Application note

Multiple Accelerometers
Inline calibration

Bosch Sensortec

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Multiple Accelerometers: Inline Calibration

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Notes	Data in this document are subject to change without notice. Product photos and pictures are for illustration purposes only and may differ from the real product's appearance.

Index of Contents

1. About this Application note

This document describes how the Inline calibration is performed and the requirements of the production environment. This application notes applies to all BMA series sensors referenced in the field technical reference codes on the previous pages.

2. Warnings

Performing offset correction on acceleration sensor is complex. An improvement of sensor performance is only possible in a very well-controlled production environment, where no vibration occurs and water level gauge is required. The water level gauge must be carefully adjusted.

Figure 1: Water level gauge

Ensuring the accuracy and reliability of the Inline calibration is the task of the user. Bosch Sensortec cannot guarantee the accuracy of the modified parameters. Depending on the user's implementation and operation, there may be a loss of accuracy.

3. Concept of Inline calibration

The total offset which can be calibrated is composed of two parts:

1. Zero g offset
2. Soldering drift

There is tiny difference on local gravity between two places. By adding an additional offset compensation step after the soldering process, the absolute accuracy may be improved. The accuracy over acceleration change will not increase by offset correction.

4. Reference water level gauge requirements

The reference water level gauge should have an absolute precision of being or below 0.05mm/m in order to get a noticeable accuracy gain.

5. Environmental requirements

For the Inline calibration, the environment needs to be free of vibration. They can be caused by wind gusts, steady winds, people walking and other events. The device under calibration should be parallel with the surface of water level gauge.

6. Implementation

6.1 Sensor offset measurement

The sensor should be operated in normal mode to get the accurate offset calibration result. There are two ways to do offset value measurement:
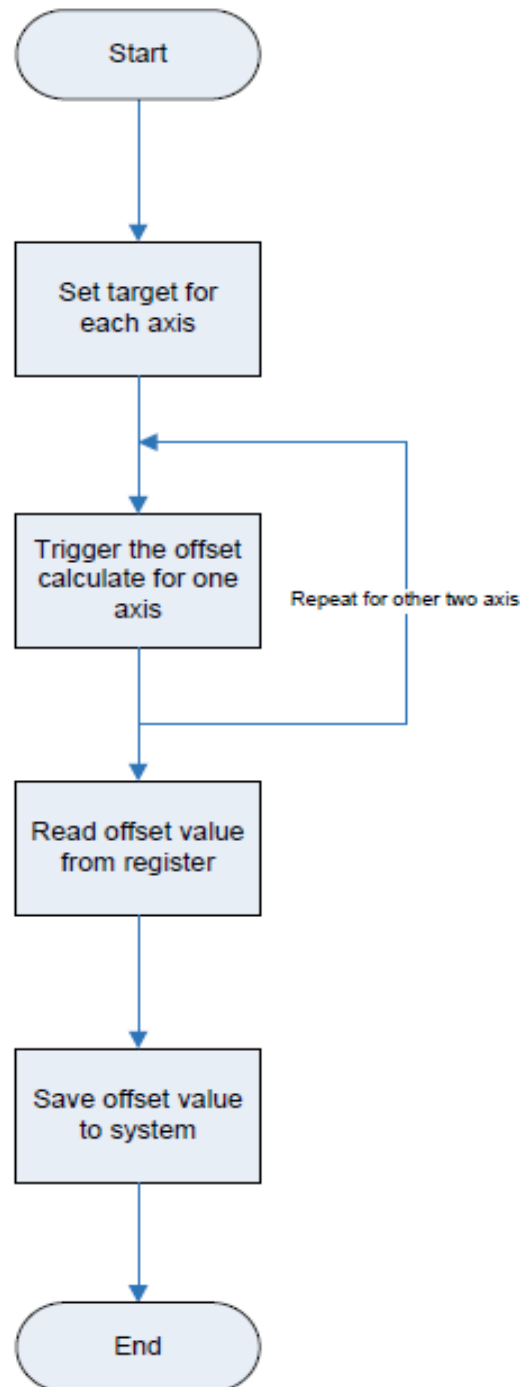
1. Calibrate via the function offered by the sensor

Figure 2: Calibration axis selection

- Set the g-range to 2g first.

- The compensation target can be chosen by setting the bits (0x37) offset_targe_x, (0x37) offset_targe_y, and (0x37) offset_targe_z according to Table 1.

(0x37) offset_target_x/y/z	Target value
00b	0g
01b	+1g
10b	-1g
11b	0g

Table 1: Offset target settings

- The calibration is triggered for each axis individually by setting the *(0x36) cal_trigger* bits. Register (0x36) cal_trigger is a write-only register, once triggered, the status of the fast correction process is reflected in the status bits (0x36) Cal_rdy. If bit (0x36) Cal_rdy is '0' while the correction is in progress, otherwise it is '1'. Bit (0x36) Cal_rdy is '0' when (0x36) cal_trigger is not '00'.

(0x36) cal_trigger	Selected Axis
00b	none
01b	x
10b	y
11b	z

Table 2: Calibration axis selection

- An average of 16 consecutive acceleration values is computed and the difference between target value and computed value is written to *(0x38,0x39,0x3A) offset_filt_x/y/z*. the public registers *(0x38,0x39,0x3A) offset_filt_x/y/z* are updated with the contents of the internal registers (using saturation if necessary) and can be read by user.

2. Calibrate via the function offered by application SW
   - Set to the target g-range to sensor
   - Read out sensor data
   - Get the average values based on the continuous numbers setting in SW
   - Get the offset value calculated by average values and target values defined in SW
   - Using this method, the length of the consecutive acceleration values can be defined freely which means the offset accuracy can be defined freely.

6.2 Calibration data storage

After gotten these offset calibration data, user can store them on external storage device, such as EEPROM, flash, etc.

6.3 Calibration data Usage

The calibration error data can be used in two ways:
1. Restore the calibration offset values into corresponding registers (0x38, 0x39, 0x3A), then all the data in accelerate value registers are compensated automatically;
2. User can read the raw data from sensor accelerator registers, then subtract calibration offset.

7. Legal disclaimer

7.1 Engineering samples

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8. Document history and modification

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