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SCHMIDT® Fieldbus Module
DeviceNet®
Instructions for Use

SCHMIDT® Fieldbus Module DeviceNet®

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1 Important information

The instructions for use contain all required information for a fast commissioning and safe operation of a **SCHMIDT® DeviceNet® Module**.

The module can only be operated in combination with a **SCHMIDT® flow sensor** based on the 600 family, which serves as base unit.

Since the present operating instructions mainly describe the fieldbus-specific aspects, please also be sure to observe the operating instructions of the connected base sensor:

- **SS 20.600**: „Instructions for Use SS 20.600“ (535084.02)
- **SS 20.651**: „Instructions for Use SS 20.651“ (547608.02)

All relevant 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. 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.

2 Basic sensor

Electrical connection

The operating voltage can only be connected to the connector of the basic sensor.

Comprehensive details for electrical and mechanical installation can be found in the general instructions for use of the basic sensor.

The operating data of the module correspond to those of the basic sensor. The additional current consumption is typical 15 mA and at maximum 25 mA.

The analogue outputs (flow velocity and medium temperature) as well as the impulse outputs (flow velocity or volume) are only available at the connector of the basic unit.

The field bus can be connected only to the field bus connector.

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

The appropriate protection class III (PELV / EN 50178) has to be considered.

Only operate the sensor within the defined range of operating voltage (see manual of basic sensor).
Undervoltage may result in malfunction; overvoltage can lead to irreversible damage.

Commissioning

The valid measuring ranges are indicated on the type label.

After applying supply voltage, the sensor signals its initialization by simultaneously switching all four horizontal status LEDs (see Figure 3) sequentially in the colours red, orange and green.

If the sensor is in the correct operational state after initialization it switches into measuring mode. All indications for flow velocity (LEDs, signal outputs and fieldbus) jump for a short period to maximum and settles after several seconds 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.

LED-display state of basic sensor

No.	State	LED 1	LED 2	LED 3	LED 4
1	Ready for operation & flow < 5 % [1]	orange	off	off	off
2	Flow > 5 %	green	off	off	off
3	Flow > 20 %	green	green	off	off
4	Flow > 50 %	green	green	green	off
5	Flow > 80 %	green	green	green	green
6	Flow > 100 % (= Overflow)	green	green	green	orange
7	Sensory element defective	flashing red	flashing red	flashing red	flashing red
8	Supply voltage too low	flashing red	flashing red	off	off
9	Supply voltage too high	off	off	flashing red	flashing red
10	Temperature of electronics too low	flashing red	off	off	flashing red
11	Temperature of electronics too high	off	flashing red	flashing red	off
12	Temperature of medium too low	orange	flashing red	flashing red	orange
13	Temperature of medium too high	flashing red	orange	orange	flashing red

Legend

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

Table 1

Carrying out the zero flow plausibility check (zfc)

The zfc has been introduced to detect an alteration of the heat transfer characteristic of the sensor element by checking its heating power at zero flow. Thus it is possible to detect deviations which are caused e.g. by contamination or other alterations of the sensor element by means of a simple test without dismounting the sensor unit (see subchapter: *Sensor status* “zfc” - handling by user).

[1] „%“ of measuring range of flow velocity of the basic sensor

3 DeviceNet – Installation

This optional module implements a slave of DeviceNet® with a galvanically decoupled fieldbus interface[2].

Network topology

The fieldbus network is based on a multidrop-design. One or more devices are connected directly or with short stub lines to a main line (trunc), whereas multiple devices can share a stub.

The network comprises a maximum of 64 participators (master and slaves). Every network must be terminated at the beginning and the end of the trunc (bus termination; between data lines “CAN_H” and “CAN_L”) using resistors with 121 Ω (1 % / 0.25 W).

The module itself has no terminating resistors integrated.
The trunc has to be terminated at each of his ends with external termination resistors.

Only cables which are specially certified for DeviceNet installation should be used (see subchapter Fieldbus cable).

The maximum permitted trunc length (including the maximum stub lines at the ends of the trunc) as well as the sum of its stub lengths depends on the transmission rate[3] and the type of the cable (see Table 2). The sum of the length of the stubs must not exceed the total length of the trunc.

Transmission rate [kbit/s]	Max. network length [m]	Max. sum of stub lengths [m]
125	500	156
250	250	78
500	100	39

Table 2: Admissible line lengths for “thick” cables

The particular stub may not be more than 6 m in length.

The transmission rate will be set manually whereas one position selects automatic baud rate which is set by the bus master.

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[2] The fieldbus connections are galvanically decoupled from the electronics of the basic sensor.
[3] Specifications apply to the “thick” cable with an outer diameter of 12.2 mm.

Fieldbus connector

The connector of the module is designed as a 5-pin M12 plug (male, A-coded) with a thread for the connecting cable[4] (pin assignment see Figure 1 and Table 3).

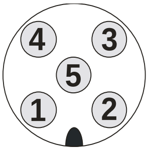


Figure 1:
View on connector of module (male)

Pin	Designation	Function
1	Shielding	EMC
2	V+	+24 V (DeviceNet)
3	V-	GND (DeviceNet)
4	CAN_H	Positive data line
5	CAN_L	Negative data line

Table 3 Pin assignment of fieldbus interface

The shielding of the plug-in connector (and therefore the cable shielding) is in electrical contact with the metallic housing of the module and the basic sensor.

The module plug itself is waterproof. However, if no bus cable is attached, the plug should be protected against moisture with a cap to protect the pins and the electrical signals also.

The power supply (“V+, V-“) should be used to supply the DeviceNet network only.

Fieldbus cable

For connection, data cables specifically specified for DeviceNet are commercially available.

It is strongly recommended to use a connecting cable which is suitable for DeviceNet.

To achieve high immunity and low interference emission, the cable shield must be grounded at only one point (for the shielding concept see recommendations of the ODVA®[5]). Independent of that, the fieldbus cable should be installed separately from other electrical cables.

Good grounding of the cable shield is essential.
The appropriate protection class PELV (EN 50178) has to be considered.

[4] Spigot nut is on connecting cable.
[5] Open DeviceNet Vendor Association

4 DeviceNet – Configuration

Device address and baud rate

The device address is manually set by several control elements inside the housing (see Figure 2). For this, the two captive screws of the housing cover must be unscrewed to open the lid.

Figure 2 Control elements for manual settings

Configuration:

- The address of the device is set with two rotary decimal switches.
  Permitted address area: 0 … 63 (default: 11)
- The baud rate is set with two sliding switches.

Value	B	A	Baud rate [kBit/s]
0	OFF	OFF	125
1	OFF	ON	250
2	ON	OFF	500
3	ON	ON	Automatic

After finishing the manual settings, make sure that the cover is properly closed and the screws are stoutly tightened.

5 DeviceNet – LED signalling

The four horizontally arranged LEDs above the label “Flow” indicate the status of the basic sensor (see also Table 1).

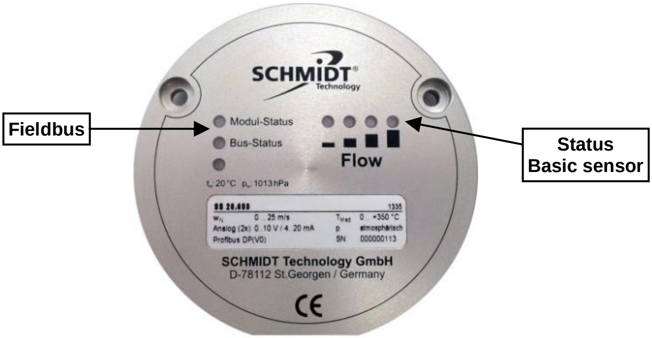


Figure 3 Arrangements of LEDs

The vertically arranged LEDs on the left are related to DeviceNet:

- The topmost LED indicates the status of the module (DeviceNet):
  ○ Off = No supply voltage
  ◐ Flashing green = Automatic detection of baud rate in progress
  ● Green = Operational
  ◐ Flashing red = Failure
  ● Red = Critical failure
  ◐ Red/green, alter. = Self-test
- The middle LED indicates the status of fieldbus (DeviceNet):
  ○ Off = Offline / no supply voltage
  ◐ Flashing green = Online, still no connection established
  ● Green = Online, connection established
  ◐ Flashing red = Time limit exceeded
  ● Red = Critical error (e. g. short circuit)
  ◐ Red/green, alter. = Self-test
- The bottom LED indicates the status of the internal electronics:
  ○ Off = Not operational
  ◐ Flashing green = Initialisation in progress
  ● Green = Online
  ◐ Flashing red = Configuration error
  ● Red = Internal error (z. B. defect)

6 DeviceNet – Commissioning

To integrate the **SCHMIDT® flow sensor** into the process control via DeviceNet an EDS file is available on the homepage:

https://www.schmidt-sensors.com/sensoren.html

The file is formatted as a zip archive and can be found in the tab of each sensor type which is capable of DeviceNet.

Product profile

All **SCHMIDT® flow sensors** that are featuring a DeviceNet module can formally described as follows:

- Vendor ID: 923
- Vendor name: **SCHMIDT Technology GmbH**
- Product profile: Generic (0x2B)
- Product code: 2
- Product name: **SCHMIDT DN flow sensor**

The type of the base sensor is not explicitly named in the EDS file.
It can be derived from its material number (class 0x64, instance #1, attribute #103):

- **SS 20.600**: 524600
- **SS 20.651**: 546650

Data structure

The **SCHMIDT® flow sensors** are specified with the self-defined data class "0x64" by the following instances:

- **Instance #1**
  - **Reading of sensor status and primary measured values**

#	Name	Access	Type	Value
1	Sensor status	Get	UINT	content see attributes
2	Temperature of Medium	Get	INT	0,1 x unit (see attributes)
3	Volume flow	Get	REAL	unit see attributes
4	Flow velocity	Get	UDINT	in [mm/s]

  - **Customer specific parametrization**

#	Name	Access	Type	Value
11	Averaging	Get / Set	USINT	averaging of above-mentioned values (#2 … #4); in [s]
12	Unit of volume flow	Get / Set	USINT	selection see attributes
13	Standard conditions	Get / Set	USINT	selection see attributes

#	Name	Access	Type	Value
14	Pipe inner diameter	Get / Set	UINT	in [mm]
15	Unit of temperature of medium	Get / Set	USINT	selection see attributes
51	Hysteresis (COS) of temperature of medium	Get / Set	UINT	increment: 0.1 °C
52	Hysteresis (COS) of volume flow	Get / Set	REAL	unit see #12
53	Hysteresis (COS) of flow velocity	Get / Set	UDINT	in [mm/s]
54	I/O Assembly Instance	Get / Set	USINT	details see „Assembly Object“

- **Sensor configuration (fix parameters)**

#	Name	Access	Type	Value
101	Software version	Get	UINT	of fieldbus module
102	Serial number	Get	UDINT	of flow sensor
103	Material number	Get	UDINT	of flow sensor
104	Configuration number	Get	UDINT	of flow sensor
105	Overpressure	Get	USINT	predefined, typ. overpressure in operation, in [bar]
106	Measuring range of flow velocity	Get	UDINT	in [mm/s]
107	Lower measurement range of temperature of medium	Get	INT	in [0.1 °C]
108	Upper measurement range of temperature of medium	Get	INT	in [0.1 °C]
109	Measuring range of volume flow	Get	REAL	calculated; unit see #12
111	Maximum temperature of electronics	Get	SINT	in [°C]

- **Reading of diagnostic reports**

#	Name	Access	Type	Value
110	Temperature of electronics	Get	INT	in [°C]
150	Parametrization error	Get	UINT	Impermissible parameter value

Note:
The volume flow $\dot{V}_N$ is calculated from the product of the measured flow velocity w_N and the pipe cross-sectional surface A_R (for this purpose the pipe diameter D_R is required), weighted with a profile factor PF which depends of the pipe diameter:

$$\dot{V}_N = PF \cdot A_R \cdot w_N = PF \cdot \frac{\pi}{4} \cdot D_R^2 \cdot w_N$$

The profile factors are stored in the fieldbus module and are automatically taken into account.

Attributes (customer specific parametrization)

The attributes listed below comprises all sensor parameters that can be modified by the customer:

- **Averaging (#11)**
  Moving average over a defined time interval of flow velocity, volume flow and medium temperature.
  - Data type: Unsigned8
  - Unit: Seconds
  - Value range: 0 … 120 (default: 0)

- **Unit of volume flow (#12)**
  Moving average over a defined time interval of flow velocity, volume flow and medium temperature.
  - Data type: Unsigned8
  - Value range: (default: 0)

Value	Unit
0	m^3/h
1	m^3/min
2	m^3/s
3	l/h
4	l/min
5	l/s
6	ft^3/h
7	ft^3/min
8	ft^3/s
9	cm^3/h
10	cm^3/min
11	cm^3/s

- **Standard conditions (#13)**
  Standard flow velocity and standard volume flow refer to these environmental conditions.
  - Data type: Unsigned8
  - Value range: (default: 0)

Value	Reference	Temperature	Pressure
0	SCHMIDT	20.0 °C	1013.25 hPa
1	ISO6358	20.0 °C	1000.00 hPa
2	ISO2533	15.0 °C	1013.25 hPa
3	DIN1343	0.0 °C	1013.25 hPa

- **Inner pipe diameter (#14)**

  Required to calculate volume flow from the measured flow velocity (profile factor considered).
  - Data type: Unsigned16
  - Unit: 0.1 mm
  - Value range: 150 … 50,000 (default: 0)

- **Unit of medium temperature (#15)**
  - Data type: Unsigned8
  - Value range: (default: 0)

Value	Unit
0	°C
1	°F
2	K

  - Note:

    The measuring range limits of the medium temperature (attributes #107 and #108) depend on the sensor type. They are unmodifiable, neither the values nor the unit of measurement ([0.1 °C)] can be configured.

- **Hysteresis (COS) of medium temperature (#51)**
  - Data type: Unsigned16
  - Unit: 0.1 °C
  - Value range: 0 … 65,535 (default: 0)

- **Hysteresis (COS) of volume flow (#52)**
  - Data type: Real
  - Unit: customized, see attribute #12
  - Value range: 0 … max. of real (default: 0)

- **Hysteresis (COS) of flow velocity (#53)**
  - Data type: Unsigned32
  - Unit: 1 mm/s
  - Value range: 0 … 4,294,967,295 (default: 0)

- **I/O assembly instance (#54)**
  - Data type: Unsigned8
  - Value range: (default: 0)

Value	Selection
1	Instance #1 (12 Byte)
2	Instance #2 (8 Byte)

7 DeviceNet – Communications

Operation modes

The following DeviceNet operational modes are supported:

- Polling
- Bit-strobe
- Cycling
- Change of state (= COS)

Amendment COS:

- The sensor sends a message at its own if one of the following values has changed by a certain amount, the so-called hysteresis:
  - Flow velocity
  - Temperature of medium
  - Volume flow
- The hysteresis is configurable by the customer for each of the above-mentioned measured values and inhibits that the slightest change of a value causes a COS-telegram.
- The possible value entries are not limited (except by the bit width of the corresponding registers). It is the customer's responsibility to parameterize meaningful amounts (e.g. 1% of the measuring range).

Assembly Object (0x04)

An "assembly object" bundles the attributes of multiple objects so that their data can be sent or received through a single data packet (fragmented telegram).

Two instances are defined with cyclic or at least frequently relevant information. The respective instance is selected with attribute #54 of Object 0x64.

- **Instance #1**

#	Name	Access	Type	Value
3	Data	Get	Array of Byte	12 Byte

- **Instance #2**

#	Name	Access	Type	Value
3	Data	Get	Array of Byte	8 Byte

The content of both instances differs only regarding the transmitting of the flow velocity:

Instance	Data width	Transmitted content
#1	12 Byte	Sensor status Temperature of medium Volume flow Flow velocity
#2	8 Byte	Sensor status Temperature of medium Volume flow

Attribute *Sensor status*

Adjacent to the actual measurement data, the additional attribute *Sensor status* (attribute #1 of object 0x64) reports important, partially invalid operating conditions as well as possible defects of the base device:

Value	Designation
0	Sensor in normal operation (none of the states below)
1	Sensor element defective
2	Medium temperature too high
3	Medium temperature too low
4	Supply voltage too high
5	Supply voltage too low
6	Electronics temperature too high
7	Electronics temperature too low
8	Other fault (e.g. no adjustment data, CRC-error …)
9	Within the internal zfc limit
10	Within the external zfc limit

- Value 1 and 8:
  The sensor exhibits an essential defect and must be send in for repair to the vendor.
- Value 2 … 7:
  One or more operational conditions are impermissible.

  Stop impermissible operating conditions immediately, otherwise the sensor may suffer irreparable damage.
- Value 9 and 10:
  Operational conditions within the interval suitable for zfc (“zero flow plausibility check” to control the sensory characteristic), description see next subchapter.

Sensor status "zfc" - handling by user

As the heating capacity at zero flow depends on different parameters, it is important to make sure that the defined environmental parameters are observed during the test. These are:

Environmental parameter	Value / range
Flow velocity	0 m/s
Temperature of medium (real at the measuring point)	10 – 30 °C
Temperature of medium (sensor output) [6]	20 – 40 °C
Pressure	atmospheric[7]

As soon as the above environmental conditions are available, the *sensor status* can be used for checking the zfc. For a sensor with proper function, it must assume the value "9" (optimal) or "10" (extended range).

If the zfc value is 9, the heating capacity is within the range defined during the adjustment, i.e. the sensor element works optimally.

If the zfc value assumes "10", minor deviations in relation to the adjustment have been determined. This can be caused by several reasons:

- The heat transfer has changed (e. g. by soiling deposits on the sensor element) - there is a slight shift in the sensor characteristic.
- One or more environmental conditions required for a correct determination of the zfc were not observed, i.e. the test is invalid.

Recommendation for this case:

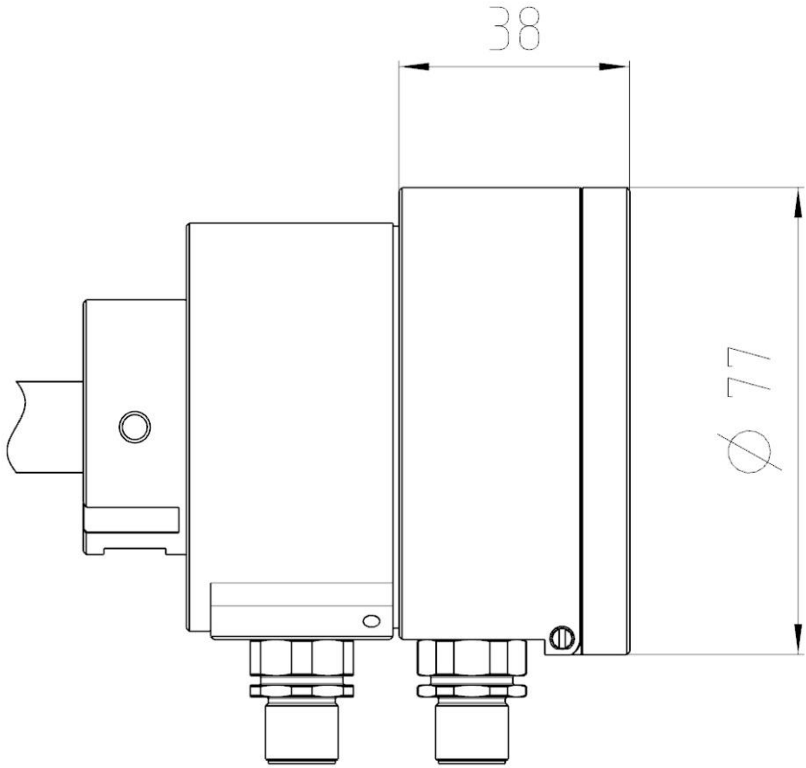
Observe the further progress of the zfc of this sensor and critically scrutinize measured values, possibly arrange cleaning. Equip the sensor head with a protective cap to ensure zero flow.

If the zfc value does not correspond to 9 or 10 under correct environmental conditions, then it indicates a serious deviation of the sensory characteristic. In this case, the sensor has to be instantly maintained (e.g. visual inspection, cleaning, calibration, repair, etc.).

[6] In case of low or zero flow the measured medium temperature is about 10 K higher than the real temperature because of crosstalk between heater and temperature element.

[7] Atmospheric = 700 … 1,300 mbar

8 Dimensions



Dimensions in mm

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