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better measurement



SCHMIDT[®] Volume Flow Sensor
IL 30.0xx
Instruction for Use

SCHMIDT® Volume Flow Sensor IL 30.0xx

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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.
- 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-m ³ /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 page 7).

The sensor measures both volume flow as well as the temperature of pure¹ air and gas with working pressure up to 16 bar (gauge pressure).

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 smoothed air flows
- Excellent sensitivity
- High measurement dynamics

These properties make the sensor highly suitable for:

- Consumption of compressed air
- Consumption of gases



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

¹ No chemically aggressive content / abrasive particles; check suitability in individual cases

3 Mounting instructions

General information on handling

The 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 dismantling 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 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.

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:

- 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 types with MPM it is recommended to provide at least 10xD in front of the sensor and 5xD after the sensor. Concerning the **IL 30.005** (without MPM) the standard lengths (up to 45xD inlet) should be used.

If this is not possible the run-in distance should take up 2/3 of the available measuring length and the run-out distance 1/3 of it.

Accessories for installation

For mounting of the **SCHMIDT® Volume Flow Sensor IL 30.0xx**, an extensive assembly of accessories is available to cover a wide range of applications (see Table 2).

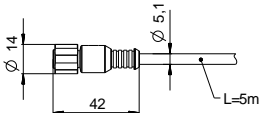
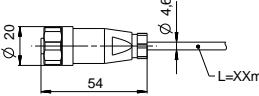
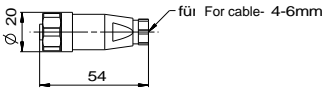
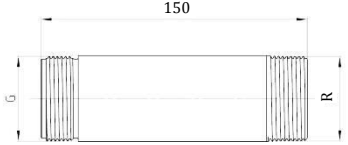
Type / article No.	Drawing	Mounting
Connecting cable fixed length: 5 m 523 565		<ul style="list-style-type: none"> - Threaded ring, hexagon - Plug injection-moulded - Wires: 5 x 0.34 mm² - Material: Stainless steel PUR, PVC
Connecting cable optional length: x m 523 566 x = 2 ... 100 m Step: 0.1 m		<ul style="list-style-type: none"> - Threaded ring, hexagon - Wires: 5 x 0,34 mm² - Material: Stainless steel PA, PUR, PP Free of halogen²
Coupler socket Thread locking system (VA) 523 562		<ul style="list-style-type: none"> - 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		<ul style="list-style-type: none"> - 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 cable³ (pin assignment: Figure 2 and Table 3).

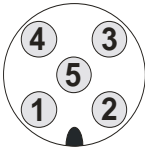


Figure 2:

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	Medium temperature	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 (EN 50178) has to be considered.

³ Spigot nut is on connecting cable

Power supply

For proper operation the sensor requires direct voltage with a nominal value of 24 V with permitted tolerance of $\pm 10\%$.

Deviating values lead to deactivation of measuring 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 operating voltage ($U_S = 24 V_{DC} \pm 10\%$).

Undervoltage⁴ may result in malfunction; overvoltage can lead to irreversible damage.

Operating current of the sensor (impulse output current not included) is typically 90 (40) mA, maximum 300 (120) mA (**IL 30.005** in brackets).

Specifications for operating voltage apply to the connection at the sensor. Voltage drops generated due to line resistances must be considered by the customer.

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: $R_L \leq 500 \Omega$; $C_L \leq 10 \text{ nF}$

Wiring of impulse output

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



Don't connect anything other to this port than expansion modules from **SCHMIDT Technology**.

⁴ For $U_S < 15 \text{ V}$ the electronics shuts down.

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 (Table 4):

- In error-free operation: Volume flow (bar graph mode)
- Problems in operation: Detected error cause

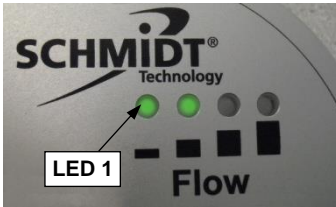


Figure 3

No.	State	LED 1	LED 2	LED 3	LED 4
1	Operational & volume flow $\leq 5\%$ 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	Supply voltage too low	◐	◐	○	○
9	Supply voltage too high	○	○	◐	◐
10	Temperature of electronics too low	◐	○	○	◐
11	Temperature of electronics too high	○	◐	◐	○
12	Temperature of medium too low	●	◐	◐	●
13	Temperature of medium too high	◐	●	●	◐

Legend

- LED off
- LED shines green
- LED shines orange
- ◐ LED flashes red (approx. 2 Hz)

Table 4

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).

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

Table 5

The measuring range of the medium temperature T_M is specified between -20 °C and $+60 \text{ °C}$.

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 signalling⁶

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 limits⁷ can damage the measuring probes and, therefore, is seen as a critical error:
 - 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).
 - 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.

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).
 - Pulse valence:

IL 30.005; IL 30.010 MPM:	0.1 Norm-m ³
IL 30.015 MPM; IL 30.020 MPM:	1.0 Norm-m ³
 - Pulse duration (fix): 1 s
- Error signalling
As long as the analogue flow volume output signals 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 a short-term over- or undershooting of the safety limit values can lead to permanent damage of the sensor which must be avoided by all means.



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

Ambient condition pressure

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.

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.


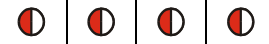
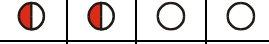
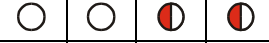
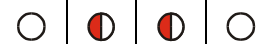
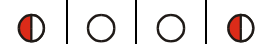
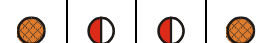

Error image	Possible causes	Troubleshooting
 <p>No LED is shining All signal outputs are at zero</p>	<p>Problems with supply U_S:</p> <ul style="list-style-type: none"> ➤ No U_S available ➤ Wrong polarity (DC) ➤ $U_S < 15\text{ V}$ <p>Sensor is defective</p>	<ul style="list-style-type: none"> ➤ Connector screwed on correctly? ➤ Supply voltage connected correctly? ➤ Supply voltage at sensor plug available (cable break)? ➤ Power supply sufficient?
<p>Start sequence is repeated continuously (all LEDs flashes simultaneously in red - yellow - green)</p>	<p>U_S unstable:</p> <ul style="list-style-type: none"> ➤ Power unit cannot supply switch-on current ➤ Other consumers overload power source ➤ Wire resistance too high 	<ul style="list-style-type: none"> ➤ Supply voltage at sensor stable? ➤ Power supply sufficient? ➤ Voltage losses over cable negligible?
	Sensor element defective	Send in sensor for repair
	Supply voltage $U_S < 21.6\text{ V}$	Increase supply voltage
	Supply voltage $U_S > 26.4\text{ V}$	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
<p>Signal \dot{V}_N is too large / small</p>	<p>Measuring medium does not correspond to air Sensor elements are soiled</p> <p>Sensor elements are moistened</p>	<p>Gas correction considered?</p> <p>Send in sensor for cleaning / maintaining</p> <p>Dry sensor elements</p>
<p>Signal \dot{V}_N is fluctuating</p>	<p>U_S unstable</p> <p>Installation conditions:</p> <ul style="list-style-type: none"> ➤ Run-in or run-out distance is too short ➤ Strong fluctuations of pressure or temperature 	<p>Check voltage supply</p> <p>Check installation conditions</p> <p>Check operating parameters</p>
<p>Analogue signal permanently at maximum</p>	Load resistance of signal output is at $+U_S$	Connect load resistance to GND

Table 6



LED off



LED shines orange



LED shines green



LED flashes red (approx. 1 Hz)

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.

Also a completed declaration of decontamination, in conjunction with all shipping documents, must be attached at the outside of the shipment package.

The appropriate form "Declaration of decontamination" is enclosed to the sensor. Alternatively it can be downloaded from

www.schmidt-sensors.com.

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 calibration certificate for new devices or in case of a re-calibration. The certificate is 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-m ³ /h 1": 0.50 ... 229 Norm-m ³ /h 1½": 1.00 ... 417 Norm-m ³ /h 2": 2.00 ... 712 Norm-m ³ /h
Measuring accuracy \dot{V}_N	±(3 % of measured value + 0.3 % of fmr ¹¹)
Response time (t_{90}) \dot{V}_N	Approx. 5 s
Measuring accuracy T_M	≤ ±2 K (volume flow > 2 % of fmr)
Measurement direction	Unidirectional
Medium to be measured	Clean (compressed-) air, nitrogen; other gases on request
Compression strength	16 bar (overpressure)
Humidity range	≤ 95 % rel. humidity, non-condensing
Operating temperature	-20 °C ... +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: $R_L \leq 500 \Omega$ / $C_L \leq 10$ nF
Impulse output	Highside driver (open drain, short circuit protected) Pulse valence: 0.1 / 1.0 Norm-m ³ Pulse duration: 1 s (transistor conducting) Pulse high level ¹² : > $U_S - 1$ V Current limit: typ. 50 mA (max. 65 mA)
Display	4 dual LED (quasi-analogue display of \dot{V}_N / sensor status)
Supply Voltage U_S	24 V DC ± 10 %
Current consumption (without impulse output)	IL 30.005: typ. 40 mA, max. 120 mA IL 30.0xx MPM: typ. 90 mA, max. 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. 100 m (recommended; observe wire resistance)
Type / class of protection	IP 64 (housing) / III (SELV) or PELV (EN 50178)
Material	Anodized aluminium

⁸ MPM: Multipoint-Measurement; except IL 30.005 with only one measurement point

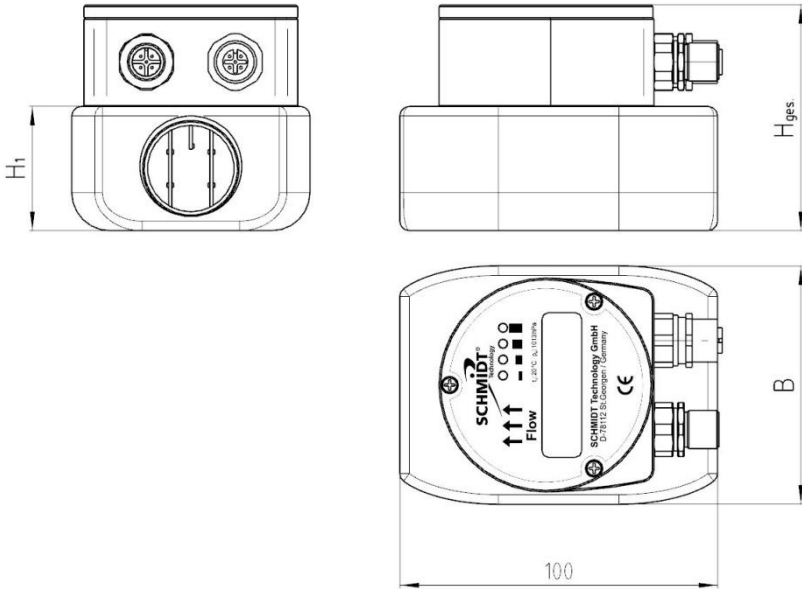
⁹ Based on standard (Norm) conditions $T_N = 20$ °C and $p_N = 1013.25$ hPa

¹⁰ Minimal value of measuring range = lower detection limit

¹¹ fmr: final value of measuring range

¹² Current limiting not active

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 Declaration of Conformity

EU-Declaration of conformity



SCHMIDT Technology GmbH herewith declares that the products

SCHMIDT® Flow Sensor

IL 30.005, IL 30.010 MPM, IL 30.015 MPM, IL 30.020 MPM

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

are 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**
- Immission (industrial): **EN 61000-6-2: 2006+A1:2011**

This declaration certifies 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, 10.07.2018

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

Helmar Scholz
Head of R&D Division Sensors

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