MMS213 *preliminary*

OOB Detection Module, With I2C Interface Accelerometer

Key Features

- Small package: 28.6mm X 15mm X 9mm
- 3 axis output
- Fast I2C slave (400 KHz.) mode interface
- 4.5V to 5.5V single supply continuous operation
- Low power consumption: typically < 150uA@5 V
- Embedded power up/down and self-test function
- On chip mixed signal processing
- RoHS compliant

Applications

- Washing machine OOB detection
- Other environment where unbalanced rotating movement detection is needed

OOB: Out of Balance

Product Overview

The MMS213 is a sensor module product which is targeted for OOB (Out-out-balance) applications. A typical environment where OOB occurs is within washing machines.

With MMS213, machine developers are able to detect the existence of a basket out-of-balance condition in the spin mode and may take further actions to correct it, which may include a manual alarm system or an automatic rebalance operation. The MMS213 module includes three-axis MEMS accelerometer.

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1.1 Block diagram

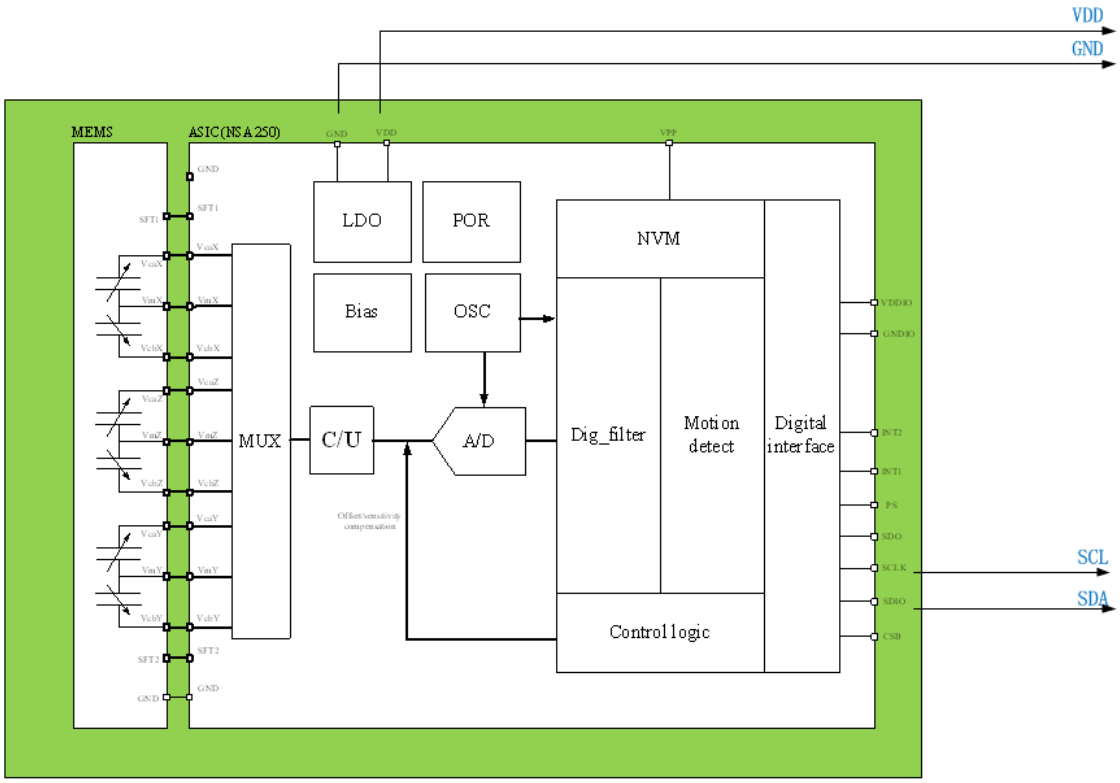

Figure 1 Block Diagram

1.2 Connector description

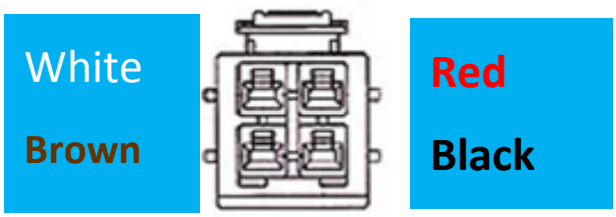

Figure 2 connector front view

Table 1 Connector Description

Pin#	Color	Name	Description
1	Red	VDD(Red)	Power supply
2	Black	GND(Black)	Ground
3	Brown	SDA(Brown)	I2C SDA
4	White	SCL(White)	I2C SCL

Table 2 Wiring Harness Specifications

item	description
Type	RWP 4 X 0.12 mm, standard copper
Length	Customized, 38 ± 2 cm
Tip treatment	4 stripped, tinned & stranded copper wires with shrink tube of ϕ1.5mm size The tube color is the same as the wire

2 Mechanical and electrical specifications

2.1 Mechanical characteristics

Vdd = 2.5 V, T = 25 °C unless otherwise noted (a)

a. The product is factory calibrated at 2.5 V. The operational power supply range is from 1.62V to 3.6 V.

Table 3.Mechanical characteristic

Symbol	Parameter	Test conditions	Min	Type	Max	Unit
TCSo	Sensitivity change vs. temperature	±2g		0.01		%/°C
Tyoff	Typical zero-g level offset accuracy			±80		mg
Tcoff	Zero-g level change vs. temperature	Max delta from 25°C		±0.6		mg/°C
An	Acceleration noise density	Normal Mode		0.8	200	mg/sqrt(Hz)
Top	Operation temperature range		-40		85	°C

2.2 Electrical characteristics

Vdd = 2.5 V, T = 25 °C unless otherwise noted

Table 4.Electrical characteristics

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
Vdd	Supply voltage		4.5	5	5.5	V
Idd	current consumption in normal mode	Top=25℃, ODR=1kHz		150		uA
Idd_lp	current consumption in low power mode	Top=25℃, ODR=62.5Hz, BW=500Hz		8		uA
Idd_sm	current consumption in suspend mode	Top=25℃		1		uA
VIH	Digital high level input voltage	I2C	0.7*3.3			V
VIL	Digital low level input voltage	I2C			0.3*3.3	V
VOH	high level output voltage		0.9*3.3			V
VOL	Low level output voltage				0.1*3.3	V
BW	System bandwidth		1.95		500	Hz
ODR	Output data rate		1		1000	Hz
Wake-up time	twu	From stand-by		1		ms
Start-up time	tsu	From power off		2		ms
PSRR	Power Supply Rejection Rate	Top=25℃			20	mg/V

3 Communication interface

3.1 I2C Electrical specification

Table 5.Electrical specification of the I2C interface pins

Symbol	Parameter	Min	Max	Unit
fscl	Clock frequency		400	kHz
tscl_l	SCL low pulse	1.3		us
tscl_h	SCL high pulse	0.6		us
Tsda_setup	SDA setup time	0.1		us
Tsda_hold	SDA hold time	0.0		us
tsusta	Setup Time for a repeated start condition	0.6		us
thdsta	Hold time for a start condition	0.6		us
tsusto	Setup Time for a stop condition	0.6		us
tbuf	Time before a new transmission can start	1.3		us

The figure below shows the definition of the I2C timing given in Table 6:

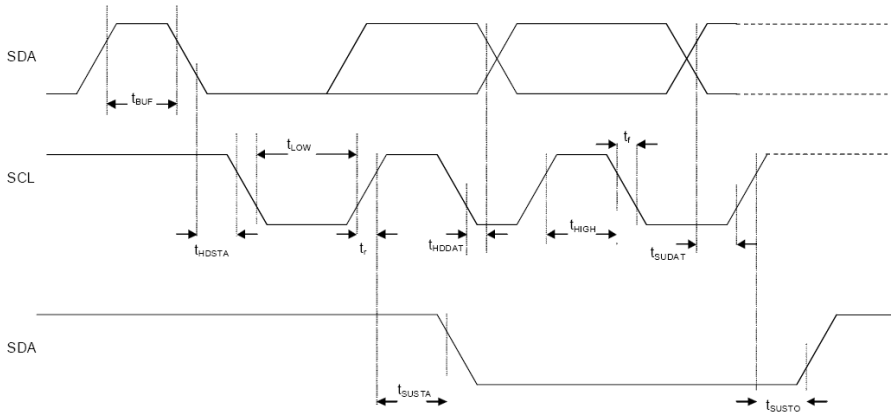

Figure 3 I2C Slave timing diagram

3.2 I2C Operation

I2C bus uses SCL and SDA as signal lines. Both lines are connected to VDDIO externally via pull-up resistors so that they are pulled high when the bus is free. The I2C device address of MMS213 is shown below.

Table 6.I2C Address

SAD_6	SAD_5	SAD_4	SAD_3	SAD_2	SAD_1	SAD_0	W/R
0	1	0	0	1	1	1	0/1

Table 7.SAD+Read/Write patterns

Command	SAD[6:0]	R/W	SAD+R/W
Read	0011001	1	01001111(33h)
Write	0011001	0	01001110(32h)

The I2C interface protocol has special bus signal conditions. Start (S), stop (P) and binary data conditions are shown below. At start condition, SCL is high and SDA has a falling edge. Then the slave address is sent. After the 7 address bits, the direction control bit R/W selects the read or write operation. When a slave device recognizes that it is being addressed, it should acknowledge by pulling SDA low in the ninth SCL (ACK) cycle.

At stop condition, SCL is also high, but SDA has a rising edge. Data must be held stable at SDA when SCL is high. Data can change value at SDA only when SCL is low.

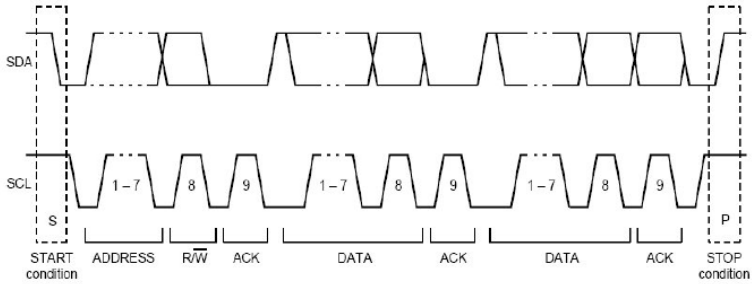

Figure 4 I2C Protocol

Table 8.Transfer when master is writing one byte to slave

Master	S	SAD+W		SUB		DATA		P
Slave			SAK		SAK		SAK	

Table 9.Transfer when master is writing multiple bytes to slave

Master	S	SAD+W		SUB		DATA		DATA		P
Slave			SAK		SAK		SAK		SAK	

Table 10.Transfer when master is receiving (reading) one byte of data from slave

Master	S	SAD+W		SUB		SR	SAD+R			NMASK	P
Slave			SAK		SAK			SAK	DATA		

Table 11.Transfer when master is receiving (reading) multiple bytes of data from slave

Master	S	SAD+W		SUB		SR	SAD+R			MAK		MAK		NMASK	P
Slave			SAK		SAK			SAK	DATA		DATA		DATA		

4 Data Fetching

4.1 Data Format

4.1.1 ACC_X_LSB (02H), ACC_X_MSB (03H)

X-axis acceleration data, the value is expressed in two complement byte and are left justified.

Table 12.ACC_X_LSB register

Default data: 0x00 Type: R

D[1]	D[0]	Unused	Unused	Unused	Unused	Unused	Unused

Table 13.ACC_X_MSB register

Default data: 0x00 Type: R

D[9]	D[8]	D[7]	D[6]	D[5]	D[4]	D[3]	D[2]

4.1.2 ACC_Y_LSB (04H), ACC_Y_MSB (05H)

Y-axis acceleration data, the value is expressed in two complement byte and are left justified.
Same format as X-axis

4.1.3 ACC_Z_LSB (06H), ACC_Z_MSB (07H)

Z-axis acceleration data, the value is expressed in two complement byte and are left justified.
Same format as X-axis

4.1.4 Example

Table 14 Data sample in 2G range

XLSB	XMSB	OUTPUT (mg)
0x00	0x40	1000
0x00	0x00	0
0x00	0xC0	-1000

4.2 Operate Sequence

After Power on, continuously read 6 registers from 0x02 to 0x07, convert the data to 3 axis' value (x, y, z) base on the format introduced in 4.1

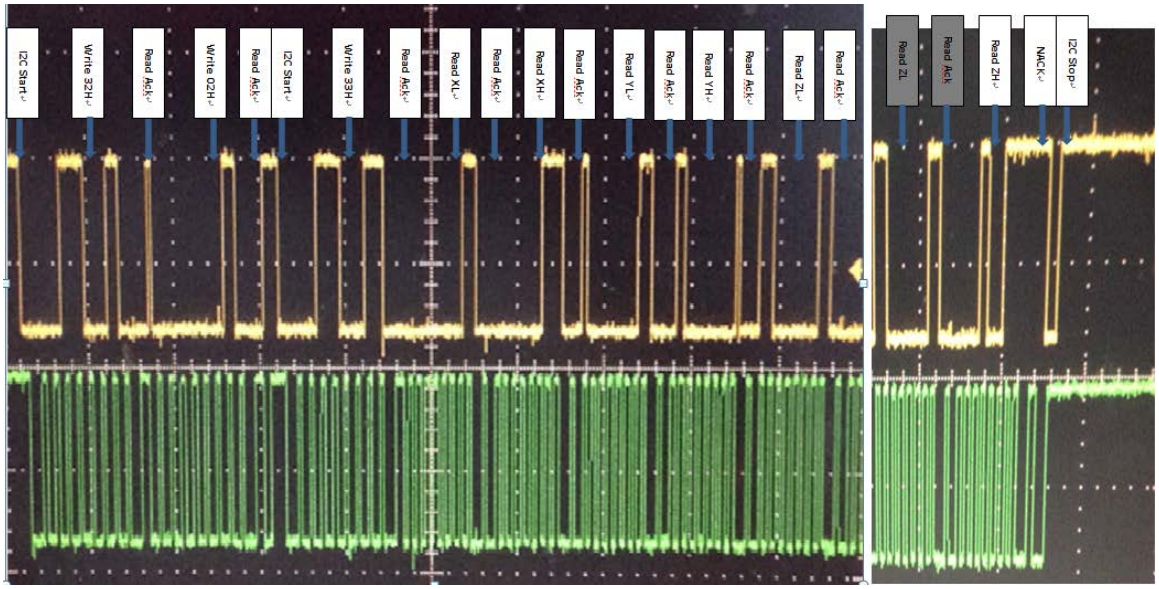

Figure 5 Actual IIC Communication Waveform

5 Package information

5.1 Outline dimensions

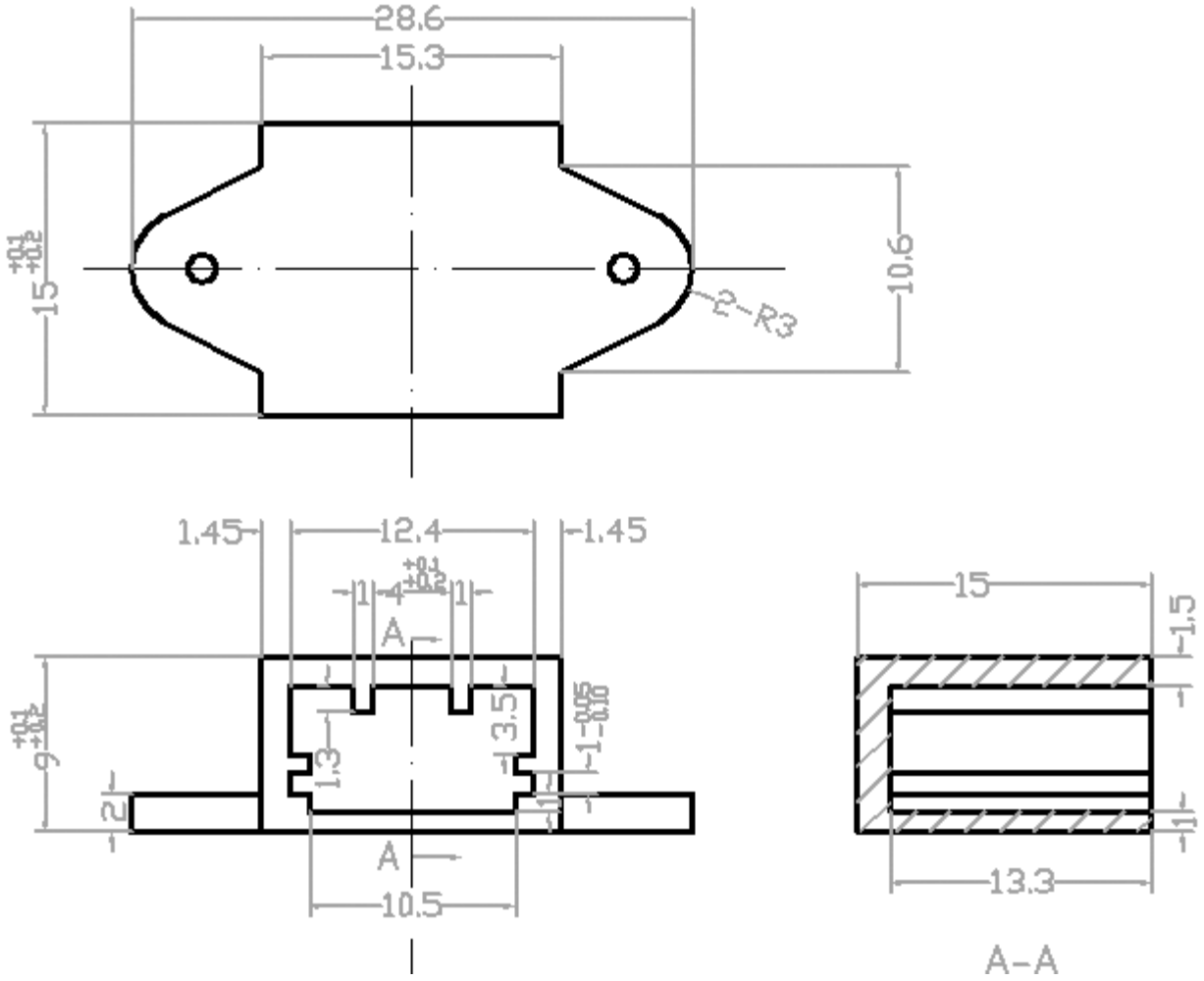

Figure 5 package dimensions

6 Revision history

Table 15.Document revision history

Date	Revision	Changes
10-Aug-2014	1.0	Initial release

单击下面可查看定价，库存，交付和生命周期等信息

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