Absolute pressure correction of LME/LMI pressure sensors

Application note

First Sensor is now part of TE connectivity

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1. Introduction

It is known that the sensitivity of calorimetric type differential pressure sensors is proportional to gas density in the vicinity of the flow-sensing element of the sensor which is in turn proportional to absolute pressure. Correction of the sensor output is typically performed as:

$$\Delta P_{cor} = \Delta P_{meas} \frac{100}{P_{atm}}$$

where ΔP_{cor}, ΔP_{meas} and P_{atm} are corrected and measured differential pressure and atmospheric pressure (measured in kPa).

2. Applied differential pressure

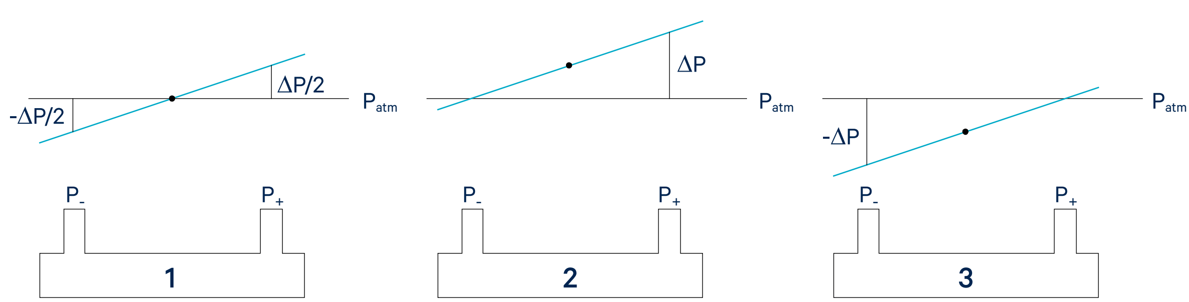
In many applications, applied differential pressure is much lower than atmospheric pressure and standard correction procedure is reasonably accurate. Measurements of differential pressure higher that ~1 kPa may require more accurate correction procedures. It should be taken into consideration that differential pressure can be applied in different ways. Figure 1 shows as an example three possible schemes of applying differential pressure ΔP. In all these cases, common mode pressure P_{com} is different while the same differential pressure is applied.

As was mentioned above, pressure sensitivity is proportional to absolute or common mode pressure. Therefore, sensor response in scheme 2 is higher then in scheme 1 and response in scheme 3 is lower than in scheme 1.

Factory calibration is performed in accordance with scheme 1 where common mode pressure equals atmospheric pressure. Uncorrected measured differential pressure equals:

$$\Delta P_{meas} = U_{out}\, SF$$

where U_{out} is the output signal and SF is the scale factor.



$P_+ = P_{atm} + \Delta P/2$
$P_- = P_{atm} - \Delta P/2$
$P_{com} = P_{atm}$

$P_+ = P_{atm} + \Delta P$
$P_- = P_{atm}$
$P_{com} = P_{atm} + \Delta P/2$

$P_+ = P_{atm}$
$P_- = P_{atm} - \Delta P$
$P_{com} = P_{atm} - \Delta P/2$

Figure 1: Three possible schemes of applying differential pressure ΔP

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As an example, figure 2 shows experimentally measured error (deviation from nominal linear pressure response) of a 1250 Pa sensor. Pressure response was measured in accordance with schemes 1 - 3 with no output signal correction.

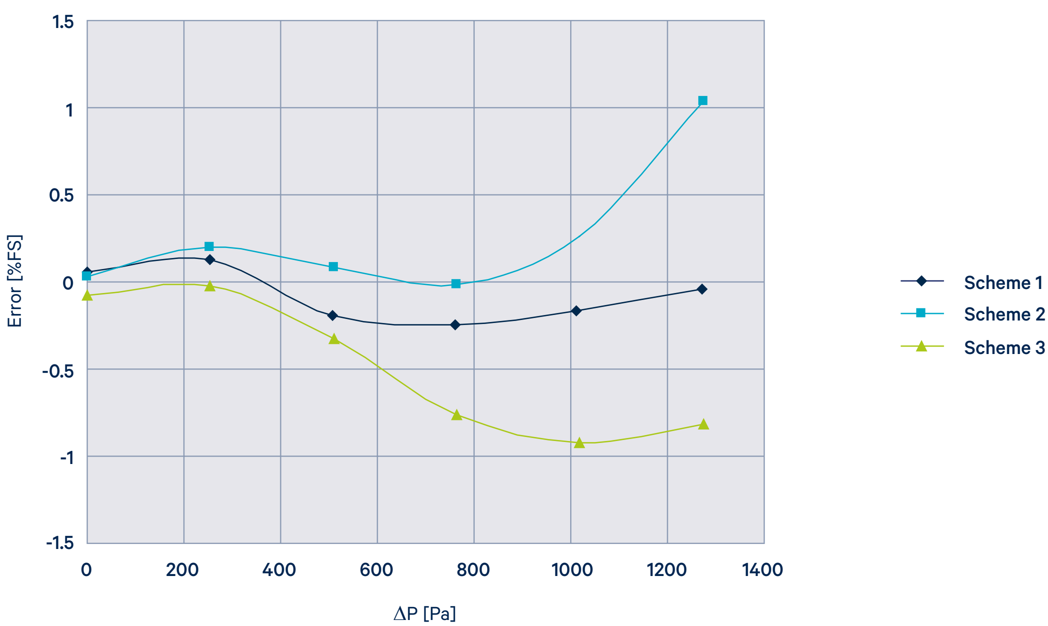

Figure 2: Experimentally measured error of a 1250 Pa sensor

3. Examples of output signal correction

Output signal correction according to scheme 1:

$$\Delta P_{cor} = U_{out}\, SF \frac{100}{P_{atm}}$$

Output signal correction according to scheme 2:

$$\Delta P_{cor} = U_{out}\, SF \frac{100}{P_{atm} + U_{out}\, SF \frac{100}{2P_{atm}}}$$

Output signal correction according to scheme 3:

$$\Delta P_{cor} = U_{out}\, SF \frac{100}{P_{atm} - U_{out}\, SF \frac{100}{2P_{atm}}}$$