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SCHMIDT® Flow Sensor

SS 20.261

Instructions for Use

SCHMIDT® Flow Sensor SS 20.261

Table of Contents

Imprint:

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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 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 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** (article number: 526 335) is designed for stationary measurement of the flow velocity as well as the temperature of pure[1] air and gases at working pressure of up to 10 bar.

The sensor is based on the measuring principle of a thermal anemometer and measures the mass flow of the measuring medium as flow velocity which is output in a linear way as standard velocity[2] 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. 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 sensor **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*). During procedures that could yield soiling like transport, mounting or dismounting of the sensor it is recommended to place the enclosed **SCHMIDT Technology** 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 protective cap should be placed onto the sensor tip.

Systems with overpressure

The **SS 20.261** is designed for an working overpressure up to 10 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**.

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[1] No chemically aggressive parts / abrasive particles. Check suitability in individual cases.
[2] Corresponds to the actual flow velocity under standard conditions.

- Only appropriately pressure-tight mounting accessories are used.

  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 compression fitting is loosened under pressure!

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

General installation conditions

The sensor should preferably be installed in horizontally positioned pipes. A downward flow with low flow speeds (< 1 m/s)[3] 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 ±3° is allowed[4].

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).

Due to system characteristics the lower measuring range limit of the sensor is 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).

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

[3] In case of vertical downdraft and maximum overpressure of 8 bar.
[4] Measurement deviation < 1 %

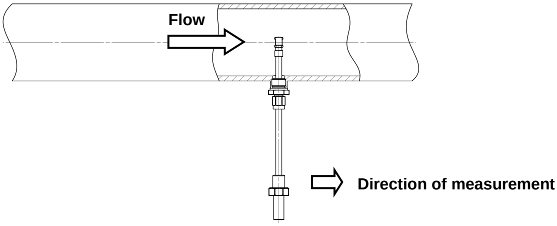


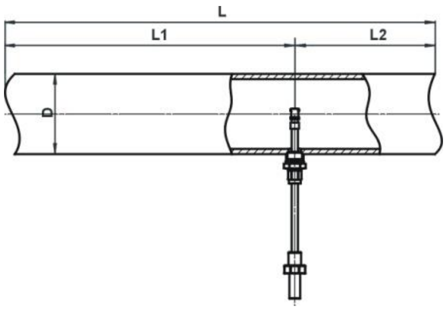
Figure 1 Positioning in a pipe

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 state and low in turbulence 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.



L = Length of entire measuring distance

L1 = Length of run-in distance

L2 = Length of run-out distance

D = Inner diameter of measuring distance

Figure 2

The following Table 1 shows the required steadying stages depending on the pipe's inner diameter "D" various causes of disturbance.

Flow obstacle upstream of measuring distance	Minimum length of distance	
	Run-in L1	**Run-out 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 or additional measures must be applied[5]. The profile factors specified in Table 2 may become void by the use of flow rectifiers.

Calculation of volume flow

If the cross section area of the pipe is known, the output signal of flow velocity w_N can be used to calculate the standard volumetric flow of the medium.
For this purpose, an average flow velocity $\overline{w_N}$, that is constant over the pipe's cross-section, is calculated with the help of the profile factor PF[6], which is dependent on the pipe's diameter D:

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

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

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

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

SCHMIDT Technology provides a convenient calculation tool to compute flow velocity or volume flow in pipes (circular or rectangle) for all its sensor types and measuring ranges on its homepage:

www.schmidt-sensors.com or www.schmidttechnology.de

Table 2 lists profile factors and volume flow measuring ranges (with certain sensor measuring ranges) for standard pipe diameters.

[5] Alternatively flow rectifier could be used, e.g. honeycomb ceramics.
[6] Considers the flow profile and the sensor obstruction.

Diameter of measuring pipe				Profile faktor	Volumetric flow [m³/h]			
Nominal size	Norm value		Inner		Min. @	@ sensor measuring range [m/s]		
	DN	[inch]	[mm]	PF	0.2 m/s	40 m/s	60 m/s	90 m/s
25	25	1	26.0	**0.796**	0.30	61	91	137
			28.5	**0.796**	0.37	73	110	165
	32		32.8	**0.796**	0.48	97	145	218
		1 1/4	36.3	**0.770**	0.57	115	172	258
40	40	1 1/2	39.3	**0.748**	0.65	131	196	294
			43.1	**0.757**	0.80	159	239	358
			45.8	**0.763**	0.91	181	272	407
50	50	2	51.2	**0.772**	1.14	229	343	515
			54.5	**0.775**	1.30	260	391	586
			57.5	**0.777**	1.45	291	436	654
			64.2	**0.782**	1.82	365	547	820
65	65	2 1/2	70.3	**0.786**	2.20	439	659	988
			76.1	**0.792**	2.59	519	778	1,167
80	80	3	82.5	**0.797**	3.07	614	920	1,380
100	100	4	100.8	**0.804**	4.62	924	1,386	2,079
110			107.1	**0.806**	5.23	1,046	1,568	2,353
125	125	5	125.0	**0.812**	7.17	1,435	2,152	3,229
130	125		131.7	**0.814**	7.98	1,597	2,395	3,593
150	150	6	150.0	**0.817**	10.40	2,079	3,119	4,678
160			159.3	**0.820**	11.77	2,353	3,53	5,295
170			182.5	**0.825**	15.54	3,108	4,661	6,992
190			190.0	**0.826**	16.86	3,372	5,059	7,588
200	200		206.5	**0.829**	19.99	3,998	5,997	8,996
	250		260.4	**0.835**	32.02	6,404	9,605	14,408
300	300		309.7	**0.840**	45.56	9,112	13,668	20,502
	350		339.6	**0.842**	54.91	10,982	16,474	24,711
400	400		388.8	**0.845**	72.23	14,446	21,670	32,505
450	450		437.0	**0.847**	91.47	18,294	27,440	41,161
500	500		486.0	**0.850**	113.53	22,706	34,059	51,089
550	550		534.0	**0.852**	137.39	27,477	41,216	61,824
600	600		585.0	**0.854**	165.27	33,054	49,581	74,371

Table 2

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 (G½ or Rp½) of the compression fitting is screwed (see Figure 3).

Note:

Before mounting depressurize system with overpressure media.

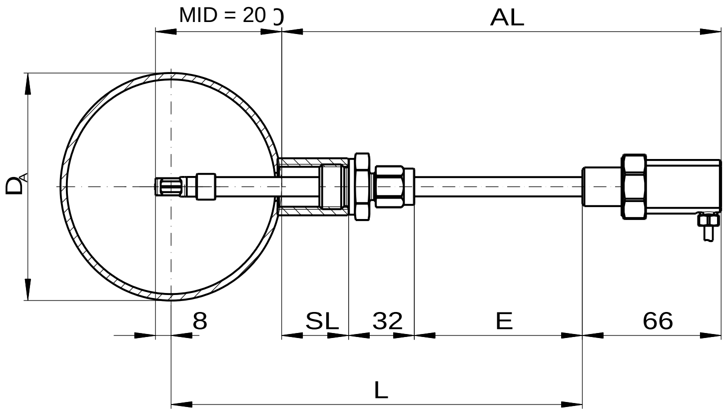


Figure 3

L	Sensor length [mm]	D_A	Outer diameter of 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]

- Bore a mounting opening in a pipe wall.
- Weld connecting piece with an internal thread G½ resp. Rp½ in the center above the mounting opening on the pipe.
  Recommended length of connecting piece: 15 ... 40 mm
- Slacken spigot nut of compression fitting (SW17) to such an extent that sensor probe can be moved without jamming and push it up carefully to the dead end of the sensor head.
- Depending on type of compression fitting:
  - G½: Check if O-ring seal is installed and fitted tightly.
  - Rp½: Wrap thread with common sealing tape, e. g. made of PTFE.
- Plug the holding bracket of the pressure protection chain into the thread of the compression fitting.
- Remove protective cap from sensor tip.
- Screw the threaded part of the 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.

- Observe the correct seat and alignment of the chain bracket.
- 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 spigot 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 ±3° relative to ideal measuring direction.

- Hold sensor and tighten spigot 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 octagonal part of the sensor enclosure.
- Make sure to close the safety chain before pressure is applied. The chain lock must be hung up in a way to avoid sagging of the chain (see Figure 4).

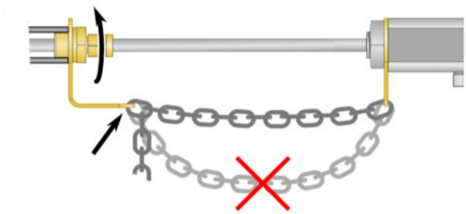


Figure 4: Safety chain installation

Mounting accessories

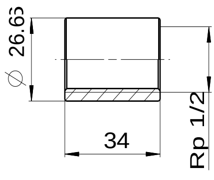
Type / article No.	Drawing	Mounting
Clamp[7] a.) 524 916 b.) 524 882		- Internal thread Rp½ - Material: a.) Steel, black b.) Stainless steel 1.4571

Table 3

[7] Must be welded.

4 Electrical connection

The sensor is equipped with a 4-pin cable firmly fixed to the sensor enclosure (pin assignment refer to Table 4).

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

Table 4

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

Operating voltage

For proper operation the sensor requires DC voltage with a nominal value of 24 V with permitted tolerance of ±10 %. It is protected against a polarity reversal; typical operating current is 40 mA, at maximum 60 mA[8].

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

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

Analog outputs

Both analog outputs, signalizing flow velocity and temperature of the medium, are designed as current interface (4 … 20 mA), featuring permanent short-circuit protection with respect to the supply voltage $+U_B$.
The apparent ohmic resistance R_L of max. 300 Ω must be connected between the signal output and GND (see Figure 5).
Load capacity C_L is limited to a maximum of 10 nF.

[8] Both signal outputs deliver 22 mA at minimum supply voltage.

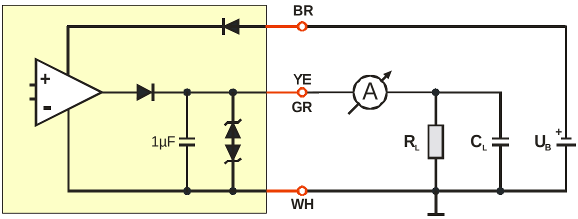


Figure 5

5 Signalization

Light emitting diodes

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

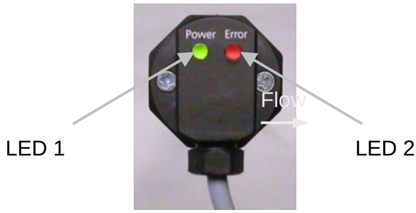


Figure 6

Operating state	LED 1	LED 2
Supply voltage: None, wrong polarization, too low	LED off	LED off
Ready for operation	LED on: green	LED off
Supply voltage beyond specification range Medium temperature beyond specification range	LED flashes (approx. 2 Hz): green	LED off
Sensor defective	LED on: green	LED flashes (approx. 2 Hz): red

- ○ LED off
- ● LED on: green
- ◐ LED flashes (approx. 2 Hz): green
- ◐ LED flashes (approx. 2 Hz): red

Analog outputs

- Error signaling
  The current interface delivers 2 mA[9].
- Representation of flow velocity
  The measuring range of the corresponding measuring value is mapped in a linear way to the signaling range of its analog output.
  For measuring flow velocity the range reaches from zero to the selectable end of the measuring range $w_{N,max}$ (= 100 % ≙ 20 mA in Figure 7). A higher flow up to 110 % ≙ 21.6 mA) is still output in a linear way, moreover the signal remains constant.

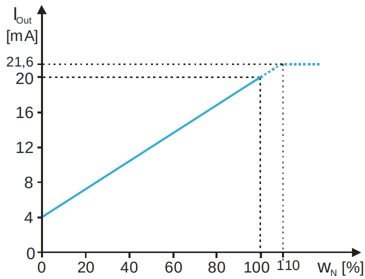
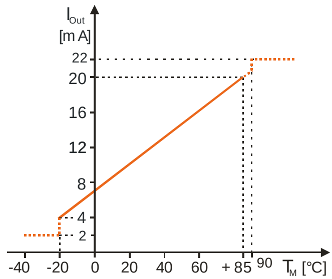
Flow velocity w_N	Medium temperature T_M
	
$w_N = \frac{w_{N,max}}{16\ mA} \cdot (I_{Out,w_N} - 4\ mA)$	$T_M = \frac{105\ °C}{16\ mA} \cdot (I_{Out,T_M} - 4\ mA) - 20\ °C$

Figure 7 Representation specification for measuring functions

- Representation of medium temperature
  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, flow velocity at the sensor head must be > 2 m/s. An excessive temperature value is output if flow velocity is < 2 m/s.

[9] 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 compression fitting, correct installation of safety chain.
- 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).
Make sure to close safety chain before pressure is applied.

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[10] of 8 bar_{op}. If it is used with lower pressures, the detection limit (DL) rises slightly. Higher pressures can cause a minimum output signal at zero flow.

Example: DL (8 bar_{op}) = 0.2 m/s
DL (0 bar_{op}) = 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.

[10] Maximum overpressure: 10 bar

Eliminating malfunctions

The following Table 5 lists possible errors (error images).
A description of the way to detect errors is given. Furthermore, possible causes and measures to be taken to eliminate them are listed.

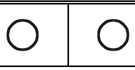
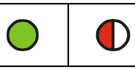
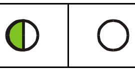
Error image	Possible causes	Troubleshooting
 I_{wN} & I_{TM} = 0 mA	Problems with supply voltage U_B: ➢ No U_B available ➢ U_B has wrong polarity ➢ U_B < approx. 6.5 V Sensor defective	➢ Sensor cable connected correctly? ➢ Supply voltage connected to control? ➢ Supply cable broken? ➢ Power supply unit large enough?
 I_{wN} & I_{TM} = 2 mA	Sensor element defective	Send in sensor for repair
 I_{wN} = 2 mA I_{TM} = 2 / 22 mA	Supply voltage beyond specification range (too low / high) Medium temperature beyond specification range (too low / high)	Check operating voltage and reduce it Check 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 foreign gas factor correct? Clean sensor tip Check installation direction
Flow signal w_N is fluctuating	U_B unstable Mounting conditions: ➢ Sensor head is not in optimal position ➢ Run-in/run-out distance is too short Strong fluctuations of pressure or temperature	Check voltage supply Check mounting conditions Check operating parameters

Table 5

8 Service information

Maintenance

Soiling of the sensor head may lead to distortion of the measured value. Therefore, the sensor head must be checked for contamination at regular intervals. If contaminations are visible, the sensor can be cleaned as described below.

Cleaning of sensor head

If the sensor head is soiled or dusty, it could be cleaned carefully by means of compressed air.

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

In case of persistent deposits, the sensor chip as well as the interior of the chamber head can be cleaned carefully by using residue-free drying alcohol (e.g. isopropyl alcohol) or soapy water with special cotton swabs.

Figure 8 Suitable cotton swabs with small cleaning pads

For this purpose cotton swabs that have small, soft cotton pads are suitable, e.g. type "SP4" of the brand "CONSTIX Swabs" of the manufacturer "CONTEC" (see Figure 8). The flat, narrow side of the pads fit just between chamber head wall and sensor chip and therefore exerts a controlled, minimal pressure on the chip. Conventional cotton swabs are too big and therefore can break the chip.

Under no circumstances do attempt to pressurize the chip with greater force (e.g. by swabs with thick head or lever movements with its stick).
Mechanical overloading of the sensor element can lead to irreversible damage.

The stick may only be moved back and forth in parallel to the chip surface with great care to rub off the dirt. If necessary, several cotton swabs have to be used.

Before restarting the sensor its head must be completely dried. The drying process can be accelerated by gently blowing.

If this procedure does not help, the sensor must be sent to **SCHMIDT Technology** for cleaning or repair.

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 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[11] w_N - Standard - Precision	 ±(5 % of measured value + [0.4 % of final value; min. 0.02 m/s]) ±(3 % of measured 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 5 to 0 m/s)
Temperature gradient w_N	< 8 K/min (at w_N = 5 m/s)
Measuring range T_M	-20 ... +85 °C
Measuring accuracy T_M (w_N ≥ 2 m/s)	±1 K (0 ... 40 °C) ±2 K (remaining measuring range)
Operating temperature - Medium - Electronics	 -20 ... +85 °C 0 ... +70 °C
Humidity range	0 ... 95 % rel. humidity (RH), non-condensing
Operating overpressure	≤ 10 bar
Operating voltage U_B	24 V_{DC} ± 10 % (reverse voltage protected)
Current consumption	Typ. < 40 mA, max. 60 mA
Analog outputs - Type current output - Maximum load	2 pcs. (short-circuit protected) 4 ... 20 mA (2 mA error signalization) R_L ≤ 300 Ω / C_L ≤ 10 nF
Electrical connection	Non-detachable connecting cable, pigtail[12], 4-pin, length 2 m
Maximum cable length	100 m
Type of protection	IP54 (enclosure), IP66 (sensor)
Protection class	III (SELV) or PELV (according EN 50178)
Mounting tolerance	±3° (relative to flow direction)
Min. tube diameter	DN 25
Mounting	Integrated compression fitting G½ or R½
Probe length L	200 / 350 mm
Weight	250 g max.

Table 6

[11] Under conditions of the reference
[12] With cable end sleeves

10 Declarations of conformity

SCHMIDT Technology GmbH herewith declares in its sole responsibility, that the product

SCHMIDT® Flow Sensor SS 20.261

Part-No. **526 335**

is in compliance with the appropriate

CE European guidelines and standards

and

UKCA UK statutory requirements and designated standards.

The corresponding declarations of conformity can be download from **SCHMIDT®** homepage:

www.schmidt-sensors.com

www.schmidttechnology.de

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