

- Standard flow in air
- Reference pressure: 1000 hPa
- Reference Temperature: +20°C

Tube		**Volumetric Flow**					
Inch	mm	m^3/h		m^3/min		cfm	
		Min	Max	Min	Max	Min	Max
1¼”	36	50	507	0.85	8.5	29.3	298.6
1½”	41.9	74.2	756.5	1.26	12.6	43.7	445
2”	53.1	127.3	1298	2.16	21.6	75	764
2½”	68.9	223	2273	3.79	37.9	134	1338
3”	80.9	318	3176	5.29	52.9	183	1869
4”	100	491	4880	8.13	81.3	289	2872
5”	125	767	7624	12.8	127.1	451	4487
6”	150	1106	10996	18.4	183.3	651	6471
8”	200	1973	19611	32.9	326.9	1161	11541
10”	250	3082	30642	51.4	510.7	1814	18033
12”	300	4439	44125	73.54	735.4	2612	25967
Flow range for Air at 6 barg, 50°C and 90% humidity. For other gas and condition please download Flow Range software from www.suto-itec.com							

14.2 Analog output

Scaling table analogue output (standard range):

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

Tube		Flow							
inch	mm	m^3/h	m^3/min	l/min	l/s	cfm	kg/h	kg/min	kg/s
1 1/4"	32.80	472.10	7.87	7868.3	131.14	277.9	560.7	9.35	0.16
	36.00	574.57	9.58	9576.2	159.60	338.2	682.5	11.37	0.19
	36.30	584.93	9.75	9748.9	162.48	344.3	694.8	11.58	0.19
1 1/2"	39.30	691.72	11.53	11528.7	192.15	407.1	821.6	13.69	0.23
	40.00	717.49	11.96	11958.2	199.30	422.3	852.2	14.20	0.24
	41.80	787.47	13.12	13124.5	218.74	463.5	935.3	15.59	0.26
	43.10	840.36	14.01	14006.0	233.43	494.6	998.2	16.64	0.28
	45.80	953.69	15.89	15894.9	264.92	561.3	1132.8	18.88	0.31
2"	50.00	1145.11	19.09	19085.2	318.09	674.0	1360.1	22.67	0.38
	51.20	1202.22	20.04	20037.0	333.95	707.6	1428.0	23.80	0.40
	53.10	1294.69	21.58	21578.2	359.64	762.0	1537.8	25.63	0.43
	54.50	1365.54	22.76	22759.1	379.32	803.7	1622.0	27.03	0.45
	57.50	1529.37	25.49	25489.4	424.82	900.2	1816.5	30.28	0.50
	60.00	1669.32	27.82	27821.9	463.70	982.5	1982.8	33.05	0.55
	64.20	1918.19	31.97	31969.9	532.83	1129.0	2278.4	37.97	0.63
2 1/2"	65.00	1968.69	32.81	32811.4	546.86	1158.7	2338.3	38.97	0.65
	68.90	2214.70	36.91	36911.7	615.19	1303.5	2630.6	43.84	0.73
	70.30	2311.21	38.52	38520.1	642.00	1360.3	2745.2	45.75	0.76
	71.10	2364.11	39.40	39401.8	656.70	1391.5	2808.0	46.80	0.78
	76.10	2714.85	45.25	45247.5	754.13	1597.9	3224.6	53.74	0.90
3"	80.00	3003.87	50.06	50064.4	834.41	1768.0	3567.9	59.46	0.99
	82.50	3198.39	53.31	53306.5	888.44	1882.5	3798.9	63.32	1.06
	84.90	3387.18	56.45	56453.1	940.88	1993.6	4023.2	67.05	1.12
	90.00	3810.93	63.52	63515.5	1058.59	2243.0	4526.5	75.44	1.26
4"	100.00	4710.50	78.51	78508.4	1308.47	2772.5	5595.0	93.25	1.55
	107.10	5409.63	90.16	90160.5	1502.67	3184.0	6425.4	107.09	1.78
	110.00	5706.55	95.11	95109.2	1585.15	3358.8	6778.1	112.97	1.88
5"	125.00	7377.83	122.96	122963.9	2049.40	4342.4	8763.2	146.05	2.43
	133.70	8440.57	140.68	140676.1	2344.60	4967.9	10025.4	167.09	2.78
6"	150.00	10636.80	177.28	177280.1	2954.67	6260.6	12634.1	210.57	3.51
	159.30	11996.66	199.94	199944.3	3332.40	7061.0	14249.3	237.49	3.96
	182.50	15764.26	262.74	262737.7	4378.96	9278.5	18724.3	312.07	5.20
	190.00	17086.58	284.78	284776.3	4746.27	10056.8	20294.9	338.25	5.64
8"	200.00	18955.11	315.92	315918.6	5265.31	11156.6	22514.3	375.24	6.25
	206.50	20207.22	336.79	336787.0	5613.12	11893.5	24001.5	400.03	6.67
10"	250.00	29652.71	494.21	494211.8	8236.86	17452.9	35220.6	587.01	9.78
	260.40	32209.47	536.82	536824.6	8947.08	18957.8	38257.4	637.62	10.63
12"	300.00	42750.79	712.51	712513.2	11875.22	25162.2	50778.1	846.30	14.11
	309.70	45560.04	759.33	759334.0	12655.57	26815.6	54114.8	901.91	15.03
	339.60	54781.89	913.03	913031.5	15217.19	32243.4	65068.2	1084.47	18.07
	400.00	76001.41	1266.69	1266690.2	21111.50	44732.8	90272.1	1504.54	25.08

15 Appendix B - Modbus communication example

03 (0x03) Read holding register

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
Starting address Hi	1 byte	Byte count	1 byte
Starting address Lo	1 byte	Register Hi	1 byte
No. of points Hi	1 byte	Register Lo	1 byte
No. of points Lo	1 byte	:	:
CRC	2 bytes	Register Hi	1 byte
		Register Lo	1 byte
		CRC	2 bytes

05 (0x05) Write single coil

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
Coil address Hi	1 byte	Coil address Hi	1 byte
Coil address Lo	1 byte	Coil address Lo	1 byte
Data Hi	1 byte	Data Hi	1 byte
Data Lo	1 byte	Data L	1 byte
CRC	2 bytes	CRC	2 bytes

16 (0x10) Write multiple registers

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
Starting address Hi	1 byte	Starting address Hi	1 byte
Starting address Lo	1 byte	Starting address Lo	1 byte
No. of registers Hi	1 byte	No. of registers Hi	1 byte
No. of registers Lo	1 byte	No. of registers Lo	1 byte
Byte count	1 byte	CRC	2 bytes
Data Hi	1 byte		
Data Lo	1 byte		
:	:		
Data Hi	1 byte		
Data Lo	1 byte		
CRC	2 bytes		

17 (0x11) Report slave ID

Request		Response	
Slave address	1 byte	Slave address	1 byte
Function code	1 byte	Function code	1 byte
CRC	2 bytes	Byte count	1 byte
		Slave ID	2 bytes
		Device run indicator	2 bytes
		Product code	2 bytes
		Product name	20 bytes
		CRC	2 bytes

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