Pulsation Damping Kit

Application Note for Liquid Flow Sensors

Preface

This application note describes how to use the Pulsation Damping Kit with Sensirion liquid flow sensors. It primarily addresses the ml/min flow range.

The included damping tube implements a novel damping concept[1] to provide a considerable damping effect with a short tube and low internal volume.

Note: The kit is optimized for plug-and-play usability and not for industrialization, chemical compatibility or cost. If you find this concept useful for your application and want to use it in your product, contact Sensirion for further assistance.

Important: To view and log data for the evaluation of pulsation, use the free Sensirion viewer software. The sampling rate should be set to 2 ms when examining pulsatile flows. To assess the accuracy of a measurement setup, a balance is a good reference.

1 Introduction

In many applications liquid flow is delivered by a pump or valve that creates a non-continuous flow rate. Examples are peristaltic pumps, piston or (piezo) membrane pumps or valves. Besides the flow source, a fluidic system is made of several additional components. They all influence the way a generated pulse is dampened while propagating through the system. The particular combination of resistance and capacity, i.e. the specific design of your fluidic system, defines the damping of such a pulse down- or upstream of the pump and therefore also the way the pulse arrives at and is measured by Sensirion's liquid flow sensor.

The pulsation damping kit at hand enables you to gather first experiences with the flow damping concept in case of pulsatile flows.

Figure 1: Effect on a pump's flow profile when using the pulsation damping kit.

Sensirion liquid flow sensors are calibrated under steady-state conditions, i.e. non-pulsating flow rates, over the sensor's specified measurement range. Due to their high sampling rate in combination with a fast response time, it is possible to measure and visualize pulsating or quickly changing flow rates.

[1] Patent pending

There are two main effects which can impact the sensor output in case of pulsating flows:

- The actual peak flow rates of a pulsating flow can be much higher than the average flow rate set at the pump and can therefore exceed the sensor's output limit (check the sensor datasheet for the output limit specification). When the measurement saturates at the sensor's output limit, flow rates above the output limit are not recorded correctly.
- Exceedingly fast changes in the flow rate can lead to a distortion of the flow profile and thus of the sensor signal output. This will result in incorrect measurement results.

2 Pulsation Damping Kit – Test Instructions

It can be difficult to implement effective pulsation damping for a fluidic system before you have gathered some basic experience with the concept. To assist the first steps and allow for a quick evaluation of this approach, Sensirion offers a pulsation damping kit that contains all necessary components to dampen pulsating flows for the measurement with Sensirion liquid flow sensors.

Figure 2: Components of Sensirion's pulsation damping kit (labeled in green); example setup with the SLF3S-1300F.

The pulsation damping kit contains[2]:

- Damping tube with ¼-28 flat bottom male-male, made from PU, ~34 cm total length
- ¼-28 flat bottom fluidic restrictor male-female, 0.5 mm ID through hole, made from POM (black)
- ¼-28 flat bottom female-female union, made from POM (white)

To test the pulsation damping kit in combination with a Sensirion liquid flow sensor, install the restrictor on the outlet (downstream) side of the sensor and the damping tube between sensor and pump or valve in one of the following configurations (elements in square brackets are optional):

- In → Pump/Valve → [Union] → Damping Tube → Sensor → [Restrictor] → Out
- In → Sensor → [Restrictor] → Damping Tube → [Union] → Pump/Valve → Out

The restrictor should not be installed on the inlet (upstream) side of the sensor. The orifice causes turbulence in the direction of the flow and will disturb the measurement. This is especially the case for flow rates higher than a few ml/min. The ideal operating range of the damping tube is within a few hundred mbar. It can be used with decreased performance up to approximately 1 bar but has a slightly higher burst pressure of a few bar.

Always start testing with DI water. Ensure chemical compatibility of the wetted parts of the kit components as well as of the sensor before using other media for your measurement. For example, PU is not compatible with IPA.

To view and log data for a later analysis of the measured data, use the free Sensirion Sensor Viewer Software. The sampling rate should be set to 2 ms when examining pulsating flows.
To assess the accuracy of your measurement setup, a balance is a suitable reference.

[2] Note: The pulsation damping kit does not contain a flow sensor. It is optimized for a plug-and-play usability and not for industrialization, chemical compatibility or cost.

3 Measurement Example

Figure 3 demonstrates the effectiveness of the components of the pulsation damping kit when used with a pulsating pump.

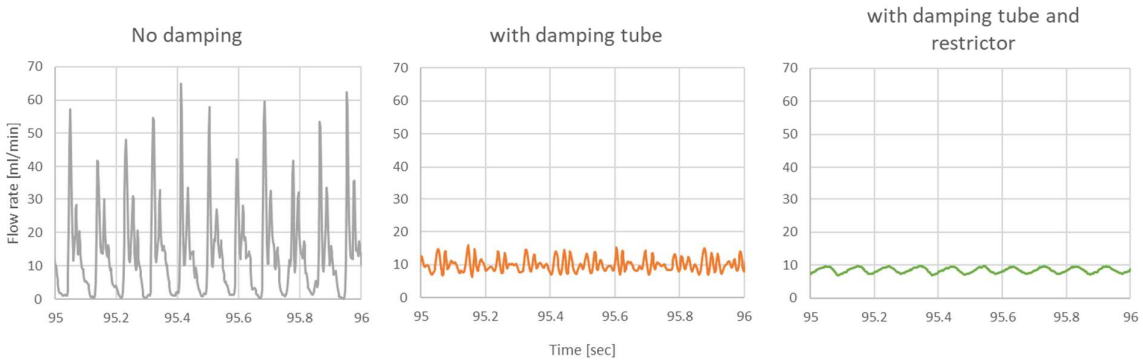

Figure 3: Measurement data of the SLF3S-1300F with and without flow damping components

4 Next Steps

If you find this concept useful for your application and want to use it in your product in combination with a Sensirion liquid flow sensor, contact Sensirion for further assistance. Sensirion can either supply you with the pulsation damping kit or advise you with aspects or dimensions if you want to build your own pulsation damping system.

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