

AN04

Bi-Directional Flow Measurement

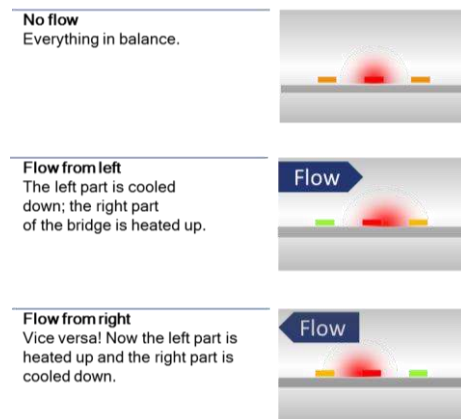


1. Introduction

The VPFlowScope product line has unique bi-directional measurement capabilities. But when do you use them? What are the benefits? In this application note we will describe how the VPInstruments' Thermabridge™ sensor works.

2. Principle of operation

Back in 1974, one of the founders of VPInstruments, Anton van Putten, invented world's first thermal flow sensor made in a silicon (not silicone!) chip. His unique design can be seen as the blueprint of many thermal mass flow sensors found in automotive, HVAC and industrial applications. The original Thermabridge™ sensor combines flow direction measurements with thermal mass flow sensing over a full 0 ... 150 m_n/sec range. This enables you to measure reverse flow, where other flow meters would deliver very unreliable measurement results.



3. Application: ring network

In compressed air networks, bi-directional flow may occur more often than you would think. This happens especially in large ring networks, when facilities have multiple compressor rooms or when large receivers are used. The picture below shows a case of a system with two compressor rooms. In this case, the compressors are equipped with large 5 m³ receiver tanks. When the compressors in room A are in standby mode, the running compressor in room B can fill up the tanks in room A and vice versa. This causes large misreadings when uni-directional flow meters would be used.



The figure above shows a system overview

4. Signal readout

The Modbus RTU table will give you positive or negative numbers for all flow registers. The totalizer will run backwards when flow is reversed.

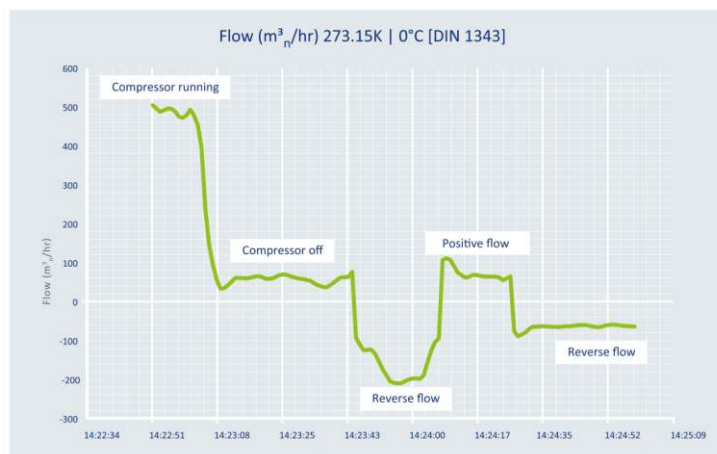
You can also set the 4 ... 20 mA output to bi-directional. In that case, 12 mA is zero, 4 mA is -100% flow and 20 mA is + 100% flow. In other words: half the original range is used for either direction.

The pulse counter (0 ... 20 mA) will not send any pulses as long as the totalizer value is negative. Therefore, we do not recommend using the pulse output if you want to have an instant reading of reverse flow, especially when reverse flow occurs often. If it is only an occasional event, it is okay to use the pulse mode.

TIP: Always use bi-directional flow meters during compressed air audits. This can reveal issues which may otherwise cause a lot of questions during the report phase. Examples seen:

- back flow into the compressor due to failing drains
- leaking non-return valves
- return flow into the receiver in case of multiple compressor rooms
- overseen branches and ring networks

Here you can see an example graph taken from a real system. In this case, you can see the reverse flow in compressor room B. Without bi-directional flow meters, this reverse flow would not have been noticed, and even worse, it could even lead to wrong conclusions about the actual usage of compressed air.



This figure: a graph showing “breathing” of the receiver vessel when compressor is in standby mode

5. Additional tips and tricks

- Did you know that the VPFlowScope DP offers standard bi-directional sensitivity? With the thermal VPFlowScope it is a special option, which you have to order.
- The positive flow direction is shown on all products, with a clear arrow on the product id label.
- Each flow meter is calibrated in the positive flow direction only. But thanks to the symmetric design the reverse flow accuracy is within 5%.