EN

Competence in Solids

SWR engineering

DensFlow

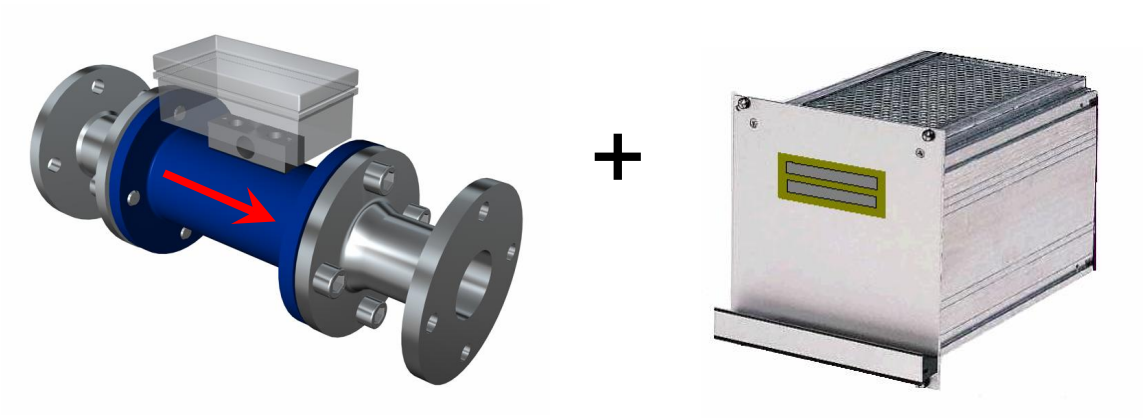
Flow-Measurement for Densephase-Conveying

Operating Instructions

SWR engineering Messtechnik GmbH

1 System Overview

Overview of the measuring system



Sensor (Measuring Pipe) Evaluation Unit

2 Function

- DensFlow is a measuring system especially developed for measuring the flow rate of conveyed solids in densephase.
- DensFlow is working according to the latest microprocessor technology. By special capacitive linking of an electromagnetic wave a homogeneous measuring field is produced in the pipe.
- The electromagnetic wave brought into the pipe is reciprocally acting with the solid particles. These signals are evaluated in frequency and amplitude.
- The measurement of the solid speed is done by means of correlation. Two capacitive sensors are used for the production of the correlation signals.
- A complete measuring unit consists of the sensor (measuring pipe) and the evaluation unit.

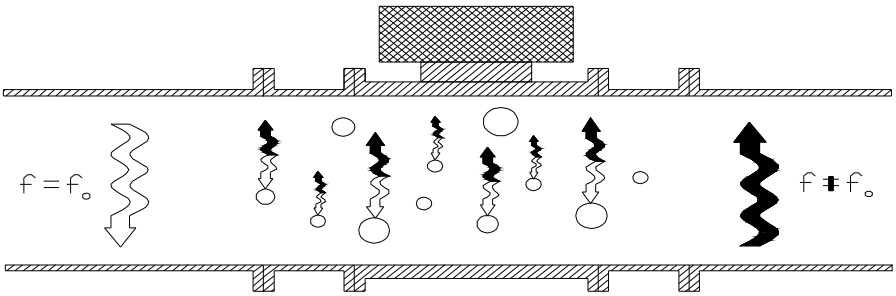


Fig. 2: Coupling of the microwaves

3 Safety

- The measuring system DensFlow was designed, built and tested to be safe and was shipped in safe condition. Nevertheless persons or objects may be endangered by components of the system if these are operated in an inexpert manner. Therefore the operational instructions must be read completely and the safety notes must be followed.
  In case of inexpert or irregular use, the manufacturer will refuse any liability or guarantee.

3.1 Regular Use

- The measuring system must be installed for measuring the flow rate only. Other usage and modifications of the measuring system are not permitted.
- Only original spare parts and accessories of SWR engineering must be used.
- In order to prevent defects on the electronics, caused by e.g. electrostatic surge, the flow velocity has to be below 50 m/s (e.g. free-blowing backwards).

3.2 Identification of Dangers

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

Warning!

- This symbol in the operating instructions marks actions, which may represent a danger for life and limb of persons when carried out in an inexpert manner.

Attention!

- All actions which may endanger objects are marked with this symbol in the operating instructions.

3.3 Operational Safety

- The measuring system must be installed by trained and authorised personnel only.
- Switch off the supply voltage for all maintenance, cleaning or inspection works on the tubes or on components of the DensFlow. Follow the notes of the chapter maintenance.
- The components and electrical connections must be checked for damages regularly. If a damage is found, it is to be repaired before further operation of the instruments.

3.4 Technical Progress

- The manufacturer reserves the right to adapt technical data to the technical progress without particular advance notice. If you have any questions, SWR engineering will be pleased to inform you on possible changes and extensions of the operating instructions.

4 Mounting and Installation

4.1 Delivery Range

- Measuring instrument in a 19"-rack system.
- Sensor for installation into the pipe.
- Seal-ring for adjustment to the pipe.
- Operating instructions.

4.2 Auxiliary

- Appropriate wrench or ring wrench for screwing.
- Tools for adjusting the wiring.

4.3 Mounting of the Measuring Pipe

- The sensor is to be mounted as follows:
- Determine the place of mounting on the pipe. On horizontal or inclined pipes the sensor should be mounted from top.
- Follow the necessary distances of valves, bows, fans or cellular wheel sluices etc. and also other measurement devices like temperature and pressure etc. to the sensor (see fig. 3).
  The mounting has to be in a vertical position.

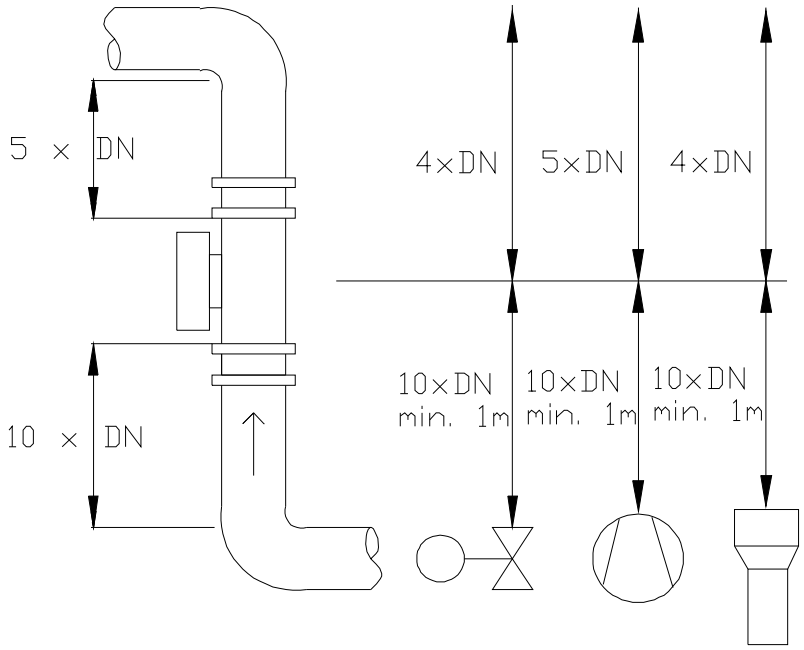


Fig. 3: Minimal distances of the sensor to pipe bends and baffles.

WARNING !
Before the installation you have to check, if there is a burr, a disalignment or a seal in the intersection of the pipe and measuring sensor. If so, these resistances in the pipe must be removed.

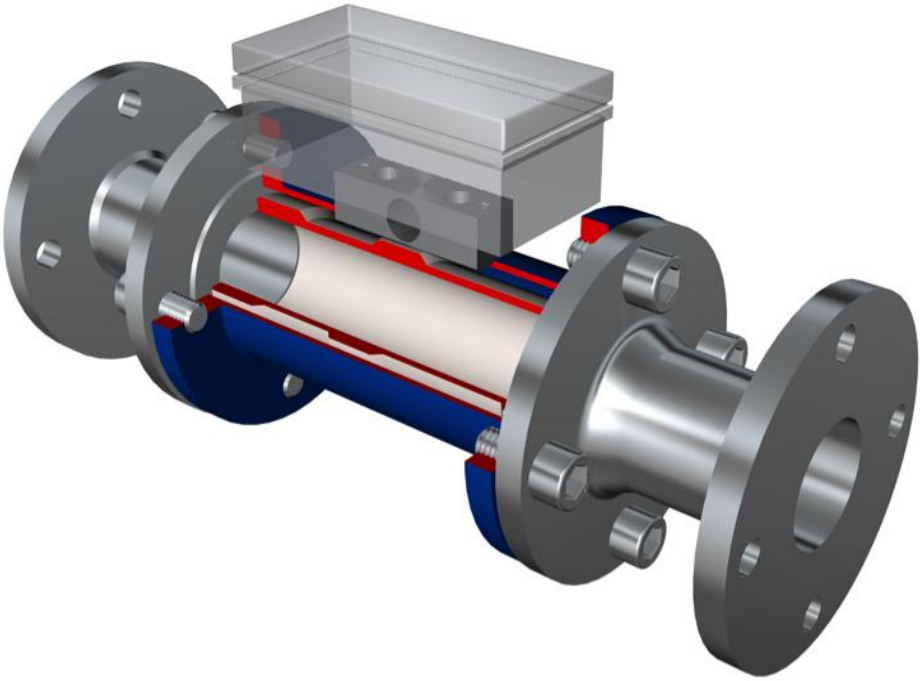


Fig. 4: Installation of the sensor accommodation.

- The electronic equipment should be installed at a maximum distance of 300 m from the sensor. The housing is prepared for the 19"-rack system.

4.4 Overview of the Connection of the Senor Pipe and Evaluation Unit

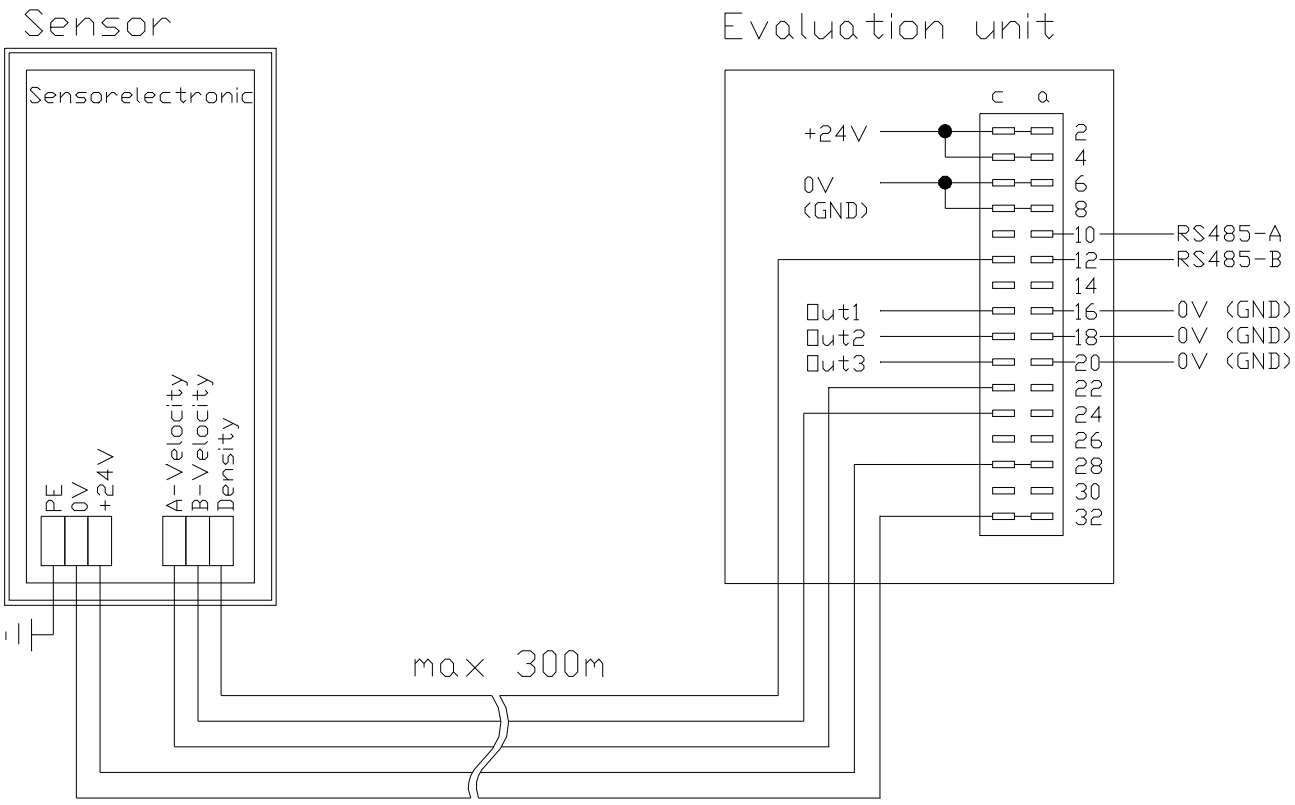
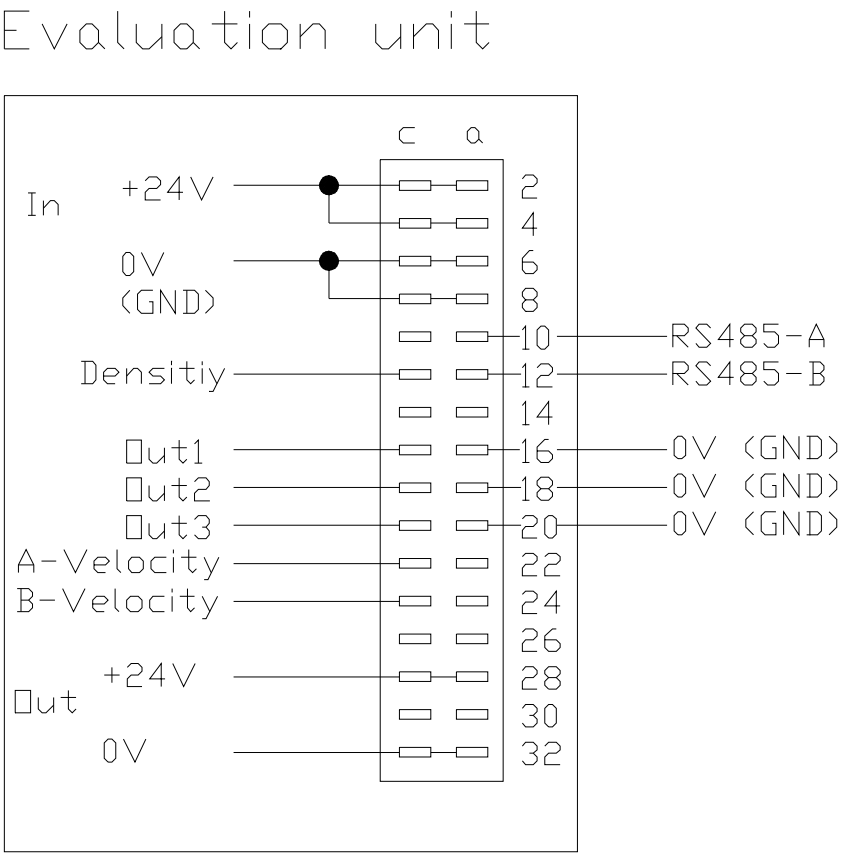


Fig. 5: Wiring of the Sensor Pipe and Measuring Instrument

A maximum length of 300 m of the sensor cable should not be exceeded.
A 5-wired cable is needed between sensor and evaluation unit.

Electrical Connection



- *Fig. 6: Electrical Connection*

Evaluation Unit			
Terminal No.		**Connection**	
Connection of the Supply Voltage			
2a/c + 4a/c		Input Supply Voltage +24 V DC	
6a/c + 8a/c		Input Supply Voltage GND	
Connections			
RS485	10a	RS 485 Data A	
	12a	RS 485 Data B	
Throughput	16c	Output 4..20mA +	
	16a	Output 4..20mA – (GND)	
Density	18c	Output 4..20mA +	
	18a	Output 4..20mA – (GND)	
Velocity	20c	Output 4..20mA +	
	20a	Output 4..20mA – (GND)	
Sensor	12c	Density	0..20mA
	22c	Velocity A	0..20mA
	24c	Velocity B	0..20mA
	28a/c	Output Supply Voltage +24V	+24V DC
	32a/c	Output Supply Voltage 0V	GND

5 Commissioning

- For start-up the measurement system it is necessary to adjust the sensor. After switching on the power supply there is at least a warm-up time of 5 minutes required before any adjustment starts. Please check again :
  - The correct cabling between sensor and the evaluation unit.
  - The correct adjustment of the sensor pipe.

Commissioning DensFlow

For start-up the sensor has to be calibrated and parameterized to each product, which will be measured. It is necessary to assign the mass flow to the display and initial value. The menu functions are mostly self-explaining. Following a short introduction to the overview:
By leaving the menu level and confirming the memory function all values changed are transferred.

Basic Function — At least a two-point-calibration (normally min and max) are sufficient for measuring the density function. Enter the data in menu 3.5 and 3.6.
The velocity measurement is firmly defined as an absolute measurement by the distance of the sensor plates and does not have to be calibrated.

Min-Point — Set point 1 to 0, when the mass flow is shut down and the measuring pipe is **empty,** calibrate this point now.

Max-Point — Set point 2 to known maximum flow rate with normal conveying and calibrate as well. This value can be adjusted later on when weighing by adjustment of correction factor 2.6.
Thus the basic function of the measuring system is given and it is now ready for operation

Adjustment — See menu 2, point 1 to 6 for the adjustments to the individual local conditions regarding material, measuring units, etc.

Analog Output 1 — is firmly configured for the measuring of the throughput. The measuring range is adjusted in menu point 2.2.
0 = 4 mA
Max =20 mA

Analog Output 2 — is firmly configured for the measuring of the velocity. The measuring range is adjusted in menu point 2.1.
0 = 4mA
Max = 20mA

Analog Output 3 — is firmly configured for the measuring of the velocity. The measuring range is fix adjusted to
0 m/s = 4 mA
10m/s = 20 mA

Average	The measuring range filter is used for the adjustment to slower working devices or for a continuous output of the analog output. Menu point 2.3 for velocity and Menu point 2.4 for density.
Storage	Adjusted values are confirmed by pressing the ENTER-button. Leaving the menu level by pressing the ESC-button. All changes are automatically stored and the new values are set as standard.

Suggestion for the Calibration Procedure:

Step 1 Input of the requested throughput value of the final value of the measuring range in menu point 2.2

e.g.: 20mA = 20000 Kg/h

Step 2 Input of the requested density value of the final value of the measuring range in menu point 2.1

e.g.: 20mA = 800 Kg/m³

Step 3 Alignment of the minimum density value with empty pipe.
min = 0 kg/m³ in menu point 3.5

Step 4 Alignment of the maximum density value by complete filled pipe (e.g. 800 kg/m³) in menu point 3.6

Step 5 Input the diameter of the pipe in menu point 2.5

Step 6 Conveying of the product on maximum throughput rate over a constant time interval (e.g. 10 min.). During this time period the throughput must not change.

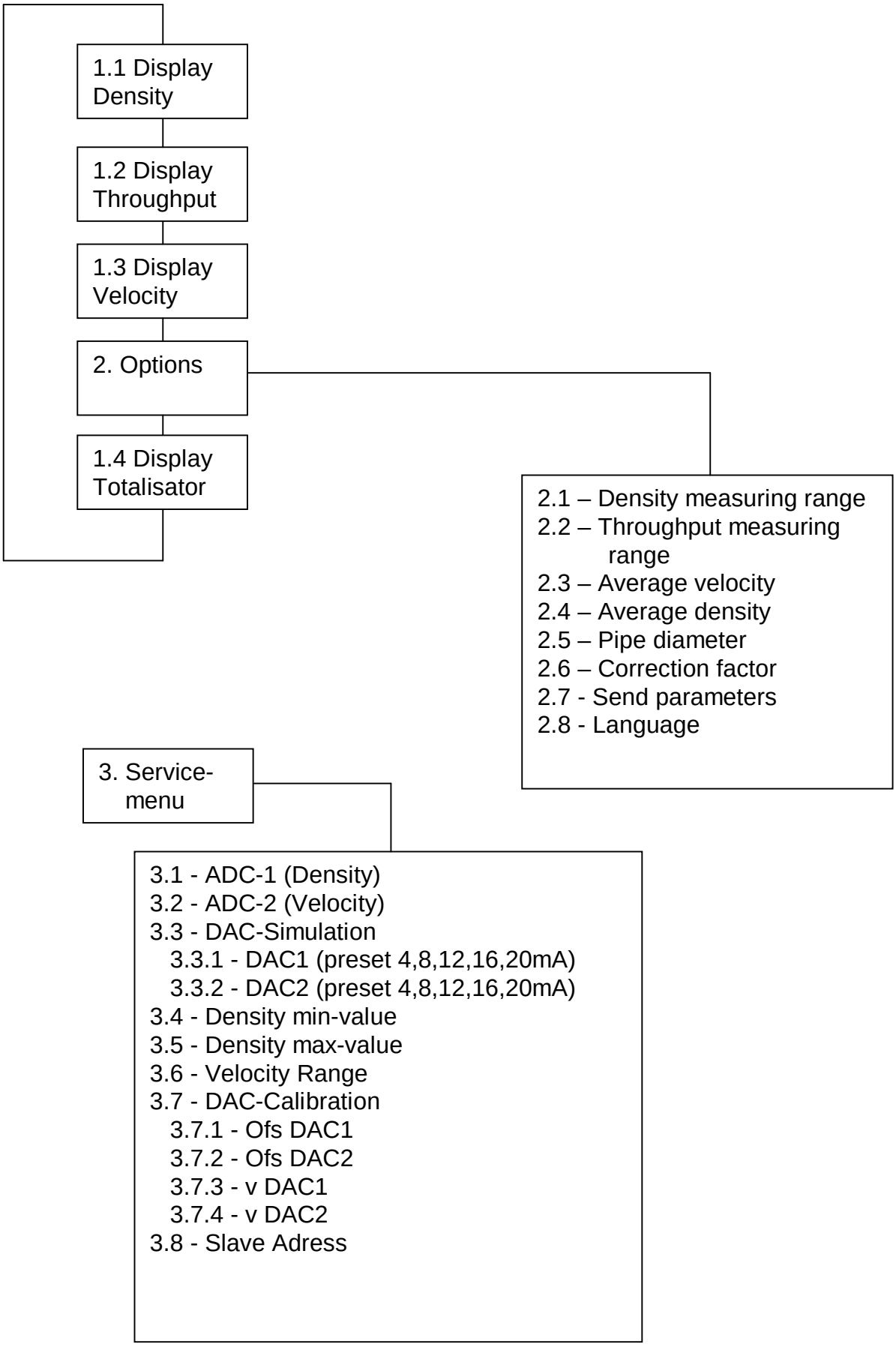
Step 7 Measurement of the throughput quantity by weighing.

Step 8 Calculation of the correction factor by differentiation

$$\text{Correction factor} = \frac{\text{Value measured}}{\text{Value weighted}}$$

Step 9 Correction of the measured value by entering the correction factor in menu point 2.6

6 Menu Structure of DensFlow



7 Menu Parameters of the System in Detail

1. Display of the Measured Values	2. Options	3. Diagnosis
1.1 - Density	2.1 - Density measuring range [kg/m³]	3.1 - A/D-1 (Density)
1.2 - Throughput	2.2 - Throughput measuring range [kg/h]	3.2 - A/D-2 (Velocity)
1.3 - Velocity	2.3 - Average velocity	3.3 - Current output (mA – preset)
1.4 - Totalisator	2.4 - Average density	3.4 - Density min value
	2.5 - Pipe diameter [mm]	3.5 - Density max value
	2.6 - Correction factor	3.6 - Velocity measuring range [m/s]
	2.7 - Send parameters	3.7 - DAC-Calibration
	2.8 - Language	3.8 - Slave Adress

Use of the Evaluation Unit by:

ENTER-button **à Selection and Confirming**

UP- / DN-button **à Changing**

ESC-button **à Backwards**

1.0 Display:

1.1 Display of the measured density in kg/m³

DENSITY
0.0 Kg/m3

1.2 Display of the calculated throughput from density and velocity [kg/h]

THROUGHPUT
0.0 Kg/h

1.3 Display of the measured velocity in m/s

VELOCITY
0.00 m/s

1.4 Display of the total flowrate since last reset

TOTALISATOR
0.00 Kg

2. **Options:**
Press ENTER Button

OPTIONS

2.1 Entry of the density measuring range in 50 kg/m³ - steps.

Density Range = 800 [Kg/m³]

2.2 Entry of the throughput range in 100 kg/m³ - steps.
Final value of measuring range [kg/h] = 20mA

Throughput Range = 20000 Kg/h

2.3 Entry of the average time for the velocity (0..120s)
à Damping of the signal

Average V = 10s [25]

2.4 Entry of the average time for the density (0...120s)
à Damping of the signal

Average D = 10s [25]

2.5 Entry of the pipe diameter in mm.
Necessary for the correct calculation of the quantity.

Pipe Diameter = 32.0 mm

2.6 Entry of the correction factor for the throughput (0.1...10)
Here the value received can be corrected lateron by changing the preset value to 1.

Correction Factor = 1.0

2.7 Send parameter
By pressing YES the parameters factor correction, throughput range, density measuring range will be send via RS485 interface to all connected instruments

Parameter send = No / Yes

2.8 Select Language
between German and English

Language English

3. Service menu:
To get into the diagnostic mode press
ESC and ENTER button at the same time

Service menu

3.1 Display current value A/D-converter 1 (Density)

ADC 1 (Density) I=0.0mA [0h]

3.2 Display Voltage level A/D-converter 2 (Velocity)

ADC 2 (Velocity) I=0.0mA [0h]

3.3 Selection Current value for test purposes.

DAC Simulation

Here a constant current (4, 8, 12, 20mA)
can be presetted on output 1 for testing purposes.

DAC 1 [ENTER] I = 04mA

Here a constant current (4, 8, 12, 20mA)
can be presetted on output 2 for testing purposes.

DAC 2 [ENTER] I = 04mA

3.4 Entry of the minimum value for the density range.
usually 0-value (Measuring pipe empty).
The dimensionless value must be changed
so far, until 0% are indicated.

Density Min = 0072 [0.0%]

3.5 Entry of the maximum value for the density range.
Here you can enter the value, which can
maximally be expected or a second measuring
point. The dimensionless value must be changed
so far, until the requested percentage is indicated.

Density Max = 2568 [100%]

3.6 Input of the velocity
Standard = 10m/s ex works presetted.

Velocity range = 10.0 m/s

3.7 DAC-Calibration for current outputs
press ENTER to select submenu

DAC-Calibration

Offset Calibration
for 4 mA output 1 (throughput)

DAC-Calibration Of's DAC1 +0

Offset Calibration
for 4 mA output 2 (density)

DAC-Calibration
Of's DAC2 +0

Span Calibration
for 20 mA output 1 (throughput)

DAC-Calibration
V DAC1 +1

Span Calibration
for 20 mA output 2 (density)

DAC-Calibration
V DAC2 +1

3.8 Slave Adress
select slave adress for ModBus - comunication

Slave Adress
001

Totalisator
with the totalisator function it is possible to monitor entire flow rate since the last reset of the Totalisator

TOTALISATOR
1,0 Kg

A RESET of the counts can be accomplished over pressing the ENTER and selection of YES or NO with UP / DOWN button.

TOTALISATOR
Reset: 'NO'

Stop Totalisator
press ESC

TOTALISATOR
H: 1,0 Kg

8 Maintenance

- **Warning!**
  Danger of shock with opened housing!
- Switch off the supply voltage for all maintenance or repair works on the measuring system. The pipe must not be in operation during a sensor exchange.
- Repair and maintenance work must be carried out by trained or expert personnel only.

9 Warranty

Warranty is granted for two years starting from delivery date under the condition that the operational instructions have been followed, no interventions on the appliances have been made and the components of the system show no mechanical damage or wear resistance.

In case of a defect during the warranty period, defective components are repaired or are replaced free of charge. Replaced parts turn into the property of SWR. If desired by the customer that the parts should be repaired or replaced in its factory, then the customer has to take over the costs for the SWR-service staff.

SWR is not responsible for damage, which did not develop at the delivery article; especially SWR is not responsible for escaped profit or other financial damages of the customer.

10 Trouble shooting

- **Warning!**
  The electrical installation must only be checked by expert personnel.

Problem	**Cause**	**Measure**
Measuring system does not work.	Power supply interrupted. Break of a cable. Fuse defective. Device defective.	Check the power supply. Check the connecting cables for a possible break of a cable. Exchange the fuse in the field housing .
Measuring system outputs wrong values	Calibration not correct. Calibration shifted by abrasion on front end of sensor.	Delete input signal correction, new calibration according to section 6. Delete input signal correction, new calibration according to section 6.
Relay flickering	Hysteresis too small.	Increase hysteresis, check effects caused by external devices.

Do not open, as otherwise the warranty claim expires!

11 Technical Data

Sensor Pipe	
Housing:	Steel St52, powder-coated (stainless steel 1.4541) option NW 10....250, Flange DIN 2576
Inner pipe:	Ceramics, POM, PTFE
Protection category:	IP65
Operating temperature:	Sensor pipe: -20....+ 120 °C Option: -20....+ 220 °C Sensor electronic: 0....+ 60 °C
Max. working pressure:	10 bar, option20 bar
Max. accept. flow velocity	50 m/s
Working frequency:	100kHz
Transmitting power:	max. 2 mW
Weight:	Depending on nominal size
Dimension:	Ø NW + 90mm, L 500mm
Accuracy:	+/- 2...5% in calibrated range
Evaluation Unit	
Supply voltage:	24V DC
Power consumption:	12 W
Operating temperature:	–10...+45 °C
Dimension:	19"-rack system, 3HE, 28TE, L=227mm
Weight:	approx. 0.7 kg
Additional Data:	
Input:	2 x Velocity 0..20mA or 0..10V 1 x Density 0..20mA 1 x PFM-Input 14V, Imax 35mA, 30..3kHz
Connections:	Connector (DIN 41612) Type B, 32-pol., connector
Current output:	Throughput: : 4...20mA Density : 4...20mA Velocity : 4...20mA Load < 500 Ω
Serial output:	RS232 / 485, MOD-Bus-Protocol Sub-D 9-pol., connector
Control unit:	LCD-Display, lighted, 16 x 2 digits 4 x push buttons
Data storage:	EEPROM

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