

### **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

#### SENSIRION THE SENSOR COMPANY

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### 4.3 Gas Recognition



# **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): <u>http://www.ftdichip.com/Drivers/VCP.htm</u>



# **3** SOFTWARE MANUAL

# 3.1 START SFC5xxx Viewer

Start  $\rightarrow$  All Programs  $\rightarrow$  Sensirion AG  $\rightarrow$  SFC5xxx Viewer

#### 퉬 Sensirion AG

SFC5xxx Viewer

# 3.2 CONNECT TO THE DEVICE

S SFC5xxx Viewer V0.22 (Disconnected)	
Session Device	
System Data Display	
System Information	Communication Interface (SHDLC)
Product Type: - Product Name: -	RS485 (SHDLC) Baudrate: 🗸 🗸
Article Code: - Serial Number: -	Device Address:
Version: -	
Available Flow Calibrations:	Active Calibration:
Open Session	as and Kange
Connection	as ID: -
Port COM1 -	ow Hange: -
Echo On (Halfduolex)	itial Calibration
Device	ate: -
Baudrate 115200	emperature: -
	ressure: -
© Fixed Address: 0	ast Recalibration
<ul> <li>Scan until first Device found</li> </ul>	ate: -
Scan all (0254)	ompany: - emperature: -
	ressure: -
Cancel Open	ccuracy: -

- 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.

ion Device				
em Data Displa	y DeviceNet			
stem Information	CCCE (D. 00020000)			Communication Interface (SHDLC)
duct Name:	SFC3000			RS485 (SHDLC) Baudrate: 115200 -
icle Code: rial Number:	1-000488-01 12430074			Device Address: 0 Change Address
rsion: I	Firmware: V1.48, Hardware: V1.00, SHDLC: V1.0	0		
libration	Elew Celibratione:			Active Calibration:
valiable	e Flow Calibrations:		!	
Gas:	Air	Location in Calibration Memory:	0	Gas: Air
nange: Gas ID:	0		active	Gas ID: 0
nitial Calibration:	07. Nov. 2014 by Sensirion, 23°C, Accuracy:	0% of SP/0% of FS		How Range: 50 Flow Unit: ml/min
Last Recalibratio	n: N/A			Initial Calibration
Gas:	02	Location in Calibration Memory:	1	Date: 07. Nov. 2014
Range: Gas ID:	60 mi/min 1			Company: Sensirion Temperature: 23°C
Initial Calibration:	07. Nov. 2014 by Sensirion, 23°C, Accuracy:	0% of SP/0% of FS	1	Pressure: 4 bar (inlet), 3 bar (inlet to outlet)
Last Recalibratio	n: NZA			Accuracy: 0% of Setpoint/0% of Fullscale
Gas:	He	Location in Calibration Memory:	2	Last Recalibration
Gas ID:	2			Company: N/A
Initial Calibration:	07. Nov. 2014 by Sensition, 23°C, Accuracy:	0% of SP/0% of FS	1	Temperature: N/A Pressure: N/A
Last necalibratio			_	Accuracy: N/A
			I	l i i i i i i i i i i i i i i i i i i i
			- I	l i i i i i i i i i i i i i i i i i i i
			- I	l i i i i i i i i i i i i i i i i i i i
			1	l i i i i i i i i i i i i i i i i i i i
			1	l i i i i i i i i i i i i i i i i i i i
			1	l i i i i i i i i i i i i i i i i i i i
			1	l i i i i i i i i i i i i i i i i i i i
			1	l i i i i i i i i i i i i i i i i i i i
				l i i i i i i i i i i i i i i i i i i i

- 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

Communication Interface (SHDLC)						
RS485 (SHDLC) Baudrate:	115200 👻					
Device Address:	0 Change 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

ision Device									
tem Data Display DeviceN	let								
evice Signal Buffer Configurati	ion					Data Capture Con	trol		
ignals and Colors:				Buffer a	value every:	Displayed Time [s]	]: 3 🌩	(	Continuou
urrent How [1	]			1 🚔	ms			(	Single Sh
ow Serbonic [1	1					Log to:		[	Run
w Setpoint						Flow Scaling			
etpoint Source (volatile setting	)	Setpo	int persists afte	er Reset		Normalized	[0 1]		
Digital Setpoint		Setpoint:	0	[0 1]	Set	Physical (Calib Defined )	ration Unit) [01 ml/min]		Configur
							vecium onit (o 100 %)		
2									
-									
0 -									
+									
+									
8		1 1		1 1					1
Ι									
6									
-									
+									
+									
4 -									
, İ									
-									
+									
ł									
.0				- i - i	<u> </u>				

• Choose a setpoint type, "Digital Setpoint" to set manually a value

How Setpoint	
Setpoint Source (volatile setting)	Setpoint persists after Reset
Digital Setpoint	Setpoint: 0 [0 1] Set

#### or "Waveform Generator" to use the MFCs internal waveform generator.

Flow Setpoint Setpoint Source (volatile setting) Waveform Generator

Configure



• If you selected the "Waveform Generator" click on the "Configure" button to specify a specific waveform.

Setpoint Generator Configuration							
Waveform:	Sine (float period	i) 🔻					
Lower Setpoint	0.1	[0 1]					
Higher Setpoint	0.9	[0 1]					
Period time (float)	1000	[ms]					
Param 3 (not used)	1000	[ms]					
	Cancel	OK (Write to Device)					

### 3.4.2 FLOW SCALING

_ Flo	w Scaling		
۲	Normalized	[0 1]	
$\bigcirc$	Physical (Calibration Unit)	[0 1000 ml/min]	
$\bigcirc$	User Defined Medium Unit	[0 100 %]	Configure

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

SFC5xxx Vie	ewer V1.11 (Connected	to 'SFCxxxx' or	Port 'COM74', Addi	ess: 0)				
Session D	levice							
System Data	a Display DeviceNet							
Device Sign	al Buffer Configuration					Data Capture Control		
Signals an	id Colors:			Buff	er a value every:	Displayed Time [s]:	3 🜩	Continuous
Flow Setpo	pint [1]					Log to:		Run
Flow Setpoin	nt					Flow Scaling		
Setpoint Sou	urce (volatile setting)		Setpoint pe	rsists after Reset		Normalized	[0 1] at [0 1000 ml/min]	
Digital Setp	oint 🔻		Setpoint: 0	[0 1]	Set	<ul> <li>User Defined Medium</li> </ul>	Unit [0 100 %]	Configure
1.2								
ţ								
10								
1.0								
ţ								
0.8								
ţ								
0.0								
ţ								
0.4								
ţ								
0.2								
-								
ţ								
0.0		0.2	0,4		0.6	0.8	1.0	12

- 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"

S SFC5xxx Viewer V1.11 (Connected to 'SFCxxxx' on Port 'COM74', Address: 0)			
Session Device			
System Data Display DeviceNet			
DeviceNet MAC ID & Baudrate Settings			
MAC ID: 63 📥 Baudrate: 0: 125kB 🔻		Read from Device	Write to Device
DeviceNet Flow Unit			
Flow Unit: Unknown Unit / No DeviceNet ENGUNIT			
The DeviceNet Flow Unit is linked to the User Defined Medium Unit.		Read from Device	Write to Device
DeviceNet: Polled IO Consume/Produce Assemblies			
Output Assembly 7	Input Assembly 2		
Buto 0 1	Buto 0 1 2		
Type INT	Type BYTE INT		
Data Setpoint	Data Exception Status Flow		
See document: "SFC5xxx DeviceNet Communication Interface Reference"		Read from Device	Write to Device

### 3.5.1 MAC ID & BAUDRATE

DeviceNet MAC ID & Baudrate Settings
MAC ID: 63 
Baudrate: 0: 125kB
Vitte to Device
Write to Device

- 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

DeviceNet Flow Unit							
Flow Unit: 1001h: 0 65535 - counts -	]						
The DeviceNet Flow Unit is linked to the User Defined Medium Unit.	Read from Device	Write to Device					

- Select the unit to be used for the flow in DeviceNet. (Default: 0 ... 65535 counts  $\rightarrow$  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

DeviceNet: Polled IO Consume/Produce Assemblies

Consume	Produce
Output Assembly 7	Input Assembly 2
Byte     0     1       Type     INT       Data     Setpoint	Byte         0         1         2           Type         BYTE         INT           Data         Exception Status         Flow
See document: "SFC5xxx DeviceNet Communication Interface Reference"	Read from Device Write to Device

- 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.	Descri	ption			
7	Size = 2 Byte Type Data	2 Bytes 0 1 INT Setpoint	-		
8	Size = 3 Byte Type Data	3 Bytes 0 USINT Override	1 2 INT Setpoint		
19	Size = Byte Type Data	4 Bytes 0 1 R Se	2 3 EAL		
20	Size = Byte Type Data	5 Bytes 0 USINT Override	1 2 3 REAL Setpoin	4 t	

Input Assemblies:

Nr.	Description													
	Size =	3 Bytes												
2	Byte	0												
2	Туре	BYTE	INT											
	Data	Exception Status	Flow											
	Size =	8 Bytes												
6	Byte	Byte 0		3 4	ŀ	5	6	7						
0	Туре	Type BYTE		INT INT		USINT		INT						
	Data	Data Exception Status		Flow Setpoint		Override	Va	Valve						
	Size = 5 Bytes													
1/	Byte	0	1 2	3 4										
14	Туре	BYTE	REAL											
	Data	Exception Status	Flo	W										
	Size =	14 Bytes												
18	Byte	0	1 2	3 4	5	5 6	7	8	9	10	11	12	13	
10	Туре	BYTE	REAL			REAL			USINT		RE	AL		
	Data Exception Status		FI	ow		Setp	oint		Override		Va	lve		

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



### 3.6 **M**ENU

### 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.

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

• 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 $\rightarrow$ 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  $\rightarrow$  Firmware Update.

Firmware Upo	late	The sectors
Current Vers Firmware: HW: SHDLC:	sion on Device 1.34 1.00 1.00	
HEX-File for	Update	
Hexfile:		Browse
Update Pro	gress:	
	Emergency U	pdate Update Close

- 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 $\rightarrow$ Advanced Settings/Tools $\rightarrow$ 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".

User Defined Medium Unit
When you set the setpoint or read the current flow value you can choose between three different scale factors: Normalized: [01] Physical (Calibration Unit): [0Fullscale @ Calibration Unit] User Defined Medium Unit: [0Fullscale @ User Defined Medium Unit] The "Calibration Unit" is set during calibration and can not be changed. If you want to use a different physical unit, use the "User Defined Medium Unit".
User Defined Medium Unit:       1 <ul> <li>Percent %</li> <li>Ino time base</li> <li>Range @ User Defined Medium Unit: [0 100 %]</li> </ul>
Close



### 3.6.6 Device $\rightarrow$ Advanced Settings/Tools $\rightarrow$ Controller Gain

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

Flow Controller User Gain						
User Gain						
The "User Gain" is a global, additional gain factor to the predefined "Flow Controller Gain". It will be applied to all gas calibrations and is stored in the non-volatile memory of the device. So this gain will persist after a device reset and affects all available calibrations.						
Be careful when changing this value! =1.0: Default <1.0: The controller is smoother and more stable. >1.0: The controller is faster but at a too large gain it will be unstable!						
Value: 1.000						
Set Default Cancel Apply OK						

- 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 $\rightarrow$ Advanced Settings/Tools $\rightarrow$ 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 nonlinear 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 $\rightarrow$ Advanced Settings/Tools $\rightarrow$ 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.

0	Sas Recognition Tool	ſ					
	This tool demonstrates the gas recognition. The heat conductivity of the gas inside the mass flow controller is measured and compared to the reference value from the loaded gas calibration.						
	Reference heat conductivity [Ticks]: 16250						
	Measured heat conductivity [Ticks]: 16244						
	Tolerance +/- [Ticks]: 500						
	Measure Gas OKI						

### 3.6.9 Device $\rightarrow$ Advanced Settings/Tools $\rightarrow$ Sensor Temperature

• Displays the chip temperature of the flow sensor.

Sensor Temperature
Sensor Temperature: 26.2°C
Read OK



# 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

FC5xxx Viewer	/1.11 (Connected to	o 'SFCxxxx' o	n Port 'COM7	4', Address: 0)					
ssion Device									
stem Data Displ	ay DeviceNet								
evice Signal Buff	er Configuration						Data Capture Cont	rol	
Signals and Col	ors:				Buffer a	value every:	Displayed Time [s]	3 🌩	Continuous
Jurrent How	[1]				1 🚍	ms			Single Shot
Iow Scipolin	10						Log to:		Run
low Setpoint							Flow Scaling		
Setpoint Source (v	olatile setting)						Normalized	[0 1]	
Waveform Genera	ator 🔹					Configure	<ul> <li>Physical (Calibr</li> <li>User Defined N</li> </ul>	ation Unit) [0 1000 ml/min] ledium Unit [0 100 %]	Configure
1.2				· · ·		· · · ·			
+									
1									
.0 +									
Ť									
I									
8									
+ ;									
+ ;									
).6				I			1	I I I I I I	
t l									
†									
t									
.4									
I									
1									
).2									
ł									
ł									
ł									
).0 +	<u>-</u>		· · ·	+ +		+ + + +		+ + + <u>+</u>	· · · · ·
0.0	0.2			0.4		0.6	0.8	1.0	1

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

Flow Setpoint	
Setpoint Source (volatile setting)	
Waveform Generator 🔹	Configure

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

Setpoint Generator Configuration								
Waysform	[Severa							
Scaling:	DC							
Lower Setpoint	Square Sine Saw Tooth							
Higher Setpoint	Triangle Sine (float period	)						
High time (int)	500	[ms]						
Low time (int)	500	[ms]						
	Cancel	OK (Write to Device)						



• Configure the square waveform with the following settings and click "OK (Write to Device)".

Setpoint Generator Configuration							
Waveform:	Square	•					
Lower Setpoint	0.05	[0 1]					
Higher Setpoint	1	[0 1]					
High time (int)	500	[ms]					
Low time (int)	500	[ms]					
	Cancel	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".

Displayed Time [s]:	<ul> <li>Continuous</li> <li>Single Shot</li> </ul>
Log to:	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

	Lonnected to 'Sh	-Cxxxx on Port COMb, Add	ress: 0)				
ssion Device							
stem Data Display De levice Signal Buffer Confi	viceNet				Data Canture Control		
ignals and Colors:			Buffer a	value every:	Displayed Time [s]:	3 🚔	Continuo
urrent Flow	[1]		1 🚔	ms	propriot control follo		Single Sh
low Setpoint	[1]				Log to:		Stop
ow Setpoint					Flow Scaling		
etpoint Source (volatile s	etting)				Normalized	[01] n Lloit) [01000 ml/min]	
Naveform Generator	•			Configure	<ul> <li>User Defined Medi</li> </ul>	um Unit [0 100 %]	Configur
.2							
I							
.0 -							1
+							
18							
-							
t i i i							
.6 -							
ł							
Į							
.4 -							
Į i i							
+							
.2							
ł							
, <u>t</u>	_						
28.5		29.0	29.5	3	0.0	30.5	31.0
urrent Flow				Flow Setpoint			
Average: 1.000 🚔 s		0.05	6815 [1]	Average: 1.00	00 🌲 s		0.0793 [1]



• 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)".

Setpoint Generator Cor	nfiguration	
Waveform:	Square	<b></b>
Lower Setpoint	0.001	[0 1]
Higher Setpoint	0.01	[0 1]
High time <mark>(i</mark> nt)	5000	[ms]
Low time (int)	5000	[ms]
	Cancel	OK (Write to Device)

• On the "Graph Control" menu, set the Displayed Time to 8 seconds and click "Run"

Displayed Time [s]:	Continuous Single Shot
Log to:	Run

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

ession Device					
stem Data Display DeviceNet					
Device Signal Buffer Configuration			Data Capture Co	ontrol	
Signals and Colors:		Buffer a value eve	ry: Displayed Time	s]: 8 📩	Continuou
Current Flow [1]		1 🚔 ms			Single Sh
low Serboint [1]			Log to:		Stop
low Setpoint			Flow Scaling		
etpoint Source (volatile setting)			Normalized	[0 1] (0 1000 (	
Naveform Generator 👻		Configur	User Defined	Medium Unit [0 100 %]	Configure
.012					
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verage: 1 000 🛋 s	0.00	00025 rt1 Average:	1 000 🛋 s		0.01 m
1.000 💌 8	0.00	VVVLJ [1] Average.			0.01 [1]

• 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<sub>2</sub> calibration to other gas with higher or lower heat conductivity, e.g. He or CO<sub>2</sub>, 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<sub>2</sub> as it's the gas used for demonstration), Gas Recognition Tool will activate the alarm.



If the Air/N<sub>2</sub> calibration data is activated again, the same procedure results in confirmation of the right gas type.

