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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





ITG-3200 3-Axis Gyro Evaluation Board Application Note Rev 1.1

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1. Revision History

Date	Revision	Description
12/07/2009	1.0	Initial release
03/18/2010	1.1	Added assembly drawing, revised schematic, revised BOM, other edits for readability.



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2. Purpose

This document describes the hardware and circuitry on the ITG-3200 3-Axis Evaluation Board (EVB). It includes applying the EVB to a larger system, understanding the key signals and circuit functions, hardware jumper settings, and port connectors.

2.1 Usage

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

- X-, Y-, and Z-Axis gyros with $\pm 2,000$ °/sec full-scale range;
- 16-bit digital data measured using on-chip ADCs, transmitted over I²C interface.

The Evaluation board may be used independently with the I²C serial communications interface. Alternatively, it may be connected to InvenSense's ARM Evaluation Board (INV-ARMEVB) for connectivity to a host Windows PC using the USB interface.

2.2 Related Documents

The following documents are recommended for a more comprehensive understanding of the components and systems described in this Application Note.

- ITG-3200 Product Specification
- ITG-3200 EVB Schematic Diagram (included in this document)

3. ITG-3200 3-Axis EVB Overview

The ITG-3200 3-Axis EVB contains the ITG-3200 3-axis digital gyroscope and its interface circuitry. It contains removable and 'solder-across' jumper points that permits several circuit configurations.

Referring to Figure 1, the EVB is populated on its top side only for ease of measurement access. The 20-pin (10 x 2-pin) Main header connector is designed to interface with the InvenSense INV-ARM EVB, which is a host microcontroller board useful for adapting the ITG-3200 3-Axis EVB to a personal computer via its USB port.

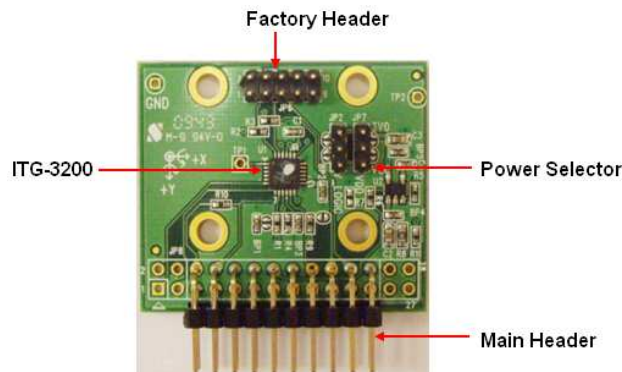


Figure 1. Top side of the ITG-3200 3-Axis EVB

The 10-pin (5 x 2-pin) Factory extension header is intended for connecting additional devices to the EVB, such as a digital-output compass, etc. The 3-pin power selection header is used to select which voltage supply is interfaced to the ITG-3200.

The Power select jumper allows the ITG-3200 VDD to be supplied either directly from a 3.3V DC input on the main header, or by a local 3.0V voltage regulator.

3.1 ITG-3200 Key Function and Pin-outs

The ITG-3200EVb is a fully-tested evaluation board, providing a quick evaluation of the ITG-3200 X-, Y-, and Z-axis angular rate gyroscope. The ITG-3200 uses 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. Refer to the ITG-3200 Product Specification for a complete description.

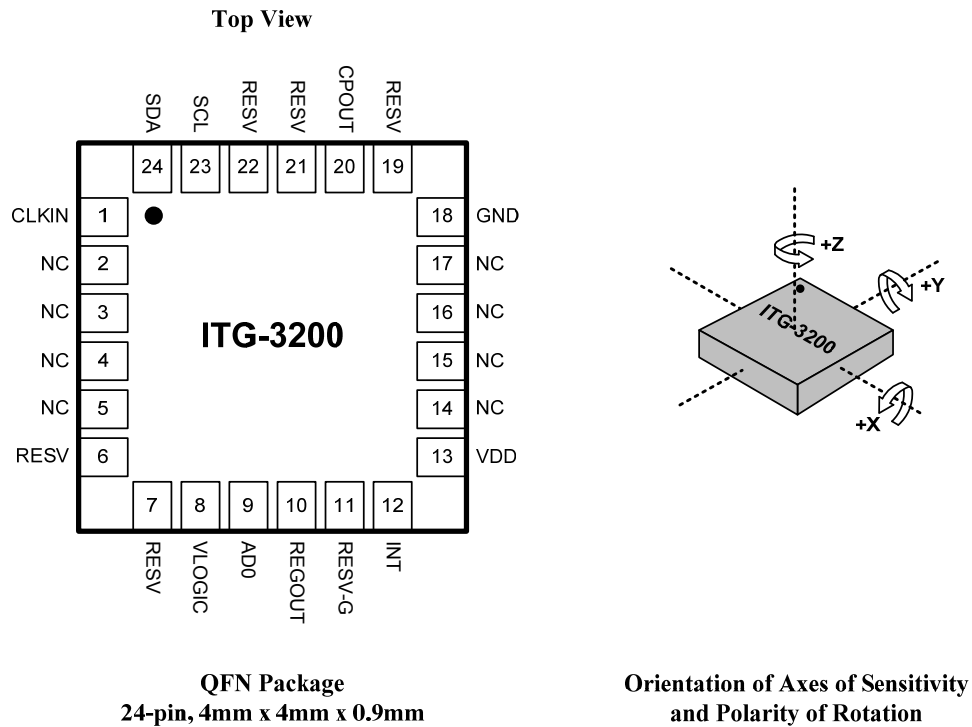


Figure 2. Top View Pin-Out and Sense Orientation of the ITG-3200

4. Signal Paths and Configurable Connections

4.1 ITG-3200 Functional Block Diagram

The ITG-3200 consists of a MEMS gyroscope, a data-acquisition and digital signal processing section, and a data interface which is compatible to I²C. The data interface is a slave.

VDD and GND are the main supply voltage connections, and VLOGIC is an input which sets the data interface logic-high level. This allows VDD to be different than the IO voltage. Thus, for example, VDD could be 2.6VDC while the data interface could connect to a 1.8V I²C bus, by using a VLOGIC of 1.8V. REGOUT is for connecting the (nominally) 1.7V internal voltage regulator to a bypass capacitor. CPOUT is for connecting a charge pump capacitor to the internal charge pump.

INT is the ITG-3200 interrupt and may be software configured to a variety of modes. AD0 is the LSB of the I²C device address, so that when it is tied logic-low, the ITG-3200 address is 68h, and when logic-high (VLOGIC) the ITG-3200 address is 69h.

Refer to the ITG-3200 product specification for power-on-timing waveforms for VDD and VLOGIC.

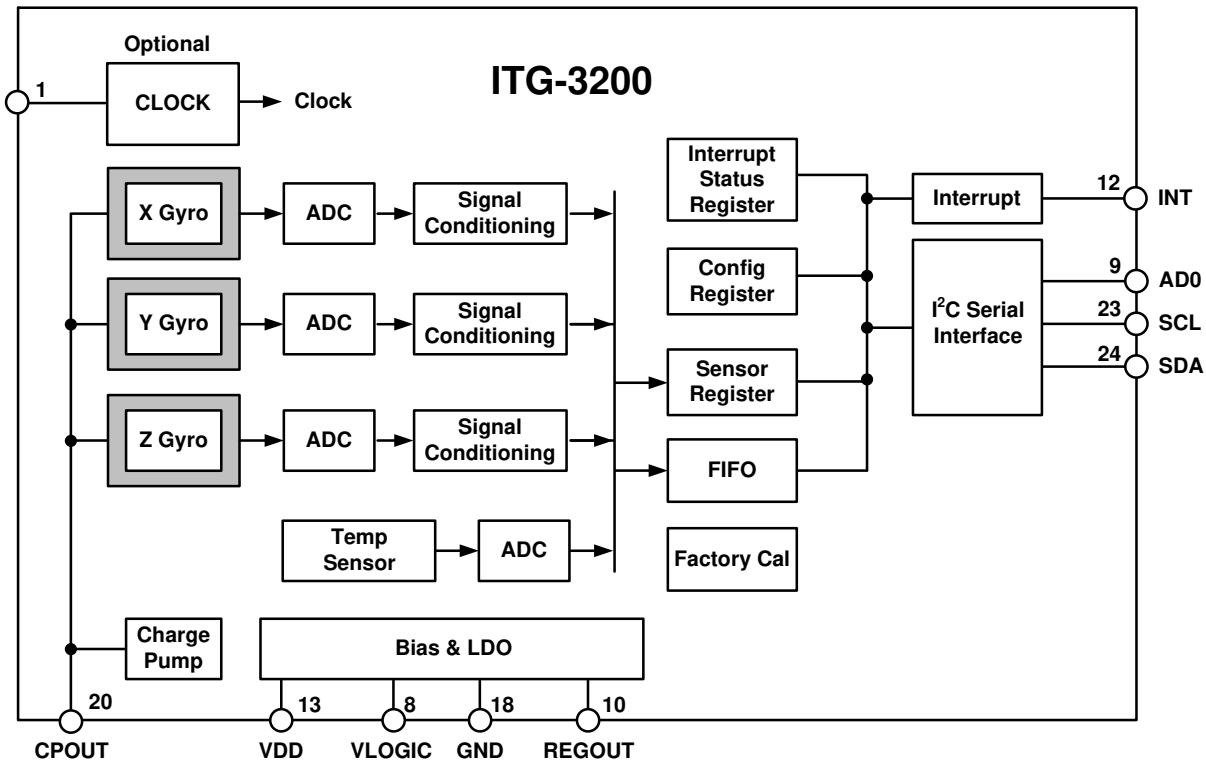


Figure 3: ITG-3200 Functional Block Diagram



4.3 Bill of Materials (Parts Stuffing List) for ITG-3200 EV Board

Parts Stuffing BOM for ITG-3200 EV Board. Also refer to Assembly Drawing for ITG-3200 EV Board

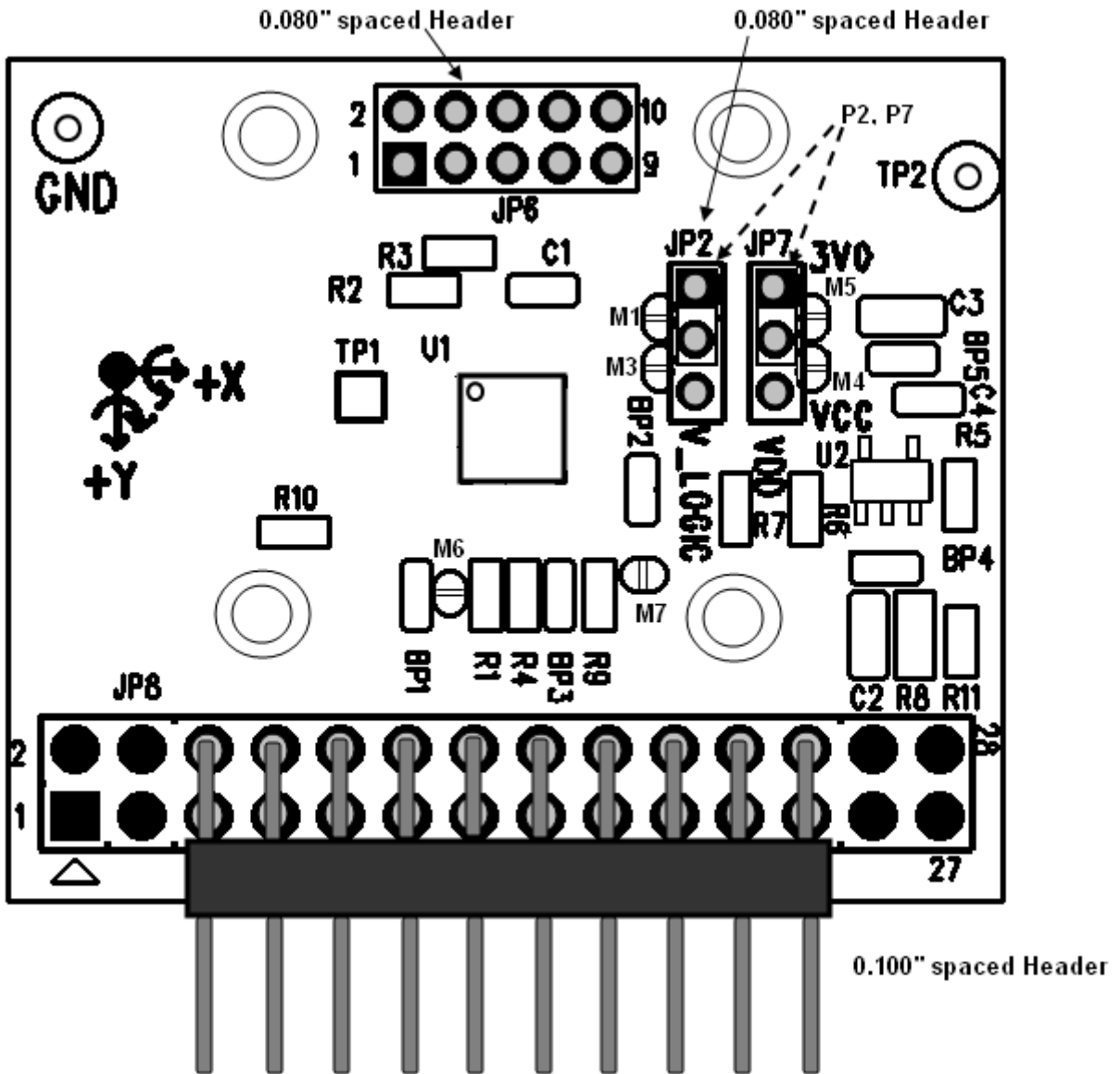
Table 1. Parts stuffing list the ITG-3200 EVB. Only the top side requires component assembly

Item	Quantity	Reference	Part	PCB Footprint
1	5	BP1,BP2,BP3,BP4,BP5	0.1uF	402 smt
2	1	C1	2200pF/50V	402 smt
3	2	C2,C3	0.47uF/0603	603 smt
4	1	C4	0.033uF	402 smt
5	2	JP2,JP7	HEADER 3 pin, 80mil, 180D, Male	3-pin 2mm header
6	2	P2,P7	PLUG 80mil 2-pin Short circuit plug	Plugs to JP2, JP7
7	1	JP6	HEADER 5X2 pin, Male, 180D, 2.0mmx2.0mm	SIP2X5N2
8	1	JP8	HEADER 10X2 pin, Male, 90D, 2.54mmx2.54mm	HDB2X10NRA
9	4	R1, R2,R3,R4	10K	402 smt
10	1	R5	1M	402 smt
11	1	R8	2R2/0603	603 smt
12	2	R6, R10	0 Ohm	402 smt
13	1	U1	ITG-3200	QFN-24
14	2	R9, R7	DO NOT STUFF	0402 smt
16	1	U2	YB1210-ST25R300, 3.0V Regulator ¹	SOT-235
17	1	M7	Solder across Jumper	Split oval
18	5	M1, M3, M4, M5, M6	Do not solder across Jumper	Split oval
19	1	Blank PCB	ITG-3200 EVB REV B	

Note 1: www.yobon.com.tw

4.4 Assembly Drawing for ITG-3200 EV Board

Figure 4. ITG-3200 EV Board Assembly Drawing. Follow the Parts Stuffing List for assembly instructions.



4.5 Power Supply Connections

JP2 and JP7 are 3 header-pin plug-in jumpers which allow users to select between the on-board LDO and an external DC supply to the ITG-3200. For details, please refer to Table 2. Power Selection Jumpers.

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

Selecting the raw VCC line to power the chip is generally done while designing and evaluating with an embedded platform, where the host processor and related electronics need full control over the motion processing chip's power supply. When the user intends to use the on board LDO 3V0 power, the external VCC must be higher than 3.7V to ensure the LDO works properly. If the user provides VCC with 5V, JP2 and JP7 must be set as "1-2 short" to enable the on-board 3.0V LDO. The ITG-3200 VDD and VLOGIC operation range is 2.1V to 3.6V.

Refer to the ITG-3200 product specification for power-on-timing waveforms for VDD and VLOGIC.

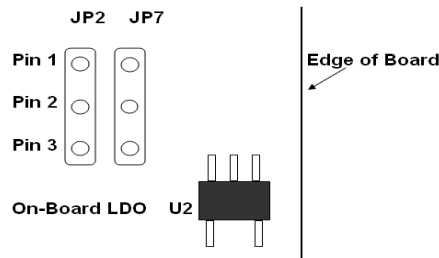


Figure 5. JP2 and JP7 Pin-out

4.6 ITG-3200 EVb Connector Signals Description

Table 2. Power Selection Jumpers (use P2, P7 to short pins as required)

JP2 Pin Number	Signal Description
1-2 short	ITG-3200 VLOGIC = 3V using on board LDO
2-3 short	ITG-3200 VLOGIC = VCC (from external)
JP7 Pin Number	Signal Description
1-2 short	ITG-3200 VDD = 3V using on-board LDO
2-3 short	ITG-3200 VDD = VCC (from external)



Table 3. "Main Header" User Interface Signals

JP8 Pin Number	Signal Name	Signal Description
1	RESV1	Reserved. Do not connect to this pin.
3	RESV2	Reserved. Do not connect to this pin.
5	RESV5	Reserved. Do not connect to this pin.
7	INT	ITG-3200 pin 12 interrupt output to host controller
9	RESV4	Reserved. Do not connect to this pin.
11	CLKIN	ITG-3200 pin 1 external clock input
13	CPOUT	ITG-3200 pin 20 (charge pump capacitor)
15	GND	GND
17	GND	GND
19		3V on-board LDO (regulated DC) output
21	RESV-G	Reserved. Do not connect to this pin.
23	VCC	VCC from ARM-7 Controller Board or external 3.3V at >100mA
25	NC	Not Connected
27	NC	Not Connected
2	NC	Not Connected
4	NC	Not Connected
6		Do not connect to this pin.
8	VLOGIC	VLOGIC DC Input, ITG-3200 pin 8, sets I ² C bus logic levels
10	RESV3	Reserved. Do not connect to this pin.
12	NC	Not Connected
14	LDO_EN	EVb on-board 3V LDO enable (when pulled to VCC)
16	NC	Not Connected
18	REGOUT	ITG-3200 pin 10, on-chip regulator bypass capacitor
20	SCL	ITG-3200 pin 23 I ² C clock line
22	SDA	ITG-3200 pin 24 I ² C data line
24	AD0	ITG-3200 pin 9 I ² C Address bit zero
26	NC	Not Connected
28	NC	Not Connected

**Table 4. Extended Factory Connector pin functions**

JP6 Pin Number	Signal Name	Signal Description
1	VCC	Power from ARM-7 controller board or external 3.3V at >100mA
3	GND	GND
5	NC	Not Connected
7	NC	Not Connected
9	NC	Not Connected
2	LDO_V_OUT	3V Output from LDO
4	SCL	ITG-3200 I ² C clock line
6	SDA	ITG-3200 I ² C data line
8	AD0	ITG-3200 I ² C Address bit zero
10	RESV-G	Reserved. Do not connect to this pin.

4.7 Serial Bus Levels, Speeds and Terminations

The ITG-3200 supports fast mode I²C up to 400Hz. The I²C bus open-drain pull up resistors are R2 and R3 for SDA and SCL; both are 2.2kohm connected to either 3.0V or the externally provided VCC. The pull up level is selected by JP2. Please refer to Table 2. Power Selection Jumpers.

4.8 Solder-Across “M” Jumpers

For fast and permanent configuration connections, a set of solder-across jumpers are provided.

4.9 Table 5. Solder-Across “M” Jumpers – what they do and how to connect

M Number	M Jumper function
1	Shorts JP2 pins 1-2 to set ITG-3200 VLOGIC = 3.0V using on board LDO
3	Shorts JP2 pins 2-3 to set ITG-3200 VLOGIC = VCC externally supplied voltage
4	Shorts JP7 pins 2-3 to set ITG-3200 VDD = VCC externally supplied voltage
5	Shorts JP7 pins 1-2 to set ITG-3200 VDD = 3.0V using on board LDO
6	Pulls ITG-3200 VLOGIC pin 8 to V_LOGIC supply. It is in parallel with R1
7	Shorts ITG-3200 pin 11 as required by Product Specification.

5. Data Gathering Options

The ITG-3200 Digital Sensor Data is available at the Main Header connector. Alternately, for connectivity with a host PC, an InvenSense ARM Interface Board may also be used.

5.1 Connection to ARM7 Interface EVB

For communications via USB to a host computer, the ITG-3200EVB may be connected to InvenSense's ARM7 Microprocessor Interface board, the INV-ARMEVB. It serves as an interface between a Windows PC USB port, and the ITG-3200 EVB Main header.

The following photo shows the connection of ITG-3200 to INV-ARMEVB. Connection between the two boards is made via the Main header connector.

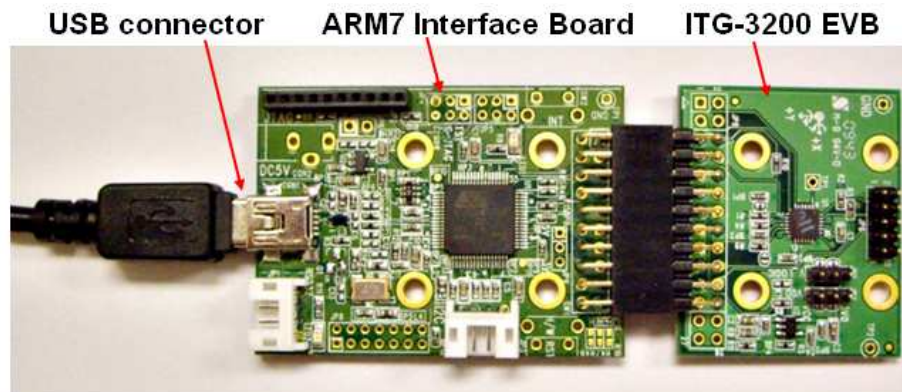


Figure 6: Connect ITG-3200 to ARM Board

5.2 Use of ITG-3200 without ARM EVB board

I²C signals are available on JP8. The user may develop tools to communicate with the ITG-3200. There is no bus mode selection setting required.

6. Special Instructions

6.1 Electrostatic Discharge Sensitivity

The ITG-3200 gyro can be permanently damaged by an electrostatic discharge. Proper ESD precautions for handling and storage are recommended.

7. Mechanical Dimensions

The ITG-3200EVB is a 4 layer PCB with 32mm x 38mm overall dimensions. The mounting holes are arranged to fit 19.56mm x 18.54 mm fixture screw centers, offset from the edge of the board by 9.22mm and 3.05mm as shown.

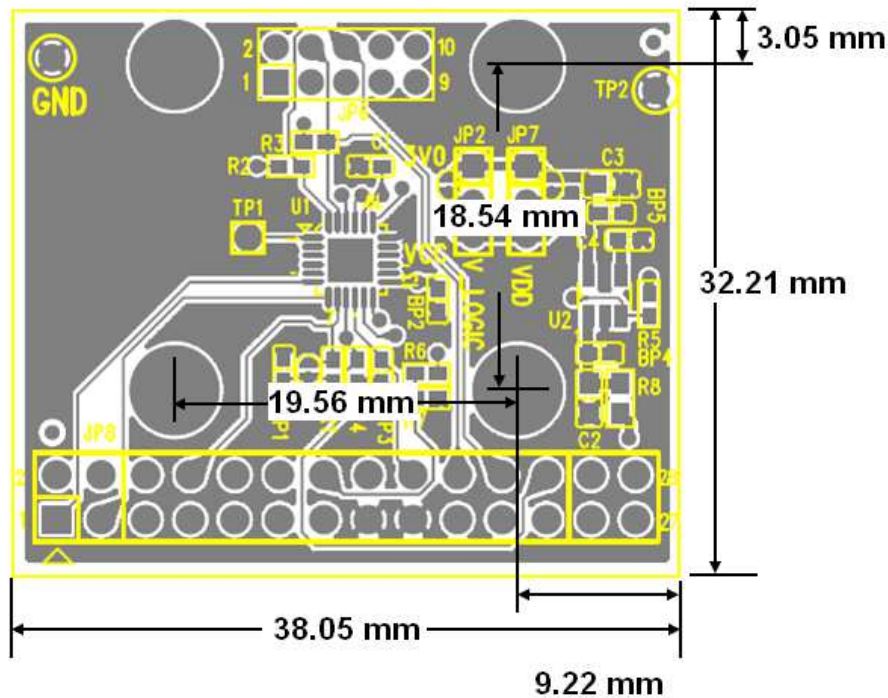


Figure 7: ITG-3200 Dimensions, Top Side shown

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