Simply a question of
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SCHMIDT® Flow Sensor
SS 20.250
Instructions for Use

SCHMIDT® Flow Sensor
SS 20.250

Table of Contents

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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 (refer to *chapter 2)*. In particular, it is not designed for direct or indirect protection of personal or machinery.
- **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.

General note

All dimensions are indicated in mm.

2 Application range

The **SCHMIDT® Flow sensor SS 20.250** (article number: 526340) is designed for stationary measurement of the flow velocity as well as the air and gas temperature at atmospheric pressure conditions.

The sensor is based on the measuring principle of a thermal anemometer. It measures the mass flow of the measuring medium as flow velocity which is output in a linear way as standard velocity[1] w_N 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 medium to be measured. The sensor is designed for the use inside closed rooms and is not suitable for outdoor use.

⚠ When using the sensor outdoors, it must be protected against direct exposure to the weather.

3 Mounting instructions

General information on handling

The flow sensor **SS 20.250** is a sensitive measuring instrument. Therefore, avoid applying mechanical force onto the sensor tip.

⚠ The head of the sensor probe can be damaged irreversibly due to mechanical loads.
Leave the protective cap during mounting as long as possible attached and handle the sensor with care.

Flow characteristics

To avoid distortion of measurement results, appropriate installation conditions must be guaranteed to ensure that the gas flow is supplied to the sensor in a quiet (low in turbulence) state. The corresponding measures depend on the flow-determining system properties (pipe, flow box, outdoor environment etc.), they are described in the following subchapters for different mounting variants.

⚠ Correct measurements require a (laminar) flow low in turbulence.

Because the sensor has to measure the temperature of the medium also, the temperature measuring sleeve must be in direct contact with the measured medium. That means that a minimum immersion depth (MID) of 58 mm is required.

[1] Corresponds to the actual velocity under standard conditions.

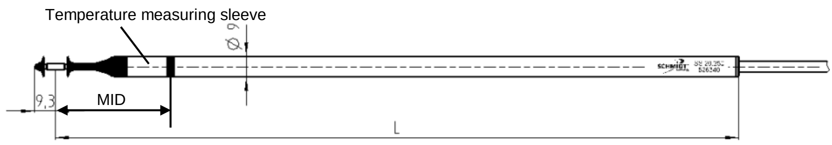
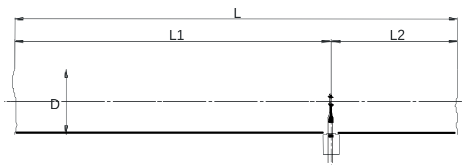


Figure 3-1

Installation in pipes or channels

The central installation of the sensor over the pipe cross-section must be realized on a point where the flow is quiet. The simplest method[2] for obtaining a quiet flow is to provide a sufficiently long distance in front of the sensor (run-in distance) and behind the sensor (run-out distance) straight without disturbances (such as edges, seams, bend etc., refer to installation drawing 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	Inner diameter of measuring distance

Figure 3-2

The required abatement distances (in relation to the pipe inner diameter D) in case of different fault causes are listed in Table 1.

Flow obstacle upstream of the measuring distance	Minimum length of run-in distance (L1)	Minimum length of run-out distance (L2)
Light bend (< 90°)	**10 x D**	**5 x D**
Reduction / expansion / 90° bend	**15 x D**	**5 x D**
Two 90° bends in a plane (2-dimensional)	**20 x D**	**5 x D**
Two 90° bends (3-dimensional)	**35 x D**	**5 x D**
Shut-off valve	**45 x D**	**5 x D**

Table 1

This table lists the *minimum values* required in each case. If the listed straight conduit lengths cannot be achieved, the measurement accuracy may be impaired.

Under the conditions mentioned above, a flattened, parabolic velocity profile is produced over the pipe cross-section which reaches its maxi-

[2] Alternatively flow rectifiers, e.g. honeycomb ceramics, can be used.

mum w_N in the middle of the pipe (optimum measuring point). This measuring value can be converted to an average flow velocity $\overline{w_N}$ constant over the cross-section by means of a so called profile factor PF. This profile factor depends on the pipe diameter and is shown in Table 2.

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

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

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

$$\dot{V}_N = \overline{w}_N \cdot A \cdot 3600$$

D	Inner diameter of pipe [m]
A	Cross-section area of pipe [m^2]
w_N	Standard flow velocity in pipe centre [m/s]
$\overline{w}_N$	Average standard flow velocity in tube [m/s]
PF	Profile factor (for pipes with circular cross-sections)
$\dot{V}_N$	Standard volumetric flow [m^3/h]

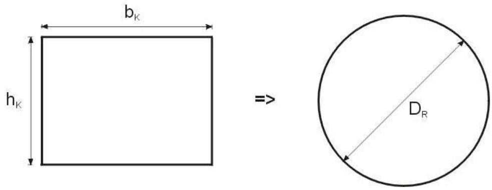
PF	Tube Ø		Measuring range of volumetric flow [m³/h]			
	Inside [mm]	Outside [mm]	for sensor measuring range			
			1 m/s	**2.5 m/s**	**10 m/s**	**20 m/s**
0.710	70.3	76.1	10	25	99	198
0.720	82.5	88.9	14	35	139	277
0.740	100.8	108.0	21	53	213	425
0.760	125.0	133.0	34	84	336	672
0.795	150.0	159.0	51	126	506	1,012
0.820	182.5	193.7	77	193	772	1,544
0.840	206.5	219.1	101	253	1,013	2,026
0.845	309.7	323.9	229	573	2,292	4,583
0.850	631.6	660.0	959	2,397	9,587	19,175

Table 2

For calculating flow velocity or volume flow in pipes for different sensor types, **SCHMIDT Technology** offers a flow calculator that can be downloaded from its homepage.

http://www.schmidt-sensors.com/ or http://www.schmidttechnology.com/

Since the situation is similar to that in a pipe, the volumetric flow in a square chamber can be calculated in the same way, i.e. by equating the hydraulic diameters of both cross-section forms. The result for a rectangle is a “diameter” D_R equivalent to a circular pipe:



b_K: Width of rectangular channel
h_K: Height of rectangular channel

D_R: Equivalent pipe diameter

$$D_R = \frac{2 \cdot b \cdot h}{b + h}$$

Figure 3-3

According to this the volumetric flow in a chamber is calculated:

$$A_R = \frac{\pi}{4} \cdot D_R^2 = \frac{\pi}{4} \cdot \left(\frac{2 \cdot b_K \cdot h_K}{b_K + h_K} \right)^2$$

$$A_R = \pi \cdot \left(\frac{b_K \cdot h_K}{b_K + h_K} \right)^2$$

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

$$\dot{V}_N = \overline{w}_N \cdot A_R$$

$$\dot{V}_N = PF \cdot \pi \cdot \left(\frac{b_K \cdot h_K}{b_K + h_K} \right)^2 \cdot w_N$$

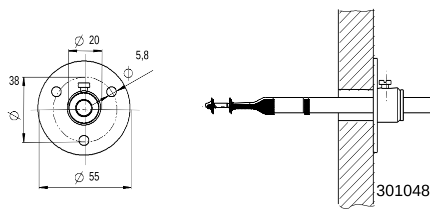
b_K/h_K	Width/height of square chamber [m]
D_R	Inner diameter of equivalent pipe [m]
A_R	Cross-section area of equivalent pipe [m²]
w_N	Flow velocity in the middle of pipe [m/s]
$\overline{w}_N$	Average flow velocity in tube [m/s]
PF	Profile factor pipe[3] with inner diameter D_R
$\dot{V}_N$	Standard volumetric flow [m³/s]

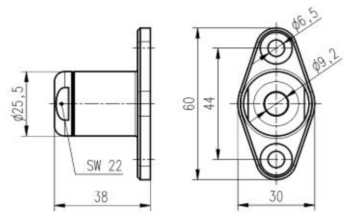
Wall installation

In general there are two options available for sensor installation on or (directly) in a wall:

Installation with flange

SCHMIDT Technology offers two types of flanges.





Mounting flange 301048 Wall mounting flange 520181

Figure 3-4

The simple mounting flange made of brass fixes the sensor by means of a locking screw and is not pressure-tight. The wall mounting flange suitable for clean rooms is made of stainless steel and uses an O-ring on

[3] The profile factors are equal for both cross-section forms.

the contact surface to separates the medium to be measured from the environment.

Assembly:

- Drill a bushing bore with 10 … 12 mm diameter in the wall.
- Align and drill bore pattern for fastening screws according to the required position of the locking screw (mounting flange 301048) or mounting plate (wall mounting flange 520181).
- Screw down the flange.
- Remove protective cap and insert sensor probe carefully in a coaxial direction into flange.
- Adjust immersion depth of the probe and fasten sensor by means of a locking screw (mounting flange 301046) or lock nut (wall mounting flange 520181).

Mounting with through-bolt joint

SCHMIDT Technology offers two through-bolt joints (abbr.: TJ) that differ in material (brass or stainless steel; for details refer to subchapter *“Accessories”*).

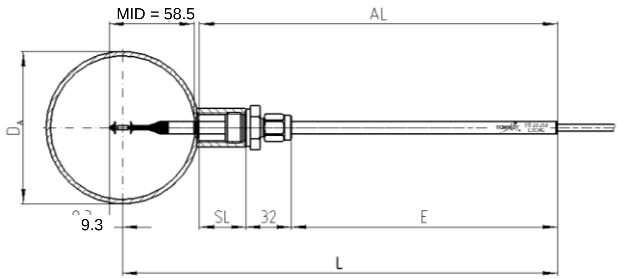


Figure 3-5

L	Sensor length [mm]	D_A	Outer diameter of the pipe [mm]
SL	Length of the weld-in sleeve [mm]	*E*	Sensor tube setting length [mm]
AL	Projecting length [mm]	*MID*	Minimum immersion depth [mm]

The through-bolt joints are mounted using an external thread G½. Normally, a clamp with internal thread G½ resp. Rp½ (for details refer to subchapter *“Accessories”*) is welded as a connecting piece onto the bore in the medium-transporting system wall and the TJ is screwed in. The further assembly is carried out as described in the previous subchapter.

Accessories

For installation of the **SCHMIDT® Flow sensor SS 20.250** there is a wide variety of accessories available covering the most diverse applications.

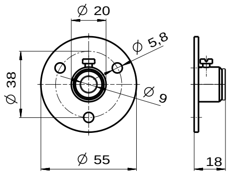
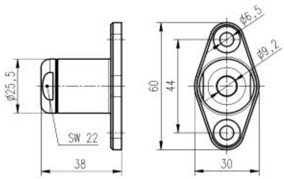
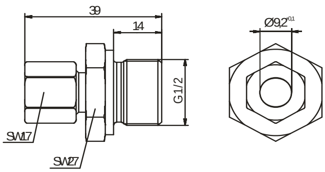
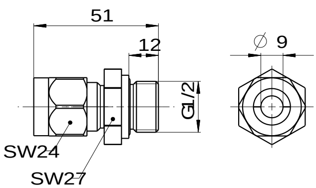
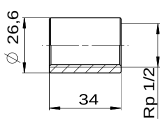
Type / article No.	Drawing	Assembly
Mounting flange 301048		- Immersion sensor - Wall - Fastening by means of a screw - Material: Steel, electropol. Zn PTFE
Wall mounting flange 520181		- Immersion sensor - Wall - Fastening by means of a clamping ring - Material: Stainless steel PTFE
Through bolt joint 532160		- Immersion sensor - Pipe (typ.) - Wall - Incorporation in clamp - Material: Stainless steel 1.4571 PTFE
Through bolt joint 517206		- Immersion sensor - Pipe (typ.) - Wall - Incorporation in clamp - Material: Brass PTFE, NBR
Clamp a.) 524916 b.) 524882		- Internal thread Rp½ - Material: a.) Steel, black b.) Stainless steel 1.4571

Table 3

4 Electrical connection

The sensor is equipped with a 5-pin cable firmly fixed to the housing pipe with open cable ends (pin assignment refers to Table 4).

Designation	Function	Wire color of cable
Power	Operating voltage: $\pm U_B$ in DC mode Operating voltage: U~ in AC mode	brown
Analog w_N	Output signal: Speed	yellow
Analog T_M	Output signal: Temperature of the medium	green
GND	Operating voltage: $\pm U_B$ in DC mode Operating voltage: U~ in AC mode	white
AGND	Reference ground of analog outputs	gray

Table 4

During electrical installation ensure that no voltage is applied and inadvertent activation is not possible.

The cable has a standard length of 2 m; further lengths between 2.5 ... 100 m can be ordered optionally.

Operating voltage

For proper operation the sensor requires DC or AC voltage with a nominal value of 24 $V_{(eff)}$ with permitted tolerance of ± 10 %. Typical operating current is approx. 60 mA and at maximum 100 mA[4].

Only operate sensor in the defined range of operating voltage (24 V DC / AC ± 10 %).
Undervoltage may result in malfunction; overvoltage may lead to irreversible damages.

The specifications for the operating voltage are valid for the internal connection of the sensor. Voltage drops generated due to cable resistances must be considered by the customer.

[4] Both signal outputs 22 mA (maximum measuring values), minimum operating voltage.

Analog outputs

Both analog outputs for flow and temperature are equipped with an "Auto-U/I" feature, that means that the signal electronics switches automatically between operation as voltage (U) or current interface (I) depending on the value of the load resistance R_L (switching threshold: R_L = 500 / 550 Ω; for details refer to chapter *5 Signalizations*).

For voltage mode a load resistance of at least 10 kΩ is recommended.

It is recommended to connect the same resistance value (e.g. 300 Ω each for I mode or 10 kΩ each for U mode) to both analog outputs (even if one of them is not used).

The apparent resistance R_L must be connected between the corresponding signal output and the electronic reference potential for the sensor outputs (refer to Figure 4-1).

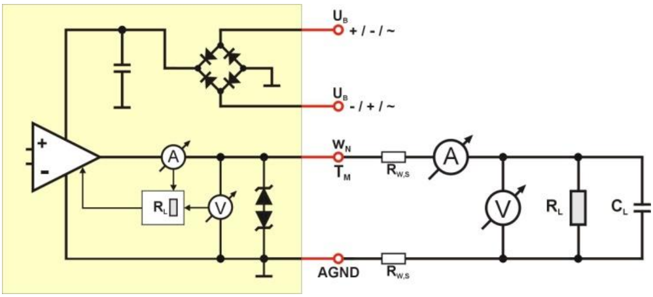


Figure 4-1

With alternating operating voltage, AGND must be selected as measuring reference potential.

If the sensor is used with direct voltage, also the mass of the supply voltage can be used as reference potential as long as it is short-circuited with AGND. This procedure is not recommended because mass offset and noise may interfere the output signal in voltage mode.

With alternating operating voltage, AGND must be selected as measuring reference potential for the signal output.
Otherwise, AGND should be selected as measuring reference potential for the signal output.

The signal outputs have a permanent short-circuit protection against both rails of the operating voltage.

The maximum load capacity is 10 nF.

5 Signalizations

Optical

The sensor **SS 20.250** is equipped with a light ring on its cable exit that signals the current sensor state (refer to Table 5).

Symbol	Light	Sensor state
	Off	Supply voltage: none, wrong polarity, too low
	Green (permanently)	Sensor ready for operation
	Flashes green	Supply voltage too high *or* Medium temperature beyond specification range
	Flashes red	Sensor defective

Table 5

Analog outputs

- Switching characteristic Auto-U/I

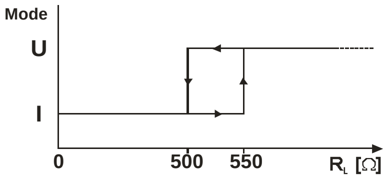


Figure 5-1

Depending on the signal value, the accuracy of the mode switching point detection can be reduced. Therefore, it is recommended to select the resistance in such a way that a secure detection can be maintained (< 300 Ω for current mode and > 1 kΩ for voltage mode).

With a zero signal in voltage mode, the electronic system generates test pulses that correspond to an effective value of approx. 1 mV. The latest measuring devices may trigger in response to such a pulse and display short-term measuring values of up to 20 mV. In this case it is recommended to install an RC filter before the measuring input with a time constant of 20 … 100 ms.

- Representation of measuring range

The measuring range of the corresponding measuring value is mapped in a linear way to the signaling range of its associated analog output.

For flow measurement the measuring ranges from zero flow up to the selectable end of the measuring range $w_{N,max}$ (refer to Table 6).

The measuring range of the medium temperature T_M is specified between -20 and +70 °C (refer to Table 9) and is output in a linear way.

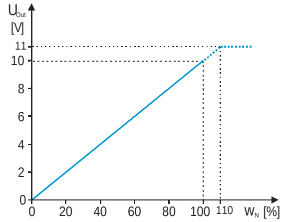
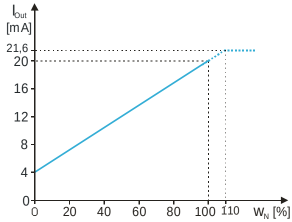
<table>
<tr><th>Voltage mode (U)</th><th>Current mode (I)</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>$$w_N = \frac{w_{N,\max}}{10V} \cdot U_{Out}$$</td><td>$$w_N = \frac{w_{N,\max}}{16mA} \cdot (I_{Out} - 4mA)$$</td></tr>
</table>

Table 6

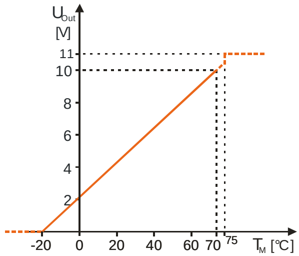
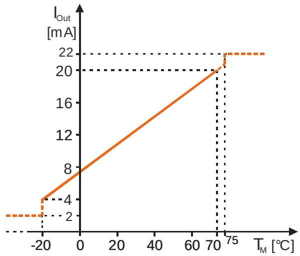
<table>
<tr><th>Voltage mode (U)</th><th>Current mode (I)</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>$$T_M = (\frac{90}{10V} \cdot U_{Out} - 20)°C$$</td><td>$$T_M = [\frac{90}{16mA} \cdot (I_{Out} - 4mA) - 20]°C$$</td></tr>
</table>

Table 7

Note regarding commissioning:

Normally the temperature output provides approx. 5 V or 12 mA because the typical prevailing room temperature of approx. 25 °C corresponds to half of the measuring range.

- Error signaling

  In current mode the interface outputs 2 mA.
  In voltage mode the output switches to 0 V.

- Exceeding measuring range for flow

  Measuring values larger than $w_{N,max}$ are output in a linear way up to 110 % of the signaling range (11 V or 21.6 mA). For higher values of w_N the output signals stays constant.

- Medium temperature beyond specification range

  Operation beyond the specified limits may damage the sensor and is displayed as follows (also refer to images in Table 7):

  - Medium temperature below -20 °C

The analog output for T_M switches to error (0 V or 2 mA).
The analog output for w_N switches to error (0 V or 2 mA).

- Medium temperature above +70 °C (at approx. 75 °C[5])
  The analog output for w_N switches to error (0 V or 2 mA).
  The analog output for T_M switches directly to the maximum output values of 11 V or 22 mA.

6 Startup

Before switching on the **SCHMIDT® Flow sensor SS 20.250**, it must be checked if the sensor is installed correctly, both mechanically and electrically.

If the sensor is in the correct operational state, it is ready for measurement approx. 10 s after switching on the supply voltage.

7 Information concerning operation

Environmental condition Temperature

The **SCHMIDT® Flow sensor SS 20.250** monitors both medium and operating temperature of the electronics. As soon as one of the measured values leaves the specified operation range, the sensor switches off flow measurement and reports a corresponding error. As soon as proper operational conditions are restored, the sensor resumes measuring mode.

Even leaving the specified operating temperature range for a short period can cause an irreversible sensor damage.

Environmental condition Medium

The **SCHMIDT® Flow sensor SS 20.250** is designed for use in clean to slightly soiled media.

Soiling or other gratings on the sensor cause distortions of measurements.
Therefore, the sensor must be checked for soiling at regular intervals and cleaned if necessary.

The coated versions have particularly high chemical media resistance against organic solvents, acids and caustics in liquid or gaseous state, for example:

[5] The switching hysteresis for the threshold is approx. 2 K.

Acetone, ethyl acetate, methyl ethyl ketone, perchlorethylene, peracetic acid, xylene, alcohols, ammonia, petrol, motor oil (50 °C), cutting oil (50 °C), sodium hydroxide, acetic acid, hydrochloric acid, sulphuric acid.

The suitability of the mentioned above or other similar chemicals must be checked for every individual case due to different ambient conditions.

(Condensing) liquid on the sensor causes serious measurement distortions.
The sensor works correctly when it is dry again (as long as the condensate has not damaged it by corrosion or similar).

Sterilizability

Both uncoated and coated sensor can be sterilized during operation.

Alcohols (drying without leaving residues) and hydrogen peroxide (uncoated version only) are approved and certified as disinfectants.

Other disinfectants must be checked by the customer if necessary.

8 Service information

Maintenance

Heavy soiling of the sensor tip may lead to distortion of the measured value. Therefore, the sensor tip must be checked for soiling at regular intervals. If soiling is visible, the sensor can be cleaned as described below.

Cleaning of the sensor tip

The sensor tip can be cleaned to remove dust or soiling by moving it carefully in warm water containing a washing-up liquid or other permitted cleaning fluid (e.g. Isopropanol)[6]. Persistent incrustations or gratings can be previously softened by prolonged immersion and then removed by means of a soft brush or cloth. Avoid applying force to the sensitive sensor tip.

The sensor tip is a sensitive measuring system.
During manual cleaning proceed with great care.

Before putting it again into operation, wait until the sensor tip is completely dry.

[6] Other cleaning fluids on request.

Eliminating malfunctions

The following table lists possible errors (error images) and a description to detect errors. Furthermore, possible causes and measures to be taken to eliminate errors are listed.

Error image	Possible causes	Troubleshooting
 Signal light off Both signal outputs at zero	Supply voltage U_B: ➢ No U_B available ➢ U_B (DC) has wrong polarity ➢ $U_{B.DC}$ < 15 V Sensor defective	Supply voltage: ➢ Check if connected correctly to control unit ➢ Check if there is supply voltage at the sensor plug (cable break)
	Sensor defective	Send in sensor for repair
	Temperature too low / high	Increase / reduce temperature
	Operating voltage too high	Reduce operating voltage
Flow signal w_N too large / small	Measuring range too small / large	Check sensor configuration
	I-mode instead of U-mode or vice versa	Check measuring resistance value
	Medium to be measured is not air	Check the foreign gas correction
	Sensor tip soiled	Clean sensor tip
Flow signal w_N is fluctuating	U_B unstable	Check the voltage stability
	Sensor head is not in optimum position Run-in / run-out distance is too short	Check mounting conditions
	Strong fluctuations of pressure or temperature	Check operating parameters
Analog signal in U-mode has offset or is noisy	Measuring resistance of signal output is at GND	Connect measuring resistance to AGND
Analog signal permanently at maximum	Measuring resistance of signal output at $+U_{B,DC}$	Connect measuring resistance to AGND
Analog signal switches between min. and max.	Measuring resistance of signal output is at GND ($U_{B,AC}$)	Connect measuring resistance to AGND

Table 8

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.

Calibration

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

Measuring parameters	Standard velocity w_N of air, based on standard conditions 20 °C and 1013.25 hPa Medium temperature T_M
Medium to be measured	Air or nitrogen, other gases on request
Measuring range w_N	0 ... 1 / 10 / 20 m/s Special measuring range: 1 … 20 m/s (in steps of 0.1 m/s)
Lower detection limit w_N	0.06 m/s
Measuring accuracy[7] w_N - Standard - Precision (optional)	 ±(5 % of meas. value + [0.4 % of final value; min. ± 0.02 m/s]) ±(3 % of meas. value + [0.4 % of final value; min. ± 0.02 m/s])
Reproducibility w_N	±1.5 % of measured value
Response time (t_{90}) w_N	3 s (jump from 0 to 5 m/s)
Measuring range T_M	-20 ... +70 °C
Measuring accuracy T_M (w_N > 2 m/s)	±1 K (10 ... 30 °C) ±2 K (remaining measuring range)
Humidity range	0 ... 95 % rel. humidity (RH), non-condensing
Operating pressure	Atmospheric (700 ... 1,300 hPa)
Operating voltage U_B	24 $V_{DC/AC}$ ± 10 %
Current consumption	typ. < 60 mA, 100 mA max.
Analog outputs - Type: Auto-U/I Switching Auto-U/I - Voltage output - Current output - Switching hysteresis Maximum load capacity	Flow velocity, medium temperature Automatic switching of signal mode on basis of R_L[8] 0 ... 10 V for $R_L \geq$ 550 Ω 4 ... 20 mA for $R_L \leq$ 500 Ω ΔR_L = 50 Ω 10 nF
Electrical connection	Non-detachable connecting cable, pigtail[9], 5-pin, length 2m Special lengths: 2.5 … 100 m (in steps of 0.1 m)
Maximum cable length	Voltage signal: 15 m, current signal: 100 m
Type of protection	IP 65
Protection class	III (SELV) or PELV (EN 50178)
Min. immersion depth	58 mm
Probe length L	300 / 500 mm
Weight	200 g max. (with 2 m cable)

Table 9

[7] Under conditions of the reference.
[8] Value of the load resistance / working resistance.
[9] With cable end sleeves

10 Declaration of conformity

EU-Declaration of conformity

SCHMIDT Technology GmbH herewith declares that the product

SCHMIDT® Flow Sensor SS 20.250

Part-No. **526 340**

is in compliance with the following European guideline:

No.: **2014/30/EU**

Text: Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to **electromagnetic compatibility (EMC)**

The following European standards were used for assessment of the product therefore:

- Emission (residence): **EN 61000-6-3: 2007/A1:2011/AC:2012**
- Imission (industrial): **EN 61000-6-2: 2006+A1:2011**

This declaration certificates the compliance with the mentioned directive but comprises no confirmation of attributes. The security advices of the included product documentation have to be observed. The above mentioned product was tested in a typical configuration.

St. Georgen, 20.04.2016

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