



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China





MPU-3000 & MPU-3050 3-Axis Evaluation Board User Guide Revision 2.0



CONTENTS

| | |
|--|----|
| 1. REVISION HISTORY | 3 |
| 2. PURPOSE | 4 |
| 3. MPU-3000 & MPU-3050 3-AXIS EV BOARD OVERVIEW..... | 5 |
| 4. MPU-3000 & MPU-3050 3-AXIS EVB SCHEMATICS | 7 |
| 5. DATA GATHERING OPTIONS | 11 |
| 6. SPECIAL INSTRUCTIONS | 12 |
| 7. DIMENSION DRAWING | 12 |



1. Revision History

| Date | Revision | Description |
|------------|----------|----------------------------------|
| 10/01/2010 | 1.0 | Initial release |
| 07/15/2011 | 2.0 | Added compatibility for MPU-3050 |



2. Purpose

This document describes the hardware and circuitry on the MPU-3000™ & MPU-3050™ 3-Axis Evaluation (EV) Board. It covers applying the EV board to a larger system, understanding key signals and circuit functions, hardware jumper settings, and port connectors.

2.1 Usage

This evaluation board provides three axes of motion sensing, comprised of:

- X-, Y- and Z-Axis gyros with $\pm 250^\circ/\text{sec}$, $\pm 500^\circ/\text{sec}$, $\pm 1000^\circ/\text{sec}$, $\pm 2000^\circ/\text{sec}$ selectable full-scale range.
- Digital data measured using on-chip ADCs, is transmitted over I²C or SPI interfaces.

The Evaluation board may be used by itself using SPI or I²C serial communications interfaces. Alternatively, it may be connected to InvenSense's ARM Evaluation Board (INVARMEVB) for connectivity to a host computer using USB interface.

2.2 Related Documents

The following documents are recommended for additional information regarding the products and systems described in this Application Note.

- MPU-3000 & MPU-3050 Product Specification
- MPU-3000 & MPU-3050 Register Map and Register Descriptions
- MPU-3000 & MPU-3050 EVB schematics

3. MPU-3000 & MPU-3050 3-Axis EV Board Overview

The MPU-3000 & MPU-3050 3-Axis EV Board contains the MPU-3000 or MPU-3050 Digital Motion Processing Unit. It contains a number of 'solder-across' jumper points that permit several circuit configurations.

Refer to Figure 1. The EV Board is populated on its top side only for easy of measurement access. The 10x2 customer header connector is designed to connect with the InvenSense ARM Evaluation Board (INVARMEVB), which is a host microcontroller board useful for adapting the MPU-3000 & MPU-3050 3-Axis EV Board to a personal computer via its USB port.

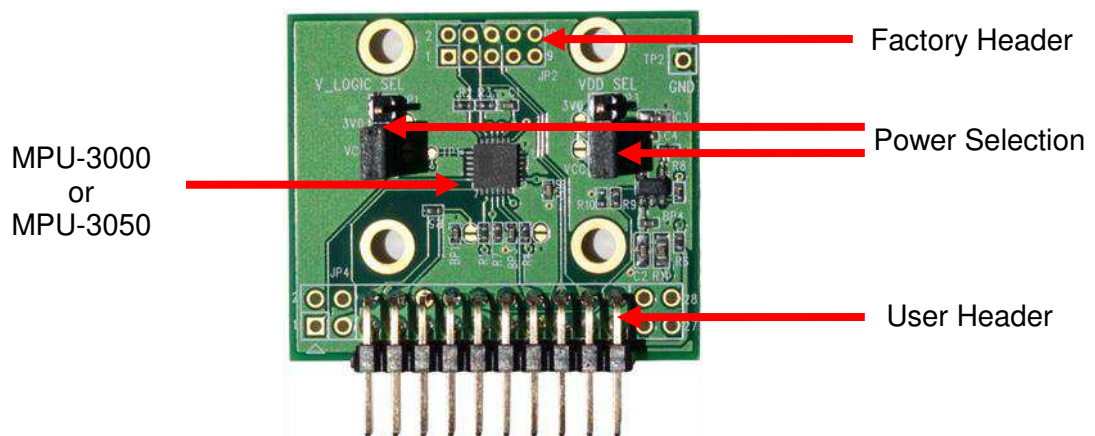


Figure 1. Top side of the MPU-3050 3-Axis EV Board

The 5x2 extension factory header is intended for connecting additional devices to the EV Board, such as a camera image stabilization processor, or a digital-output compass, etc. The 3-pin power selection headers are used to select which voltage supply is fed to the MPU-3000 & MPU-3050.

3.1 MPU-3000 & MPU-3050 Key Function and Pin-outs

The MPU-3000 & MPU-3050 EVB is a fully-tested evaluation board, providing for quick evaluation of the MPU-3000 & MPU-3050's X-, Y-, and Z-axis angular rate gyroscope. The MPU-3000 & MPU-3050 use InvenSense's proprietary MEMS technology with vertically driven vibrating masses to produce a functionally complete, low-cost motion sensor. All required conditioning electronics are integrated into a single chip measuring 4 x 4 x 0.9mm. It incorporates X-, Y- and Z-axis low-pass filters and an EEPROM for on-chip factory calibration of the sensor. Factory trimmed scale factors eliminate the need for external active components and end-user calibration. A built-in Proportional-To-Absolute-Temperature (PTAT) sensor provides temperature compensation information. The product is lead-free and Green Compliant.

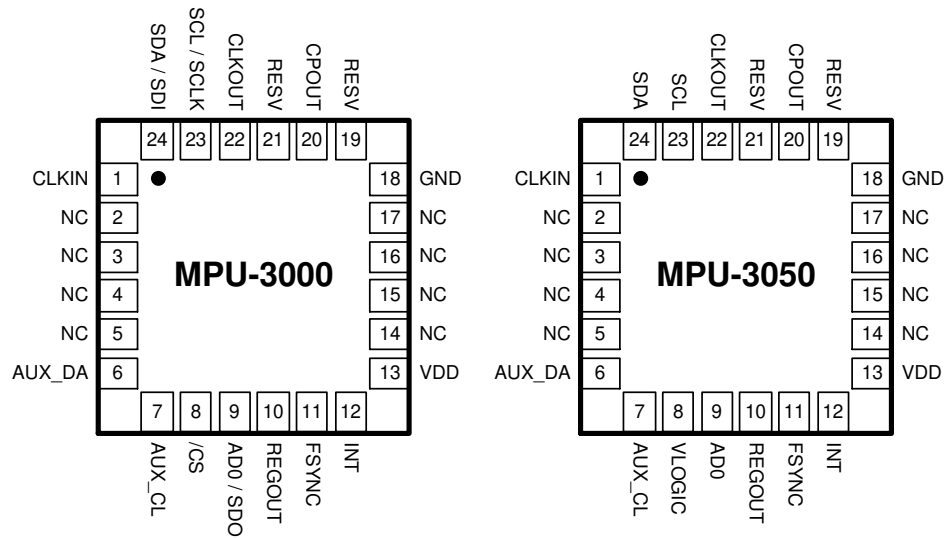


Figure 2. MPU-3000 & MPU-3050 QFN Package (Top View) 24-pin 4mm x 4mm x 0.9mm

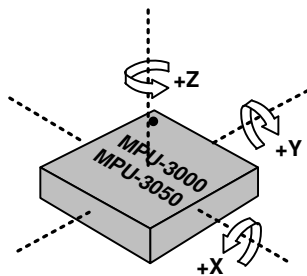


Figure 3. Orientation of Axes of Sensitivity and Polarity of Rotation

3.2 MPU-3000 & MPU-3050 Bus Connection

The MPU-3000 communicates to a system processor using either SPI or I²C serial interfaces. The MPU-3050 communicates to a system processor using an I²C serial interface. The device always acts as a slave when communicating to the system processor.

4. MPU-3000 & MPU-3050 3-Axis EVB Schematics

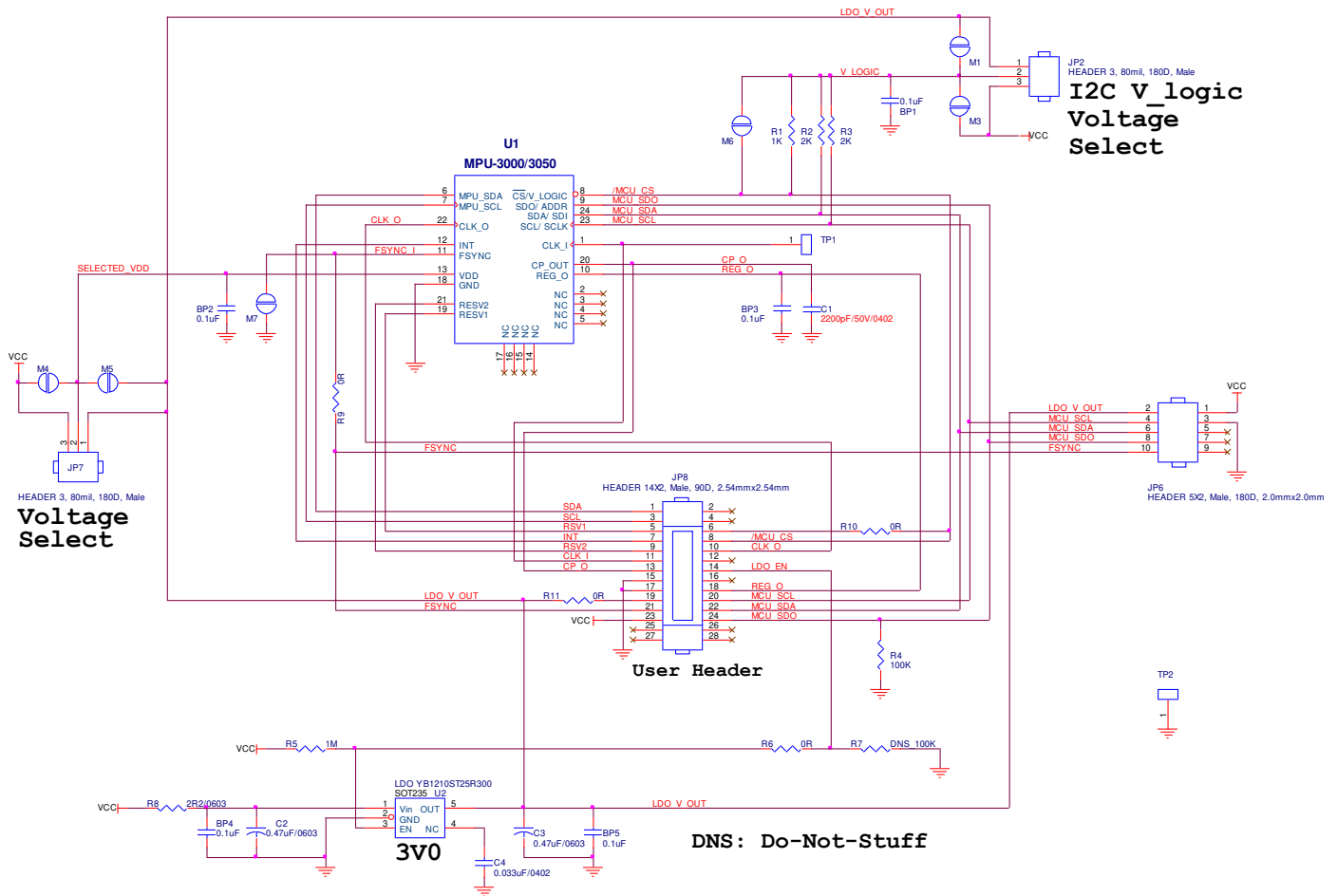


Figure 4. Schematics

4.1 Bill of Materials

Table 1. Bill of Materials

| Item | Quantity | Reference | Part | PCB Footprint |
|------|----------|---------------------|---|----------------|
| 1 | 5 | BP1,BP2,BP3,BP4,BP5 | 0.1uF | C0402 |
| 2 | 1 | C1 | 2200pF/50V | C0402 |
| 3 | 2 | C2,C3 | 0.47uF/0603 | C0603 |
| 4 | 1 | C4 | 0.033uF | C0402 |
| 6 | 4 | JP1,JP3,JP4,JP5 | Solder | JP2P1_8X1_3S |
| 7 | 2 | JP2,JP7 | HEADER 3, 80mil, 180D, Male | J79\3S |
| 8 | 1 | JP6 | HEADER 5X2, Male, 180D, 2.0mmx2.0mm | SIP2X5N2 |
| 9 | 1 | JP8 | HEADER 14X2, Male, 90D, 2.54mmx2.54mm | HDB2X14NRA |
| 11 | 2 | R4,R1 | 100K | R0402 |
| 12 | 2 | R3,R2 | 10K | R0402 |
| 13 | 1 | R5 | 1M | R0402 |
| 14 | 1 | R8 | 2R2/0603 | R0603 |
| 17 | 1 | U1 | MPU-3000, 24-Lead QFN (4mm x 4mm x 0.9mm) | QFN5_5S24P0_5T |
| 18 | 1 | U2 | YB1210ST25R300 | SOT235 |

4.2 Power Supply Connections

JP2 and JP7 are 3 header-pin plug-in jumpers which allow users to select between on-board LDO and external DC supply to the MPU-3000 & MPU-3050. For details, please refer Table 2. Power Selection Jumpers.

The on-board 3.0V LDO (Low-dropout voltage regulator) is a low-noise version with stable enable-disable profile. Its output is called 3V0 on the schematic, and using it will assure that the gyroscope and accelerometer performance will meet intended specifications.

Selecting the raw Vcc line to power the chip is generally done while designing and evaluating an embedded platform, where the host processor and related electronics needs full control over the motion processing chipset's power supply.

When user intends to use on board LDO 3V0 power, external Vcc must be provided with higher than 3.7V to ensure that the LDO works properly.

If user provides Vcc with 5V, JP2 and JP7 must be set as "1-2 short". MPU-3000 & MPU-3050 VDD and VLOGIC operation range is 2.1V to 3.6V.

4.3 MPU-3000 & MPU-3050 EVB connector signals description

Table 2. Power Selection Jumpers

| JP2 Pin Number | Signal description |
|----------------|------------------------------|
| 1-2 short | VLOGIC = 3V |
| 2-3 short | VLOGIC = Vcc (from external) |
| JP7 Pin Number | Signal description |
| 1-2 short | VDD = 3V |
| 2-3 short | VDD = Vcc (from external) |

Table 3. User Interface Connector Signals

| JP8 Pin Number | Signal description |
|----------------|---|
| 1 | Reserved |
| 3 | Reserved |
| 5 | Reserved |
| 7 | INT, INT output to controller |
| 9 | Reserved |
| 11 | CLK_I |
| 13 | CPOUT |
| 15 | GND |
| 17 | GND |
| 19 | 3V |
| 21 | FSYNC |
| 23 | Receive power from ARM-7 Controller Board or external. It should be 5V, with >200mA |
| 25 | NC |
| 27 | NC |
| 2 | NC |
| 4 | NC |
| 6 | NC |
| 8 | SPI CS |
| 10 | Reserved |
| 12 | NC |

| JP8 Pin Number | Signal description |
|----------------|----------------------------------|
| 14 | EVb on board LDO enable |
| 16 | NC |
| 18 | REGOUT |
| 20 | I ² C SCL or SPI SCLK |
| 22 | I ² C SDA or SPI SDI |
| 24 | I ² C Addr or SPI SDO |
| 26 | NC |
| 28 | NC |

Table 4. Extended Factory Connector

| JP6 Pin Number | Signal description |
|----------------|--|
| 1 | VCC, power from ARM-7 controller board or external power. It should be 5V, with >200mA |
| 3 | GND |
| 5 | NC |
| 7 | NC |
| 9 | NC |
| 2 | 3V |
| 4 | I ² C SCL or SPI SCLK |
| 6 | I ² C SDA or SPI SDI |
| 8 | I ² C Addr or SPI SDO |
| 10 | FSYNC |

4.4 Connecting the FSYNC Line

The FSYNC line is intended for use in a camera's image-stabilization system. It is an input from the camera platform to the EV Board, and is intended to synchronize the MPU-3000 & MPU-3050's serial bus transfer with the master timing set by the camera system. FSYNC can originate from the host processor via JP8 pin-21, or from JP6 pin-10. There is no external pull-up termination for the FSYNC line.

4.5 Serial bus Levels, Speeds and Terminations

The MPU-3000 & MPU-3050 support I²C up to 400kHz, and SPI (MPU-3000 only) up to 1MHz serial clock rates. The I²C bus open drain pull up resistors are connected to either 3.0V or external provided Vcc (3V or 5V depend on user). The pull up level is selected by JP2. Please refer to Table 2. Power Selection Jumpers.

5. Data Gathering Options

The MPU-3000 & MPU-3050's Digital Sensor Data is available at the User Header. Alternatively, for connectivity with a host PC, an InvenSense ARM Processor Board may be used.

5.1 Connection to ARM EVB

For communications via USB to a host computer, the MPU-3000 & MPU-3050 EVB can be connected to InvenSense's ARM processor board, the INV-ARMEVB.

The photo below shows the connection of MPU-3000 & MPU-3050 to INV-ARMEVB. Connection between the two boards is made via the user header.

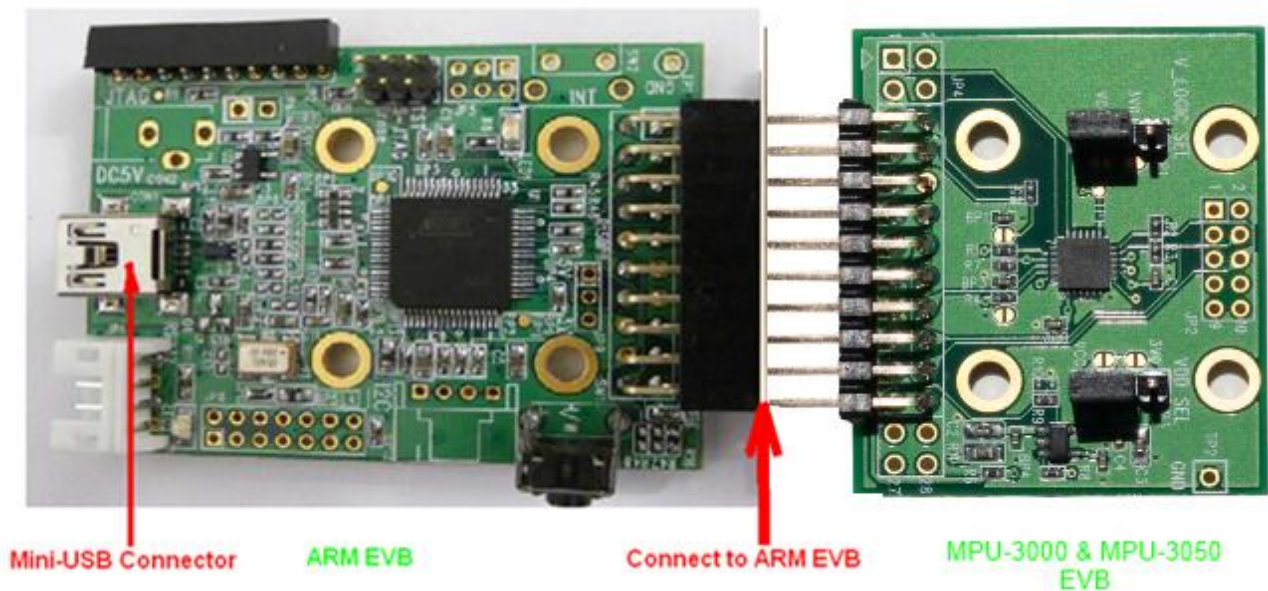


Figure 5. Connect MPU-3000 & MPU-3050 EVB to ARM Board

1.1 Use of MPU-3000 & MPU-3050 without ARM EVB board

I²C and SPI signals are available on JP8 and JP6. User can develop tools to communicate with the MPU-3000 & MPU-3050. There is no bus mode selection setting needed.

6. Special Instructions

6.1 Electrostatic Discharge Sensitivity

The MPU-3000 & MPU-3050 gyro can be permanently damaged by an electrostatic discharge. ESD precautions for handling and storage are recommended.

7. Dimension Drawing

The MPU-3000 & MPU-3050 EV board is a 4 layer PCB with 32mm x 38mm dimension.

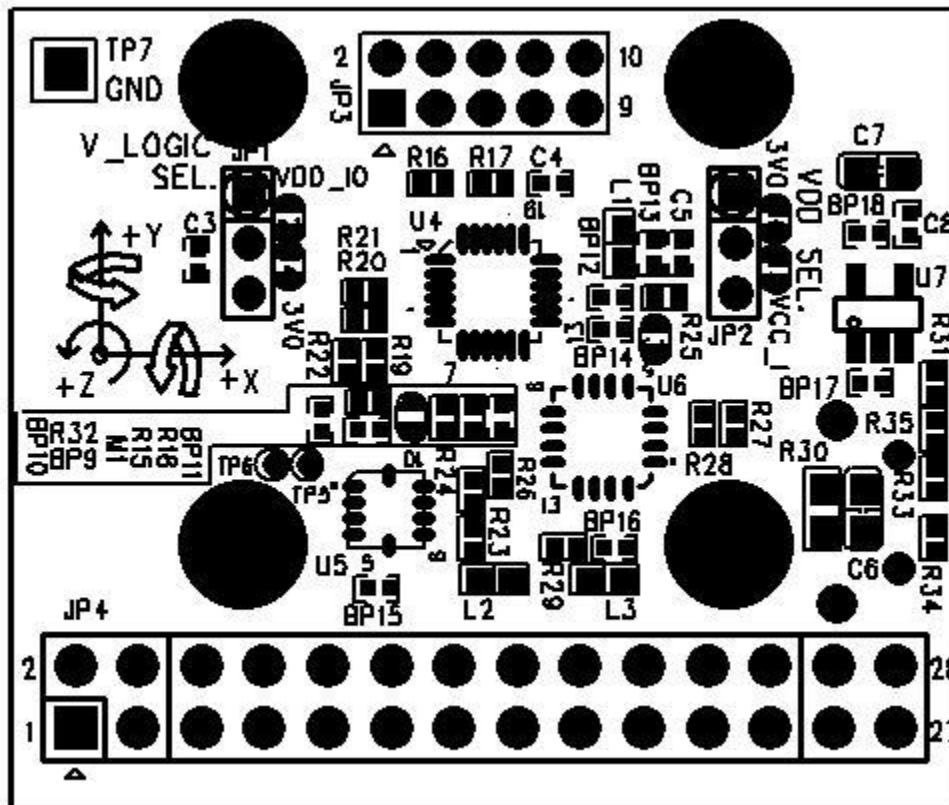


Figure 6. MPU-3000 & MPU-3050 EVB Dimensions



This information furnished by InvenSense is believed to be accurate and reliable. However, no responsibility is assumed by InvenSense for its use, or for any infringements of patents or other rights of third parties that may result from its use. Specifications are subject to change without notice. InvenSense reserves the right to make changes to this product, including its circuits and software, in order to improve its design and/or performance, without prior notice. InvenSense makes no warranties, neither expressed nor implied, regarding the information and specifications contained in this document. InvenSense assumes no responsibility for any claims or damages arising from information contained in this document, or from the use of products and services detailed therein. This includes, but is not limited to, claims or damages based on the infringement of patents, copyrights, mask work and/or other intellectual property rights.

Certain intellectual property owned by InvenSense and described in this document is patent protected. No license is granted by implication or otherwise under any patent or patent rights of InvenSense. This publication supersedes and replaces all information previously supplied. Trademarks that are registered trademarks are the property of their respective companies. InvenSense sensors should not be used or sold in the development, storage, production or utilization of any conventional or mass-destructive weapons or for any other weapons or life threatening applications, as well as in any other life critical applications such as medical equipment, transportation, aerospace and nuclear instruments, undersea equipment, power plant equipment, disaster prevention and crime prevention equipment.

InvenSense® is a registered trademark of InvenSense, Inc. MPU-3000™ and MPU-3050™ are trademarks of InvenSense, Inc.

©2011 InvenSense, Inc. All rights reserved.

