

---

## ***To facilitate discussion/evaluation of Microbridge's MB-LPS series micro-flow-based differential pressure ( $\Delta P$ ) sensors***

Micro-flow-based differential pressure sensors (abbreviated "MFS" in this document) are typically used to measure differential pressure generated by gas flow passing through an air-flow duct or "flow tube". This type of measurement implies that the sensor is connected in parallel to the main air-flow, and is connected across the element which converts volume flow or linear air flow velocity into differential pressure. Such conversion elements, designed for different applications and in use for decades, include Pitot tubes, Venturi tubes, calibrated diaphragms, and special flow-to-pressure converters used in respiration equipments such as Fleisch or Lilly tubes.

The construction of these conversion elements should be guided by the specific requirements of their usage within the specific application. For example, it may be important that the element work with humidified or dusty air, or it may be important that it be tilt-insensitive. Perhaps most importantly, conversion elements determine the flow-measurement range, as required for a particular application – for example, ranging from units of l/min to 1000's of l/min (spirometry). They can work in ducts with cross-section of more than several hundreds of cm<sup>2</sup> (HVAC applications) or in flow tubes with diameter of ~1-2cm (respiration-measurement). In some applications these elements must work for years without re-calibration, in others, they need work for only few minutes (disposable flow tubes for medical applications), or may be intended to be re-calibrated before each use. In some applications an overall accuracy of ~10%FS is acceptable, while in other applications accuracy ~1-2%FS is essential. It is obvious that one type of flow-to-pressure conversion element successfully used in one application may be quite inappropriate in another application. It also should be understood that Microbridge's involvement in the design of the whole flow-measuring system is limited to the choice or design of MFS to measure the differential pressure range which is the best fit for the particular application.

To make a right choice of the MFS, it is important to know the following requirements:

- full-scale measurement range in Pa (units of pressure);
- dynamic range (i.e. full-scale divided by resolution – such as 100x, or 1000x, or 10000x, etc);
- operating temperature range;
- properties of gas in the main flow (humidity, dust, chemical composition);
- time response;
- possibility to make auto zero or recalibrate the system periodically.

If some of these requirements cannot be determined in advance, (for example, if the measurement range is defined in l/min (units of flow) instead of in units of pressure such as Pa), then it is important to make a proper estimation of the measurement range in units of pressure, while taking into consideration also the construction of the flow tube and conversion element discussed above (which must be the responsibility of the customer).

Some important features of Microbridge MFSs (MB-LPS) which should be understood by the user:

1. Typical gas flow through Microbridge's MB-LPS sensors does not exceed 2-3 $\mu$ l/s which is intended to be far lower than the main flow (in the HVAC air duct or medical respiration tube), to be measured by the system. Microbridge's MB-LPS sensors cannot measure direct gas flow and can be reasonably used only in a by-pass (shunt) configuration. Microbridge believes that this by-pass configuration provides the best protection of the sensor against dust and liquid content which may be present in the main flow.

2. There are two main types of MB-LPS → sensors with (a) linear, and (b) nonlinear pressure response. The operating measurement range of "linear" sensors varies from  $\leq 25$ Pa to  $\geq 500$ Pa. The sensors have dynamic range of ~1000x, which is enough for many applications such as HVAC, but may not be sufficient for medical applications where a dynamic range of 5000-20000x may be needed. Sensors with nonlinear pressure response have higher resolution at low  $\Delta P$  and lower sensitivity and resolution at high  $\Delta P$ . This type of pressure response may be preferable for respiration applications.

The sensors provide amplified output (0.5 – 4.5V), have lower power consumption, powered by 5VDC (compared to 8-10VDC for some competitors' sensors), have temperature compensation of Offset and Sensitivity, and have much smaller size. One of the biggest advantages is that they operate by using at least 100 times less flow passing through the sensor than the sensors manufactured by the competitors, which provides substantially greater immunity to contamination by small particles in the main flow (see Microbridge's app note MB-APP51 re dust test).

Note that MB-LPS sensors can be calibrated such that they can operate with almost all existing flow tubes. This capability may be useful for pilot evaluation of MB-LPS in an existing application, and comparison with competing sensors. After such a pilot-evaluation phase, it may be advisable to redesign the flow tube to use more effectively the advantages provided by Microbridge MB-LPS sensors and reach the best performance of the overall flow meter.

Information furnished by Microbridge Technologies is believed to be accurate and reliable. However, no responsibility is assumed by Microbridge Technologies for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Microbridge Technologies. Trademarks and registered trademarks are the property of their respective companies.

© 2009 Microbridge Technologies, Inc. 1980 Sherbrooke St. West, Suite 505, Montreal, Quebec, H3H 1E8 Tel: 514-938-8089 Fax: 514-938-9089