EN

Competence in Solids

SolidFlow 2.0

Solid volume measurement

Operating Instructions

SWR engineering Messtechnik GmbH

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1. System overview

A measuring point consists of the following components:

- Transmitter (in the DIN rail housing or field housing)
- Sensor mount for welding to the pipeline
- Sensor (union nut, spacer rings, sealing ring for adjusting to the wall thickness)
- Installation instructions
- C1- or C3-box (optional)

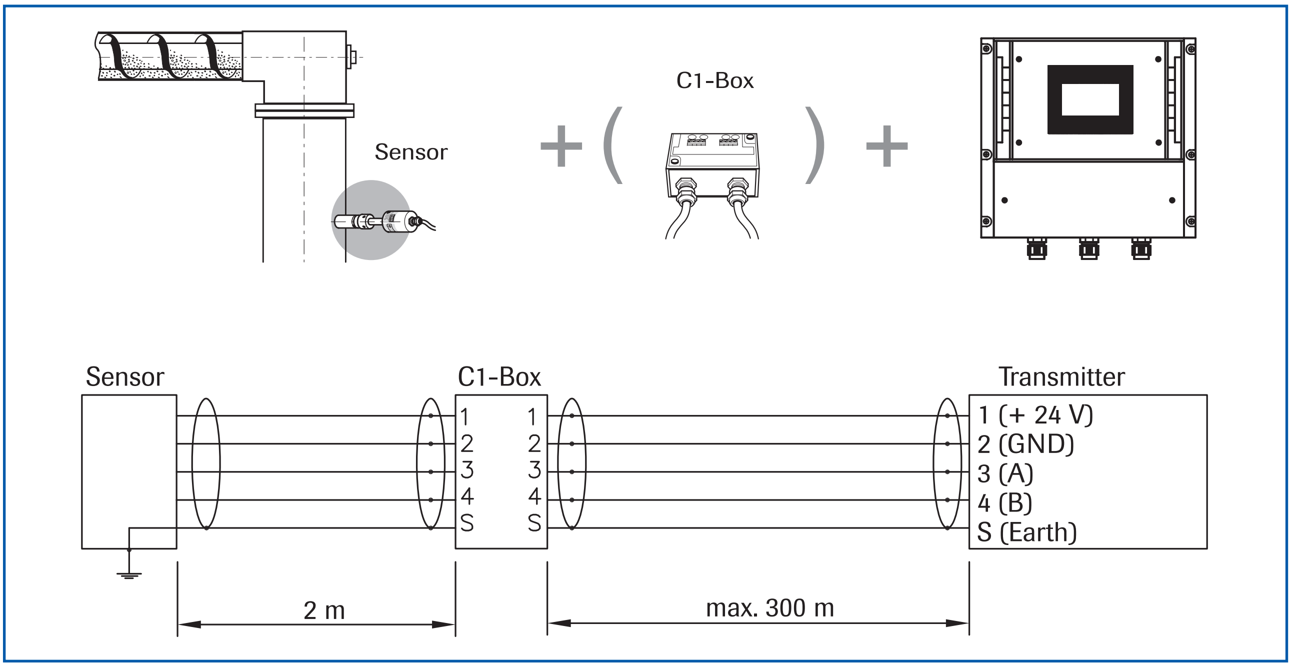


Fig. 1: Overview with C1-box and field housing transmitter

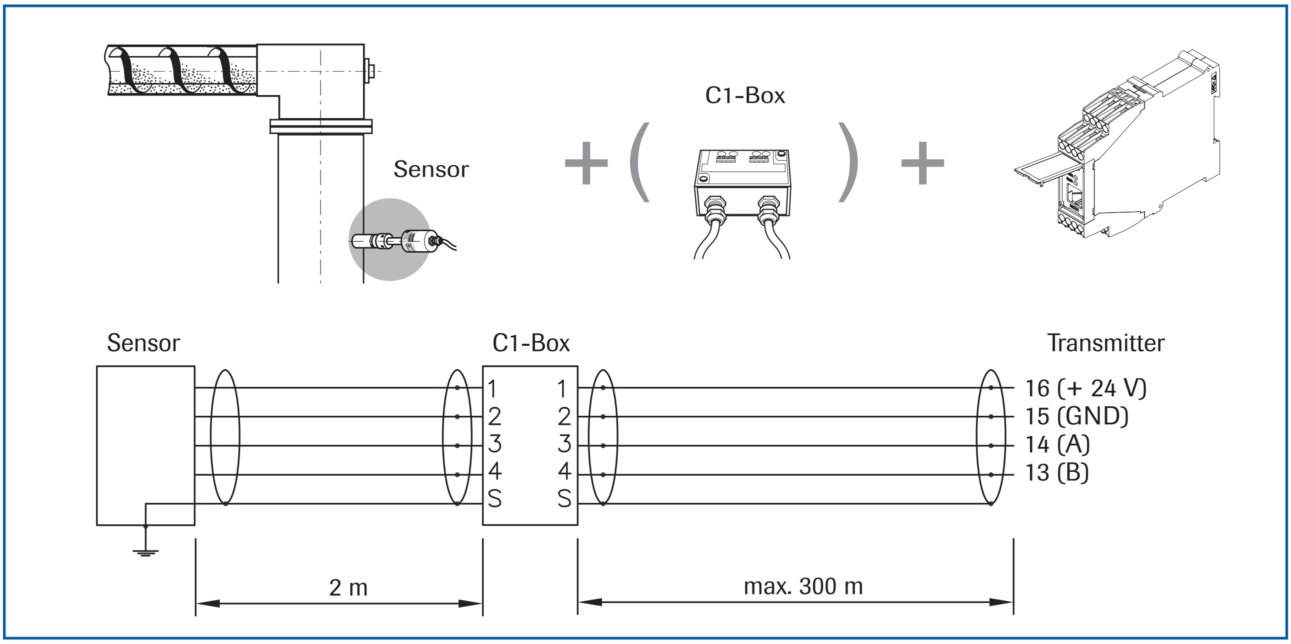


Fig. 2: Overview with C1-box and DIN rail transmitter

The system can be equipped with up to three sensors. Different C-boxes (C1, C3) are used accordingly.

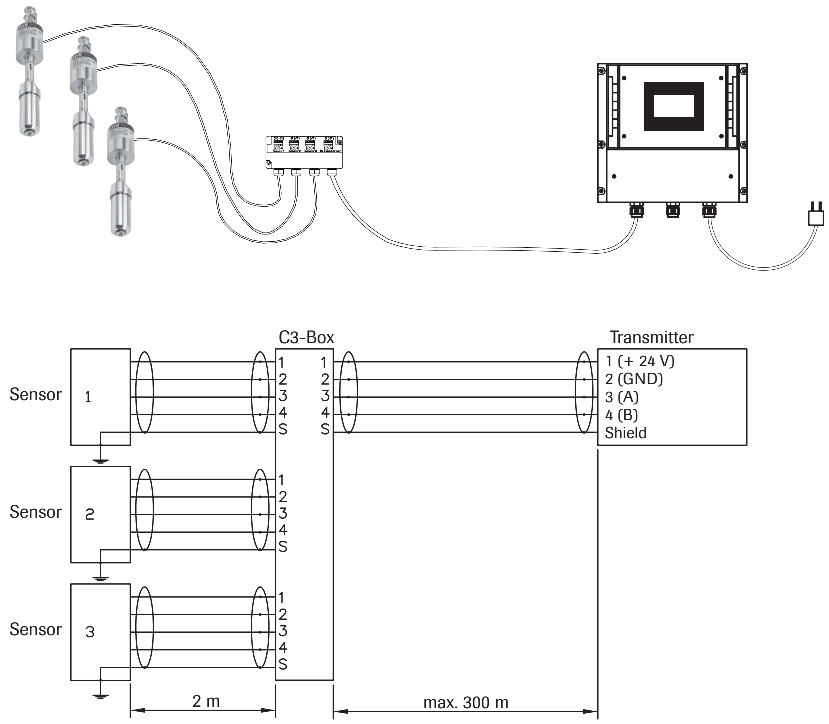


Fig. 3: Overview with C3-box and field housing transmitter

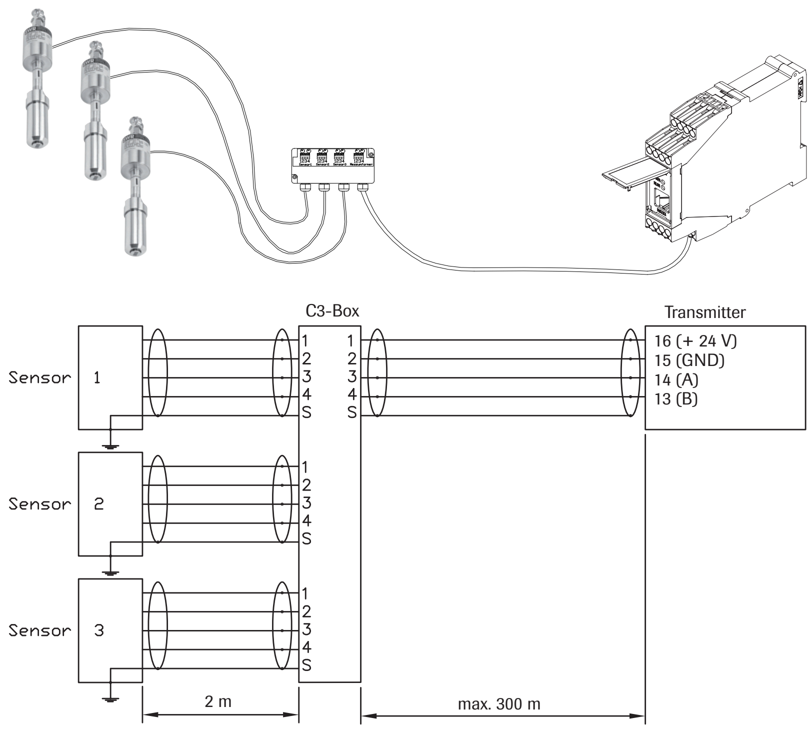


Fig. 4: Overview with C3-box and DIN rail transmitter

2. Function

- The SolidFlow 2.0 is a measuring system which has been specially developed for measuring the quantity of solids conveyed in pipelines.
- The sensor works with the latest microwave technology. It is only used in metallic pipelines. The special integration of microwave technology together with the metallic pipeline creates a homogeneous measurement field.
- The microwave radiation in the pipeline is reflected by the solid particles and received by the sensor. The frequency and amplitude of the received signals are analysed.
- The frequency-selected evaluation system ensures that only moving particles are measured and deposits are suppressed.
- SolidFlow 2.0 features active stratification compensation which increases measurement accuracy.

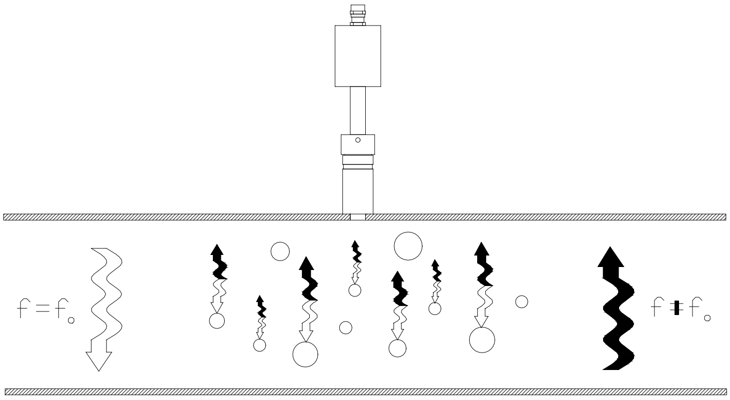


Fig. 5: Integration and reflection of microwaves

3. Safety

The SolidFlow 2.0 measuring system has a state of the art, reliable design. It was tested and found to be in a perfectly safe condition when leaving the factory. Nevertheless, the system components may present dangers to personnel and items if they are not operated correctly.
Therefore, the operating manual must 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 with the following symbols:

Warning!
- This symbol is used in the operating manual to denote actions which, if not performed correctly may result in death or injury.

Attention!
- This symbol is used in the operating manual 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.
- During all maintenance, cleaning and inspection work on the pipelines or SolidFlow 2.0 components, make sure that the system is in an unpressurised state.
- Switch off the power supply before performing any maintenance work, cleaning work or inspections on the pipelines or the SolidFlow 2.0 components. See the instructions in the section entitled Maintenance and care.
- The sensor must be taken out of the pipeline before any welding work is performed.
- 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 concerning technical developments without notice. SWR engineering will be delighted to provide information about the current version of the operating manual, and any amendments made.

4. Mounting and installation

4.1 Typical components of the measurement point:

- Transmitter in the DIN rail housing or field housing
- Sensor mount for welding to the pipeline
- Sensor (union nut, spacer rings, sealing ring for adjusting to the wall thickness)
- Installation instructions
- C1- or C3-box (optional)

4.2 Required equipment

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

4.3 Sensor installation

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.
- Note: Depending on the application, up to 3 sensors can be used on pipeline diameters larger than 200 mm, whereby the sensors must be mounted offset in relation to each other at an angle of 120°.
- The distances apply to vertical and horizontal installations.
- Ensure that the measurement point is at an adequate distance from valves, manifolds, blowers and bucket wheel feeders and other measurement ports such as those used for pressure and temperature sensors, etc. (See Fig. 6)

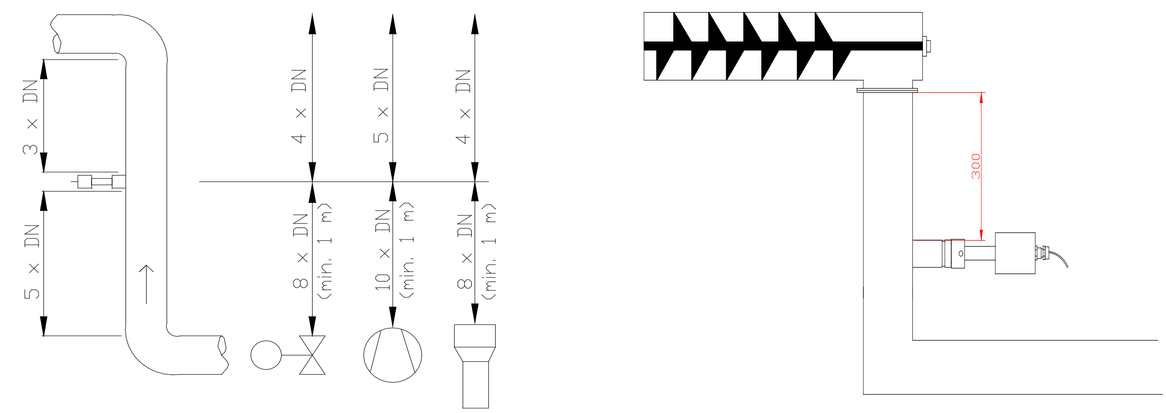


Fig. 6: Minimum distances of the measurement point from pipe geometries and fittings

- On free-fall applications (for example, after screw conveyors or bucket wheel feeders), a drop height of at least 300 mm is ideal.

- Weld the sensor mount to the pipe.
- Drill through the pipe through the sensor plug (Ø 20 mm). Ensure that the borehole is not angled so that the sensor can be installed precisely at a later stage.

Attention!

- After drilling, it is essential to check whether the drill bit has caused any burrs on the borehole edges. Any burrs on the pipe must be removed using a suitable tool. If the burrs are not removed they may affect the sensor's calibration.
- If the sensor is not installed immediately insert a plug until it is installed (see also Fig. 7). The plug must be inserted together with the seal, two sealing rings and the locking ring, and secured using the union nut.
  Use a 32 mm open-ended spanner to tighten the union nut.

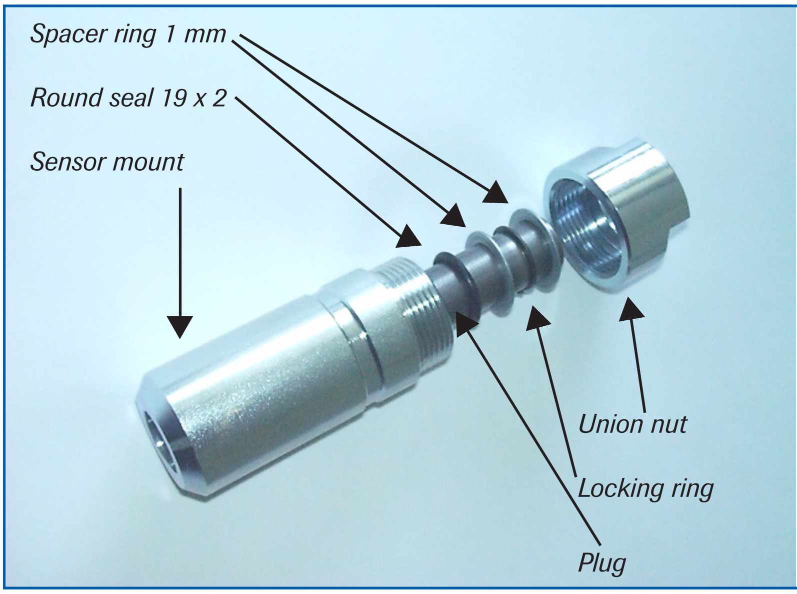


Fig. 7: Install the sensor mount and the plug

- Remove the sealing plug to insert the sensor.
- The sensor is supplied pre-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 using 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 spacer rings
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 insert the sensor into the sensor guide as shown in Figure 8a.

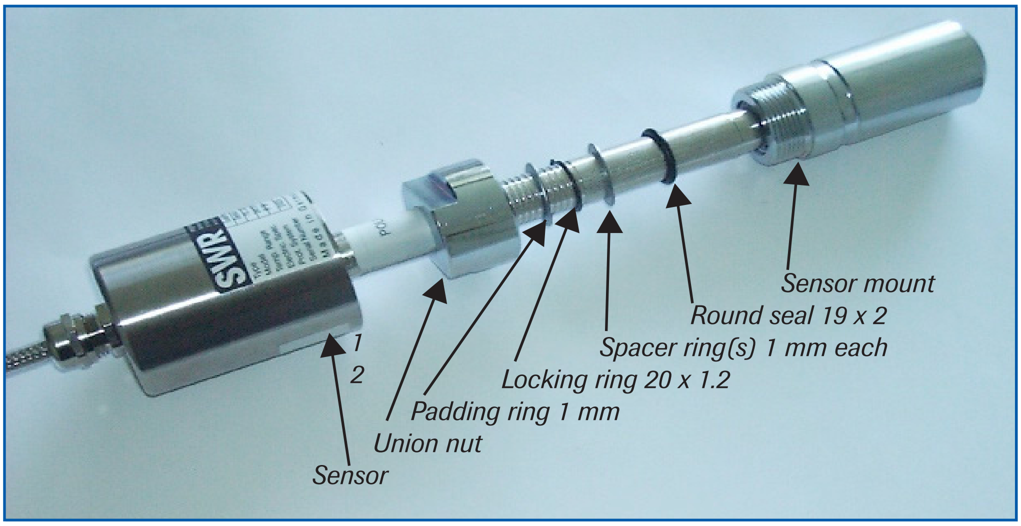


Fig. 8a: Install the sensor mount and the sensor

- and align it longitudinally to the pipe axis as shown on the polarisation sticker (Fig. 8b). Then seal the measurement point with the union nut.

Fig. 8b: Sensor alignment

4.4 Mounting the transmitter

- The entire transmitter can be installed at a maximum distance of 300 m from the sensor. The housing is prepared for installation on a DIN rail according to DIN EN 60715 TH35.

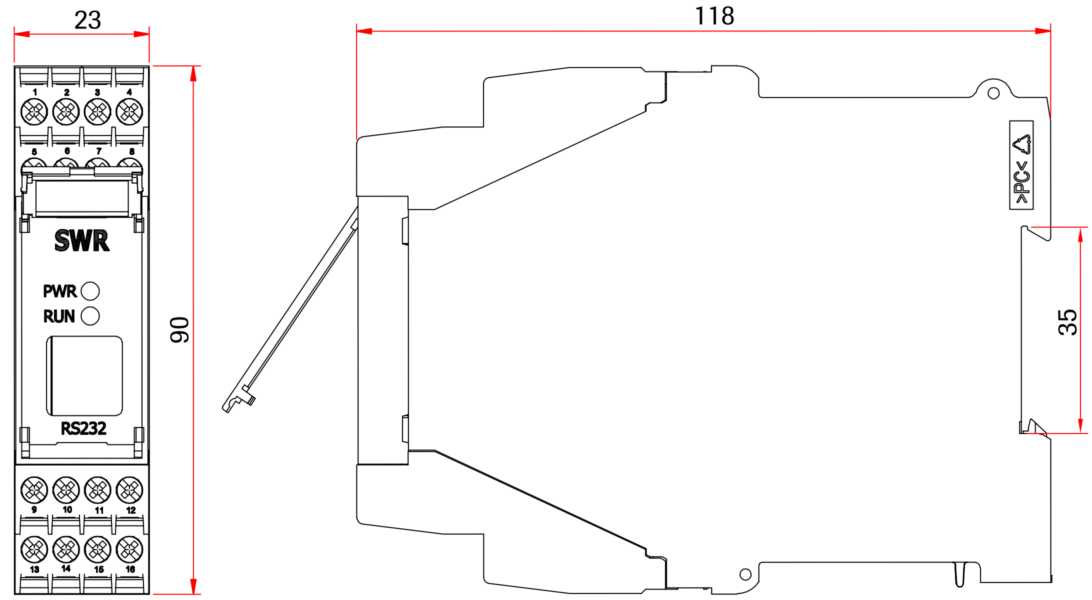


Fig. 9: DIN rail housing for the transmitter

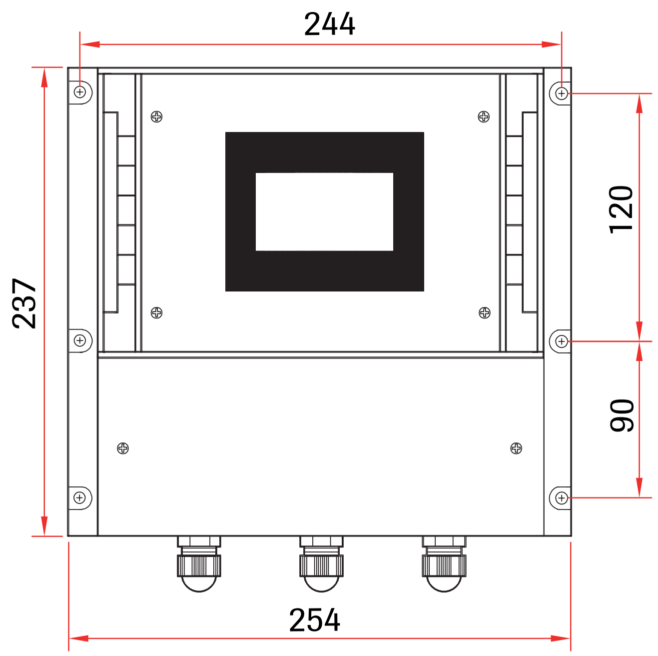


Fig. 10: Field housing for the transmitter

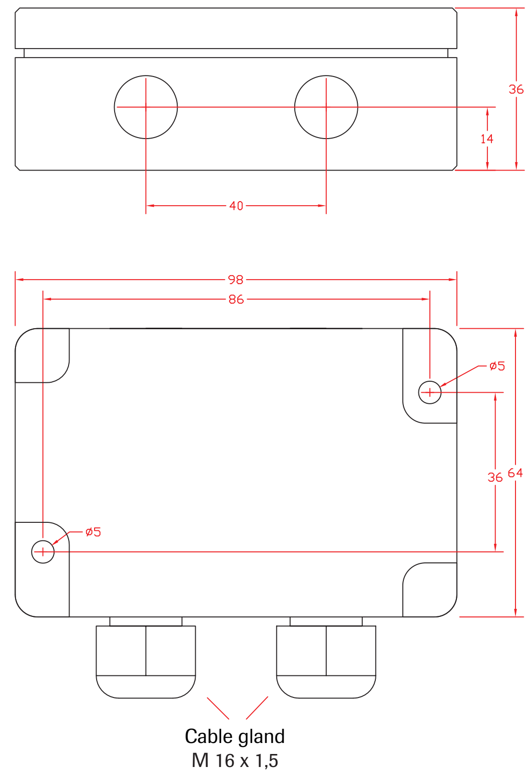


Fig. 11: C1-box dimensions

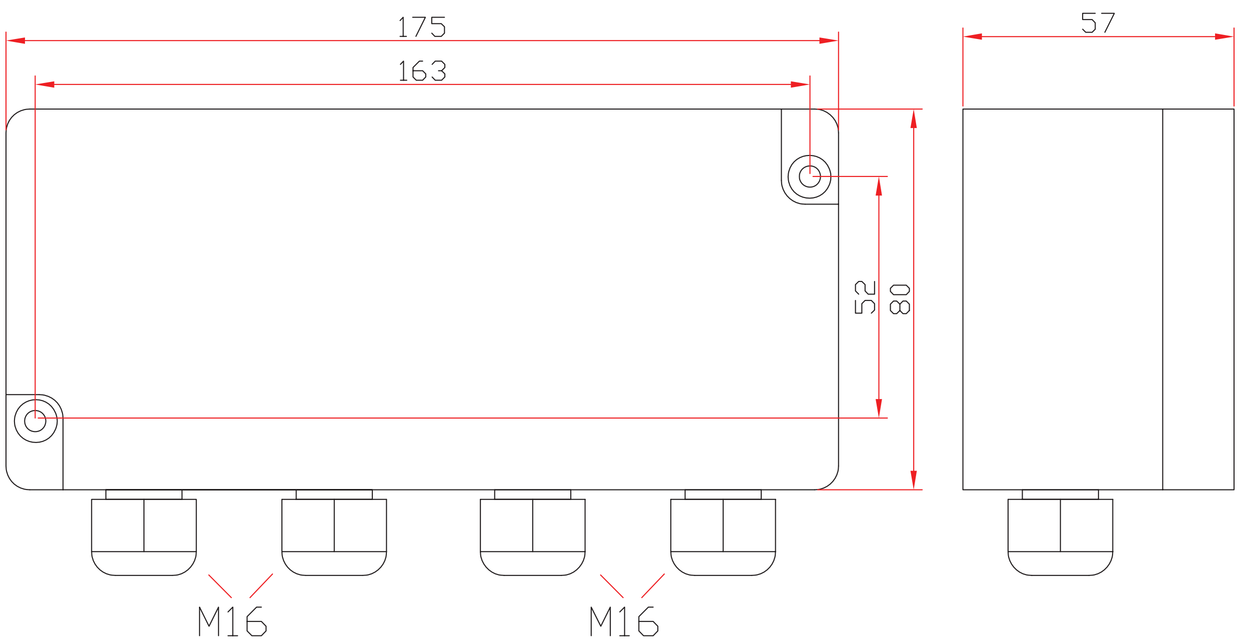


Fig. 12: C3-box dimensions

4.5 Use in hazardous areas

Dust explosion zone identification: **II 1/2D Ex tD IP 65 T84 °C**

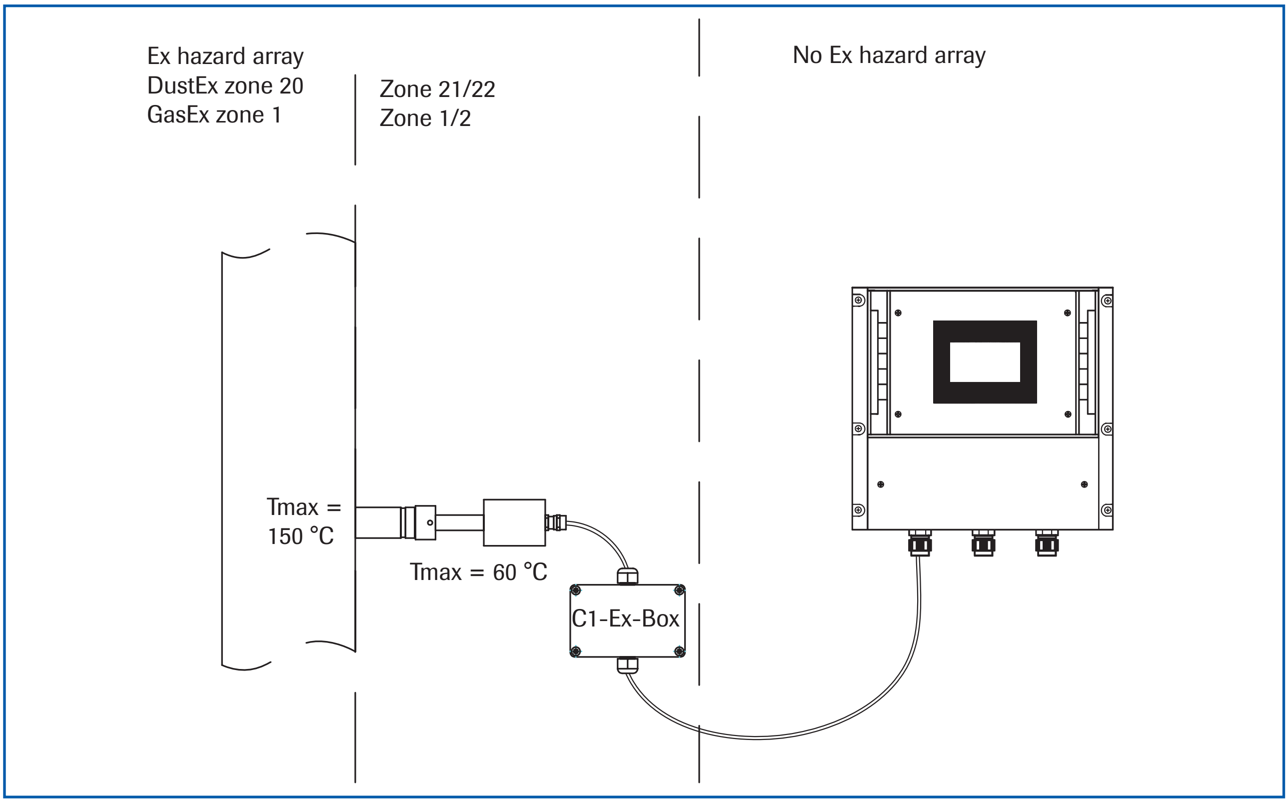
Zone 20: 0 °C ≤ $T_{process}$ ≤ 80 °C

Zone 21: -10 °C ≤ T_{amb} ≤ 60 °C

- Equipment group 2
- Equipment category: 1/2
  Waveguide window zone 20 / housing zone 21
- For explosive mixtures of air and combustible dust
- IP code 65
- Maximum surface temperature 84 °C at Ta = 60 °C

Gas explosion zone identification: **II 1/2D Ex tD A20/21 IP 65 T84 °C**
II 2G Ex d IIC T5/T3

- Equipment group 2
- Equipment category: 2
- Zone 1
- For explosive mixtures of air and combustible gases
- IP code 65
- Permitted process temperature 0 to 150 °C
- Temperature class T3
- Maximum surface temperature 84 °C at Ta = 60 °C



5. Electrical connection

5.1 DIN rail terminal layout

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 used	**6** Alarm relay NC (break contact)	**7** Alarm relay C	**8** Alarm relay NO (make contact)

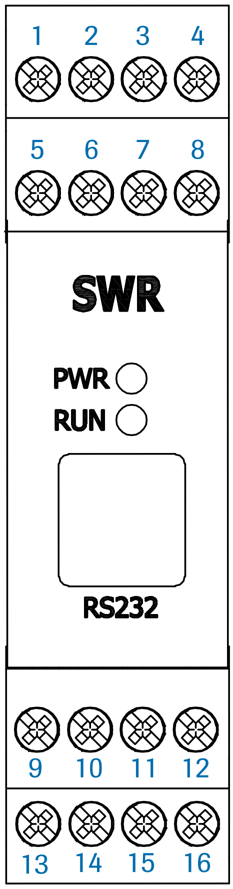


Fig. 14: Electrical connection of the transmitter

9 Not used	**10** Not used	**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

5.2 Field housing terminal layout

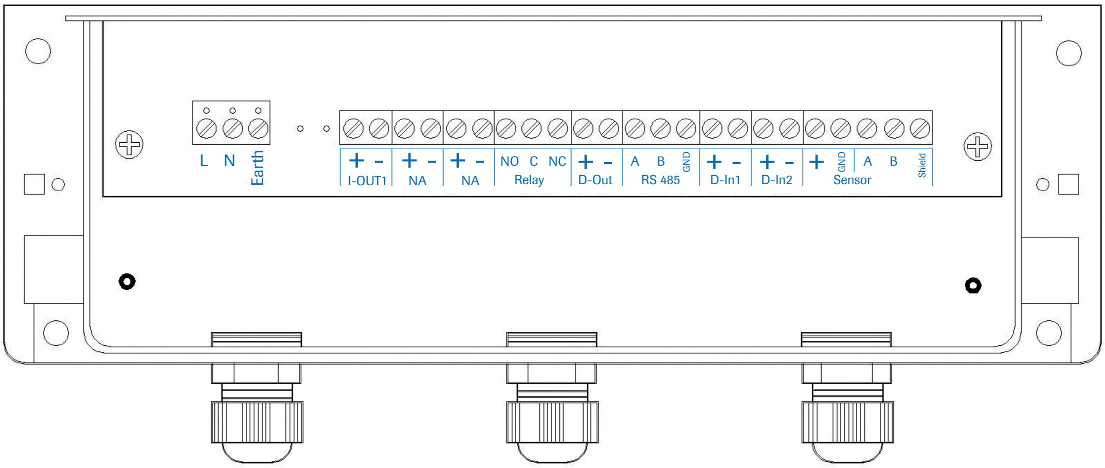


Fig. 15: Electrical connection

Transmitter			
Terminal No.		**Connection**	
Power supply connection			
L / +24 V		Input power supply 230 V / 50 Hz, 110 V / 60 Hz (optional 24 V DC)	
N / 0 V		Input power supply 230 V / 50 Hz, 110 V / 60 Hz (optional 24 V DC)	
Earth		Earth	
Connections			
I-out1	+	Current output +	
	-	Current output -	
	Na	Not used	
	Na	Not used	
	Na	Not used	
	Na	Not used	
Min. / Max. relay	NO	Floating change-over contact NO (make contact)	
	C	Floating change-over contact C (common conductor)	
	NC	Floating change-over contact NC (break contact)	
D-out	+	Digital pulse output +	
	-	Digital pulse output -	
RS 485	A	RS 485 interface data A	
	B	RS 485 interface data B	
	GND	RS 485 interface ground	
D-in1	+	Digital interface 1 (+)	
	-	Digital interface 1 (-)	
D-in2	+	Digital interface 2 (+)	
	-	Digital interface 2 (-)	
Sensor	+	Power supply + 24 V	Cable no. 1
	GND	Power supply 0 V	Cable no. 2
	A	RS 485 data A	Cable no. 3
	B	RS 485 data B	Cable no. 4
	Shield	Shield	Shield

5.3 C1-box terminal layout

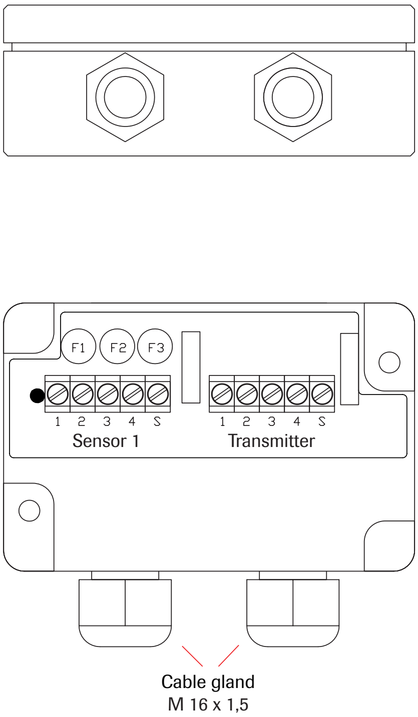


Fig. 16: Electrical connection

5.4 C3-box terminal layout

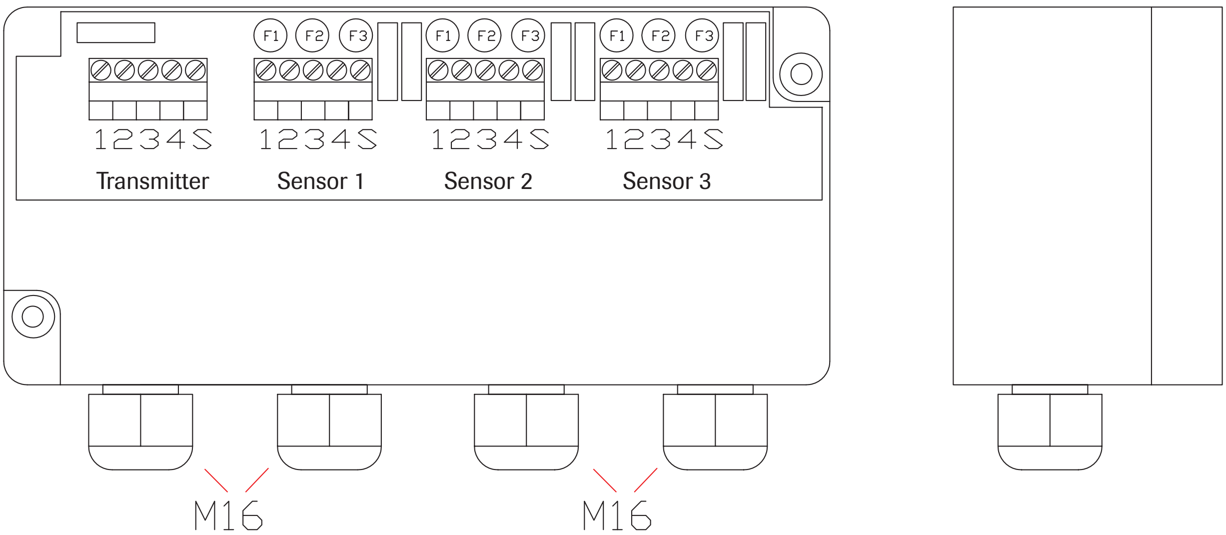


Fig. 17: Electrical connection

6. Operator interface

The operator interface differs depending on the system design:

- DIN rail housing without display, operation via PC software
- Field housing with display, alternative operation via PC software
- One to three sensor system

First of all, the different system versions are described below. Following that, the basic operation of the SolidFlow 2.0 system as a one sensor system is then described without going back over the different versions.

6.1 Differences between the DIN rail and field housing transmitter

The transmitter in the DIN rail housing is only a part of the functions available in the field housing. The following overview clarifies the differences between the two versions.

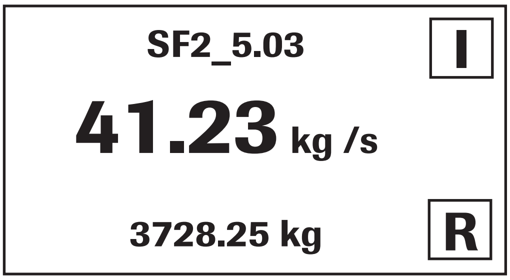
Function	Field housing	DIN rail
Menu system		
• via PC software	yes	yes
• via display	yes	no
Measurement value display current output	yes	yes
Measurement value display pulse output	yes	no
Alarm system relay output	yes	yes
Remote control digital input	yes	no
Autocorrect analogue input	yes	no
Totaliser display	yes	no
• via PC software	yes	yes
• via display	yes	no
Error output		
• on current output	yes	yes
• at relay	yes	yes
• via PC software	yes	yes
• via display	yes	no
• on status LED	no	yes

The transmitter in the DIN rail can only be configured via a serial connection and a PC program. On the transmitter in the field housing, all functions can be configured by menu via the touch-sensitive display. The field housing transmitter can also be configured by PC.

The menu items on the display and in the PC software are numbered in a uniform manner so that they can be referred to later on.

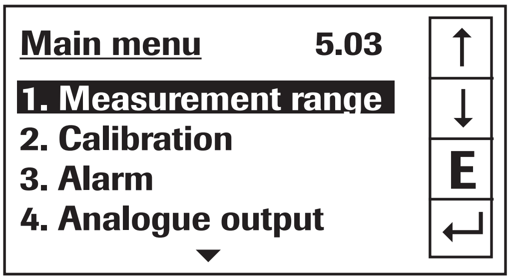
6.2 Display

If just the display is used, all the main functions can be controlled via the display. The display is touch-sensitive and available keys are displayed directly in context.



The start page display the following values:

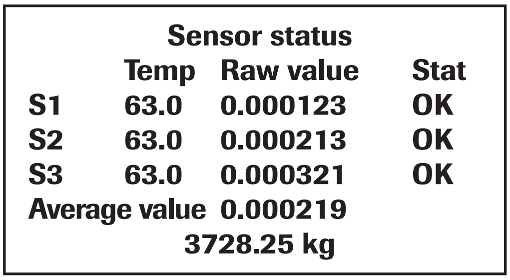
- Tag No "SolidFlow", freely selectable text which describes the material or the measuring point
- Measurement, here in [kg/s]
- Totaliser value since the last totaliser reset, here in [kg]
- [I] key for info
- [R] key for totaliser reset



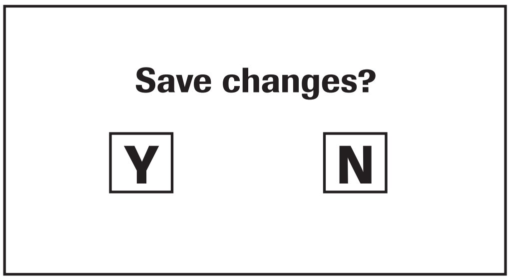
To access the menus, press and hold any area of the display for several seconds.
The sub-menu selection will be displayed:

In the menus and input fields, the displayed keys can be used to browse, select, edit or reject:

- Arrow: Scroll down the page, Select an option, Select a position in the input text
- [E] for ESC: Interrupt the function without making any changes
- Return: Select the function or confirm the input
- [C] for Clear: Delete a symbol or number.



With button [I] an information window can be opened, in which raw value, temperature and sensor status can be checked.



If any data has been changed, the change will only be taken into account when you exit the complete menu structure and answer [Yes] when asked if you wish to save the changes.

For reasons of simplicity, a further display menu screen has been dispensed with.
The display screens are directly derived from the menu structure in chapter 6.5.

Protection against unauthorised use:

If, a password has been entered in menu **7. System** in **7.6. Password** , which is different to the "0000" default setting, you will be asked to enter a password when attempting to access the menus. After the password has been successfully entered, the menus will be unlocked for approx. 5 minutes (from the last menu entry).

6.3 PC interface

With the DIN rail version, communication with a laptop or PC is performed either on the terminals via an RS 485 or at the front via an RS 232 interface. The field housing version is connected to the terminals via an RS 485 interface or at the front via USB.

✔ The **RS 485 connection** is attached to the transmitter in the field housing at the ModBus A (+) and ModBus B (-) terminals On the DIN rail version, these connections are nos. 12 and 11, accordingly.
RS 485 is a bus connection; the ModBus address and the baud rate can be set on the device. Upon delivery, the communication parameters are set to:

- ModBus address 1
- Baud rate 9600, 8, E,1

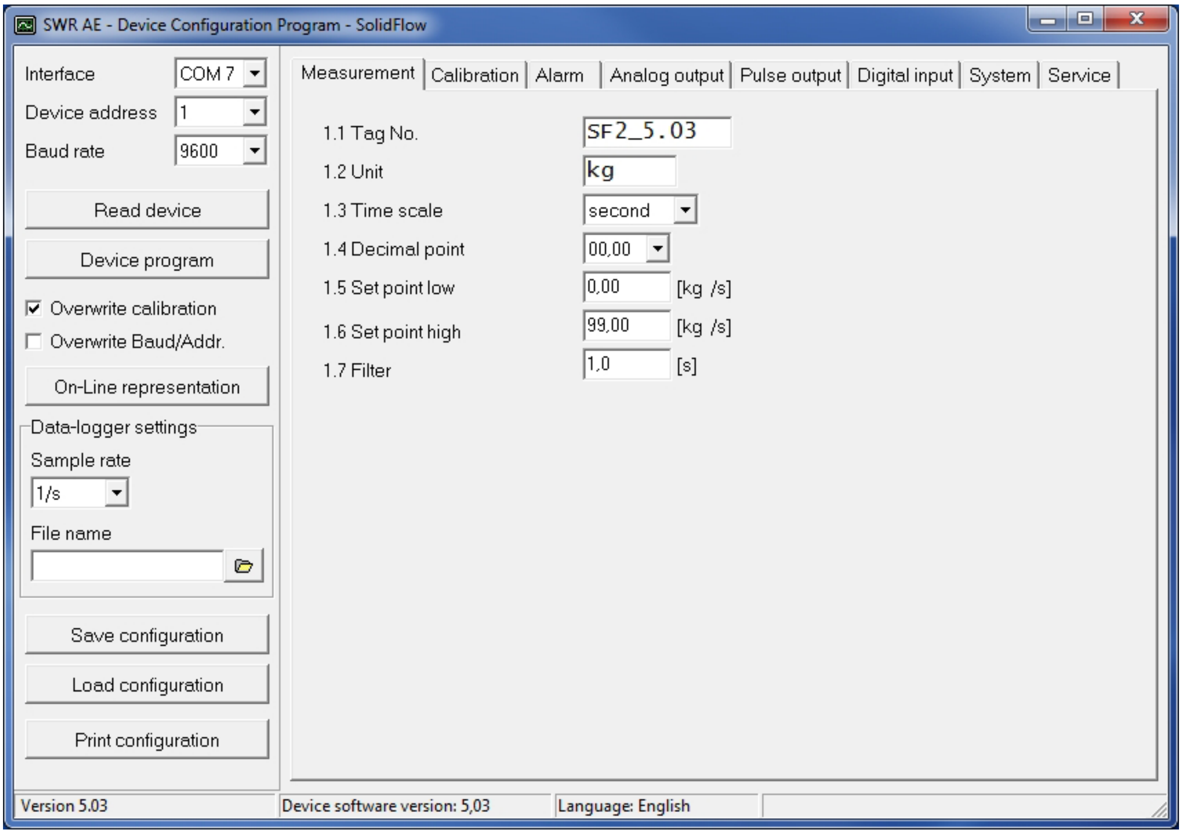
An RS 485 to USB adapter can be purchased from SWR.

✔ For the **RS 232 connection** to the DIN rail version, a special cable and USB converter are supplied. **USB** uses a standard USB-A-B cable.
RS 232 and USB are point-to-point connections which are not bus-compatible. The ModBus address and baud rate for the front connections cannot be changed and are always:

- ModBus address 1 (or the device answers to all addresses)
- Baud rate 9600, 8, E,1

When connected to the PC for the first time, any interface drivers enclosed with the transmitter must be installed.

After starting the software, the communication parameters must first be entered accordingly. These can be found in the top left of the program window.



Communication is established by clicking on "Read device". The acknowledgement message "Parameter read in" is displayed. If an error message is displayed instead, check the communication parameters and cable connections between the PC and the transmitter.

The edited data is transmitted to the transmitter via “Device program”.
Critical data concerning the ModBus communication and the calibration must be confirmed before the parameters are transmitted to the transmitter:

✔ If, when saving the the parameters in the transmitter, the system calibration data is changed, this action must be confirmed by checking “Overwrite calibration”.

✔ If, when saving the the parameters in the transmitter, the system interface parameters are changed, this must be confirmed by checking the selection “Overwrite Baud/Addr.”.

In addition, with the PC software,

- the transmitter parameters can be saved in a file (Save configuration)
- the transmitter parameters can be loaded from a file (Load configuration)
- the transmitter parameters can be printed (Print configuration)
- the measured values can be logged in a data logger file (enter the file name and storage rate, and activate the data logger on the online display)

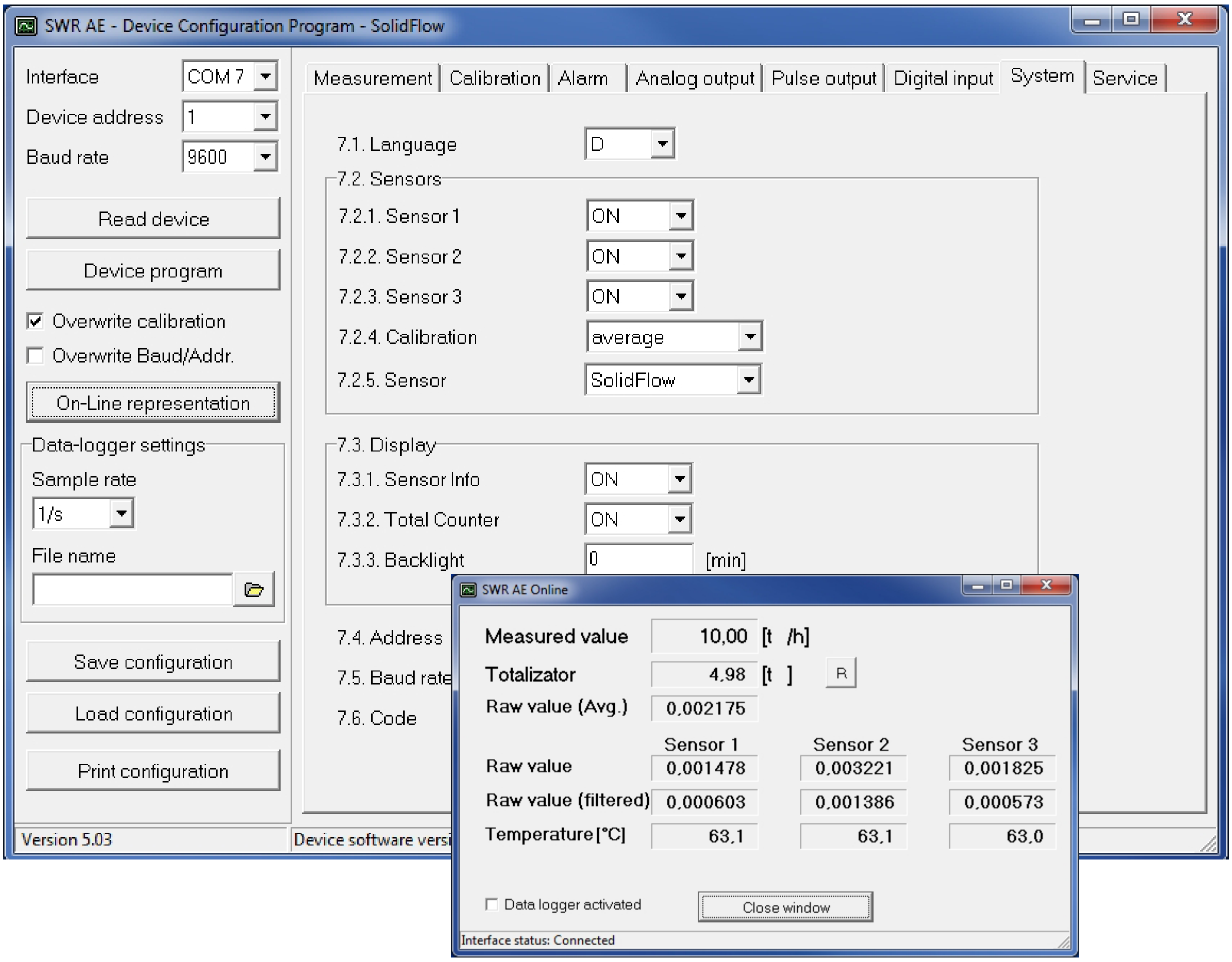
The software language can be set by right-clicking the “Sprache/Language/Langue” field in the bottom program line on “German/English/French”.

Protection against unauthorised use:
The PC interface does not have a password prompt as it is assumed that only authorised personnel will have access to the PC and the software. However, the password to operate the display can be read and changed in menu **7. System** in **7.6. Password**.

6.4 One or more sensor system

Up to three sensors can be connected to a transmitter if, for example, a larger flow section needs to be illuminated. In the transmitter, the corresponding number of sensors will then be registered and a joint average value will be calculated from their measurements.

The sensors are registered in menu 7 (System):



The multi-sensor function has no effect on the service and will not be explained in the following document.

If multiple sensors are used, this will only affect the application of sensors and the monitoring of sensors by the transmitter.

The presence of multiple sensors makes itself felt on the online-display and on the info area of the display.

For the construction of a multi-sensor system note the following:

- The sensors have to be activated in the transmitter (Menu Service, 7.2 Sensors)
- Activated sensors are addressed by the transmitter on the sensor side, digital bus at the following addresses:
    - Address 1 – sensor 1
    - Address 2 – sensor 2
    - Address 3 – sensor 3

- With delivery of a multi-sensor system the sensors will be preconfigured on the addresses 1 – 2 – 3 and noted in the transmitter as active.
- Sensors and transmitters, which are not preconfigured for a multi-sensor system always have address 1, only sensor 1 will be activated.
- Sensors which are inserted afterwards in a system must be adjusted by means of an separate service software to the required address.
- The correct address will be factory-preset when ordering spare parts with specified sensor number.

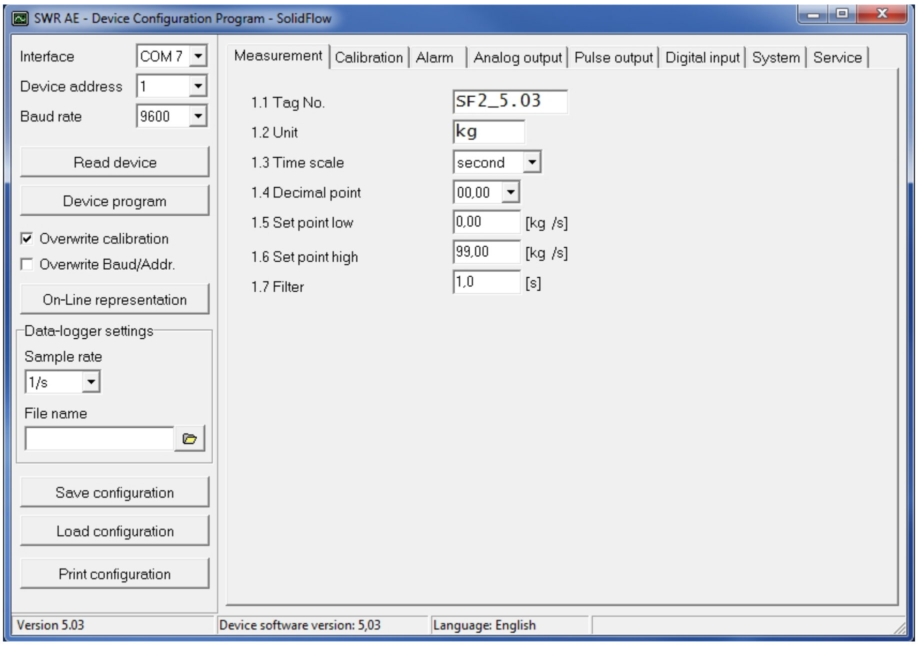
Procedure with a multi-sensor system with no pre-configured sensors:

Always note:

- Disconnection of power before electrical mounting!
- Specify the necessary number of sensors of a measuring point (see example with 3 Sensors)
- Connection of power supply and C3-Box to the transmitter
- Activation of 3 sensors see menu 7.2 (configuration software or display)
- Connection of sensor 3 to the transmitter: the sensor logs in as sensor 1
- For setting the sensor on address 3 use the service software, the sensor will log in as sensor 3
- For setting sensor 2 on address 2, it is the same procedure
- Connect at last Sensor 1

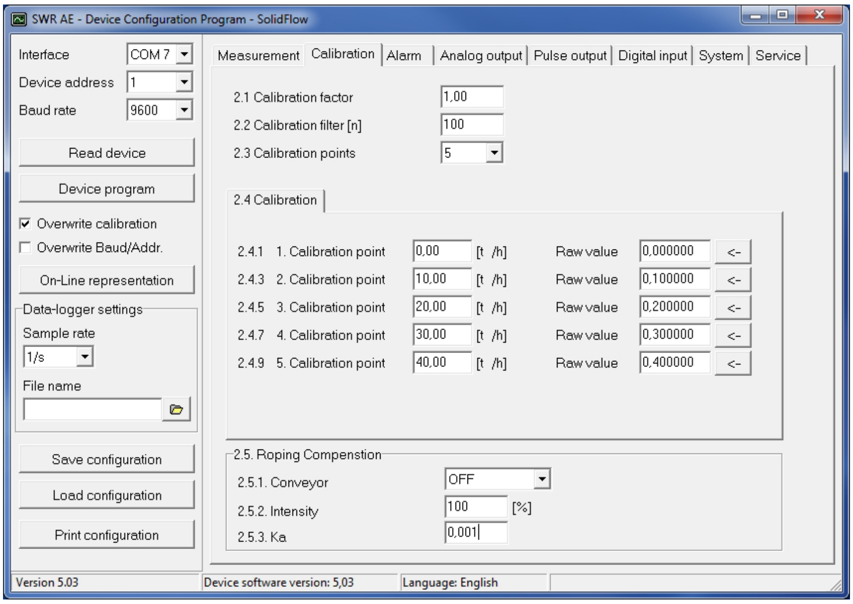
6.5 Menu structure

The menu structure supports the user when adjusting the measuring range, the calibration, the measurement values and the choice of additional functions. In this connection, the numbering both on the display and in the PC interface is identical:



1. Measurement range

1.1	Tag No.	**Input:** Free text (10 characters)	Name of the measurement point or product.
1.2	Unit	**Input:** Unit text, e. g. kg	Required mass flow unit.
1.3	Time scale	**Selection:** hour / minute / second	time base for the integration by the totaliser and the pulse output.
1.4	Decimal point	**Selection:** 0000, 0.000, 00.00, 000.0	Number representation and decimal point-accuracy in the measurement menu.
1.5	Set point low	**Input:** 0 … 9999	Throughput rates under this value will not be displayed at the current output. This does not concern the display indicator, totaliser or pulse output.
1.6	Set point high	**Input:** 0 … 9999	Throughput rates above this value will not be displayed at the current output. This does not concern the display indicator, totaliser or pulse output.
1.7	Filter	**Input:** 0.0 s … 999.9 s	Filtering of measurement for the indicator and the output values.



2.	Calibration (depending on the selection in system 7.2 Sensors)		
2.1	Calibration factor	**input:** 0.01 … 9.99	Factor for the subsequent adjustment of the actual measurement. All measurements are measured with this factor.
2.2	Calibration filter	**Input:** n = 1 … 9999	Average number n for the raw value when performing a calibration. n values are combined into an average value with PT1 character, in order to obtain a more stable representation. This filter also affects the representation of the calculated raw value in the online window.
2.3	Calibration points (support points)	**Input:** 2 … 5	Number of support points for a linearisation above the operating range.
2.4	Calibration	**Calibration sub-menu**	
2.4.1	P1 value	**Input:** Measurement	Output measurement in the selected mass/time unit.
(2.4.2)	P1 calibration	**Transfer:** Raw value	Transfer of the current raw value (filtered) from the mass flow with the key [←]. The value can also be entered directly.
	. . . (depending on the number of support points)		For additional support points (depending on [2.3]), additional value pairs can be set.
2.4.n	Pn value	**Input:** Measurement to be displayed	
(2.4.n)	Pn calibration	**Transfer:** Current raw value	

2.5 Roping compensation **Roping compensation sub-menu**

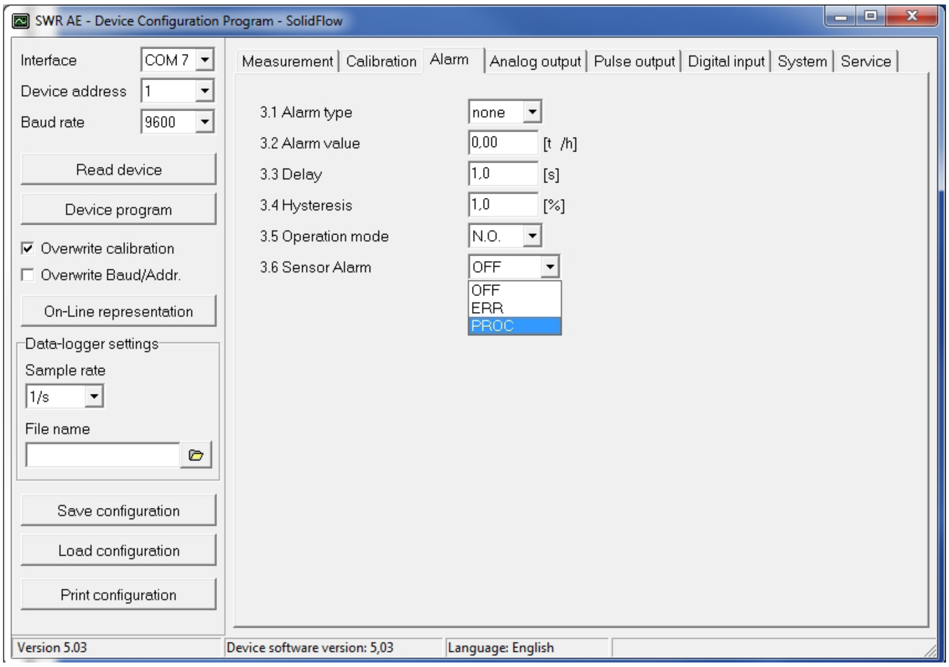
The stratification compensation is used to compensate for measurement uncertainties which can arise due to stratification. The sensors are supplied with an optimum default setting for normal conveying conditions. If the measurement is influenced by unusual flow stratifications or stratification shifts, the intensity of the compensation can be increased from 0 % to up to 100 %.

The sensor has two parameter sets for gravimetric and pneumatic conveying conditions. They should be selected depending on the type of conveyance. The intensity adds part of the compensated measurement to the uncompensated measurement: Both parts are weighted and calculated according to the selected intensity.

By using this function, it is recommended, to put the intensity initially on 100 %, to activate the compensation and if necessary to adjust with correction factor Ka. Thereafter the intensity should be taken back and be increased by increments of 10 % only to assess in each case the quality of measuring results.

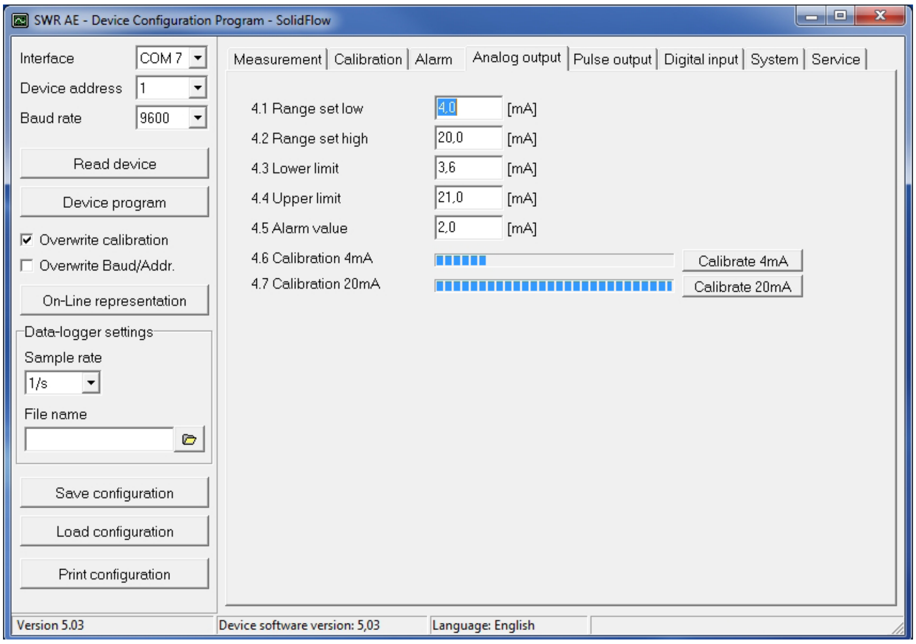
A manual parameter set can be set and permanently stored by trained SWR personnel.

2.5.1	Conveyor	**Selection:** AUS (OFF)/ GRV / PNE / MAN	AUS (OFF): no compensation GRV: gravimetric conveyance = free fall PNE: Pneumatic conveyance MAN: Manual parametrisation (only for trained SWR personnel)
2.5.2	Intensity	**Input:** 1 … 100 %	Strength of calculation of compensated signal with the uncompensated signal, e. g.: 0 %: 0 % compensated signal element, 100 % uncompensated signal component 10 %: 10 % of the compensated and 90 % of the uncompensated signals are calculated 100 %: the output signal contains 100 % of the compensated component
2.5.3	Ka	**Input:** 0.001 … 65.535	Correction factor on the compensated signal! By the compensation the compensated signal can be at a significantly higher value level. To achieve a linear settlement of the two values (compensated and uncompensated) via the parameter intensity, the compensated value can be brought in the same order as the uncompensated value by using Ka.



3. Alarm

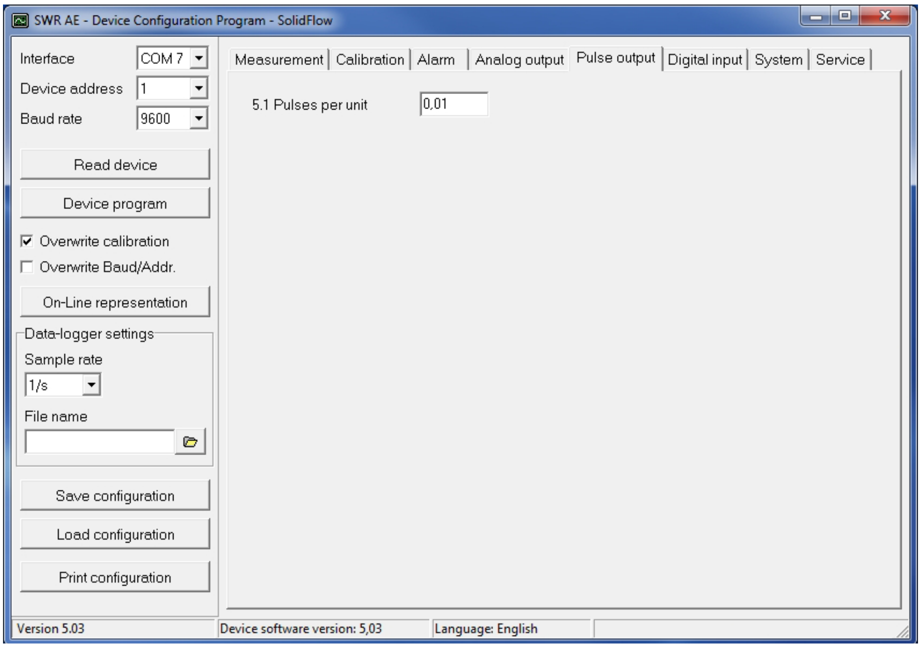
3.1	Alarm type	**Selection:** Min/Max/none	The relay is operated if the measurement exceeds or falls below the max. limit or min. limit.
3.2	Alarm value	**Input:** 0 … 999.9 in the selected unit	limit value for monitoring Min. or Max.
3.3	Delay	**Input:** 0.1 … 99.9 s	The value must permanently exceed or fall below the set limit during this time.
3.4	Hysteresis	**Input:** 0,1 … 99.9 %	The alarm continues for as long as the measurement is not smaller or larger than the limit value plus or minus hysteresis.
3.5	Operation mode	**Selection:** NC / NO	**NC:** the relay is closed while there is no alarm. **NO:** the relay is closed, if there is an alarm.
3.6	Sensor Alarm	**Selection:** OFF / ERR / PROC	**OFF:** Sensor or process errors will not activate the relay. **ERR:** Serious sensor errors lead to an alarm on the relay. **PROC:** fatal sensor errors and process problems lead to an alarm on the relay. More informations to the signal levels ERR or PROC will be found in section 7.3 error detection.



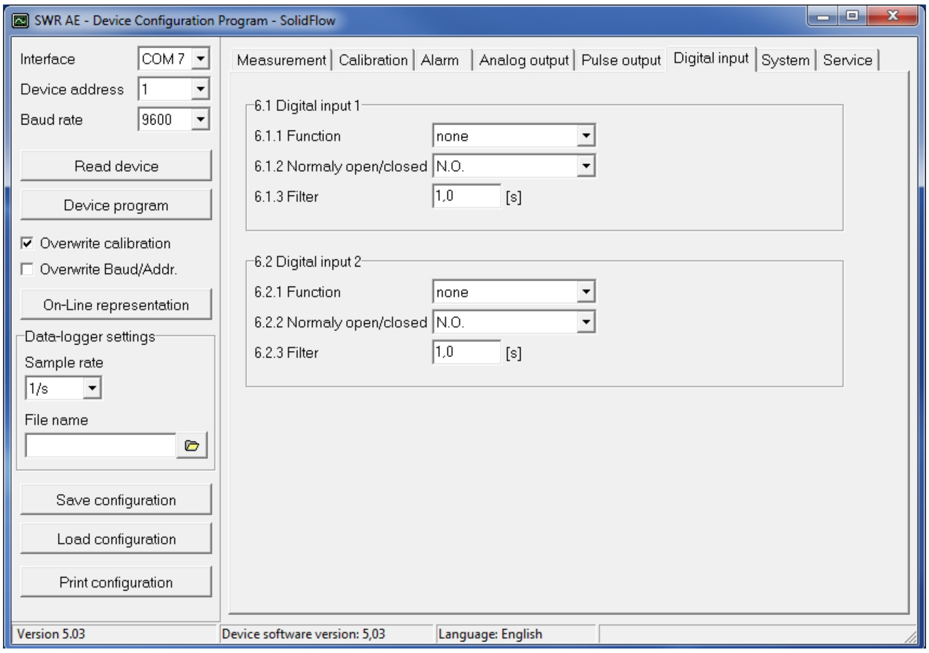
4.	Analogue output		
4.1	Range set low	**Input:** 0 … 22 mA	(Standard: 4 mA)
4.2	Range set high	**Input:** 0 … 22 mA	(Standard: 20 mA)
4.3	Lower limit	**Input:** 0 … 22 mA	(Standard: 3.6 mA)
4.4	Upper limit	**Input:** 0 … 22 mA	(Standard: 20 mA)
4.5	Alarm value	**Input:** 0 … 22 mA	(Standard: 3 mA)
4.6	Calibration 4 mA	**Selection:** Set output current	 The current can be set via key functions and adjusted at the receiving end.
4.7	Calibration 20 mA	**Selection:** Set output current	 The current can be set via key functions and adjusted at the receiving end.

The current output can be calibrated this way that the zero point (output of 4 mA) is set to the noise level of the measuring point.
If the noise level goes down due to process changes, sensor-layer or other effects of aging, the output will be less than 4 mA and the zero offset can be detected. (zero drift)

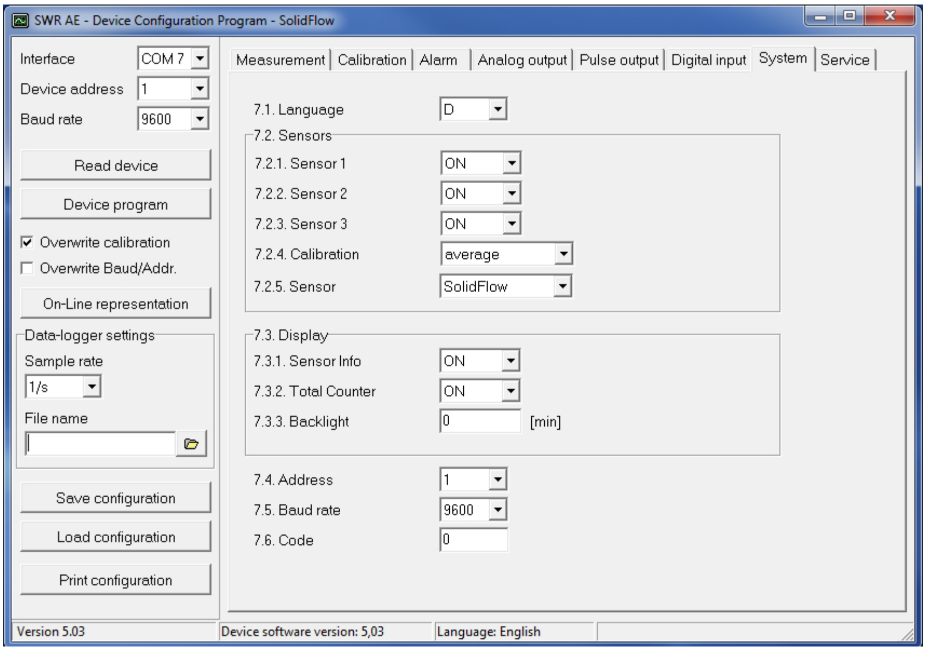
If this function is not required because of process-technical reasons, the zero point must be set during calibration on a raw value of zero and/or the MIN-limit (4.3) is to be set to 4 mA.



5.	Pulse output		
5.1	Pulses per unit	**Input:** 0.01… 99.9	The set number of pulses is emitted for each mass unit. e. g.: Tonnes are selected as the mass unit, 10 is selected as the number of pulses per mass unit: 1000 kg/10 = 100 kg. A pulse will be emitted every 100 kg. To improve readability, for connected systems (SPC, PLC, counters, etc.) the maximum pulse frequency is 50 Hz. If the number of pulses to be emitted per second exceeds this frequency, they will be emitted with a delay.



6.	Digital input		
6.1	Digital input 1		
6.1.1	Function	**Selection:** none / reset totaliser / AutoCal	One of the functions can be executed remotely via the digital input.
6.1.2	Normally open / close (working direction)	**Selection:** NO / NC	If necessary, invert the value of the input level.
6.1.3	Filter	**Input:** 0,1… 99.9 s	Time during which the requested signal must remain pending.
6.2	Digital input 2	As digital input 1	



7.	System		
7.1	Language	**Selection:** D / E / F	
7.2	Sensors	**Sensor function and calibration**	
7.2.1	Sensor 1	**Selection:** On / Off	On: Sensor is evaluated Off: Sensor is ignored
7.2.2	Sensor 2	**Selection:** On / Off	On: Sensor is evaluated Off: Sensor is ignored
7.2.3	Sensor 3	**Selection:** On / Off	On: Sensor is evaluated Off: Sensor is ignored
7.2.4	Calibration	**Selection:** Single / Average	**This function is used only for multi-sensor systems!** **Single:** Calibration of single sensors: Each sensor is converted via an individual calibration table from the raw value to the throughput, after that the calculation of average throughput on the throughput values of the individual sensors is taking place. (This function should only be used by trained personnel of SWR.) **Average:** Calibration by the average value from raw values: The throughput will be calculated with a common calibration table after forming the average from raw values.

7.2.5	Sensor	**Selection:** SolidFlow / PicoFlow	The transmitter verifies the availability of registered sensors on the selected type, calculates the measurement values on this basis and signals if necessary corresponding errors. Incorrect sensor selection leads to a refusal to communicate.
7.3.	Display		
7.3.1	Sensor info	**Selection:** On / Off	Show/hide Info key
7.3.2	Total Counter	**Selection:** On / Off	Display/do not display totaliser value
7.3.3	Backlight	**Input:** 0 … 99	Display lighting in minutes 0 = continuously 1… 99 min
(7.3.4	Contrast)		
7.4	Baud rate	**selection:** 4800/9600/19200/ 38400 baud	Communication speed of the transmitter if operated on a PLC or PC as a ModBus-slave.
7.5	Address	**Input:** 1… 255	ModBus address of transmitter, if operated on a PLC or PC as a slave.
7.6	Code		

7. Start-up procedure

7.1 Basic start-up

Upon delivery, the sensor is not calibrated to the product to be measured and must be parameterised when started up. During the process, the mass flows measured by the sensor are assigned the display values and output quantities required by the user.

The following points must first be checked:

- Check sensor is flush with the internal surface of the pipeline.
- The correct connection between the sensor and the transmitter.
- A warm-up time of approx. 5 minutes before starting calibration and after switching on the sensor's power supply.

The expected flow rate must first be determined for the measurement point, and the required measuring range and physical units must be entered in ***menu 1 (Measurement).***
The system is then calibrated on at least two operating points (one empty measurement and one operating point) in ***menu 2 (Calibration)***:

Min point	While there is no mass flow, the 1st point is set to 0 and the calibration for the zero point is performed.
Max point	During normal conveyance, the 2nd point is set to a known flow rate and calibration is also performed. The value can be corrected afterwards during weighing.

The device has thus performed its basic function and the measurements are displayed.

Additional support points	If non-linearities occur when measuring with different flow rates, up to 5 support points can be selected in ***menu 2 (Calibration).*** These support points can then be calibrated with different flow rates.

7.2 Adjusting the measurement values

The system's additional functions can be set in the following menus:

Alarms	Values for flow rate lower or upper limits can be set in ***menu 3 (Alarm)***. A sensor monitoring alarm can also be activated here.
Analogue output	The analogue output values are assigned in ***menu 4 (Analogue output)***. The required measuring range is assigned a corresponding output value here (4… 20 mA). Upper and lower limits of the permitted power and power in the event of failure are set here. Power output can also be calibrated here.
Pulse output	An internal totaliser function integrates the mass flow over time. In ***menu 5 (Pulse output),*** the pulse output can be configured, so that the system emits pulses corresponding to a defined conveyed mass.
Digital input	In ***menu 6 (Digital input),*** the system's digital inputs can be assigned various functions and their working direction.
System	In ***menu 7 (System),*** functions such as selection of the menu language, the number of connected sensors and their average, the display screen or ModBus addressing and speed are summarised.
Totaliser	The entire flow volume since the last totaliser reset can be read with the totaliser function. A reset can be performed via an external control cable (see ***menu 6 (Digital input)***) or directly via the Display by pressing the R symbol (see ***menu 7 (System)***).

7.3 Error signalling

For monitoring the availability a wide range of functions for self-diagnostics were integrated, in order to signal various errors:

Fatal errors (ERR) lead to a failure of the entire system and always set the current output of the system to alarm value and can optionally activate the relay:

- Failure of the communication to a sensor (sensor failure)
- Failure of a subcomponent of a sensor (temperature monitoring, heating control, memory, data consistency etc. on the sensor)
- Inconsistency of signal paths in the sensor (the amplifier stages, DC offsets)

Process failures (PROC) lead to less reliable measurement values and are not signalled at the current output of the system, but will be displayed on the Display (field housing) or LED (Din rail) as well as optionally activated on the relay:

- Temperature instability in the sensor due to thermal stress from outside (over-temperature, low temperature)
- Overload of the sensor caused by material flow (too much, too little)

Process failures show if necessary temporary appearing oddities in the process, which can be avoided with a better adjustment of sensor parameters or conveying parameters. They thus deliver more an indication of potential for optimization at the measuring point.

Type of fault	Display (Field housing)	Run-LED (DIN rail)	Relay (optional)	Current output
No fault	Sensor status OK on the information display (Button [I])	Single flash every second	Normal state	4 ... 20 mA
PROC	Display with error code in the bottom display line; advan-ced information on key [I]	Double flash every second	Activated, when Relais-Alarm-Option PROC is chosen	4 ... 20 mA
ERR	Display with error code in the bottom display line; advan-ced information on key [I]	Double flash every second	Activated, when Relais-Alarm-Option PROC or ERR is chosen	2 mA (or for the current output adjusted, chosen alarm value)

Error codes are composed of the letter S or E, supplemented by a 3-digit hexadecimal value from „000” to „FFF”. In this code, single errors will be signalled in the different bit positions.

Time Out error: In order not to complicate the start up of a process plant by process- or heating status errors, nonfatal errors will be signalled only after a period of about 5 minutes after a reset of the measuring system at the outputs. The time-out period is visible in a small “t” in the left upper corner of the display (field housing only).

7.4 Compatibility

For the SolidFlow 2.0 systems two different software versions for the transmitter and associated PC software are available.

Technical innovations have caused a supplement of new functions, so that only the corresponding versions can be used together on transmitter and PC:

Sensor	Transmitter (Field housing or DIN rail)	PC software
All SolidFlow 2.0		
	all transmitters with FW version 3.xx	Versions till V.5.01
	all transmitters from V.5.03	Versions from V.5.03

8. History of versions

FW V.3.xx / V.5.01:

- Fully functional release for transmitter and PC

FW V.5.03 / V.5.03:

- Improvement of error monitoring (ERR, PROC)
- Change from fixed point to floating-point values in the calibration table
- Introduction of product variant PicoFlow
- Zero drift detection for the current output
- Parameters KA for rope compensation
- Error-timeout for the reset

9. Maintenance

Warning!

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

10. 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 repaired at SWR's plant free of charge as considered appropriate. 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 travel 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.

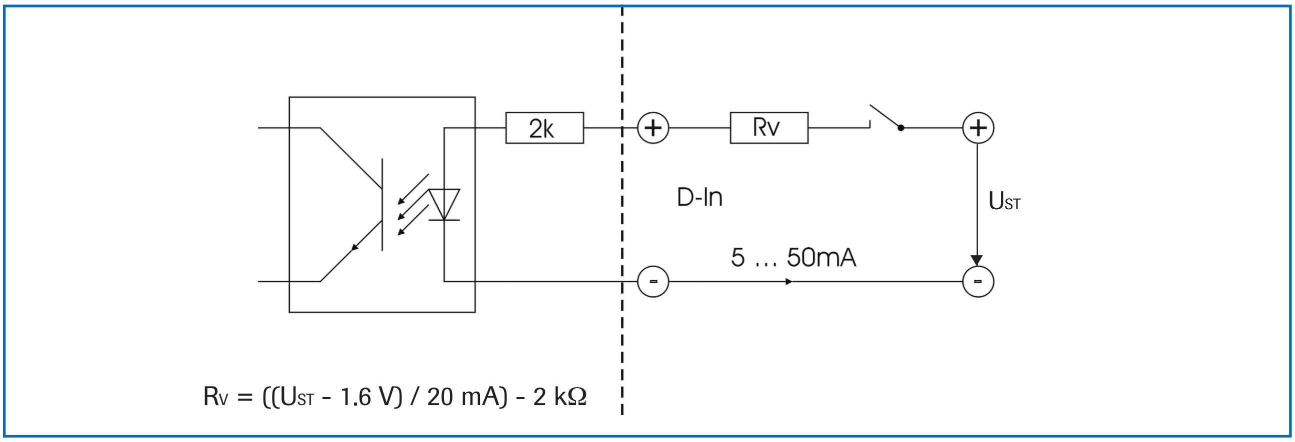
11. Troubleshooting

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

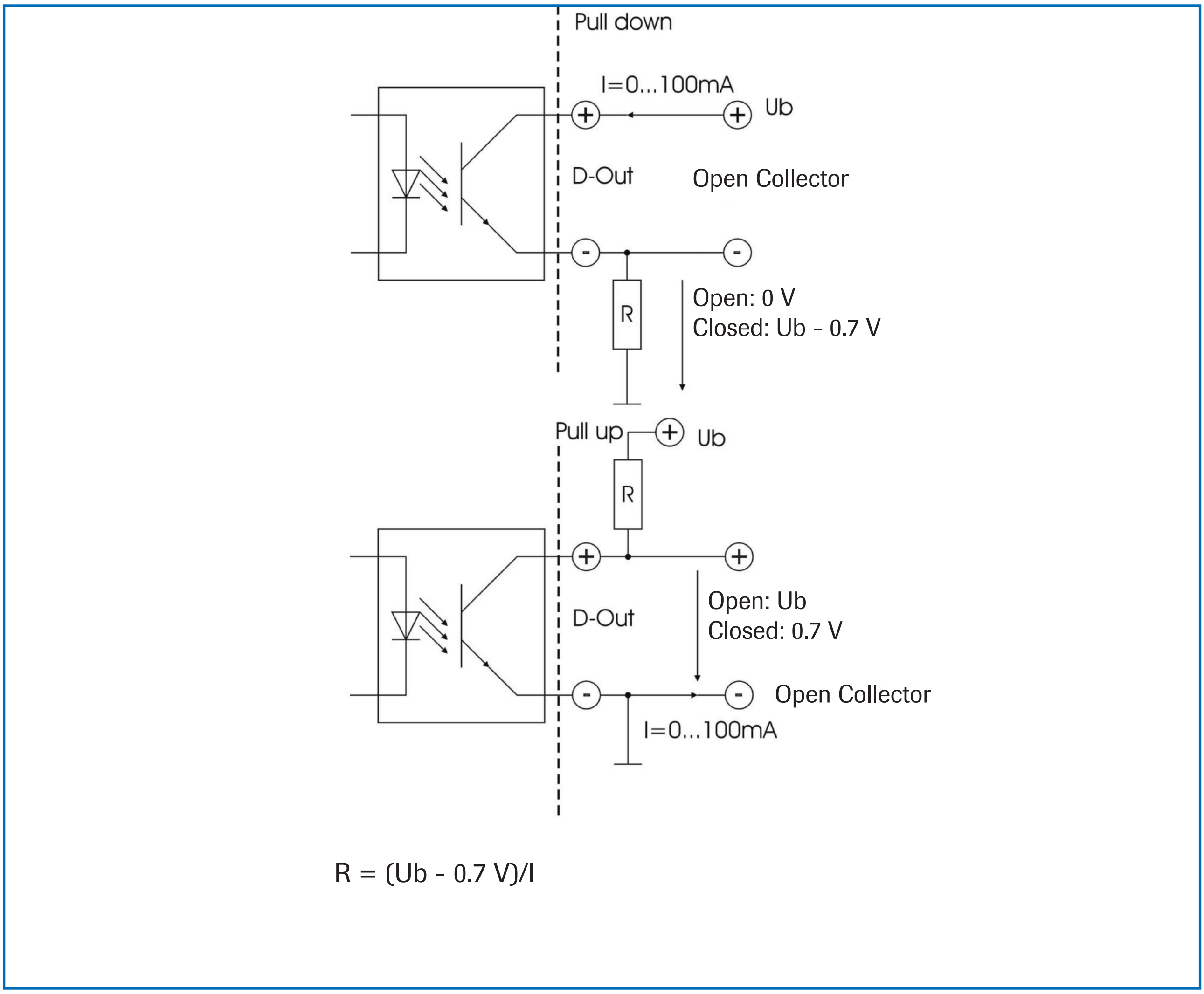
Error	Cause	Action
Measuring system does not work. POW LED does not light up. RUN LED does not light up.	Power supply interrupted.	Check the power supply.
	Cable break.	Check the connection cables for a possible cable break.
	Defective fuse.	Replace fuse.
	Defective device.	Notify SWR and rectify the error as instructed on the telephone.
Measuring system does not work. POW LED does light up. RUN LED does not light up.	Microprocessor does not start.	Switch the power supply off and on again. Remove programming cable.
Measuring system works. POW LED does light up. RUN LED flashes two or three times per cycle.	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.	Check cable lengths.
	Error code on display available.	Further error diagnosis by error code.
Measuring system outputs incorrect values.	Calibration incorrect.	Perform a recalibration.
	Calibration shifted by abrasion on the sensor head.	Perform a recalibration.
Switch output relay chatters.	Hysteresis too low.	Increase hysteresis. Check for fault caused by external consumer.
The warranty will be rendered void if you open the device.		

12. Connection examples

12.1 Digital input



12.2 Impulse output



13. Technical data

Sensor	
Housing material	Stainless steel 1.4571
Protection category	IP 65, dust explosion zone 20 or gas explosion zone 1 (optional)
Ambient operating temperature	Sensor tip: -20 ... + 80 °C Optional: -20 ... + 200 °C Sensor element: 0 ... + 60 °C
Max. operating pressure	1 bar, optional 10 bar
Operating frequency	K band 24.125 GHz, ± 100 MHz
Transmission power	Max. 5 mW
Weight	1.3 kg
Dimensions	Ø 60, Ø 20, L 271 mm
Measuring accuracy	± 2 ... ± 5 % (in the calibrated measuring range)
Field housing transmitter	
Power supply	110/230 V, 50 Hz (optional 24 V DC)
Power consumption	20 W / 24 VA
Protection category	IP 65 to EN 60 529/10.91
Ambient operating temperature	-10 ... +45 °C
Dimensions	258 x 237 x 174 (W x H x D)
Weight	Approx. 2.5 kg
Interface	RS 485 (ModBus RTU) / USB
Cable screw connectors	3 x M16 (4.5 - 10 mm Ø)
Connection terminals cable cross-section	0,2 – 2,5 mm² [AWG 24-14]
Current output	4 ... 20 mA (0 ... 20 mA), load < 500 Ω
Switch output measurement alarm	Relay with switchover contact - Max. 250 VAC, 1 A
Data backup	Flash memory
Pulse output	Open Collector - max. 30 V, 20 mA
DIN rail transmitter	
Power supply	24 V DC ± 10 %
Power consumption	20 W / 24 VA
Protection type	IP 40 to EN 60 529
Ambient operating temperature	-10 ... +45 °C
Dimensions	23 x 90 x 118 (W x H x D)
Weight	Approx. 172 g
Interface	RS 485 (ModBus RTU) / RS 232C
DIN rail fastening	DIN 60715 TH35
Connection terminals cable cross-section	0,2 – 2,5 mm² [AWG 24-14]
Current output	4 ... 20 mA (0 ... 20 mA), load < 500 Ω
Switch output measurement alarm	Relay with switchover contact - Max. 250 VAC, 1 A
Data backup	Flash memory

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Competence in Solids

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