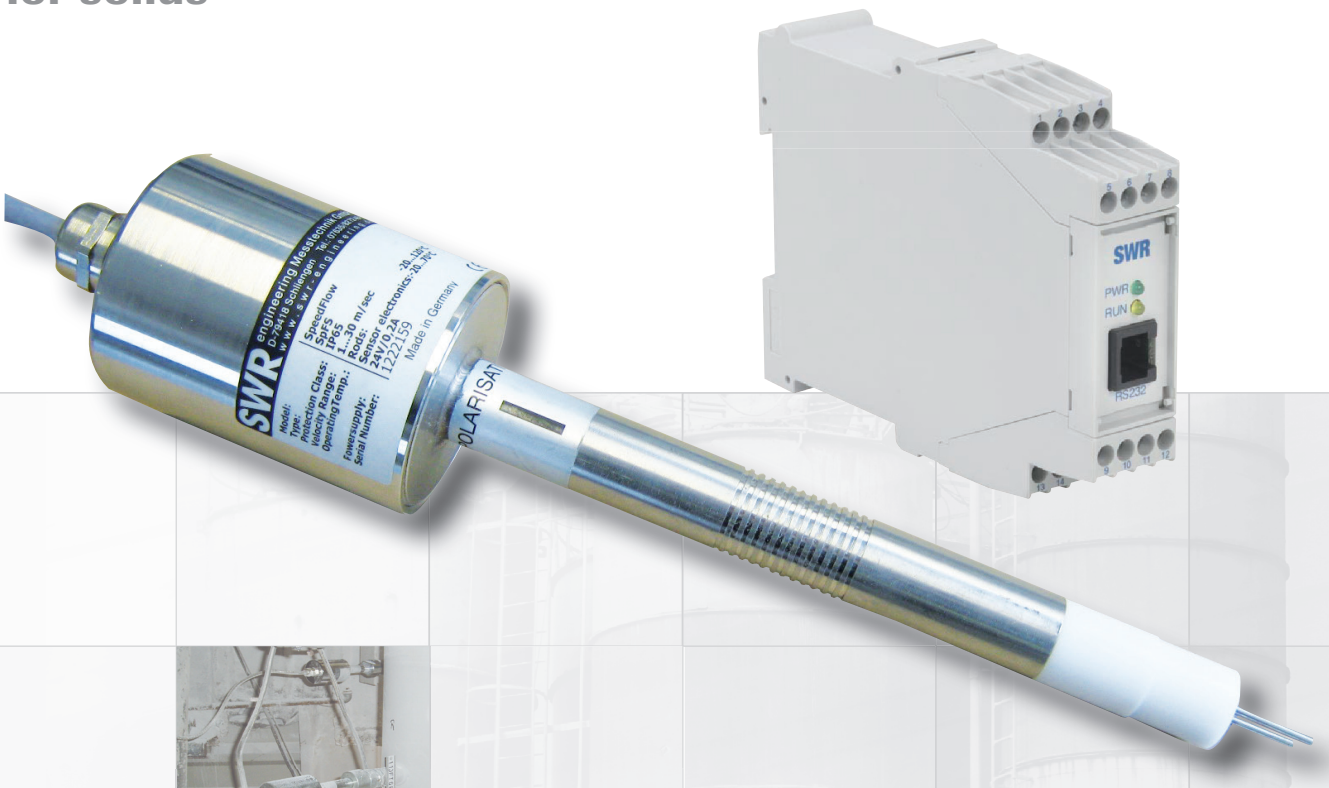
EN

Competence in Solids

SWR engineering

SpeedFlow

Measurement of velocity for solids



Operating Instructions

SWR engineering Messtechnik GmbH

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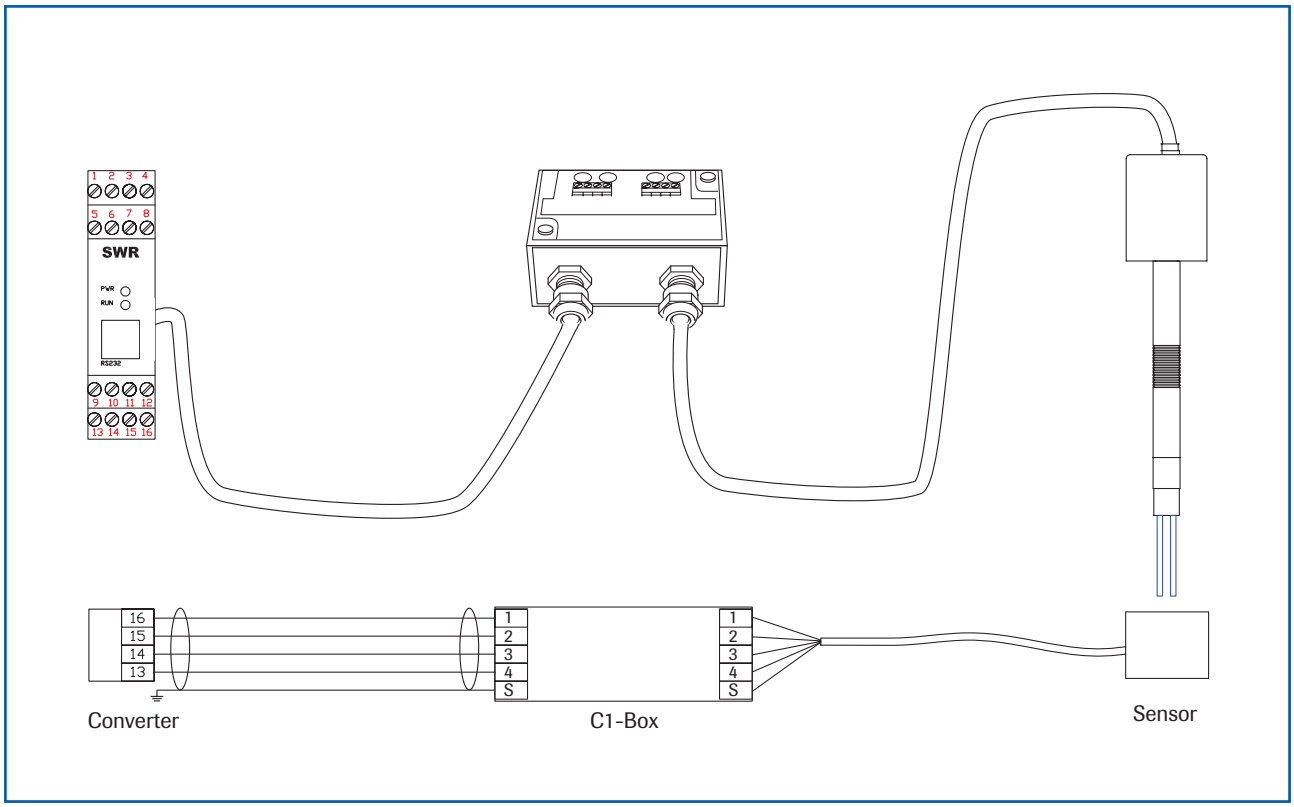
1. System overview

A complete measurement point consists of the following components:

- Transmitter in DIN rail housing
- Sensor accommodation for welding to the pipeline
- Sensor (union nut, distance washer, sealing ring for adjusting to the wall thickness)
- Operating instructions
- C1-Box (optional)



The measuring sensor is connected to the transmitter using a shielded 4-wired cable with the length of the cable not exceeding 300 m.

1.1 Using the optional C1-Box

The C1-Box is a terminal block with a fuse and terminal resistor for connecting longer bus and supply lines.

2. Function

- The SpeedFlow is a measuring system which has been specially developed for measuring the speed of solids being transported.
- The sensor uses the triboelectric effect. It is only used in metallic pipelines.
- The electrodes fitted in the pipeline receive an electrical pulse from the solid particles as they pass. The received signals are evaluated using an auto-correlation process which thus calculates the speed.
- A measurement point generally consists of the sensor, C1-Box and the transmitter.

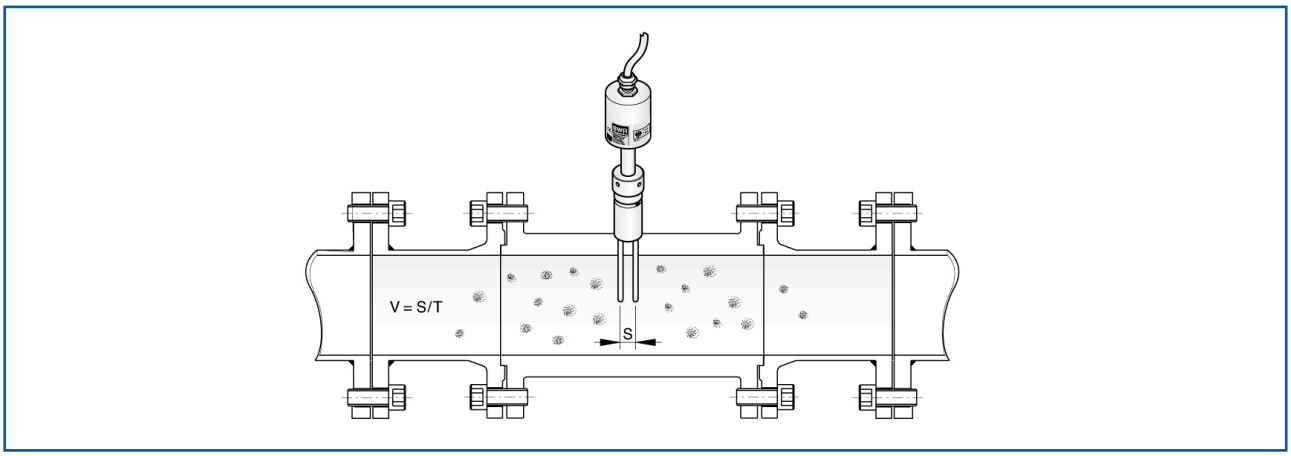


Fig. 2: SpeedFlow sensor in the pipeline

3. Safety

The SpeedFlow measuring system has a state of the art, reliable design and and has been tested and found to be in a perfectly safe condition when it left the factory. Nevertheless the system components may present dangers to personnel and items if they are not operated correctly.
The operating instructions can therefore be read in full and the safety instructions followed to the letter.
If the device is not used correctly for its intended purpose the manufacturer's liability and warranty will be void.

3.1 Normal use

- The measuring system may only be installed in metallic pipes to measure the medium passing through them.
  It is not suitable for any other use or measuring system modifications.
- Only genuine spare parts and accessories from SWR engineering may be used.

3.2 Identification of hazards

- Possible dangers when using the measuring system are highlighted in the operating instructions using the following symbols:

Warning!

- This symbol is used in the operating instructions to denote actions which, if they are not performed correctly may result in death or injury.

Attention!

- This symbol is used in the operating instructions to denote actions which may result in danger to property.

3.3 Operational safety

- The measuring system may only be installed by trained, authorised personnel.
- In case of maintenance-work on the pipe or on components of the SpeedFlow-sensor, make sure that the piping is in unpressurized condition.
- Switch off the power supply before completing any maintenance work, cleaning work or inspections on the pipelines or the *SpeedFlow* components.
- The sensor must be taken out of the pipeline before any welding work.
- The components and electrical connections must be inspected for damage at regular intervals. If any signs of damage are found, they must be rectified before the devices are used again.

3.4 Technical statement

- The manufacturer reserves the right to adjust technical data to technical development without notice. SWR engineering will be delighted to provide information about what the operating instructions is up to date and any amendments which have been made to it.

4. Mounting and installation

4.1 Supplied equipment

- Transmitter in DIN rail housing
- Sensor accommodation for welding to the pipeline
- Sensor (union nut, distance washer, sealing ring for adjusting to the wall thickness)
- Operating instructions
- C1-Box

4.2 Required tools

- Ø 20 mm-twist drill bit
- 32 mm open-ended spanner for union nut
- Pliers for circlips (Ø 20 mm) to adjust the sensor to the wall thickness

4.3 Mounting of the sensor

Proceed as follows to install the sensor:

- Decide on the installation position on the pipe. It should be installed from the top on horizontal or angled pipelines.
- The distances apply to vertical and horizontal installations.
- Ensure that the measurement point is an adequate distance from valves, manifolds, blowers and bucket wheel feeders and other measurement ports such as those for pressure and temperature sensors, etc. (See Fig. 3)

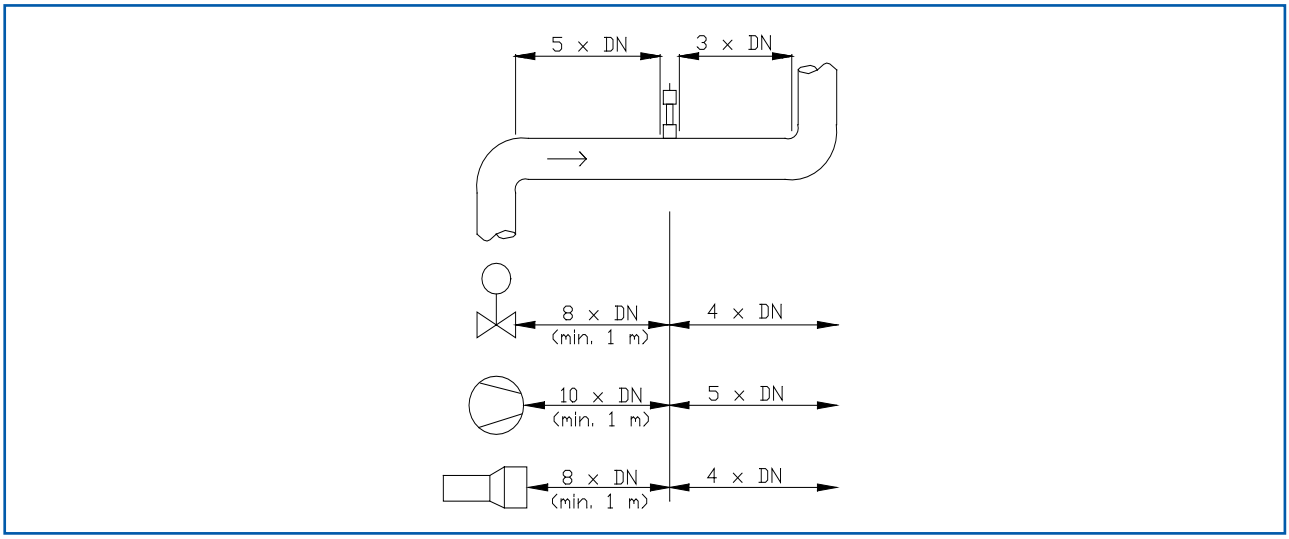


Fig. 3: Minimum distances of the measurement point from pipe geometries and fittings

- Weld the sensor accommodation on to the pipe.
- Drill through the pipe through the sensor (Ø 20 mm). Ensure that the borehole is not angled so that the sensor can be installed precisely later.

Warning!

- After drilling it is essential to check whether the drill bit has caused any burr on the borehole edges. Any burr on the pipe must be removed using a suitable tool. If the burr is not removed it may affect the sensor's calibration.
- If the sensor is not installed immediately insert a dummy plug until it is installed (see also Fig. 4). The dummy plug must be inserted together with the seal, two sealing rings and the circlips for shafts and secured using the union nut. Use a 32 mm open-ended spanner to tighten the union nut.

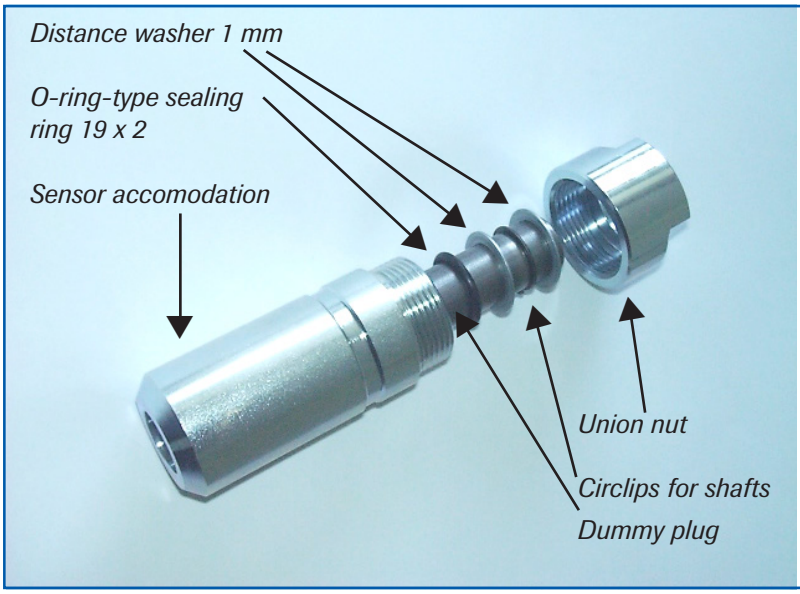


Fig. 4: Installation of the sensor accomodation and the dummy plug

- Remove the dummy plug to insert the sensor.
- The sensor is supplied ready-assembled for the specified wall thickness or, if no wall thickness was specified, to a wall thickness of 4 mm. Check again that it is correctly adjusted before installation (see table). If necessary the wall thickness must be remeasured with a depth gauge. The weld-on socket is 93 mm long. It is important that the sensor does not project into the pipe. The sensor may be up to 1 mm inside the pipe wall without this causing a measurement error.

Wall thickness (mm)	Position on the sensor neck	Number of distance washers
3.0	1	2
4.0	1	1
5.5	2	2
6.5	2	1
8.0	3	2
9.0	3	1
10.5	4	2
11.5	4	1
13.0	5	2
14.0	5	1

- Now the sensor is put into the sensor accommodation and screwed with the union nut according to figure 5a.

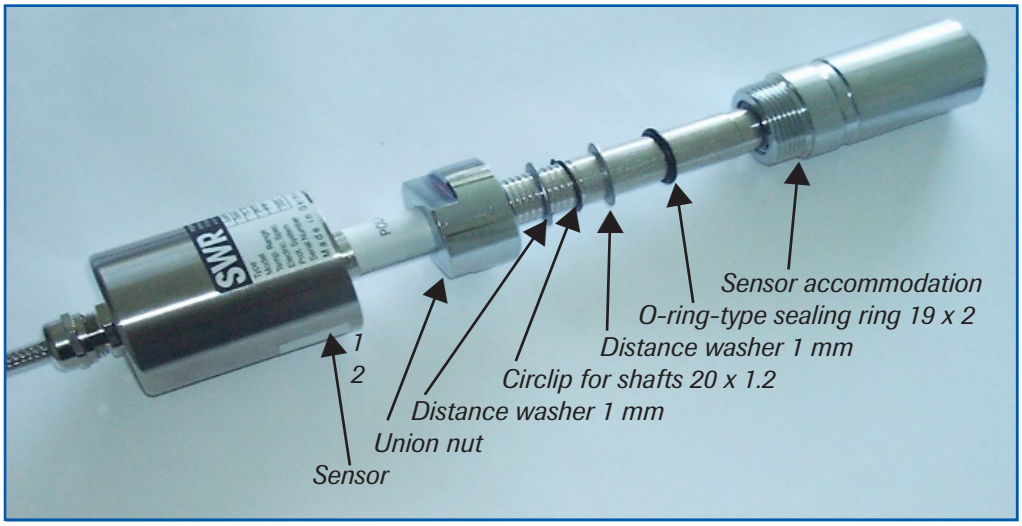


Fig. 5a: Installation of sensor accommodation and sensor

- and align it longitudinally to the pipe axis as marked on the sticker (Fig. 5b). The two sensor-rods must be inline with the flow. Then seal the measurement point with the union nut.

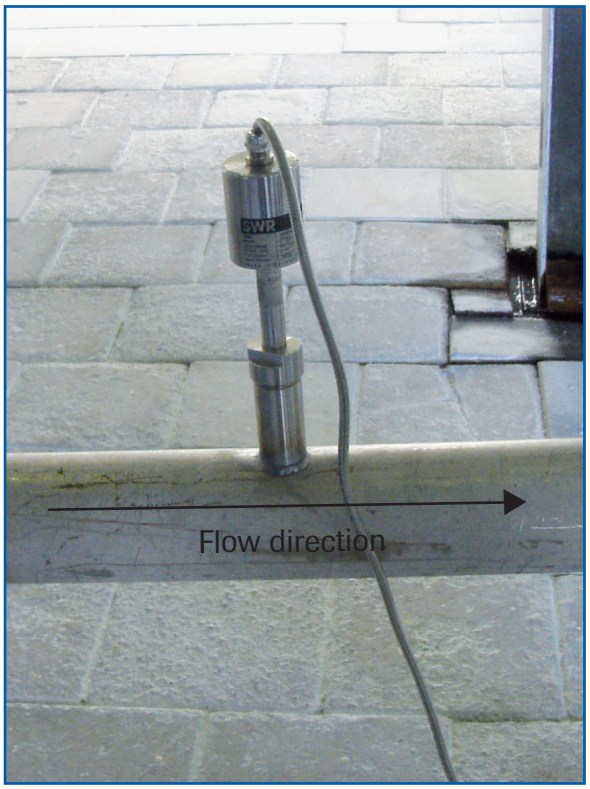


Fig. 5b: Sensor alignment

4.4 Mounting of the transmitter

- The entire transmitter can be installed at a maximum distance of 1 km from the sensor. The housing is prepared for installation on a DIN rail to DIN EN 60715 TH35.

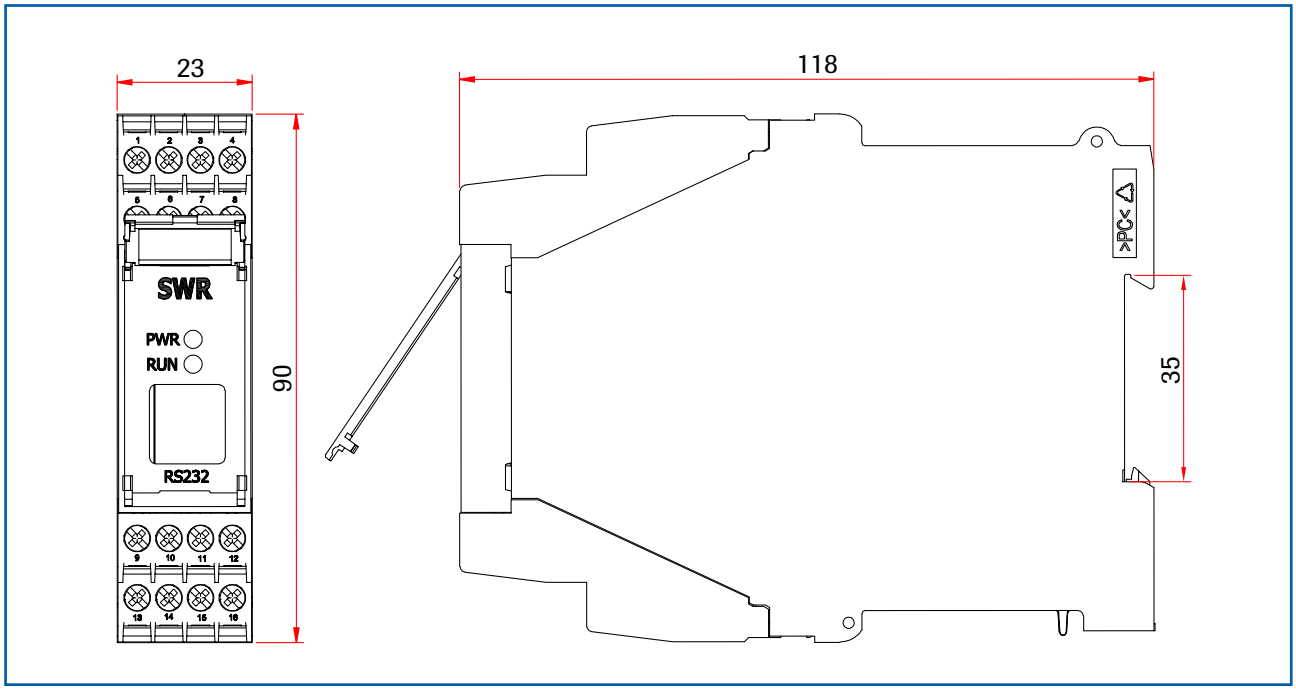


Fig. 6: DIN rail housing for the transmitter

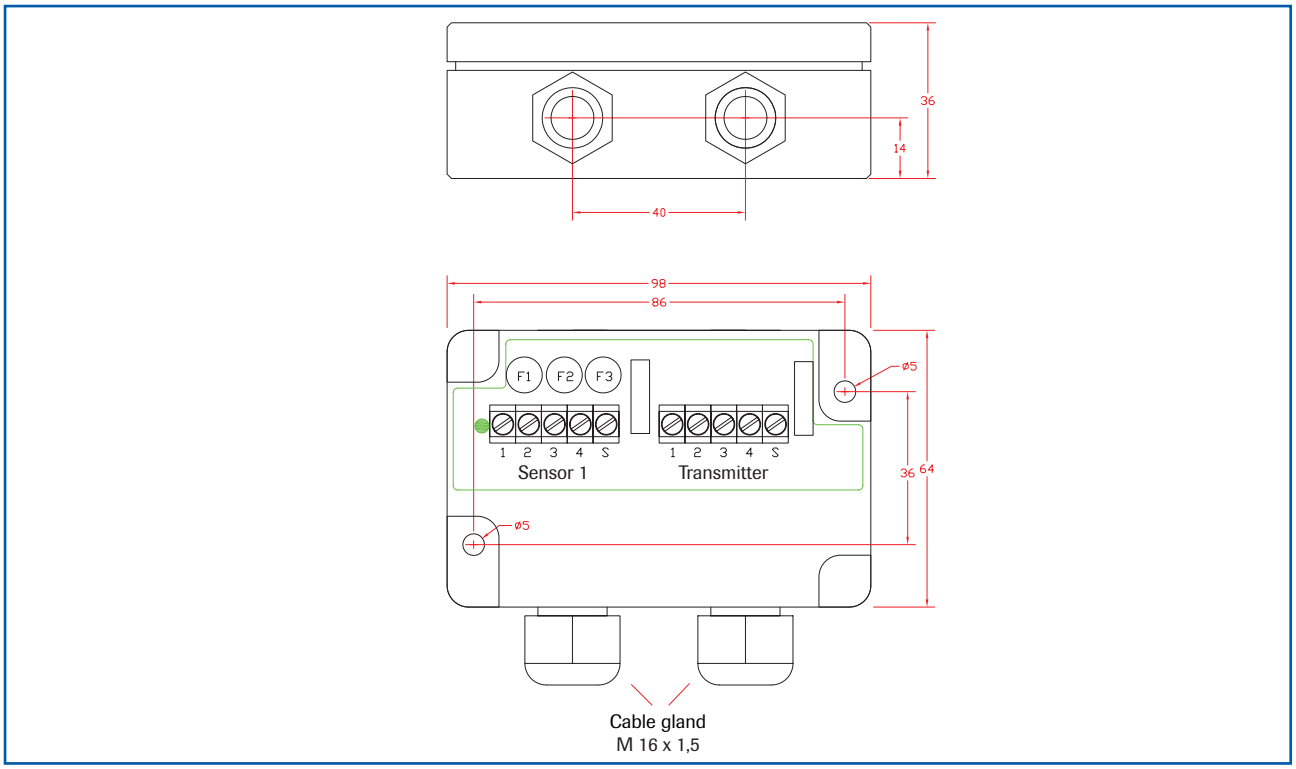
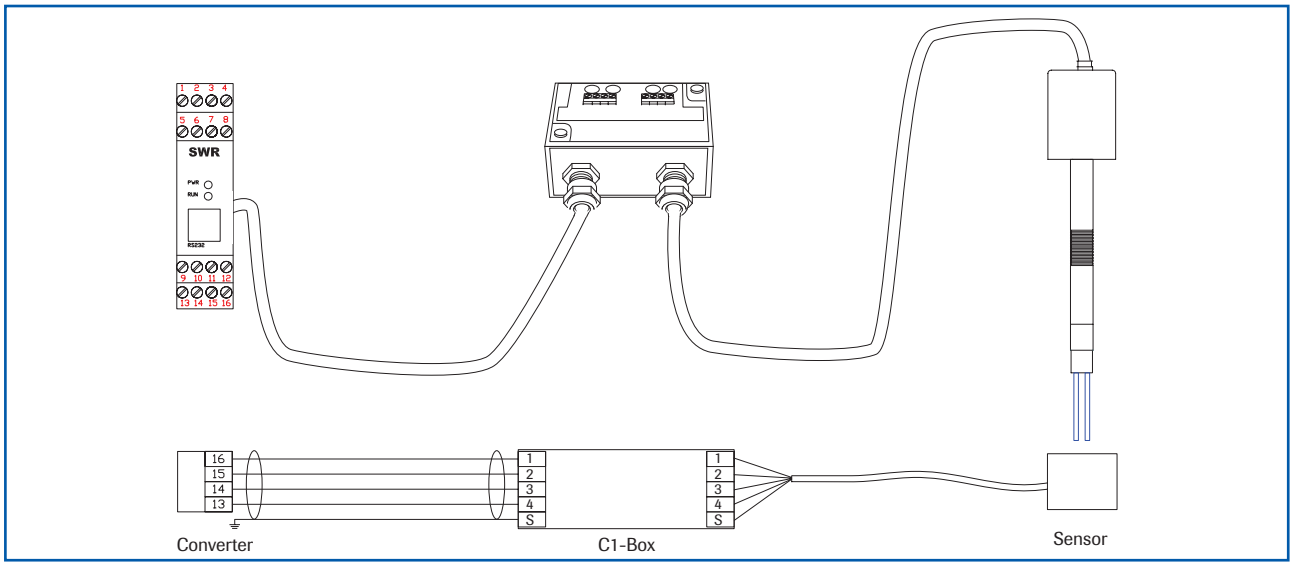


Fig. 7: Field housing for the C1-Box

5. Electrical connection



1 Current output - 4 ... 20 mA	**2** Current output + 4 ... 20 mA	**3** Input Power supply 0 V DC	**4** Input Power supply + 24 V DC
5 Not available	**6** Alarm relay NC (opener)	**7** Alarm relay C	**8** Alarm relay NO (closer)

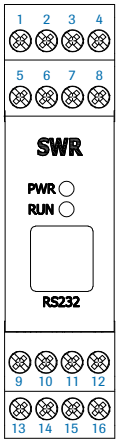


Fig. 9: Electrical connection of the transmitter

9 Not available	**10** Not available	**11** RS 485 interface Data B	**12** RS 485 interface Data A
13 **Sensor connection Cable 4** RS 485 Data B	**14** **Sensor connection Cable 3** RS 485 Data A	**15** **Sensor connection Cable 2** Power supply 0 V	**16** **Sensor connection Cable 1** Power supply + 24 V
Connect shield to earth			

6. Commissioning

Check the following:

- The correct connection between the sensor and transmitter.
- The correct installation of the sensor on the internal wall of the transport pipe.

If despite the above being correct the measurement is still not successful, consult SWR.

Commissioning the SpeedFlow

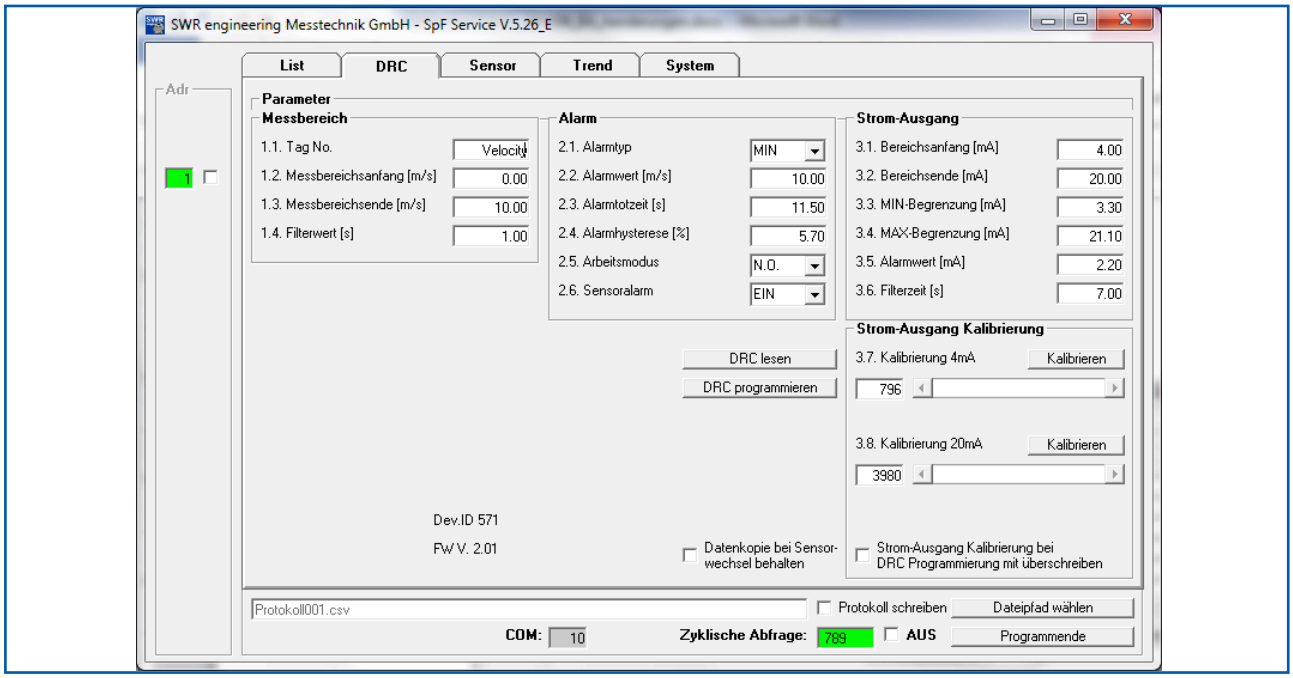
The sensor is an absolute measuring device and must be parameterised during the commissioning procedure. The menu functions in the supplied SpeedFlow configuration program are essentially self-explanatory. The program has been tested with all current Windows operating systems.

The connection may be made using the RS 232 C interface (socket in the front panel) using the supplied cable or using the integral RS 485 interface (bus-capable) on screw terminals 11 and 12. By assigning different addresses to the various transmitter the devices can be actuated in the bus using the ModBus protocol. The following is a brief introduction as a summary.
All the changed values must be saved by exiting the menu level and confirming the save function.

Starting the menu	After starting the SpeedFlow configuration program, open the interface (COM1 to 10 can be selected). Fix the baud rate at 9600 Bd. Set the address of the transmitter (standard = 1).
Current output	The output values are set in menu points 3.1 to 3.8. The output value (current) is assigned to the measuring range here. Standard 0 = 4 mA Max = 20 mA The measuring range filter is used to adjust to slower recording devices or a continuous output at the analogue output.
Alarms	can be entered by the user in menu 2.
Analogue output	is modified in menu 3 and can be adjusted here to suit the user's requirements. (Between 0 - 22 mA)
Storage	After making changes they can be saved using menu point *Device Program*. If you confirm *Overwrite calibration* the change will be made.

Following the menu parameters in detail:

7. Menu structure of the SpeedFlow configuration program



1. Measuring range

1.1	**Tag No**	Adjust material (10 digits)
1.2	**Start of measuring range**	Range 0 ... 999
1.3	**End of measuring range**	Range 0 ... 999
1.4	**Filter value**	Range 0.1 ... 99.9 s

2. Alarms

2.1	**Alarm 1**	
2.1	**Alarm type**	Select: Min / Max / None
2.2	**Alarm value**	-10 to 110 % in physical units
2.3	**Alarm down time**	Range 0.1 ... 99.9 s
2.4	**Alarm hysteresis**	0.1 ... 99.9 %
2.5	**Operating mode**	Select: Working / Closed-circuit principle
2.6	**Sensor alarm**	Alarm for sensor error: On / Off

3. Analogue output

3.1	**Start of range**	Range: 0 ... 22 mA (standard: 4 mA)
3.2	**End of range**	Range: 0 ... 22 mA (standard: 20 mA)
3.3	**MIN limit**	Range: 0 ... 22 mA (standard: 3 mA)
3.4	**MAX limit**	Range: 0 ... 22 mA (standard: 20 mA)
3.5	**Alarm value**	Range: 0 ... 22 mA (standard: 3 mA)
3.6	**Filter time**	Range: 0.1 ... 99.9 s (standard: 1 s)
3.7	**Calibration: 4 mA**	Adjust output current (4 mA calibrated)
3.8	**Calibration: 20 mA**	Adjust output current (20 mA calibrated)

8. System settings in detail

1. MEASURING RANGE

1.1 Tag No.

Freely selectable designation of the measuring medium or place, max. 10 characters

1.2 Start of measuring range

Enter the value of the required start of the measuring range. Normally 0.0.

1.3 End of measuring range

Enter the value of the required end of the measuring range.

1.4 Filter value

Adjustable damping for the **display** in seconds.
Range: 0.1 ... 99.9 s

2. ALARMS

Effect on the relay

2.1 Alarm type

Min/Max - upper or lower limit value

2.2 Alarm value

Trigger threshold
Range -10 ... 110 % of the measuring range values in physical units.

2.3 Alarm down time

Response time for how long the value must be below or above the limit value before the alarm relay switches. Range: 0.1 ... 99.9 s

2.4 Alarm hysteresis

Value to reset the alarm.
Range: 0.1 ... 99.9 % of the defined measuring range.

2.5 Operating mode

Select the contact: Work or closed-circuit
NO (working current) - NC (closed-circuit current)

2.6 Sensor alarm

Alarm for sensor error
ON /OFF

3. ANALOGUE OUTPUT

3.1 Start of range

Value to be set for minimum current output.
(Standard 4 mA) - Range 0 ... 22 mA

3.2 End of range

Value to be set for maximum current output.
(Standard 20 mA) - Range 0 ... 22 mA

3.3 MIN limit

Minimum current output value to be set.
Range 0 ... 22 mA (standard 3 mA)

3.4 MAX limit

Maximum current output value to be set.
Range 0 ... 22 mA (standard 20 mA)

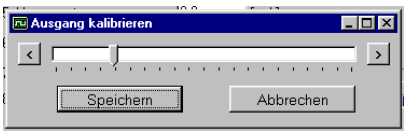
3.5 Alarm value

Output value to be set for alarm (sensor error or internal alarm), at the same time the relay drops out.
Range 0 ... 22 mA (standard 3 mA)

3.6 Filter time

Damping to be set for the current output.
Range 0.1 ... 99.9 s (standard 1 s)

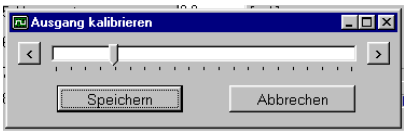
3.7 Calibration 4 mA



Min. output current to be set
Adjust to the external measuring system
(if display is different).

Adjust the output current to 4 mA using the < and > keys.

3.8 Calibration 20 mA



Max. output current to be set
Adjust to the external measuring system
(if display is different).

Adjust the output current to 20 mA using the < and > keys.

9. Brief description of the PC operating software

The “SPF Service V.5.xx (E)” PC software can communicate with a sensor via RS 232 (front connector on the rail [DRC]) or via RS 485 (screw-terminal).

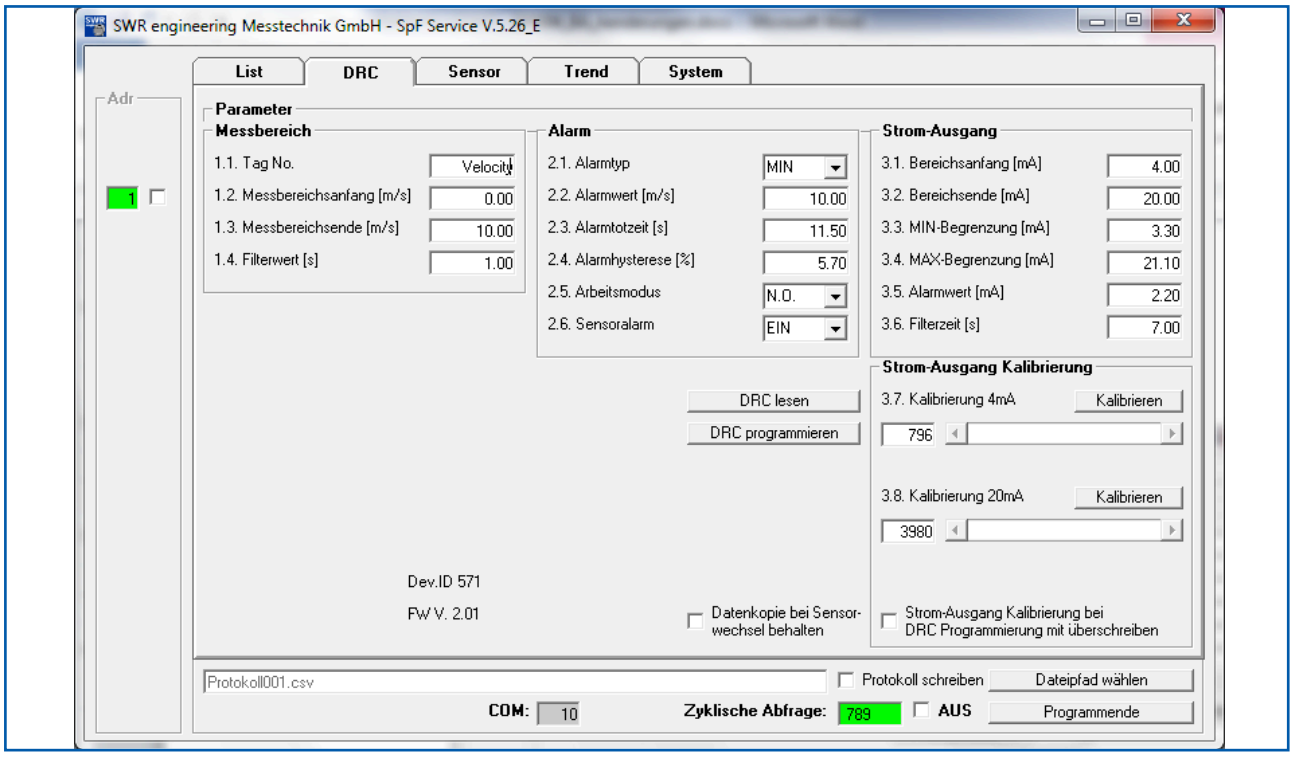
The ModBus RTU log is used.

- Interface standard is 9600 baud, 8 data bits, even parity, 1 stop bit.
- Standard sensor address is 1.
- Only one point-to-point connection can be established with one sensor via RS 232.
- A bus system can be established via RS 485.
- 1 sensor can be portrayed with the standard PC software.
- Up to 10 sensors can be portrayed with an optional PC software.

All settings required to operate the system can be activated via the PC software.

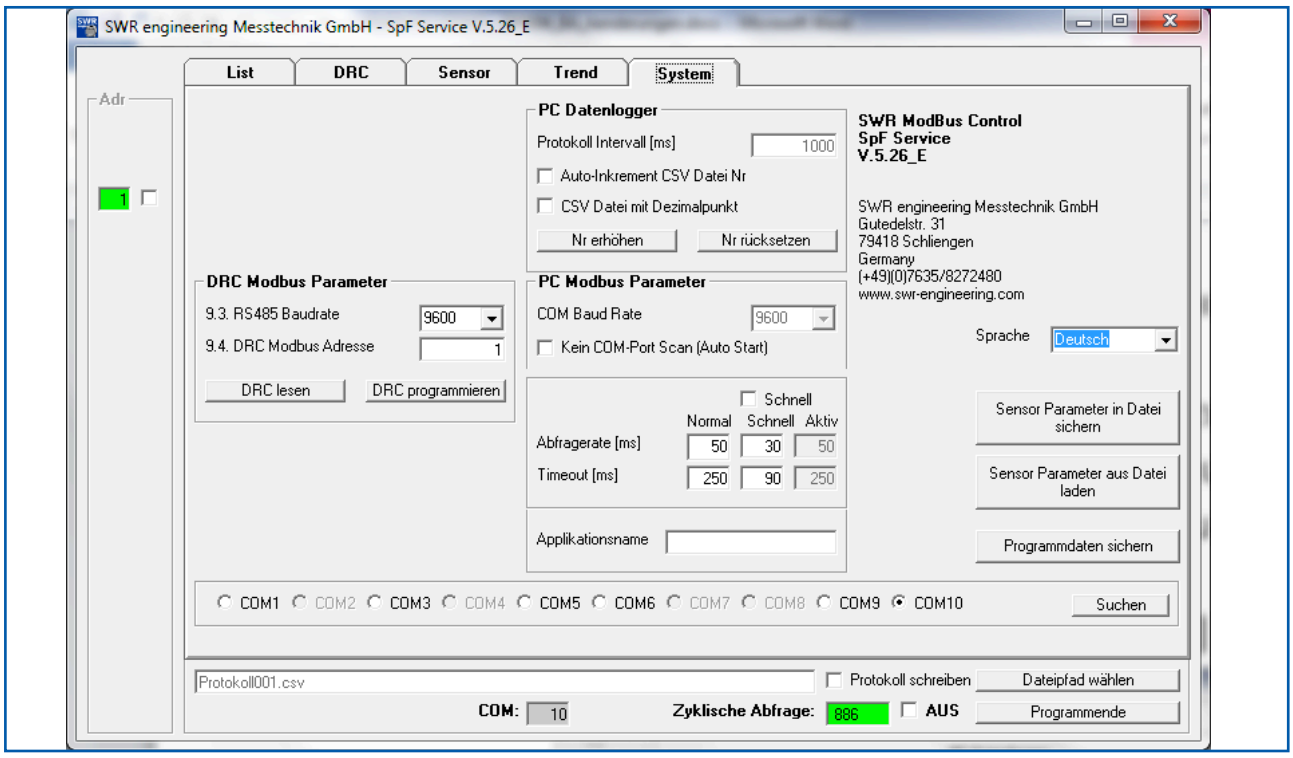
- Interfaces and log file settings (data logger function) are activated in the System tab.
- Current output, the signal’s measuring range, alarms and relay actions are set in the DRC tab.
- Parameters for improving the measurement procedure are set in the Sensor menu.
- The List and Trend tabs provide an overview of the measurement results from the measuring points.

9.1 DRC tab



Settings for customer system signals, see section 7.

9.2 System tab



Language:

- German or English can be selected.

Backup files:

- ***Saving program data:***
  Saves the settings from the PC program in a file so that they are available during the next start-up. These are automatically saved at the end of the program.
- ***Save sensor parameters in a file / load sensor parameters from a file:***
  Here, the measuring point parameters (DRC and sensor) can be saved into and read back from a file.
- All backup files are saved in text format and can be opened with a normal text program.

Communication:

- COM port (COM1 to 10) of the interface used on the PC.
- The baud rate for the communication must be the same on both devices.
- If the baud rate for the DRC is changed, the new transmission rate will only apply after the DRC has been switched off and on again.
- ModBus query rate and Timeout:
  Here, the intervals at which a query is sent to the connected system is set along with the time frame in which the response can be expected.

Logging (PC data logger):

- A log file is created for the sensor. The logs are saved as CSV files.
- The decimal separator (comma or point) can be defined by ***CSV with decimal point***.
- The logging time interval can be entered as ***Log interval [ms]***.
- The file name is automatically filled in with the ModBus address and serial number of the sensor in order to enable clear identification.
- Automatic numbering of the files can be activated with the ***Auto-Increment*** option.
  The file numbers then increase each day (at midnight) and each time the program is started.
- The file number can be manually adjusted with ***"Increase no."*** or ***"Reset no."***.
- The ***file path*** and ***active logging*** can be set in the footer.

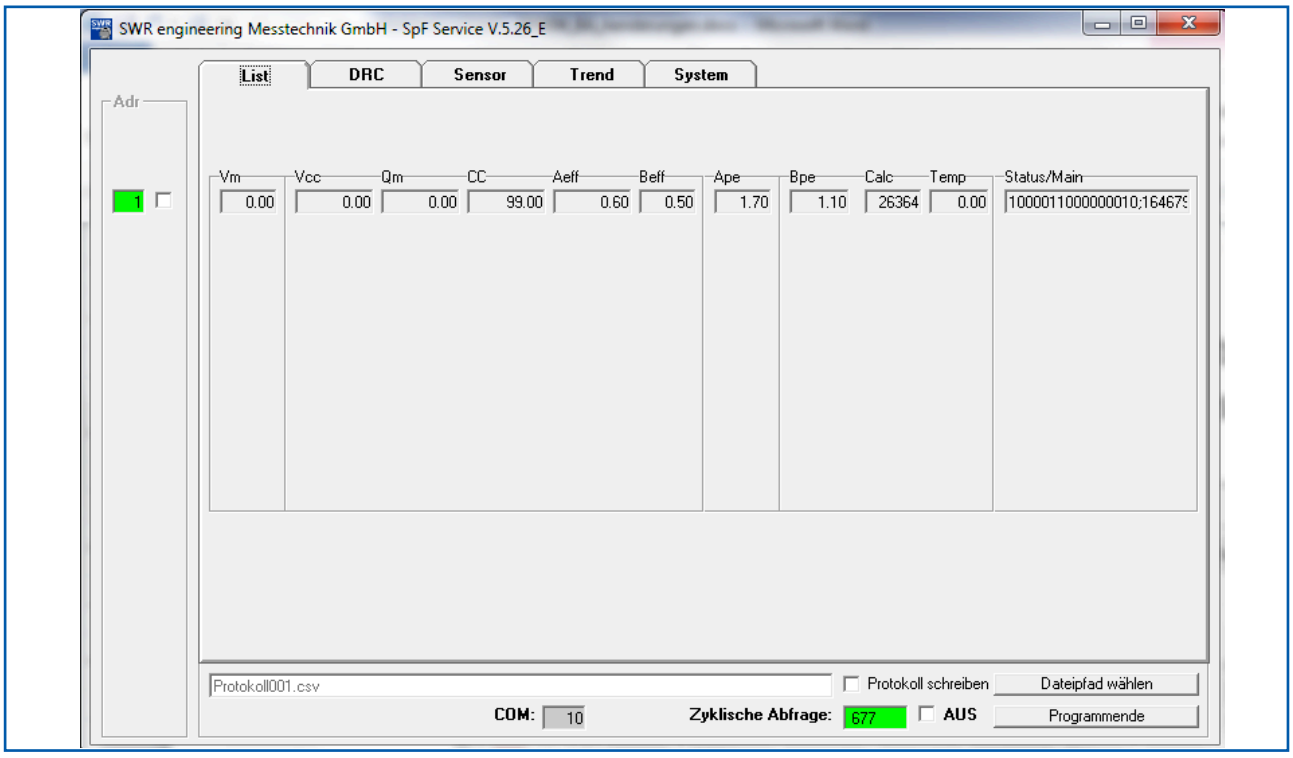
No COM-port scan (auto-start):

If this option is selected, when starting, the software immediately begins with the most recently configured port and protocol settings.

9.3 List tab

Here, the sensor is portrayed in an overview list.

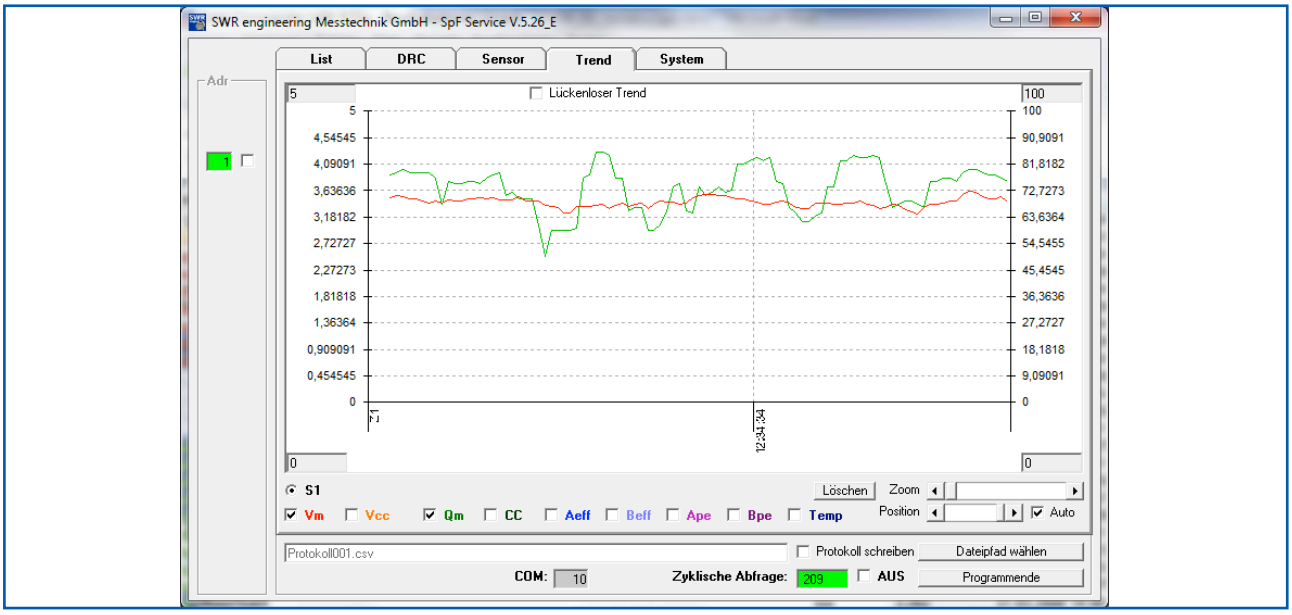
Up to 10 sensors can be managed with the optional PC software.



The sensor is portrayed with its main measurement value ***Vm*** and several secondary measurement values which provide information about the quality and condition of the measuring point.

All values in this list are held in the log file and portrayed as trend lines (Trend tab).

9.4 Trend tab

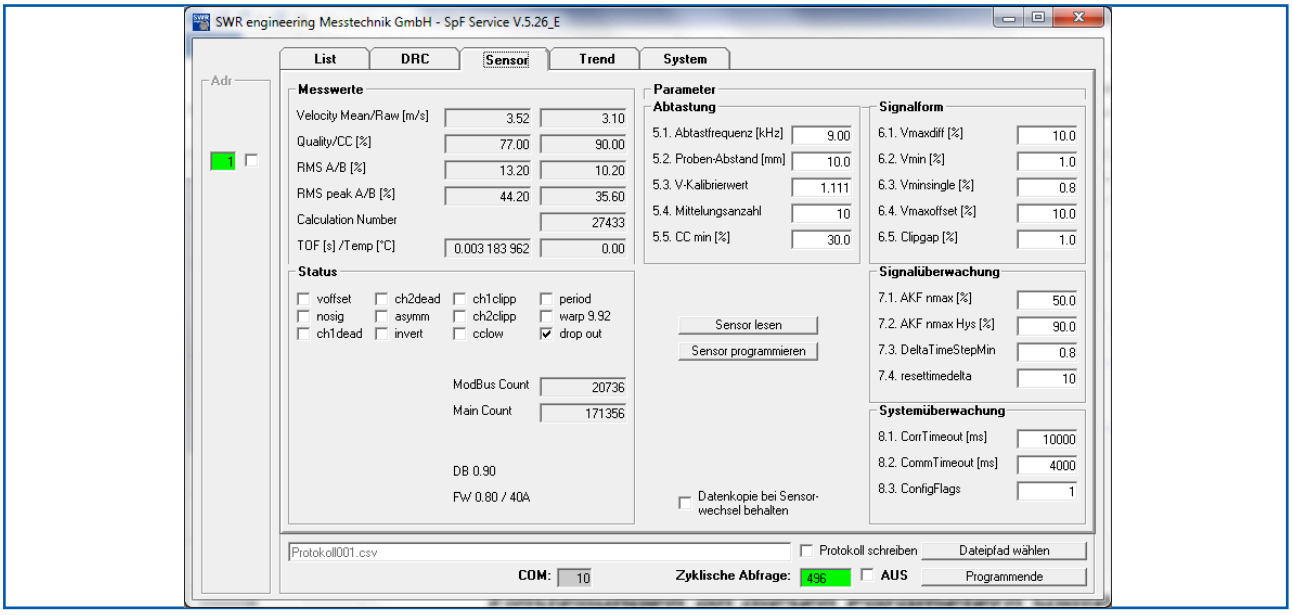


All values measured by the sensor from the overview list (List tab) are portrayed here as trends.
Vm and ***Vcc*** are scaled on the left scale and all other values are scaled on the right scale.

If upper and lower scale values are entered in the ***grey fields*** , these will be used – if the fields remain empty, automatic scaling will take place. With ***Zoom*** and ***Pos***, the signal's resolution and history can be set.

9.5 Sensor tab

The measurement parameters, measurement values and quality numbers of the currently selected sensor are portrayed here. These parameters are provided as default settings or, if necessary, are selected when starting up the sensor for the first time and permanently saved in the sensor.



These parameters should only be set by trained personnel – as a rule by SWR employees – and should only be adjusted in special cases.

10. Maintenance

Warning!

- Switch the power supply off before all maintenance and repair work on the measuring system. The transport pipe must not be operational to replace the sensor.
- Repair and maintenance work may only be carried out by electricians.
- The system requires no maintenance.

11. Warranty

On condition that the operating conditions are maintained and no intervention has been made on the device and the components of the system are not damaged or worn, the manufacturer provides a warranty of 1 year from the date of delivery.

In the event of a defect during the warranty period, defective components will be replaced or repair at SWR's plant free of charge at discretion. Replaced parts will become SWR's property. If the parts are repaired or replaced at the customer's site at its request, the customer must pay the travelling expenses for SWR's service personnel.

SWR cannot accept any liability for damage not suffered by the goods themselves and in particular SWR cannot accept liability for loss of profit or other financial damages suffered by the customer.

12. Trouble shooting

Warning!
The electrical installation may only be inspected by trained personnel

Problem	Cause	Measure
Measuring system does not work. POW LED not lit. RUN LED not lit.	Power supply interrupted.	Check the power supply.
	Cable break.	Check the connection cables for a possible cable break.
	Fuse defective.	Replace fuse.
	Device defective.	Notify SWR and rectify the error as instructed on the telephone.
Measuring system does not work. POW LED lit. RUN LED not lit.	Microprocessor does not start.	Switch the power supply off and on again. Remove programming cable.
Measuring system works. POW LED lit. RUN LED flashes quickly.	No sensor communication.	Sensor defective. Cable break between sensor and measuring system.
	Sensor connected incorrectly.	Check connection cable.
	Sensor defective.	Replace sensor.
	Sensor not receiving 24 V supply.	Make sure the power supply is connected.
	Excessive voltage drop in the supply cable to the sensor.	Increase supply cable cross-section.
Measuring system outputs incorrect values.	Calibration incorrect.	Calibration factor changed. Normal V = 1
Switch output relay chatters.	Hysteresis too low.	Increase hysteresis. Check for fault caused by external consumer.
Do not open, as otherwise the warranty claim expires!		

12. Technical data

Sensor	
Housing material	Stainless steel 1.4571
Protection category	IP 65, dust Ex zone 20 or gas Ex zone 1 (optional)
Operating temperature	Sensor tip -20 ... +80 °C Optional: -20 ... +200 °C Sensor electronic: 0 ... +60 °C
Max. working pressure	1 bar, optional 10 bar
Sensor tip material	Tungsten carbite
Transmitting power	Max. 5 mW
Weight	Approx. 1.5 kg
Dimensions	Ø 60, Ø 20, L 320 mm (incl. rod length)
Accuracy	± 1 % in calibrated range
Transmitter	
Power supply	24 V DC ± 10 %
Power consumption	20 W / 24 VA
Protection category	IP 40 to EN 60 529
Operating temperature	-10 ... +45 °C
Dimensions	23 x 90 x 118 (W x H x D)
Weight	Approx. 172 g
DIN rail mounting	DIN 60715 TH35
Connection terminals Cable cross-section	0,2 – 2,5 mm² [AWG 24-14]
Current output signal	4 ... 20 mA (0 ... 20 mA), load < 500 Ω
Alarm output	Relay with switching contact - Max. 250 V AC, 1 A
Data backup	Flash memory

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