Few-Pascal Differential Pressure Sensors are Enabling Applications and Markets in Air Flow Measurement

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Mainstream measurement of air flow typically brings to mind industrial applications such as building ventilation duct-work, or medical breathing-measurement which were done in a hospital or in a doctor’s office (e.g. spirometers, lung-ventilators). Often, the air-flow measurement is done by measuring differential pressure at two points along an air-flow path, requiring a differential pressure sensor. Over the past decades, these applications/markets have been limited by the differential pressure sensors which have been available.

When a designer wants to measure air flow, he/she must design an air-velocity probe, and the design must use a readily-available differential pressure sensor. This has limited the resolution of the measurements and limited the ability to measure the lowest air-flow velocities.

During past years, it has been difficult to make sensors for differential air pressures below a few hundred Pascals (Pa) full scale (i.e. a few mbar full-scale). Membrane-type sensors become difficult or expensive at very low pressures. This has led to the commercialization of differential pressure sensors which sense pressure from very small air-flow through the sensor (pressure-from-flow sensors). These are enjoying commercial success, stemming from the ability to achieve lower price-points in mass-production. Still, it has been difficult to make sensors with full-scale less than about 500Pa (2”H2O), because the required flow-through increases as the full-scale pressure decreases, bringing non-ideal functioning of the sensor.

Yet the product definitions in new or updated applications often demand more-sensitive sensors. If such more-sensitive sensors are not available, often the designer may use a 4”H2O sensor (for example) and ignore the upper part of the measurement range (and may have to live with insufficient accuracy or resolution at low air flows). New applications emerge in many different fields: optimizing sports/athletic performance (bicycling, sailing), monitoring room air flow such as in clean rooms and computer data centers, pressurizing telecom lines, and many more.

An important example is the design of patient-friendly and technically-effective monitoring of sleep-apnea. This demands the best resolution at the lowest differential pressures, such as below 0.1Pa. Since the goal is home-care, to reach millions of patients, price-points of the sensor must also be attractive for inclusion in mass-produced apparatus for individual patients.

Another important and growing application is air-flow monitoring around computing equipment in data centers. Since the number of such data centers has been rapidly increasing, so has the concern with energy-efficiency of the air-cooling. Here the air flow must be monitored in the open air surrounding the equipment. There is no air-flow duct or flow-to-pressure conversion element as there is in a building HVAC duct or in a breathing tube. The differential pressures are much lower than in typical HVAC applications. The sensors need resolution well below 0.1Pa, and don’t need full-scale beyond about 100 Pa.

Microbridge Technologies Canada, Inc has focused on converting several years of original technology R&D to bring to market a unique differential pressure sensor to anticipate the needs of these applications and markets. An inexpensive and accurate sub-1”H2O sensor removes limitations for designers, allowing simpler designs and enabling measurement of lower air flows. In our interactions with the market, we have seen designers re-orient their applications from 2”H2O or 4”H2O full-scale sensors to 0.2”H2O or even 0.1”H2O full-scale sensors, just because the lower full-scale ranges are now available.

Microbridge also believes that the new applications will demand better immunity to certain factors present in the operating environment: dust, humidity, electromagnetic interference. As mentioned above, the pressure-from-flow measurement principle brings inevitable air flow “leakage” through the sensor. If this leakage is too great, this can draw dust and humidity toward the sensor, which may bring headaches for the designer if the effects become too significant. Fundamentally, while this “leakage” through the sensor is unavoidable for this extremely sensitive range, it must be kept to a minimum. Microbridge’s technology allows the sensors to be designed to allow hundreds of times less leakage than competitors, bringing much more flexible usage and making the designer’s job easier. For example, Microbridge’s sensors can be connected with a filter while remaining in calibration even while the filter becomes more and more obstructed; or can be connected by meters of connection tubing while not changing calibration. In experimental in-house studies (MB-APP51, and MB-APP54, see links below), our sensors were connected without filter directly to dusty air flows and humid air flows, comparing with competitors, and outlasted the competitors by multiples of exposure.

With the rise of wireless communications, electromagnetic interference is another environmental factor which can affect sensor performance in many applications including HVAC and medical instruments. This has brought surprising challenges to sensor manufacturers. In new environments full of EMI, our integrated single-chip design with amplified analog output has brought an additional benefit.

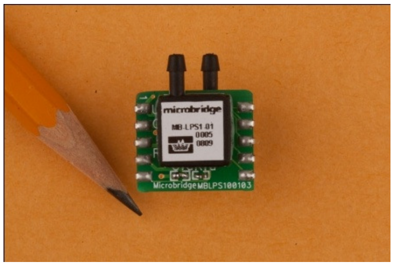
Note re units of differential pressure: 250Pa = 1”H2O = 0.0025bar.

http://www.mbridgetech.com/pressure-sensors.php

http://www.mbridgetech.com/design-guide.php

http://www.mbridgetech.com/pdfs/MB-APP51-Dust_Test-AN.pdf

http://www.mbridgetech.com/pdfs/MB-APP51-Dust_Test-AN.pdf



Caption: Microbridge’s differential pressure sensor technology allows small and uncomplicated packaging (packaging flexibility).

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Over 20 years in advanced research, development and manufacturing, including product engineering, test, failure analysis, materials research, micro-thermal devices, microsystems (MEMS) design and process engineering. 1991 through 2003, attained Full Professor of Electrical and Computer Engineering at Concordia University, Concordia Research Chair, head of microelectronics fabrication activities. Principal Product and Test Engineer (1988-91), Digital Equipment Corporation, Cupertino, CA. PhD (1988) Electrical Engineering, Stanford University. Member IEEE.

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