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SCHMIDT® Technology

SCHMIDT® Mass Flow Sensor
IL 30.2xx
Instructions for Use

SCHMIDT® Mass Flow Sensor IL 30.2xx

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1 Important information

The instructions for use contain all required information for a fast commissioning and safe operation of **SCHMIDT® mass 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 as follows (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.

Note on hazards due to electrostatic discharge (ESD).

General note

All dimensions are given in mm.

2 Application range

The **SCHMIDT® Mass Flow Sensor IL 30.2xx** is designed as inline sensor i.e. the tubular measuring section is already integrated in its basic body.

Two variants with different inner diameters are offered (see Table 1 as well as chapter *10 Dimensions*):

Type	Inner-Ø [mm]	Thread connection	Volume flow [Norm-l/min]	Article No.
IL 30.208	10	DN8 (G¼)	20/100/200	572 900
IL 30.212	13	DN12 (G⅜)	300/500	572 901

Table 1

The connection to the pipe system is realised via the internal threads on both sides in the T-shaped base body, with the following delivery options:

- With fitted push-in fittings for hoses:
  Plug-in connector for pneumatic hose with an outer diameter of 12 mm resp. 16 mm (see Figure 4 for details).
- With enclosed measuring section extensions (1 pair):
  - Pipe double nipple acc. to EN 10204 in stainless steel (1.4404/316L)
  - **IL 30.208**: Length 100 mm, with thread R¼ on both sides
  - **IL 30.212**: Length 150 mm, with thread R⅜ on both sides

The **IL 30.2xx** measures both volume flow as well as temperature of pure air and other inert[1] gases that are classified in fluid group 2 according to **Pressure Equipment Directive 2014/68/EU** (PED), i.e. no chemically aggressive components or abrasive particles are included.

The sensor is designed for a maximum operating pressure[2] of 8 bar and is therefore 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 $\dot{V}_N$ (unit: norm-l/min) of the measuring medium, referring to standard conditions of T_N = 1013.25 hPa and p_N = 20 °C, which is output linearly. Therefore, the resulting output signal is independent of pressure and temperature of the measured medium.

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

[1] Check suitability in individual cases.
[2] Overpressure

3 Mounting instructions

General information on handling

The **SCHMIDT® Mass Flow Sensor IL 30.2xx** 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 probe 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.

In general, great care is required when handling the sensor.
The dimensions and tolerances prescribed by the manufacturer must be observed strictly for the customized installation.
Corresponding dimensional drawings are available as download:

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

Systems with overpressure

The **IL 30.2xx** is designed for a working pressure[3] up to 8 bar. As long as the measuring medium is operated with overpressure, make sure that:

- There is no overpressure in the system during installation.

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

- Only appropriately pressure-tight mounting accessories are used.
  The threads of the pipe system must be sealed with suitable measures (e.g. sealing tape).
- The threads are screwed into the sensor's housing without tilting, to avoid damaging of its body.
- Before applying pressure, the mounted sensor was checked for a safe and firm installation.

[3] Overpressure

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 result in serious harm to your health.

- After pressurization check for any leakages and eliminate them immediately if there are some.

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 (e.g. distortion of the flow profile due to pipe bends) can cause distortion of measurement results. The unique sensor design reduces these to a minimum.

To achieve optimum measurement results, it is nevertheless advisable to feed the gas flow into the sensor with minimal turbulences.

The best way to achieve this is to ensure that you have sufficient straight lengths upstream (“Run-in distance”) and downstream (“Run-out distance”) of the installed sensor.

The length of the respective distances are specified as a multiple of the inner pipe diameter D and depends on the flow obstacle (see Table 2).

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 / 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 2

If the specified distances cannot be provided, the run-in distance should take up ⅔ and the run-out distance ⅓ of the available measuring pipe length.

4 Electrical connection

Both the **IL 30.208** and **IL 30.212** are available in two functional variants with different electrical connections:

- Analogue variant:
  The sensor issues the measured volume flow $\dot{V}_N$ via an analogue current interface (4 ... 20 mA).
  It is connected by a permanently attached 4-pin cable with open end (stranded wires with ferrules, pin assignment refers to Table 3).

Wire color	Designation	Function
Brown	Power	Operating voltage: $+U_B$ (+24 V)
White	GND	Operating voltage: Mass
Yellow	Analogue $\dot{V}_N$	Output signal: Mass flow
Green	AGND[4]	Reference potential: Analogue output

Table 3 Pin assignment analog variant

- Digital variant:
  In addition to the analogue current interface (4 ... 20 mA) for $\dot{V}_N$, this variant has a hybrid interface with serial communication that can be configured for two different modes:
  - Proprietary **SCHMIDT®** module interface
  - Modbus interface (RTU); baud rate is fixed at 9600 Bd

  The interface must be configured to the corresponding mode and can then only operate the modules/devices compatible with this mode.

  The configuration of the interface mode can be carried out by the customer using the optional “PC programming kit”.
  The sensor is connected via a none-detachable 5-pin cable with a M12 connector (A-coded, male, 8-pin; see Figure 1 and Table 4):

Figure 1:
View on connector of sensor (male)

Pin	Bezeichnung	Funktion	Aderfarbe
1	Power	$+U_B$ (+24 V)	Weiß
2	B	RS485-B	Braun
3	GND	GND	Grün
4	Analogue $\dot{V}_N$	Norm mass flow	Gelb
5	n.c.	/	Grau
6	A	RS485-A	Rosa
7	AGND[4]	Reference output $\dot{V}_N$	Blau
8	n.c.	/	Rot

Table 4 Pin assignment digital variant

[4] GND and AGND are coupled internally; AGND should be used as reference potential for the analogue signal output.

The specified wire colours apply when using one of the connection cables available from **SCHMIDT®**.

For details on design and operation:

- With module / Modbus interface, see:
  "*Additional_instructions_Digital_Communication-IL30xxx-577638_02*"
- With the PC programming kit[5], see:
  "*Operating instructions-PC_Prog_Kit-564714_02*"

All operating instructions as well as information on further accessories are available on the **SCHMIDT®** homepage:

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

Power supply

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

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

Deviating values lead to deactivation of measuring 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* Signalling).

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. The customer must consider voltage drops generated due to line resistances.

The operating current of the sensor is at minimum 25 mA up to a maximum[6] of 100 mA.

Consider the appropriate protection class III (SELV or PELV).

Wiring of analogue output

The analogue output is designed as short-circuit protected current interface (4 … 20 mA) using a highside driving stage.

The load resistance R_L should be connected to the reference potential AGND (to avoid problems with mass offset).

Load specification: $R_L \leq 300\ \Omega$; $C_L \leq 10$ nF

[5] User interface software with Modbus functionality: Version 4.0.0 or higher

[6] Inrush current with lowest supply voltage

5 Signalling

Light emitting diodes

The **SCHMIDT® Mass Flow Sensor IL 30.2xx** has two LEDs (see Figure 2) to indicate its operational status (see Table 5).

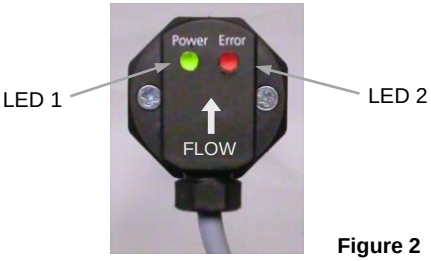


Figure 2

Operating state	LED 1	LED 2
Supply voltage: None, wrong polarization, too low	○	○
Ready for operation	●	○
Supply voltage beyond specification range *or* Medium temperature beyond specification range	◐	○
Sensor defective	●	◐

Table 5

○ LED off
● Green LED is on
◐ Green LED flashes (approx. 2 Hz)
◐ Red LED flashes (approx. 2 Hz)

Analogue output

The measuring range of volume flow $\dot{V}_N$ is mapped in a linear way to the signal range of the analogue output.

- Representation of mass flow
  The signalization ranges from zero to the variant-specific end of the measuring range $\dot{V}_{N,max}$ (= 100 % in Figure 3). A higher mass flow is still output up to 110 % (= 21.6 mA) linearly, beyond this the signal remains constant.
- Error signalling
  - The interface outputs[7] 2 mA.
  - Operating parameters (U_B, T_M) are outside of specification.
  - The sensor is defective.

[7] In accordance to NAMUR specification

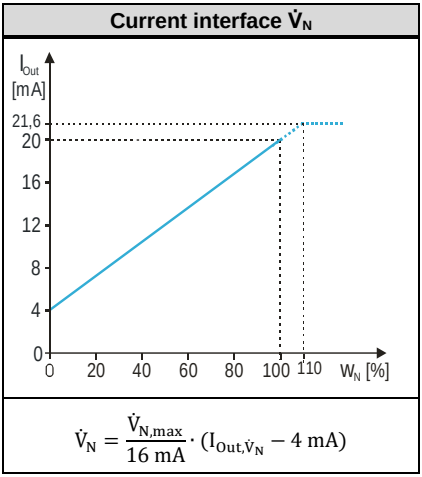


Figure 3 Volume flow

6 Commissioning

Before applying supply voltage to the **SCHMIDT® Mass Flow Sensor IL 30.2xx,** the following checks have to be carried out:

- Mechanical mounting:
  - All screw connections are tightened properly.
  - Suitable pressure protection measures have been implemented (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).

If the sensor is in the correct operational state after initialization (no error signalling), it switches into measuring mode.

The indications for mass flow jump for a short period to maximum and settles after approx. one second at the correct measuring value provided the sensor probe have medium temperature already.

Otherwise, the process will prolong until the sensor has reached medium temperature.

7 Information concerning operation

Ambient condition temperature

The **SCHMIDT® Mass Flow Sensor IL 30.2xx** monitors the temperature of both medium and electronics.
As soon as the specified operation temperature range of -20 … +60 °C is left[8], the sensor switches off its mass flow measuring function 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® Mass Flow Sensor IL 30.2xx** 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.

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 probe causes serious measurement distortions and can also damage the sensor irreversibly.

[8] Monitoring thresholds are -25/+70 °C with threshold hysteresis of approx. 2 K (also applies to variants with installed hose plug-in connections)

8 Service information

Troubleshooting

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

Error image	Possible causes	Troubleshooting
○ ○ $I_{\dot{V}_N}$ = 0 mA	Problems with supply voltage U_B: ➢ No (too less) U_B available ➢ U_B has wrong polarity Sensor defective	➢ Sensor cable connected correctly? ➢ Voltage supply connected to control? ➢ Supply cable broken? ➢ Power supply sufficient? Send in sensor for repair
● ◐ $I_{\dot{V}_N}$ = 2 mA	Sensor element defective	Send in sensor for repair
◐ ○ $I_{\dot{V}_N}$ = 2 mA	Supply voltage beyond specification range (too low/high) Medium temperature beyond specification range (too low/high)	Check supply voltage and set it correctly Check medium temperature and set it correctly
Mass flow signal $\dot{V}_N$ 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 load resistance Special gas factor correct? Clean sensor tip Check installation direction
Mass flow signal $\dot{V}_N$ is fluctuating	U_B unstable Mounting conditions: ➢ Sensor head is not in optimal position ➢ Run-in/-out distance is too short Strong fluctuations of pressure or temperature	Check voltage supply Check mounting conditions Check operating parameters

Table 6

○ LED off ◐ LED flashes (2 Hz): Green
● LED on: Green ◐ LED flashes (2 Hz): Red

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

Transport / shipment of the sensor

The **SCHMIDT® Mass Flow Sensor IL 30.2xx** should be well protected against vibrations and shocks during transport or shipping. Ideally, the sensor is shipped 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. Parts attached by the customer, such as measuring section extensions or pipes, have to be removed completely (but leave the push-in hose connections attached to sensor).

- **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 “Service & Support for Sensors”, category “Product Downloads”.

Alternatively, it can be downloaded from

www.schmidttechnology.de

under "Service & Support für Sensorik”, category “Produkt-Downloads”.

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

Test and material certificates

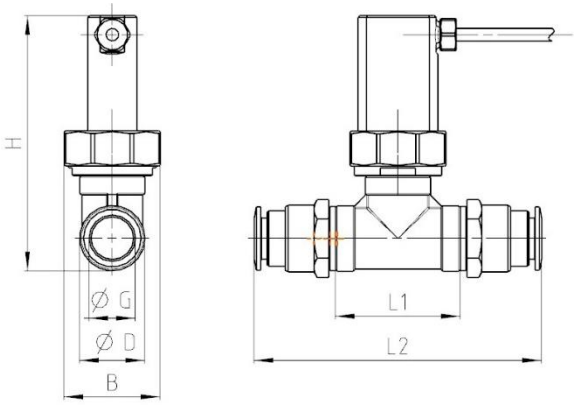
Every new sensor is accompanied by a certificate of compliance according to EN 10204-2.1. Material certificates are not available.
Upon request, we shall prepare, at a charge, a factory calibration certificate, traceable to national standards.

9 Technical data

Sensor technology	Thermal inline mass flow sensor
Measurand	Standard[9] mass flow $\dot{V}_N$ Temperature of medium T_M (output digital version only)
Measuring ranges[10] $\dot{V}_N$	IL 30.208: 0,2 … 20 l/min; 1 … 100/200 l/min IL 30.212: 3… 300/500 l/min
Measuring accuracy[11] $\dot{V}_N$	±(5 % of measured value + [0.4 % of fmr; min. 0.1 l/min])
Response time (t_{90}) $\dot{V}_N$	< 10 s
Measuring accuracy T_M	≤ ±2 K ($\dot{V}_N$ > 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	8 bar (overpressure)
Humidity range	Measuring mode: non-condensing (< 95 % RH)
Operating temperature[12]	-20 … +60 °C
Installation connection (inner threads)	IL 30.208 DN8 (G¼; hose outer Ø: 12 mm) IL 30.212 DN12 (G⅜; hose outer Ø: 16 mm)
Analogue output $\dot{V}_N$	Current interface (short circuit protected) Signal range: 4 … 20 mA (2 mA error signal) Load: R_L ≤ 300 Ω / C_L ≤ 10 nF
Module / Modbus Interface[13]	RS485 (EIA-485), 2-wire, 3,3 V (no termination resistor) 9600 Bd (fix); 8 data bits, no parity bit, 1 stop bit Modbus RTU (9600 Bd fix)
Display	Green LED: Functional status Red LED: Sensor status (defective = flashing)
Supply Voltage U_S	24 V DC ± 10 %
Current consumption	Typ. 25 mA; max. 100 mA
Electrical Connection - Analogue version: - Digital version:	Non-detachable connection cable: Pigtail, 4 x 0.14 mm², 2 m long, PVC (grey), outer-Ø 3.8 mm M12 connector (male, A-coded, 8 pins, external thread), at cable of 0.2 m length, PVC (grey), outer-Ø 4 mm
Length of connection cable	Max. 100 m (recommended; consider wire resistance)
Type of protection	Enclosure: IP64; connector[13]: IP67 (with connected cable)
Class of protection	III (SELV or PELV)
Material	Enclosure: PBT (Ultradur B4300 G4) Fixture: Brass, nickel-plated Tube body: Stainless steel

[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] Under adjustment conditions; fmr: final value of measuring range
[12] With push-in fittings for pneumatic hoses: T_{min} = -10 °C
[13] Only digital version

10 Dimensions



	1/4 Zoll 572900	3/8 Zoll 572901
H	78	81
L1	34	39
L2	92	92
B	30	30
Ø D	17	21
Ø G	G1/4	G3/8

Figure 4
(Left: Basic sensor without hose plug-in connections
Right: With fitted hose plug-in connections)
All dimensions in mm

11 Declarations of Conformity

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

SCHMIDT® Mass Flow Sensor IL 30.208/212

Part-Nos. **572 900** and **572 901**

are 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

SCHMIDT Technology GmbH
Feldbergstraße 1
78112 St. Georgen
Germany
Phone +49 (0)7724 / 89 90
Fax +49 (0)7724 / 89 91 01
E-Mail sensors@schmidttechnology.de
URL www.schmidt-sensors.com
www.schmidttechnology.de