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SCHMIDT® Technology

SCHMIDT® Fieldbus Module
PROFIBUS DP-V0
Instructions for Use

SCHMIDT® Fieldbus Module PROFIBUS DP-V0

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Imprint:

Version: 543565.02B
Subject to modifications

1 Important information

The instructions for use contain all required information for a fast commissioning and safe operation of a **SCHMIDT® Profibus Module DP-V0**.

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 should only be connected to the connector of the basic sensor[1].

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 25 mA and at maximum 40 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 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.

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[1] Alternatively the operating voltage can also be connected to the fieldbus module plug (pin 2 and 7); however, this is no longer recommended by the PNO.

LED-display state of basis sensor

No.	State	LED 1	LED 2	LED 3	LED 4
1	Ready for operation & flow < 5 % [2]	●	○	○	○
2	Flow > 5 %	●	○	○	○
3	Flow > 20 %	●	●	○	○
4	Flow > 50 %	●	●	●	○
5	Flow > 80 %	●	●	●	●
6	Flow > 100 % (= Overflow)	●	●	●	●
7	Sensory 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 orange
● LED shines green	◐ 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 chapter *Carrying out the zero flow plausibility check (zfc)*).

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

3 PROFIBUS – Installation

This optional module implements a slave of PROFIBUS DP with performance level V0 based on a galvanically decoupled RS485 interface[3] for two-wire operation.

Network topology

The bus devices are connected in a line, individual devices may, depending on transmission rate, be connected via a stub to the main line.

A line segment comprises a maximum of 32 participators (masters, slaves and / or repeaters). Their number can be increased up to 126 by interposing repeaters, but every segment must be actively terminated at the beginning and the end of the main line (bus termination).

The module has no terminating resistors integrated, so that an external wiring is required if applicable.

Some commercial available connectors specially tailored for PROFIBUS installation feature switchable terminating networks thus allowing trouble-free termination (see subchapter: *Fieldbus cable*).

The maximum permitted line length per segment as well as the sum of its stub lengths depends on the transmission rate[4] (see Table 2).

Transmission rate [kbit/s]	Max. segment length [m]	Max. sum of stub lengths [m]
9.6 / 19.2 / 45.45	1,200	500
93.75	1,200	100
187.5	1,000	33
500	400	20
1500	200	6,7
3000 / 6000 / 12000	100	0

Table 2: Admissible line lengths for cables of type A

For transmission rates > 1.5 MBit/s, stub lines must be avoided.

The transmission rate will be set by the bus master automatically.

[3] The connections on the bus side (pins 3, 4, 5, 6 and 8) are galvanically decoupled.
[4] Specifications apply to cables of type A.

Fieldbus connector

The module features a D-Sub9 connector (female) with PROFIBUS compliant pin assignment[5] (see Figure 1 and Table 3).

Figure 1:
View on connector of module (female)

Pin	Designation	Function
1	nc	Not connected
2	[M24]	Obsolete (mass of 24 V supply)
3	RxD/TxD-P	DATA-B
4	CNTR-P (RTS)	Repeater control signal
5	M5	Ground (bus termination)
6	P5	5V (bus termination)
7	[P24]	Obsolete (+ 24 V supply)
8	RxD/TxD-N	DATA-A
9	nc	Not connected

Table 3 Pin assignment of fieldbus interface

The shielding of the plug-in connector has electrical contact with the sensor housing.

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 electrical signals.

Fieldbus cable

It's intended to use a cable of type A which has been specially designed for PROFIBUS (purple insulation colour).

It is strongly recommended to use a PROFIBUS connecting cable of type A.

To achieve high immunity and low interference emission, the cable shield must be connected to the protective earth, preferable on both line endings, achieving a good conductivity by using large shield clamps (earth potential depends on the shielding concept). Independent of that, the data line 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.

[5] Applying of the operating voltage to the fieldbus module plug (pin 2 and 7) is no longer recommended by the PNO.

Assembly of fieldbus cable

The fieldbus cable comprises two data lines plus a screen and must be fitted with a PROFIBUS-compliant D-SUB9 connector (male), preferably with an integrated and switchable bus termination network.

The module has no terminating resistors integrated, so that an external wiring is required.

When attaching the cable to the connector take following in account:

1.) Data lines of the cable must not be interchanged.
As installation aid the terminals of the connector are marked with letters and the data lines are color-coded.

Line	Function	Colour
A	RxD/TxD-N (negative)	green
B	RxD/TxD-P (plus)	red

Mnemonic: B & red = Bre(a)d

2.) Data lines of incoming and outgoing device nodes must not be interchanged.
On the connector, arrows are indicating the direction of "ingoing" and "outgoing" cables.

3.) If the node represents the end of the segment, which means that there is only one incoming data cable:
- The cable has to be placed on the "ingoing" channel.
- The bus has to be terminated. The integrated terminating network has to be set to "on".

4.) If both data cables are connected, the bus must not be terminated.
A present terminating network in the plug must be switched "off".

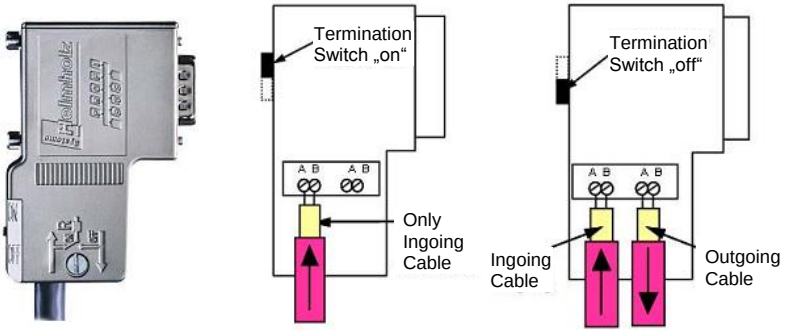


Figure 2

4 PROFIBUS – Configuration and signalling

Device address

The device address is manually set by means of two decimal rotary switches inside the housing (see Figure 4). To do this, the two captive screws of the housing cover must be unscrewed (see Figure 3).

After setting the address, make sure that the cover is properly closed and the screws are stoutly tightened.

Permitted address area: 0 … 99

LED signalling

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

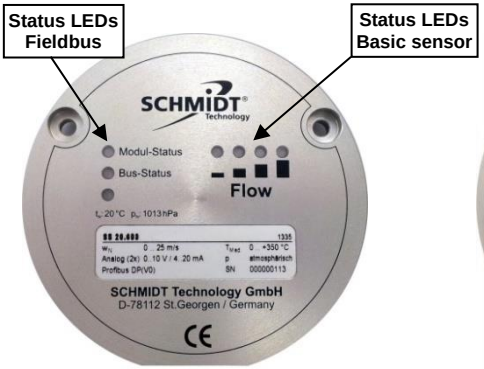


Figure 3 Housing closed

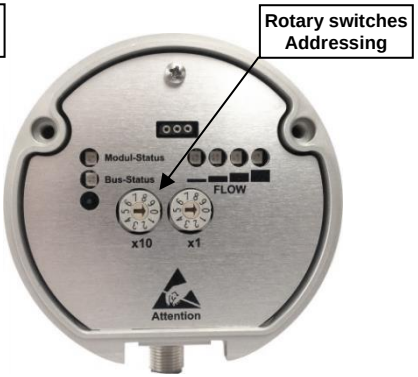


Figure 4 Housing opened

The vertically arranged LEDs on the left are related to PROFIBUS[6]:

The topmost LED indicates the module status (device):

- Green = ready for operation
- Red = error

The middle LED indicates the status of the network (communication):

- Green = Online
- Flashing green = Connected, but no data exchange
- Off = Offline
- Flashing red = Fieldbus error

[6] The third lowermost LED has no function here.

5 PROFIBUS – Commissioning

To integrate the **SCHMIDT® flow sensor** into the process control via PROFIBUS a GSD 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 PROFIBUS.

After the initial receipt of configuration and parameter data, the module changes into the cyclic "Data exchange" mode according to PROFIBUS DP-V0.

Two basic configurations are available to determine the structure and content of the data telegram.

Structure	Identification	Transferred content
12 Byte Input	0x1B	Sensor status Temperature Volume flow Flow velocity
8 Byte Input	0x17	Sensor status Temperature Volume flow

Parameterization

The parameters listed below can be configured via the PROFIBUS (also see subchapter: Diagnosis messages).

- **Averaging**
  Averaging (moving, arithmetic average) of flow velocity, volume flow and medium temperature
  - Data type: Unsigned8
  - Unit: Seconds
  - Value range: 0 … 120
- **Pipe inner diameter**
  Calculating of volume flow (profile factor is considered)
  - Data type: Unsigned16
  - Unit: 1 mm
  - Value range: 15 … 5,000

- **Unit of volume flow**
  - Data type: Unsigned8
  - Value range:

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**

  Flow velocity and volume flow refer to these environmental conditions (standard conditions).
  - Data type: Unsigned8
  - Value range:

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

- **Unit of medium temperature**
  - Data type: Unsigned8
  - Value range:

Value	Unit
0	°C
1	°F
2	K

  - Note:
    The measuring range limits of the medium temperature (see chapter: *Diagnosis messages*) depend on the sensor type. They are unmodifiable, neither the values nor the unit of measurement can be configured.

6 PROFIBUS – Communications

Cyclic data exchange

The bytes are PROFIBUS-compliant transmitted, i.e. first the MSB and last the LSB.

Octet	Meaning	Data type
0 -1	Sensor status	Unsigned 16
2 - 3	Medium temperature (0.1 x configured unit)	Signed 16
4 - 7	Volume flow (configured unit)	IEEE 754 Float (32 bit)
8 - 11	Flow velocity (mm/s)	Unsigned 32

The telegram part *sensor status* indicates the operating status of the sensor and can assume one of the following numerical values (integer):

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

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) [7]	20 … 40 °C
Pressure	atmospheric[8]

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

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

If this 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 necessary for the correct determination of the zfc were not observed, i.e. the test is invalid.

Recommendation for this case:
Observe the further progression 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 value of *sensor status* 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.).

[7] 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.
[8] Atmospheric: p = 700 … 1,300 mbar

Diagnosis messages

The diagnosis telegram contains additional, device-specific information and is divided into two blocks:

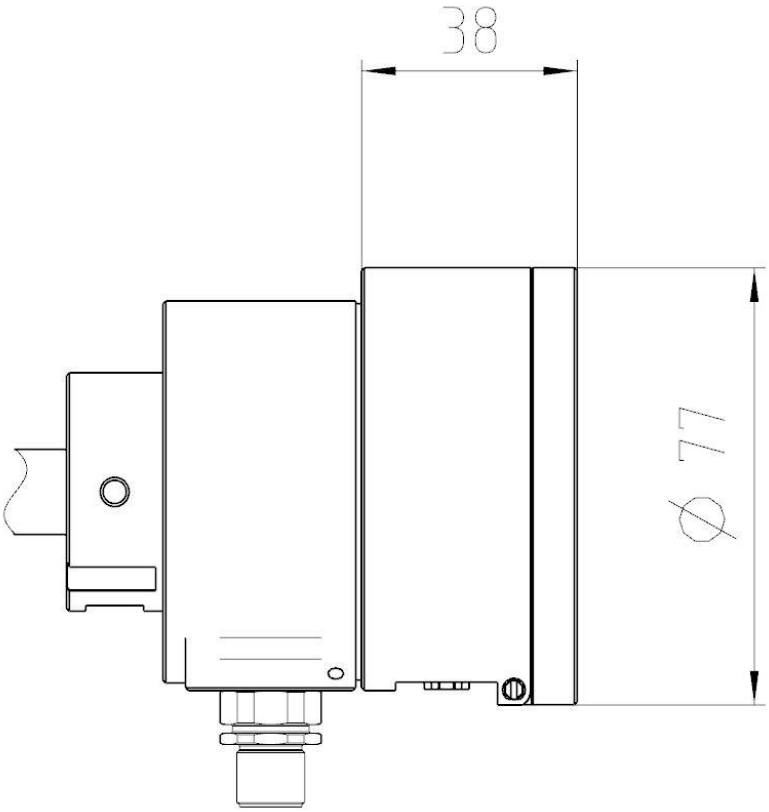
1.) The first block contains a bus-specific error diagnosis.
An entry in this block results in an error or the operating state STOP on the process control. Parameterization errors are also displayed here.

2.) The second block contains sensor-specific information and has no effect on the communication via the PROFIBUS.

Octet	Parameters	Description
1st block: Error diagnosis		
7	Extended diagnostic header	Length of the diagnostic block
8	Reserve	
9	Error	Bit 0: parameterization error Bits 1 – 7: reserved
2nd Block: Information diagnosis		
10	Extended diagnostic header	Length of the diagnostic block
11,12	Sensor status	Operational status of sensor
13	Averaging	See parameters
14,15	Pipe diameter	See parameters
16	Unit of volume flow	See parameters
17	Standard conditions	See parameters
18	Unit of medium temperature	See parameters
19, 20	Software version	Of PROFIBUS module
21 - 24	Serial number	Of sensor
25 - 28	Material number	Of sensor
29 - 32	Configuration number	Of sensor
33	Overpressure	Predefined operating overpressure (bar)
34 - 37	Measuring range of flow velocity	in mm/s (unmodifiable unit)
38 - 39	Measuring range of medium temperature, lower limit	In 0.1 °C
40 - 41	Measuring range of medium temperature, upper limit	In 0.1 °C
42 - 45	Measuring range of volume flow	In the configured unit
46	Actual temperature of electronics	In °C (unmodifiable unit)
47	Maximum temperature of electronics	In °C (unmodifiable unit)

Table 4 Diagnostic parameters

7 Dimensions



Dimensions in mm

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