OOB(1) Detection Module, With I^2C Interface Accelerometer

MXC62020GMW

FEATURES

- Small package: 28.6mm X 15mm X 9mm
- High resolution rated at 1 milli-g
- Fast I2C slave (400 KHz.) mode interface
- 1.8V compatible IO
- 2.7 V to 5.25 V single supply continuous operation
- Low power consumption: typically < 2 mA @ 5.0 V
- Embedded power up/down and self-test function
- On chip mixed signal processing

APPLICATIONS

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

The Module Functional Block Diagram

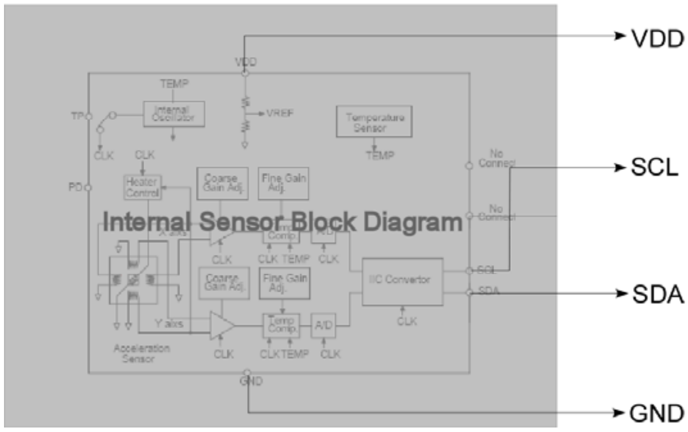


Fig.1 FUNCTIONAL BLOCK DIAGRAM

DESCRIPTION:

The MXC62020GMW 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 MXC62020GMW, 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.

(1) OOB: Out of Balance

The MXC62020GMW module employs start-of-art dual-axis MEMS accelerometer MXS62020MP produced by MEMSIC Inc. As shown in Fig.1 above, this sensor is equipped with on-chip mixed signal processing and integrated I2C bus, allowing the device to be connected directly to a microprocessor eliminating the need for A/D converters or timing resources. The sensor measures acceleration with a full-scale range of +/- 2 g and a sensitivity of 512counts/g @5.0 V at 25°C. It can measure both dynamic acceleration (e.g. vibration) and static acceleration (e.g. gravity). The sensor design is based on MEMSIC proprietary heat convection principle and requires no moving mass inside the chip.

One Technology Drive, Suite 325, Andover, MA01810, USA
Tel: +1 978 738 0900 Fax: +1 978 738 0196
www.memsic.com

Mechanical Specifications : (all size tolerance + / - 0.1mm unless otherwise specified)

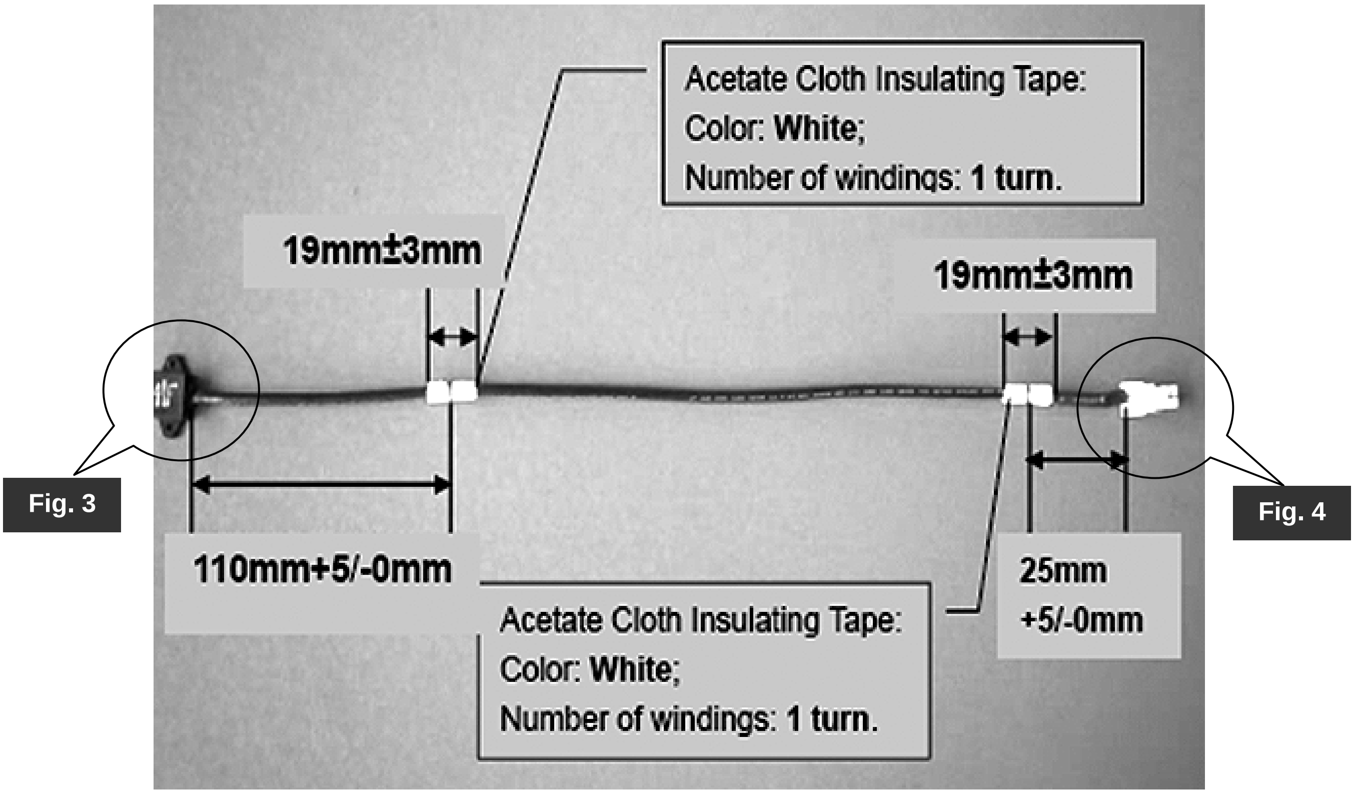


Figure 2 Overall Mechanical Size

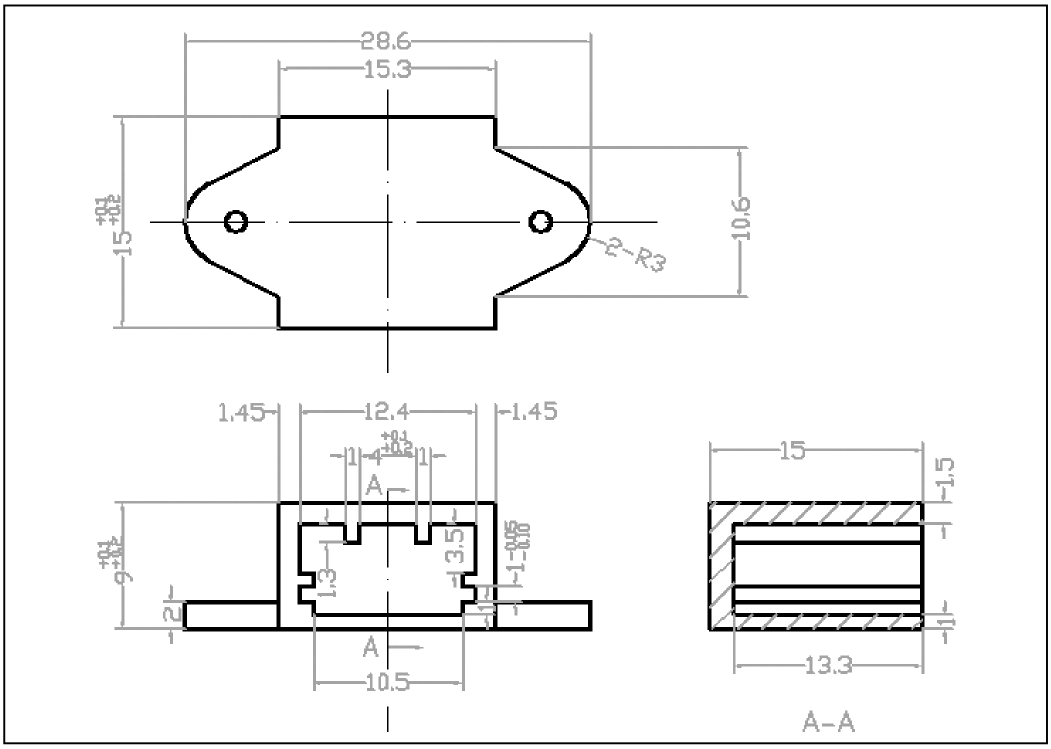


Figure 3 Test Head Mechanical Size

HYPER-TECH Systems
14 Odem ST. P.O.B. 7042 Petach Tikva 4917001, ISRAEL | Office: +972-3-924-3352
Fax: +972-3-9243385 | sales@hypertech.co.il | www.hypertech.co.il

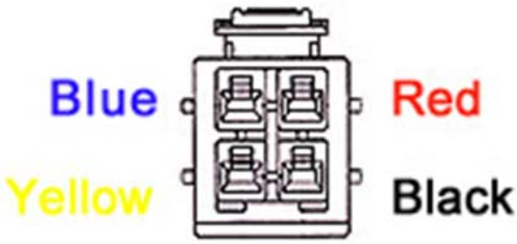


Figure 4 Connector Front View
(for details size, refer to JST PW Connector Datasheet, part number VLP-04V-1)

Wiring Harness Specifications	
Type	RWP 4 X 0.12 mm, standard copper
Length	Customerized, 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.

Table 1 Wiring Harness Specifications

Pin	Color Code	Name	Description
1.	**Red**	**V_{DD}(Red)**	**Power supply**
2.	**Black**	**GND(Black)**	**Ground**
3.	**Yellow**	**SDA(Yellow)**	**I^2C SDA**
4.	**Blue**	**SCL(Blue)**	**I^2C SCL**

V_{DD} – This is the supply input for the accelerometer module. The DC voltage should be between 2.7 and 5.25 volts.

GND – This is the ground pin for the accelerometer module.

SDA – This pin is the I^2C serial data line, and operates in FAST (400 KHz.) mode.

SCL – This pin is the I^2C serial clock line, and operates in FAST (400 KHz.) mode.

Table 2 MXC62020GMW Pin Descriptions

Electrical Specifications : (Measured @ 25°C, Acceleration = 0 *g*; V_{DD} = 5.0V unless otherwise specified)

No.	Parameter	Conditions	Min	Typical	Max	Units
1	Operating Range[1]	Along each axis	±2.0			G
2	Nonlinearity	Best fit straight line		0.5		% of FS
3	Alignment Error[2]			±1.0		degree
4	Transverse Sensitivity[3]			±2.0		%
5	Sensitivity		471	512	553	counts/g
6	TC of Sensitivity	Δ from 25°C	-15		+10	%
7	Zero *g* Offset Bias Level		1946	2048	2150	counts
8	Zero *g* Offset TC	Δ from 25°C		0.8		m*g*/°C
9	Tout		2550	2710	2870	counts
10	Tout Sensitivity		2.00	2.33	2.60	counts/°C
11	Noise Density, RMS	within 20Hz		0.7	1.0	m*g*/ $\sqrt{Hz}$
12	Resolution	@ 1Hz. BW		0.5	1.0	mg
13	Frequency Response	@ -3dB	15	17	19	Hz
14	Self-test Excitation Level		1.7	2.2	2.7	G
15	Output Drive Capability	@ 2.7 V – 5.25 V			100	µA
16	Turn-On Time[4]			75	100	Ms
17	Operating Voltage Range		2.7	5.0	5.25	V
18	Supply Current			1.8		mA
19	Power Down Current				1.0	µA
20	Operating Temperature Range		-40		+85	°C

NOTES

1 Guaranteed by measurement of initial offset and sensitivity.

2 Alignment error is specified as the angle between the true and indicated axis of sensitivity.

3 Cross axis sensitivity is the algebraic sum of the alignment and the inherent sensitivity errors.

4 Output settled to within ±17mg.

Table3 Module Electric Performance Specifications

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Logic Input Low Level	V_{IL}		-0.5		$0.3V_{DD}$	V
Logic Input High Level	V_{IH}		$0.7V_{DD}$		V_{DD}	V
Hysteresis of Schmitt input	V_{hys}		0.2			V
Logic Output Low Level	V_{OL}		0.0		0.4	V
Input Leakage Current	I_i	$0.1Vdd<V_{in}<0.9Vdd$	-10		10	µA
SCL Clock Frequency	f_{SCL}		0		400	kHz
START Hold Time	$t_{HD;STA}$		0.6			µS
START Setup Time	$t_{SU;STA}$		0.6			µS
LOW period of SCL	t_{LOW}		1.3			µS
HIGH period of SCL	t_{HIGH}		0.6			µS

Data Hold Time	$t_{HD;DAT}$		0		$0.7t_{LOW}$	µS
Data Setup Time	$t_{SU;DAT}$		0.1			µS
Rise Time	t_r	From V_{IL} to V_{IH}			0.3	µS
Fall Time	t_f	From V_{IH} to V_{IL}			0.3	µS
Bus Free Time Between STOP and START	t_{BUF}		1.3			µS
STOP Setup Time	$t_{SU;STO}$		0.6			µS

Table4 I²C I/O Specifications

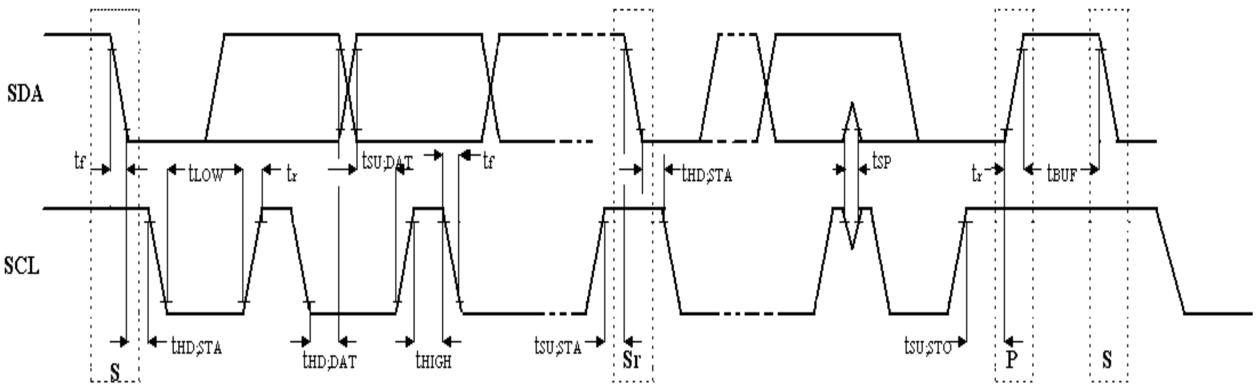
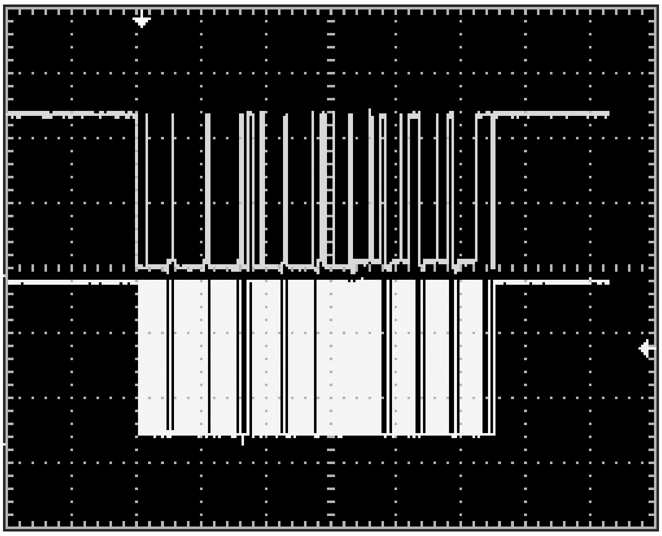


Table5 Typical I²C Communication Timing Diagram

Note: samples of actual waveform of IIC communication for MXC62020GMW is attached in Appendix I. Please refer to the graphs in Appendix for detailed information.

Appendix I: Actual IIC Communication Waveform (for a typical data read cycle)

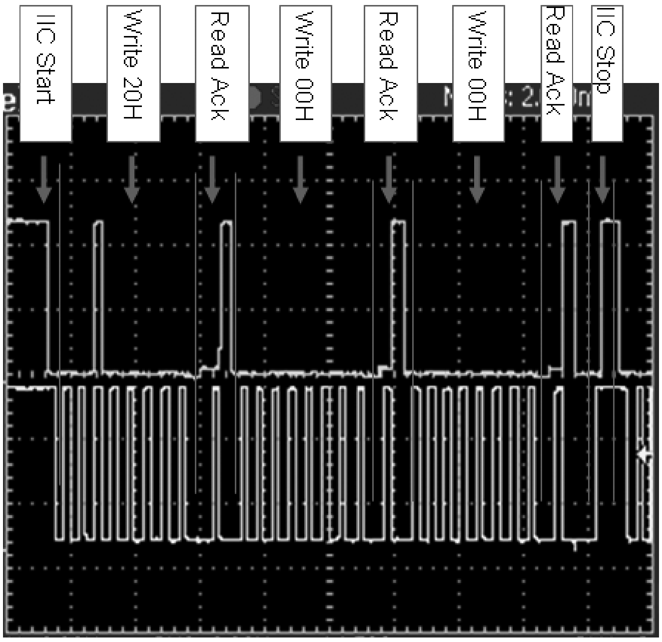


Sample Data:

XH: 08H / XL: 13H
XOUT: 2067

YH: 08H / YL: 03H
YOUT: 2051

Detailed Sequence:



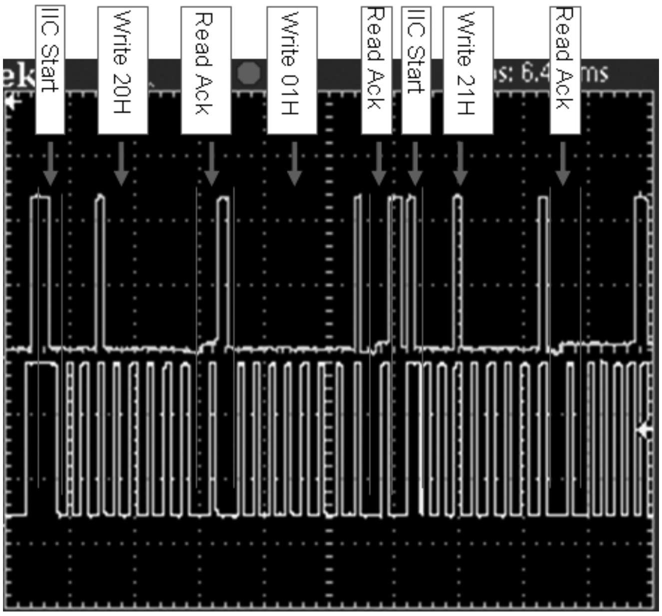
Step 1:

(1) locate device: by writing 20H

(2) locate register: by writing 00H

(3) get acceleration data ready: by writing 00H into reg. 00H

HYPER-TECH Systems
14 Odem ST. P.O.B. 7042 Petach Tikva 4917001, ISRAEL | Office: +972-3-924-3352
Fax: +972-3-9243385 | sales@hypertech.co.il | www.hypertech.co.il

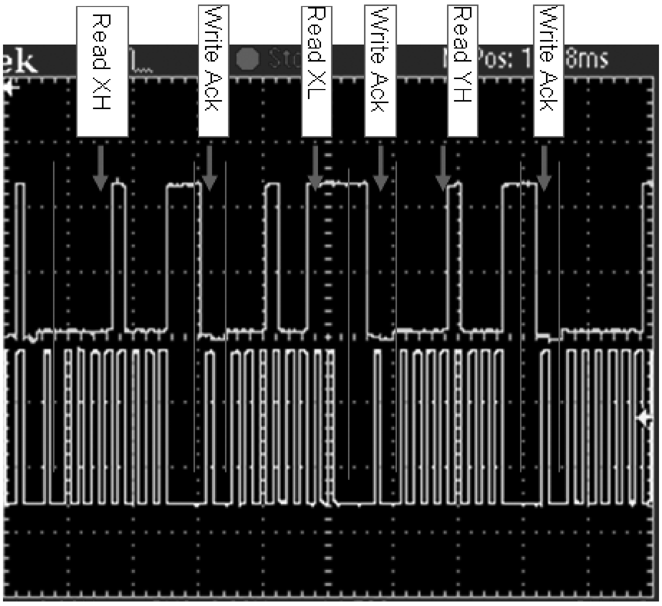


Step 2:

(1) locate device: by writing 20H

(2) specify the starting register: by writing 01H

(3) get ready for reading data: by writing 21H

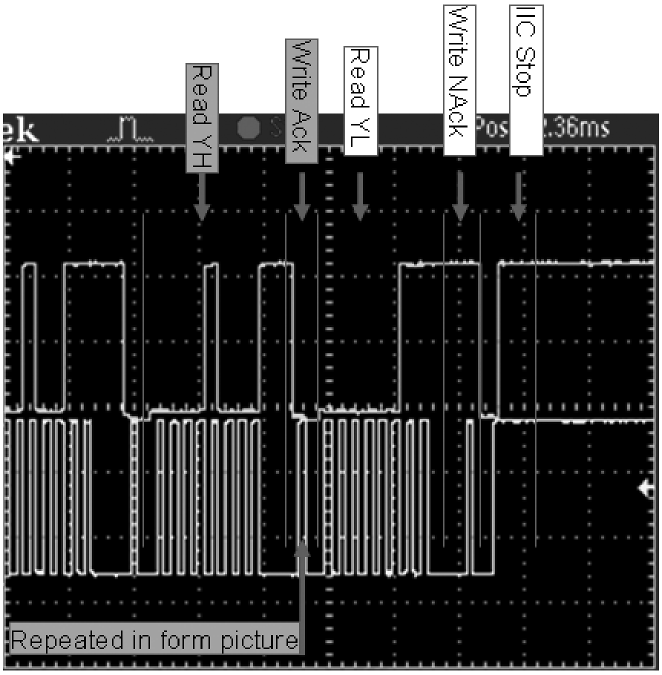


Step 3:

(1) read XH

(2) read XL

14 Odem ST. P.O.B. 7042 Petach Tikva 4917001, ISRAEL | Office: +972-3-924-3352
Fax: +972-3-9243385 | sales@hypertech.co.il | www.hypertech.co.il



Step 4:

(1) read YH

(2) read YL

(3) Complete cycle: by writing NACK

HYPER-TECH Systems

14 Odem ST. P.O.B. 7042 Petach Tikva 4917001, ISRAEL | Office: +972-3-924-3352
Fax: +972-3-9243385 | sales@hypertech.co.il | www.hypertech.co.il