T400-Series Technical Note

Totalizing Delivered Volume Flow

INTRODUCTION

Transonic® customers sometime need the capability to totalize (integrate) flow readings over a period of time. This capability may be useful in applications such as:

- Bioprocess Control: monitoring the wear and imminent failure of the nutrients' circulating tubing inside peristaltic pump heads. This is monitored:
  - by a decrease in flow as reported by a Transonic® Flowsensor while pump RPM is kept at its initial process speed (Tubing Integrity Test)
  - by the Total Integrated Volume pumped (Tubing Life Test)
- Heart Bypass Applications: When the perfusionist employs a Transonic® Flowsensor to adjust the non-occlusive setting of the bypass pump head, the total amount of blood pumped during a procedure may also be tracked to study blood cell hemolysis during bypass.

Transonic® Tubing Flowmeters do not incorporate a totalizing flow feature. This capability may be implemented as follows:

I. SEPARATE FLOW TOTALIZER MODULE

A stand-alone flow totalizer may be purchased from a third party, such as:

- Red Lion model PAX (an Analog Output Panel Meter, www.redlion.net);
- Honeywell Minitrend QX Paperless Recorder (www.honeywellprocess.com).

II. TOTALIZING FLOW FROM FLOW SIGNAL INTEGRATION VIA COMPUTER SOFTWARE

Integrating the TS410 ml/min readings from a certain start time to a certain stop time to arrive at a totalized milliliter or liter reading is a simple process once the flow signal is brought into a system monitor computer (Fig. 1).

The following steps are necessary to achieve highest accuracy in totalizing flow:

1. Zero Offset Adjustment: Monitor the TS410 flow output over an initial period of time (3 to 30 seconds) when you know that the system pump is stopped, flow is zero, and the system loop is at its normal operating conditions (proper liquid inside the Flowsensor within 5ºC of actual operating conditions).
   - Record the averaged flow reading during this period. Use this value in the computer program to make a zero offset adjustment for subsequent flow readings.
   - This zero adjustment step may be omitted in applications where the monitored flow is large compared to our Flowsensor's stable and low zero offset – but one should realize that a small zero offset, integrated over a long period of time, will become a large number. Perform a proper error analysis based on the specifications of the Flowsensor you are using, the expected rate of flow during the monitoring period, and whether the flow integration period includes extended no-flow periods.
2. Start Signal: When starting the pump-on cycle, a start signal must be provided to integrate the zero-adjusted flow readings over time.
   - Software may do this automatically by monitoring changes in flow above a certain threshold; the same software could do an automatic zero offset adjustment over a look-back period before the start signal.
3. Stop Signal: Once a certain condition is met, stop the flow integration, record (store) the totalized flow and take the next process action.

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Totalizing Delivered Volume Flow Cont.

A computerized flow totalizer function may be implemented in a Bioprocess setting via standard OPC process monitoring software such as DeltaV, and in a research setting using, for instance, ADI's PowerLab/ LabChart (available from Transonic Systems Inc.® or ADI, Sidney, Australia)

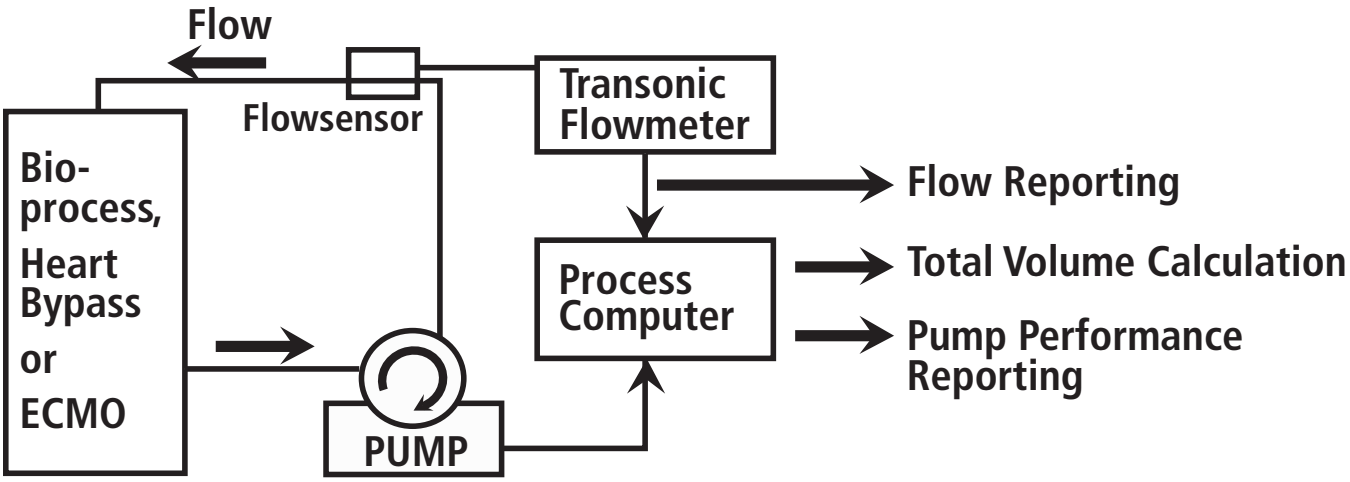

Fig. 1: Schematic showing Transonic® Flowmeter and Flowsensor integrated into a heart bypass, extracorporeal membrane oxygenation (ECMO) or bioprocess circuit.

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Transonic Systems Inc. is a global manufacturer of innovative biomedical measurement equipment. Founded in 1983, Transonic sells "gold standard" transit-time ultrasound Flowmeters and monitors for surgical, hemodialysis, pediatric critical care, perfusion, interventional radiology and research applications. In addition, Transonic provides pressure and pressure volume systems, laser Doppler Flowmeters and telemetry systems.

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