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SCHMIDT® Technology

SCHMIDT® Volume Flow Sensor

IL 30.0xx

Instructions for Use

SCHMIDT® Volume Flow Sensor IL 30.0xx

Table of Contents

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Subject to modifications

1 Important information

The instructions for use contain all required information for a fast commissioning and safe operation of **SCHMIDT® volume flow sensors**.

- These instructions for use must be read completely and observed carefully, before putting the unit into operation.
- Working on a pressurized system as well as assembly, electrical installation, commissioning and operation of the sensor may only be carried out by trained specialists. Safety and accident prevention regulations must be observed.
- 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 errors contained in these instructions for use or 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 personal or malfunction of the device.

General note

All dimensions are given in mm.

2 Application range

The **SCHMIDT® Volume Flow Sensor IL 30.0xx** is designed as inline sensor i.e. the tubular measuring section is already integrated in its basic body.

Four variants with different diameters are offered:

Type	Inner-Ø [mm]	Thread connection	Volume flow [Norm-m³/h]	Article No.
IL 30.005	16.1	DN 15 / G½	76.3	550 250
IL 30.010 MPM	27.3	DN 25 / G1	229	550 251
IL 30.015 MPM	41.9	DN 40 / G1½	417	550 252
IL 30.020 MPM	53.1	DN 50 / G2	712	550 253

Table 1

Connection to the pipe system is carried out by the internal threads on both sides of the base body, suitable extended measuring sections are offered by **SCHMIDT Technology** as optional accessory (see Table 2).

The **IL 30.0xx** measures both volume flow as well as the temperature of pure air and other inert[1] gases which are classified in fluid group 2 according to the **Pressure Equipment Directive 2014/68/EU** (PED), i.e. no chemically aggressive components or abrasive particles are included.

The sensor and the aforementioned measuring sections are designed for a maximum operating pressure of 16 bar and are covered by **article 4, paragraph 3 of the PED**. Accordingly, the devices are designed and manufactured in accordance with the sound engineering practice.

The sensor is based on the measuring principle of a thermal anemometer and measures the standard volume flow of the measuring medium which is output in a linear way as standard (respective: Norm) volume flow $\dot{V}_N$ (unit: m³/h), referred to standard conditions of T_N = 1013.25 hPa and p_N = 20 °C. Thus, the resulting output signal is independent of the pressure and temperature of the measured medium.

The sensor features several special properties, notably due to the unique Multi-Point-Measurement design (MPM) of its sensor elements:

- Best measurement results even in not fully smoothened air flows
- Excellent sensitivity
- High measurement dynamics

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

[1] Check suitability in individual cases.

3 Mounting instructions

General information on handling

The **SCHMIDT® Volume Flow Sensor IL 30.0xx** is a precision instrument with high measuring sensitivity, which can be achieved only by a delicate structure of its measuring probes. Therefore, applying mechanical forces to the probe tips inside the housing should be avoided if possible. In case of cleaning by the customer, this should preferably be made contactless (e.g. with a spray) or only with appropriate care.

The sensor probes should not be touched or exposed to any other mechanical effects.

Likewise, a touch can cause electrical damage to the ESD-sensitive sensor elements.

The sensor probes can be damaged by ESD.

To protect the sensitive inside, **SCHMIDT Technology** delivers the sensor with protective caps placed into both ends of its body which should be removed only before final installation. And vice versa when dismounting the sensor the protective caps should be attached in place immediately. In general, great care is required when handling the sensor.

The housing of the sensor is made of anodized aluminium. This ensures a low-friction screw-in of the installation pipes into the housing. Due to the softness of the material, however, the thread windings could be irreversibly damaged when tilting the pipes while screwing in.

The threads of the sensor body can take irreversible damage if handled incorrectly, i.e. by tilting pipes when screwing in.

If the sensor is installed without the extended measurement sections, which are offered optionally by **SCHMIDT Technology**, the dimensions and tolerances prescribed by the manufacturer must be observed strictly for the customized installation.

Corresponding dimensional drawings are available as download from

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

The mounting position of the sensor is arbitrary.

Systems with overpressure

The **IL 30.0xx** is designed for a maximum working pressure of 16 bar. As long as the measuring medium is operated with overpressure, make sure that:

- There is no overpressure in the system during installation.
- Only appropriately pressure-tight mounting accessories are used.
- All connections to pressurized systems are checked for pressure tightness from time to time.

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

The extended measuring sections, which are optionally available from **SCHMIDT Technology** (see subchapter *Accessories*), are delivered with two O-Rings which are intended as pressure seals for easy installation (must be applied by customer). If the customer uses his own pipes, suitable installation and sealing equipment must be used (e.g. sealing tape). In any case take care that the threads are screwed into the housing without tilting, to avoid damaging of the sensor body. Furthermore, before applying pressure, the sensor must be checked for a safe and firm installation. After pressurization check for any leakages and eliminate them immediately if there are some.

Before applying pressure, make sure that all screw connections are firmly seated and cannot be loosened. Unscrewing while the system is under pressure can damage the sensor and can also result in serious harm to your health.

The pressure sealing parts of the installation have to be checked regularly for pressure tightness and safe installation.

Flow characteristics

Local turbulences of the medium can cause distortion of measurement results. The resulting measurement distortions are reduced to a minimum by the special sensor design “MPM” (Multi-Point-Measurement – all variants except **IL 30.005**). In order to get maximum accuracy it’s nevertheless advisable to smooth turbulences of the gas flow before applying it to the sensor.

The simplest method is to provide a sufficiently long distance both in front of (run-in distance) as well as behind the sensor (run-out distance) absolutely straight and without disturbances.

The absolute length of the respective distances is indicated as a multiple of the inner diameter D of the pipe.

For optimal measurement results it is recommended to provide standard distances of at least 10•D before and 5•D after the sensor. Using sensor types with MPM these distances can be reduced to at least 3•D before and 3•D after it in case of modest sources of disturbance (e.g. 90° arcs).
If this is not possible, the run-in distance should take up ⅔ of the available measuring length and the run-out distance ⅓ of it.
In particular, care must be taken to ensure that the inner diameters of the attached pipes correspond exactly to that of the sensor. Steps in the pipe cross-section lead to strong deviations of measurement results and require longer inlet distances.

Accessories for installation

For mounting of the **SCHMIDT® Volume Flow Sensor IL 30.0xx**, there are several accessories available (see Table 2).

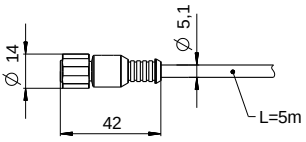
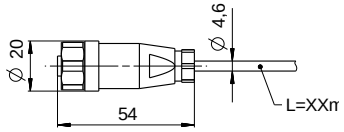
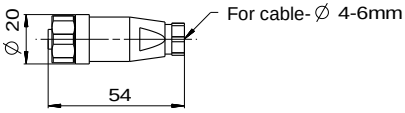
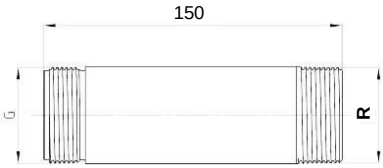
Type / article No.	Drawing	Mounting
Connecting cable fixed length: **5** m 523 565		- Threaded ring, hexagon - Plug injection-moulded - Wires: 5 x 0.34 mm² - Material: Stainless steel PUR, PVC
Connecting cable optional length: **x** m 523 566 **x** = 2 … 100 m (Step: 1 m)		- Threaded ring, hexagon - Wires: 5 x 0.34 mm2 - Material: Stainless steel PA, PUR, PP Free of halogen[2]
Coupler socket Thread locking system (VA) 523 562		- Threaded ring, hexagon - Material: Stainless steel PA, PUR, PP - Connection of leads: Bolted (5 x 0.75 mm²)
Extended measuring sections ½": 556 954 1": 556 955 1½": 556 956 2": 556 957		- Type of thread: G and R - Material: Stainless steel (pipe) NBR 70 (O-rings)

Table 2

[2] According to IEC 60754

4 Electrical connection

The sensor features two connectors:

- Main connector:
  - Connection of voltage supply
  - Output of measuring signals
- Module connector:
  For connection of an optional extension module.

Figure 1

Main connector

This connector is a 5-pin plug, type M12 (male, A-coded) with a thread for the connecting cable[3] (pin assignment: Figure 2 and Table 3).

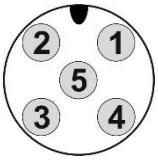


Figure 2:
View on connector of sensor (male)

Pin	Designation	Function	Wire colour
1	Power	$+U_S$ (+24 V)	Brown
2	Analogue $\dot{V}_N$	Volume flow	White
3	GND	GND	Blue
4	Analogue T_M	Temperature of medium	Black
5	Impulse	Volume	Grey

Table 3 Pin assignment

The specified lead colours are valid for connecting cables from **SCHMIDT Technology** (see subchapter *Accessories*).

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

The plug housing, and thus also a possibly screen of a plugged connection cable, is electrically connected to the metal housing of the sensor.

The appropriate protection class III (SELV) respective PELV (according EN 50178) has to be considered.

[3] The spigot nut is located at the connecting cable.

Power supply

For proper operation the sensor requires direct voltage with a nominal value of 24 V with permitted tolerance of ±10 %.
Deviating values lead to deactivation of measuring of the volume flow or even to defects and, therefore, should be avoided. As far as it is functionally possible, the LED indication reports the faulty operational conditions (see *chapter 5*).

Only operate sensor within the defined range of supply voltage (U_S = 24 V_{DC} ± 10 %).
Undervoltage may result in malfunction; overvoltage can lead to irreversible damage.

Specifications for operating voltage apply to the connection at the sensor. Voltage drops generated due to line resistances must be considered by the customer.
The operating current[4] of the sensor is at minimum 25 (15) mA up to a maximum of 300 (180) mA.

Wiring of analogue outputs

Both analogue outputs (volume flow and temperature of medium) are designed as short-circuit protected current interfaces (4 … 20 mA).
The respective load R_L must be connected to the reference potential (GND) of the sensor.

Load specification: $R_L \leq 500\ \Omega$; $C_L \leq 10$ nF

Wiring of impulse output

The pulse output (volume) is designed as highside driver (P-MOSFET, open drain) connected to the (reverse protected) operating voltage. The output is protected by two methods, a serial diode against higher external voltage as well as generally by an analogue current limitation with a limit of typical 50 mA (max. 65 mA).

The load has to be connected to GND.

Module connector

The **SCHMIDT® Volume Flow Sensor IL 30.0xx** comes with an additional connector (M12, female, A-coded, 5-pin) for connecting optional expansion modules (see Figure 1).

Only expansion modules from **SCHMIDT Technology** may be connected to the module connector.

[4] Current of impulse output not included; operation current of IL 30.005 in brackets.

5 Signalling

Light emitting diodes

The **SCHMIDT® Volume Flow Sensor IL 30.0xx** has four Duo-LEDs (see Figure 3) to indicate its operational status (see Table 4):

- In error-free operation: Volume flow (bar graph mode)
- Problems in operation: Cause of detected error

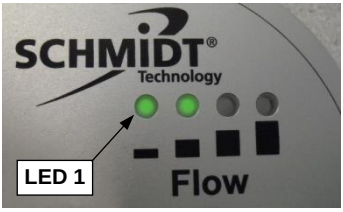


Figure 3

No.	State	LED 1	LED 2	LED 3	LED 4
1	Ready for operation & volume flow < 5 %[5]	⊗	○	○	○
2	Volume flow > 5 %	●	○	○	○
3	Volume flow > 20 %	●	●	○	○
4	Volume flow > 50 %	●	●	●	○
5	Volume flow > 80 %	●	●	●	●
6	Volume flow > 100 % = overflow	●	●	●	⊗
7	Sensor element defective	◐	◐	◐	◐
8	Operating voltage too low	◐	◐	○	○
9	Operating voltage too high	○	○	◐	◐
10	Electronic temperature too low	○	◐	◐	○
11	Electronic temperature too high	◐	○	○	◐
12	Medium temperature too low	⊗	◐	◐	⊗
13	Medium temperature too high	◐	⊗	⊗	◐

Table 4

○ LED off ⊗ LED on: orange

● LED on: green ◐ LED flashes (1 Hz): rot

[5] „%“ of final value of measuring range of volume flow

Analogue outputs

- Representation of measuring range
  The measuring range of the corresponding measuring value is mapped in a linear way to the signal range.
  For volume flow measurement the measuring ranges from zero to the variant-specific end of the measuring range $\dot{V}_{N,max}$ (see Table 5, left).

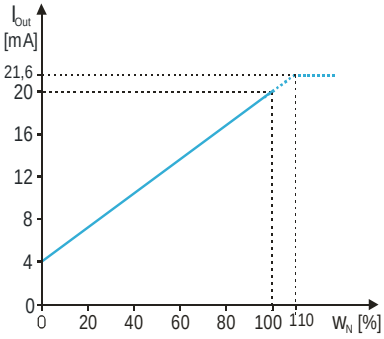
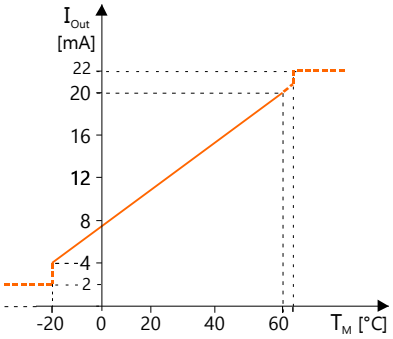
Volume flow	Temperature of medium
	
$\dot{V}_N = \frac{\dot{V}_{N,max}}{16\ mA} \cdot (I_{Out,\dot{V}_N} - 4\ mA)$	$T_M = \frac{80\ °C}{16\ mA} \cdot (I_{Out,T_M} - 4\ mA) - 20\ °C$

Table 5

The measuring range of the medium temperature T_M is specified between -20 °C and +60 °C.

Note regarding commissioning:

Normally the temperature output indicates approx. 12 mA because the typical prevailing room temperature of 20 °C corresponds to about half of the measuring range.

- Error signalling[6]
  The interface outputs 2 mA.
- Exceeding measuring range of volume flow
  Measuring values higher than $\dot{V}_{N,max}$ are output linearly up to 110 % of the signalling range (this corresponds to the maximum output of 21.6 mA, see left image in Table 5). For higher values the output signal remains constant.
  Error signalling doesn't take place because damage of the sensor is unlikely.

[6] In accordance to NAMUR specification

- Medium temperature beyond specification range
  Operation beyond specified limits[7] can damage the measuring probes and, therefore, is seen as a critical error:
  - o Medium temperature below -20 °C:
    The analogue output for T_M switches to error signalling (2 mA).
    The measuring function of volume flow is switched off; its analogue output also reports an error (2 mA).
  - o Medium temperature above +60 °C:
    Up to 65 °C the temperature is still output linearly (corresponds to 21 mA), e.g. to enable an overshooting of a heating control. The volume flow is measured and displayed further on.
    Above this critical limit the measurement of volume flow is switched off and its outputs are going to error (2 mA / locked). The output for T_M jumps directly to its maximum value of 22 mA which differs from standard error signalling.
    In case of excessive temperature, this avoids a harmful feedback of the heating control that might be measuring by means of the medium temperature sensor. The standard error signaling (2 mA) could be identified by the control as a very low temperature of the medium which would lead to further heating.

Impulse output

- Signalling
  One impulse represents a defined volume that has flowed.
  During the pulse signal itself, the output transistor switches through for a fixed time (conducting) otherwise the transistor is locked (high impedance).
  - o Pulse valence:
    IL 30.005; **IL 30.010 MPM**: 0.1 Norm-m³
    IL 30.015 MPM; **IL 30.020 MPM**: 1.0 Norm-m³
  - o Pulse duration (fix): 1 s
- Error signalling
  As long as the analogue flow volume output signals an error (2 mA), the pulse output is locked (high impedance).

[7] Switching hysteresis for the threshold is approx. 2 K.

6 Commissioning

Before applying supply voltage to the **SCHMIDT® Volume Flow Sensor IL 30.0xx** the following checks have to be carried out:

- Mechanical mounting:
  - All screws are tightened properly.
  - Suitable pressure protection measures are carried out (e.g. sealing tape in the threads).

For measurements in media with overpressure check if all screws are tightened properly and all mechanical connections are pressure tight.

- Connecting cable:
  - Proper connection in the field (switch cabinet or similar).
  - Tight fit of spigot nut of the connector of the connecting cable at sensor enclosure.

If the sensor is in the correct operational state after initialization it switches into measuring mode. The indication of volume flow (both LEDs and signal outputs) jumps for a short period to maximum and settles after approx. one second at the correct measuring value provided the sensor probe has medium temperature already. Otherwise, the process will prolong until the sensor has reached medium temperature.

7 Information concerning operation

Ambient condition temperature

The **SCHMIDT® Volume Flow Sensor IL 30.0xx** monitors the temperature of both medium and electronics. As soon as one limit of the specified operation ranges is exceeded, the sensor switches off one or both measuring functions associated with the medium depending on the situation and report the corresponding error. As soon as proper operational conditions are restored, the sensor resumes normal function.

Even short-term exceedance or undershooting of operating temperatures can cause irreversible damage to the sensor.

Ambient condition medium

The **SCHMIDT® Volume Flow Sensor IL 30.0xx** is suitable for clean, non-combustible air and gases that contain neither dust, abrasive particles or vapours nor gaseous oils or chemical aggressive components.
Depending on the consistency and composition, deposits or other contaminants may lead to falsification of the measured value and should be avoided coercively (see *chapter 8*).

Soiling or other deposits on the sensing elements cause false measurement results. Therefore, the sensor should be checked for contaminations regularly and, if necessary, has to be cleaned or send in for maintenance.

When cleaning, use only mild agents (such as isopropanol) and avoid direct contact of the sensor elements as far as possible.
The suitability of the sensor for use in any non-clean media must be checked in individual cases.
Condensing liquid fractions in gases or even immersion into liquids can damage the probe and therefore must be avoided strictly. Also, the significantly higher heating capacity of liquids distorts the measuring results seriously (in this case a much higher volume flow is detected and will be signalled).

(Condensing) liquid on the measuring probes causes serious measurement distortions and can also damage the sensor irreversibly.

For maximum accuracy in real applications, the **SCHMIDT® Volume Flow Sensor IL 30.0xx MPM** is matched in pressures > 3 bar. In order to avoid additional measurement deviations, the use of it at > 50 % of the measuring range is only recommended at pressures > 3 bar.

When using a **SCHMIDT® Volume Flow Sensor IL 30.0xx MPM** in higher standard volume flows (> 50 % of measuring range), a minimum operating pressure of 3 bar is recommended for optimal measurement results.

8 Service information

Troubleshooting

Possible errors (error images) are listed in Table 6.
Furthermore several causes and measures to eliminate the error are described.

Causes of any error signaling have to be eliminated immediately. Exceeding or falling below the permitted operating parameters can result in permanent damage to the sensor.

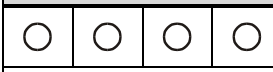
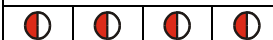
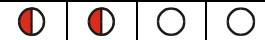
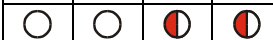
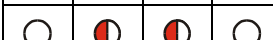
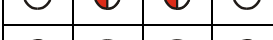
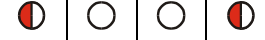
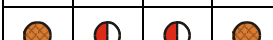
Error image	Possible causes	Troubleshooting
 No LED is shining All signal outputs are at zero	Problems with supply U_S: ➢ No U_S available ➢ Wrong polarity (DC) ➢ U_S < 15 V Sensor is defective	➢ Connector screwed on correctly? ➢ Supply voltage connected correctly? ➢ Supply voltage at sensor plug available (cable break)? ➢ Power supply sufficient?
Start sequence is repeated continuously (all LEDs flashes simultaneously in red - yellow - green)	U_S unstable: ➢ Power unit cannot supply switch-on current ➢ Other consumers overload power source ➢ Wire resistance too high	➢ Supply voltage at sensor stable? ➢ Power supply sufficient? ➢ Voltage losses over cable negligible?
	Sensor element defective	Send in sensor for repair
	Supply voltage U_S < 21.6 V	Increase supply voltage
	Supply voltage U_S > 26.4 V	Decrease supply voltage
	Electronic temperature too low	Increase temperature of environment
	Electronic temperature too high	Decrease temperature of environment
	Medium temperature too low	Increase medium temperature
	Medium temperature too high	Reduce medium temperature
Signal $\dot{V}_N$ is too large / small	Measuring medium does not correspond to air Sensor elements are soiled Sensor elements are moistened	Gas correction considered? Send in sensor for cleaning / maintaining Dry sensor elements
Signal $\dot{V}_N$ is fluctuating	U_S unstable Installation conditions: ➢ Run-in or run-out distance is too short ➢ Strong fluctuations of pressure or temperature	Check voltage supply Check installation conditions Check operating parameters
Analogue signal permanently at maximum	Load resistance of signal output is at $+U_S$	Connect load resistance to GND

Table 6

 LED off

 LED on: green

 LED on: orange

 LED flashes (1 Hz): rot

Transport / shipment of the sensor

For transportation or dispatching of the sensor, it must be well protected against vibrations and shocks. Ideally, the sensor is shipped with fitted protective caps and in its original packaging.
Soiling, mechanical stress and / or touching the sensor elements should be avoided.

Calibration

If the customer has made no other provisions, we recommend repeating the calibration at a 12-month interval. For this purpose the sensor must be sent in to the manufacturer.
A calibration can be carried out only if the basic sensor, i.e. without mounted extended sections or other pipes, is sent in. Also make sure that there are no damages especially concerning the sensor elements and the inner mounting threads.

Spare parts or repair

No spare parts are available, since a repair is only possible at the manufacturer's facility. In case of defects, the basic sensor must be sent in to the supplier for repair. Any other installed parts like pipes or measurement extensions have to be removed.

- **A completed declaration of decontamination must be attached.**

The appropriate form “Declaration of decontamination” form is enclosed with the sensor and can also be downloaded from

www.schmidt-sensors.com

under “Calibration Service Center”.

Alternatively it can be downloaded from

www.schmidttechnology.de

under the heading "Product Downloads" in "Service & Support / Sensor Technology”.

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

Test and material certificates

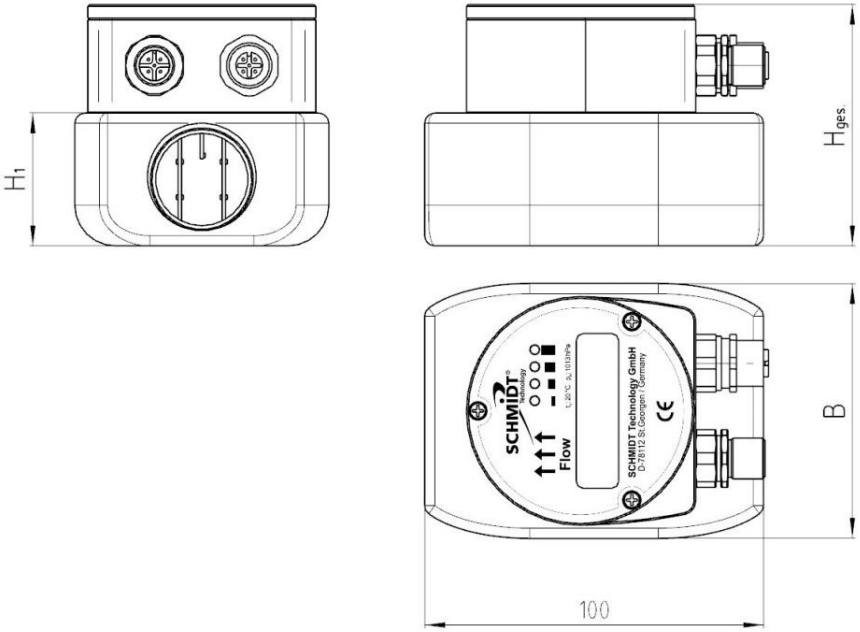
Every new sensor is accompanied by a certificate of compliance according to EN 10204-2.1. Material certificates are not available.
Upon request, we shall prepare, at a charge, a factory calibration certificate, traceable to national standards.

9 Technical data

Sensor technology	Thermal inline volume flow sensor (with MPM[8])
Measurands	Standard[9] volume flow $\dot{V}_N$ Temperature of medium T_M
Measuring ranges[10] $\dot{V}_N$	½": 0.15 … 76.3 Norm-m³/h 1": 0.50 … 229 Norm-m³/h 1½": 1.00 … 417 Norm-m³/h 2": 2.00 … 712 Norm-m³/h
Measuring accuracy $\dot{V}_N$	±(3 % of measured value + 0.3 % of fmr[11]) With higher volume flows (> 50 % of fmr) an operating pressure > 3 bar is recommended for optimal measuring results.
Response time (t_{90}) $\dot{V}_N$	Approx. 5 s
Measuring accuracy T_M	≤ ±2 K (volume flow > 2 % of fmr)
Measurement direction	Unidirectional
Mounting position	Arbitrary
Medium to be measured	Clean (compressed-) air, nitrogen; other gases on request (fluid group 2 according PED 2014/68/EU)
Compression strength	16 bar (overpressure)
Humidity range	≤ 95 % rel. humidity, non-condensing
Operating temperature	-20 … +60 °C
Installation	Inner threads DN 15 … DN 50 (G½ … G2)
Analogue output	Current interface (short circuit protected) Signal range: 4 … 20 mA (2 mA error signal) Load: R_L ≤ 500 Ω / C_L ≤ 10 nF
Impulse output	Highside driver (open drain, short circuit protected) Pulse valence: 0.1 / 1.0 Norm-m³ Pulse duration: 1 s (transistor conducting) Pulse high level: > U_S – 1 V (current limiting inactive) Current limit: Typ. 50 mA (max. 65 mA)
Display	4 dual LEDs (bar graph display of $\dot{V}_N$ / sensor status)
Supply Voltage U_S	24 V DC ± 10 %
Current consumption (without impulse output)	IL 30.005: ≤ 120 mA IL 30.0xx MPM: ≤ 300 mA
Electrical Connection	Main connector: M12, male, A-coded, 5-pin Module connector: M12, female, A-coded, 5-pin
Length of connection cable	Max. 30 m (observe wire resistance)
Type / class of protection	IP64 (housing) / III (SELV) or PELV (EN 50178)
Material of housing	Anodized aluminium

[8] MPM: Multi-Point-Measurement; except IL 30.005 with only one measurement point
[9] Based on standard (Norm) conditions T_N = 20 °C and p_N = 1013.25 hPa
[10] Minimal value of measuring range = lower detection limit
[11] fmr: final value of measuring range

10 Dimensions



Type	$H_{ges.}$	H_1	B	Article number
IL 30.005	59	27	75	550 250
IL 30.010 MPM	71	39	75	550 251
IL 30.015 MPM	86	54	75	550 252
IL 30.020 MPM	98	66	82	550 253

All dimensions in mm

11 Declarations of Conformity

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

SCHMIDT® Volume Flow Sensor IL 30.0xx

Part-Nos. **550 250, 550 251, 550 252, 550 253**

is in compliance with the appropriate

European guidelines and standards

and

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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