

How to generate single-tap interrupt using BMA253

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1 Introduction

Single-tap interrupt is a built in feature inside BMA253 12-bit 3-axis digital accelerometer. It can be used to wake up a system in low power mode 1 (LPM1) in order to save overall power consumption of the system. The working principle of single-tap is described in BMA253 datasheet online at <https://ae-bst.resource.bosch.com/media/tech/media/datasheets/BST-BMA253-DS000-01.pdf> on page 31 Section 4.7.6.

BMA253 LPM1 mode automatically switches between normal mode (130uA) and suspend mode (2.1uA) according to the preselected sleep time. The calculated average current and final output data rate (ODR) are as shown below in Table 1. The formula is in datasheet page 17.

Table 1 BMA253 average current in LPM1 mode

Bandwidth	Sleep time	Average current	Final ODR
1KHz	1000ms	2.21uA	1Hz
1KHz	500ms	2.33uA	2Hz
1KHz	100ms	3.24uA	9.9Hz
1KHz	50ms	4.36uA	19.6Hz
1KHz	25ms	6.54uA	38.6Hz
1KHz	10ms	12.66uA	91.7Hz
1KHz	6ms	18.78uA	144.9Hz
1KHz	4ms	25.59uA	204.1Hz
1KHz	2ms	41.79uA	344.8Hz
1KHz	1ms	62.68uA	526.3Hz
1KHz	0.5ms	84.32uA	714.3Hz

For example, when BMA253 is configured to work in LPM1 mode with 25ms sleep time, the calculated average current is about 6.54uA and final ODR is about 38.6Hz.

The single-tap interrupt will be generated when two of the following conditions are valid:

- The slope or differential acceleration exceeds the tap_th (tap threshold). Within the tap_shock amount of time, all other slope accelerations will be ignored
- After the tap_shock amount of time, within the tap_quiet amount of time there are also no slope or differential acceleration exceeds the tap_th

The single-tap interrupt will be cleared automatically when the above conditions are no longer valid.

If BMA253 works under LPM1 mode, every time when BMA253 wakes up from suspend mode to normal mode, it will take number of samples defined in tap_samp to see if there is any sample exceeds the tap_th or not. If not, then it will go to suspend mode automatically.

2 Sample code

Below is the pseudo code to initialize the BMA253 for single-tap interrupt. The settings can be fine-tuned to meet the requirements in different applications. Finally BMA253 will consumes about 9uA monitoring single-tap event on the background.

```
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; // default value for 1KHz bandwidth (130uA)
    Write 0x56 to register 0x11; // set to LPM1 mode with 25ms sleep time (6.5uA)

    // configure interrupt registers
    Write 0x20 to register 0x19; // route single-tap interrupt to INT1 pin
    Write 0x05 to register 0x20; // default value for active-high, push-pull on INT1 pin
    Write 0x0E to register 0x21; // temporarily latch the interrupt for 50ms. After
                                // 50ms the interrupt will be cleared automatically
    Write 0x04 to register 0x2A; // default value for 50ms tap_shock and 30ms
                                // tap_quiet. (These durations can be fine-tuned)
    Write 0x04 to register 0x2B; // 2 samples of tap_samp will be evaluated every
                                // time when BMA253 wakes up and 250mg tap_th
                                // (can be fine-tuned) (9uA)

    // enable single-tap interrupt
    Write 0x20 to register 0x16; // enable single-tap interrupt
}
```

3 Test results

Below is the screenshot of the Development Desktop software. The software works with the APP2.0 application base board that has the BMA253 shuttle board plugged in.

Figure 1 shows that the single-tap interrupts on INT1 pin are generated. The tap motion can come from any directions. Figure 2 shows the logic analyzer screenshot with 50ms temporarily latch time.

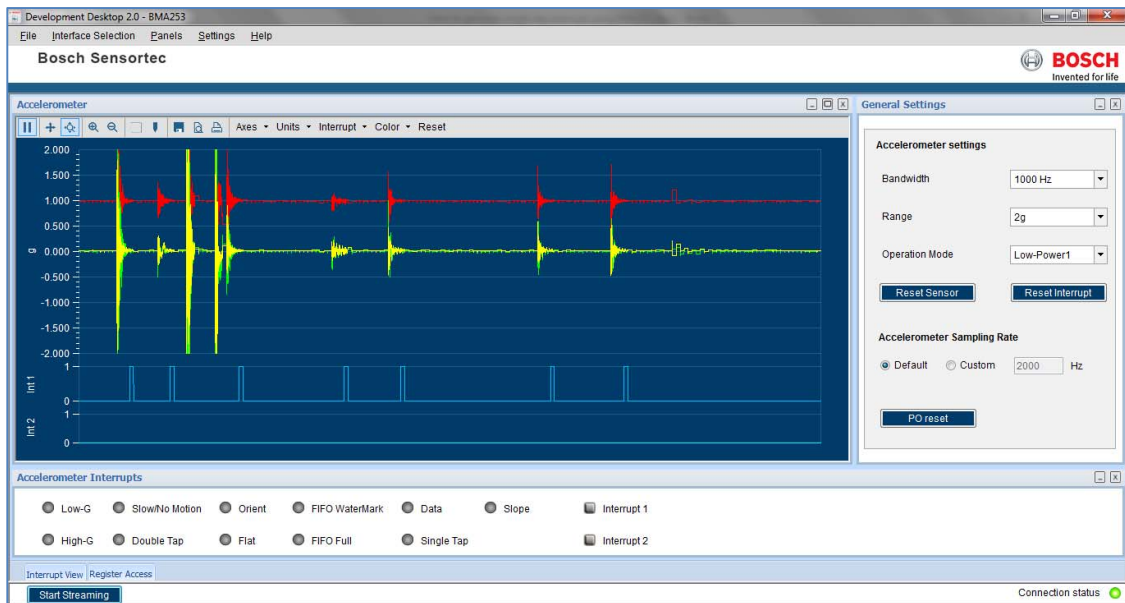


Figure 1: Single-tap interrupt

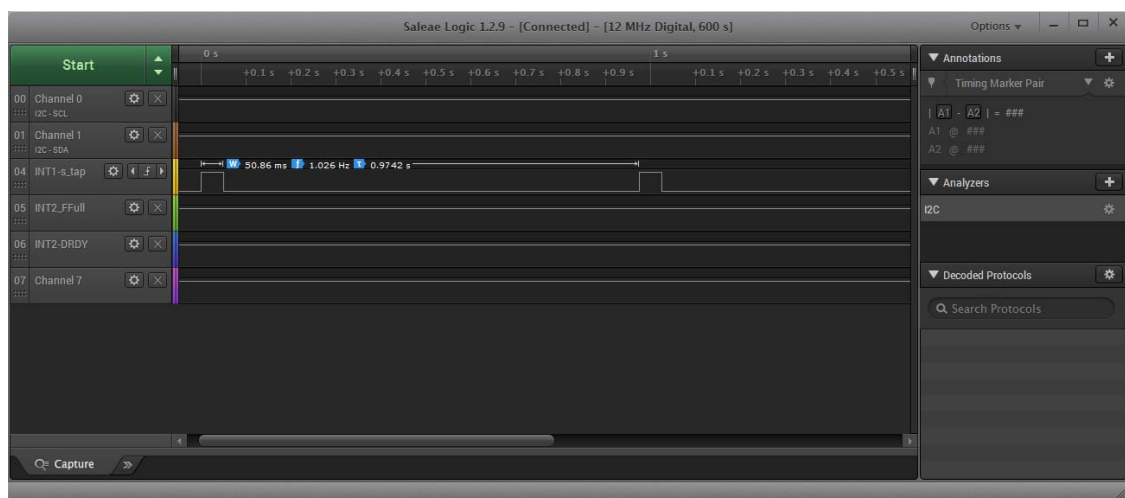


Figure 2: Logic analyzer screenshot

4 Legal disclaimer

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5 Document history and modification

Rev. No	Chapter	Description of modification/changes	Date
1.0		Document creation	August 16 th , 2017

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