

# Application Note for Liquid Flow Sensors

## Analog Cable Configurator

### Summary

This document describes, step by step the tasks required to correctly configure and program the sensor for use with the SCC1 Analog Sensor Cable in your application. By following this guide you will be able to setup your analog sensor signal to align with your desired flow range.

Alternatively, when set up as a switch, the liquid flow sensor can detect both, a single threshold or a flow range and respond accordingly.

## 1. Introduction

The SCC1 cables are interchangeable and behave according to the settings saved in the sensor. This has the advantage that a machine or system can be pre-equipped with all the necessary SCC1 cables, while the sensors can be batch configured and installed later. Sensors can also be reconfigured without disconnecting the SCC1 cable on the system side.

To change the output behavior of the SCC1-Analog cable, use the SCC1-USB cable and the software “Sensor Configurator for SCC1-Analog”. Remember that the configurations are NOT saved in the SCC1 cables.

If you use more than one configuration in your machines (for example for different end customers) it is a good idea to physically mark sensors with different settings (for example with a sticker) and keep a registry of the sensors with serial numbers, settings and where they are installed.

To determine the proper settings for the analog output or the digital output it is almost always necessary to measure a few examples of the system’s flow / dosing behavior with the “USB RS485 Sensor Viewer” software. We strongly recommend to save this data together with a short description of the measurement (system settings, medium, used settings). This can be extremely helpful for troubleshooting.

Please also see the datasheet of the SCC1-Analog, which contains the necessary information, including wire assignment and voltages.

## 2. Programming the Sensor

To program the sensor you need to install the programs “SCC1-Analog Configurator Liquid Flow Meters” and “Sensor Viewer Software”. Both can be downloaded from Sensirion’s website at: <http://www.sensirion.com/liquidflow-download>

The sensors are programmed via the SCC1-USB cable. For additional information see the datasheet for the SCC1-USB cable.

### 2.1 Testing the flow with the Sensor Viewer Software

As a first step always measure your system’s flow or dosing behavior with the Sensor Viewer. This is the only way to properly understand the flow profile and to decide on the proper settings (see the Figure 1 for reference).

- a. Choose the correct calibration field. This depends on the liquid medium you are using. See the sensor’s datasheet for this. You can set the correct field permanently using the “Edit Default ...” button.
- b. Choose the measurement resolution. At 9 bit the sensor measures more than 1’000 measurements per second (> 1kHz). A higher resolution (10-16 bit) results in less noise and a longer sampling time.
- c. The effective sampling time is shown in the bottom right corner.
- d. Start the measurement with “Run”.
- e. Use the “Autoscale” function or zoom in by dragging a box across the graph to see the flow.
- f. Note the shape of the dispense pulse. It is helpful to at least save a screen shot for later reference and, ideally,...

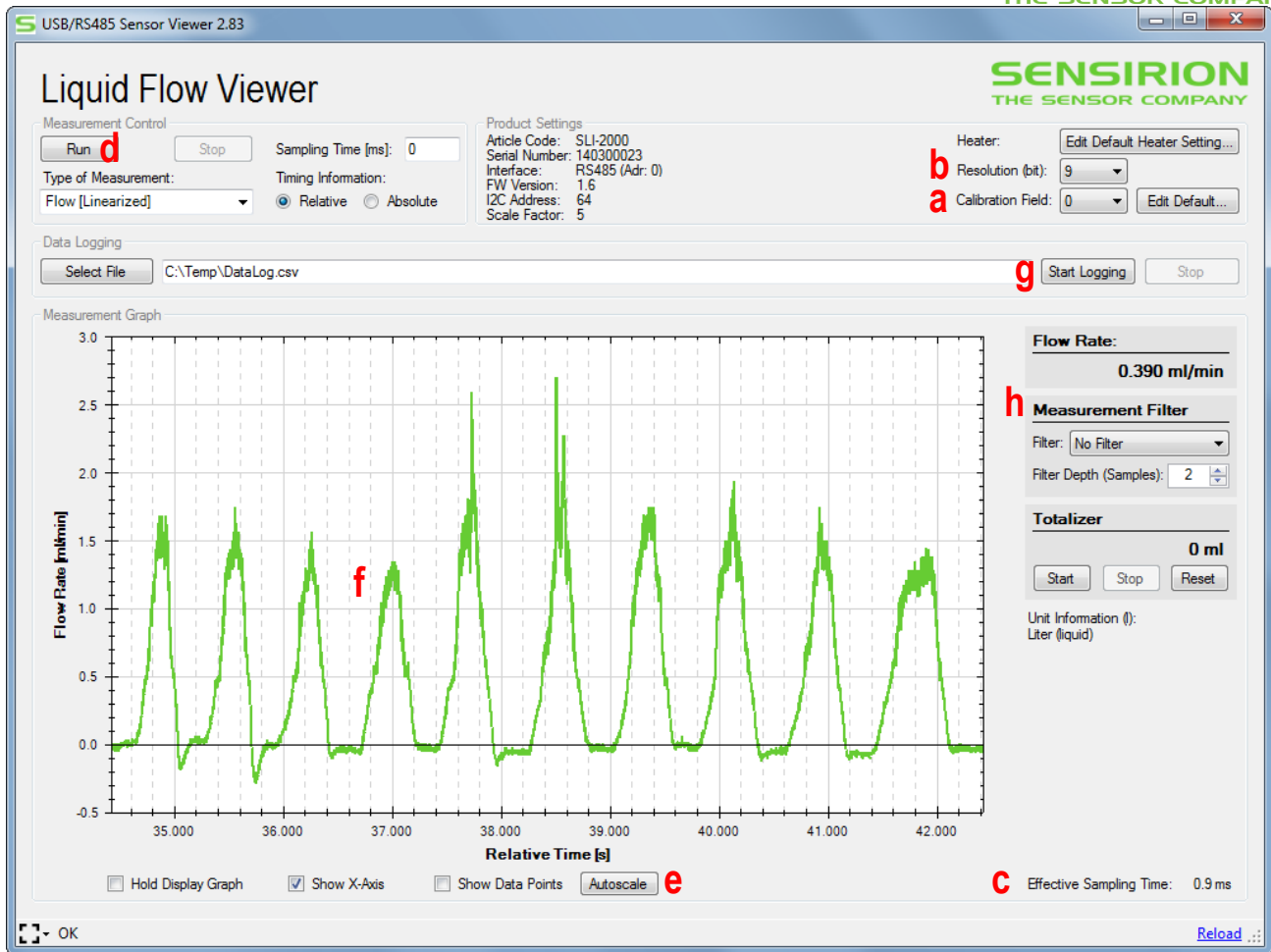


Figure 1: Liquid Flow Viewer

g. ...save the measurement data in a file by selecting a file and starting the logging.

h. The overall sampling rate can further be controlled with the filter function. The filtered signal will be displayed in blue. The Filter Depth determines the number of samples used for filtering. (Note that a very high filter depth might be necessary to achieve a very slow output behavior. For example: 9 bit resolution results in a sampling time of ~ 0.9 seconds together with a filter depth of 1100 the sensor output updates every 1 second.)

Caution: Make sure you have set the correct calibration field using the Edit Default button before proceeding (a.).

## 2.2 Starting and setting up the Sensor Configurator

Perform the following steps to connect to the sensor:

1. Connect the sensor via the SCC1-USB cable to your computer
2. Start the SCC1-Analog Configurator, see Fig. 2.
3. Choose the COM port and Address of the USB cable. (the default address is 0)
4. Click "Connect"
5. Click "Read settings"

The configuration fields of the program are updated with the current values. After changing any setting, remember it is necessary to click "Write settings" to write the changes to the sensor. These settings are used for all further configurations.

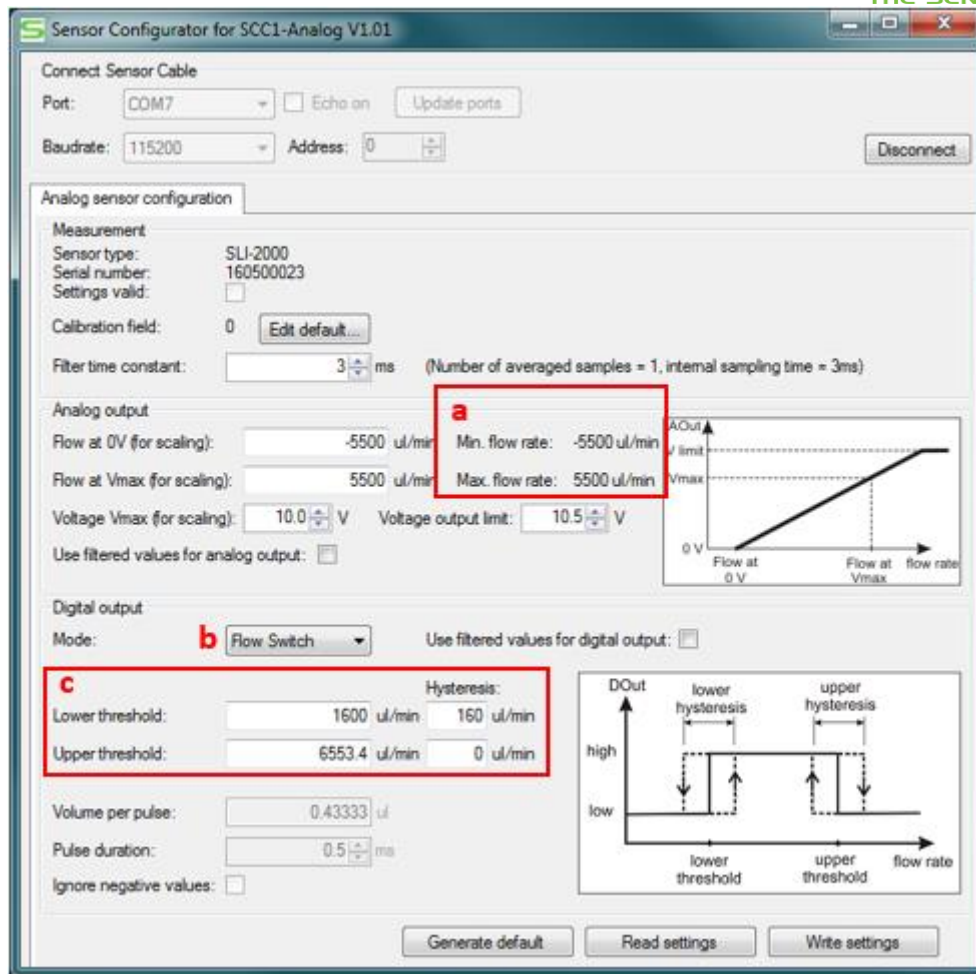


Figure 2: Setting the flow switch thresholds.

## 2.3 Analog Output

Changing the analog output settings might not always be necessary. The default settings are: 5 V output at zero flow, 0 V at the minimum (maximum negative) flow rate and 10 V at the maximum positive flow rate.

Possible reasons to change the settings for the analog output are:

- Change of the calibration field, if another calibration is required for the medium in use. See the datasheet for the available calibration fields.
- Flow rates are always positive: Setting zero flow at 0 Volt will double the voltage resolution of your analog signal acquisition. Should the flow ever become negative, the cable output will remain at 0V.
- Flow rates only cover a small range of the sensor's flow range: Setting your required minimum and maximum flow rate to 0 and 10 Volt will give you much more resolution of the analog signal acquisition.
- Flow changes are fast but only the average shall be captured slowly: By setting the filter constant and enabling it for the analog output you can "smooth" the signal output and make it suitable for a slower signal acquisition.

For a description on how to calculate the flow rate from the voltage signal, please see the SCC1-Analog datasheet.

## 2.4 Digital Output

The digital output can function simultaneously with the analog output and offers two modes:

- Flow Switch
- Volume Counter

These will be discussed below. For a more detailed description of the electrical specifications of the digital output, please see the SCC1-Analog datasheet.

### 2.4.1 Flow Switch

The flow switch mode allows for a simplified signal output. The sensor's digital output switches between the high and low state depending on whether the measured flow rate is inside or outside the set threshold flow rates.

The hysteresis setting can be used to prevent unwanted rapid switching or gate jittering, if the flow signal is close to the threshold (see Fig. 3).

There are two conceptually different use cases for the flow switch:

- Single Threshold Switch, and
- Target Flow Range Switch.

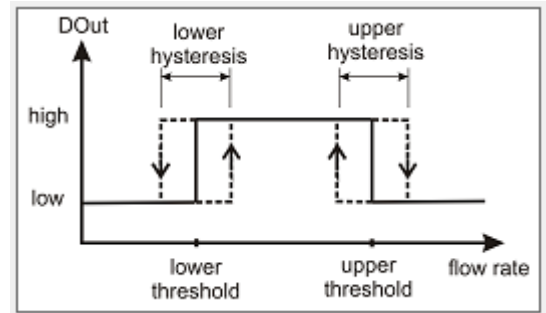


Figure 3: Hysteresis

#### Single Threshold Switch

The most common application is to detect when the flow rate rises above a certain limit. In this case the upper threshold must be set to or slightly above the maximum flow rate of the sensor. See Figure 4.

To detect, when the flow rises above a certain limit (e.g. blue line at 1 ml/min in Figure 4) do not set both thresholds, because the switch output will only be high for the short moment when the flow signal rises above the lower threshold (blue line) and goes back to zero once it crosses the upper threshold (red line). The correct way is to set the upper threshold to a value slightly above the sensor's output limit. This avoids that the upper threshold is ever reached and the switch output does not switch back to low when the flow signal rises any higher. The SCC1-Analog Configurator automatically displays the sensor's output limits (see Fig. 2a). When activating the flow switch setting (Fig. 2b), the software automatically sets the upper threshold (Fig. 2c) to above the full scale output limits.

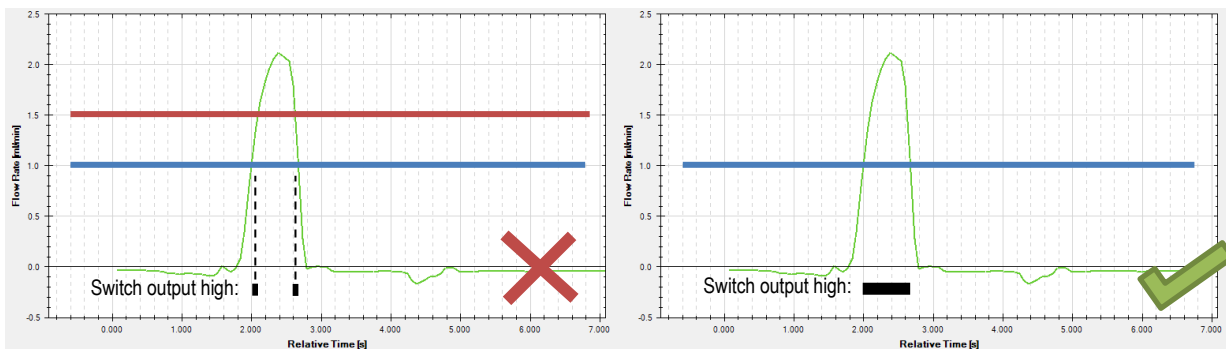
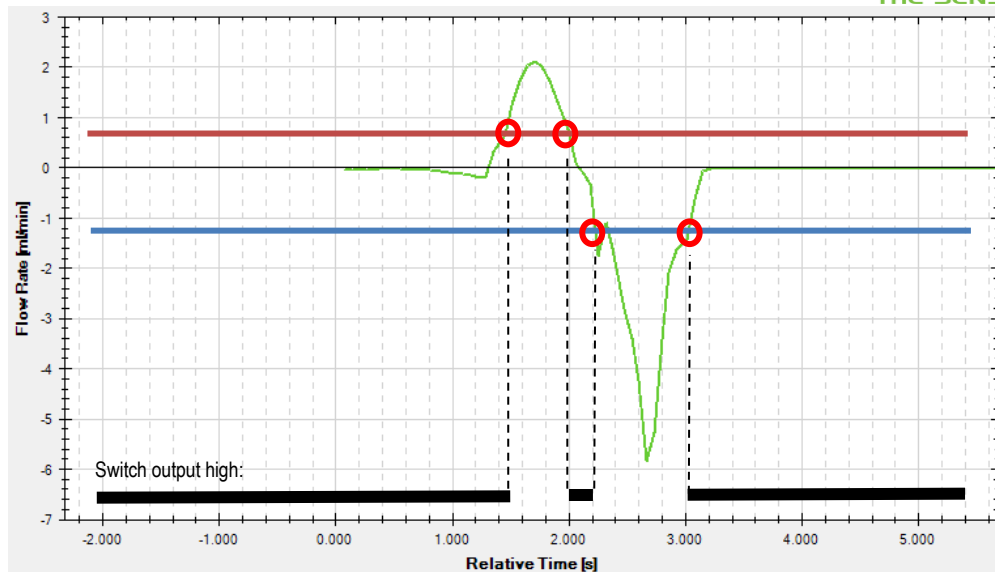


Figure 4: Correct setting to detect flow above a limit. Red line should be above the sensors output limit and not within the measurable flow range of your system.

#### Target Flow Range Switch

Alternatively, the flow switch mode can be used to verify that the flow rate is within a target flow range:



**Figure 5: Switch output when the flow signal is outside of the target flow range and exhibits fluctuations around the switch levels**

To detect, when the flow exceeds or falls below a target flow range (e.g. -1 to 1 ml/min in Figure 5) the lower and upper threshold must be set accordingly and the switch signal changes each time the flow signal crosses either threshold (red circles in Figure 5). The switch output is high when the flow signal is between the thresholds and low outside.

It often helps to use filtered or smoothed values for the switch output if there are short spikes in the flow which should not result in a signal. The hysteresis windows can then be set more strictly.

## 2.4.2 Volume Counter

The volume counter provides a pulsed output – one pulse per set volume. You can choose the volume that must flow through the sensor until the next pulse with the given duration is generated.

The volume counter is a simple output signal. However, note the following aspects:

- The length of the pulse must be detectable by your hardware. Consult your hardware's manual for its input capabilities.
- The calibration field must be set correctly, i.e. it has to be set to water, if the liquid used is (largely) water.
- The maximum resolution is limited by the minimal pulse duration. For example:
 

If your controller's (e.g. PLC) input port requires the pulse to be 20 ms long and needs 20 ms waiting time between pulses, only 25 pulses per second are possible and with a safety margin it might be 20 pulses to run stable. If the maximum flow rate is 1 ml/min = 0.016 ml/sec = 16 ul/sec, the best possible resolution is 0.83 ul/sec (setting: 0.00083 ml per pulse).
- Choose "Ignore negative values" if you don't want to account for negative values. This is important if you sometimes have negative flow or no flow for longer durations. At zero flow the sensor will still see a tiny offset which, if it is negative, can accumulate over time to a large negative value in the internal counter and the cable will not output any pulses until the positive flow has compensated this.

## Headquarters and Subsidiaries

SENSIRION AG  
Laubisruetistr. 50  
CH-8712 Staefa ZH  
Switzerland

phone: +41 44 306 40 00  
fax: +41 44 306 40 30  
[info@sensirion.com](mailto:info@sensirion.com)  
[www.sensirion.com](http://www.sensirion.com)

Sensirion Taiwan Co. Ltd.  
phone: +41 44 306 40 00  
[info@sensirion.com](mailto:info@sensirion.com)

Sensirion Inc. USA  
phone: +1 312 690 5858  
[info-us@sensirion.com](mailto:info-us@sensirion.com)  
[www.sensirion.com](http://www.sensirion.com)

Sensirion Japan Co. Ltd.  
phone: +81 3 3444 4940  
[info-jp@sensirion.com](mailto:info-jp@sensirion.com)  
[www.sensirion.co.jp](http://www.sensirion.co.jp)

To find your local representative, please visit [www.sensirion.com/contact](http://www.sensirion.com/contact)

Sensirion Korea Co. Ltd.  
phone: +82 31 337 7700~3  
[info-kr@sensirion.com](mailto:info-kr@sensirion.com)  
[www.sensirion.co.kr](http://www.sensirion.co.kr)

Sensirion China Co. Ltd.  
phone: +86 755 8252 1501  
[info-cn@sensirion.com](mailto:info-cn@sensirion.com)  
[www.sensirion.com.cn/](http://www.sensirion.com.cn/)