



Competence in Solids

SWR
engineering

ClampFlow P/C

Flow rate measurement
of solids in hose lines



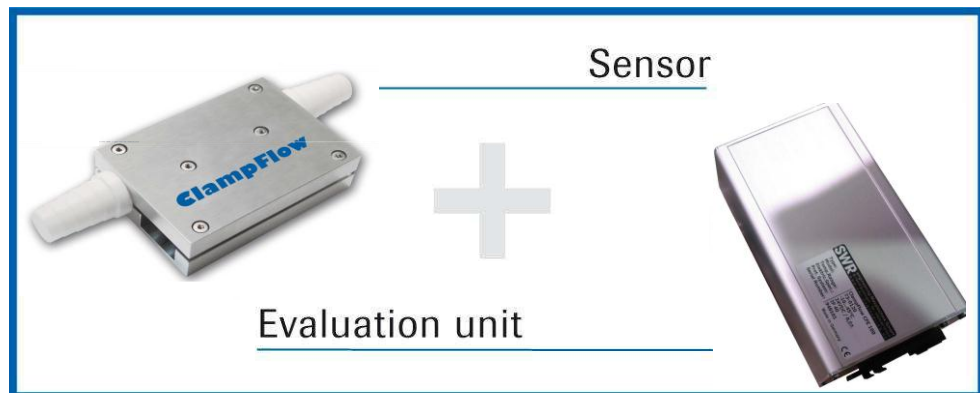
Operating Instructions



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1 System Overview

A ClampFlow – Measuring system consists of the following components:



2 Function

ClampFlow is a measuring system especially developed for the measurement of small flow rates under pneumatic conveying in flexible hose lines.

ClampFlow 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 measuring points are used for the generation of the correlation signals.

A complete measuring unit consists of the sensor (clamping the pipe) and the evaluation unit. Software to calibrate the system is also provided, then a laptop provided by the customer is also needed (See Fig. 2).

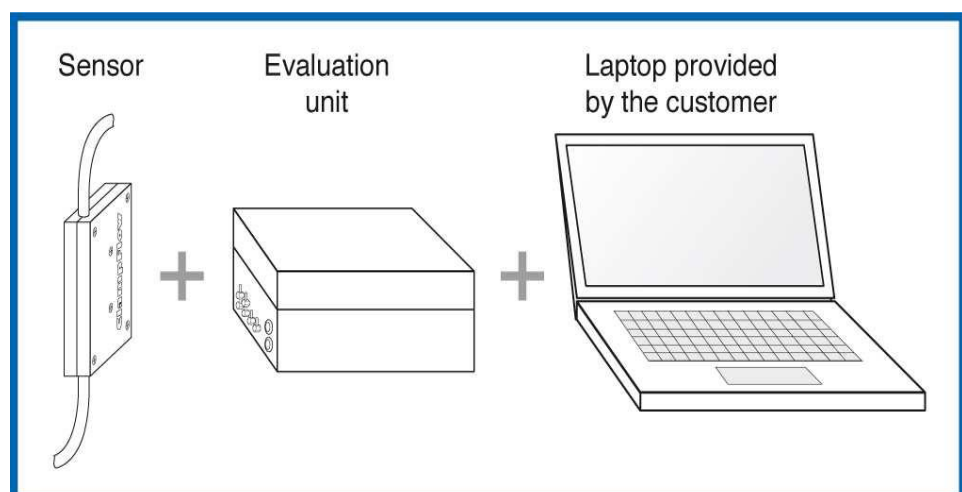


Fig 2: One laptop provided by the customer is necessary to calibrate the system

3 Safety

The measuring system ClampFlow 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 inexperienced manner. Therefore the operational instructions must be read completely and the safety notes must be followed.

In case of inexperienced or irregular use, the manufacturer will refuse any liability or guarantee.

3.1 Regular Use

The system must be installed for measuring the flow rate only. Other usage and modifications of the system are not permitted. Only original parts and accessories of SWR Engineering must be used.



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 inexperienced 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 authorized personnel only.

Switch off the supply voltage for all maintenance, cleaning, or inspection work on the pipes or on components. Follow the notes on chapter of maintenance. The components and electrical connections must be checked for damage regularly. If 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 field housing

Sensor for clamping around the pipe and/or plugging into the pipe supported with a bulk head connector

Second bulk head connector for power and 4-20mA connections to customer system

Calibration software

Operational Instructions

4.1 Auxiliary

Appropriate wrench or ring wrench for screwing

Tools for adjusting the wiring

4.2 Mounting of the Measuring Pipe

Determine the place of mounting on the flexible hose pipe. If using a ClampFlow C, the two parts of the sensor have to be clamped directly on the flexible hose pipe in the place where the measurement is needed (see Fig. 3).

If using a ClampFlow P, cut the flexible hose pipe in the place where the measurement is needed and plug it on each side of the sensor (see Fig. 4).

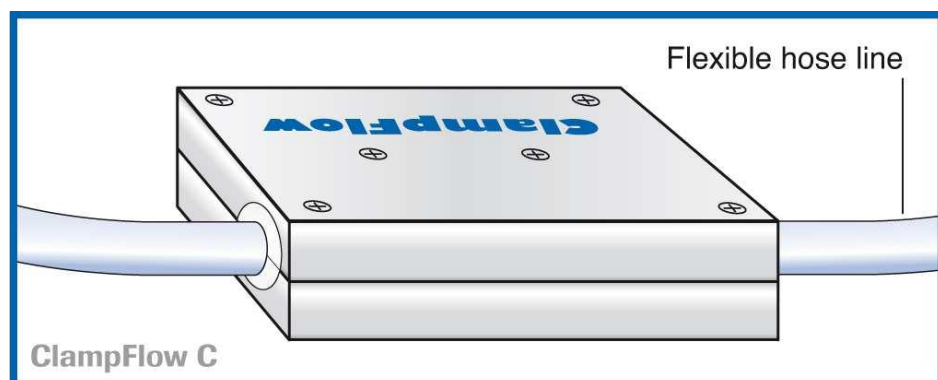


Fig. 3: mounting the ClampFlow C by clamping it on the flexible hose line

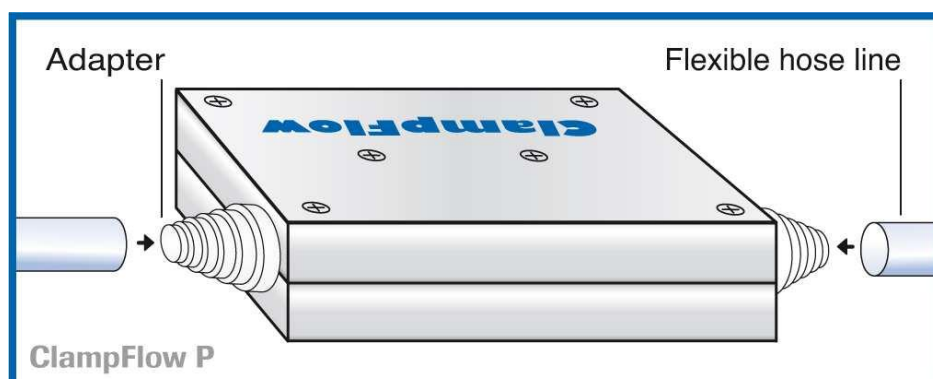


Fig. 4: mounting the ClampFlow P by plugging the flexible hose lines on it

4.3 Communication Lines

There are several communication lines available:

For process data there are two current outputs available, scalable from 4 to 20mA they show flow rate, density (loading in the hose) or velocity on request.

For communication there are two physical lines available: Either the integrated USB-to- RS485 or the external RS485 interface can be used for communication over Modbus Protocol.

4.4 Electrical Connection

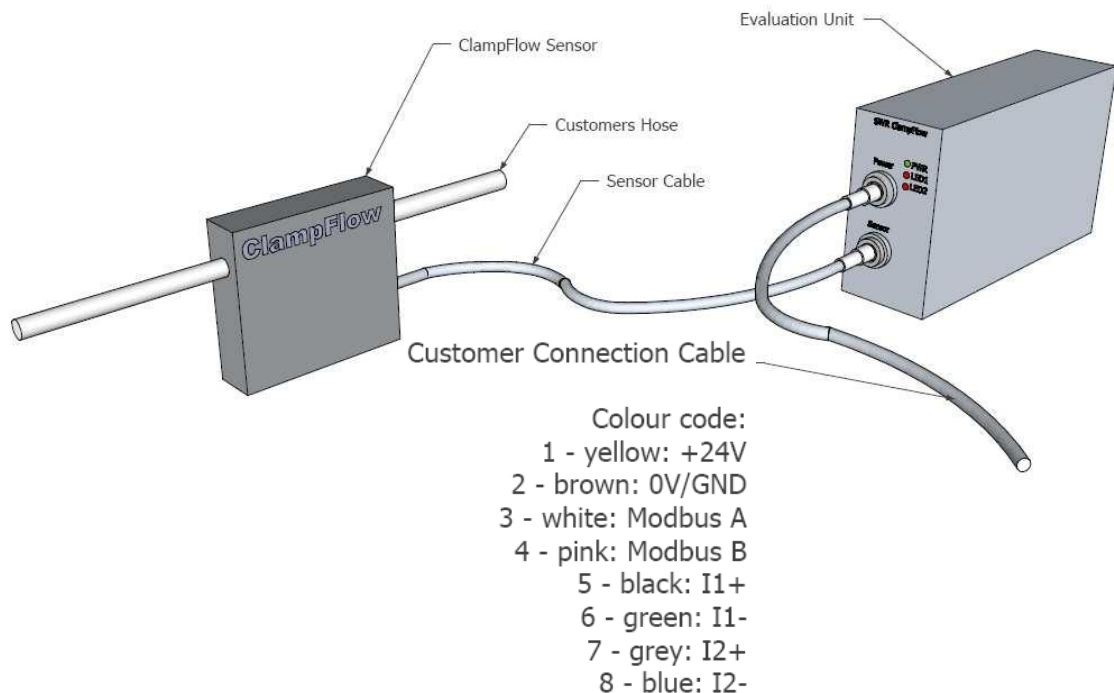


Fig. 5: Wiring of the Sensor and Evaluation Unit to customer system

CONNECTIONS

Transmitter unit		
Terminal		Connection
Supply voltage		
1 (yellow)		Input supply voltage +24 V / DC
2 (brown)		Input supply voltage 0 V / DC
Connections		
I-out 1	5 (black)	Current output + 4..20mA
	6 (green)	Current output - 4..20mA
I-out 2	7 (grey)	Current output + 4..20mA
	8 (blue)	Current output - 4..20mA
Modbus	3 (white)	RS 485 interface data A
	4 (pink)	RS 485 interface data B

A maximum length of 300 m from Evaluation Unit to customers system should not be exceeded. The distance between Sensor and evaluation unit is limited by original cable length (10m).

5 Commissioning and menu structure

For start-up the measurement system it is necessary to adjust the sensor. After switching on the power supply there is a warm-up time of 15 minutes required before any adjustment starts. Please check again:

- The original cabling between sensor and the evaluation unit.
- The correct cabling between evaluation unit and customer system.
- The correct adjustment of the sensor pipe.
- USB or RS485 connection to customers' laptop

Commissioning ClampFlow through the software

- | | |
|----------------|--|
| Basic Function | For start-up the sensor has to be calibrated and parameterized to each product which will be measured. All calibration is done through the delivered software. |
| Density | Two-point-calibration are sufficient for measuring the density function: zero point (or empty pipe) and max (full pipe or maximum flow rate). See §6.2 "Loading" window. |
| Velocity | The velocity measurement is firmly defined as an absolute measurement by the distance of the sensor plates, only the accuracy of this measurement has to be adjusted. See §6.3 "Correlation" window. |

Starting up the software

The software is made of several register in the upper side of the window, named: "Loading", "Correlation", "MassFlow", "AutoComp", "Trends", "Info".

5.1 "Info" window

We first need to adjust the communication parameters in the "Info" window.

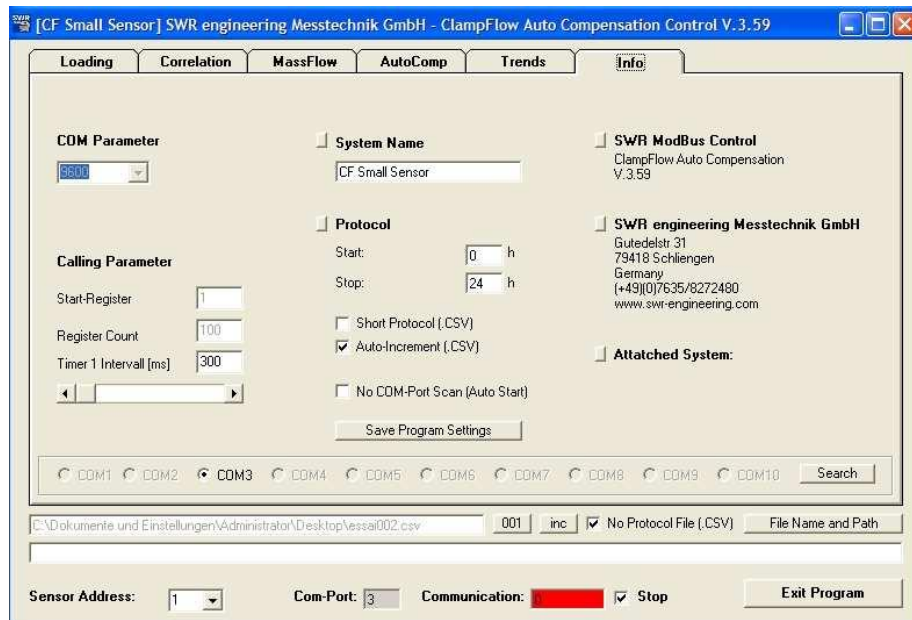


Fig. 6: software opened in the Info window.

- | | |
|---------------|--|
| COM Parameter | Set the communication Baud Rate to communicate with the sensor: normally 9600 Bauds. |
|---------------|--|

Calling Parameters are the communication settings. They are preset and do not have to be changed (See Fig. 6).

System name is used to give a name or a label to the system, this is useful if working with several systems at the same time, to make the difference between each one.

Protocol is made to adjust the writing protocol settings. They should be fixed as shown (See Fig. 4).

Sensor Address here you can select which sensor you want to connect by entering its address. As a factory default the address of the sensor is "2". The address can be changed (See "Loading" window)

COM port Normally the COM-Port should be automatically found, but if not, it is possible to select the correct COM-Port manually, or launch a new automatic search by pressing the button "Search".

File Name and Path by pressing this button you can select where you want to save the log data, and which name you want to use.
Example: C:\Desktop\test.CSV

The file will be automatically created with one additional number of 3 digits. Here, the file name will finally be test001.CSV

- The "001" button set the number back to 001.
- The "inc" button increment the number one by one, to create a new log file with the same name but a different number.
Example: test002.CSV
- To start recording the data in the designated file, the "No protocol file(.CSV)" button must be unselected.

Communication When all parameters are correct, you can start the communication by unselecting the "stop" button. If communication is correct, the red color changes to green and the number of received data starts increasing.

If red color is still, then the communication is not working: check again if COM-Port, Baud Rate, or other parameters are correct and try again.

Save Program Settings

By pressing this button, all the settings from this window will be saved. The setting is saved by exiting the Program as well.

5.2 “Loading” window

This window contains all information and parameters to adjust the density or loading measurement: to measure how full is the pipe.

Scaling

This is only information about “Mean Value” levels:

- Max Value -> 1500000 means that when the Mean Value reaches this number, this means that 100% of the pipe is full.

- Zero Value -> 500000 means that when the Mean Value decreases to this number, then 0% of the pipe is full, the pipe is empty.

Mean Value

This value increases when material is detected in the pipe, and decreases when less material is detected in the pipe. When calibrated, this value should move between 500000 and 1500000 (See “Scaling” above)

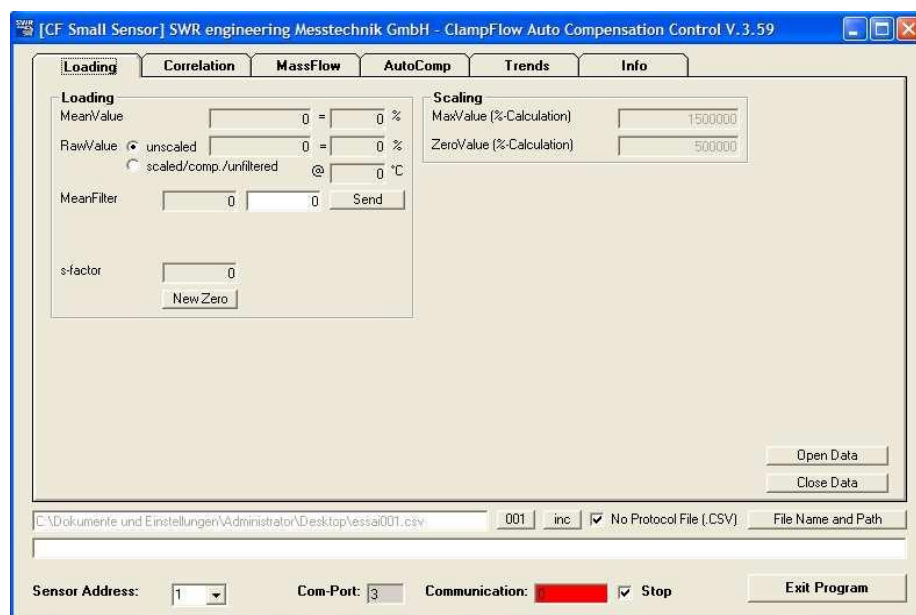


Fig. 7: software opened in the Loading window.

Raw Value

This is the original value given from the sensor. Can be displayed un-scaled, or scaled and temperature compensated.

Mean Filter

This is a time filter to smooth the read signal. The left grey window is the current sensors value, the right white window is the open space to write any other value. The unit is close to 1 seconds. For using a 5 seconds filter you must then write Mean Filter = 50 in the white space, and then press the “Send” button. This new value now appears in the grey space.

s-factor

This factor is automatically adjusted when doing the maximum value calibration.

New Zero

Press this button only when the pipe is empty. By pressing this button, the current Raw Value level will be set as the new zero point. The Mean Value will now show zero at this point.

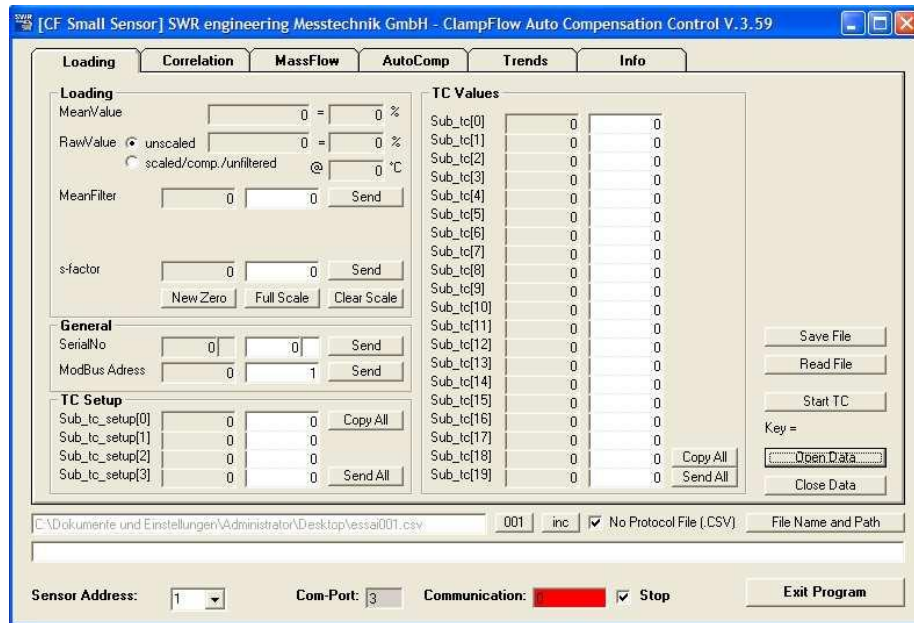


Fig. 8: software opened in the Loading window with all additional data.

- Open Data press this button to have access to additional settings (See Fig. 8).
- Close Data press this button to close access to additional settings.

- Full scale Press this button only when the pipe is full of material. By pressing this button the current Raw Value level will be set as the full scale point. The Mean Value will now show 100% at this point.

- s-factor This factor can now be also manually adjusted: write the desired value and press the “Send” button.

- Serial-No Device serial number. Not to be modified.

- Modbus Address This is the address of the sensor. If using several sensors in the same communication loop, then each sensor needs a different address. If you change the address of the sensor, then you need to change the software connection address according to this sensor new address (See “Info” window).

- TC Setup Temperature compensation Setup. Not to be modified.
 - “Copy All” will read the actual TC Setup values out of the sensor.
 - “Send All” will write the values from the right white numbers to the sensor memory (left grey numbers)

- TC Values Temperature compensation values. Not to be modified. Save file
 - Save all “Loading” parameters into a .CFG file.
 - Read file Read all “Loading” parameters out of a saved .CFG file.
- All read parameters will appear in the white spaces. Then you can compare them with the parameters already in memory inside the sensor.
- To modify the parameters inside the sensor with this data, you have to press “Send” or “Send All” for each line or group of lines you want to set inside the sensor.

5.3 “Correlation” window

This window contains all information and parameters to adjust the velocity measurement: how fast is moving the material.

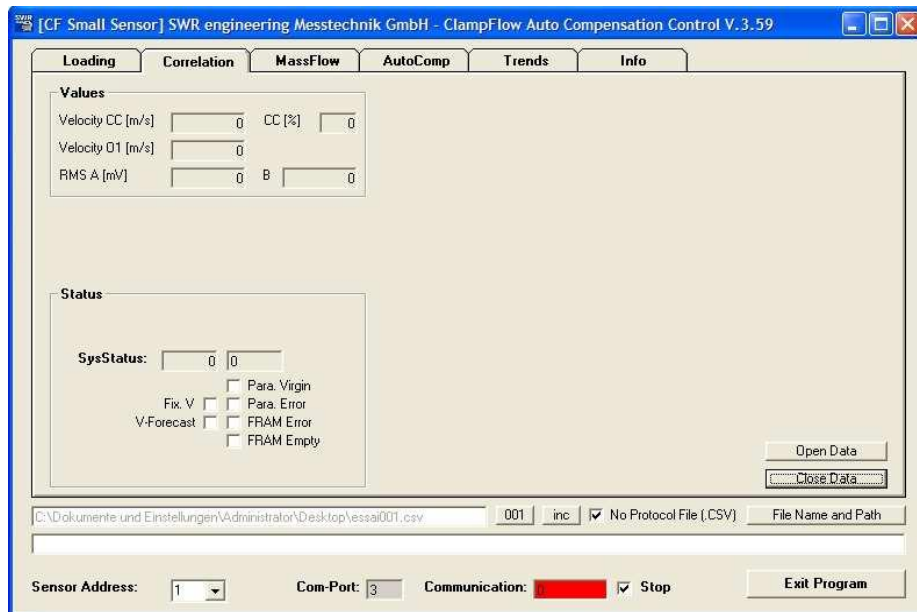


Fig. 9: software opened in the Correlation window.

Velocity CC

This shows the velocity calculated by the correlator. Even if the material is not moving any more, some electrical noise will be detected by the sensors and the correlator will try to calculate velocity out of it. The correlator is always working.

CC[%]

This value gives an information about the quality of the correlator velocity calculation. If material is flowing in the pipe, the correlator will find a good correlation and quality will probably be higher than 50%. If there is mostly noise in the line, correlation will be bad and CC[%] probably quite low.

Velocity 01

This one is the final velocity we are using for the flow rate measurement. When material is flowing (when „RMS A“ is bigger than „NST“), if we are working with the correlator, then this velocity will be the same as calculated by the correlator (Velocity CC). If we decided to work with fix velocity, then the velocity displayed will be the fixed velocity decided.

RMS A... B...

This two windows give information about the signal strength (A and B) on the two measuring points. The correlator will try to correlate this two signals to find the material velocity. The level of signal is normally much higher when material is moving, this difference is the basis to use „NST“ level (see „NST“ below).

Sys Status

For SWR internal use only.

Fix. V

Fix velocity. Use this box to validate the use of fixed velocity in “Velocity 01“. If not validated, the system will use the correlated velocity from “Velocity CC“.

V-Forecast The correlator needs some seconds after the flow has started to find and display the calculated velocity. In some cases, if this first seconds are important, you can validate this box: then as soon as „RMS A“ is higher than „NST“, velocity will be displayed during the first seconds using the last velocity known during the previous flow. After this first seconds velocity is calculated as normal.

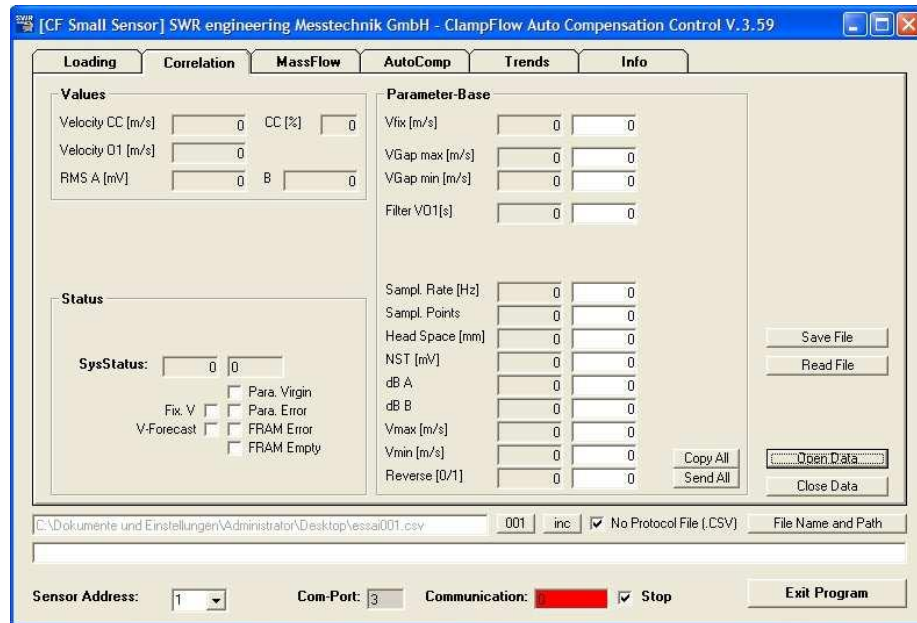


Fig. 10: software opened in the Correlation window with all additional data.

Para. Virgin For SWR internal use only.

Para. Error For SWR internal use only.

FRAM Error For SWR internal use only.

FRAM Empty For SWR internal use only.

Open Data press this button to have access to additional settings (See Fig. 10).

Close Data press this button to close access to additional settings.

Vfix Write here the value for fixed velocity to use when “Fix V” box is selected.

Vgap max What is the maximum velocity the correlator will try to calculate. This should be quite close to the assumed real maximum velocity to improve the correlator efficiency.

Vgap min What is the minimum velocity the correlator will try to calculate. Should be set to Zero.

Filter V01 Time filter, in seconds, to smooth the calculated velocity.

Sample Rate Adjust how many readings per second we want to use for RMS A and B, to improve the velocity correlation quality.

Sampl. Points Adjust how many points we want to compare between RMS A and B, to improve the velocity correlation quality.

Head Space Distance between the two velocity measuring points inside the sensor. This is fixed, must not be modified.

NST The adjustment of this value is very important, it has to be adjusted between the low level of “RMS A” (no flow in the pipe) and the high level of “RMS A” (during flow). As long as “RMS A” is lower than “NST”, Velocity 01 will

show “zero” = no flow velocity in the pipe.- As soon as “RMS A” goes higher than “NST”, then Velocity 01 will show a velocity (from correlator or fix).

dB A	This signal damping can be modified to increase or decrease the strength of “RMS A”
dB B	This signal damping can be modified to increase or decrease the strength of “RMS B”
Vmax	What is the maximum velocity the correlator will try to calculate. This should be quite close to the assumed real maximum velocity to improve the correlator efficiency.
Vmin	What is the minimum velocity the correlator will try to calculate. Should be set to Zero.
Reverse	Select 0 or 1 to adjust the direction of the velocity calculation (if sensor is mounted in the reverse position).
Copy all	Read the actual values out of the sensor (on left grey windows) and write them on the right white windows.
Send All	write the values from the right white numbers to the sensor memory (left grey numbers)
Save file	Save all “Correlation” parameters into a .CFG file. This file can be the same as used for the “Loading” save because this parameters are not saved in the same position than the “Loading” ones.
Read file	Read all “Correlation” parameters out of a saved .CFG file. All read parameters will appear in the white spaces. Then you can compare them with the parameters already in memory inside the sensor. To modify the parameters inside the sensor with this data, you have to press the “Send all” button.

5.4 “MassFlow” window

This window contains all information and parameters to adjust the flow rate measurement.

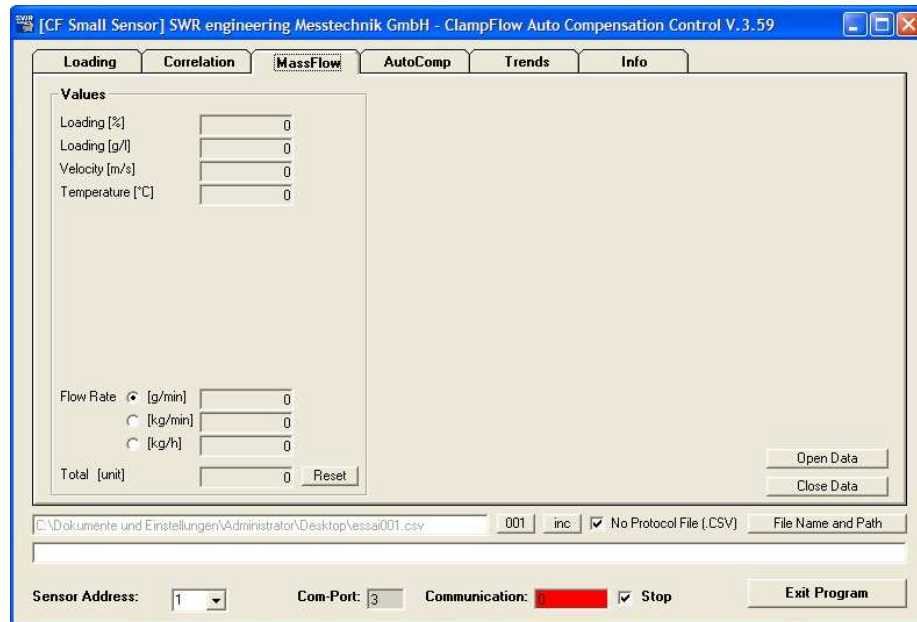


Fig. 11: software opened in the MassFlow window.

- | | |
|--------------------|---|
| Loading [%] | gives information about the current loading measurement displayed in %. |
| Loading [g/l] | gives information about the current loading measurement displayed in g/l. |
| Velocity | gives information about the current velocity. |
| Temperature | gives information about the current sensor temperature. |
| Flow Rate | You can choose which unit to display the Flow Rate (g/min; kg/min; kg/h). |
| Total | This is a totalizer to calculate how much material has been produced (unit depends on the “Flow Rate” unit). |
| Reset | This will reset the totalizer number to zero, to start a new totalizer. |
| Open Data | press this button to have access to additional settings.
(See Fig.12) |
| Close Data | press this button to close access to additional settings. |
| Bulk Density | Insert here the material bulk density for a correct Flowrate calculation. |
| d | Inner diameter of the pipe. |
| k-Factor | Correction factor. After the calibration has been done, if there is still a stable difference between the sensor values and the control measurements, calculate the correction factor needed to correct it. The sensor measurement is now corrected by this factor. |
| Current Out Select | Two analog 4..20mA outputs are available from the sensor. Select which signal you want to have out of it by typing in the related number.
- if “1” → OUT1 = loading ; OUT2 = velocity
- if “2” → OUT1 = loading ; OUT2 = flow rate |

- if "3" → OUT1 = flow rate ; OUT2 = velocity
- if "4" → OUT1 = flow rate ; OUT2 = loading
- if "5" → OUT1 = velocity ; OUT2 = loading
- if "6" → OUT1 = velocity ; OUT2 = flow rate
- if "75", "76", "77", "78" → test modes for OUT 1 and 2.

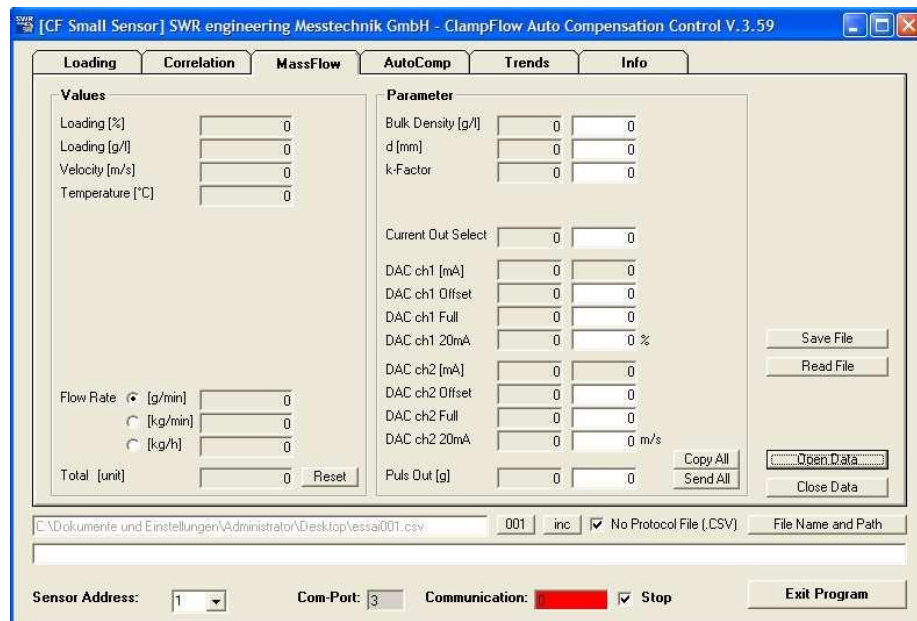


Fig. 12: software opened in the MassFlow window with all additional data.

DAC ch1 [mA]	displays the current output1 current level.
DAC ch1 Offset	adjust the level of the 4mA current if needed.
DAC ch1 Full	adjust the level of the 20mA current if needed.
DAC ch1 20mA	calibrate the 20mA level meaning (for example 20mA for 10% loading)
DAC ch2 [mA]	displays the current output2 current level.
DAC ch2 Offset	adjust the level of the 4mA current if needed.
DAC ch2 Full	adjust the level of the 20mA current if needed.
DAC ch2 20mA	calibrate the 20mA level meaning (for example 20mA for 15m/s velocity)
Pulse Out	Adjust the pulse output (for example one pulse every 50g)
Copy all	Reads the actual values out of the sensor (on left grey window) and write them on the right white windows.
Send All	write the values from the right white numbers to the sensor memory (left grey numbers)
Save file	Save all "MassFlow" parameters into a .CFG file. This file can be the same as used for the "Loading" and/or "Correlation" save because this parameters are not saved in the same position than the other ones.
Read file	Read all "MassFlow" parameters out of a saved .CFG file. All read parameters will appear in the white spaces. Then you can compare them with the parameters already in memory inside the sensor. To modify the parameters inside the sensor with this data, you have to press the "Send all" button.

5.5 “AutoComp” window

This window contains all information and parameters to adjust the automatic zero compensation for a more accurate measurement. The zero compensation should only work when the pipe is empty (no flow), to prevent measurement errors due to caking material or temperature change offsets.

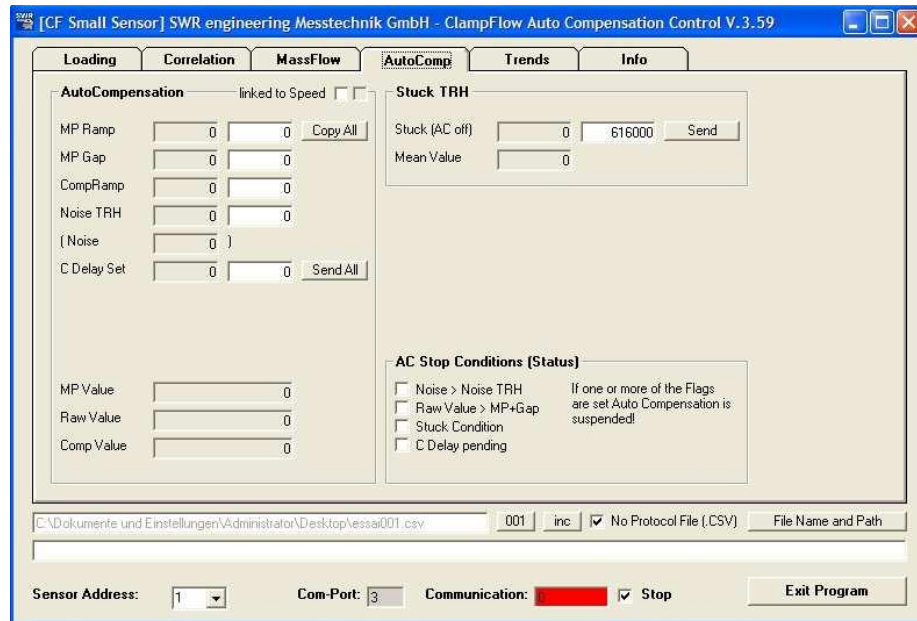


Fig. 13: software opened in the AutoComp window.

- Linked to Speed** If this box is validated, then the Auto-Compensation will not work while a velocity is measured. (as long as “RMS A” is bigger than “NST”)
- MP Ramp** Moving pointer ramp. A moving pointer is moving alongside the sensor “Raw Value”. It will move up or down to reach the “Raw Value” level until it reaches it, +/- the “MP Gap”. But its maximum increasing ramp is defined here (how many points per second).
- MP Gap** Moving pointer gap. As long as the moving pointer is inside this gap around the “Raw Value” level, the moving pointer does not need to move. The Auto-Compensation is possible.
- CompRamp** Compensation Ramp. The “Mean Value” is continuously corrected with the compensation value. This value is kept fix while material is flowing, but is adjusted again to display a stable “zero” value if there is no flow (empty hose).
- To make this all conditions must be fitted (See: “AC Stop Conditions”), then if needed this compensation value will be adjusted to display again a perfect zero value. How fast this compensation value is changed is defined by this compensation ramp.
- Noise TRH** Here you can define a noise limit to stop the Auto-Compensation. If the Noise is higher than this limit then no compensation is possible. (Same philosophy as “RMS- A” and “NST”).
- Noise** Display the level of noise detected in the sensor.

C Delay Set	Delay in seconds. After all conditions are fitted, this additional delay has to be waited to start the Auto-Compensation.
MP Value	displays the current moving pointer value
Raw Value	displays the current Sensor Raw value
Comp Value	displays the current compensation value
Stuck	If “Mean Value” is bigger than this “Stuck” value, then no compensation is allowed. (in case there is a real material stuck in the pipe, even if no flow will be detected anymore, no Zero Compensation must be started at this stage. Set this level quite high to detect only real stuck.
Mean Value	displays the correct Mean Value
AC Stop Conditions.	Here are displayed all the conditions that may cause the stop of the Auto-Compensation. Very useful to adjust all Auto-Compensation parameters.
Copy all	read the actual values out of the sensor (on left grey windows) and write them on the right white windows.
Send All	write the values from the right white numbers to the sensor memory (left grey numbers)

5.6 “Trends” window

This window is useful to see how the system reacts looking at several parameters trends over time, alone or simultaneously. Two scales are available in this chart, one in the left side, one in the right side. For each scale you can select the min. and max. level displayed.

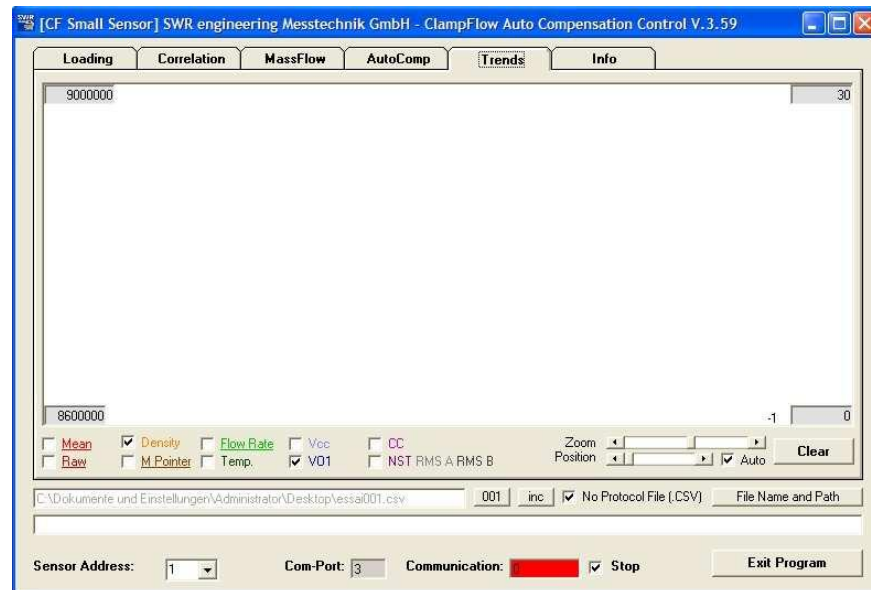


Fig. 14: software opened in the Trends window.

Mean	If selected, the Mean trend will appear according to the left hand scale.
Raw	If selected, the Raw trend will appear according to the left hand scale.
Density	If selected, the Density trend will appear according to the right hand scale.
M Pointer	If selected, the Moving Pointer trend will appear according to the left hand scale.
Flow Rate	If selected, the Flow Rate trend will appear according to the left hand scale.
Temp	If selected, the Temperature trend will appear according to the right hand scale.
Vcc	If selected, the Correlated Velocity trend will appear according to the right hand scale.
V01	If selected, the Finally Used Velocity trend will appear according to the right hand scale.
CC	If selected, the Correlation Quality Level trend will appear according to the right hand scale.
NST RMS-A RMS-B	If selected, the NST, RMS A and RMS B will appear automatically scaled for best fit the window.
Zoom	Increase or decrease the Zoom on the charts.
Position	Change the position from where to look at the charts.
Auto	If selected, the position is automatically corrected to follow the incoming new values on the charts.
Clear	Clear all values to start a new chart reading.

Warning!



Danger of shock with open 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.

6 Warranty

Warranty is granted for one year 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.

7 Troubleshooting

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. Device defective.	Check the power supply. Check the connecting cables for a possible break of a cable.
Measuring system outputs wrong values	Calibration not correct. Calibration shifted by changed measuring conditions (new material, new position)	Delete input signal correction, new calibration according to section 6. Delete input signal correction, new calibration according to section 6.
Sensor error	Wrong connection of the sensor Sensor out of order	Check the wiring. Exchange sensor
Do not open, as otherwise the warranty claim expires!		

8 Technical Data

Sensor	
Housing:	Aluminum (optional plastic)
Protection category	IP65
Environment temperature:	sensor electronic: 0....+ 60 °C
max. working pressure:	0,1 bar
Max. material temperature	60°C
Voltage:	24V / DC
Power	2W / 3VA
Weigh:	600g
Dimension:	L= 105 x W=75 x H= 29mm
Accuracy:	+/- 5% in calibrated measuring range
Evaluation Unit	
Supply voltage	24 VDC +/- 10%
Power consumption	12 W, 14 VA
Protection category	IP40 to EN 60 529
Operating temperature	-10...+45 °C [14... 113 °F]
Enclosure dimensions	L= 184, W= 60 , H= 105 mm
Weight	approx. 350 g
Current output signal	2 x 4...20 mA (0...20mA), Load < 500
Measurement value alarm relay output	Relay with switching contact Max. 250V AC, 1A
USB-Port	2.0
RS485 Interface	Modbus Interface
Data storage	Flash



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