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Achieving High Accuracy in the Low Vacuum Range With Posifa's PVC4000/PVC5000

Due to the memory size of the processor within the PVC4000/PVC5000 series vacuum transducer, there is a limited number of spaces for a calibration table. Calibration points are defined in such a way as to ensure high accuracy in the high vacuum states (i.e., below 10,000 mTorr or 1,333 Pa).

The downside of this shifted attention towards the high vacuum state is that it leaves measurement in the low vacuum range (i.e. from 760,000 mTorr to 10,000 mTorr) rather coarse.

To achieve a higher accuracy level in the low vacuum range with the PVC4000/PVC5000, Posifa has developed a method that can be used — when implemented within a master MCU with a bigger memory — to interpolate multiple calibration points between 760,000 mTorr and 10,000 mTorr, achieving the enhanced accuracy.

The goal is to create an extended calibration table in the master MCU, which will then read the raw data from the vacuum sensor PVC4000/5000 and perform linear interpolation using the extended calibration table. This calibration is "extended" in the following two ways:

- The Y column of the calibration table uses 32-bit integers instead of 16-bit, accommodating 760,000
- An additional six calibration points are added at 25,000, 50,000, 100,000, 200,000, 300,000, and 413,000 mTorr, respectively

First, the master MCU stores the following table in its memory. This table contains the base sensitivity of the vacuum sensor based on the raw reading and the corresponding vacuum level:

Base Sensitivity Table		
Position	Default Sensitivity (Raw) (X)	Vacuum (mTorr) (Y)
0	0	760,000
1	144	413,000
2	185	300,000
3	329	200,000
4	684	100,000
5	1,344	50,000
6	2,745	25,000
7	5,841	10,000

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The sensitivity is calculated by determining the difference between the raw value at 760,000 mTorr and the raw value at various levels.

Since every sensor has a slightly different sensitivity level, a coefficient needs to be applied to the base sensitivity in order to have corrected calibration for that particular sensor.

Below are the steps to be performed by the master MCU:

1. Read X[0] from the sensor's calibration table. This is the raw reading at atmospheric pressure of 760,000 mTorr. For example, X[0] = 18,095
2. Read X[1] from the sensor's calibration table. This is the raw reading at 10,000 mTorr. For example, X[1] = 23,185

Read From Sensor	Example Raw Value	Vacuum (mTorr)
X[0]	18,095	65,536
X[1]	23,185	10,000

3. Calculate the coefficient factor to apply to the sensitivity value
    a. Coeff = (X[1] – X[0]) / 5,841 = 0.871426
    b. 5,841 comes from the original default sensitivity level at 10,000 mTorr

4. Calculate the new X[1] to X[6] position based on the coefficient number
    a. Adjusted X[1…6] = X[0] + Coeff * X[1] default values in the default sensitivity table
    b. Example: X[1] = 18,095 + 0.87142 * 144 = 18,220

5. Calculate and fill out the interpolated values
    a. Example of the table as shown with interpolated values

Position	Interpolated Raw Value X	Vacuum (mTorr)
0 (from sensor's calibration table)	18,095	760,000
1	18,220	413,000
2	18,256	300,000
3	18,382	200,000
4	18,691	100,000
5	19,266	50,000
6	20,487	25,000
7 (from sensor's calibration table)	23,185	10,000

6. Add this interpolated table to the calibration table read from the sensor to create the extended calibration table