SCHMIDT® Technology

SCHMIDT® Flow Sensor
SS 23.400 ATEX 3
Instructions for Use

SCHMIDT® Flow Sensor

SS 23.400 ATEX 3

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Version 514622.02B

Subject to modifications

1 Important information

These instructions for use contain all the required information for fast commissioning and safe operation of **SCHMIDT® flow sensors:**

- These instructions for use must be read completely and observed carefully, before putting the unit into operation.
- Any claims under the manufacturer's liability for damage resulting from non-observance or non-compliance with these instructions will become void.
- Tampering with the device in any way whatsoever - with the exception of the designated use and the operations described in these instructions for use - will forfeit any warranty and exclude any liability.
- The unit is designed exclusively for the use described below (see chapter 0). In particular, it is not designed for direct or indirect personal protection.
- **SCHMIDT Technology** cannot give any warranty as to its suitability for certain purpose and cannot be held liable for accidental or sequential damage in connection with the delivery, performance or use of this unit.

Symbols used in this manual

The symbols used in this manual are explained in the following section.

Danger warnings and safety instructions - read them carefully!

Non-observance of these instructions may lead to injury of the personnel or malfunction of the device.

Risk of explosion - read carefully!

Important instructions for use in areas subject to explosion hazards.

General information

Operate the sensor only with the original SCHMIDT Technology connecting cable (see chapter 4 Electrical connection).Use of any other cable makes the ATEX approval null and void.

Only suitable for use in clean gases.

The medium to be measured must not contain oils, residue forming substances or abrasive particles.

When transporting the sensor or carrying out not approved cleaning operations, always place the yellow protective cap on the sensor tip.

All dimensions are given in mm.

2 Application range

The **SCHMIDT® flow sensor** is designed for stationary measurements of the flow velocity as well as air and gas temperatures at atmospheric pressure and under clean ambient conditions.

The sensor is based on the measuring principle of the thermal anemometer and measures the mass flow of the measuring medium as flow velocity which is output in a linear way as standard velocity w_N (unit: Nm/s [1]), based on standard conditions of 1013.25 hPa and 20 °C. Thus, the resulting output signal is independent from the pressure and temperature of the measuring medium.

The essential characteristics of the product are listed below:

- Measuring task
  - Measurement of the flow velocity
  - Detection of the flow direction (bidirectional measurement, optional)
- Application examples
  - Laminar-flow monitoring in cleanrooms
  - Monitoring of the room cross-flow
  - Cooling air monitoring
  - Flow measurement in test benches
  - Draft monitoring
- Use in areas subject to explosion hazards

  The device can be installed only in hazardous areas with gases (G) and in Zone 2.

Notes:

Only suitable for use in clean gases.

The medium to be measured must not contain oils, residue forming substances or abrasive particles.

[1] Nm/s: Standard meter per second

3 Mounting instructions

Three different holder types covering the most important applications are available as accessories (see Table 1) for the installation of the **SCHMIDT® flow sensor**.

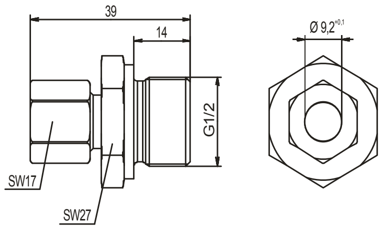
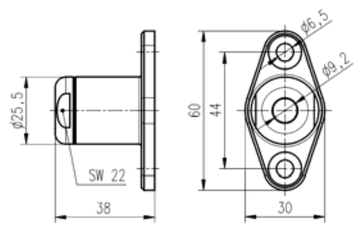
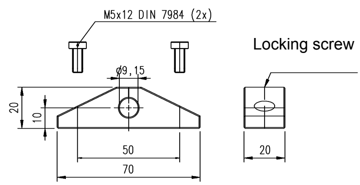
Type / article No.	Drawing	Mounting
Through bolt joint V4A 301 082		Used as: - Immersion sensor To be fixed on: - Pipe (typ.) - Wall Fixed by means of: - Screwing into a welding stud[2] Material: - Stainless steel 1.4571 - Clamping ring PTFE
Wall mounting flange 520 181		Used as: - Immersion sensor To be fixed on: - Wall - plain surface To be fixed by means of: - 2 screws M5[3] Material: - Stainless steel 1.4571 - Clamping ring PTFE - O ring Viton
Wall mounting bracket 503 895		Used for: - Room cross-flow To be fixed on: - Wall - plain surface To be fixed with: - 2 screws M5 x 12[4] Material: - Anodized aluminum

Table 1

All types attach the sensor by clamping the sensor tube with a friction fit. This allows stepless positioning of the sensor on the holder in the axial

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[2] A common welding stud (not included in the scope of delivery) must be welded.
[3] Countersunk head, not included in the scope of delivery.
[4] Included in the scope of delivery.

direction of the longitudinal sensor axis (immersion depth) and in rotational direction around the same axis (tilting).

- The angle of tilting[5] to the flow direction should not exceed ±5° in order to avoid significant measuring errors (> 1%).
- In inhomogeneous, laminar flow fields (for example a quasi-parabolic speed profile in a pipe), the sensor tip should be positioned at point with the highest speed (adjustment of the immersion depth) because this position normally has the largest distance to interfering elements such as boundary surfaces.

Both the through-bolt joint as well as the wall mounting flange are pressure-tight up to an overpressure of 500 mbar provided the installation has been carried out properly [6]. The customer bears the responsibility for securing the sensor against unintended discarding due to overpressure.

Flow with medium separation

To ensure the enclosure type of protection IP54 observe the following mounting drawing for media-separated installation using the through-bolt joint or wall mounting flange (see for example Figure 3-1).

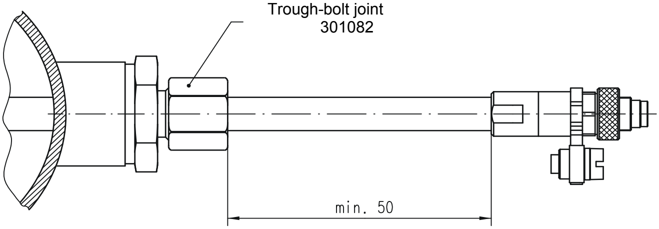

Figure 3-1

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[5] Deviation between the measurement direction of the sensor tip and the flow direction
[6] The screw-in thread of the through-bolt joint must be sealed for this purpose, for example by means of a copper seal or Teflon tape.

Pipe-related flow

The installation in a flow-guiding pipe is carried out by means of a through-bolt joint 301082 (see Figure 3-1):

- Screw the threaded part of the through-bolt joint into the pipe union (hexagon with AF27).
  - ➢ If pressure tightness is required, first, seal the thread (e.g. wrap it with a Teflon tape).
- Unscrew the spigot nut (AF17) to such an extent that the sensor can be inserted without jamming.
- Remove the protective cap from the sensor tip and insert the sensor into the guide of the DG so that its tip is in the middle of the pipe.
- Tighten the spigot nut slightly by hand or with a fork wrench (AF17) to fasten the sensor.
- Align the sensor according to the nominal flow direction (direction of the arrow) (the immersion depth must be maintained).

  ⚠ The angular deviation should not exceed ±5° relatively to the ideal position. Otherwise, the measurement accuracy may be impaired.
- To tighten the spigot nut, turn the fork wrench (AF17) a quarter of a turn. While doing this hold the sensor to ensure that it remains in position.

To reach the accuracy specified in the data sheets, the sensor has to be positioned in a straight pipe section with undisturbed flow profile. An undisturbed flow profile can be achieved if a sufficiently long distance in front of the sensor (run-in distance) and behind the sensor (run-out distance) is held absolutely straight without disturbances (such as edges, seams, bends etc.).

The design of the run-out distance is also important, since disturbances do not only act **in** the direction of the air flow but also lead to turbulences **against** the flow direction.

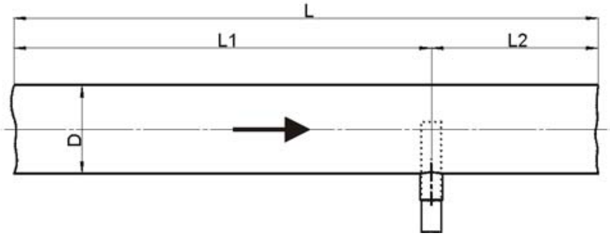


Figure 3-2

L	Length of the entire measuring distance
L1	Length of the run-in distance
L2	Length of the run-out distance
D	Diameter of the measuring distance

The following Table 2 specifies the required straight lengths of the pipe section depending on the pipe diameter in case of different disturbances.

Flow obstacle upstream of the measuring distance	Minimum length of the run-in distance (L1)	Minimum length of the run-out distance (L2)
Light bend (< 90°)	**10 x D**	**5 x D**
Reduction (the pipe diameter is reduced relatively to the measuring distance)	**15 x D**	**5 x D**
Expansion (the pipe expands to the measuring distance)	**15 x D**	**5 x D**
90° bend or T-junction	**15 x D**	**5 x D**
Two 90° bends in one plane (2-dimensional)	**20 x D**	**5 x D**
Two 90° bends with 3-dimensional change of direction	**35 x D**	**5 x D**
Shut-off valve	**45 x D**	**5 x D**

Table 2

This table lists the *minimum values* required in each case. If it is not possible to observe the specified run-in and run-out distances, increased deviations of the measurement result are to be expected, to avoid this it is necessary to take additional measures, for example to use flow rectifiers[7]. Under laminar conditions a quasi-parabolic speed profile emerges over the pipe cross-section, whereas the flow velocity at the pipe walls remains almost zero and in the pipe center it reaches the optimum measuring point, its maximum reaches w_N. This measuring parameter can be converted to speed in the middle $\overline{w_N}$ constant over the pipe cross-section using a correction factor, the so called profile factor PF.The profile factor depends on the pipe diameter[8] and is given in Table 3.

PF	Pipe Ø		Measuring range of volumetric flow [m³/h]			
	Inner [mm]	Outer [mm]	for sensor measuring range			
			1 m/s	2.5 m/s	5 m/s	10 m/s
0.710	70.3	76.1	10	25		99
0.710	76.1	82.5	12	29		116
0.720	82.5	88.9	14	35		139
0.740	100.8	108.0	21	53		213
0.750	107.1	114.3	24	61		243
0.760	125.0	133.0	34	84		336
0.775	131.7	139.7	38	95		380
0.795	150.0	159.0	51	126		506
0.810	159.3	168.3	58	145		581
0.820	182.5	193.7	77	193		772
0.840	206.5	219.1	101	253		1,013
0.840	260.4	273.0	161	403		1.610
0.845	309.7	323.9	229	573		2,292
0.845	339.6	355.6	276	689		2,755
0.850	388.8	406.4	363	908		3,633
0.850	437.0	457.0	459	1.147		4,590
0.850	486.0	508.0	568	1.419		5,677
0.850	534.0	559.0	685	1.713		6,853
0.850	585.0	610.0	822	2,056		8,225
0.850	631.6	660.0	959	2,397		9,587

Table 3

[7] For example honeycombs made of plastic or ceramics.
[8] Both inner air friction as well as locking using the sensor can be applied.

Thus, it is possible to calculate the standard volumetric flow of the medium using the measured standard flow velocity in a pipe with known inner diameter:

$$A = \frac{\pi}{4} \cdot D^2$$

-{}- $$\overline{w}_N = PF \cdot w_N$$

$$\dot{V}_N = \overline{w}_N \cdot A \cdot EF$$

D	Inner diameter of the pipe [m]
A	Cross section of the pipe [m^2]
w_N	Flow velocity in the middle of the pipe [m/s]
$\overline{w}_N$	Flow velocity in the middle of the pipe [m/s]
PF	Profile factor (for pipes with circular cross-section)
EF	Measuring unit factor (conversion to non-SI units)
$\dot{V}_N$	Standard volumetric flow [m^3/s]

Flow behind a wall

The wall mounting flange 520 181 is designed for the installation of the flow sensor SS 23.400 as an immersion sensor through a (locally even) wall (e.g. wall of a flow box). In general, the flange differs from the though-bolt joint only by the type of fastening on the wall. The threaded bush included in the delivery has a broadened base provided with a plane contact surface and two holes that allow a fast and easy installation by means of two screws.

Apart from that all advantages, requirements and installation instructions for the through-bolt joint regarding the permanent sensor installation apply (see subchapter Pipe-related flow).

Mounting as a cross-flow sensor

The mounting as a cross-flow sensor is carried out by means of a wall mounting bracket 503895[9]. Ideally, the sensor must be placed in the direction of the flow behind the hole. The sensor tip must be located in the middle of the opening.

To ensure the type of protection IP54, the following mounting drawing must be observed (Figure 3-3).

[9] Mounting kit including screws

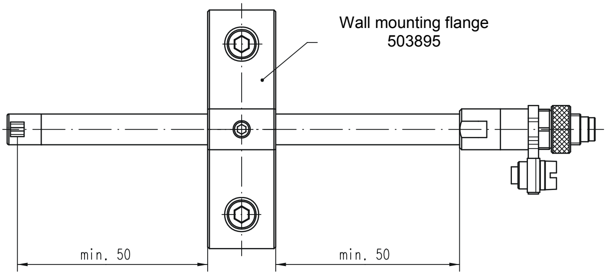


Figure 3-3

ATEX Installation regulation

The sensor must be installed properly in the following order:

- Mechanical installation

  See previous subchapter

- Connection of the equipotential bonding

  The metallic enclosure of the sensor must have electrical connection to a ground conductor or an equipotential bonding conductor according to EN 60079-0 chapter 15. The expression „electrical connection“ does not always require a conductor; for example, the equipotential bonding can also be implemented by means of a grounded holder which is in permanent electric, low-resistance contact with the sensor enclosure[10]. When using a cable the locking screw at the plug-in connector of the sensor is designed for this purpose.

  In general the following applies for the grounding:

  - The external ground connection on the enclosure must be connected to the equipotential bonding of the Ex area with low resistance.
  - No equipotential current must flow between the Ex areas and non-hazardous areas.

[10] However, the types of holders supplied by SCHMIDT Technology are not suitable for this purpose.

- Minimum cable cross-section: 1 x 4 mm^2
- The screw must be firmly tightened at the terminal so that the conductor cannot be loosened or twisted.

- Connecting the cable
  - Connect the shield meshwork (in the non-hazardous area) to the ground potential on a large surface.
  - No equipotential current must flow between the Ex areas and non-hazardous areas.

- Labeling

The rating plate for labeling according to the standards is fixed at the sensor by means of a wire loop.

If required, the customer can attach this plate at another place provided that it can be clearly assigned to the sensor and is legible and undetachable. Examples are:

- Mounting it directly at the sensor by means of machine screws through the fixing hole.
- Mounting it undetachably onto the wall according to
- EN 60079-0, chapter 29.6. The side with the warning note "Do not disconnect under voltage" must remain visible.

4 Electrical connection

Plug-in connector

The sensor is equipped with a plug-in connector which is firmly integrated in the housing. The connector has the following data:

Number of connection pins:	7 (plus shield connection on the metallic housing)
Type:	male
Fixation of connecting cable:	Screw M9 (spigot nut on the cable)
Protection type:	IP67 (with screwed cable)
Model:	Clip, series 712

View of plug-in connector of the sensor

WARNING!
DO NOT DISCONNECT THE CONNECTING CABLE AND THE SENSOR WHEN THEY ARE UNDER VOLTAGE!

Figure 4-1

Pin assignment

The pin assignment of the plug-in connector is given in the following Table 4.

Pin	Designation	Function	Wire color Connecting cable
1	Power	Operating voltage U_B	white
2	TXD	RS232	brown
3	RXD	RS232	green
4	OC1	Switching output 1: Direction or switch threshold	yellow
5	OC2	Switching output 2: Switch threshold	gray
6	Analogue	Velocity signal	Pink
7	Ground	Mass	Blue
	Shield	Electromechanical shielding	Shield meshwork

Table 4

All signals use the electric reference potential GND.

The cable shield is continuously connected to the metallic housing of the plug-in connector and the sensor and must be connected to an anti-interference potential, e.g. ground (depending on the shielding concept).

The wire color mentioned in table 4 is applicable for the use of a SCHMIDT® cable with material No. 505911-x (x = 1 / 2 / 3).

The ATEX approval is valid only when the cable by SCHMIDT® mentioned above with material No. 505911-x (x = 1 / 2 / 3) is used.

Only operate the sensor in the defined voltage range (7.5 ... 26.4 V_{DC}) [11] . Undervoltage may result in malfunction. Overvoltage may lead to irreversible damage to the sensor.

Electrical assembly

Prior to carry out operations such as assembly, electrical connection, repair work or loosening a plug-in connector, make sure that

- The system is disconnected from the mains.
- The system cannot be switched on inadvertently.

The following safety measures must be observed in hazardous areas:

- Check if the device category corresponds to the specified zones.
- Check if the operation approval from the operator is available.
- Check if there is an explosive atmosphere available.
- Compliance with the applicable regulations and the entire relevant documentation for this device.

[11] See table 5

Operating voltage

The flow sensor is protected against a polarity reversal of the operating voltage.

It has a nominal voltage range of U_B = 7.5 ...26.4 V_{DC}, whereby the minimum operating voltage $U_{B,min}$ depends on the dimensioning of the analog signal output (see Table 5).

Analog output type	Signaling range	$U_{B,min}$
Current	0 / 4 ... 20 mA	12 V
Voltage	0 ... 10 V	12 V
	0 ... 2 / 5 V	7,5 V

Table 5

The current consumption of the sensor is lower than 10 mA (the signal currents are not taken into account).

During communication with the RS232, the current consumption increases by another 10 mA.

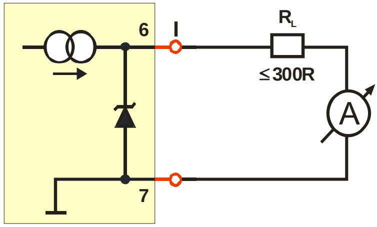
Wiring of analog output

The analog output is protected against a short circuit towards the operating voltage or the mass.

It is available in two basic versions which differ in the representation range (final value) (see Table 5):

Current interface:

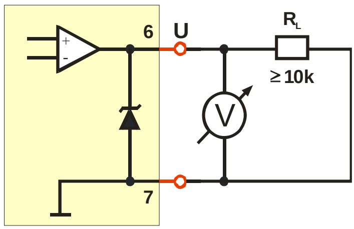
Versions:	0 ... 20 mA, 4 ... 20 mA
Type:	High side driver, load resistance against mass
Maximum load resistance R_L:	300 Ω
Maximum load capacity C_L:	100 nF
Maximum cable length:	100 m
Wiring:	



Analog output Current interface

Voltage output:

Versions:	0 ... 2 V, 0 ... 5 V, 0 ... 10 V
Type:	High side driver, load resistance against mass
Minimum load resistance R_L:	10 kΩ
Maximum load capacity C_L:	10 nF
Maximum short-circuit current:	50 mA
Maximum cable length:	15 m
Wiring:	



Analog output Voltage interface

Due to the resistance of the connecting cable[12] , a voltage drop of up to 290 mV may occur (mass offset) if the maximum length L = 15 m is used and the maximum operating voltage $I_{B,max}$ = 140 mA is applied to each wire.

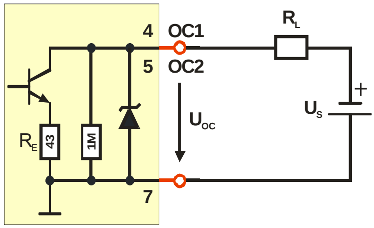
The voltage drop in the GND wire of the connecting cable can affect the analog signal at the voltage output.

[12] Special resistance value of the standard cable (0.14 mm^2): 0.138 Ω/m at ϑ = 20 °C

Wiring of switching output

The sensor is equipped with two current limited and short-circuit resistant switching outputs with the following technical data:

Type:	Low side driver, open collector
Maximum switching voltage $U_{S,max}$:	26.4 V_{DC}
Maximum switching current $I_{S,max}$:	65 mA (typ. 60 mA)
Maximum off-state resistance R_{Off}:	1 MΩ [13]
Minimum load resistance $R_{L,\,min}$:	depending on the switching voltage U_S (see below)
Maximum load capacity C_L:	depending on the switching current I_S (see below)
Maximum cable length:	100 m
Wiring:	



The individual switching outputs can be used as follows:

- Direct driving of ohmic or inductive loads (e.g. LED or relays) with a maximum power consumption of 65 mA.
- Direct activation of digital inputs with integrated pull-up resistor (e.g. PLC input).

Due to the measuring resistance R_M of 1 MΩ connected in parallel to the transistor, the switching stage has a comparatively low off-state resistance. In case of a low resistance load, this is of no importance but it must be taken into account in case of a high resistance pull-up resistance R_L . For a digital evaluation, we recommend to choose the R_L value in a way that the active high level in case of a locked transistor is 10% below the switching voltage U_S:

$$R_{L,\max} = \frac{R_M}{\frac{U_S}{U_{R_L}} - 1} = \frac{R_M}{\frac{U_S}{0{,}1 \cdot U_S} - 1} = \frac{R_M}{9} \approx 110 k\Omega$$

[13] Switching transistor, additional leakage current of the TVS diode ($U_{OC} \approx U_{S,max}$) connected in parallel: < 100µA

Thanks to the open collector design, the switching outputs can switch a switching voltage U_S which is independent of the operating voltage U_B of the sensor. Therefore, they do not behave, even in connection with the protective mechanisms, like ideal switches but in conductive condition there is always an open circuit voltage U_{OC} resulting from the switching stage so that there are the following restrictions:

- Below the maximum current $I_{S,max}$, the open circuit voltage U_{OC} results from the voltage drop via the emitter resistance R_E plus residual voltage over the collector emitter distance of the switching transistor:

$$U_{OC} \approx 43\Omega \cdot I_S + 0{,}2V$$

- If the maximum current is almost reached, the emitter resistance locks the switching transistor by an inverse feedback applying an increasing switching current so that the voltage drop over the transistor (from $U_{OC} \approx 2.6$ V) rises significantly while the current remains constant (analog current limiting).

- From this borderline case, the minimum allowed (static) load resistance $R_{L,min}$ at an actually active switching voltage U_S can be calculated[14]:

$$R_{L,\min} = \frac{U_S - 2{,}6V}{0{,}065A}$$

  Example:

  The maximum switching voltage of $U_{S,max}$ = 26.4 V is $R_{L,min}$ 366 Ω.

- If the load resistance is too low or if there is a short circuit, the excess heat resulting from the open circuit voltage U_{OC} > 8 V may destroy the switching output. If this critical voltage is exceeded, a digital short-circuit protection will be active. It switches the output off for approx. 300 ms (transistor closes) and on again (transistor opens). If the open circuit voltage is still above the critical value, the output is switched off within 1 ms for another 300 ms. This procedure is carried out until the cause of the faulty switching is eliminated.

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[14] The basic current of the switching transistor is negligible.

Due to the high capacitive load portion, the switching-on current impulse can trigger the quick-reacting short-circuit protection (permanent) although the static current requirement is below the maximum current $I_{S,max}$.

An additional resistance connected in series to the load capacity can eliminate the problem.

- Each switching output is protected against voltage peaks by a unipolar TVS diode[15] . Positive voltage impulses, e.g. due to ESD sparks or and inductive load, at the connecting pin are limited to approx. 30 V, negative impulses are short-circuited against mass (conducting-state voltage of a diode).

Wiring of serial interface

The sensor is equipped with data lines TxD and RxD of a serial interface of the RS232 type with integrated V24 level driver.

The serial interface of the sensor can only be used together with the programming interface of SCHMIDT Technology. Other connections may lead to irreversible damages.

[15] Transient Voltage Suppressor Diode

5 Signaling

Analog output

The analog sensor output reports the measured flow speed in a proportional way.

The following is applicable for all output versions:

- Overflow:

  Flow speeds which exceed the measuring range are output in a linear way up to 110% of the measuring range (end value + 10%), to signalize clearly that there is an overflow. The output signal remains constant.

- Indication of the flow direction[16]:

  According to the type, the sensor can measure the flow only in one (unidirectional) or in both directions (bidirectional). For the indication of the direction there are different possibilities in combination with the switching output OC1 (see also next item Switching outputs).

  In a unidirectional version (see figure 5-1), the switching output OC1 is used to signalize clearly a zero flow (factory setting[17]). The output transistor locks if the flow is higher than 0 m/s and conducts if it is lower or equal to 0 m/s.

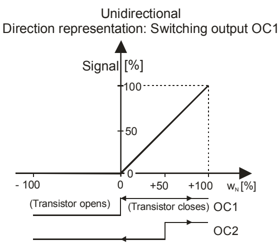

Figure 5-1

To distinguish between positive and negative flow direction, the bidirectional versions use the switching output OC1 (see Figure 5-2) or the representation area of the analog signal output is halved, that

[16] Based on the nominal measurement direction of the sensor tip defined positively.
[17] OC1 can be configured to an optional threshold value within the measuring range.

means that the zero flow is located at 50% of the measuring range (see figure 5-3).

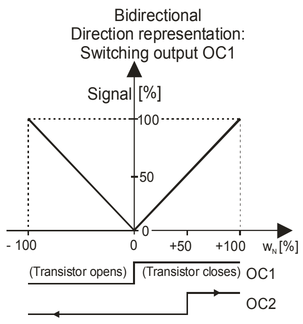

Figure 5-2

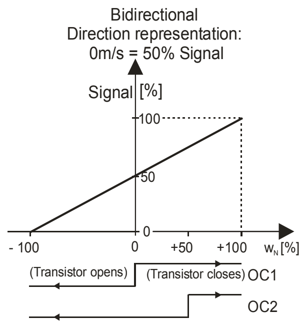

Figure 5-3

- Error signaling:

  All output variant with an indication range starting with zero (0 ... 2 / 5 / 10 V and 0 ... 20 mA) are set to zero.

  The 4 … 20 mA current interface signalizes 2 mA according to the NAMUR specification.

Switching outputs

The switching outputs are used as threshold value switches, i.e. they change their switching condition in the normal measuring operation as soon as the measured flow velocity exceeds or falls below the respective value.

- Switching hysteresis:

  The threshold value is symmetrically superimposed by a fixed hysteresis. The hysteresis width is 5% of the threshold value but is at least 0.05 m/s and is not configurable.

- Switching polarity:

  The switching polarity is defined as the change in direction of the switching state during a defined procedure (from "locked" to "conductive" or vice versa).

  Both switching outputs are configured in factory to a positive polarity that means that the previously conductive transistor locks if the switching threshold is exceeded (and, in connection with the switching load R_L, switches to a positive voltage level of U_S).

  The switching polarity is always configurable (for more detailed information, please refer to the instructions of use "Programming Tool SS 20.4xx").

- Configuration OC1:

  If the analog indication area of the bidirectional version corresponds to the amount of the measuring range, OC 1 is used to signalize the direction (see Figure 5-2).

  Otherwise it is used as a freely programmable threshold switch that is set in factory to a threshold value of 0 m/s.

- Configuration OC2:

  OC2 can generally be used as a freely programmable threshold switch and per default the middle of the positive measuring range is considered as the threshold value.

- Error messaging:

  Both switching outputs are conductive independently of the configured switching polarity.

6 Commissioning

Before switching on the device the following checks have to be carried out:

- Check the tight seat of all screws:
  - Connection terminals, PE and equipotential bonding terminals
  - Plug-in connector
- Check:
  - The tight fit of the spigot nut on the connecting cable connector.
  - Tightness between sensor connector and connecting cable (flat seal must be correctly inserted in the female cable connector).
- Check if the device is ready for operation:
  - The parameterization for this application case must be carried out.
  - All interfaces, for example inputs and outputs for control purposes must be connected and ready for operation.

5 seconds after switch-on the sensor is ready for operation. If the sensor has another temperature than the ambient temperature, this time is prolonged until the sensor has reached the ambient temperature.

In case of faults or other problems during the installation, the fault table (Table 7) can help you to resolve the problem. If the problems persist, please contact **SCHMIDT Technology**.

To facilitate the commissioning and testing of the flow sensor, the optional tool "Programming Interface" by **SCHMIDT Technology** described in the next subchapter can be used.

Parameterization using Programming Interface

The interface (see figure 6-1) allows the operator to check the function of the flow sensor on site, to configure it or to read out measured values.

The Programming Interface is provided for configuration or test purposes. A continuous operation in the field or using it as a portable device is not recommended.

Figure 6-1

It consists of a programming box, an extension cable for connection of the box and an evaluation and operating software for Windows PCs equipped with an RS232 interface (detailed information can be found in the instructions for use „SCHMIDT Programming Tool SS 20.4xx", Art. No. 505 959.01).

<u>Order data</u>

- Programming kit Art. no. 505 960

<u>Stand-alone operation</u>

The battery-operated programming box is able to test the functionality of the flow sensor independently from the PC by indicating the levels of its signal outputs via LEDs.

- A red LED for each of the two switching outputs.

- A line of ten green LEDs which indicate the current flow (analog signal output) as a quasi-proportional bar graph.

PC operation

With the help of the programming box the operating software communicates directly with the sensor via the integrated RS232 interface and offers the following basic functions:

- Display of operating parameters
  - COM port: Configuration parameters, communication status
  - Sensor: Serial number, software version
- Signal indicators (in real time)
  - Flow velocity Numeric and analog (scale or flowchart)
  - Temperature of the medium to be measured: Numeric and analog (scale)
  - Switching outputs: Switching level, switching polarity
  - Flow quality: Histogram (turbulence intensity calculated via an adjustable number of currently measured values)
- Diagnostic functions

  In case of problems with the flow sensor (e.g. during configuration or if unexpected values are shown), a diagnostic file can be created. **SCHMIDT Technology** can use this file to make an analysis.
- Sensor parameterization

  The programming kit can be used to configure the preset parameters indicated in Table 6:

Parameters	Factory setting	Setting range	Note
Response time	1 s	0.01 … 10 s	
Threshold value OC1	0 m/s	[-100] 0 … + 100 %	Set to 0 m/s for bidirectional version with indication of direction via OC1
Threshold value OC2	50 % of measuring range	[-100] 0 … + 100 %	
Switching polarity OC1/2		Polarity reversible	

Table 6

7 Information concerning continuous operation

Sterilization

The sensor can be sterilized during operation. Approved disinfectants are alcohol (drying without leaving residues) and hydrogen peroxide. If too much alcohol is applied to the sensor, the "soiling detection" can be activated and the analog signal is set to error state (2 mA). As soon as the sensor element is dry, the sensor is automatically reset to its normal function.

⚠ Due to its capillarity, the chamber head gap in the sensor tip can be filled completely with cleaning agent. In this case it might take **more than one hour** until the liquid is evaporated and the sensor works again without problems. To speed up the drying process, the measuring gap can be cleaned by means of a short compressed air blast or similar methods.

Cleaning of the system

If it is necessary at any time to clean the system in which the sensor is integrated using another than mentioned above cleaning agent, protect the sensor tip against exposure to inappropriate cleaning agents by means of the protective cap included in the scope of delivery. This applies especially to cleaning agents that do not dry without leaving residues and cleaning processes during which dirt may come in contact with the sensor tip.

⚠ Before carrying out problematic cleaning measures (e.g. using inadmissible cleaning agents), the (yellow) protective cap included in the delivery must be placed on the sensor element to protect the sensor tip.

See also chapter 8 Service information, subchapter "Cleaning of the sensor tip".

8 Service information

Maintenance

A soiled sensor tip may distort the measured value. Therefore, the sensor tip must be checked for soiling at regular intervals. If the sensor tip is soiled or wetted by a liquid, the sensor sends an error signal via the analog output (2 mA for current output with 4 .. 20 mA, zero signal for all other output versions). In this case clean the sensor as described below. If the error signal does not disappear after cleaning and drying, the sensor must be sent in to the manufacturer for repair.

Cleaning the sensor tip

If the sensor tip is soiled or dusty, it must be carefully cleaned by means of compressed air (avoid strong pressure impulses!). If this procedure is not successful, the sensor tip can be cleaned by immersing and washing it in alcohol which dries without leaving residues (e.g. isopropyl alcohol). As soon as the alcohol has evaporated, the sensor is again ready for operation.

- Do not shake or tap the wet sensor!
- Do not try to clean the sensor tip mechanically in any way. Do not touch the sensor element located in the chamber head. This may irreversibly damage the sensor.
- Do not use aggressive cleaning agent, a brush or other objects, fluffy cloths etc. to clean the sensor tip!
- Inappropriate cleaning agents may leave residues or cake on the sensor element and, therefore, lead to faulty measurements or result in permanent damage to the sensor element.
- If the chamber head gap of the sensor tip is filled with cleaning agent, speed up the drying process by blowing it out if necessary.

Eliminating malfunctions

Possible errors (error images) are listed in Table 7 below. The way to detect an error is described. Furthermore, the possible causes and measures to be taken to eliminate the error are listed.

Error image	Possible cause	Troubleshooting
No output signals (OC = 0 V; A_{Out} = 0 V / 0 mA) No contact to the PC (Prog-Box)	Operating voltage (not available / connected incorrectly)	Check operating voltage and wiring
	Sensor defective	Send in for repair
Error message of the sensor A_{Out} = 2 mA with 4 ... 20 mA interface A_{Out} = 0 mA / 0 V although there is a flow	Sensor element wetted	Wait until the element is dry
		Blow out sensor tip, if necessary
	Sensor element soiled	Clean sensor tip
	Sensor element defective	Send in for repair
Unexpected values **Analog output** Measured w_N is too large / small strong noise / drift	Sensor configuration (measuring range / indication of direction / type of output)	Check order configuration and measurement settings
	Medium to be measured does not correspond to the calibration medium. (Standard medium: Air at 1013 hPa and 20 °C)	Check medium parameters
	Installation conditions (tilting / immersion depth / rotation)	Check installation conditions
	Irregular flow conditions (turbulences / other disturbances)	Check run-in distance, increase damping of the measured values (PC with Prog-Box)
	Sensor element soiled	Clean sensor tip etc.
	Operating voltage (stability / value)	Check operating voltage
	Great fluctuations in pressure and temperature	Check medium parameters
Unexpected values **Switching output**	Configuration	Check configuration
	Faulty wiring Digital short-circuit protection active	Load resistance too small (Increase $R_L > R_{L,min}$) Reduce load capacity C_L or insert serial resistance in front of C_L

Table 7

Transport / Shipment of the sensor

Before transport or shipment of the sensor, the delivered protective cap must be placed onto the sensor tip. Avoid soiling or mechanical stress.

Recalibration

If the customer has made no other provisions, we recommend repeating the calibration at a 12-month interval. To do so, the sensor must be sent in to the manufacturer.

Spare parts or repair

No spare parts are available, since a repair is only possible at the manufacturer's facilities. In case of defects the sensors must be sent in to the supplier for repair.

If the sensor is used in systems important for operation, we recommend you to keep a replacement sensor in stock.

Test certificates and material certificates

Every new sensor is accompanied by a certificate of compliance according to EN10204-2.1. Material certificates are not available.

Upon request, we shall prepare, at a charge, a factory calibration certificate, traceable to national standards.

9 Technical data

Technical data	
Measurement value	Standard velocity w_N of air based on standard conditions 20 °C and 1013.25 hPa
Medium to be measured	Clean air or nitrogen more gases on request
Measuring range w_N	0 ... 1 / 2.5 / 5 / 10 m/s unidirectional or bidirectional
Lower detection limit	0.05 m/s
Measuring accuracy	±(3 % of measured value +0.4% of final value); min. ± 0.05 m/s
Reproducibility	± 2 % of measured value
Response time t_{90}	0.01 ... 10 s (configurable)
Storage temperature	-20 ... +85 °C
Operating temperature	0 ... +60 °C
Humidity range	0 ... 95 % rel. humidity (RH)
Operating pressure	700 ... 1300 hPa
Operating voltage U_B	7.5 ... 24 V DC (±- 10 %)
Current consumption	Type < 10 mA (without electrical load)
Analog output - Current - Voltage	Type selectable on order 0 / 4 ... 20 mA $R_L \leq 300\ \Omega$ 0 ... 10 / 5 / 2 V $R_L \geq 10\ k\Omega$
Switching outputs - Signaling - Model - Electrical data - Adjustment threshold value - Switching hysteresis - Configuration	OC1 and OC2 OC1: Direction or threshold value OC2: Threshold value Open-collector, current-limited and short-circuit-proof $U_{S,\ max}$ = 26.4 V DC, $I_{S,\ max}$ = 65 mA 0 ... 100 % of final value; min. ±0.05 m/s 5 % of switch threshold; min. 0.05 m/s via RS232 (programming kit)
Electrical connection	Plug (male) M9, 7-pin
Line length	15 m max. (voltage output) 100 m max. (current output)
Type of protection	IP 67 (enclosure) IP 67 (plug-in connector) only with correctly connected connecting cable
Mounting	Accessories (see chapter 3)
Dimensions / material - Sensor tip - Probe tube - Probe length - Plug-in connector	 Ø 9 mm x 10 mm — Anodized aluminum Ø 9 mm — Stainless steel 1.4571 L 130 / 200 / 300 mm Ø 14 mm x 40 mm — Stainless steel 1.4571
Weight	approx. 60 g (with 300 mm probe length)

10 EC Declaration of conformity

EG-Konformitätserklärung

SCHMIDT Technology GmbH erklärt, dass das Erzeugnis

SCHMIDT® Strömungs-Sensor **SS 23.400 ATEX 3**

Material-Nr. **513 970**

- den wesentlichen Schutzanforderungen entspricht, die in der Richtlinie des Rates zur Angleichung der Rechtsvorschriften der Mitgliedsstaaten über elektromagnetische Verträglichkeit (**2004/108/EG**) festgelegt sind.

  Kennzeichnung: CE

  Zur Beurteilung hinsichtlich elektromagnetischer Verträglichkeit wurden folgende Normen herangezogen:

Störaussendung (Emission)	**EN 61000-6-3:2007 Wohnbereich**
Störfestigkeit (Immunity)	**EN 61000-6-2:2005 Industriebereich**

- den wesentlichen Anforderungen entspricht, die in der Richtlinie der Europäischen Gemeinschaft auf dem Gebiet des Explosionsschutzes (**94/9/EG:** Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen - Explosionsschutzrichtlinie -) festgelegt sind.

  Zur Beurteilung der Erzeugnisse hinsichtlich der Einhaltung der Richtlinie (Anhang II) wurde ein Prüfbericht erstellt und die Ergebnisse hinterlegt.

  Kennzeichnung: Ex **II 3G Ex nA II T4**

  Für die Verwendung in explosionsgefährdeten Bereichen durch Übereinstimmung hinsichtlich Konzeption und Bau des festgelegten Gerätes werden folgende Normen (für Gase) eingehalten:

Allgemeine Bestimmungen	**EN 60079–0:2006**
Zündschutzart nA	**EN 60079–15:2005**

Weitere Anforderungen dieser Richtlinie gelten für die Herstellung und das Inverkehrbringen dieses Gerätes. Das Produkt wird unter einem Qualitätssicherungssystem - interne Fertigungskontrolle (Anhang VIII) - hergestellt.

Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, beinhaltet aber keine Zusicherung von Eigenschaften. Die Sicherheitshinweise der mitgelieferten Produktdokumentation sind zu beachten. Die oben genannten Produkte wurden in einer typischen Konfiguration getestet.

i.V. Helmar Scholz
Leiter Entwicklung Sensoren

St. Georgen, Juni 2009

11 ATEX prototype test certificate

DEKRA

(1) **Baumusterprüfbescheinigung**

(2) **- Richtlinie 94/9/EG -**
Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen

(3) **BVS 09 ATEX E 081**

(4) **Gerät:** **Strömungssensor Typ 23.400 ATEX 3**

(5) **Hersteller:** **Schmidt Technology GmbH**

(6) **Anschrift:** **78112 St. Georgen/Schwarzwald**

(7) Die Bauart dieses Gerätes sowie die verschiedenen zulässigen Ausführungen sind in der Anlage zu dieser Baumusterprüfbescheinigung festgelegt.

(8) Die Zertifizierungsstelle der DEKRA EXAM GmbH bescheinigt, dass das Gerät die grundlegenden Sicherheits- und Gesundheitsanforderungen für die Konzeption von Geräten der Kategorie 3 zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen gemäß Anhang II der Richtlinie erfüllt.
Die Ergebnisse der Prüfung sind in dem vertraulichen Prüfbericht Nr. BVS PP 09.2093 EG niedergelegt.

(9) Die grundlegenden Sicherheits- und Gesundheitsanforderungen werden erfüllt durch Übereinstimmung mit:

EN 60079-0:2006	Allgemeine Anforderungen
EN 60079-15:2005	Zündschutzart 'n'

(10) Falls das Zeichen "X" hinter der Bescheinigungsnummer steht, wird in der Anlage zu dieser Bescheinigung auf besondere Bedingungen für die sichere Anwendung des Gerätes hingewiesen.

(11) Diese Bescheinigung bezieht sich nur auf die Konzeption und die Baumusterprüfung des beschriebenen Gerätes in Übereinstimmung mit der Richtlinie 94/9/EG.
Für Herstellung und Inverkehrbringen des Gerätes sind weitere Anforderungen der Richtlinie zu erfüllen, die nicht durch diese Bescheinigung abgedeckt sind.

(12) Die Kennzeichnung des Gerätes muss die folgenden Angaben enthalten:

Ex II 3G Ex nA II T4

DEKRA EXAM GmbH
Bochum, den 19. Juni 2009

Zertifizierungsstelle   Fachbereich

Seite 1 von 2 zu BVS 09 ATEX E 081

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Your Notes

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