Recalibration Tool – SFC5XXX / SFM5XXX – Mass Flow Controller / Meter

Summary

This document is a manual for the installation and usage of the "SFC5xxx Recalibration Tool" software for recalibration of Sensirion's mass flow controllers / meters.

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1. Software installation

1.1. SFC5XXX recalibration tool

• Double-click the SFC5xxx_RecalibrationTool_Vx_xx.msi file to start the installer and follow the onscreen instructions.



4	Welcome to the InstallShield Wizard for SFC5xxx Recalibration Tool
•	The InstallShield(R) Wizard will install SFC5xxx Recalibration Tool on your computer. To continue, dick Next.
	WARNING: This program is protected by copyright law and international treaties.

Note: This software requires Microsoft .Net Framework 3.5. On most computers with Windows XP or newer this software should be pre-installed. If not, you can download it from the Microsoft website.

1.2. 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>

2. Software manual

2.1. Start recalibration tool

Start \rightarrow All Programs \rightarrow Sensirion AG \rightarrow SFC5xxx Recalibration Tool

Sensirion AG

SFC5xxx Recalibration Tool

2.2. Connect to the device

SFC5xxx Recalibration Tool V0.40 (Disconnected)			
Session Device			
System Data Display			
System Information		Communication Interface (SHDLC)	
Product Type: - Product Name: -		RS485 (SHDLC) Baudrate:	*
Article Code: -			
Version:		Device Address.	ess
Calibration			
Available Flow Calibrations:		Active Calibration:	
	Open Session	as and Range	
	Connection	as: -	
	Port COM75	low Range: -	
		low Unit:	
	Echo On (Halfduplex)	late:	
	Device	ompany: -	
	Baudrate 460800 👻	ressure: -	
		couracy: -	
	Fixed Address: U	ast Recalibration	
	Scan until first Device found	ompany: -	
	Scan all (0254)	emperature: -	
		ressure: -	
	Cancel Open		

Make sure that 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): \square

Baudrate:	 Address:	

2.3. Main window

2.3.1. 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.

on Device					
n Data Display					
em Information	FOF (0.0000000)			Communication Interface (SHDLC)	
duct Type: Sr duct Name: Sf de Code: 1- al Number: 12 sion: Fir	-Cooce (0x00022000) FC5400 111111-11 2345678 mware: V1.45, Hardware: V1.00, SHDLC: V1.00			RS485 (SHDLC) Baudrate: 115200 Device Address: 0 Cha	▼ ange Address
vailable	Flow Calibrations:			Active Calibration:	
Gas: lange: ias ID: iitial Calibration: ast Recalibration:	Air 0.5 l/min 1 01. Dez. 2014 by Sensition AG, 23°C, Accuracy N/A	Location in Calibration Memory: ac : 0.5% of SP/0.5% of FS	0 tive	Gas and Range Gas: Air Gas ID: 0 Row Range: 0.5 Row Unit: I/min	
ange: as ID: itial Calibration: ast Recalibration:	He 200 mi/min 2 01. Dez. 2014 by Sensition AG, 23°C, Accuracy: N/A	Location in Calibration Memory: 0.5% of SP/0.5% of FS	1	Initial Calibration Date: 01. Dez. 2014 Company: Sensition AG Temperature: 23°C Pressure: 4 bar (inlet), 3 bar (inlet to o Accuracy: 0.5% of Setpoint/0.5% of Fill	utlet) Jilscale
Gas: lange: ias ID: nitial Calibration: ast Recalibration:		Location in Calibration Memory:	2	Last Recalibration Date: N/A Company: N/A Temperature: N/A Pressure: N/A	
Gas: lange: ias ID: itial Calibration: ast Recalibration:	-	Location in Calibration Memory:	3	Accuracy: IVA	
ໂລຣ: ange: as ID: itial Calibration: ast Recalibration:	-	Location in Calibration Memory:	4		
ange:	-	Location in Calibration Memory:	5		

- 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.

2.3.2. Change baud rate / device address

	-	
RS485 (SHDLC) Baudrate:	11520	• • •
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.

2.4. Menu

2.4.1. Device: get device error state



 The SFC5xxx has an internal 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	ОК	Input supply within range	
3	ОК	Valve supply within range	
4	OK	Signal processor successful initialized	
5	OK	Sensor communication OK	
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	OK		
12	OK	-	
13	OK	+	
14	OK		
15	ОК		
16	ОК	-	
17	OK		
18	ОК		
19	ОК		

• 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.

2.4.2. 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.

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2.4.3. Device \rightarrow 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.

2.4.4. Device → firmware update

• To update the firmware on the device click on the menu item Device \rightarrow Firmware Update.

Current Ve	rsion on Device		
Firmware:	1.34		
HW:	1.00		
SHDLC:	1.00		
HEX-File fo	or Update		
Hexfile:			Browse
Hexfile: Update Pn	ogress:		Browse

- 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.

2.4.5. 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".

When you s choose betv	et the setpoint or veen three differe	read the current flo nt scale factors:	w value you can	
Normalized: Physical (Ca User Define The "Calibra	[0 libration Unit): [0 d Medium Unit: [0 tion Unit" is set d) 1]) Fullscale @ Cal) Fullscale @ Us luring calibration an	ibration Unit] er Defined Medium d can not be chang	Unit ged.
Medium Uni		priyalour unit, uso u	le User Denned	
Medium Uni User Define	". d Medium Unit:	priyalour unit, uso u		
Medium Uni User Define	". d Medium Unit:		Ino time base	

2.4.6. Device \rightarrow advanced settings/tools \rightarrow controller gain

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

User Gain	
The "User Gai "Flow Controlle It will be applie memory of the and affects all	n" is a global, additional gain factor to the predefined r Gain". d to all gas calibrations and is stored in the non-volatil device. So this gain will persist after a device reset available calibrations.
Be careful whe =1.0: Default <1.0: The con >1.0: The con	en changing this value! troller is smoother and more stable. roller is faster but at a too large gain it will be unstable
	V 1 1 000 A

- 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.

2.4.7. 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. This is a safety feature which prevents wrong operation due to mistake of user etc.

his tool demonstrates the gas recognition	n.
he heat conductivity of the gas inside th	e mass flow controller is
leasured and compared to the reference alibration.	value from the loaded gas
Reference heat conductivity [Ticks]:	16250
Measured heat conductivity [Ticks]:	16244
Tolerance +/- [Ticks]:	500 🚔

2.4.8. Device \rightarrow advanced settings/tools \rightarrow sensor temperature

• Displays the chip temperature of the flow sensor.

Sensor Temperature:	26.2°C
Pood OV	

2.5. Create new calibration

You can create new gas calibrations based on existing calibration for a similar gas.

• To open the "Create new Calibration" window, right click in the main window on an empty, grey calibration field and choose from the context menu "Create new Calibration".

alibration		
Available	Flow C	Calibrations:
Gas: Range: Gas ID: Initial Calibration:	Air 0.51/min 0 01. Dez. 2014	Locatic by Sensirion AG, 23°C, Accuracy: 0.5% of
Last necalibration.	N/A	
Gas: Range: Gas ID:	He 200 ml/min 0	Locatio
Initial Calibration: Last Recalibration:	01. Dez. 2014 02. Dez. 2014	by Sensirion AG, 23°C, Accuracy: 0.5% of by CompanyName, 20°C, Accuracy: 0.5% of
Gas:	-	Locatio
Range:	-	Create new Calibration
Gas ID: Initial Calibration	-	Load Calibration from File

• Select an existing calibration with similar gas characteristics from the drop-down menu.

Source Calibration New Calibration base	d on:	Flash Loca	ation 1: He	e (0), 200 ml/min	•
Gas and Range	2	Flash Loca	tion 1: He	e (0), 200 ml/min	
Gas ID:	-				
Gas Name:					
Fullscale Flow:					
Init Encoding:			•	•	•
nitial Calibration					
Company:				Operator:	
Temperature [°C]:				Calibrated with process Gas (check = yes)	1
nlet Pressure [ba <mark>r</mark>]:				Differential Pressure [bar]:	
Accuracy (% of SP):				Accuracy (% of FS):	1
Date and Time	Year	Month	Day	Hour Minute <u>Now Invalidate</u>	

- Enter the calibration metadata and click "OK".
- Perform a recalibration to define a lookup table which translates the sensor measurements to the new gas calibration.
 - \rightarrow Please continue with chapter 2.6: Perform a Recalibration

2.6. Perform a recalibration

• Before starting the recalibration, you must make sure that the calibration which you want to recalibrate is activated (marked red). If it is not the case, right click on the desired calibration field and choose from the context menu "Load Calibration".

Available	Flow Calib	rations:
Gas: Range: Gas ID: Initial Calibration: Last Recalibration:	Air 0.51/min 0 01. Dez. 2014 by Sensin N/A	Location in ion AG, 23°C, Accuracy: 0.5% of SP/0
Gas:	He	Location in
Gas ID: Initial Calibration: Last Recalibration:	2 01. Dez. 2014 by Sensi N/A	Edit Calibration Metadata Delete Calibration
Gas: Range:	-	Save Calibration to File Load Calibration from File

• To open the "Flow Recalibration" window, right click on the active (red) calibration field and choose from the context menu "Recalibrate".

Gas:	Air	Location in				
Range:	0.51/min					
Gas ID:	0					
Initial Calibration:	01. Dez. 2014 by Sensirion AG, 23°C, Accuracy: 0.5% of SP/0.					
Last Recalibration:	N/A					
Gas:	He	Location in				
Gas: Range:	He 200 ml/min	Recalibrate				
Gas: Range: Gas ID:	He 200 ml/min 2	Recalibrate Edit Calibration Metadata				
Gas: Range: Gas ID: Initial Calibration:	He 200 ml/min 2 01. Dez. 2014 by Sensi	Recalibrate Edit Calibration Metadata				
Gas: Range: Gas ID: Initial Calibration: Last Recalibration:	He 200 ml/min 2 01. Dez. 2014 by Sensi N/A	Recalibrate Edit Calibration Metadata Delete Calibration				
Gas: Range: Gas ID: Initial Calibration: Last Recalibration:	He 200 ml/min 2 01. Dez. 2014 by Sensi N/A	Edit Calibration Metadata Delete Calibration Save Calibration to File				

The recalibration window, described in the next chapter, appears.

2.6.1. Recalibration window

If you open the "Flow Recalibration" window for the first time and selected a calibration that was not recalibrated before, "Flow Recalibration" window will look like the image below.

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If the sensor has become inaccurate due to changes in environmental conditions or aging, the sensor readings can be corrected with an additional lookup table. With this tool you can find, set and verify the points for this lookup table. Instructions are described below in the document.

2.6.2. Recalibration metadata

On the top left part of the window, you can enter the metadata for the recalibration.

Reca	libration	Condit	ions					
Company CompanyName		Ope	erator			of Setpoint	of Fullscale	
		XYZ			Accuracy [%]	0.5	0.2	
Tempe	rature [°	C]					Inlet (abs.)	Diff. (in-out)
20					Pressure [bar]	4	3	
Year	Month	Day	Hour	Minute				
2014	12	2	13	28	Now	Calibrated with p	process Gas (ch	eck=yes) 🔽

2.6.3. Physical/normalized flow values

• Choose the scaling for the flow values that you want to use to fill the lookup table.

 Flow Value Scaling
 Physical: Use the physical unit which was used in the initial calibration.

 Physical [0 ... 200 ml/min
 Normalized [0 ... 1]

2.6.4. Fill lookup table

• Enter a series of setpoints in the green table to the column "MFC Setpoints".



- It is important that the process gas is connected to the MFC and the whole system including the reference flow meter is purged with it.
- Once the checkbox of the given setpoint is selected, MFC flow is set to the corresponding value. Measure the actual flow using a reference flow meter.



- Enter the reference reading in the column "Flow Reference".
- Repeat these steps for all setpoints (up to 31 points).
- When you have entered all the points of the lookup table, click the button "Write Data to Device and enable Correction".

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Important:

• For the recalibration to be accurate, it is very important to include the measured reference flow (offset) at the 0 setpoint of the MFC in the lookup table.

If you would like to recalibrate a mass flow meter (MFM), input the MFM flow reading in the left column of the lookup table, instead of the MFC setpoint. Insert the flow reference measurements in the right column.

2.6.5. Verify lookup table



- The flow correction is activated and can be verified by selecting the setpoints again. Now, the mass flow controller reading and the reference flow meter reading should correspond to the selected setpoint.
- If no setpoint is selected, the setpoint is set to zero. The valve is then closed completely independent of the measured flow and flow correction.
- If any deviations are found, the recalibration procedure has to be repeated.
- If the result is good, the recalibration is complete and you can close the window using the "Close" button.

2.7. Edit calibration metadata

• To open the "Edit Calibration Metadata" window, right click on the main window on a calibration field and choose from the context menu "Edit Calibration Metadata".

Available Flow Calibrations:

Air 0.51/min 0 01. Dez. 2014 by Sensir N/A	Location in ion AG, 23°C, Accuracy: 0.5% of SP/0		
He 200 ml/min 0	Recalibrate Edit Calibration Metadata		
01. Dez. 2014 by Sens 02. Dez. 2014 by Comp -	Delete Calibration Save Calibration to File Load Calibration from File		
	Air 0.5 l/min 0 01. Dez. 2014 by Sensii N/A He 200 ml/min 0 01. Dez. 2014 by Sens 02. Dez. 2014 by Comp -		

Gas and Hange	· · · ·				
Gas ID:	0		1		
Gas Name:	He)		
Fullscale Flow:	200		- 0	ml/min	
Jnit Encoding:	milli (10	^-3)	v	nom liter (0°C, 1013 hPa)	* per minute *
Initial Calibration					
Company:	Sensirio	n AG		Operator:	RFU
Temperature [°C]:	mperature ["C]: 23 It Pressure [bar]: 4		Calibrated with process Gas (check = yes)		
Inlet Pressure [bar]:			T I	Differential Pressure [bar]	3
Accuracy (% of SP):		0.5		Accuracy (% of FS):	0.5
Year Month Day Date and Time 2014 12 1			Day 1	Hour Minute	nvalidate
Last Recalibration					
Company:	Compar	nyName		Operator:	XYZ
Temperature [°C]:	emperature [°C]: 20 Ilet Pressure [bar]: 4		Calibrated with process Gas (check = yes)		
Inlet Pressure [bar]:				Differential Pressure [bar]	3
Accuracy (% of SP):		0.5		Accuracy (% of FS):	0.2
Date and Time	Year 2014	Month 12	Day 2	Hour Minute	Invalidate

• In this window you can change the metadata of a given calibration.

Important Notices

Warning, Personal Injury

Do not use this product as safety or emergency stop devices or in any other application where failure of the product could result in personal injury. Do not use this product for applications other than its intended and authorized use. Before installing, handling, using or servicing this product, please consult the data sheet and application notes. Failure to comply with these instructions could result in death or serious injury.

If the Buyer shall purchase or use SENSIRION products for any unintended or unauthorized application, Buyer shall defend, indemnify and hold harmless SENSIRION and its officers, employees, subsidiaries, affiliates and distributors against all claims, costs, damages and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if SENSIRION shall be allegedly negligent with respect to the design or the manufacture of the product.

ESD Precautions

The inherent design of this component causes it to be sensitive to electrostatic discharge (ESD). To prevent ESD-induced damage and/or degradation, take customary and statutory ESD precautions when handling this product. See application note "ESD, Latch up and EMC" for more information.

Warranty

SENSIRION warrants solely to the original purchaser of this product for a period of 12 months (one year) from the date of delivery that this product shall be of the quality, material and workmanship defined in SENSIRION's published specifications of the product. Within such period, if proven to be defective, SENSIRION shall repair and/or replace this product, in SENSIRION's discretion, free of charge to the Buyer, provided that:

- notice in writing describing the defects shall be given to SENSIRION within fourteen (14) days after their appearance;
- such defects shall be found, to SENSIRION's reasonable satisfaction, to have arisen from SENSIRION's faulty design, material, or workmanship;
- the defective product shall be returned to SENSIRION's factory at the Buyer's expense; and

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