SENSIRION
THE SENSOR COMPANY

Viewer Software

SFC5XXX / SFM5XXX – Mass Flow Controller / Meter

Summary

This document is a brief installation guide and user manual for the SFC5xxx/SFM5xxx Viewer software.

1 HARDWARE EQUIPMENT

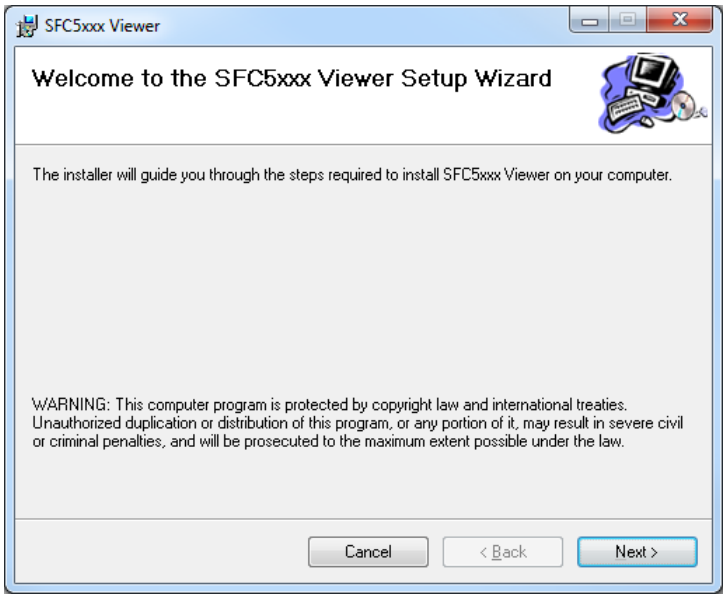
You will find all the necessary hardware in the EK-F5X Evaluation Kit:

- SFC5XXX / SFM5XXX
- RS485-to-USB adapter cable
- 230/100V AC adapter
- Software in the USB memory stick

2 SOFTWARE INSTALLATION

2.1 SFC5XXX VIEWER

- Double-click the SFC5xxx_Viewer_Vx_xx.msi file to start the installer and follow the onscreen instructions.



Note: This software requires Windows Vista (or later) and Microsoft .NET Framework 4.5. If this framework is not installed on your computer, you can download it from the Microsoft website.

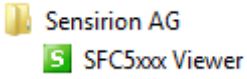
2.2 VIRTUAL COM PORT DRIVER

- Plug the RS485-to-USB adapter cable into the computer and wait for the automatic driver installation.
- If automatic installation does not take place you have to do this manually. The Virtual Com Port (VCP) driver can be downloaded here (be sure to choose the correct version: 64/32 bit operation system): http://www.ftdichip.com/Drivers/VCP.htm

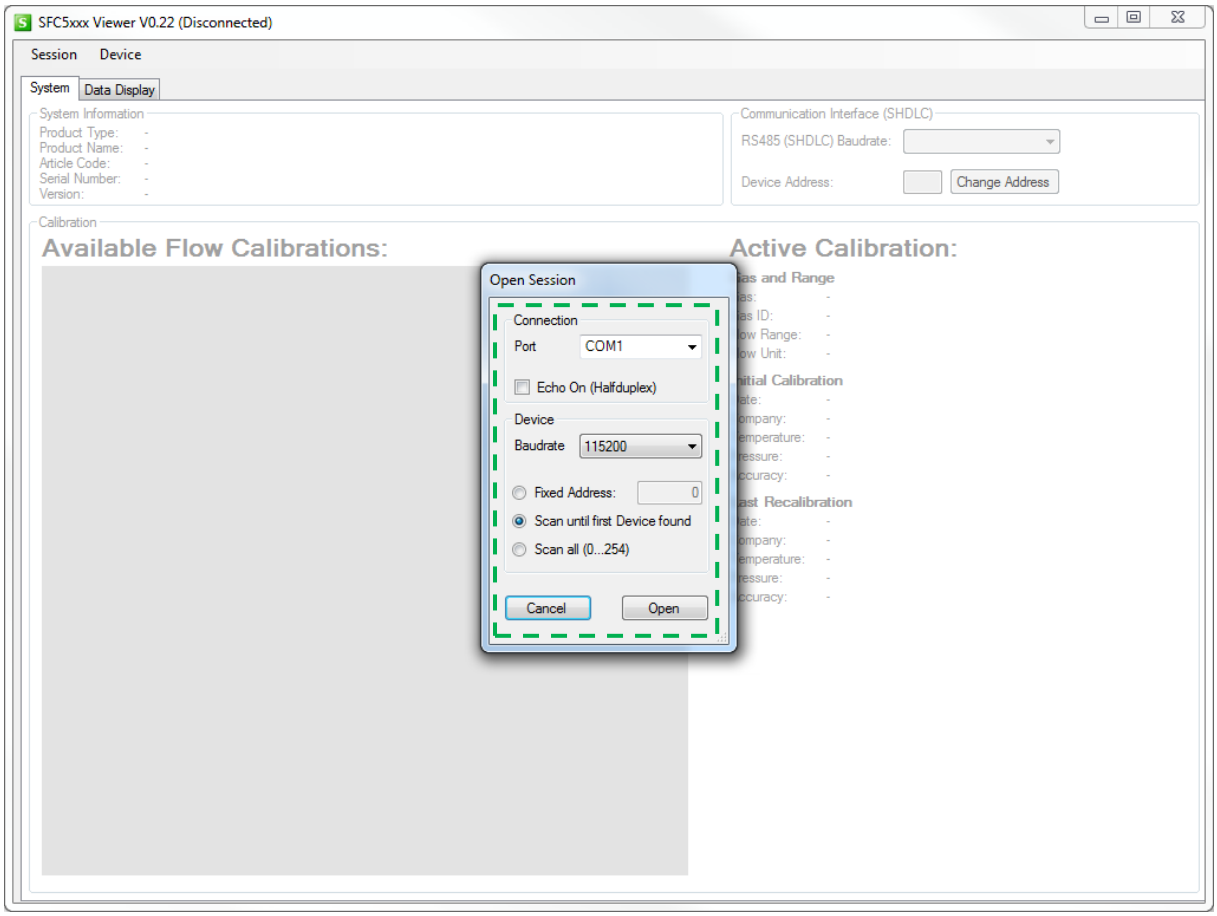
3 SOFTWARE MANUAL

3.1 START SFC5XXX VIEWER

Start → All Programs → Sensirion AG → SFC5xxx Viewer



3.2 CONNECT TO THE DEVICE



- Make sure the MFC is connected to the computer and powered correctly.
- Select the COM-Port/USB-Serial-Port that is connected to the Mass Flow Controller.
- Set an appropriate baud rate (default is 115200) and RS485 address (default value is 0).
- Click “Open”.

Write down your settings if you have changed the connection parameters (see chapter 3.3.2):

Baudrate: …… Address: ……

3.3 SYSTEM TAB

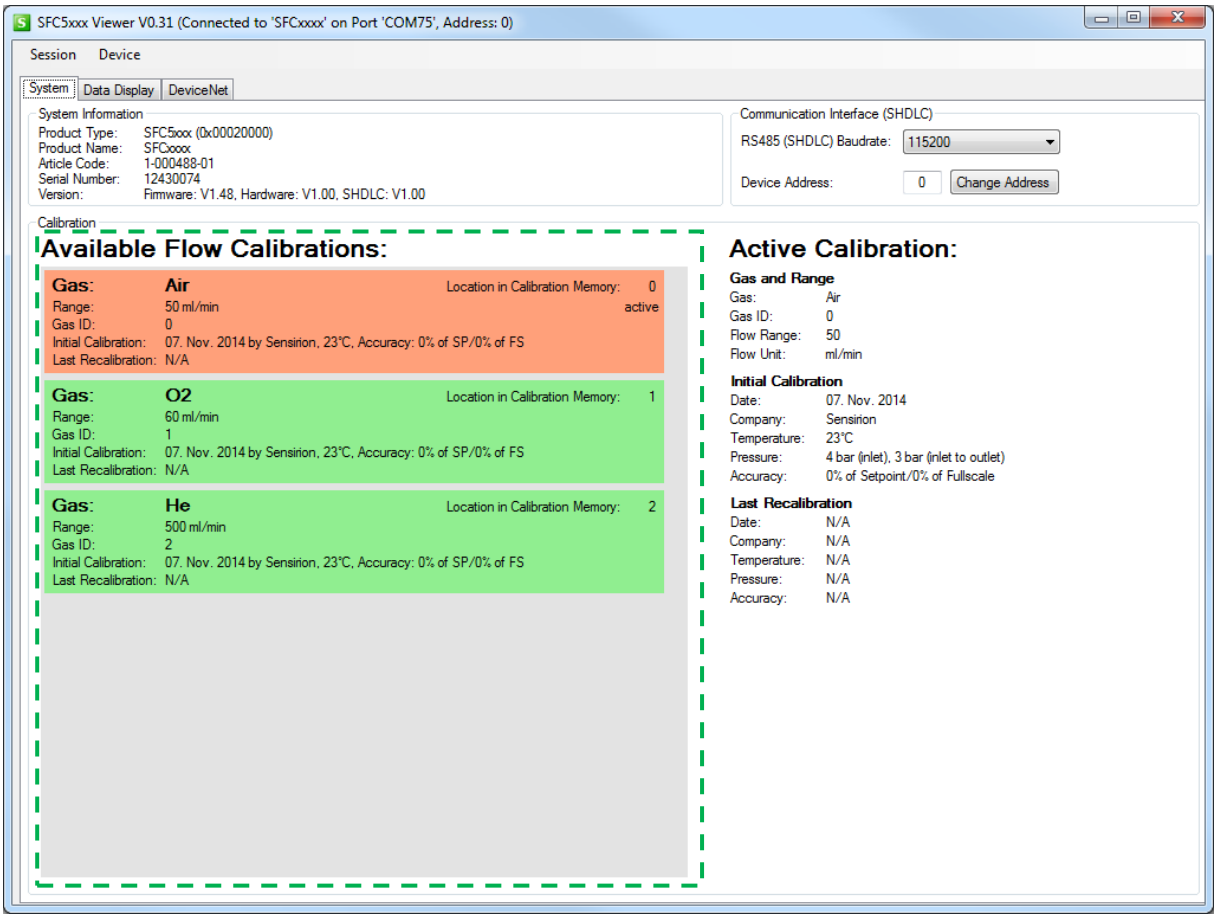
3.3.1 SELECT CALIBRATION

After you have successfully connected to the MFC, you should see a list of calibrations, as shown in the picture below.

Active calibration is highlighted in red.

If more than one calibration is stored on the MFC, all non-active calibrations are shown in green.

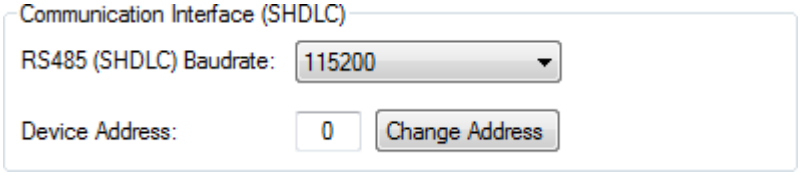
Unused calibration fields are grey.



- Above the list of calibrations you can see system information from the MFC and on the right side you will find information about the calibration which is currently activated.

- You can select the appropriate gas calibration from the multigas selection “Available Flow Calibrations” by right clicking on the calibration → Load Calibration.

3.3.2 CHANGE BAUD RATE / DEVICE ADDRESS



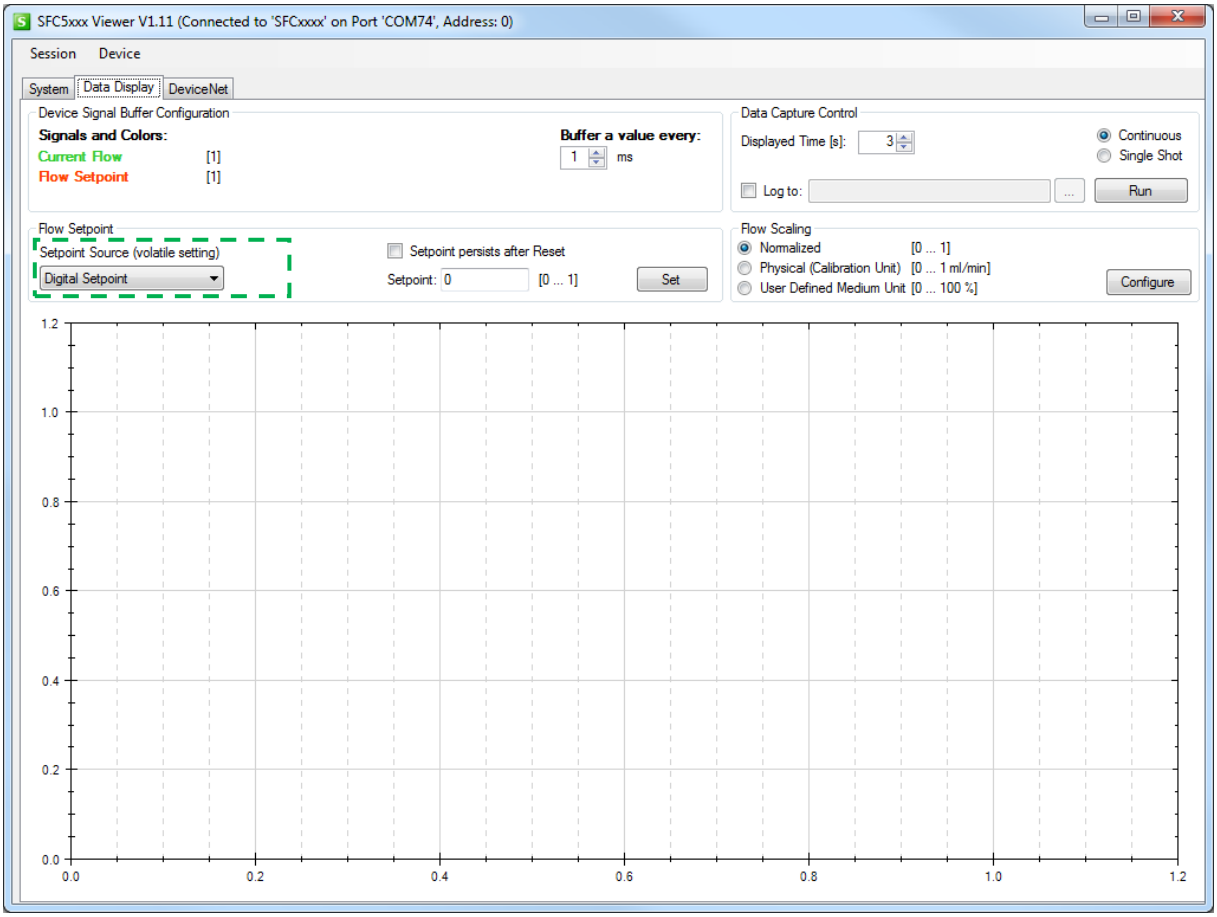
- To change the baud rate select another baud rate from the drop down list. You will be asked if you want to change the baud rate. → Click “Yes”.

- To change the address, enter the new address from 0 to 254 into the address field and click “Change Address”.

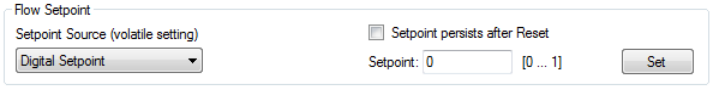
Note: The new baud rate and address will persist after a reset or power down. You will need it next time to connect. Therefore, please write down the new settings on page 5.

3.4 DATA DISPLAY TAB

3.4.1 SETPOINT CONFIGURATION

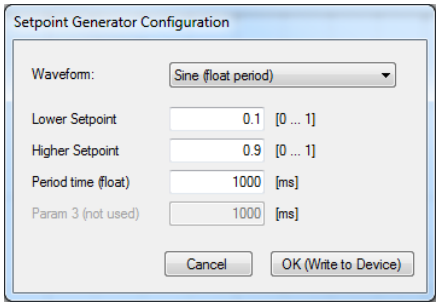


- Choose a setpoint type, “Digital Setpoint” to set manually a value



or “Waveform Generator” to use the MFCs internal waveform generator.

- If you selected the “Waveform Generator” click on the “Configure” button to specify a specific waveform.

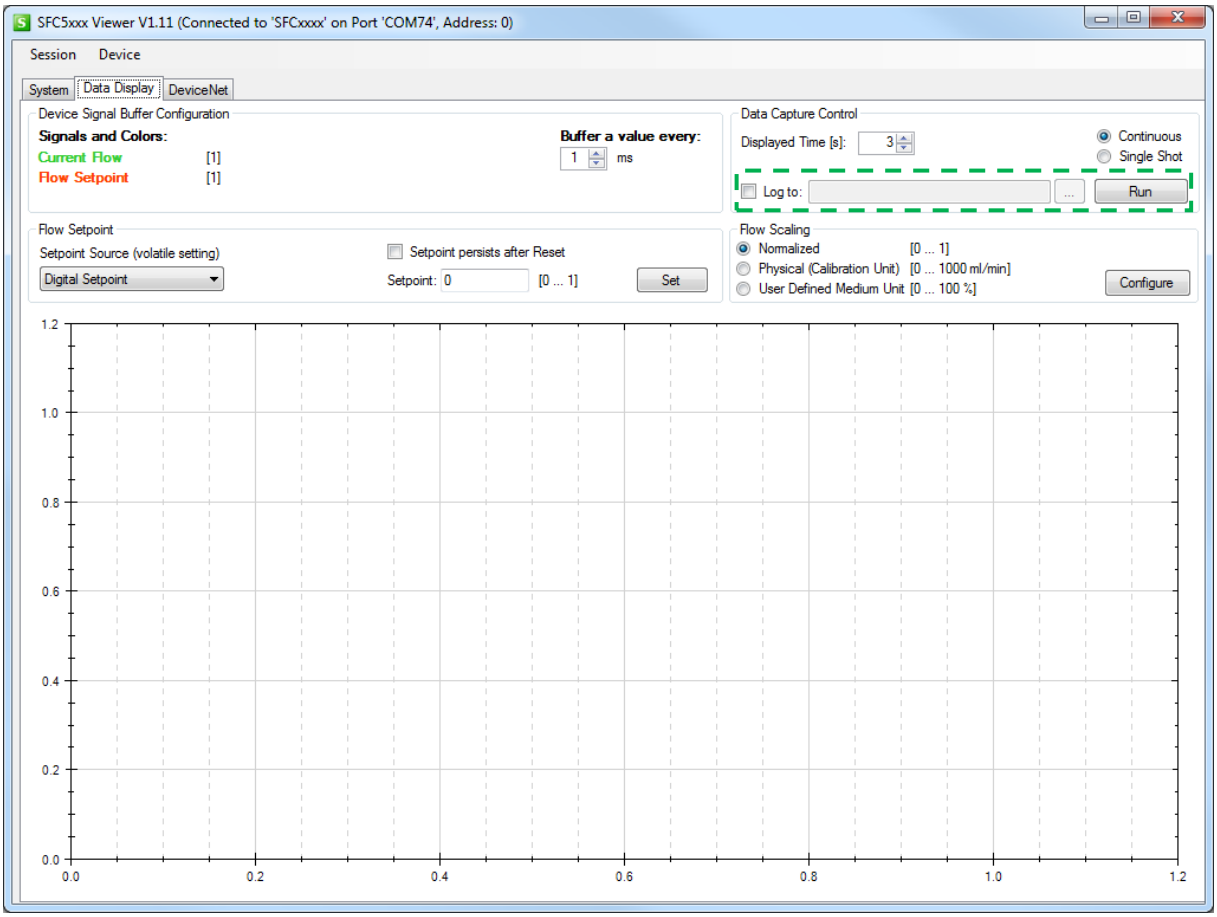


3.4.2 FLOW SCALING

The setpoint and measured flow can be read or written as normalized, physical (Calibration Unit) or “User Defined Medium Unit” value.

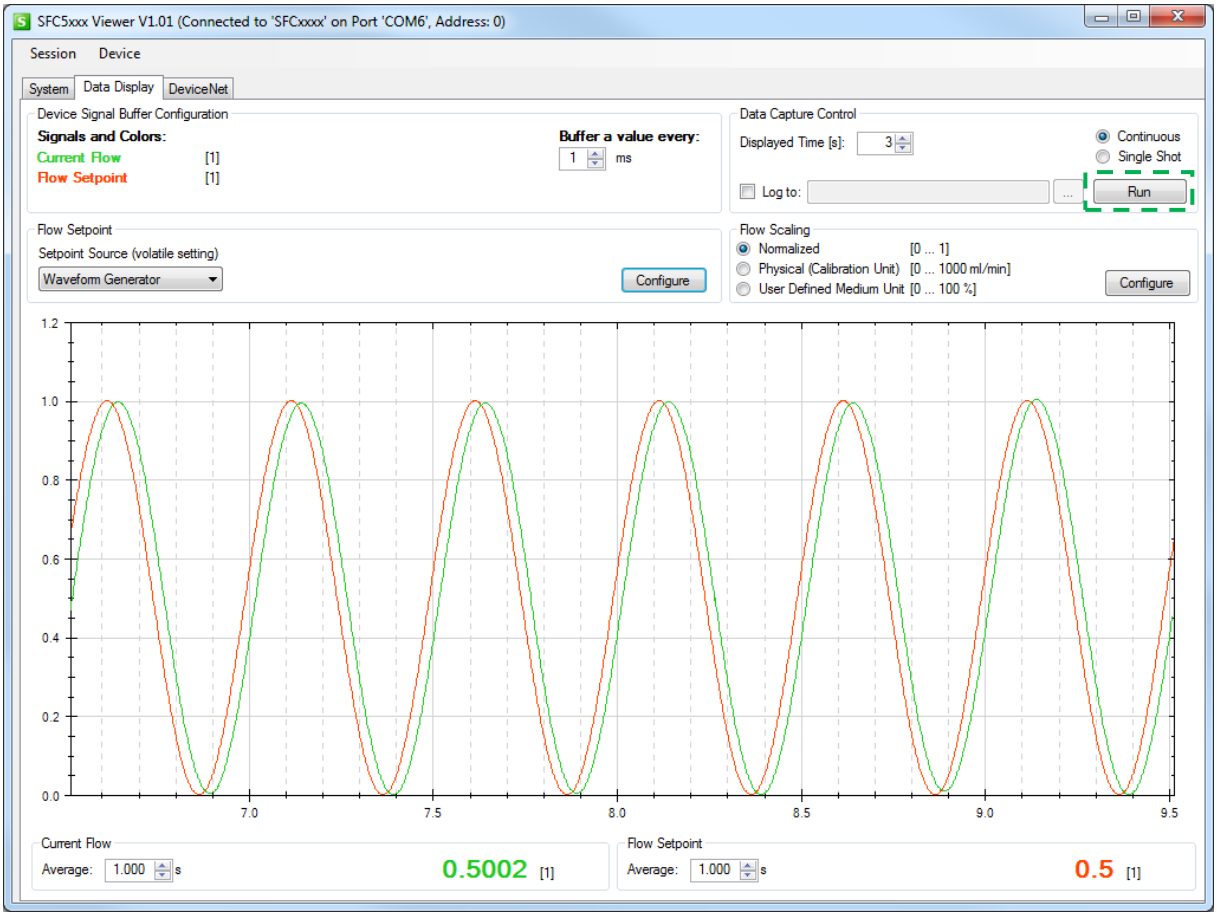
Normalized:	The values are scaled in the range 0 (no flow) to 1 (full-scale flow).
Physical (Calibration Unit):	The values represent a physical flow and are in the range 0 (no flow) up to the full-scale.
User Defined Medium Unit:	The values are scaled to a user defined unit. See: Device → Advanced Settings/Tools → User Defined Medium Unit

3.4.3 DATA LOGGING



- Select the checkbox “Log to:” to enable data logging.
- Click on the “…” button to choose the folder where the data log file should be saved.
- After starting capturing data (click on the “Run” button), a log file with the filename format “SFC5xxx_Log_[DATE]_[TIME].csv” will be created in the specified folder. Data logging is active as long as data capturing is active.

3.4.4 DEMONSTRATION

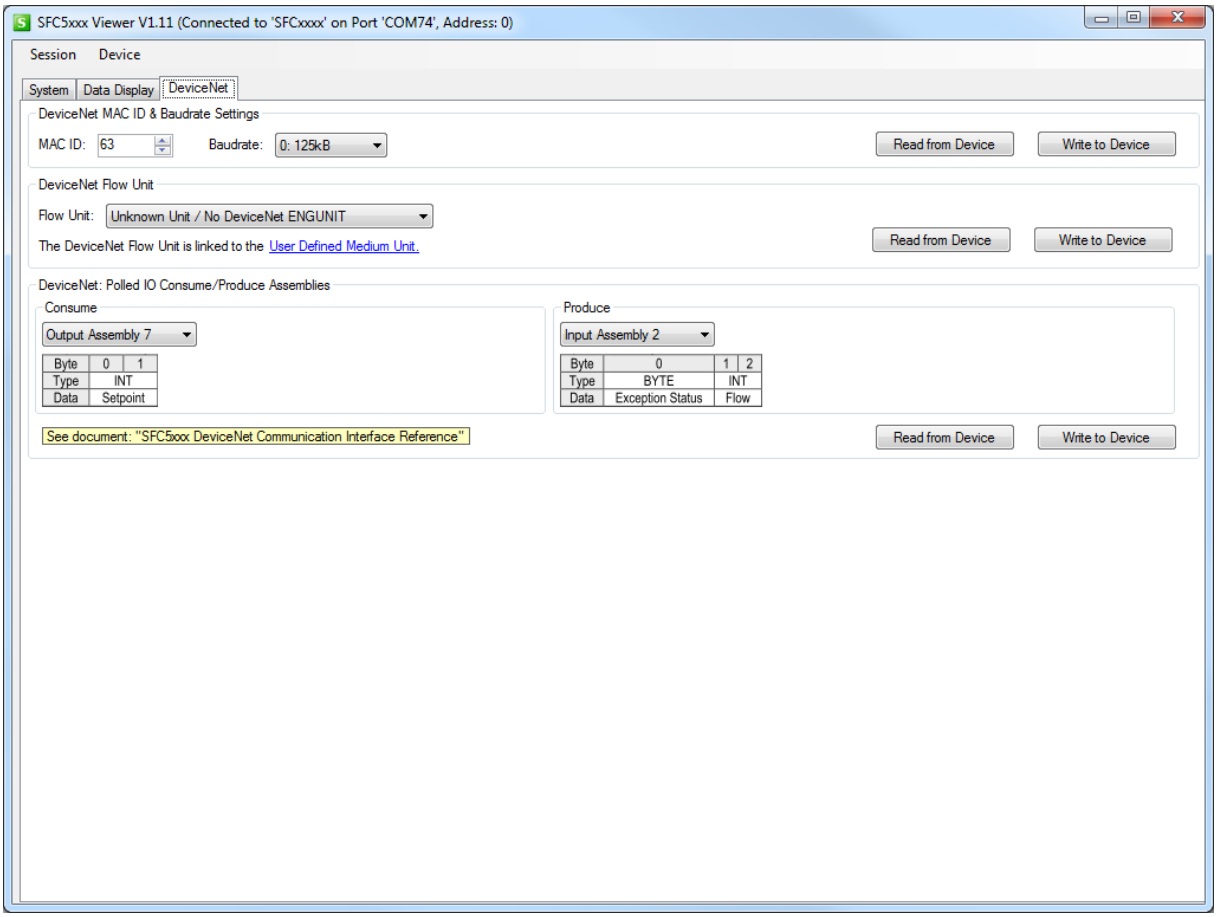


- After the desired set point type is chosen, start data capturing using the “Run” button.
  red: flow set point, generated by the internal sine waveform generator
  green: measured flow

Note: With the default baud rate it may not be possible to transfer two signals at the same time by an interval of 1ms seamless. If the “Buffer overflow” warning is shown, you should increase the baud rate or set “Buffer a value every:” to at least 2ms to get a continuous signal without gaps.

3.5 DEVICENET TAB

Here you can configure the basics settings for DeviceNet devices before you install it in your system. If you are familiar with DeviceNet you can also configure these settings directly through your DeviceNet master. See our DeviceNet documentation: “SFC5xxx DeviceNet Communication Interface Reference”



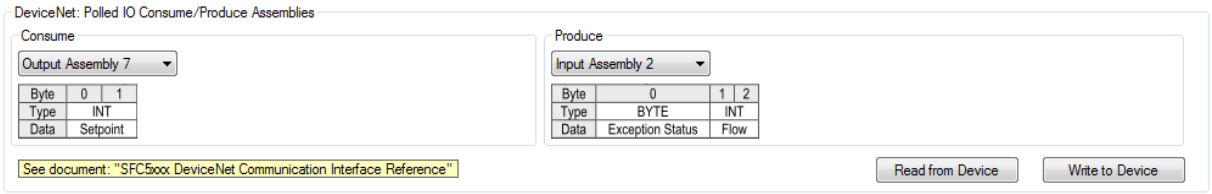
3.5.1 MAC ID & BAUDRATE

- Select a DeviceNet MAC ID between 0 and 63. (Default: 63)
- Select the baud rate 125kB, 250kB or 500kB. (Default: 125kB)
- Each device on a DeviceNet bus must have a different MAC ID and the same baud rate.
- Click the “Write to Device” button to store the settings.

3.5.2 FLOW UNIT

- Select the unit to be used for the flow in DeviceNet. (Default: 0 … 65535 counts → full-scale)
- If you use the INT data type for flow, make sure that in the selected unit covers the whole flow range and that the flow resolution is sufficiently high.
- Click the “Write to Device” button to store the settings.

3.5.3 POLLED I/O CONSUME/PRODUCE ASSEMBLIES



- In the panel “Consume” you can select the process data set which is sent from the network to the device (Output Assembly). (Default: Output Assembly 7)
- In the panel “Produce” you can select the process data set which is sent from the device to the network (Input Assembly). (Default: Input Assembly 2)
- Click the “Write to Device” button to store the settings.

Output Assemblies:

Nr.	Description
7	Size = 2 Bytes Byte 0 1 Type INT Data Setpoint
8	Size = 3 Bytes Byte 0 1 2 Type USINT INT Data Override Setpoint
19	Size = 4 Bytes Byte 0 1 2 3 Type REAL Data Setpoint
20	Size = 5 Bytes Byte 0 1 2 3 4 Type USINT REAL Data Override Setpoint

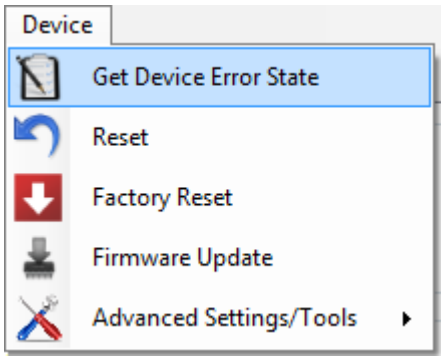
Input Assemblies:

Nr.	Description
2	Size = 3 Bytes Byte 0 1 2 Type BYTE INT Data Exception Status Flow
6	Size = 8 Bytes Byte 0 1 2 3 4 5 6 7 Type BYTE INT INT USINT INT Data Exception Status Flow Setpoint Override Valve
14	Size = 5 Bytes Byte 0 1 2 3 4 Type BYTE REAL Data Exception Status Flow
18	Size = 14 Bytes Byte 0 1 2 3 4 5 6 7 8 9 10 11 12 13 Type BYTE REAL REAL USINT REAL Data Exception Status Flow Setpoint Override Valve

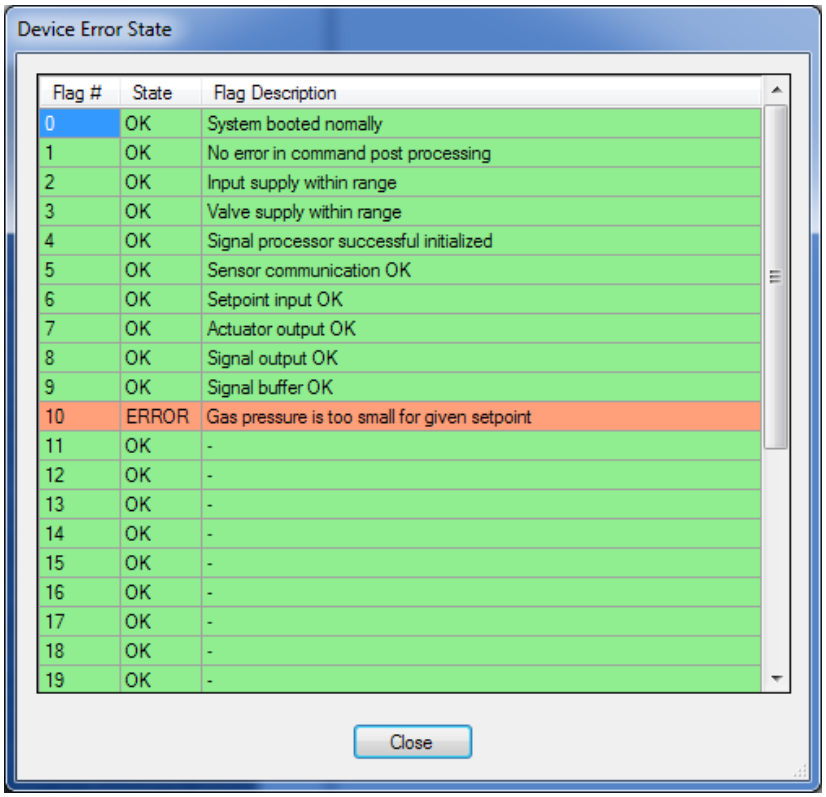
For more information see our DeviceNet documentation: “SFC5xxx DeviceNet Communication Interface Reference”

3.6 MENU

3.6.1 DEVICE → GET DEVICE ERROR STATE



- The SFC5xxx has an internally error status register. You can show the "Device Error State" window by clicking on the menu item Device → Get Device Error State.



Flag #	State	Flag Description
0	OK	System booted nomally
1	OK	No error in command post processing
2	OK	Input supply within range
3	OK	Valve supply within range
4	OK	Signal processor successful initialized
5	OK	Sensor communication OK
6	OK	Setpoint input OK
7	OK	Actuator output OK
8	OK	Signal output OK
9	OK	Signal buffer OK
10	ERROR	Gas pressure is too small for given setpoint
11	OK	-
12	OK	-
13	OK	-
14	OK	-
15	OK	-
16	OK	-
17	OK	-
18	OK	-
19	OK	-

- If e.g. gas supply pressure drops down and MFC can't reach the setpoint, the correspondent error status will turn red in the "Device Error State" list.

3.6.2 DEVICE → RESET

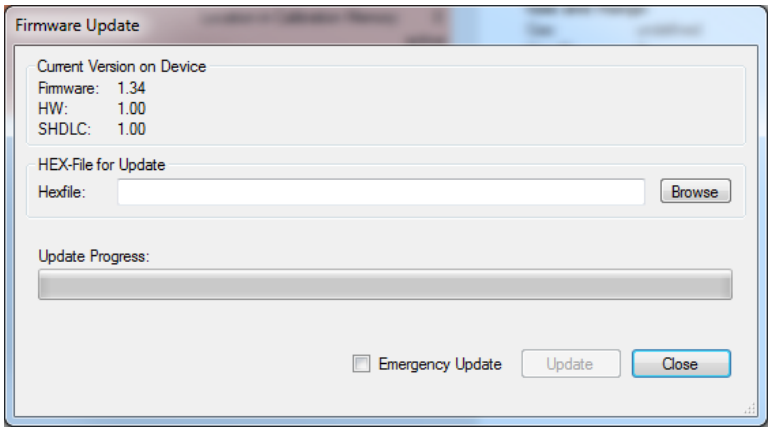
- You can perform a device reset by clicking on the menu item Device → Reset. This reset has the same behavior as a power down.

3.6.3 DEVICE → FACTORY RESET

- If you click the menu item Device → Factory Reset, all settings are set to the factory settings. The gas-specific settings such as calibration are not affected by the factory reset.

3.6.4 DEVICE → FIRMWARE UPDATE

- To update the firmware on the device click on the menu item Device → Firmware Update.

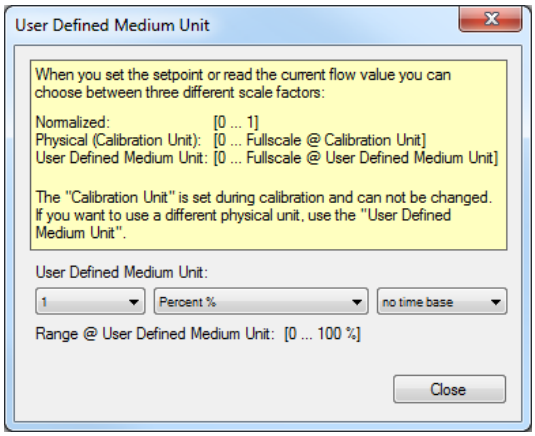


- Click Browse on the Firmware Update dialog window → open the firmware file (*.hex) → click Update. Do not unplug the device while the update is in progress!

Note: If the update process is interrupted by something and the device will no longer operate, there is one last chance. You have to return to the firmware update dialog window (you may need to click away some error messages) → open the firmware file → select the Emergency Update check box → click Update.
Caution: Make sure that you load the correct firmware. The emergency update does not check if the firmware matches to the device. If an incorrect firmware is loaded, it is no longer possible to load another firmware.

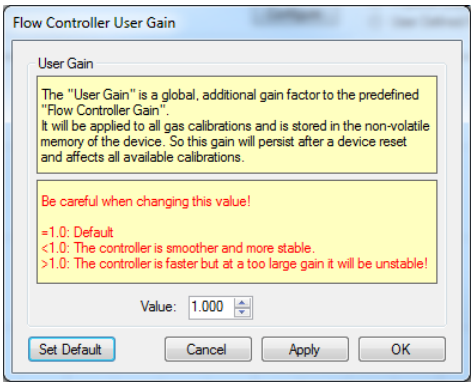
3.6.5 DEVICE → ADVANCED SETTINGS/TOOLS → USER DEFINED MEDIUM UNIT

- You can set the setpoint and read the current flow in your own unit. Here you can define this “User Defined Medium Unit”. When you set the setpoint or read the current flow value you can choose the flow scaling “User Defined Medium Unit”.



3.6.6 DEVICE → ADVANCED SETTINGS/TOOLS → CONTROLLER GAIN

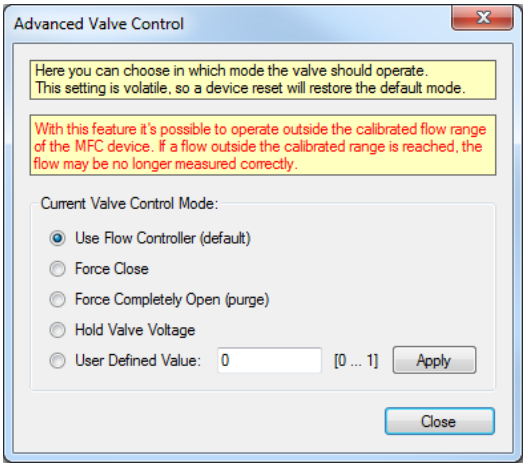
- With the "User Gain" the speed of the controller can be adjusted.



- The default value is 1.0.
- Use lower values for a smoother and more stable controller.
- Use higher values for a faster control behavior, but be careful as the controller may become unstable and start to oscillate!
- The gain parameter is global, so it will be applied to all available calibrations. It is saved in a non-volatile memory and preserved on reset/restart of the MFC device.

3.6.7 DEVICE → ADVANCED SETTINGS/TOOLS → ADVANCED VALVE CONTROL

- The valve of the MFC can operate in five different modes. With the "Advanced Valve Control" window you can temporary switch between these modes.

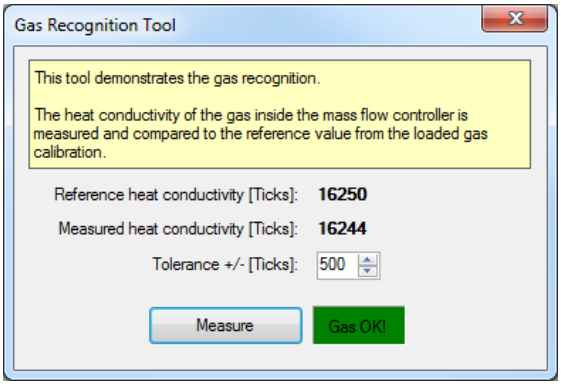


- Available valve control modes:
  - *Use Flow Controller:* The valve is controlled by the flow controller (default mode).
  - *Force Close:* The valve is closed completely.
  - *Force Open:* The valve is opened completely. As the maximum flow through the MFC is no longer limited by the calibrated flow range, this mode is useful to purge the gas system as fast as possible.
  - *Hold Valve Voltage:* After this mode is entered, the valve voltage is held at the current value until this mode is leaved.
  - *User Defined Value:* The normalized valve voltage (from completely closed to completely opened) can be manually specified with an input box. This value has a non-linear connection to the mechanical valve position and the flow through the MFC.

- Please note that the flow through the MFC device may be no longer measured correctly when it reaches values outside the calibrated flow range. Especially when the valve is fully opened (purge mode), the real flow can be significantly higher than the measured value.
- This setting is stored in a volatile memory and will be reset to the default value after a reset/restart of the MFC device.

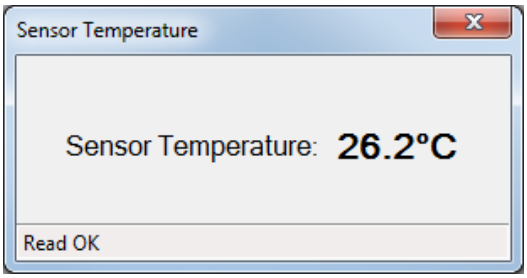
3.6.8 DEVICE → ADVANCED SETTINGS/TOOLS → GAS RECOGNITION TOOL

- The "Gas Recognition Tool" allows performing a check whether activated gas calibration is matching the media in the gas line.
  In general, this feature can be used as a safety function to prevent wrong operation due to mistake of user etc. Implementation of this safety feature has to be realized on the equipment side. In order to execute the gas recognition procedure, MFC valve is closed for 500 msec to ensure zero-flow condition and carry out a measurement of the heat conductivity. The gas recognition procedure has to be triggered using the designated command (MFC doesn't monitor the gas type in the line automatically).
  Tolerance value sets the sensitivity broadband to trigger the alarm as the exact value of measured heat conductivity may deviate from the one saved during the calibration due to temperature dependence or other factors.



3.6.9 DEVICE → ADVANCED SETTINGS/TOOLS → SENSOR TEMPERATURE

- Displays the chip temperature of the flow sensor.

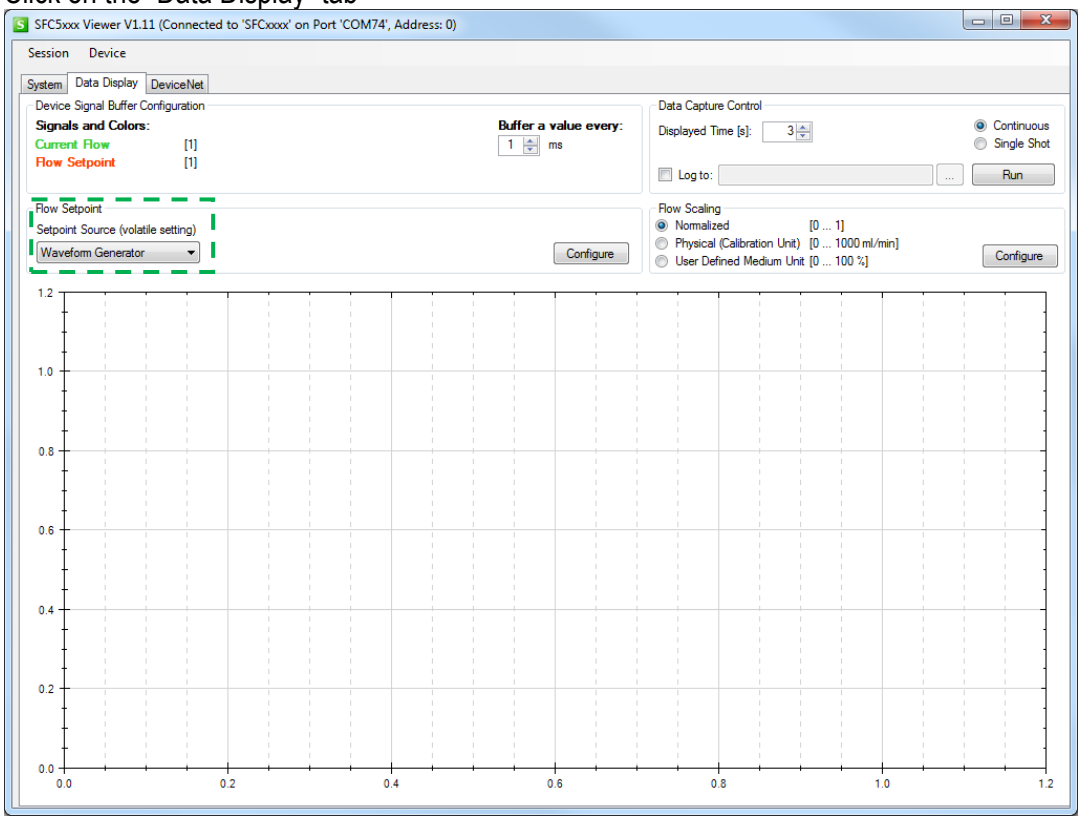


4 APPENDIX – QUALIFICATION EXPERIMENTS

The following appendix aims to provide instructions on how to carry out test on settling time and control range of Sensirion's MFC products using the SFC5XXX Viewer software.

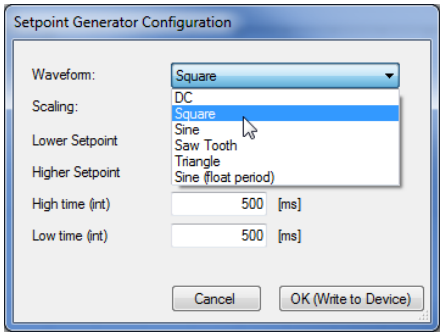
4.1 SETTLING TIME

- Click on the "Data Display" tab

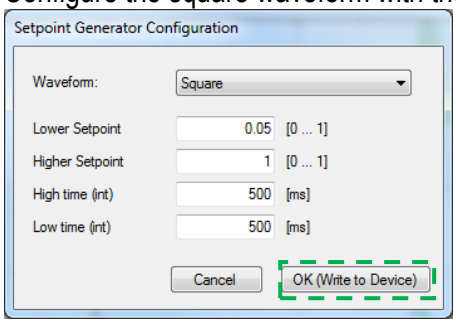


- For the setpoint type, choose "Waveform Generator" to use the MFCs internal waveform generator.

- Click on the "Configure" button and specify the square waveform from the dropdown menu.

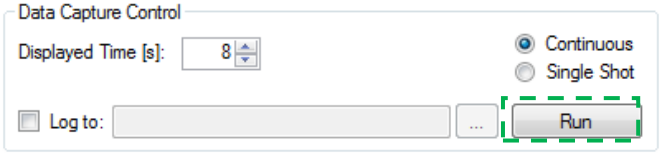


- Configure the square waveform with the following settings and click “OK (Write to Device)”.

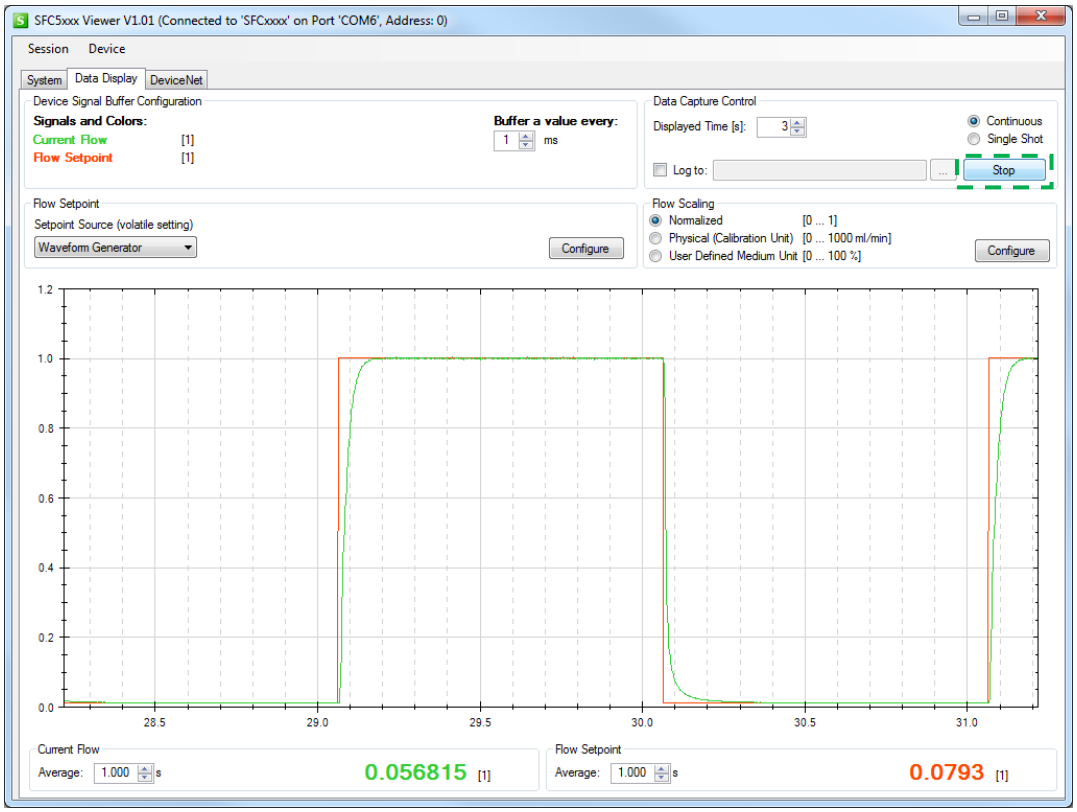


Note:
For best performance, the value of lower setpoint should not be zero. Otherwise, settling time can become significantly larger. Control algorithm has to search for the opening point of the individual valve in small steps before it can efficiently drive the valve to the flow set point.
Furthermore, the pressure in the gas supply line has to be close to calibration pressure to avoid overshoots/undershoots which may also affect settling time.

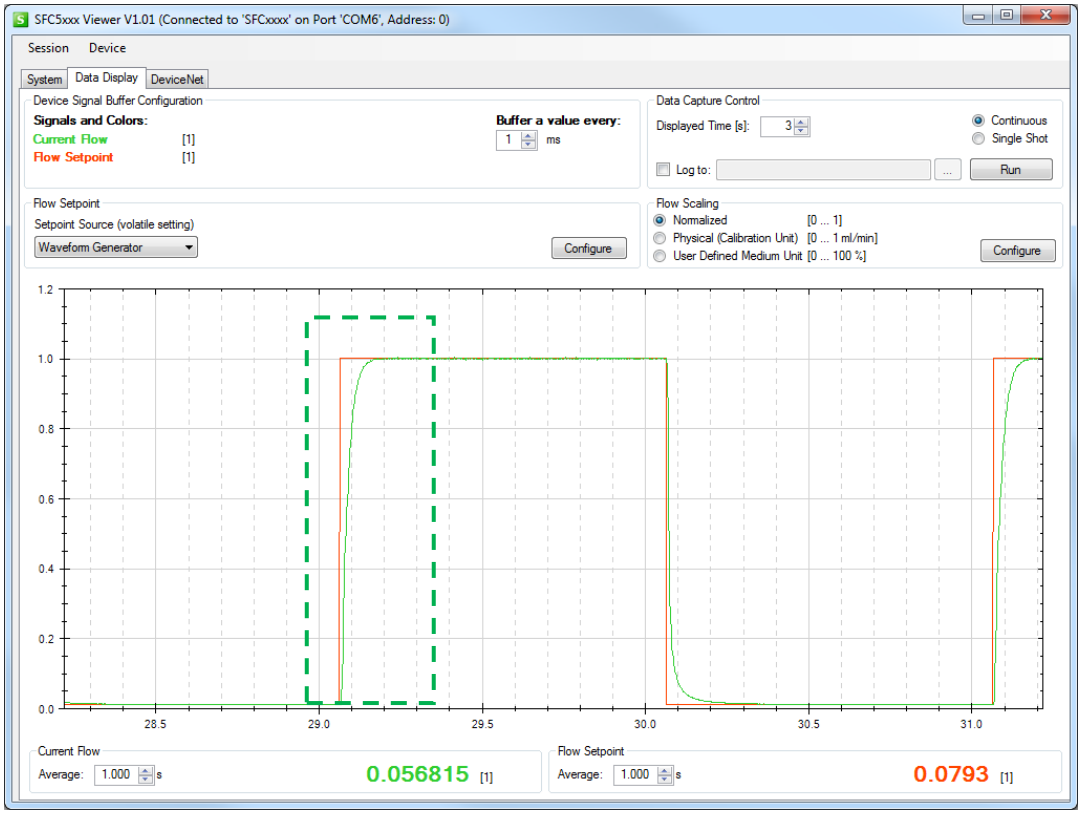
- On the Graph Control, click “Run”.



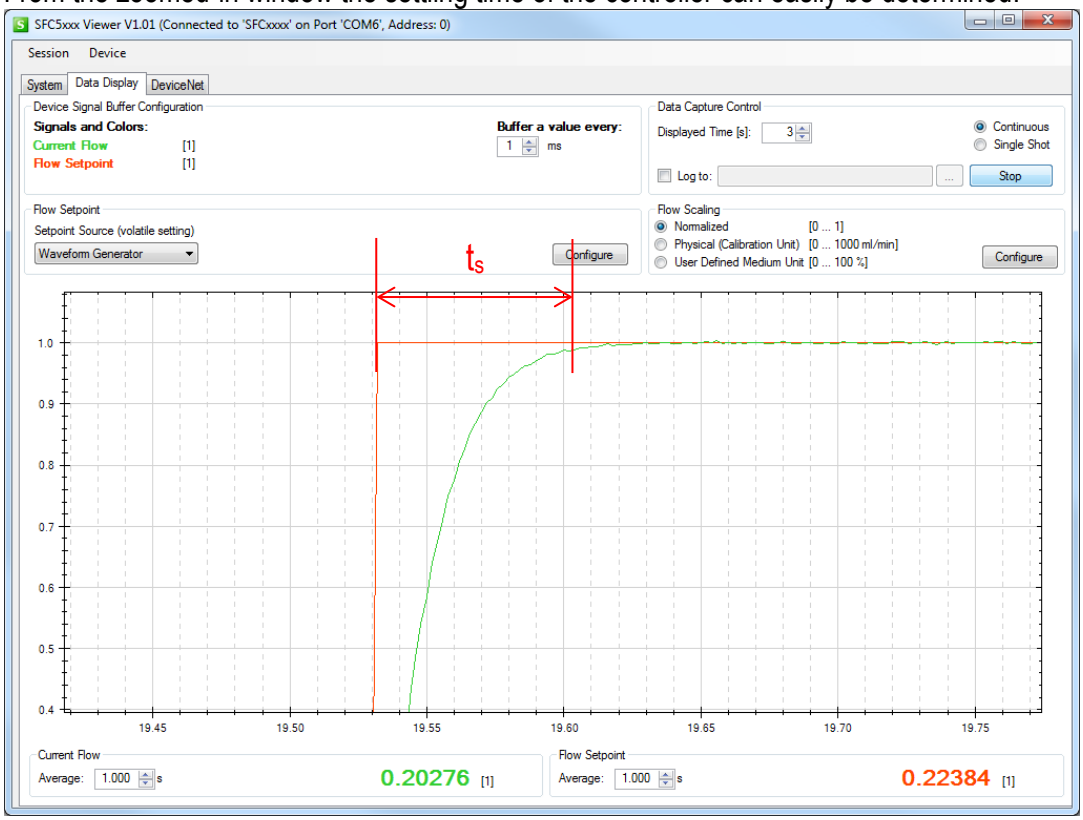
- Subsequently, the square waveform is displayed in an infinite loop running from right to left. To investigate the waveform more closely, click on “Stop” after a number of cycles.
  red: flow set point, generated by the internal sine waveform generator
  green: measured flow



- Zoom into one of the edges of the square waveform by keeping the left mouse button pressed and choose the desired window.



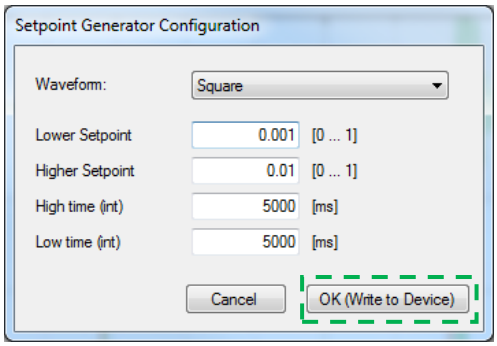
- From the zoomed-in window the settling time of the controller can easily be determined.



For medical ventilator applications, demonstration with sinus waveform function (period time 2 sec) can be advised instead of square function. Real flow follows the setpoint with just about 20 ms delay!

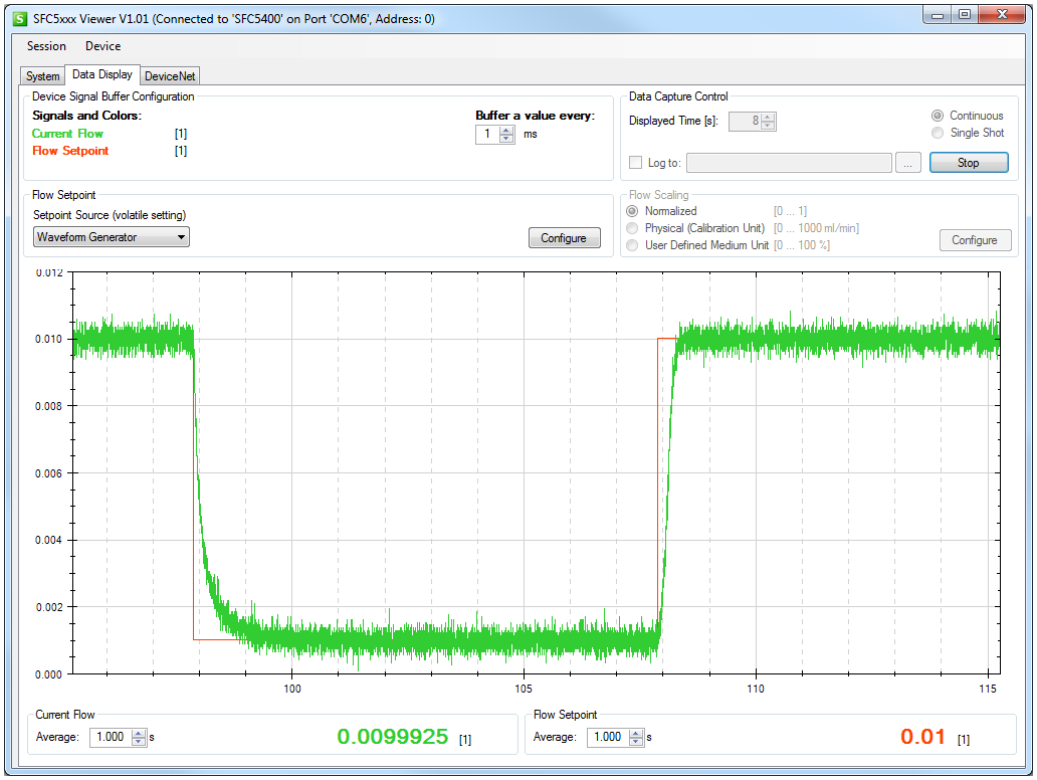
4.2 CONTROL RANGE

- Set up a square waveform as described in the previous section, but choose the following values for the higher and lower set points and the high and low times.
  Click “OK (Write to Device)”.



- On the “Graph Control” menu, set the Displayed Time to 8 seconds and click “Run”

- Zoom in the low flow values to observe the control between 0.1%FS and 1%FS.



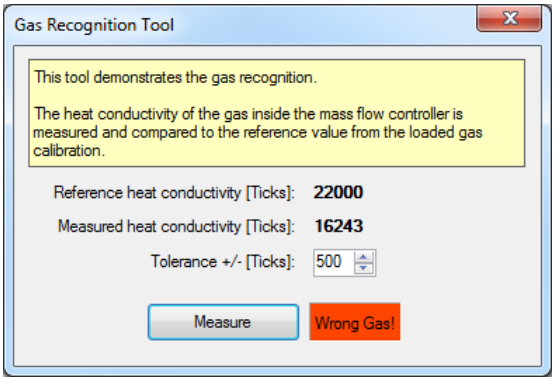
- 0.1%FS represents the control range of 1000:1. MFC reaches the 0.1% FS with no problem which proves that it is capable of working with flow values 1000 times smaller than full scale. A

value of 0.05% FS can be set as Lower Setpoint to demonstrate that real behavior exceeds specifications.

Note: The settling time is about 1 sec for reaching higher set point and about 2 secs for lower set point, which is significantly larger than typical settling point test conditions (5% --> 100% FS). This is due to the slower valve response in the ultra-low flow range. This behavior is normal.

4.3 GAS RECOGNITION

Using the multigas calibrated MFC, switch from Air/N_2 calibration to other gas with higher or lower heat conductivity, e.g. He or CO_2, and perform the gas recognition procedure as described in Section 3.6.8. Due to the mismatch between heat conductivities in calibration data of the loaded gas and measured one (which corresponds to Air/N_2 as it's the gas used for demonstration), Gas Recognition Tool will activate the alarm.



If the Air/N_2 calibration data is activated again, the same procedure results in confirmation of the right gas type.