1. Scope

This application note intends to describe the temperature compensation.

2. Description of the temperature compensation

Magnetic probing of our sensors (wafer level) occurs on multiple temperatures. Therefor the drift can be calculated and the correct sensitivity drift compensation parameter is stored in the NVRAM of the IC. There is a separate parameter for hot (HT) and for cold (LT). After packaging (QFN), an extra drift is introduced. This is experimentally found to be a constant offset:

- Sens_TC_HT_new = Sens_TC_HT_original – 15
- Sens_TC_LT_new = Sens_TC_LT_original – 6

After correction, our results show an average value of 0x67 for HT and 0x55 for LT.

Internally, the temperature sensor is trimmed to have a slope of 45.2 LSB/degC. This is the value that can be read back in the standard measurements and equals $T_{digital}$ in the following formulas. The value that the sensor has at 35degC can be read back from the IC. It is stored in register 0x24. This digital value is called TREF in the document. Typically, it should be around 0xB668, but part to part variation this will vary. The value is trimmed during probing. This value will be the pivot point for the temperature compensation. If the value of the temperature sensor is above this TREF, the HT parameter will be used to correct the sensitivity. Else the LT parameter will be used.

The conversion to degC is: $T[\deg C] = 35 + \frac{T_{digital} - TREF}{45.2}$

The temperature compensation can be enabled or disabled. In case the temperature compensation is enabled the temperature will always be measured, regardless the ZYXT settings.

2.1 AB version

Since the previous (AA) version is not suitable to be used with resolution 0 and 1, this version is made for these and can only be used for these two resolutions. Upon entry of the TC block, the MSbit gets flipped (=XOR). This way, a 2s complement is transformed in an unsigned integer, centered around 0x8000. The offset again needs to be programmed with respect to 0x8000 for the algorithm to work properly. See section 2.2 for more info.

$$Meas_{corr} = 32768 + XOR[Meas_{raw};32768] - Offset + \left\lfloor \frac{(XOR[Meas_{raw};32768] - Offset) \cdot \left\lfloor \frac{Sens_{TC} \cdot (T_{digital} - TREF)}{128} \right\rfloor}{4096} \right\rfloor,$$

where offset are the values stored in the NVRAM registers 0x04, 0x05 and 0x06. The Meas_raw values are 2s complement 16bit numbers, like measured with TC disabled.

If the value of the temperature sensor, $T_{digital}$, is above TREF then $Sens_{TC} = Sens_{TC\_HT}$. Else $Sens_{TC} = Sens_{TC\_LT}$.

The output is unsigned, centered around 0x8000.

2.2 Summary

When enabling the TC, always adapt the offset to a value in unsigned format, centered around 0x8000. For example if the offset measured without the temperature compensation enabled equals 200LSB, the offset programmed will become 32768+200=32968=0x80C8.

Temp compensation functional?	RES_i[1:0]			
	0x0	0x1	0x2	0x3
AB version	yes	yes	no	N/A(1)

Typical output a 0G	RES_i[1:0]			
	0x0	0x1	0x2	0x3
AB version, TC disabled	0x0	0x0	0x8000	N/A(1)
AB version, TC enabled	0x8000	0x8000	-	N/A(1)

(1) RES_i[1:0] = 0x3 is not useful because the decrease of the resolution by a factor 2 does not yield an increase in the full-scale range due to analog chain saturation. Instead the full-scale range is scaled with the same factor making this highest resolution obsolete from a functional perspective.

3. Revision History

Date	Revision	Authors	Remark
31-Mar-16	001	JVV	Removed AA references, v2 created
1-Jul-16	002	JVV	Corrected formula
29-Jul-16	003	JVV	Update (clarification)