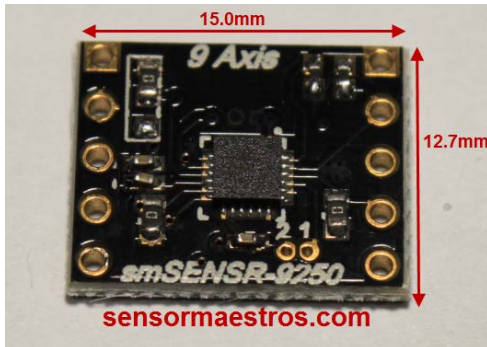# SENSOR MAESTROS

smMOTN-MPU9250

15x12.7mm *9-Axis* Accel, Gyro, Mag Breakout Board

Features

- MPU9250: 3x3x1mm Single Chip Accel, Gyro, Mag
- VDD = 2.4-3.6V, VDDIO = 1.71V-VDD
- 16bit A/D's for each Axis
- Gyro: ±250, 500, 1000, 2000°/sec
  - 3.2mA (Full Rate)
  - 8uA SLEEP
  - Programmable LowPass Filter
- Accel: ±2, 4, 8, 16g
  - 450/8.4uA Normal/Low Power Mode
  - 8uA SLEEP
  - Programmable Interrupts
- Mag: ±4800µT
  - 14bit(0.6µT/LSB)/16bit(15µT/LSB)
  - 280uA @ 8Hz

- *smWSP-ARD, smWSP Compatible*(Wireless Sensor Platform)
- 15x12.7mm(0.59x0.5") Breakout board
- 2.54mm(0.1") headers on 12.7mm(0.5") spacing
- Selectable I2C or SPI Interfaces
- Zero Ohm Resistors for selecting between I2C/SPI, interfaces, LSB of I2C Address, enable/disable Frame Synch.
- Self-Test for Accel, Gyro, Mag
- Showcased in Sensor Maestros smSFM1 BLE/USB Enabled small form-factor Sensor Fusion Module.
- Demo Software available with smWSP with Silicon Labs EFM32 Start Kit.

Applications

- IoT Sensors
- Sports Equipment
- Vibration Monitoring
- Wearables

- Medical
- RTLS/Beacon Location
- Gaming, Remote Controls

Contents

Description:

The MPU-9250 is one of the world's smallest 9-Axis Single Chip MEMS Motion sensors. The MPU-9250 provides an ultra-low power, low cost, and ultra-small form factor 9-Axis solution.

The **smMOTN-MPU9250** provides an easy to use, low-cost, small form factor breakout board for the MPU-9250. All pins are all mapped to standard 2.54mm/0.1" headers. This allows for use in a standard bread-board or to be 'wired' into an application. The header-header spacing is 12.7mm (500mil). The smMOTN-MPU9250 is selectable between SPI and I2C interfaces. The Default is I2C to select the SPI interface a simple modification to remove 4 resistors(R1, R2, R3, and R4) is performed. All MPU-9250 pins are mapped out to headers including VDDIO which selects the I/O interface voltage. Operating features are outlined below.

The smMOTN-MPU9250 also provides connections to the I2C Auxillary pins via 2 small vias labeled 1 & 2. These can be used to solder 30 AWG wire into the vias.

Device Operation:

Feature	
Single Voltage Operation	Jumper Pin3 VDDIO to Pin1 VDD
Dual Voltage Operation	Connect Pin 1 VDD = 2.4-3.6V Connect Pin 3 VDDIO = 1.71 to VDD
I2C	Default No Modifications Necessary
SPI	Remove R1, R2, R3, and R4 to allow SPI interface to operate
FSYNC	Remove R5, R5 by default is pulled to GND
AUX I2C Lines	Solder 30 AWG wires into AUX_I2C labeled with 1 & 2 silkscreen on top of PCB. 1 = AUX_SDA 2 = AUX_SCL

All **SMSTRS smMOTN, smMEM, smSENSR, smCOM**, **smBAT**, **smPWR** products are compatible with the Sensor Maestros **Wireless Sensor Platform**s such as the **smWSP** and **smWSP-ARD** that provide Rapid prototyping for Sensor and BTLE applications. The **smMOTN-MPU9250** can be plugged into either of the 10pin **smBLOCK** SPI or I2C sockets. More info provided later in document.

The MPU-9250 is also featured in a 12 DOF Sensor Fusion Module developed by Sensor Maestros described in further detail later in this document.
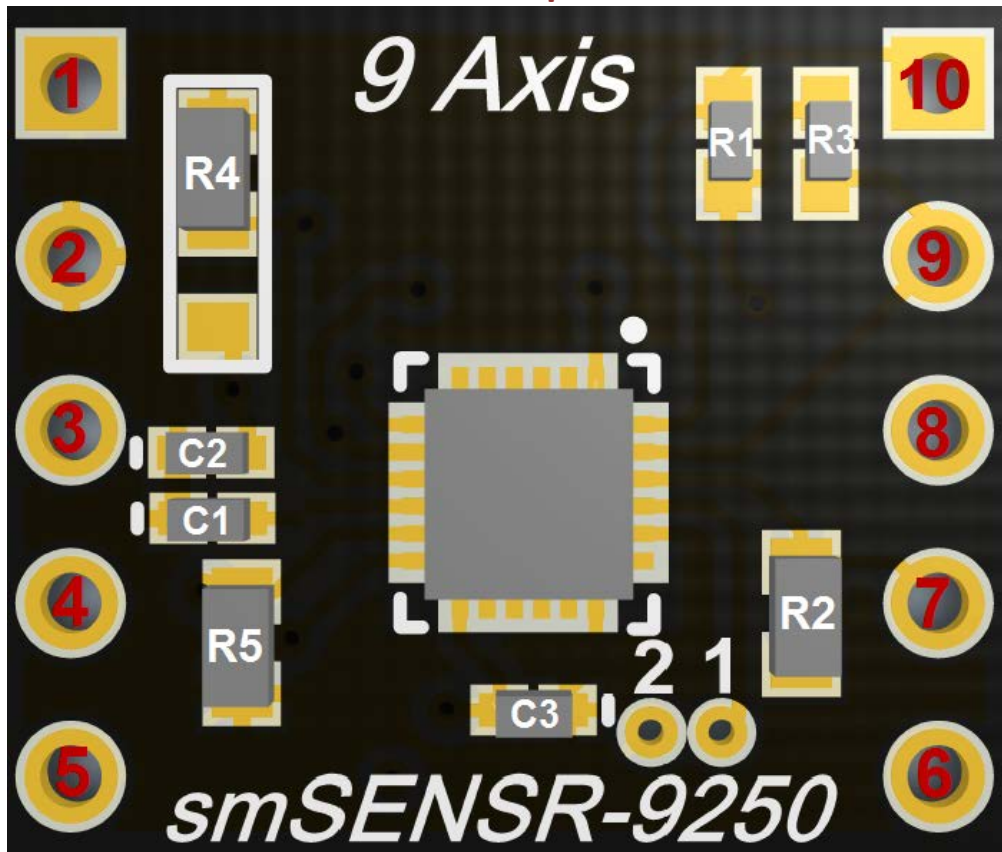
Custom Embedded PCB/Software, Wireless/Mobile Applications, and general design services can be provided by Sensor Maestros for your own application.

MPU-9250 Datasheet:
http://www.invensense.com/download-pdf/mpu-9250-datasheet/

BUY IT NOW:

smMOTN-MPU9250 Pin Descriptions

Pin	Name	Type	Function
1	VDD	Power	Power Supply, 2.4-3.6V
2	GND	Power	Ground. Connect to System GND.
3	VDDIO	Power	1.7V-VDD, **NOTE: Connect to VDD for single supply Operation**
4	FSYNCH	Output	Frame Synch. Pulled to GND via a R5/0Ω resistor by default. Remove R5 if desired to use.
5	INT	Output	User programmable Interrupt Line
6	N/C	N/C	No Connect
7	$\overline{CS}$	Input	SPI Active Low Chip Select. Default is pulled to GND via R2/0Ω resistor. **For SPI remove R2**.
8	AD0/SO	Output	I2C LSB = 0/1 set by R4. Default is 0 via R4/0Ω tied to GND. **For SPI remove R4**. SPI Slave Output. Connect to SI/SDI/MISO of Master SPI
9	SCL/SCK	Input	I2C SCL by default. Connected via R3/10kΩ to VDDIO. **Remove R3 for SPI.** SPI Serial Clock. Connect to SCK of Master SPI.
10	SDA/SI	Input	I2C SDA by default. Connected via R3/10kΩ to VDDIO. **Remove R1 for SPI.** SPI Serial Input. Connect to SO/SDO/MOSI of Master SPI.

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Wireless Sensor Evaluation Platform Ready!!

smWSP-ARD(Arduino Shield): smBLOCK SPI, I2C1
smWSP: EMBLOCK 2

Single Voltage Operation: Connect VDDIO/Pin3 to VDD/Pin1
**Dual Voltage Operation: VDDIO sets GPIO voltage**

VDDIO VDD

P1 DNI
1
2
3
4
5
HDR 1x5 2.54mm

FSYNC
INT

GND

AUX_SDA
AUX_SCL
1
2

VDDIO

R2 0
R3 10k
R1 10k

R4.1 DNI
3
2
R4 0
1

GND

R5 0

GND

U1   MPU-9250

SDA/SDI   24 SDA/SDI   VDD 13
SCL/SCLK 23 SCL/SCLK

nCS   22 CS   VDDIO 8
AUX_SDA   21 AUX_SDA   RESV/VDDIO 1
AUX_SCL   7   AUX_SCL

                         REGOUT 10
INT   12 INT

AD0/SDO   9   AD0/SDO   GND 18
                         RESV/GND 20
FSYNC   11 FSYNC

NC NC NC NC NC NC NC NC NC NC RESV/NC
2 3 4 5 6 14 15 16 17 19

VDDIO VDD

C1 0.1u
C2 0.1u
C3 0.1u

GND

P2 DNI
1
2
3
4
5
HDR 1x5 2.54mm

SDA/SDI
SCL/SCLK
AD0/SDO
nCS

Zero Ohm Jumpers:

Rx/Pin	I2C Setting	SPI Setting
R1/SDA/SDI	VDDIO	Remove R1
R2/nCS	VDD	Remove R2
R3/SCL/SCLK	VDDIO	Remove R3
R4/AD0/SDO	LSB I2C Address=0	Remove R4
R4.1/AD0/SD0	LSB I2C Address=1	Remove R4.1
R6/FSYNC	If not used connect to GND, Remove to use	

smSFM1: BLE 9-Axis Module

This is an example of the engineering expertise Sensor Maestros can provide. The smSFM1 provides a fully Developed 9/10 Axis Wireless Sensor Fusion Module that can be used for development or OEM'd for use in a commercial product. Complete USB and BLE interfaces with individual sensor output control.

- 36.8x24.0mm (1.45" x 0.95")
- Custom OEM Labeled Enclosures
- USB & BLE Data Interfaces and USB & BLE Bootloader Interfaces
- Long Range BLE Options
  - ➢ 1000m+ & 1800m+(external u.FL antenna)
- Rechargeable LiPO Battery default
  - ➢ Custom Battery options available
- ECG Add-on expansion board available
- Custom Mobile and PC Applications
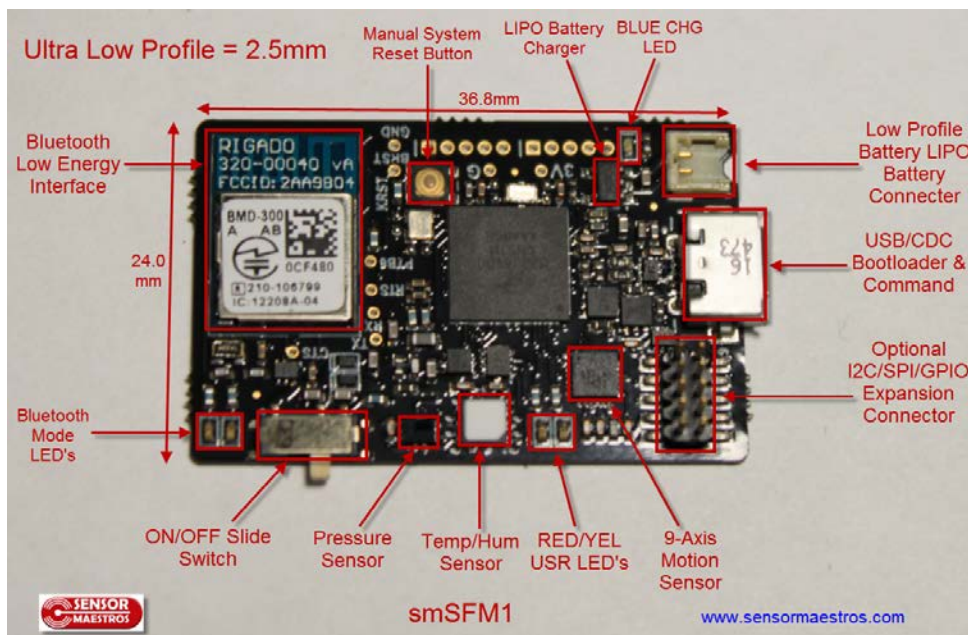
Wireless Sensor Development Kits

Sensor Maestros is the inventor of the concept of providing a pluggable wireless sensor development kit. The smWSP-ARD(Arduino Rev 3 compatible) and the smWSP/smRF-WB provide the capability to plug in any of the Sensor Maestros *smMEM*, *smSENSR*, *smMOTN*, *smCOM*, *smBAT*, and *smPWR* breakout boards directly into the smWSP-ARD or smWSP/smRF-WB using smBLOCKs to quickly plug in these pin compatible design components making it simple to swap in/out numerous different wireless, sensor, memory, and power configurations to completely customize your system and then just as easy to completely change it a day later. Gone are the days of having to work with a sensor evaluation board that has several sensors you would love to change but they are soldered directly to the PCB. Now you can pick and choose your RF, sensor, memory, power, and battery configuration. Secondarily all these components can then be un-plugged from the smWSP-ARD or smWSP/smRF to be either used in a prototype of your own, in a bread-board application, or simply be replaced by a different smBLOCK compatible component.

Overview

smWSP-ARD: Arduino Rev 3 compatible shield. Tailored to work with the nRF52 DK. Available +20dBm Long Range BLE module plugin.

smWSP: Designed to plug directly into any of the Silicon Labs EFM32 or EFR32 Starter Kits. Has an expansion header to connect to the smRF-WB.

smRF-CYW2073x-WB: Design to accommodate Cypress CYW20736/CYW20737 based modules. Can be connected to the smWSP via the expansion header.

smWSP-ARD

The **smWSP-ARD** is the second offering for the Sensor Maestros **Wireless Sensor Prototype** platform that is in the form of an Arduino Shield. The **smWSP-ARD** provides the same rapid prototype sensor functionality as the **smWSP** but in an Arduino Shield Compatible format.

See the smWSP-ARD datasheet for further details.

Features

- Allows use of all Sensor Maestros **smSENSR**, **smMEM**, **smCOM, smBAT, smPWR** Products
  - I2C and SPI **smBLOCKS** available
- Arduino Shield compatible. Pinout compatible with the nRF52 DK.
- 1 smCOM-FT230/USB-UART slot
- Selectable Power Supply
  - 3.3V from Arduino Base
  - LiPo with DC/DC, such as **smPWR-MP2148**
  - smBAT Connector
  - External Power Supply
- Allows configurable SPI and GPIO Interrupt lines from **smRF** compatible plugins such as the **smRF-LR832** to I2C and SPI smBLOCKS for Sensor and Memory products. Selectable with slide switches and DIP switch selectors.
- 4 I2C, 1 SPI, smBLOCKS
- 1 **smBAT**, 1 **smPWR**, 1 **smCOM** BLOCKS
- 1 Battery/LiPO connector
- Can be programmed directly with the Nordic nRF52 DK
- 10pin SWD Connector for use with external SWD Programmer/Debugger

Image of smWSP-ARD: Shown with smMOTN-MPU9250, smSENSR-si7006, smCOM-FT230, and smRF-LR832.

www.sensormaestros.com

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Wireless Sensor Prototype(WSP)

The *smWSP* is a platform that consists of either the *smWSP* and/or *smRF-WB* and also the Silicon Labs EFM32/EFR32 Starter Kit.   There are several combinations in how the boards can be used with or without the other boards. 3 options are outlined below.
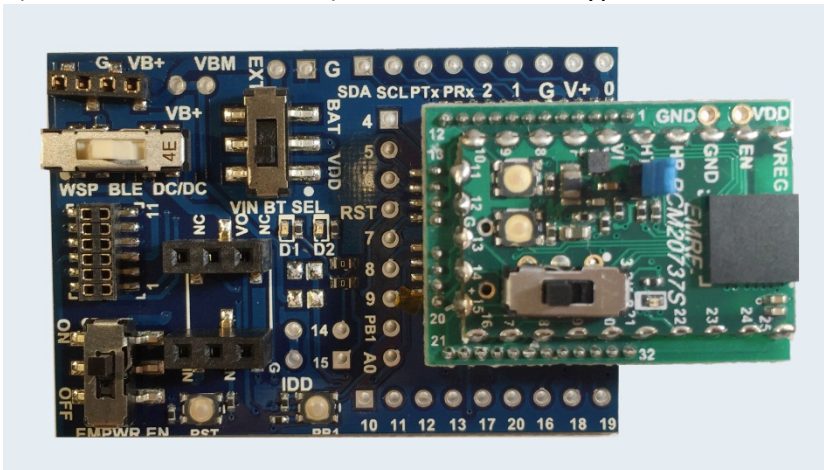
1) smWSP + smRF-WB
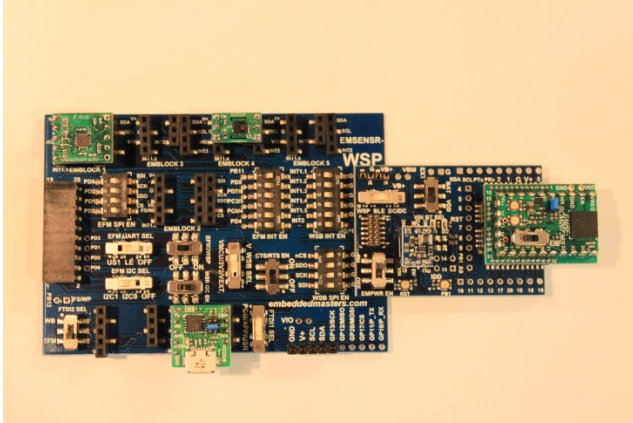
2) smWSP + EFM/EFR32 STK
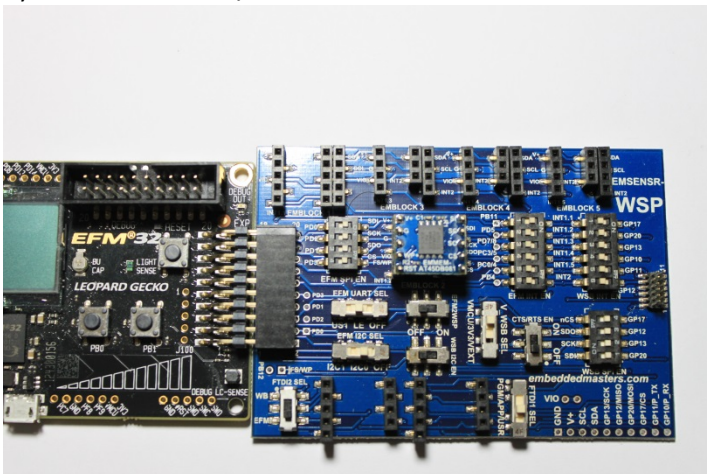
3) smRF-CYW2073x-WB(Wireless Base for Cypress CYW20736/CYW20737)

SENSOR MAESTROS

smWSP

The *smWSP* (Wireless Sensor Prototype) is a board that allows the Sensor Maestros *smSENSR*, *smMEM*, *smCOM*, *smBAT* products to be plugged into the WSP allowing Rapid Prototyping of a Sensor/Wireless Sensor system. On the right hand side it can be directly connected to the *smRF-WB* to add BTLE capability and on the Left-hand side it can directly connect to **ANY** of the Silicon Labs *EFM32/EFR32 Starter kits* to add a high performance/ultra-low power MCU capability to a system. The WSP has been designed with a Slide Switch to accommodate the slight variations of the EFM32 Starter Kits.

The *smWSP* can be used with the *smRF-WB* or with the EFM32 Starter Kits OR with both.

Features

- Allows use of all Sensor Maestros *smSENSR*, *smMEM*, *smCOM, smBAT* Products
  - I2C and SPI slots available
- Direct Connection to *smRF-WB*, for easy programming/debugging of BTLE plugins.
- Direct Connection with all Silicon Labs EFM/EFR32 Starter Kits
- 2 COM-FT230/USB-UART slots
- Selectable Voltage between: VMCU(EFM32 Starter Kits), 3V3(from EMCOM-FT230), or from Regulated voltage supplied by *smRF-WB* (typically when the *smRF-WB* is powered from a battery and uses the DC/DC converter to provide regulated voltage to the BTLE module.
- Allows for UART, LPUART, and SPI serial communication from the EFM32 Starter kits to the *smRF-WB*. Selectable with Slide Switches and DIP switch selectors.
- Several GPIO can be directly connected between EFM32 STK's and *smRF-WB*
- GPIO pins can individually be connected to Sensor INT lines for individual Interrupt control

smRF-CYW2073x-WB

The *smRF-WB*(Wireless Base) provides a means to plug in BTLE module carrier boards. It also has a connector that allows the *smBAT* products to be plugged into the kit. The *smRF-WB* can be used as a Standalone Eval/prototype board OR can be connected to the *smWSP* which allows it to be programmed by the COM-FT230 and allows it to connect to any of the *smSENSR*, *smMEM, smCOM* products for rapid prototyping. There are 2 *smCOM-FT230* slots on the *smWSP* so one may be dedicated to UART Programming/Bootload while the other is used for debug output. With the *smWSP* connected to the *smRF-WB* it also allows the user to connect to any of the Silicon Labs EFM/EFR32 Starter Kits and allows for SPI and UART COMs to the EFM32 Starter Kits and allows for several GPIO's to be directly connected to the EFM32 Starter Kit. The following carrier boards that plug directly into the WSP are the following…

smRF-WB-20736:   Cypress CYW20736 based.
smRF-WB-20737:   Cypress CYW20737 based.

Features

- Pluggable Wireless Socket. Allows for multiple options for wireless connection.
- Direct connection to *sm-WSP* for Rapid Sensor development and easy programming/debugging of the BTLE modules.
- *smBAT* battery READY for multiple Battery Options.
- Small but useable size with easy probing of all SOC pins.