Technical Document

How to perform BMA253 self-test

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1 Introduction

BMA253 has built-in self-test feature to quickly determine if the accelerometer will work properly or not after PCB reflow process without the need of physically tilting the PCB. The PCB should be stationary in the production line for self-test. The PCB can be placed at any position and orientation. If the self-tests passes, then the BMA253 will operate according to the specifications in the datasheet.

The criteria for BMA253 self-test is as shown in Figure 1. The absolute difference between the acceleration values in positive direction and negative direction of the self-test should be larger than 0.8g for X/Y axes and 0.4g for Z axis. The BMA253 self-test should be performed at ±8g full scale (FS) range. And the sensitivity is 256 LSBs/g at ±8g FS range. Therefore, 0.8g corresponds to 205 LSBs and 0.4g corresponds to 103 LSBs.

In order to ensure a proper interpretation of the self-test signal it is recommended to perform the self-test for both (positive and negative) directions and then to calculate the difference of the resulting acceleration values. Table 6 shows the minimum differences for each axis. The actually measured signal differences can be significantly larger.

Table 6: Self-test difference values

	x-axis signal	y-axis signal	z-axis signal
resulting minimum difference signal	800 mg	800 mg	400 mg

Figure 1 BMA253 self-test criteria

BMA253 self-test,

(1) should be performed at ±8g full scale range in normal mode with any output data rate (ODR)
(2) should be triggered with each axis at positive direction, then read the acceleration values after 50ms delay
(3) should be triggered with each axis at negative direction, then read the acceleration values after 50ms delay
(4) should calculate the absolute difference between the acceleration values in positive direction and negative direction for each axis
(5) should check the self-test criteria to determine the self-test result
(6) should have the soft reset once the self-test is done

Please note that the acceleration data in registers from 0x02 to 0x07 are 12-bit in 2's complements format left-justified. In order to get final signed integers for X/Y/Z axes the 16-bit value of the MSB and LSB of each axis should be right-shifted 4 times with the sign.

Section 2 of this document presents BMA253 self-test procedure in Figure 2. Section 3 gives pseudo sample code with real data examples.

2 BMA253 self-test procedure

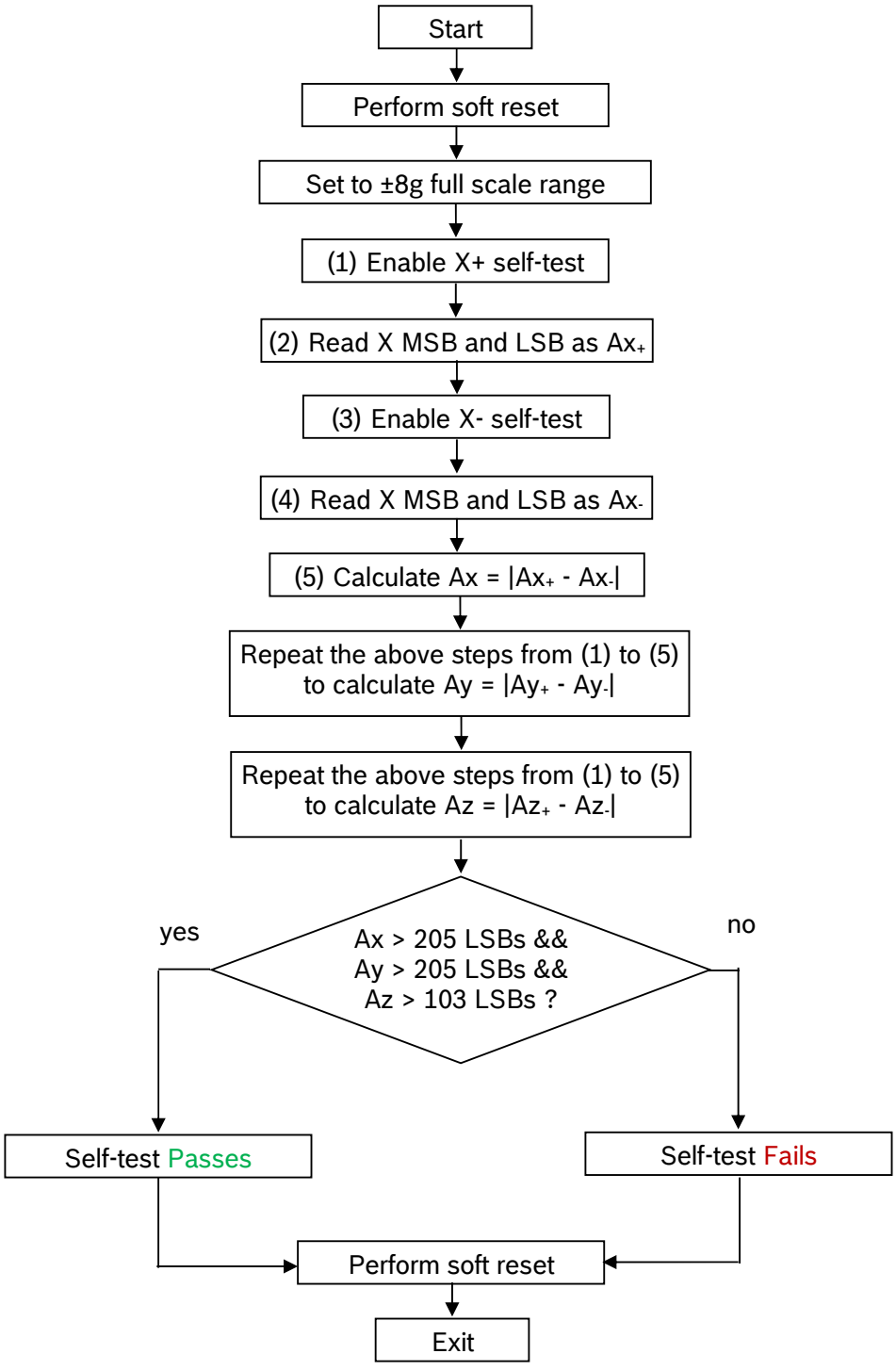

Figure 2 BMA253 self-test procedure

3 Sample code for self-test

The following is the pseudo code for BMA253 self-test. BMA253 is stationary at any position and orientation during the self-test.

```
void BMA253_selftest(void)
{
    // soft reset and set to ±8g FS range
    Write value of 0xB6 to register 0x14;          // perform soft reset to default settings with
                                                   ±2g FS range, 1000Hz BW normal mode
    Delay 50ms;
    Write value of 0x08 to register 0x0F;          // set to ±8g FS range

    // perform self-test on X axis
    Write value of 0x15 to register 0x32;          // enable X+ self-test
    Delay 50ms;                                    // short delay for BMA253 to stabilize
    Ax+ = Read register (0x03 and 0x02);           // Read X MSB and LSB
    // example:
            Ax+ = [(0x03 << 8) | 0x02] >> 4 = 0x16B1 >> 4 = 0x016B = 363 LSBs
    Write value of 0x11 to register 0x32;          // enable X- self-test
    Delay 50ms;                                    // short delay for BMA253 to stabilize
    Ax- = Read register (0x03 and 0x02);           // Read X MSB and LSB
    // example:
            Ax- = [(0x03 << 8) | 0x02] >> 4 = 0xEDB1 >> 4 = 0xFEDB = -293 LSBs
    Ax = abs(Ax+ - Ax-);                           // calculate the difference
    // example:
            Ax = abs(Ax+ - Ax-) = abs[363 – (-293)] = 656 LSBs

    // perform self-test on Y axis
    Write value of 0x16 to register 0x32;          // enable Y+ self-test
    Delay 50ms;                                    // short delay for BMA253 to stabilize
    Ay+ = Read register (0x05 and 0x04);           // Read Y MSB and LSB
    // example:
            Ay+ = [(0x05 << 8) | 0x04] >> 4 = 0x4D71 >> 4 = 0x04D7 = 1239 LSBs
    Write value of 0x12 to register 0x32;          // enable Y- self-test
    Delay 50ms;                                    // short delay for BMA253 to stabilize
    Ay- = Read register (0x05 and 0x04);           // Read Y MSB and LSB
    // example:
            Ay- = [(0x05 << 8) | 0x04] >> 4 = 0xB581 >> 4 = 0xFB58 = -1192 LSBs
    Ay = abs(Ay+ - Ay-);                           // calculate the difference
    // example:
            Ay = abs(Ay+ - Ay-) = abs[1239 – (-1192)] = 2431 LSBs
```

```
    // perform self-test on Z axis
    Write value of 0x17 to register 0x32;          // enable Z+ self-test
    Delay 50ms;                                    // short delay for BMA253 to stabilize
    Az+ = Read register (0x07 and 0x06);           // Read Z MSB and LSB
    // example:
            Az+ = [(0x07 << 8) | 0x06] >> 4 = 0x27B1 >> 4 = 0x027B = 635 LSBs
    Write value of 0x13 to register 0x32;          // enable Z- self-test
    Delay 50ms;                                    // short delay for BMA253 to stabilize
    Az- = Read register (0x07 and 0x06);           // Read Z MSB and LSB
    // example:
            Az- = [(0x07 << 8) | 0x06] >> 4 = 0xF4A1 >> 4 = 0xFF4A = -182 LSBs
    Ax = abs(Ax+ - Ax-);                           // calculate the difference
    // example:
            Az = abs(Az+ - Az-) = abs[635 – (-182)] = 817 LSBs

    if ((Ax > 205) && (Ay > 205) && (Az > 103))    // apply self-test criteria
            {
                Self-test passes;
            }
            else
            {
                Self-test fails;
            }
    }
    // example:
            because Ax = 656 LSBs > 205 LSBs and Ay = 2431 LSBs > 205 LSBs and Az =
                    817 LSBs > 103 LSBs,
            the self-test passes.

    // soft reset to default settings
    Write value of 0xB6 to register 0x14;          // perform soft reset to default settings with
                                                   ±2g FS range, 1000Hz BW normal mode
    Delay 50ms;
}
```

4 Legal disclaimer

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5 Document history and modification

Rev. No	Chapter	Description of modification/changes	Date
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