Simply a question of better measurement

SCHMIDT® Flow Sensor

SS 20.415 LED

Instructions for Use

SCHMIDT® Flow Sensor
SS 20.415 LED

Table of Contents

Imprint:

Version: 551742.02D
Subject to modifications

1 Important information

These instructions for use contain all required information for a fast commissioning and a safe operation of **SCHMIDT®** flow sensors of the **SS 20.415 LED** type.

- 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 and machinery.
- **SCHMIDT Technology** cannot give any warranty as to its suitability for a 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 - please read them!

Non-observance of these instructions may lead to personal injury or malfunction of the device.

General note

All dimensions are given in mm.

2 Application range

The **SCHMIDT® Flow Sensor SS 20.415 LED** (551490) is designed for stationary use in cleanrooms under atmospheric pressure conditions and clean environmental conditions.

The sensor measures the flow velocity of the measuring medium as standard velocity[1] w_N (unit: m/s) relative to standard conditions of 1,013.25 hPa and 20 °C. The output signal is linear and independent of pressure and temperature of the medium. The decisive characteristics of the product are listed below:

- Measuring task
  - Measurement of flow velocity
  - Detection of flow direction (bidirectional version)
- Application examples
  - Laminar-flow monitoring in cleanrooms
  - Monitoring of room cross-flow

Only suitable for the use in clean gases.
The medium to be measured must not contain oils, residue forming substances or abrasive particles.

Correct measurements requires laminar[2] flow with as low turbulence as possible.

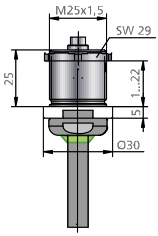
When transporting the sensor or when carrying out not approved cleaning measures, always place the protective cap on the sensor.

The **SCHMIDT® Flow Sensor SS 20.415 LED** is designed for applications inside closed rooms and is not suitable for outdoor use.

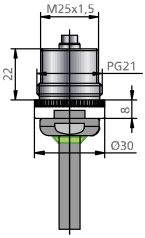
[1] Corresponds to the real velocity under standard conditions.
[2] The term “laminar” means here an air flow low in turbulence (not according to its physical definition saying that the Reynolds number is < 2300).

3 Mounting instructions

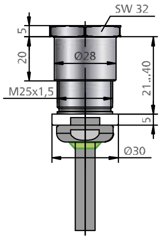
Five different mounting options are available:



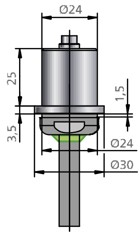
Type 1
For mounting in ceilings or frames with wall thickness from 1 … 22 mm. Opening Ø 26 mm necessary (mount-ing with counter nut) or a thread M25 x 1.5 in ceiling frame.



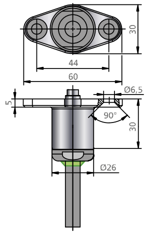
Type 2
For mounting in ceiling frames with existing opening with PG21 winding (e.g. sprinkler opening in ceiling frames).



Type 3
For mounting in ceiling frames with thickness of 21 … 40 mm, especially for ceiling frames out of hollow pro-files.
Openings required with Ø 26 mm and Ø 28.5 mm.



Type 4
For welding in stainless steel ceilings.



Type 5
For mounting under a ceiling or at a wall with two screws M6. Opening of Ø 15 mm for cable necessary and 2 threads M6.
Pressure-tight up to 300 mbar.

Mounting sequence

If not yet in place, first drill a bore into the wall or ceiling for installing the mounting bush. Then the mounting bush is fastened in the wall or ceiling. Feed connecting cable from cleanroom side through the mounting bush (open cable ends at first). The cable plug should project from the mounting bush by about 5 cm. There must be enough room behind the mounting bush, to allow the cable to be pushed backward when screwing in the sensor.

Then connect sensor with connection cable (plug in cable connector and screw on sleeve nut), insert sensor into mounting bush and tighten mount-ing screw by hand. Now the sensor can still be aligned accurately by hand, if required. Finally, the holding fixture screw must be tightened with a key wrench (wrench size 22) until the sensor is sufficiently secured against twisting (hold sensor, if necessary).

Prior to commissioning the sensor, remove the protective cap.

Mounting beneath a ceiling

The angled sensor has been designed for mounting beneath a ceiling. After screwing the sensor into the ceiling sleeve, its tip is automatically in the correct position to measure a vertical downdraft flow from the filter outlet. Only the torsional angle of the sensor arm (parallel to ceiling) has to be aligned. Then tighten the assembly screw using the key wrench until the sensor is secured against twisting (hold sensor, if necessary).

Mounting at a wall

The straight sensor has been designed for installation at a wall.

After screwing the sensor into the sleeve, its tip must be aligned in main direction of the gas flow which means the arrow engraved on the surface of the housing must show approximately in the direction of positive flow. For fine adjustment align the housing line visible on the front of the sensor tip to the flow direction as precisely as possible (e.g. in case of a vertical downdraft the sensor arrow has to point downward to the floor and the housing line is also vertically; the dashed line on the sensor tube is then exactly on the topside of the tube).

The angular deviation should not be greater than ±5° referenced to the ideal direction of the gaseous flow. Otherwise measurement accuracy may be affected (deviation > 1 %).

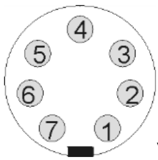
After finishing adjustment tighten the assembly screw using the fork wrench until the sensor is secured against twisting.

4 Electrical connection

Plug-in connector

The **SCHMIDT® Flow Sensor SS 20.415 LED** is equipped with a plug-in connector firmly integrated in the housing. The connector has the following data:

Number of connection pins:	7 (plus shield connection on the metallic housing)
Type:	Male
Fixation of connecting cable:	Screw M9 (on cable)
Model:	Binder, series 712



View on plug-in connector of sensor

Figure 4-1

Pin assignment

The pin assignment of the plug-in connector can be found in Table 1.

Pin	Designation	Function	Wire color
1	Power	Operating voltage : $+U_B$	White
2	TXD	Do not connect[3]	Brown
3	RXD	Do not connect[3]	Green
4	OC1	Switching output 1: Direction / threshold	Yellow
5	OC2	Switching output 2: Threshold	Grey
6	Analogue	Flow velocity signal w_N	Pink
7	GND	Operating voltage : Mass	Blue
	Shield	Electromechanical shielding	Shield meshwork

Table 1

All signals use GND as electrical reference potential.

The wire colours mentioned in Table 1 are applicable for the use of a **SCHMIDT®** cable (article nos. : 505911-4, 535279, 535281, 565072, 561972, 561973).

[3] Usable with the obsolete Programming Interface (505960).

Electrical assembly

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

The cable shield is electrically connected to the metallic housings of the plug-in connector and the sensor which are coupled to GND (VDR[4], in parallel with 100 nF). The shield and / or the housing should be connected to an anti-interference potential, e.g. ground (depending on the shielding concept).

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

Operating voltage

The **SCHMIDT® Flow Sensor SS 20.415 LED** is protected against a polarity reversal of the operating voltage.

It has a nominal operating voltage range of U_B = 24 V_{DC} ± 10 %.

Only operate sensor within the defined operating voltage range (21.6 ... 26.4 V_{DC}).
Undervoltage may result in malfunction, overvoltage may lead to irreversible damage to the sensor.

The specifications for the operating voltage are valid for the connection at the sensor. Voltage drops generated due to line resistances must be considered by the customer.

Current consumption of the sensor is typically 35 mA and at maximum 150 mA (including all maximal signal output currents).

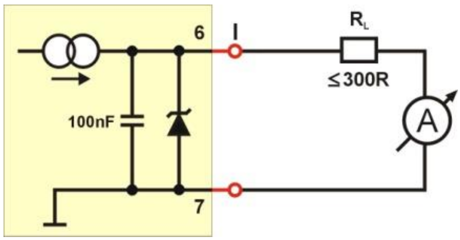
[4] Voltage dependent resistor; breakdown voltage 27 V @ 1 mA

Analog signal output

The analog output is protected against a short circuit towards both rails. It is available in two basic versions which differ in the representation range (signal interval, bipolarity) additionally (see Table 2):

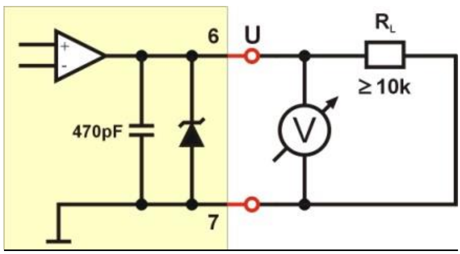
Current interface:

Signal range:	4 ... 20 mA
Type:	High side driver, load resistance against GND
Maximum load resistance R_L:	300 Ω
Maximum load capacity C_L:	100 nF
Maximum cable length:	100 m
Wiring:	



Voltage output:

Signal range:	0 ... 10 V
Type:	High side driver, load resistance against GND
Minimum load resistance R_L:	10 kΩ
Maximum load capacity C_L:	10 nF
Maximum short-circuit current:	25 mA
Maximum cable length:	10 m (recommended)
Wiring:	



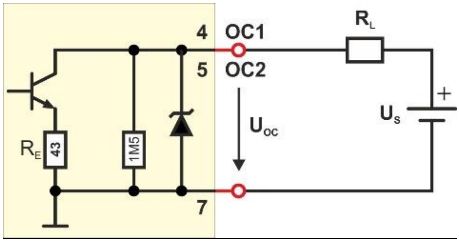
The voltage drop in the GND wire[5] of the connecting cable (mass offset) can significantly affect the analog signal of the voltage output.

[5] The specific resistance of the lead of the nominal cable (0.14 mm²) is 0.138 Ω/m (20 °C); at L = 10 m a current of $I_{B,max}$ = 150 mA can cause a voltage drop up to 240 mV.

Switching outputs

The **SCHMIDT® Flow Sensor SS 20.415 LED** is equipped with two current limited and short-circuit proved switching outputs with following technical data:

Type:	Low side driver, open collector
Maximum switching voltage $U_{S,max}$:	26.4 V_{DC}
Maximum switching current $I_{S,max}$:	55 mA (typ. 50 mA)
Maximum off-state resistance[6] R_{Off}:	1.5 MΩ
Minimum load resistance $R_{L, min}$:	Depending on switching voltage U_S (see below)
Maximum load capacity C_L:	Depending on switching current I_S (see below)
Maximum cable length:	100 m
Wiring:	



Each switching output can be used as follows:

- Direct driving of ohmic or inductive loads (e.g. LED or relay) with a maximum current consumption of 50 mA.
- Direct activation of digital inputs with (integrated) pull-up resistor R_L (e.g. PLC input).

Due to the internal measuring resistor, which is connected in parallel to the transistor, the switching stage has a comparatively low off-state resistance of 1.5 MΩ. This should be taken into account in case of a (high resistance) pull-up resistor R_L. For a digital evaluation, it is recommended to choose a value of R_L < 167 kΩ so as to achieve an active high level (locked transistor) which is 10 % below switching voltage U_S or higher.
Because of its open collector design, the switching voltage U_S is independent of the operating voltage U_B of the sensor. Thereby it does not behave like an ideal switch (in particular in combination with the protective mechanism) but exhibits in conductive condition a drop voltage U_{OC} with following behaviour:

- Well below the maximum current $I_{S,max}$, the open circuit voltage U_{OC} results from voltage drop via the emitter resistance R_E plus saturation voltage over the collector emitter path of the switching transistor:

$$U_{OC} \approx 47\ \Omega \cdot I_S + 0.2\ V$$

[6] Measuring resistor and switching transistor; additional leakage current of the TVS diode connected in parallel ($U_{OC} \approx U_{S,max}$): < 100 µA

- If the maximum current $I_{S,max}$ of 50 mA is almost reached, the emitter resistance locks the switching transistor by an inverse feedback so that the voltage drop over the transistor (increasing from $U_{OC} \approx 2.6$ V) rises significantly while the current remains constant (analog current limiting). From this borderline case, the minimum allowed (static) load resistance $R_{L,min}$ at an defined voltage U_S can be calculated[7]:

  $$R_{L,min} = \frac{U_S - 2.6\ V}{0.05\ A}$$

  Example:

  $R_{L,min} = 476\ \Omega$ at maximum switching voltage $U_{S,max} = 26.4$ V.

- If the load resistance is too low (e.g. short-circuit), a digital short-circuit protection will become active which clocks the output (switch through impulse of approx. 1 ms duration, 300 ms switched off) then on again (transistor is conductive). This procedure is carried out until the cause of the faulty switching is removed.

  In case of a high capacitive load C_L, the inrush current impulse may trigger the quick-reacting short-circuit protection (permanently) although the static current requirement is below the maximum current $I_{S,max}$. An additional resistor connected in series to C_L can eliminate the problem.

- Each switching output is protected against voltage peaks by an unipolar TVS diode[8] (see wiring diagram). Positive voltage impulses (e.g. due to an inductive load) are limited to approx. 30 V, negative impulses are short-circuited against GND (conducting-state voltage of a diode).

[7] Basic current of the switching transistor can be neglected.
[8] Transient Voltage Suppressor diode

5 Signalizing

Analog output

The following is valid for all output versions of the **SCHMIDT® Flow Sensor SS 20.415 LED**:

- Representation of measuring range:

  The measuring range of the flow velocity (0 … $w_{N,max}$ or $\pm w_{N,max}$) is mapped in a linear way to the signaling range of the used analog output type (see Table 2).

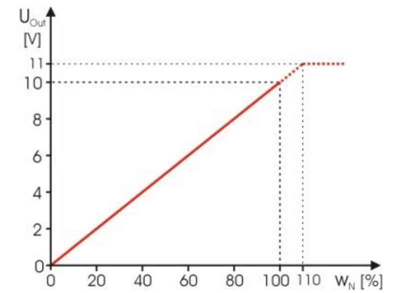
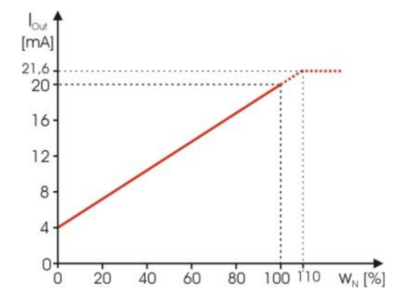
Voltage interface (U)	**Current interface (I)**
	
$w_N = \frac{w_{N,max}}{10\ V} \cdot U_{Out}$	$w_N = \frac{w_{N,max}}{16\ mA} \cdot (I_{Out} - 4\ mA)$

Table 2

- Overflow:

  Flow speeds exceeding the measuring range are furthermore output in a linear way up to 110 % of this measuring range (11 V or 21.6 mA), to signalize clearly that there is an overflow.
  For higher values of flow the output signal remains constant.

- Indication of flow direction[9]:

  Depending on its type, the sensor measures flow only in one (unidirectional) or in both directions (bidirectional).
  In an unidirectional version (see Figure 5-1), the switching output OC1 (factory setting)[10] is used to signalize explicit a zero flow. The output transistor locks if the flow is higher than 0 m/s and conducts if it is lower or equal to 0 m/s.

[9] Related to nominal measuring direction (defined as positive) of the sensor head.
[10] OC1 can be configured optionally to any threshold value within measuring range.

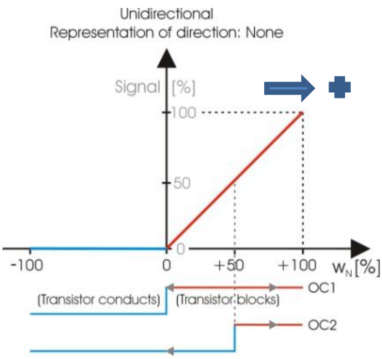


Figure 5-1

To distinguish between positive and negative flow direction, bidirectional versions use either switching output OC1 (see Figure 5-2) or the representation area of the analogue signal output is halved, that means zero flow is defined at 50 % of signalling range (see Figure 5-3).

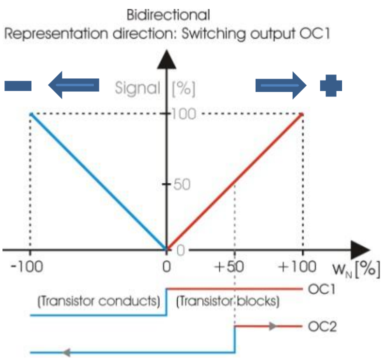


Figure 5-2

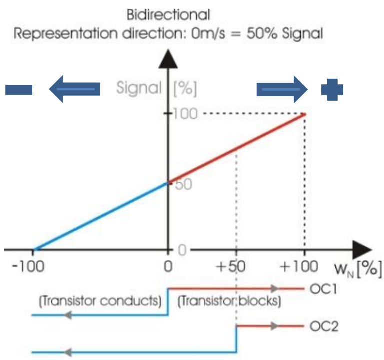


Figure 5-3

- Error signaling:
  The voltage version (0 … 10 V) is set to zero.
  The current interface (4 … 20 mA) signalizes 2 mA.
- Response time (damping of measured values):
  By default the response time of flow measurement is 1 s.
  Optionally it could be configured in the range of 0.01 … 10 s.

Switching outputs

Both switching outputs are used as threshold value switches which mean they change their switching condition during normal measuring operation as soon as the measured flow velocity exceeds or falls below the adjusted value.

- Switching hysteresis:

  The threshold value is symmetrically superimposed by a fixed hysteresis. The hysteresis width is 5 % of the threshold value (but at least 0.05 m/s) and is not configurable.

- Switching polarity:

  The switching polarity is defined as the change in direction of the switching state during a certain procedure (from "locked" to "conductive" or vice versa).

  Both switching outputs are configured by factory with positive polarity, which means that a previously conducting transistor locks if switching threshold is exceeded (and, in connection with the switching load, switches to a positive voltage level of U_S).

  Switching polarity is configurable by ordering.

- Configuration OC1:

  If the analogue indication area of the bidirectional version corresponds to the absolute value of the measuring range, OC 1 is used to signalize the direction (see Figure 5-2).

  Otherwise it is used as an optionally programmable threshold switch that is set to a threshold value of 0 m/s by factory.

- Configuration OC2:

  OC2 can generally be used as a freely programmable threshold switch (ordering). By default the middle of the positive measuring range is considered as the threshold value.

- Error signaling:

  Both switching outputs are conducting independent of their configured switching polarity

LED light ring

The **SCHMIDT® Flow Sensor SS 20.415 LED** indicates its current operating state via a light ring in the holder using coloured light code:

Colour signal	Function / failure
None	Supply voltage: None / reversed / too low
Green pulsing (2 Hz)	Supply voltage: Too high
Red pulsing (2 Hz)	Sensor defective
Red blazing	Only with current interface: Load too big (> 350 Ω)
Green blazing	Sensor operational
Orange flashing (2 Hz)	LF-Status indicator (option)

Table 3

The function “LF-Status indicator” signals a drop out of the admissible flow velocity range of 0.45 m/s ± 20 % (w_N < 0.36 m/s or w_N > 0.54 m/s).

6 Startup

The **SCHMIDT® Flow Sensor SS 20.415 LED** is ready within 5 seconds after switch-on. If the sensor has a temperature different from that of the place of use, this time will increase until the sensor has reached ambient temperature.

7 Information concerning operation

Sterilization

The **SCHMIDT® Flow Sensor SS 20.415 LED** can be sterilized during operation.

Approved disinfectants are alcohol (drying without leaving residues) and hydrogen peroxide. If too much cleaning agent is applied to the sensor, the "soiling detection" can be activated and the analog signal is set to error state (0 V or 2 mA). As soon as the sensor element is dried, the sensor is automatically reset to its normal function.

Due to its capillarity, the chamber head gap in the sensor tip can be filled with cleaning agent. In this case, it is possible that it will take **more than one hour** until the liquid is evaporated and the sensor works again without problems. To accelerate the drying process, the measuring gap can be cleaned by means of a short compressed air blast or similar methods.

Cleaning of the system

If it is necessary to clean the system in which the sensor is included using another cleaning agent than mentioned above, the sensor tip must be protected against the penetration of inappropriate cleaning agents by means of the protective cap included in the delivery. This is especially applicable for cleaning agents which do not dry without leaving residues or cleaning processes during which dirt may come into the sensor tip.

Prior to carry out problematic cleaning measures (e.g. using inadmissible cleaning agents), the (yellow) protective cap included in the delivery must be placed on the sensor head to protect its sensor element.

See also chapter *8 Service information*, subchapter *Cleaning of sensor head*.

8 Service information

Maintenance

A soiled sensor tip may distort the measured value. Therefore the sensor tip must be checked for soiling at regular intervals. If it is soiled or wetted by a liquid, the sensor sends an error signal via the analog output (0 V or 2 mA). In this case, clean sensor as described below. If the error signal does not disappear after cleaning and drying, the sensor must be sent in to the manufacturer for repair.

Cleaning of sensor head

If the sensor tip is soiled or dusty, it must be carefully cleaned by means of compressed air (avoid strong pressure impulses!). If this procedure is not successful, the sensor tip can be cleaned by immersing and washing it in alcohol which dries without leaving residues (e.g. isopropyl alcohol). As soon as the alcohol has been evaporated, the sensor is again ready for operation.

- Do not shake or tap the wet sensor!
- Do not try to clean the sensor tip by any type of mechanical methods. Do not touch the sensor element located in the chamber head. This may irreversibly damage the sensor.
- Do not use strong cleaners, brush or other objects, fluffy cloths etc. to clean the sensor tip!
- Inappropriate cleaning agents may leave residues on the sensor element and therefore lead to faulty measurements or result in permanent damage to the sensor element.

- If the chamber head gap of the sensor tip is completely filled with cleaning agent, accelerate drying process by blowing it out, if necessary.

Transport / dispatch of the sensor

Before transport or dispatch of the sensor, the delivered protective cap must be put over the sensor head. 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 **SCHMIDT Technology**.

Spare parts or repair

No spare parts are available, since a repair is only possible at **SCHMIDT Technology**. In case of defects, the sensors must be sent in to the supplier for repair.

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

Test certificates and material certificates

Every newly produced 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 quantity	Normal velocity w_N of air based on normal conditions 20 °C and 1013.25 hPa
Medium to be measured	Clean air or nitrogen; more gases on request
Measuring range	(±) 0 ... 1 / 2.5 / 5 / 10 m/s Unidirectional or bi-directional
Lower detection limit	(±) 0.05 m/s
Measuring accuracy[11] - Standard - High precision	 ±(3 % of measured value + 0.05 m/s) ±(1 % of measured value + 0.04 m/s)
Repeatability	±1.5 % of measured value
Response time (t_{90})	1 s (configurable: 0.01 ... 10 s)
Storage temperature	-20 ... +85 °C
Operating temperature	0 ... +60 °C
Humidity range	Not condensing (< 95 % rel. humidity)
Operating pressure	Atmospheric (700 ... 1,300 hPa)
Operating voltage	24 V_{DC} ± 10 %
Current consumption	Typical < 35 mA (max. 150 mA[12])
Analog output - Current - Voltage	Short circuit protected (type by ordering) 4 ... 20 mA (R_L ≤ 300 Ω; C_L ≤ 100 nF) 0 ... 10 V (R_L ≥ 10 kΩ; C_L ≤ 10 nF)
Switching outputs	2 pc., open-collector, current-limited, short-circuit-protected Switch 1 (OC1): Direction or threshold Switch 2 (OC2): Threshold Max. Load: 26.4 V DC / 55 mA Threshold: 0 ... 100 % of end value; min. ±0.05 m/s Hysteresis: 5 % of switching threshold; min. 0.05 m/s Configuration: Polarity, threshold value (by ordering)
Electrical connection	Plug (male), M9, screw, 7-pin (shielded)
Line length (max.)	Voltage output: 10 m / current output: 100 m
Protection type[13]	IP65
Protection class	III (SELV) or PELV (EN 50178)
Mounting position	Arbitrary postioning of bracket
Dimensions / material: - Sensor head - Sensor tube: Straight (L) Angled (H x L) - Screw nut	 Ø 9 mm x 10 mm Stainless steel 1.4404 Ø 9 mm Stainless steel 1.4404 300 / 301 … 1,000 mm 150 / 270 mm x 300 mm Stainless steel 1.4404

11 Under reference condition
12 Including all signal output currents
13 Only with correctly attached connecting cable

10 Declarations of conformity

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

SCHMIDT® Flow Sensor SS 20.415 LED

Part-No. **551 490**

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

SCHMIDT Technology GmbH
Feldbergstraße 1
78112 St. Georgen
Germany

Phone +49 (0)7724 / 899-0
Fax +49 (0)7724 / 899-101
Email sensors@schmidttechnology.de
URL www.schmidt-sensors.com
www.schmidttechnology.de