



**SCHMIDT<sup>®</sup> Flow Sensor**  
**SS 20.261**  
**Instructions for Use**

# SCHMIDT<sup>®</sup> Flow Sensor

## SS 20.261

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Imprint:

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Version 527254.02

Subject to modifications

# 1 Important information

The instructions for use contain all required information for a fast commissioning and a safe operation of the **SCHMIDT® Flow sensor SS 20.261**:

- 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 2*). In particular, it is not designed for direct or indirect personal protection.
- **SCHMIDT Technology** cannot give any warranty as to its suitability for a 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 personnel or malfunction of the device.

## General note

All dimensions are indicated in mm.

## 2 Application range

The **SCHMIDT® Flow sensor SS 20.261** is designed for stationary measurement of the flow velocity as well as the temperature of air and gases at working pressure of up to 8 bar.

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<sup>1</sup>  $w_N$  (unit: m/s), 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.

## 3 Mounting instructions

### General information on handling

The **SS 20.261** is a precision instrument with high measuring sensitivity. In spite of the robust construction of the sensor tip soiling of the inner sensor elements can lead to distortion of measurement results (see also *chapter 8 Service information*). During procedures that could stimulate soiling like transport, mounting or dismounting of the sensor it is recommended to place the enclosed **SCHMIDT Technology** white protective cap on the sensor tip and remove it only during operation.



During processes with enhanced risks of soiling such as transport or mounting the white protective cap should be placed onto the sensor tip.

### Systems with overpressure

The **SS 20.261** is designed for a maximum working overpressure of 8 bar. As long as the medium to be measured is operated with overpressure, make sure that:

- There is no overpressure in the system during mounting.



Mounting and dismounting of the sensor in pipes can be carried out only as long as the system is **in depressurized state**.

- Only appropriately pressure-tight mounting accessories are used.

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<sup>1</sup> Equates to the real flow velocity under standard conditions.



Only use proper pressure-tight mounting accessories (e. g. Teflon tape).

- Appropriate safety precautions are taken to avoid unintended discarding of the sensor due to overpressure.

**Attention: Risk of injuring if through bolt joint is loosened under pressure!**



The sensor is secured against unintentional discarding. But it can be driven out abruptly over the distance from its immersion depth up to the death stop (max. 350 mm).

If there are leaks in the sensor or its compressing fitting (CF) during operation, depressurize the system immediately and replace sensor.

### General installation conditions

Preferably the sensor should be mounted in horizontal pipes.

The sensor should preferably be installed in horizontally positioned pipes. A downward flow with low flow speeds ( $< 1 \text{ m/s}$ )<sup>2</sup> can lead to increased deviations and must be avoided for this reason.



Avoid installation in a pipe or chamber with downward flow because the lower measuring range limit can rise significantly.

The sensor measures the flow speed correctly only in the direction given on the housing and sensor head (arrow). Make sure that the sensor is adjusted in flow direction; a tilting of up to  $\pm 3^\circ$  is allowed<sup>3</sup>.



The sensor measures unidirectional and must be adjusted correctly relative to the flow direction.

A sensor mounted in opposite direction of the flow direction leads to wrong measuring values (too high).



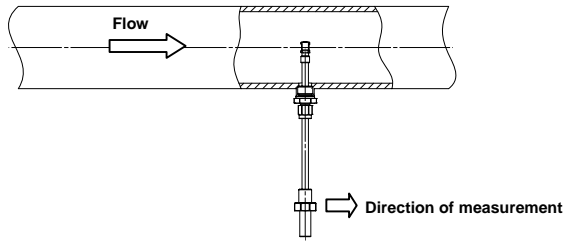
The lower measuring range limit is according to the system requirements 0.2 m/s.

The center of the chamber head is the actual measuring point of the flow measurement and must be placed in the flow as advantageous as possible, for example in the middle of a pipe (see Figure 1). Therefore this point is also used for specification of probe length L (see Figure 3).

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<sup>2</sup> In case of vertical downdraft and maximum overpressure of 8 bar.

<sup>3</sup> Measurement deviation  $< 1 \%$



**Figure 1 Positioning in a pipe**



The sensor head must be located in the **center of the pipe** to obtain a correct measurement inside the pipe.

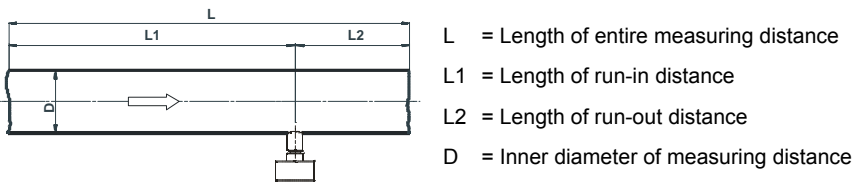
### Installation with low disturbance

Local turbulences of the medium can cause distortion of measurement results. Therefore, appropriate mounting conditions must be guaranteed to ensure that the gas flow is supplied to the sensor in a quiet and low in turbulence state in order to maintain the accuracy specified (see chapter 9 *Technical data*).



Correct measurements require quiet flow, as low-turbulence as possible.

An undisturbed flow profile can be achieved if a sufficiently long distance in front of (run-in distance) and behind (run-out distance) the sensor installation site (see Figure 2) is held absolutely straight and without disturbances (such as edges, seams, bends etc.). It is also necessary to pay attention to the design of the run-out distance because disturbances also generate turbulences **against** the flow direction.



**Figure 2**

The following Table 1 shows the required straight conduit lengths depending on the pipe inner diameter “D” and the different disturbance causes.

Flow obstacle upstream of the measuring distance	Minimum length of L1	Minimum length of L2
Light bend (< 90°)	10 x D	5 x D
Reduction / expansion / 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 (3-dimensional change in direction)	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, measurement accuracy may be impaired<sup>4</sup>.

### Calculation of volume flow

If the cross section area of the pipe is known, the output signal of the flow speed can be used to calculate the standard volumetric flow of the medium. By means of a correction factor PF<sup>5</sup>, which depends on the pipe diameter the measured value can be converted to an averaged flow  $w_N$  which is constant over the whole pipe cross-section.

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:

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

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

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

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

The measuring unit factor EF serves only for convenient conversion to non-SI measuring units, for example m<sup>3</sup>/h (see Table 2).

**SCHMIDT Technology** provides a convenient calculation tool to compute flow velocity or volume flow in pipes for all its sensor types and measuring ranges. This “Flow Calculator” can be directly used on or downloaded from SCHMIDT homepage:

<http://www.schmidttechnology.de/de/sensorik/download/FlowCalculator.zip>

<sup>4</sup> Alternatively flow rectifier could be used, e.g. honeycomb ceramics.

<sup>5</sup> Considers the parabolic flow profile and the sensor obstruction.

		Measuring unit of diameter D		
		m	cm	mm
Measuring unit volumetric flow	EF			
	m <sup>3</sup> /s	1	1,0E-04	1,0E-06
	m <sup>3</sup> /min	60	6,0E-03	6,0E-05
	m <sup>3</sup> /h	3600	3,6E-01	3,6E-03
	l/s	1000	1,0E-01	1,0E-03
	l/min	6,0E+04	6	0,06
l/h	3,6E+06	360	3,6	

Table 2

Table 3 lists profile factors and volume flow measuring ranges (with certain sensor measuring ranges) for standard pipe diameters.

Diameter of measuring pipe				Profile faktor PF	Volumetric flow [m <sup>3</sup> /h]			
Nominal size	Norm value		Inner [mm]		Min. @ 0.2 m/s	@ sensor measuring range [m/s]		
	DN	[inch]				40 m/s	60 m/s	90 m/s
25	25	1	26.0	<b>0.796</b>	0.30	61	91	137
			28.5	<b>0.796</b>	0.37	73	110	165
	32		32.8	<b>0.796</b>	0.48	97	145	218
			36.3	<b>0.770</b>	0.57	115	172	258
40	40	1 1/2	39.3	<b>0.748</b>	0.65	131	196	294
			43.1	<b>0.757</b>	0.80	159	239	358
			45.8	<b>0.763</b>	0.91	181	272	407
			51.2	<b>0.772</b>	1.14	229	343	515
50	50	2	54.5	<b>0.775</b>	1.30	260	391	586
			57.5	<b>0.777</b>	1.45	291	436	654
			64.2	<b>0.782</b>	1.82	365	547	820
			70.3	<b>0.786</b>	2.20	439	659	988
65	65	2 1/2	76.1	<b>0.792</b>	2.59	519	778	1,167
			82.5	<b>0.797</b>	3.07	614	920	1,380
80	80	3	100.8	<b>0.804</b>	4.62	924	1,386	2,079
			107.1	<b>0.806</b>	5.23	1,046	1,568	2,353
125	125	5	125.0	<b>0.812</b>	7.17	1,435	2,152	3,229
			131.7	<b>0.814</b>	7.98	1,597	2,395	3,593
130	125		150.0	<b>0.817</b>	10.40	2,079	3,119	4,678
			159.3	<b>0.820</b>	11.77	2,353	3,53	5,295
150	150	6	182.5	<b>0.825</b>	15.54	3,108	4,661	6,992
			190.0	<b>0.826</b>	16.86	3,372	5,059	7,588
200	200		206.5	<b>0.829</b>	19.99	3,998	5,997	8,996
			260.4	<b>0.835</b>	32.02	6,404	9,605	14,408
300	300		309.7	<b>0.840</b>	45.56	9,112	13,668	20,502
			339.6	<b>0.842</b>	54.91	10,982	16,474	24,711
400	400		388.8	<b>0.845</b>	72.23	14,446	21,670	32,505
			437.0	<b>0.847</b>	91.47	18,294	27,440	41,161
450	450		486.0	<b>0.850</b>	113.53	22,706	34,059	51,089
			534.0	<b>0.852</b>	137.39	27,477	41,216	61,824
500	500		585.0	<b>0.854</b>	165.27	33,054	49,581	74,371
			600					

Table 3

## Mounting

The sensor is installed using its integrated compression fitting. Normally, a sleeve is welded as a connecting piece onto a bore in the medium-guiding pipe, in which the external thread ( $G\frac{1}{2}$ ) of the compression fitting is screwed (see Figure 3).

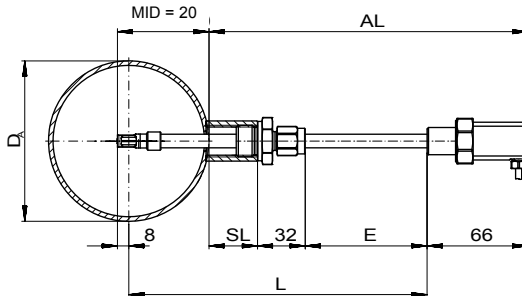


Figure 3

$L$	Probe length [mm]
$SL$	Length of weld-in sleeve [mm]
$AL$	Projecting length [mm]
$D_A$	Outer diameter of pipe [mm]
$MID$	Minimum immersion depth [mm]
$E$	Setting length of probe [mm]



Before mounting depressurize system with overpressure media.

- Bore a mounting opening in a pipe wall.
- Weld connecting piece with an internal thread  $G\frac{1}{2}$  in the center above the mounting opening on the pipe.  
Recommended length of connecting piece: 15 ... 40 mm
- Slacken compression fitting nut (SW17) to such an extent that sensor probe can be moved without jamming.
- Wrap thread using a common sealing tape, for example made of PTFE.
- Remove protective cap from sensor tip and push compression fitting up to the dead end of the sensor head.
- Screw threaded part of compression fitting one or two turns by hand into connecting piece.

- In case of a longer sensor probe push it partly into the pipe then screw thread firmly into connecting piece (hexagon SW27).



Always avoid bending of the probe during screwing.

- Carefully slide probe so that the center of the chamber head is placed at the optimum measuring position in the middle of the pipe.
- Tighten compression fitting nut slightly by hand so that sensor is fixed.
- Turn sensor manually at its enclosure into required direction and precise position while maintaining immersion depth.



Angular deviation should not be greater than  $\pm 3^\circ$  relative to ideal position.

- Hold sensor and tighten compression fitting nut by turning the fork wrench (SW17) a quarter of a turn.

Recommended torque: 10 ... 15 Nm

- Check the set angular position carefully, for example by means of a spirit level at the hexagonal part of the sensor enclosure.

### Mounting accessories

Type / article No.	Drawing	Mounting
Clamp <sup>6</sup> a.) 524 916 b.) 524 882		<ul style="list-style-type: none"> <li>- Internal thread G½</li> <li>- Material:               <ul style="list-style-type: none"> <li>a.) Steel, black</li> <li>b.) Stainless steel 1.4571</li> </ul> </li> </ul>

Table 4

<sup>6</sup> Must be welded.

## 4 Electrical connection



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

The sensor is electrically connected according to Table 5 by means of the open cable ends of a 4-wire cable firmly fixed to the sensor housing.

Wire color	Designation	Function
Brown (BR)	Power	Operating voltage: $+U_B$
White (WH)	GND	Operating voltage: Mass
Yellow (YE)	Analog $w_N$	Output signal: Speed
Green (GR)	Analog $T_M$	Output signal: Temperature of the medium

Table 5

### Operating voltage

For proper operation the sensor requires DC voltage with a nominal value of 24 V with permitted tolerance of  $\pm 10\%$  and the sensor is protected against a polarity reversal.

Deviating values lead to deactivation of the measuring function or even to failure. As far as it is possible, the LED indication as well as both analog outputs report faulty operational conditions (see chapter 5 *Signalization*).



Only operate sensor within the defined range of operating voltage (24 V DC  $\pm 10\%$ ). Undervoltage may result in malfunction. Overvoltage may lead to irreversible damage to the sensor.

## Wiring of analog outputs

Both analog outputs signaling flow and temperature of the medium are designed as 4 ... 20 mA current interface which exhibits permanent short-circuit protection against both rails of the operating voltage  $U_B$ .

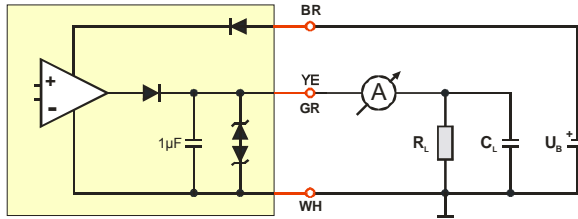


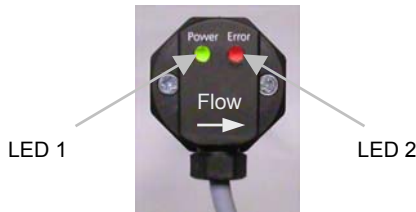
Figure 4

The apparent ohmic resistance  $R_L$  of max. 300  $\Omega$  must be connected between the signal output and GND (see Figure 4). Load capacity  $C_L$  is limited to a maximum of 10 nF.

## 5 Signalization

### Light emitting diodes

The sensor is equipped with 2 light emitting diodes (LED) indicating its functional state.



Operating state	LED 1	LED 2
Supply voltage too low	○	○
Ready for operation	●	○
Supply voltage too high Medium temperature beyond specification range	◐	○
Sensor defective	●	◑

○ LED off

● LED on: green

◐ LED flashes (approx. 2 Hz): green

◑ LED flashes (approx. 2 Hz): red

## Analog outputs

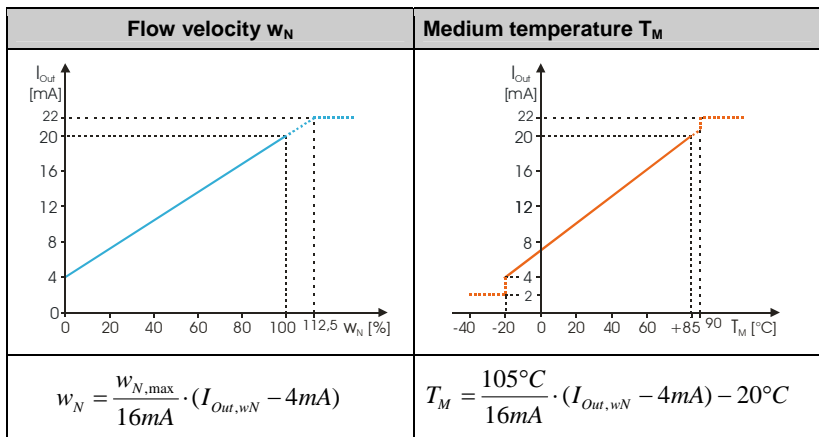
- Error signaling

If a critical operating condition occurs or if the sensor detects a defect, one or both interfaces emit 2 mA<sup>7</sup>.

- Representation of the measuring range

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

For flow measurement the measuring range reaches from zero to the selectable end of the measuring range  $w_{N,max}$  (= 100 % in Figure 4). A higher flow up to 22 mA (= 112,5 %) is still output in a linear way, moreover the signal remains constant.



**Figure 5 Representation specification for measuring functions**

The measuring range of the medium temperature is -20 to +85 °C. Falling below this temperature causes the emission of an error message of this signal output (2 mA). An exceeded temperature is output in a linear way up to 90 °C, moreover the temperature output leaps to approx. 22 mA and the flow output drops to 2 mA.



Even short-term overshooting of the operating medium temperature can cause irreversible damage of the sensor.



For a correct temperature measurement, the flow velocity on the sensor head must be > 2 m/s. An excessive temperature value is output if flow velocity is < 2 m/s.

<sup>7</sup> In accordance with NAMUR specification.

## 6 Startup

Prior to switching on the **SCHMIDT® Flow sensor SS 20.261**, the following checks have to be carried out:

- Immersion depth of the sensor probe and alignment of the housing
- Tightening of the fastening screw of the through-bolt joint
- Correct electrical connection in the field (switch cabinet or similar)



For measurements in media with overpressure check if the fastening screw is tightened properly (10 ... 15 Nm).

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

If the sensor has been stored at very cold conditions, before commissioning you have to wait until the sensor and its housing have reached ambient temperature.

## 7 Information concerning operation

The sensor is optimized for an operating overpressure of 8 bar<sub>op</sub>. If it is used with lower pressures, the detection limit (DL) rises slightly.

Example: DL (8 bar<sub>op</sub>) = 0.2 m/s, DL (0 bar<sub>op</sub>) = 0.8 m/s



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.



(Condensating) liquid on the sensor causes serious measurement distortions.

After drying the correct measuring function is restored.

## Eliminating malfunctions

The following table lists possible errors (error images). A description of the way to detect errors is given. Furthermore, the possible causes and measures to be taken to eliminate errors are listed.







Error image		Possible causes	Troubleshooting
		Problems with supply voltage $U_B$ : <ul style="list-style-type: none"> <li>➤ No <math>U_B</math> available</li> <li>➤ <math>U_B</math> has wrong polarity</li> <li>➤ <math>U_B &lt; 15</math> V</li> </ul> Sensor defective	<ul style="list-style-type: none"> <li>➤ Sensor cable connected correctly?</li> <li>➤ Supply voltage connected to the control?</li> <li>➤ Supply cable broken?</li> <li>➤ Power supply unit large enough?</li> </ul>
$I_{wN}, I_{TM} = 0$ mA			
		Sensor element defective	Send the sensor for repair
$I_{wN}, I_{TM} = 2$ mA			
		Operating voltage too high	Check the operating voltage and reduce it
$I_{wN} = 2$ mA $I_{TM} = 2 / 22$ mA		Medium temperature beyond specification range	Check the medium temperature and set it correctly
Flow signal $w_N$ is too large / small		Measuring range too small /large  Medium to be measured does not correspond to air Sensor element soiled Sensor installed in opposite direction to flow direction	Check sensor configuration Check measuring resistance Is the foreign gas factor correct? Clean sensor tip Check the installation direction
Flow signal $w_N$ is fluctuating		$U_B$ unstable Mounting conditions: <ul style="list-style-type: none"> <li>➤ Sensor head is not in optimal position</li> <li>➤ Run-in/run-out distance is too short</li> </ul> Strong fluctuations of pressure or temperature	Check the voltage supply Check mounting conditions  Check operating parameters

Table 6

## 8 Service information

### Maintenance

Soiling of the sensor element may lead to a wrong measuring result. The sensor tip must be checked regularly for soiling and must be cleaned when required.

### 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. If necessary a soft brush can be used additionally.



Do not use strong cleaners, solvents, brush or other hard objects.

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

### 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 producer 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 ... 40 / 60 / 90 m/s
Lower detection limit $w_N$	0.2 m/s
Measuring accuracy $w_N$ - Standard - Precision*	$\pm(5\% \text{ of measured value} + 0.4\% \text{ of final value})$ $\pm(3\% \text{ of measured value} + 0.4\% \text{ of final value})$
Reproducibility $w_N$	$\pm 1,5\%$ of measured value
Response time ( $t_{90}$ ) $w_N$	3s (jump from 5 to 0 m/s)
Measuring range $T_M$	-20 ... +85 °C
Measuring accuracy $T_M$	$\pm 1$ K ( $w_N \geq 2$ m/s)
Operating temperature - Medium - Electronics	-20 ... +85 °C 0 ... +70 °C
Humidity range	0 ... 95 % rel. humidity (RH), non-condensing
Operating overpressure	$\leq 8$ bar
Operating voltage $U_B$	24 V <sub>DC</sub> $\pm 10\%$ (reverse voltage protected)
Current consumption	< 60 mA
Analog outputs - Type - $R_L$ - $C_L$	2 (short-circuit protected) 4 ... 20 mA** $\leq 300 \Omega$ $\leq 10$ nF
Electrical connection	Cable fixed on housing, 4-pin, length 2 m, pigtail***
Line length	100 m max.
Protection class****	III (PELV)
Type of protection	IP 54 (enclosure) IP 67 (sensor)
Mounting	Compression fitting G1/2 (integrated)
Mounting tolerance	$\pm 3^\circ$ (relative to flow direction)
Installation length	200 / 350 mm
Weight	250 g max.

**Table 7**

\* Under alignment conditions and with regard to the reproducibility of the reference.

\*\* Error messaging: 2 mA; exceeding measuring range: up to 22 mA

\*\*\* With cable end sleeves

\*\*\*\* According EN 50178

# 10 EC Declaration of conformity

## EG-Konformitätserklärung Certificate of Conformity Déclaration de conformité CE



SCHMIDT Technology GmbH erklärt, dass das Produkt  
SCHMIDT Technology GmbH herewith declares that the product  
SCHMIDT Technology GmbH déclare que le produit

**SCHMIDT® Flow-Sensor SS 20.261** Part-No.: **526335**

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

is in compliance with the relevant protection requirements in respect of the electromagnetic compatibility (EMC) which are laid down in the guidelines of the council for the harmonization of the regulations of the members within the European community (2004/108/EG).

correspond aux prescriptions de protection établies dans la norme du conseil pour l'harmonisation de règles de droit des Etats membre sur la compatibilité électromagnétique (2004/108/EG).

Zur Beurteilung hinsichtlich elektromagnetischer Verträglichkeit wurden folgende Normen herangezogen:

The assessment of EMC for industrial applications refers to the following European standards:

Pour le jugement de la compatibilité électromagnétique normes suivantes sont appliquées:

- a) Störaussendung (Emission) / Electromagnetic Emission / Interférence  
**EN 61000-6-3:2007**
  
- b) Störfestigkeit / Electromagnetic Immunity / Immunité aux parasites  
**EN 61000-6-2:2005**

A handwritten signature in blue ink, appearing to read "Scholz".

Helmar Scholz

Leiter Entwicklung Sensoren / R&D Manager Division Sensors / Directeur développement capteur

St. Georgen, Mai 2010 / May 2010 / Mai 2010



Notes:

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