How to generate freefall interrupt using BMA253

1. Introduction

Freefall interrupt is the unique feature of an accelerometer, which means that other motions can not fake it. Here we use BMA253 12-bit digital accelerometer as an example. When the acceleromter X axis and Y axis and Z axis acceleration all enter the low-g threshold zone simultaneously, the freefall event occurs. If the freefall event lasts longer than the low-g duration amount of time, then the freefall interrupt will be generated. The relationship between the freefall duration and freefall height can be found at https://www.grc.nasa.gov/WWW/k-12/airplane/mofall.html.

2. Implementation

2.1 Sample code

Below is the pesudo code to initialize the BMA253 for freefall interrupt. The settings can be fine tuned to meet the requirements of different applications.

```
void init_BMA253(void)

{       // configure common control registers

        Write 0x03 to register 0x0F;  // default value for ±2g full scale range

        Write 0x0F to register 0x10;  // set 1KHz bandwitch or 2KHz output data rate (ODR)

        Write 0x00 to register 0x11;  // default value for normal mode


        // configure interrupt registers

        Write 0x01 to register 0x19;  // route low-g interrupt to INT1 pin

        Write 0x05 to register 0x20;  // default value for active-high and push-pull on INT1 pin

        Write 0x07 to register 0x21;  // INT1 pin is latched. Writing 0x87 to register 0x21 to
                                      clear the freefall interrupt

        Write 0x47 to register 0x22;  // set low_dur=142ms (for about 100mm height
                                      detection. If the freefall event doesn't travel more than
                                      100mm height, then BMA253 will not gnerate interrupt.
                                      This duration can be fine tuned)

        Write 0x30 to register 0x23;  // default value for low_th=48LSBs=375mg (can be fine
                                      tuned)
```

Write 0x81 to register 0x24; // default value for 125mg hysterisis low-g interrupt

// enable low-g interrupt

Write 0x08 to register 0x17; // enable low-g interrupt for freefall detection

}

2.2 Test results

Below is the screenshots of the Development Desktop software. It works with the application mother board that has the BMA253 shuttle board plugged in.

Figure 1 shows that there is no interrupt generated for the first freefall event with orange arrow, because it doesn't last longer than the low_dur of 142ms. Later on, the freefall interrupt is gnerated and latched. Since freefall event is important to hard disks, it is recommended to latch it so that the microcontroller will not miss the event.

Figure 1: Freefall interrupt