SF METER

Solids flow Measurement

USER MANUAL

Summary

1 GENERAL

1.1 INTRODUCTION

Read this manual carefully. It contains essential information for safe use of the sensor.

This document describes the procedure for mounting the sensor and its connections. It also describes **Flow32** software and the procedure to calibrate the sensor.

1.2 SENSOR DESCRIPTION

The SF-150 sensor has been specifically developed for measuring solid flow into metallic closed pipes.

Its microwave technology allows it to ensure reliable and accurate measurements regardless of temperature and pressure variations in the pipe.

Dynamic Flow is a sensor easy to install which fits to all kind of pipes.

1.3 APPLICATION DOMAIN

This manual concerns following product references :

- **SF-150Al**
- **SF-150Si**.
- **SF-300Al**
- **SF-300Si**

It also concerns **version 1.008** or **higher** of Flow32 software.

1.4 PRODUCT REFERENCE

Product reference is described as followed:

S F- 150

R **Conic BSP ½'** thread.
N **Conic NPT 3/8'** thread**.**
Al **Al2O3** Ceramic
Si **Si3N4** Ceramic**..**

Waveguide length(mm).
Ex : 100 100mm
150 150 mm

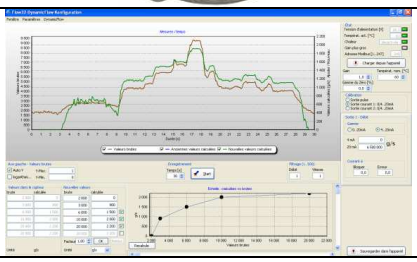
Flow
No Flow

S Standard
I Stainless
A Atex

1.5 PACKAGE

The SF-150 package consists of the following elements:

	SF-150 Flowmeter
	One sensor Adapter with 3 headless screws*.

	A bushing to weld on the pipe*.
	One 5m cable*.
	One USB cable (1.5m)*.
	One circlip diameter 20mm*.
	Flow32.exe software*.
	One ball valve (Optional)*.
	One Power Supply & Connections Box 115VAC

*：Images of different elements are not contractual. They may vary depending on the model of the sensor.

1.6 OPERATING PRINCIPLE

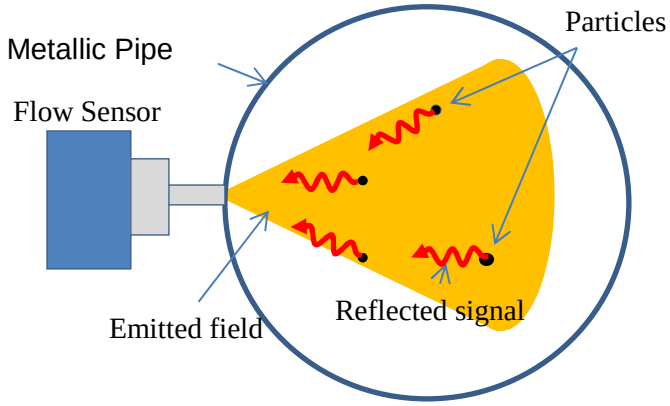


Fig 1. : Operating Principle.

Sensor is mounted on the pipe. It is necessary to drill a hole into the pipe for introducing the waveguide sensor.

The SF 150 sensor uses Doppler Effect principle to measure quantity of material passing through the pipe.

The principle of operating is as follows: an electromagnetic field is generated in the pipe. Once a particle passes through this field, it reflects a portion of the emitted signal. This reflected signal is measured by the sensor.

The sensor uses this measure to determine the flow.

Depending on the size of the pipe, a setting via **Flow32** software, will optimize the sensitivity of the sensor.

Some more calibration points are needed to adjust the detected level to the real quantity of product passed in the pipe.

2 SENSOR ASSEMBLY

2.1 MECHANICAL INSTALLATION

2.1.1 EQUIPMENT

- One **drill**.
- A drill **Ø 32mm**.
- One **circlips plier**.
- One spanner(or adjustable wrench) **SW-42**.
- Welding equipment.
- A depth gauge.

2.1.2 SENSOR POSITION DEFINITION

To ensure the best operating of the sensor, it's required to follow some rules to define the location in the pipe.

- Do not place sensor just before or just after a bend.

  - In the case of a pneumatic pipe, we recommend to keep a minimum distance equal to **five times the diameter of the pipe between bent and sensor**.

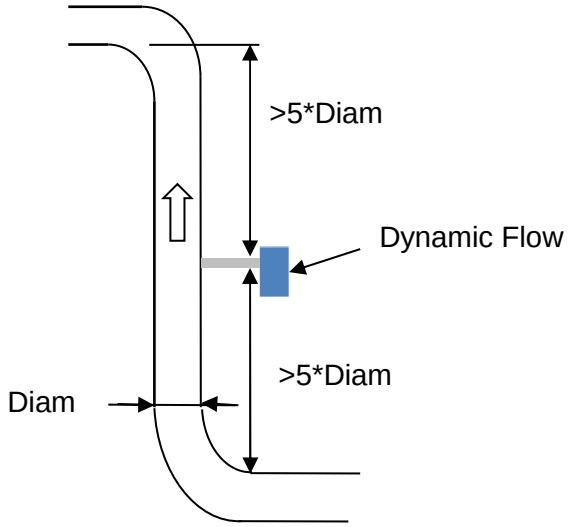


Fig 2. : Pneumatic pipe.

  - In the case of free fall pipe, the ideal is to keep a **minimum distance of 1 m** from the falling point(see point A on Fig 3).

- In order to avoid any ascent of product to measure, we recommend if it is possible , to position the sensor at least at **0,5m** of the reception point(See point B on Fig 3)

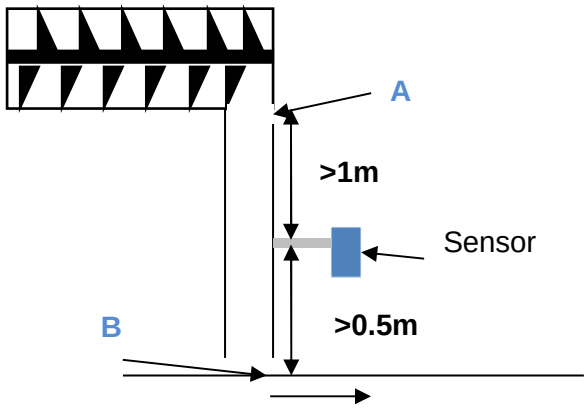
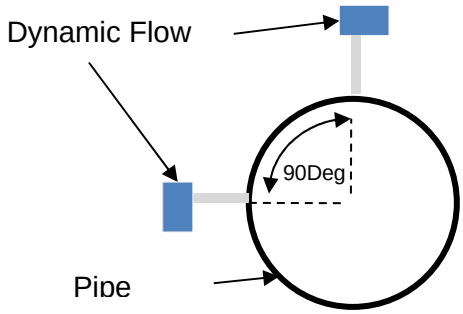


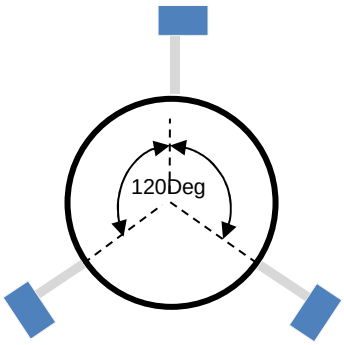
Fig 3. : Free Fall

- To measure the flow in a pipe with a diameter higher than 200mm we recommend to use several sensors according to the diagram below :

  - **Pipe Diameter > 200mm**



  - **Pipe Diameter > 300mm**



- In the case of a horizontal pipe, place the sensor on the upper part of the pipe.

However it is strongly recommended to install the sensor on Vertical pipes when it is possible.

- Place the sensor in the same direction as the flow of material passing through the pipe.

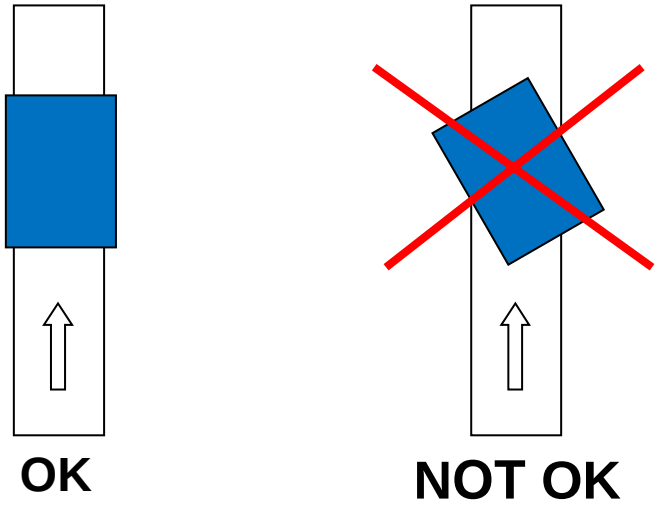


Fig 4. : Sensor Orientation

2.1.3 BUSHING MOUNTING PROCEDURE :

When possible, it's better to have a customized Bushing adapted to the thickness of the pipe.

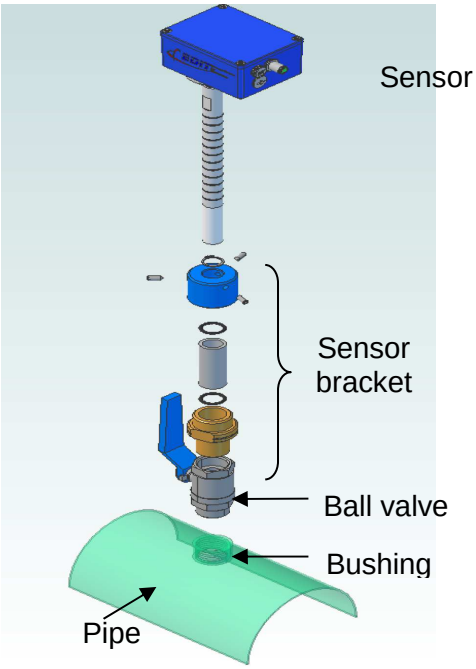
Make sure the pipe is completely empty and does not contain gas. In addition, if the pipe is pressurized before the mechanical installation is complete, the sensor may leave its location at high speed and cause serious injury.

During installation, wearing safety equipment is mandatory (safety glasses, protective clothes).

1. Drill a hole **32mm** diameter. Make sure the drill hole has no burrs.

3. If you have a valve, screw the valve and close it to seal the pipe. Use Teflon liner for sealing.

4. Fix the sensor bracket.



2.1.4 SENSOR MOUNTING PROCEDURE :

1. Position the circlip on the waveguide regarding depth of the bushing + valve + bracket + thickness of the pipe.
   For optimal operation, the sensor head should be at least flush with the inside of the pipe or slightly inside.

   Use a depth gauge to determine the exact depth

2. Unscrew the headless screws of the blue holder bracket.

3. If you have a valve, open the valve to allow the passage of the waveguide.

4. Insert the waveguide sensor proper depth.

5. Secure the sensor with the screws.

2.2 ELECTRICAL CONNECTIONS

2.2.1 SENSOR CONNECTORS :

The sensor has two connectors:

- One **connector M12** for 24 VDC power supply and analog outputs.
- A **mini USB port** used to configure the sensor. It is accessible by removing the protective cap.

2.2.2 SENSOR WIRING :

Sensor can be connected :

- Directly using M12-9pts cable delivered with equipment.
- To PSI Box.

2.2.2.1 Wiring using M12-9pts Cable

Several solutions are available to the system to retrieve flow information:

- Connection to the analog outputs 4..20mA.
- Connection to the output Pulse.

The cable M12 – 9pts is described in the following figure.

M12 connecteur Pin number	couleur	Description
1	white	pulse
2	brown	analog 1 -
3	green	analog 1 +
4	yellow	analog 2 +
5	gray	analog 2 -
6	Pink	pulse
7	blue	0VDC
8	red	24VDC
9	yellow/Green	Shielded cable

Fig 7. Cordon M12 – 9pts

The cable provides has an extra wire (Yellow/Green) it is necessary **to connect to the ground of the system.**

This connection is important because it will allow the sensor, which used microwave technology, not to be affected by the external environment.

2.2.2.2 Wiring to PSI Box

Picture bellow shows the connection of the Sensor to PS Box.

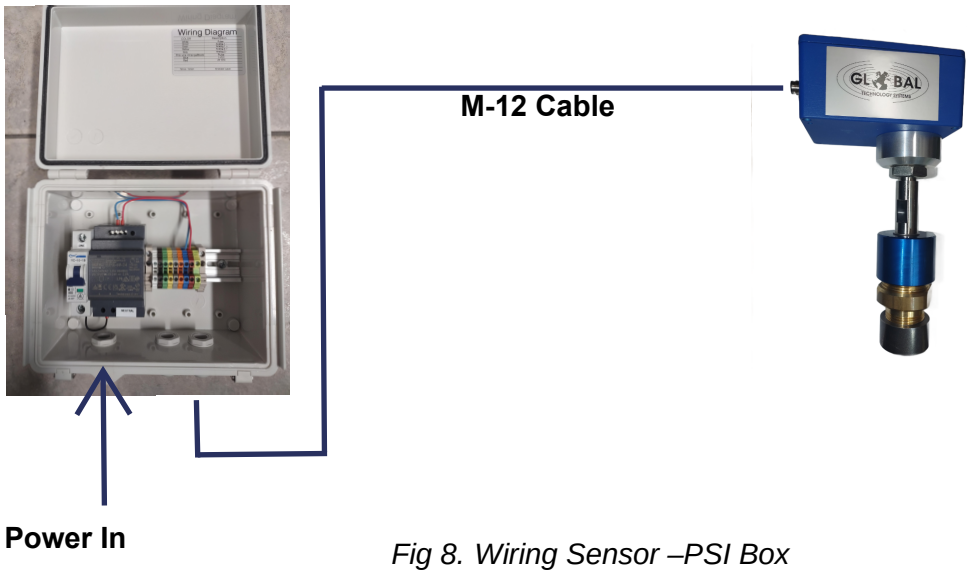


Fig 8. Wiring Sensor –PSI Box

Following drawing shows the different terminals inside PSI box to connect 110/220V and Outputs :

Wiring is indicated on a sticker inside the cover of PSI Box .

2.2.2.3 Cables Sections

The minimum section for each cable is **0.25mm²(> AWG23)**.

2.2.3 4..20MA WIRNG

2 Analog 4..20mA outputs are available from the equipment.

Each analog output can be configured separately, using Flow 32 Software.

Following drawing represent wiring of one analog output.

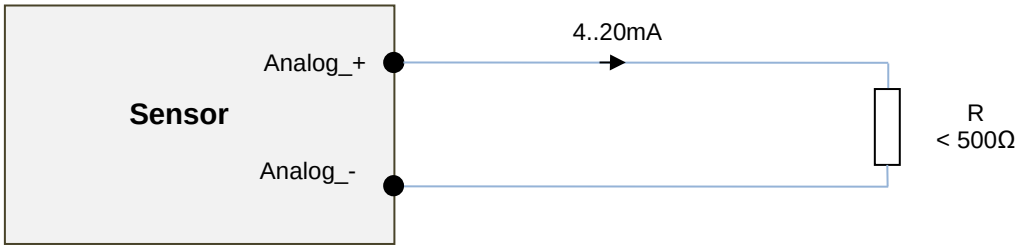


Fig 10.4..20mA wiring

2.2.4 PULSE OUTPUT WIRING

One « Pulse » output is available. It is a contact which need to be wired regarding the application.

There is no polarity and the mode NO(Normally open) or NC(Normally closed) can be set using Flow32 software.

Following drawing shows an example of wiring.

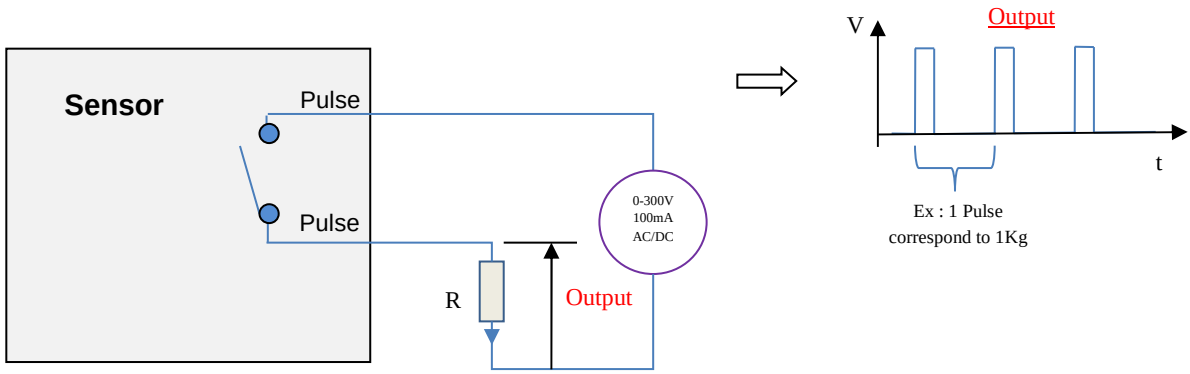


Fig 11. Pulse output Wiring

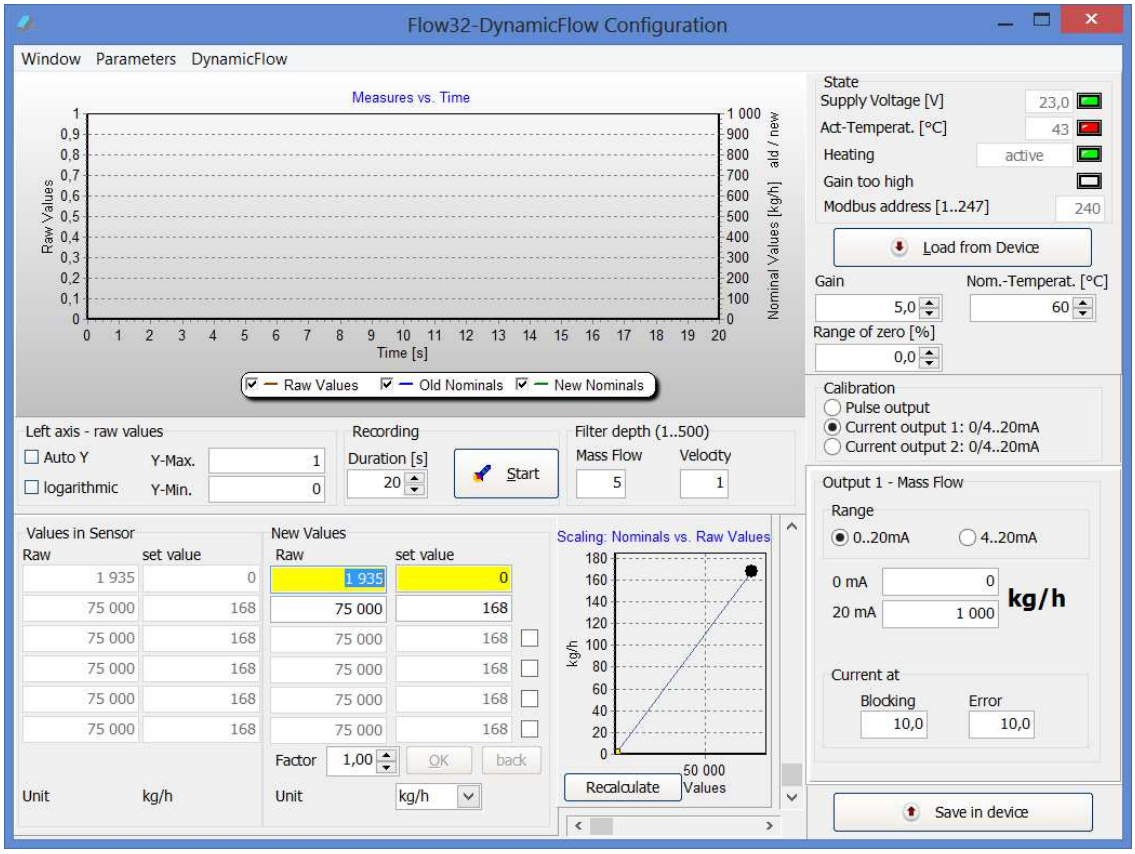
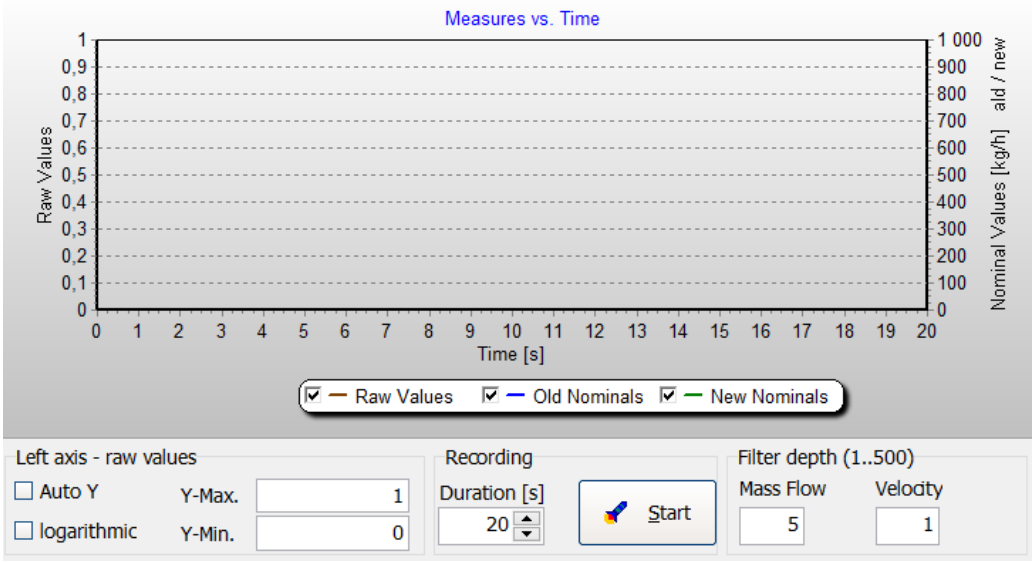


Fig 15.Main window

The window is divided into several parts :

- Graphic.
- Status lights.
- Parameters of outputs Pulse and 4..20mA.
- Calibration parameters.

3.2.4 GRAPHIC



It allows you to view the raw signal measured by the device over time (brown curve) and estimated flow from the calibration performed (green curve)

- The **« Auto Y »** button defines if the scale of gross value (left) must be adjusted automatically or manually, in which case it is necessary to define the minimum scale value in fields **« Y-Max » and « Y-Min »**.

- The **« Logarithmic »** button displays the values of the graph on a logarithmic scale

- **« Duration [s] »** defines the duration of recording (from 10s to 30mn).

- **« Start »** button starts measurement.

- The **« Filter Mass Flow and Velocity »** fields are used to average the measures to smooth the curve (1-500). The « **Mass Flow** » field defines the filtering of the analog output 1.

3.2.5 SENSOR STATUS

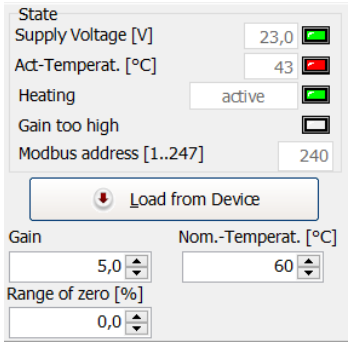


Fig 17.Status lights

Status gives several information about the device :

- **The supply voltage** being provided to the sensor : if the voltage is within the range tolerated by the sensor, a green light is on. If the voltage is too low or too high, the light will turn red.

- **Act temperature** of the device : it can be manually set in the field **« Nom Temperat. [°C] »**. we recommended to set the nominal temperature to **60°C**. Thus, the device constantly adjust his internal temperature.

- **Heating** : determines whether the system for regulating the temperature of the device is active (green light) or reaches the preset value and stop control (red light).

- **Gain too high** : The indicator lights red when the signal saturates due to too much flow. However, if the signal is too weak, it is possible to boost the gain by increasing the value in the « **Gain** » field.

- **ModBus address :** Indicates Modbus address of the sensor

- The button « **Load from device »** allows to retrieve calibration parameters currently stored in the sensor connected

- **Gain** : allows amplification of the signal (from 1 to 256).

- **Range of zero** : this field allows you to set a percentage of the measurement range below which the measured flow is considered invalid. This eliminates noise which can be generate by a very low flow.

3.2.6 CURRENT OUTPUTS PARAMETERS

3.2.6.1 Outputs 4..20mA

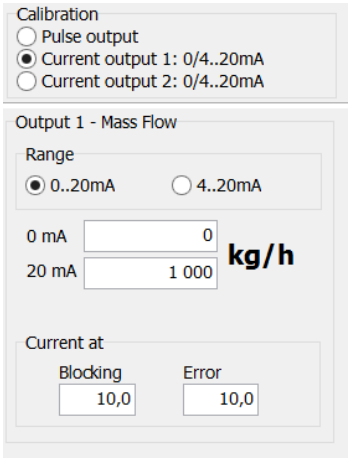


Fig 18.Outputs 4..20mA

- Here you can set the analog output you want to calibrate and parameter : **Pulse Output, Current output 1, Current output 2**.

- For current outputs 1 and 2, you can choose between a **range** of output **0…20 mA** or **4…20 mA**. Then determine fields **« 0/4 mA »** and **« 20 mA »** under their intervals Min and Max.

- **« Blocking »** field sets the output current when the analog output is blocked.

- **« Error »** field sets the output current in cas of technical problem with the sensor.

- By selecting « **Output pulse** » button, you can access to new parameters :

3.2.6.2 Output Pulse

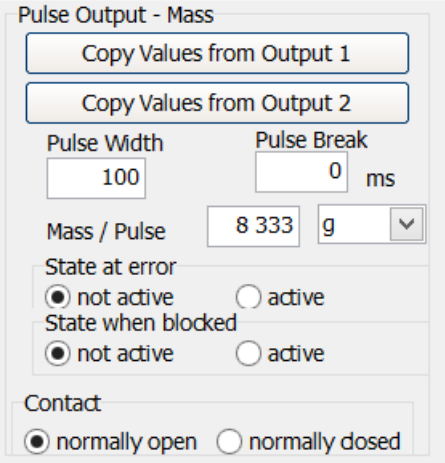


Fig 19.Outputs pulse.

- You can choose to duplicate the calibrations performed on the current outputs 1 and 2 by clicking on buttons **« Copy values from output 1 »** or **« Copy values from output 2 »**

- In the field **« Pulse with»**, determine the pulse duration (30-10000).

- In the field **« Pulse break »**, specify the minimum time between two pulses.

- In the field **« Mass / pulse »**, enter the amount product that corresponds to one pulse.

- **« State at error »** determines whether the pulse must remain activated or disabled for any technical problem with the sensor.

- **« State when blocked »** determines whether the pulse must remain activated or disabled when output pulse is blocked.

3.2.7 CALIBRATION PARAMETERS

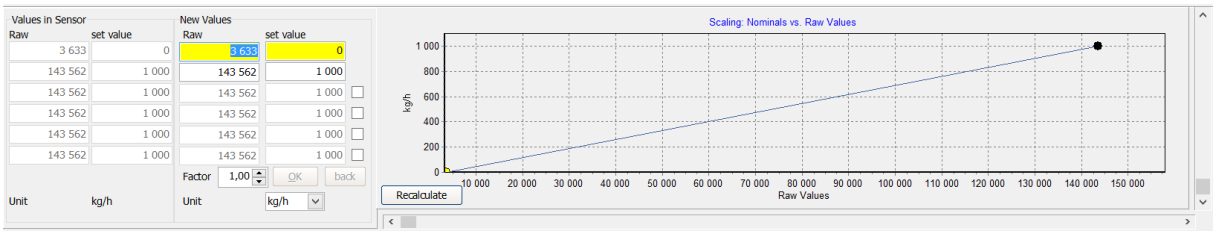


Fig 20. Calibration table.

It is in this part of the main window that you need to fill the calibration table. A calibration curve is also available to show the flow values calculated based on raw values measured by the device.

Usually 3 calibration points are sufficient (1 minimum point, 1 maximum point and 1 intermediate point). For best accuracy, **Flow32** offers the possibility **to enter up to six calibration points**.

4 CALIBRATION

The SF-150 sensor calibration consists in measuring different real flow of products going through the pipe in order to calibrate the sensor.

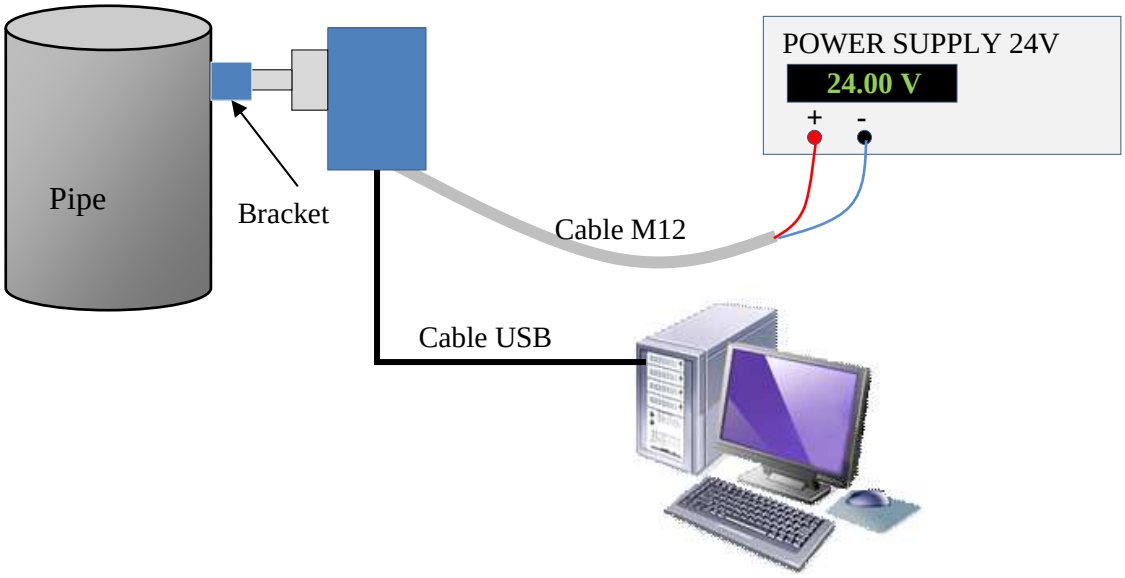
In general, 3 Measurements are sufficient to calibrate the sensor, but if the application requires more accuracy it is possible to perform up to 6 statements.

4.1 EQUIPMENT

The equipment needed for calibration is as follow :

- 1 SF-150 Flowmeter installed in the pipe and powered with 24VDC.
- 1 PC with software **Flow32** installed.
- 1 Cable USB)**.**

4.2 CONNECTIONS



It is mandatory to respect the order of the different steps described below to connect the sensor to the computer.

1. **Disconnect USB cable if it is already connected.**
2. **Turn off Power supply and Then Turn On.**
3. **Connect USB Cable from the sensor to the computer.**

4.3 PROCEDURE

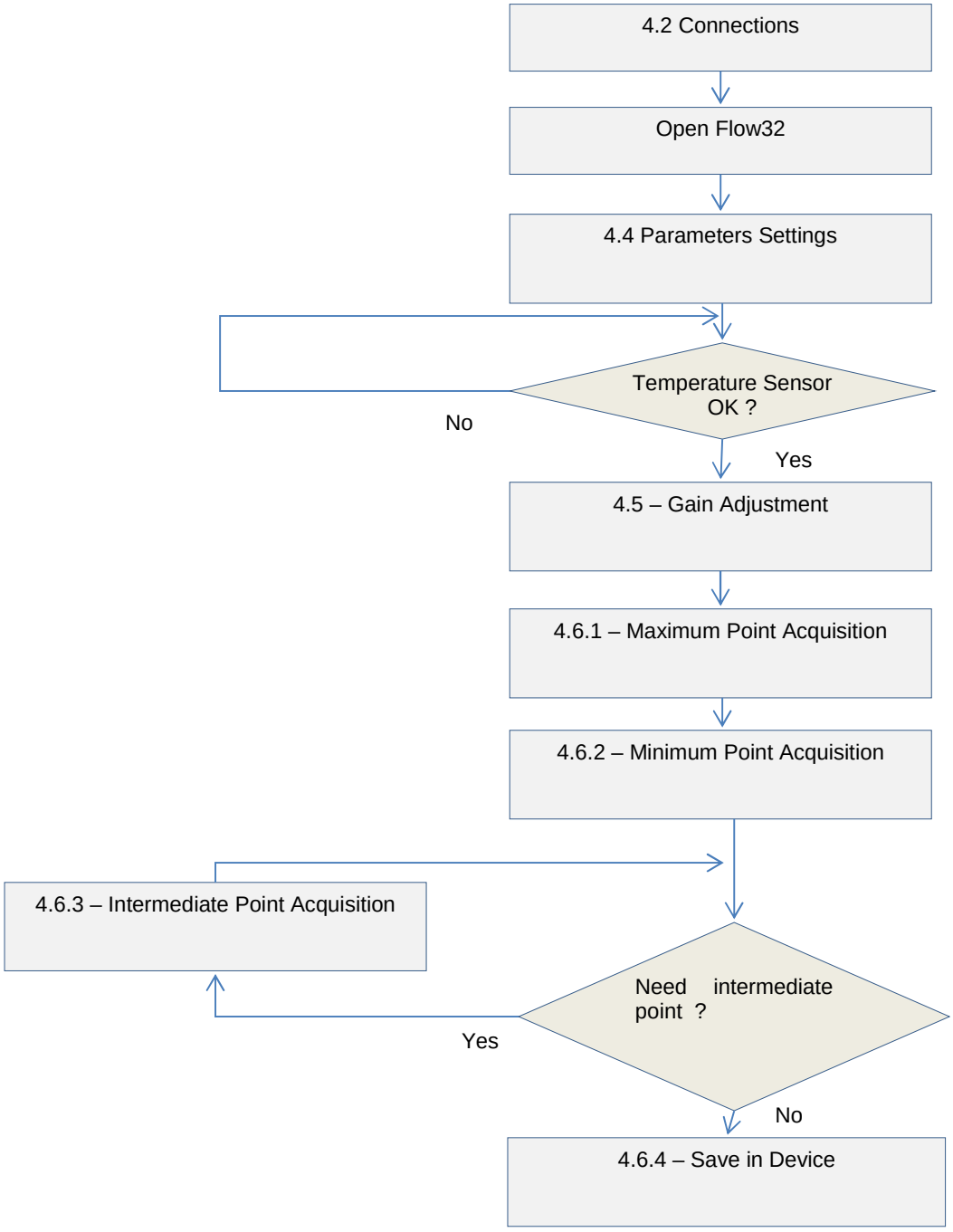


Fig 21. Calibration Organigram.

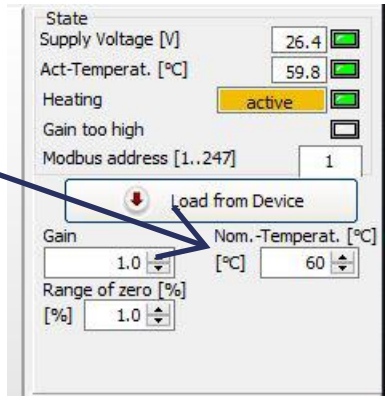
4.4 PARAMETERS SETTINGS

Start **Flow32**, open main window.

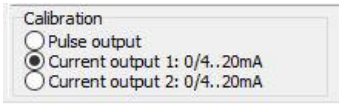
1. Check in the **Status** window, no light should be red.

If necessary, adjust the **nominal temperature**. We recommend the set to **60°C**.

If the temperature light turns red, it is necessary to wait for stabilization of the nominal temperature by the sensor.
This may take 2 or 3 minutes.



2. Choose which analog output you want to calibrate :



For analog outputs 1 and 2, select range 0…20 mA or 4…20 mA you want, and the intervals Min and Max :

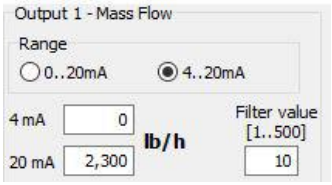


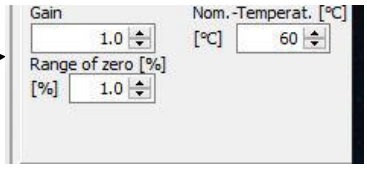
Fig 23.Choices range 0..20mA or 4..20mA.

4.5 GAIN ADJUSTMENT

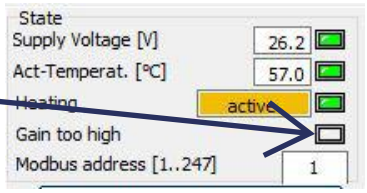
Adjust the flow in the pipe to the maximum.

Make a record by clicking on button « **Start** ». Make sure that recording time is enough long.

To use maximum sensor dynamic it is necessary to adjust the **gain**.



This operation consist in increasing the gain value until the sensor saturates (light « **Gain biggest » flashes red**).



Once saturation obtained, **decrease the gain of 10%**.

We strongly recommend to not apply a gain Higher than 20.

When the gain is determined by clicking the button 

to save parameters in the sensor.

4.6 CALIBRATION TABLE

Before starting the acquisition of calibration points, set the designed unit.

4.6.1 MAXIMUM POINT ACQUISITION

Adjust the flow in the pipe to the maximum.

Make a record by clicking « **start** » button for the time required (we recommend a minimum of 120s).

Make sure the curve is as constant as possible, repeat if necessary the acquisition.

You need to determine which is your flow maximum by performing a weighing f product over a period as longer as possible.

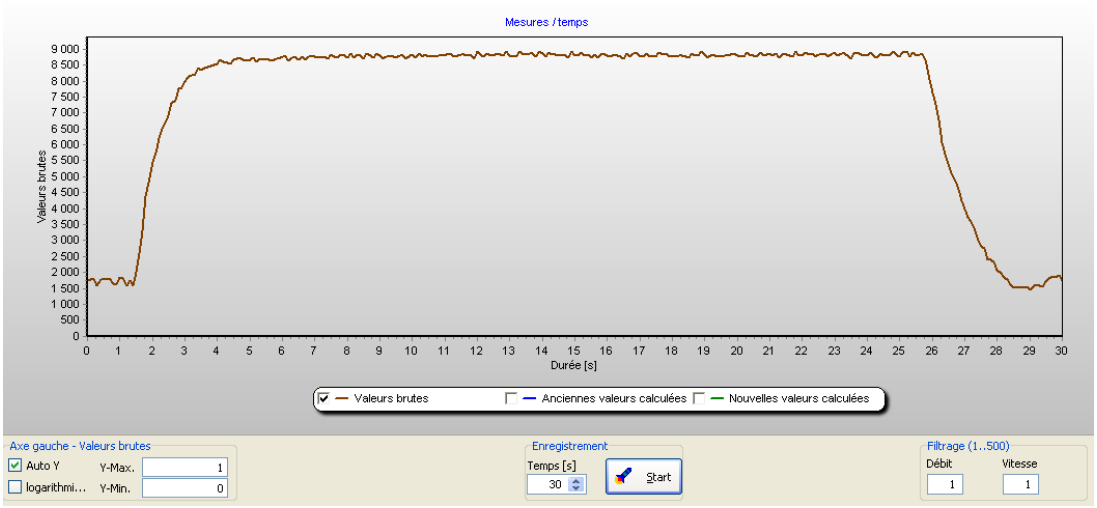


Fig 24. Example of recording raw values.

To get average value, just click the **ordinate scale** of the calculated values if you want to have **average of all data measured**.

If you only want to have **average on a part of the graph**, select part concerned using left mouse click on the graph. Keep left mouse pressed until you reach the point where you want to stop.

Then average will display in a pop up window :

Use left mouse click to select part of the curve

Fig 25. Average recovery value.

In the **« New values »** field of the main window, enter the average value of the raw values in the « **Raw** »column, and enter the actual flow value in the « **Calculated** » column.

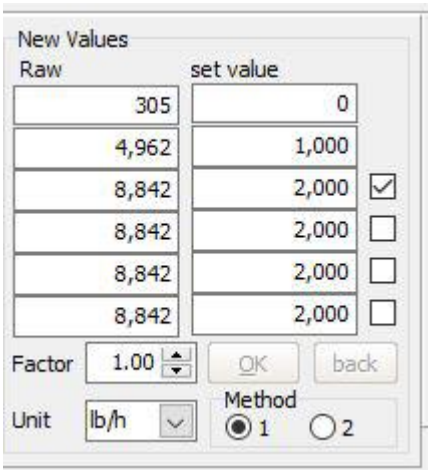


Fig 26.Calibration table.

4.6.2 MINIMUM POINT ACQUISITION

Make sure there is no product in the pipe without cutting ventilation.

Repeat acquisition operations.

Enter the new raw value corresponding to a flow of 0.

4.6.3 INTERMEDIATE POINTS ACQUISITION

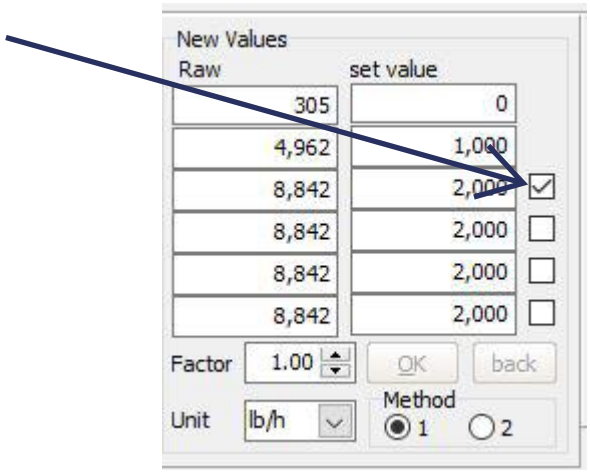
If you want to have more precision, it is possible to acquire extra points (up to 4 points).

Pass the product at intermediate flow in the pipe.

You will have to determine your actual flow by performing a weighing of product over a time period longest as possible.

Repeat acquisition operations

Enter the new raw value corresponding to the new flow having previously checked the button for this value.



Click **« Recalculate »** below the calibration curve to rearrange the recorded points. Your calibration curve is now composed of 3 points, and a third curve appears in the graphic area to indicate the estimated flow from the new calibration

Fig 27. New 3 points calibration curve.

Do not forget to click on « save in the sensor » to download new settings.

Repeat the operation to add three more extra points.

4.6.4 SAVE IN DEVICE:

Click **« Save in the device »** button at the bottom right of the main window to download the new settings in the sensor. This button flashes whenever you change a setting to remember that they must be downloaded at each modification.

4.6.5 SLOPE COEFFICIENT ADJUSTMENT :

A coefficient may be added to the slope of the curve in order to correct and improve the accuracy of the calibration. Change in the **« Factor »** field, below the table « New values ».

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5 TECHNICAL SPECIFICATIONS

Power .....20 to 30 VDC

Current consumption .....0,5 Amps Max.

Storage temperature ..... -25°C to 75°C (without condensation)

Ambient temperature ..... -20°C to 60°C

Temperature in pipe ……. ..... -20°C to 200°C(depends on Product Type)

Maximum pressure in pipe ……. .....80 bars
200bars(Option)

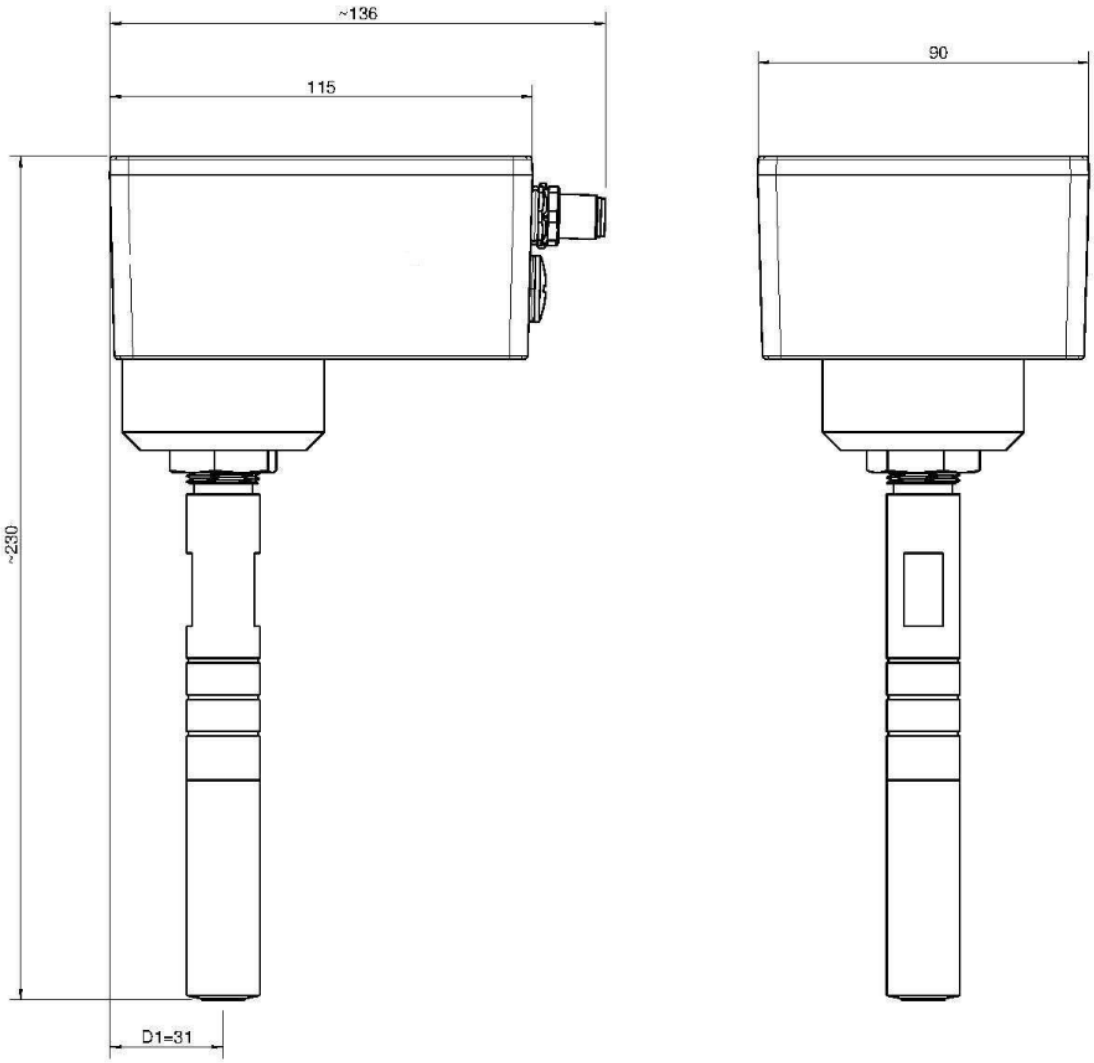
Protection IP66
IP67(Option)

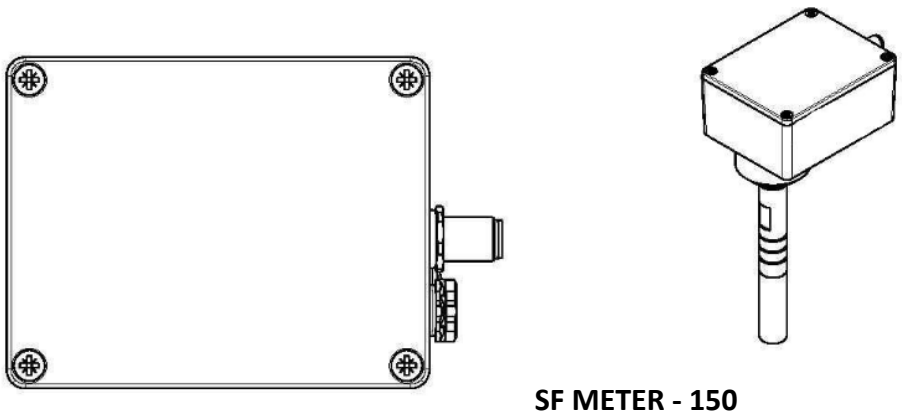
Types of outputs :

1 Output Pulse :
- Tension maximum ..... 30VAC or 30VDC
- Current maximum ..... 0,1 A

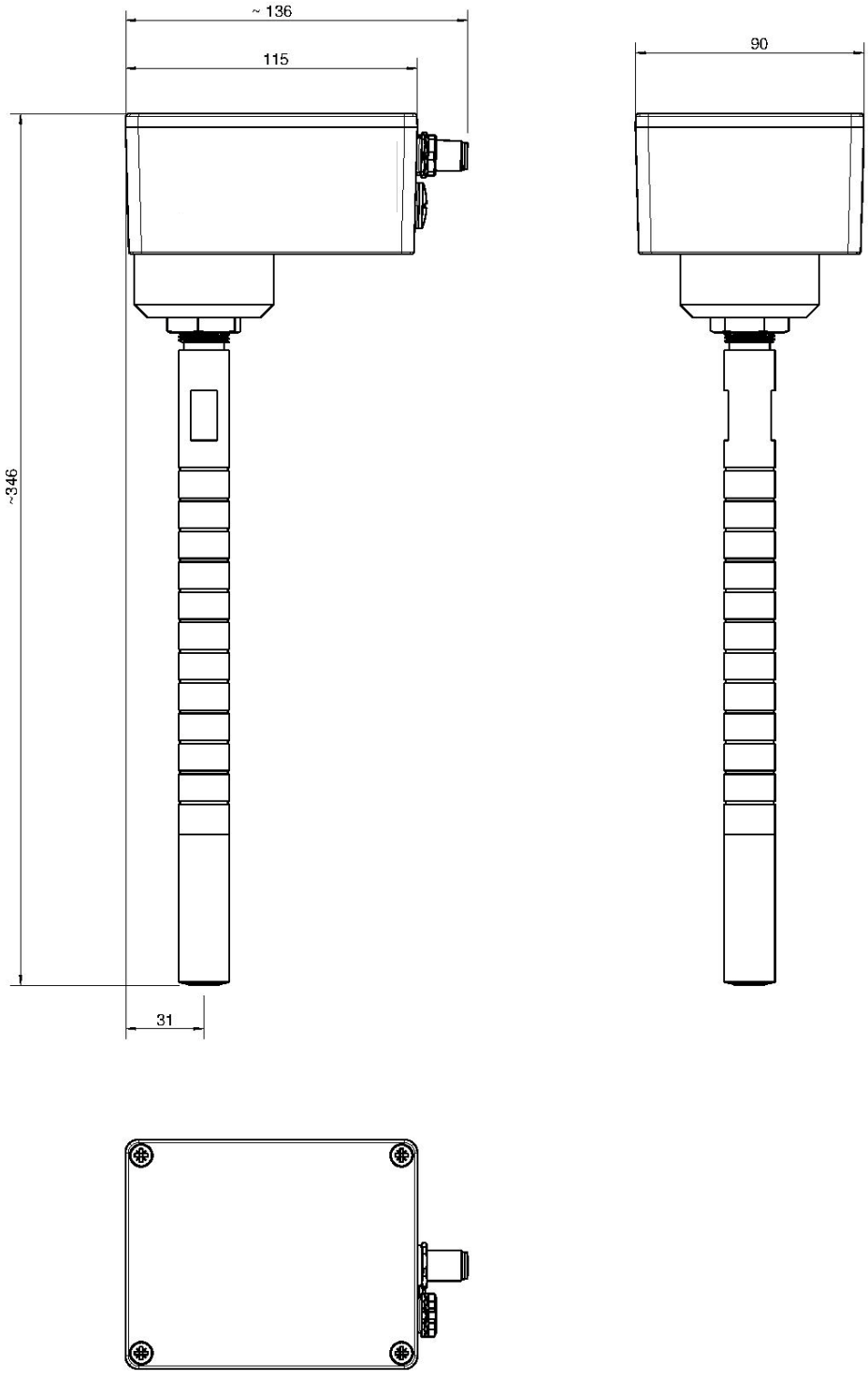
2 Outputs 4..20mA

6 DRAWINGS





SF METER - 150



SF METER - 300

7 MAINTENANCE

BEFORE INTERVENTION ON A SENSOR IN OPERATION.

- **Make sure the pipe is completely empty and does not contain gas. If the pipe is under pressure, the sensor may leave its location at high speed and cause injury.**
- **During intervention, wearing safety equipment is compulsory (safety glasses, protective clothes).**
- **Before starting intervention, make sure the sensor is not powered.**

- **Maintenance operations must be performed by a qualified technician.**

GTS Inc.

70 6th Avenue
Shalimar, Florida
32579
850-651-3388