OPERATING INSTRUCTIONS

FlowJam *Plus*

MATERIAL FLOW MONITOR WITH BLOCKAGE DETECTOR
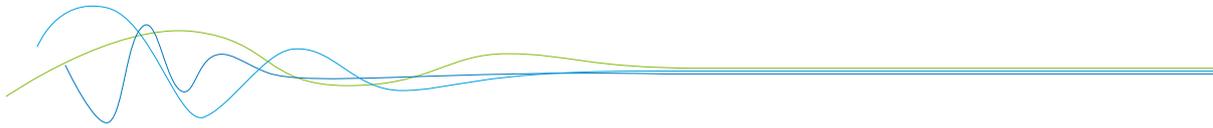
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1. System overview

A measuring point consists of the following components:

- Sensor mount for welding to the pipeline (G-1½"-socket)
- Sensor
- C1-Box (optional)
- Evaluation Unit in the DIN Rail housing
- Process adapter (optional)
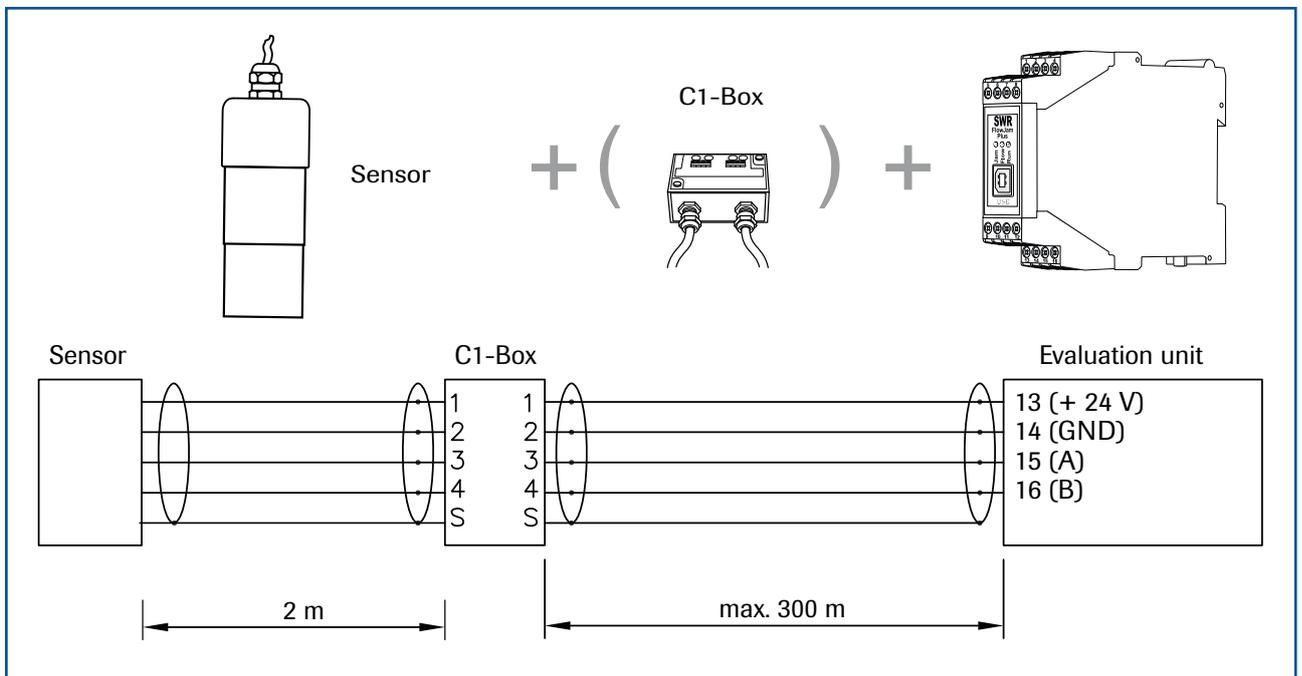
Fig. 1: Overview with C1-Box and evaluation unit
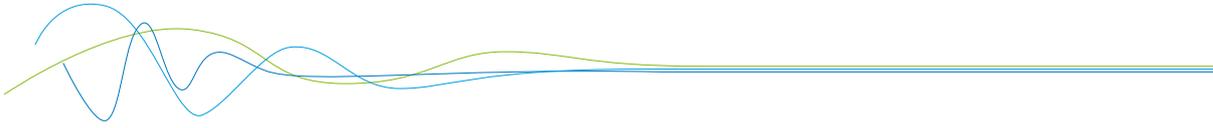
2. Function

The FlowJam Plus sensor is a further development of the FlowJam Sensor. It also detect movements of bulk solids, with a minimum speed of 0.1m/s, within the detection range (Fig.2).
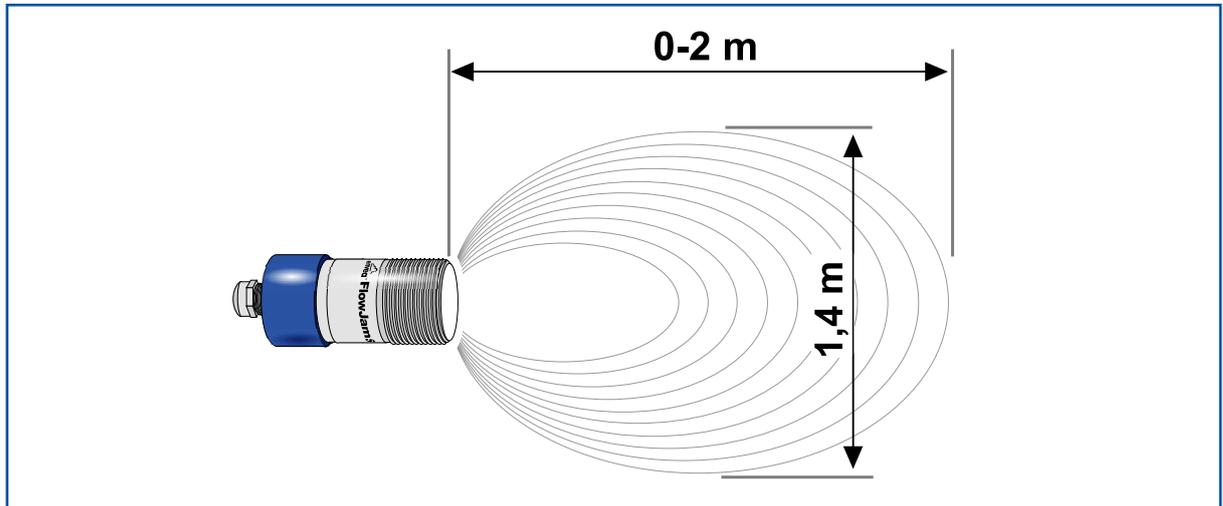

Fig. 2: Detection range FlowJam Plus

The sensor could be installed in pipes, chutes (metallic or non-metallic), hand-over points or free-fall sections. Material detection is regardless of the movement direction.

In addition, the FlowJam *Plus* is able to detect a jam at the selected position. The additional information for the detection of a blockage are obtained from the motion signal. This innovative type of evaluation makes it possible to display information about the status of the pipe at the output relay in addition to the material flow monitoring.

Reliable congestion detection is possible only when the state of full run for calibration can be established. If the sensor is installed on an already clogged pipe, the FlowJam *Plus* cannot provide reliable information about the condition of the pipe. Reliable signalling is only possible if the sensor can observe the process of clogging.

The evaluation unit distinguishes between four switching states:

- Material flow in a free pipe
- Material flow in a plugged condition (e. a. slowly sagging material pile)
- No flow in a free pipe
- No flow in plugged condition

Due to the process, there may be misinterpretations of the clogging signal. For an optimal evaluation of the signal for blockages, it is recommended to evaluate both relay contacts and use them in an AND operation. Example:

- No material flow AND blockage = alarm
- Material flow AND blockage = No alarm

The FlowJam *Plus* can be adapted to extreme process conditions via a separating flange equipped with a microwave-permeable window. In this way, applications with high pressures and temperatures can be solved. By using a separating flange, the blockage detection can be impaired.

3. Safety

The sensor FlowJam *Plus* 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

- Only original spare parts and accessories of ENVEA Process must be used.

3.2 Identification of hazards

- Possible dangers when using the measuring system are highlighted in the operation instruction with the following symbols:

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!
- 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 must be installed by trained and authorised personnel only.
- In case of maintenance-work on the pipe or on components of the FlowJam *Plus* sensor, make sure that the piping is in unpressurized condition.
- Switch off the power supply before performing any maintenance work, cleaning work or inspections on the pipelines or the FlowJam *Plus* 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 in the area.
- 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

- ENVEA Process reserves the right to adapt technical data to the technical progress without particular advance notice. ENVEA Process will be delighted to provide information about the current version of the operating manual, and any amendments made.

4. Montage and installation

4.1 Typical components of the measurement point:

- Sensor mount for welding to the pipeline (G-1½"-socket)
- Sensor
- C1-Box (optional)
- Evaluation Unit in the DIN Rail housing
- Process adapter (optional)
- Operating instructions

4.2 Required equipment

- Proved tools for electrical connections
- Tools for installation of the sensor mount

4.3 Mounting of the sensor

Proceed as follows to install the sensor:

- The sensor should be installed in a low-vibration environment.

- It is important to ensure that there are no moving parts are located in the detection area. If this is unavoidable, it is strongly recommended to shield the moving parts.

- The sensor should be installed as flush as possible with the inner wall of the pipe. Dead spaces in front of the sensor should be avoided.

- For horizontal or inclined installation situations, installation from above is recommended.

- An installation angle to the flow direction between 45° - 90° should be kept.

- When used on non-conductive conveyor lines material is measured through the wall.

- There is no need for a separate recess in the line. In order to eliminate possible interfering signals from the environment, ENVEA Process offers individual solutions.

- The measuring point can be installed in the following variants:

  - in a G 1½" threaded connector (fig. 3)

  - with the help of a pipe clamp (fig. 4)

 - for high-temperature and high-pressure applications with a separating flange (fig. 5)
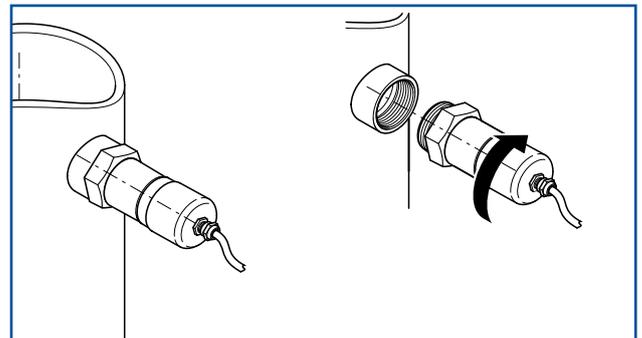

*Fig. 3: Thread mounting*
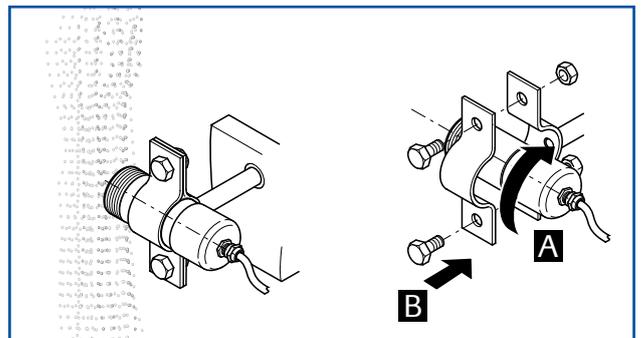
Fig. 4: Mounting with pipe clamp
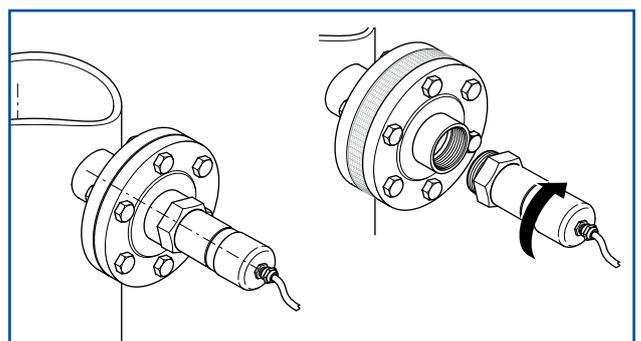
Fig. 5: Mounting with separating flange

4.4 Mounting of the Evaluation unit

The Evaluation unit can be installed at a maximum distance of 300 m from the sensor. A cable of type "Ölflex Classic 110 CY" is recommended. The cable should be four wired, twisted and shielded. A minimum cable cross-section of 0.75 mm² should be observed. For distances more than 150 m the cable cross-section should be adjusted. A cable cross-section of 2.5 mm² must not be exceeded.
The housing is prepared for DIN Rail mounting according to DIN EN 60715 TH35.
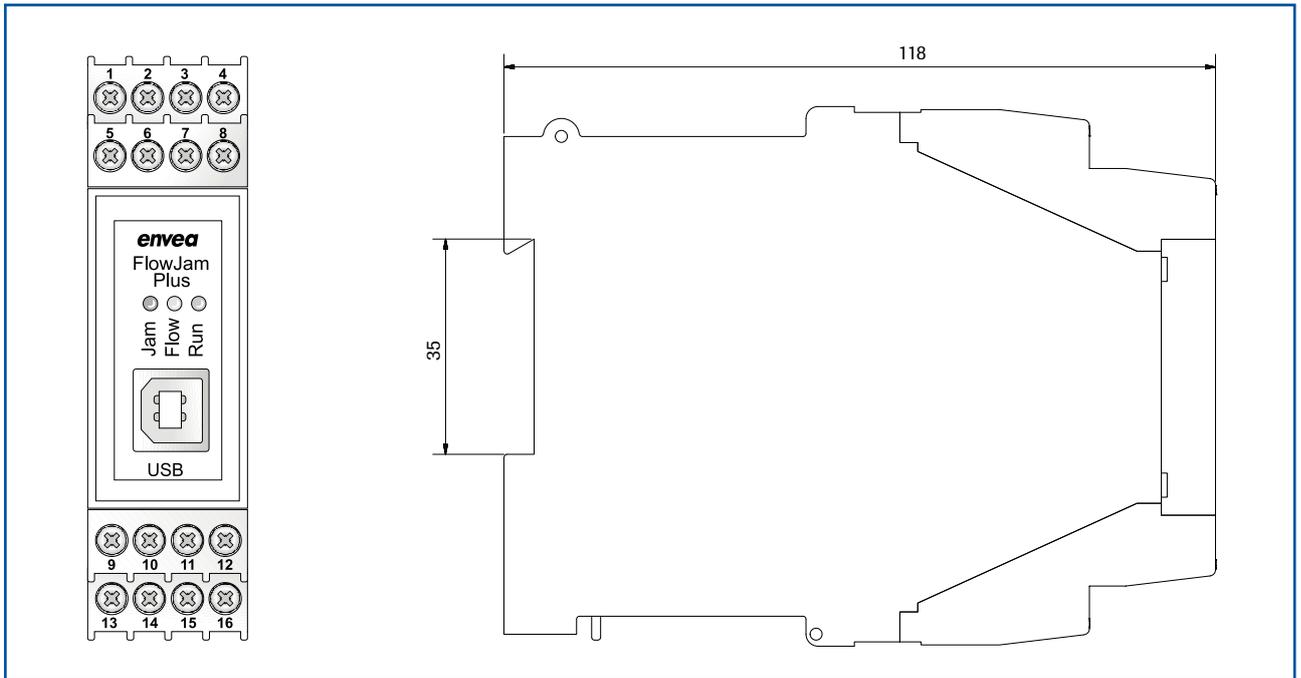

Fig. 6: Dimensions DIN Rail housing
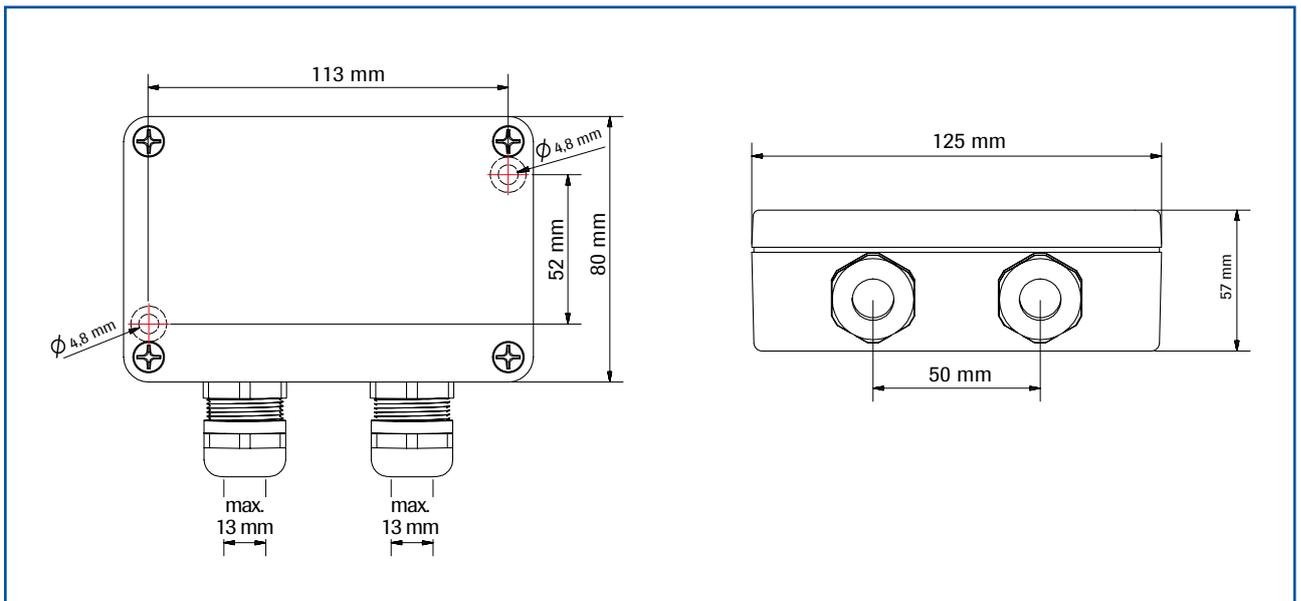
Fig. 7: Dimensions C1-Box
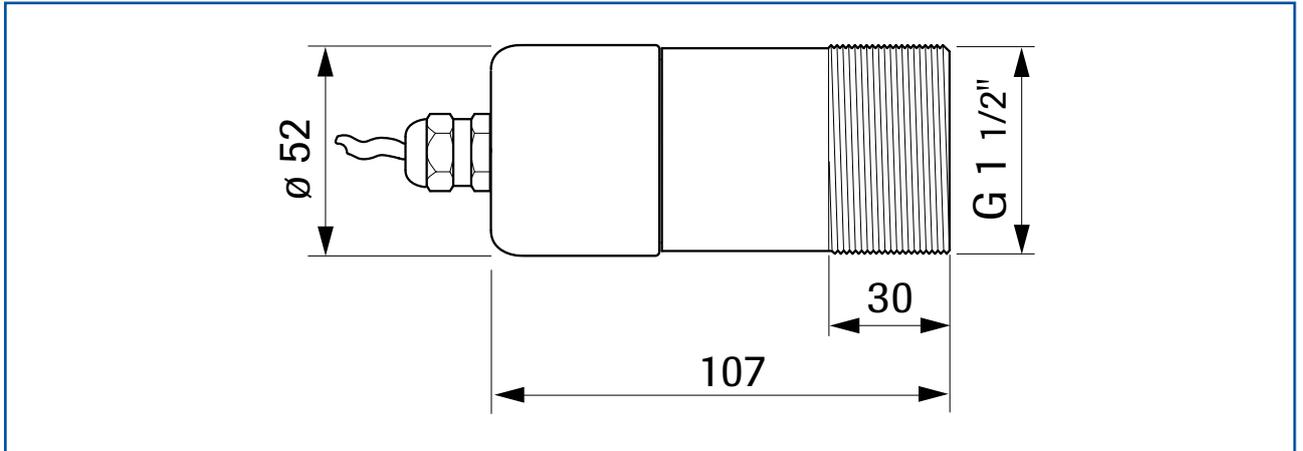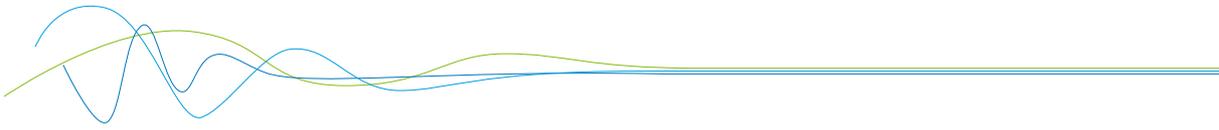
Fig. 8: Dimension FlowJam Plus
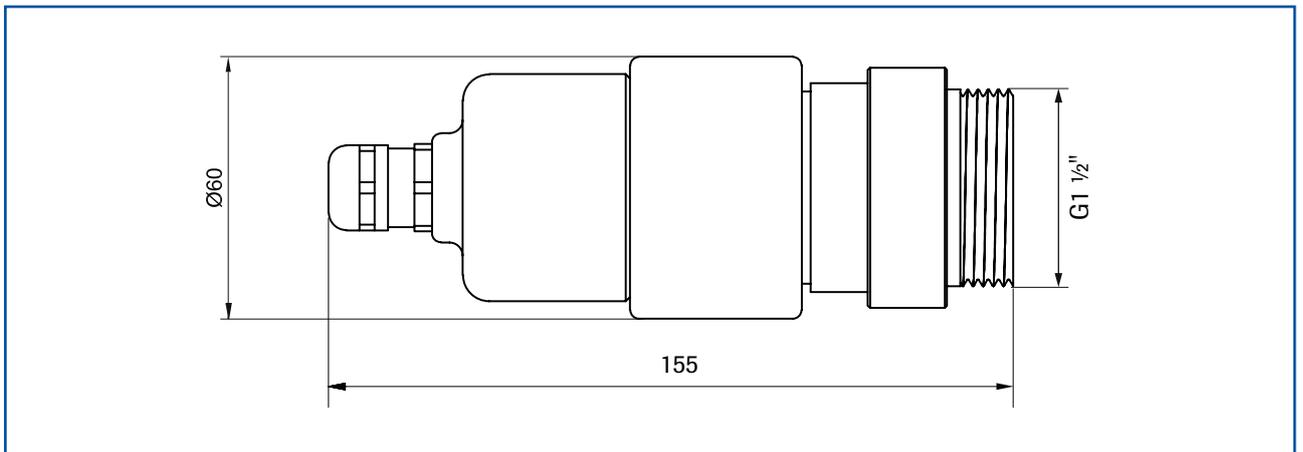
Fig. 9: Dimension FlowJam Plus Ex
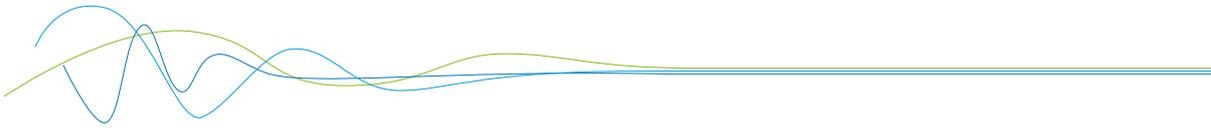
5. Electrical connection

5.1 DIN Rail terminal layout

1 Input power supply + 24 V DC	**2** Input power supply 0 V DC	**3** Flow-Relay NC	**4** Flow-Relay COM
5 Flow-Relay NO	**6** Jam-Relay NC	**7** Jam-Relay COM	**8** Jam-Relay NO
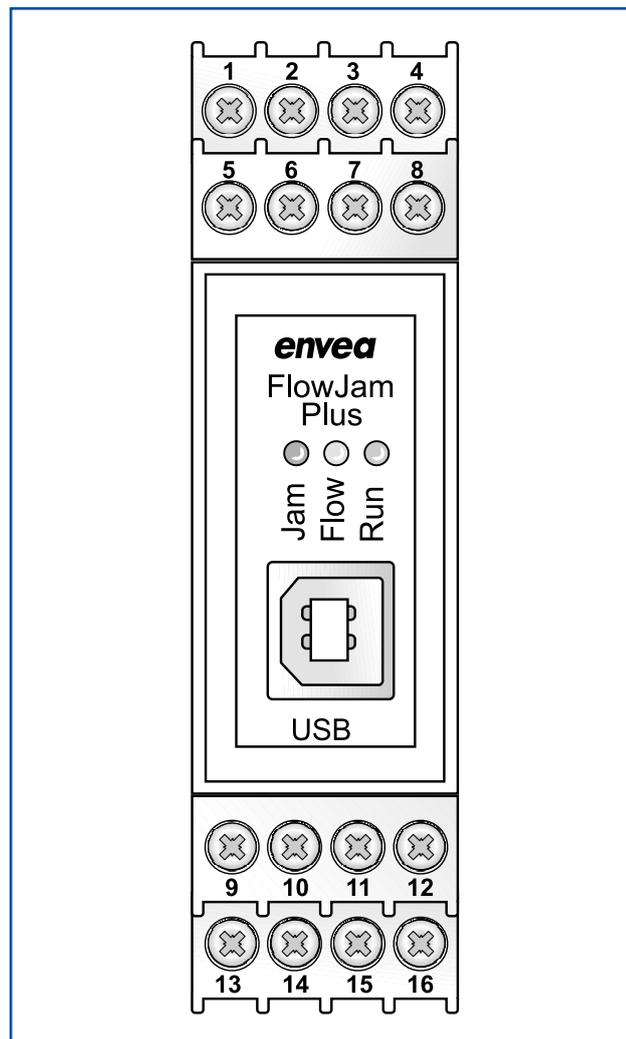
Fig. 10: Electrical connection of the Evaluation unit

9 not used	**10** not used	**11** not used	**12** not used
13 Sensor connection Cabel 1 Power supply + 24 V	**14** Sensor connection Cabel 2 Power supply 0 V	**15** Sensor connection Cabel 3 RS 485 Data A	**16** Sensor connection Cabel 4 RS 485 Data B
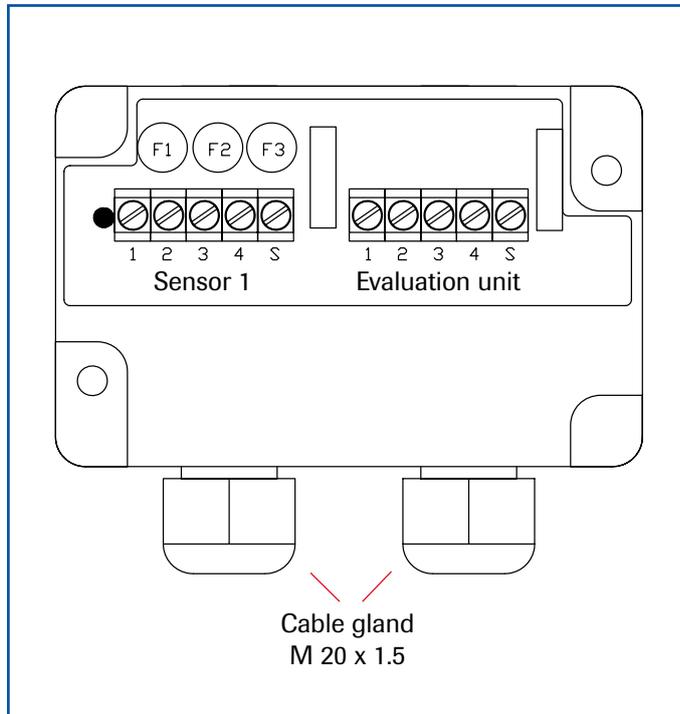
5.2 Electrical connection C1-Box

Sensor 1

1 **Power supply + 24 V**
2 **Power supply 0 V**
3 RS 485, Data A
4 RS 485, Data B
S Shield

Evaluation unit

1 **Power supply + 24 V**
2 **Power supply 0 V**
3 RS 485, Data A
4 RS 485, Data B
S Shield

Fig. 11: Electrical connection C1-Box

5.3 Electrical connection sensor
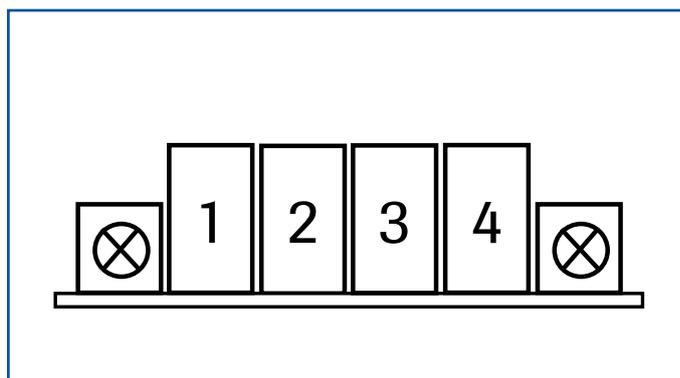
1 **Power supply + 24 V**
2 **Power supply 0 V**
3 RS 485, Data A
4 RS 485, Data B

Fig. 12: Electrical connection sensor

The housing of the FlowJam *Plus* has an EMC cable gland. This serves for laying a cable shield. The shield should only be placed on the sensor side.
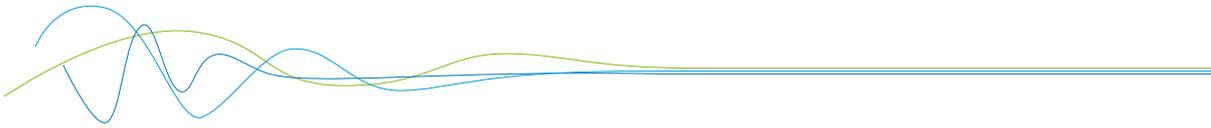
# 6. Use in hazardous areas

Marking DustEx: ⟨Ex⟩ **II 3D Ex tc IIIC T85 °C Dc**

Power supply (observe type plate)	Voltage range Power supply 24 V DC supplied by evaluation unit	Max. power consumption 1.5 W
Category	II 3D Sensor in Zone 22	
Housing protection class	Sensor = IP65 / evaluation unit = IP40	

Safety information for installation in explosive areas

1. Observe installation and safety instructions.
2. Install according to manufacturer's instructions and applicable standards.
3. Do not operate the device outside the electrical and thermal parameters.
4. Mount the housing cover and cable entries properly to ensure the housing protection class.
5. Use cable glands and cable entries that are suitable for Category II 3D.
6. A process adapter **must** be used for installation of the FlowJam *Plus* Ex in an Ex zone.

Thermal data	Category 3 (Zone 22)
Maximum permissible ambient temperature	- 20 °C . . . + 60°C
Maximum surface temperature, sensor, at + 60 °C ambient temperature	+ 80 °C
Maximum process temperature, at + 60 °C ambient temperature, when using a Tecapeek process adapter	+ 220 °C
Maximum process temperature, at + 60 °C ambient temperature, when using a POM process adapter	+ 80 °C

7. PC interface

The FlowJam *Plus* is parameterized exclusively via software. This requires an USB connection between the Evaluation unit and a laptop or PC. In the following, the software will be explained in detail.

Tab System
Settings for communication, language and data logging

PC Datalogger

Protocol interval [ms]	Interval for the query of the sensor signals in milliseconds.
Names in rows or headline	Here you can select whether the name of the column is in the header or in the preceding column.
Decimal separator	Depend on Windows language you can choose between a point and a comma separator for the further evaluation.
Row separator	Depend on Windows language you can choose between comma and semicolon as a column separator for further evaluation.
Time stamp	Possibility to choose between Windows time (File Write) or the Bus query (Bus Query).
PDS protocol extension	With the PDS extension, ENVEA Process is able to search for interferers in the signal and possibly to filter them.

PC ModBus parameter

|	
Baud rate	Possibility to select different baud rates. Default: 9600
COM search	If no COM port is displayed, this key can be used to search for available COM ports.
COM select	If the sensor is correctly connected and the COM port is set, the correct COM port is displayed or can be selected.
No COM port scan	If set, all COM ports are displayed. If the check-box is not set, only active COM ports are displayed.
Query rate [ms]	Frequency of polling time on the BUS.
Time-out [ms]	Time after which a time-out takes place on the BUS.
Application name	This name will be used next to the serial number, in the default protocol name.
Keep parameter at sensor address change	If the check-box is set, the parameters are not read in again when changing the sensor. The set parameters can thus be transferred to different sensors.
Read back after send commands	If the check-mark is set, the sensor is read back after transferring data.
Positive confirmation after read	If the check-mark is set, after every read back a feedback message has to be confirmed.
Write without confirmation	If the check-mark is set, the overwriting of parameters no longer has to be confirmed.
Write sensor parameter in file	With this function all sensor parameter could be saved.
Read sensor parameter from file	This function can be used to load a saved configuration file. If sensor replacement needed, no recalibration must take place.
Language	Select between German and English as program language.
Save program settings	This function saves the selection of the parameters for logging and communication. When restarting the software, the set parameters remain.
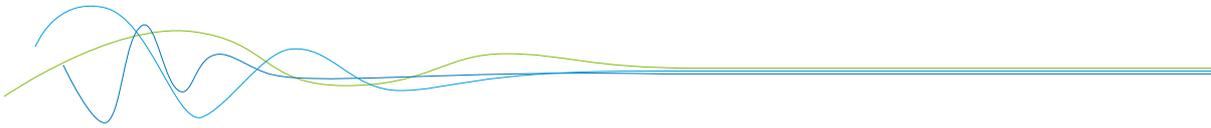
Tab Trend

Display of Sensor values and relay status
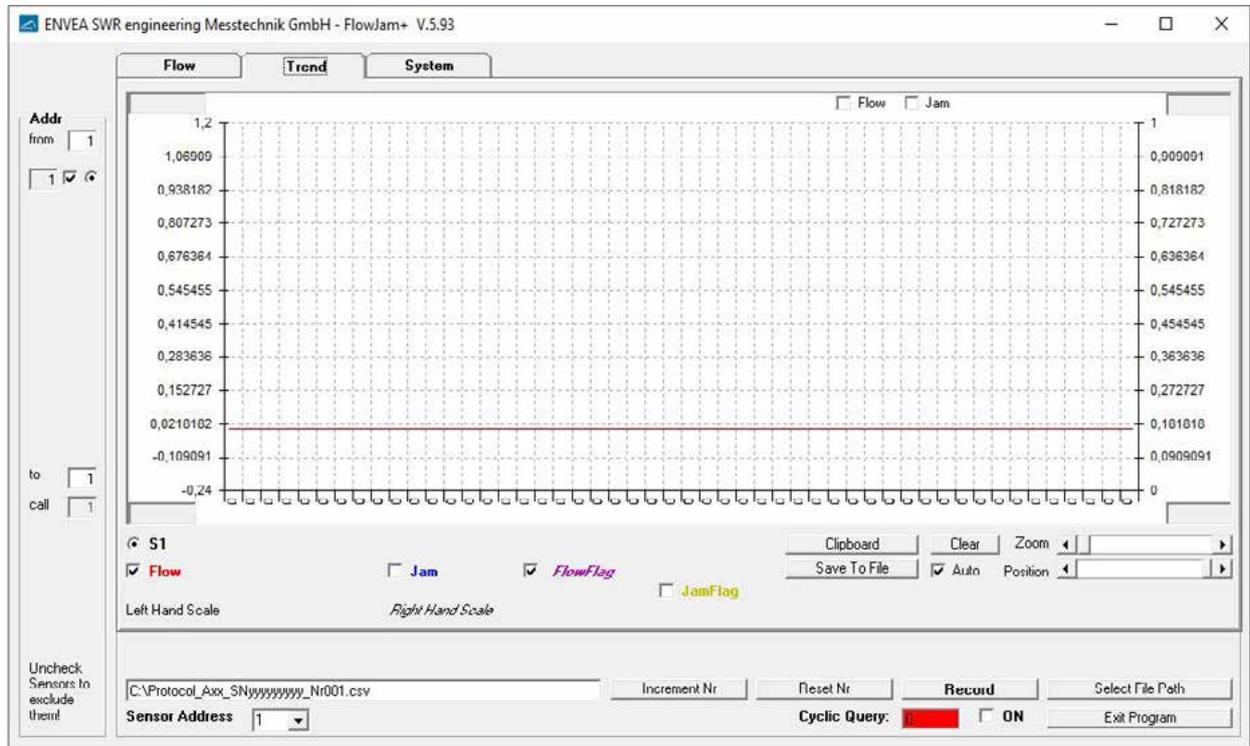
For a better representation of the trend lines, the right scale can be used by right-clicking on the respective name. If no maximum or minimum scaling value is entered, the program performs a continuous autoscaling. If the right scale is used to display sensor signals, the name of the displayed value is written in italics. The display can be further adjusted via the levers **Zoom** and **Position**.

Clipboard	Save a screenshot of displayed trend.
Save To File	If no recording has been started, the data record of the shown trend can be subsequently saved in a file.
Clear	The displayed signal will be deleted and the restarts.

Possible shown values

Flow	Trend monitoring of the Flow signal
Jam	Trend monitoring of the Jam signal
FlowFlag	Display of the Flow-Relay state
JamFlag	Display of the Jam-Relay state

Tab Flow

Input of sensor parameter
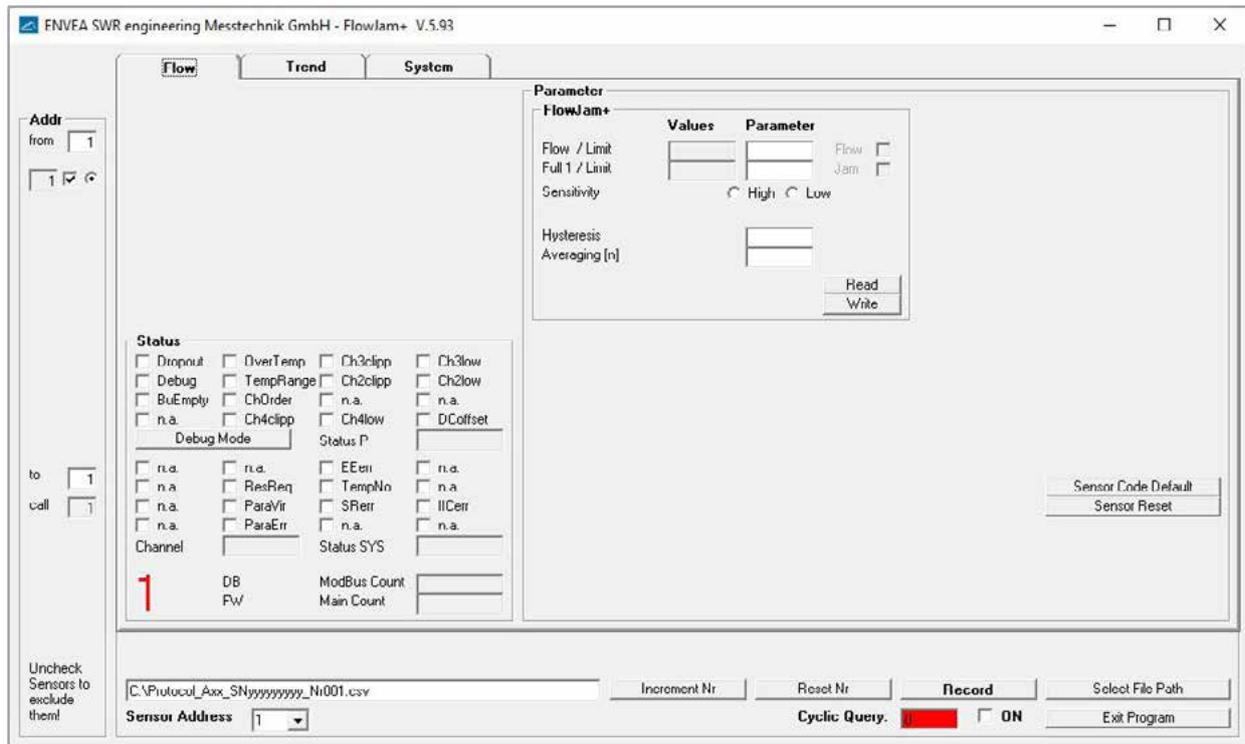
Upcoming errors are displayed here. A detailed error description takes place in the chapter Fault Clearance. The relay states are indicated by setting a hook on **Flow** or **Jam**.

Values	Actual raw values for Flow and Jam.
Parameter	Limit for Flow and Jam threshold.
Sensitivity	The sensor is delivered with a low sensitivity (**Low**). If the application requires, the sensor can be set to high sensitivity (**High**).
Hysteresis	The hysteresis indicates how many times the jam value must exceed or fall below the set limit so that the Jam-Relay indicates a change of state.
Averaging [n]	The higher this value is selected, the slower the sensor reacts to blockages. By choosing a higher averaging number, the sensor react more slowly but more reliably to blockages. *The averaging number refers only to the jam value.*
Read	Read actual sensor parameter.
Write	Write sensor parameter.
Sensor code default	Set parameter back to default.
Sensor reset	Sensor CPU restarts

8. Commissioning

8.1 Basic start up

A four-wire connection between the sensor and the evaluation unit is essential for the calibration. If an existing FlowJam system is replaced, there is the possibility of a two-wire operation between sensor and evaluation unit. For this possibility, the sensor is calibrated on site by means of a four-wire connection to the evaluation unit. After calibration, the evaluation unit can be installed at a different location via a two-wire connection of the measuring connections 1 + 2.
A two-wire connection does not allow subsequent calibration!

The parameters of the FlowJam *Plus* are set exclusively via the supplied software. For this, a USB connection between the evaluation unit and the laptop or PC is mandatory.

System requirements software:
- Windows XP or higher
- USB port

The software is on the supplied product CD. Alternatively, the software can be transmitted via your ENVEA Process contact.

For calibration the following steps have to be carried out:

1. Install sensor and evaluation unit as specified.

2. Connect sensor and evaluation unit according to specification.

3. Switch on the power supply - RUN LED lights up.

4. Run the installation routine - *FJ custom V5.66* or higher on Laptop or PC.

5. Connect the evaluation unit to laptop or PC via the supplied USB cable.

    5.1. The required driver should be installed automatically. If the required driver is not automatically installed, it is possible to download it from the internet. The name of the device is "FT232RL", the manufacturer is "FTDI".

    5.2. After successful driver installation appears under:

    Windows Device Manager at "COM & LTP" a "USB Serial Port"

    5.3. The COM number must be between 1 and 10. Otherwise no communication between the software and the evaluation unit can be established. By clicking with the right mouse button on the COM port, the numbering can be assigned manually.

    Properties → Port settings → Advanced settings

6. Start *FJ custom V5.66* or higher and select the COM port under the **System** tab. The sensor address is by default: 1.

7. By confirming the check-box **ON**, the communication to the sensor is started. If the communication is correct, the query counter is highlighted in green.

8. After the communication is activated, the software reports: **Read Sensor Parameters**.

    If this does not happen, you must manually read in the sensor parameters under the **Flow** tab via the **Read** button.

9. To define the sensor parameters, a protocol of the sensor signals could be recorded. To do this, select a file path with a click on **Select File Path**. The recording of the sensor signals started by clicking on **Record**. During recording, the **Record** button is highlighted in red.

10. Process parameters also could be read out of the trend monitoring in the tab **Trend**. Here the flow and jam signals are displayed. The left y-axis is assigned to the flow value, the right y-axis is assigned to the jam value. If no scaling upper or lower limits are manually set, the software performs autoscaling.

11. To define the flow parameter, material should be passed the sensor. The flow signal should now increase; the jam value should be stable. After about one minute, the material flow should be stopped again (No Flow - no blockage).
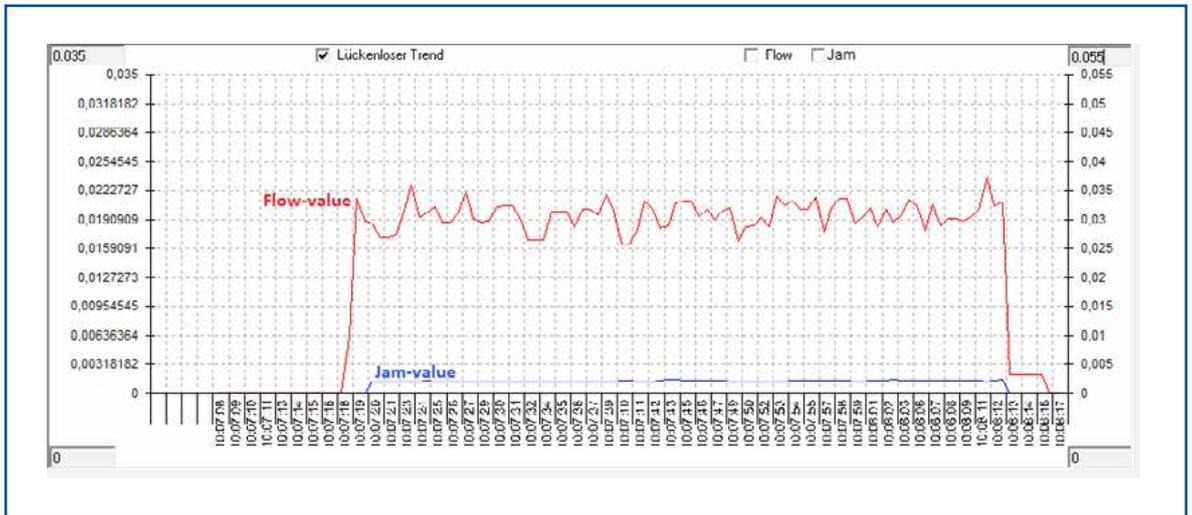

Fig. 13: Flow trend - without plugging

12. If possible, create now a blockage and let the pipe fill up with material. This blockage should be visible in the trends, similar like in figure 13. Unlike the previous trend in figure 12, at the end, the "Jam value" should rise vice versa to the "Flow value". If a forced blockage is not acceptable, you can skip this point, and the FlowJam *Plus* will use the factory defaults.
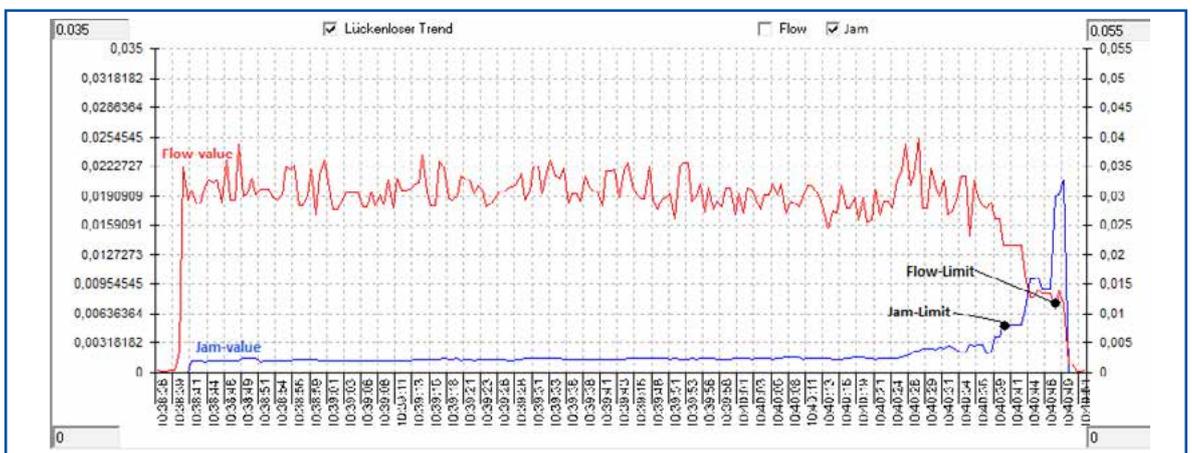

Fig. 14: Flow trend - with plugging in the end

13. The parameters for the flow and jam limits are stored in the tab **Flow**. Out of the recorded sensor signals, the needed parameter could be evaluated and stored in this tab.
It should be noted that the sensor only calculates and outputs a jam value until it falls below the flow limit. An example of the correct choice of limits is shown in figure 13. It could be lead to small deviations when reading back the sensor parameters, because of rounded values on sensor side.
14. If the parameters are correctly evaluate and entered in the corresponding fields, the parameters are sent to the evaluation unit by clicking on Write.

   Thereby, the basic function of the device is given and the measured values are evaluated.

8.2 Notes

- After switch on the power supply the measuring system needs minimum 5 sec. before delivering the first values.

- Batches less then 3 sec., will not produce reliable plugging indicators.

- The Flow Jam *Plus* is not capable to distinguish between a filled or empty pipe. The sensor is able to indicate a developing plugging.

- Avoid moving parts, the microwave can be reflected and cause false indications.

- For better process reliability, it is recommended to evaluate both relay contacts together. A blockage condition should only be alarmed if the sensor no longer detects material movement.

- By irregular material movements in the measuring range, such crumbling material, it can lead to short-term jam signals.

- A jam signal persists as long as unhindered material movement is detected again.

- When selecting the location for the FlowJam *Plus*, make sure that the temperature and pressure within the pipe or tank do not require any additional adapters like a microwave-permeable separating flange.

- If the process conditions require the use of a process adapter, ensure that there is no free space in which material could collect. Material deposits in front of the sensor may affect the blockage detection. Optionally, the flange should be closed with a non-conductive material such like POM or ceramic.

- When used on pipelines made of non-conductive material, the measurement could be made through the wall of the pipe. There is no need for a separate opening in the pipe. If there is a gap of non-conductive material between the sensor head and the pipe to be measured, for example an air gap when mounted with a pipe clamp, it may lead to a faulty measurement of the plugging conditions. With an air gap between sensor and pipeline, the sensor signals can be influenced from the outside.

9. Troubleshooting

If no flow indication is given, even if the "Flow limit" is set as low as possible and the sensitivity is high, check following:

- Material characteristics (Is it microwave permeable?)
- Position of the FlowJam *Plus*
- Distance between sensor and material

If the FlowJam *Plus* indicates flow, without any material is conveyed, it's most likely he detects motion of moving parts such screw conveyors or rotary valves or vibrations.
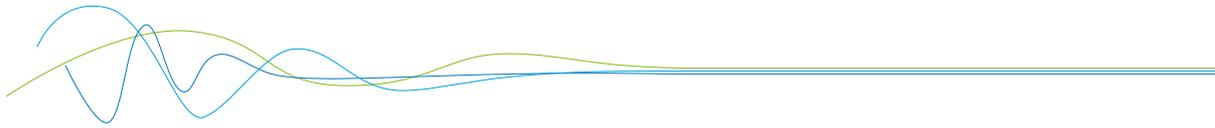
10. Technical data

Sensor	
Housing	Stainless steel 1.4571
Protection system	IP65
Using in EX-Zones	Outside: Cat. 3D Inside: Cat. 1/3D (with process-adapter)
Process temperature	- 20 ... + 80 °C (standard) - 20 ... + 220 °C (with process adapter) - 20 ... + 1000 °C (with ceramic flange)
Ambient temperature	- 20 ... + 60 °C
Working pressure	max. 1 bar (standard) / max. 20 bar (with process adapter)
Detection range	0 ... 2 m (dependent on application)
Required material speed for detection	min. 0.1 m/s
Measuring frequency	K-Band 24.125 GHz / ± 100 MHz
Transmitting power	max. 5 mW
Dimensions FlowJam *Plus*	Housing: L 107 mm / Ø 52 mm / Thread: L 30 mm / Ø G 1½
Dimensions FlowJam *Plus* Ex	Housing: L 155 mm / Ø 60 mm / Thread: L 30 mm / Ø G 1½
Weight FlowJam *Plus*	approx. 560 g
Weight FlowJam *Plus* Ex	approx. 880 g

DIN Rail Evaluation unit	
Power supply	24 V DC ± 10 %
Power consumption	20 W / 24 VA
Protection type	IP40 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) / USB
DIN Rail fastening	DIN 60715 TH35
Connection terminals cable cross-section	0.2 – 2.5 mm² [AWG 24-14]
Relay contact	Max. rated load: 250 V AC Max. peak current: 6 A Max. rated load 230 V AC: 250 VA Max. breaking capacity DC1: 3/110/220 V: 3/0.35/0.2 A Min. swithing load: 500 mW (10 V/5 mA)
Data backup	Flash memory