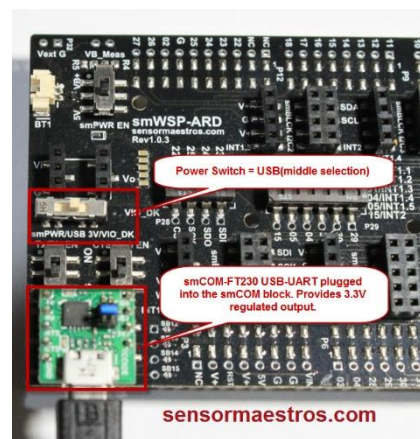
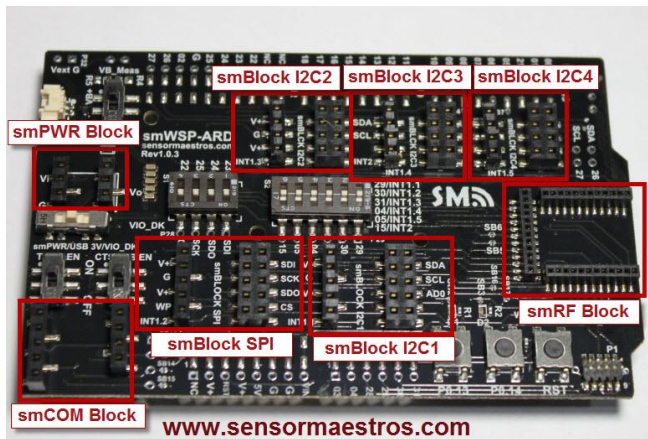


## Wireless Sensor Rapid Design Platform: Arduino/nRF52 DK Compatible



### FEATURES

- Arduino/nRF52 DK Compatible
- Rapid Prototype: 4 I2C smBLOCKs, 1 SPI smBLOCK
- Supports up to 5 sensors, or 4 sensors + 1 Serial Flash
- 1 smCOM BLOCK for USB-UART support
- DIP Switch to enabled individual Interrupt pins for each smBLOCK
- DIP Switch connect SPI pins to smBLOCK SPI
- Compatible with all smMEM, smSENSR, smMOTN, smCOM, smPWR, and smRF-nRF52 plugins
- 1.25mm LiPo Battery Connector
- CR2032 Coin Cell Holder(bottom of PCB)
- 99.1x63.5mm(3.9x2.5")
- **IAQ-LOGR Open Source Zephyr Firmware Available**

### KIT INCLUDES

- smWSP-ARD Arduino R3 Compatible base board
- smCOM-FT230 (USB-UART)
- Other smSENSR, smPWR, smMEM, smRF, Batteries, etc, can be purchased separately.

### APPLICATIONS

- IoT Sensors
- Data Logging
- Low Power Battery Applications
- Wearables
- BLE Beacon Sensors
- Industrial Sensing
- Energy Harvesting Applications
- Set-top boxes: TV, gaming, remote controllers

### IAQ-LOGR Open Source Wireless Indoor Air Quality Data Logger Application

The IAQ-LOGR is an Open Source Wireless Indoor Air Quality Data Logger application that utilizes the smWSP-ARD rapid prototyping board. The IAQ-LOGR reads and data logs CO2, Temperature, Humidity, and Ambient light. The Sensor Maeastros SENS-LOGR mobile apps can be used to configure and download data logs from the IAQ-LOGR application.

PRODUCT PAGE: [IAQ-LOGR PRODUCT PAGE](#)

Open Source Firmware Application: [IAQ-LOGR Open Source Firmware](#)

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## 2.0 Sensor Maestros Wireless Sensor Development Kits

Sensor Maestros developed the smWSP-ARD and smWSP development/rapid prototyping kits that utilize standardized hardware modules allowing for being able to quickly change the configuration of a wireless sensor by simply unplugging and plugging in a different sensor, RF/Wireless, memory, or power block because they are all standardized pinouts on breakout boards. These standardized ‘hardware blocks’ we call smBLOCKs. The concept came about because of a need to have a platform that could be used to rapidly develop wireless sensor applications for custom developed products and to be able to choose the ‘Sensors that Make Sense’. ‘Sensors that Make Sense’ has become the driving motto of the Sensor Maestros team.

The smWSP-ARD(Arduino Rev 3 compatible) and the smWSP(Silicon Labs EFM/EFR Starter Kit compatible) provide the capability to plug in any of the Sensor Maestros **smSENSR**, **smMEM**, **smMOTN**, **smCOM**, **smBAT**, and **smPWR** breakout boards directly into the smBLOCKs provided in the smWSP-ARD and smWSP kits. smBLOCKs make it simple to swap in/out numerous different wireless/RF, 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. Secondly all these components can then be un-plugged from the smWSP-ARD or smWSP 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.

### 2.1 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 allow for a future RF Expansion board.

### 2.2 Software

Sensor Maestros currently offers the following open-source firmware examples that utilize the smWSP-ARD. The smWSP-ARD is intended to be a launchpad for rapid prototyping a wireless sensor. Additional firmware examples will be available for all sorts of sensors, data converters, battery chargers, etc all using smBLOCK compatible plugin breakout boards.

#### 2.2.1 Indoor Air Quality Data Logger Reference Firmware Example(IAQ-LOGR)

- 1) Provides a Connectable BLE Beacon example for Temperature, Humidity, Ambient Light and CO2 Sensor. The IAQ-LOGR data logs the sensor data to a SPI Flash to a BLE Client and once connected to a BLE Client can download the sensor data stored on the SPI Flash.
- 2) SENSR-LOGR iOS and Android Mobile App provides real-time graphing, data-logging and sensor configuration for the smIAQ-LOGR.
  - a. Real-time sensor graphs
  - b. Each sensor can individually be configured via the SENSR-LOGR mobile app.
  - c. Configurable Sample Rates and Alarm High/Low values can be set for each sensor.
  - d. Data Log files in CSV format can be downloaded

## 3.0 Design Services

*Custom Embedded PCB/Software, Wireless/Mobile Applications design services can be provided by Sensor Maestros. To inquire about Design Services fill out an inquiry form on the Sensor Maestros website.*

[www.sensormaestros.com/inquiry](http://www.sensormaestros.com/inquiry)

## 4.0 smWSP-ARD Description

The smWSP-ARD is a Rapid Prototyping ‘Wireless Sensor Platform’(WSP). The smWSP-ARD has been designed to precisely mate with the Nordic nRF DK platforms and is compatible with any Arduino Revision 3 base board. The smWSP-ARD was developed as a need to be able to quickly prototype a wireless system using standardized hardware blocks and was developed out of necessity to have a common base board that numerous standardized pinout breakout boards we call smBLOCKs could quickly be plugged into and out of the system to re-configure the system.

The smWSP-ARD supports all Sensor Maestros smMEM, smSENSR, smMOTN, smCOM, smBAT, and smPWR breakout boards that plug directly into the smWSP-ARD 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,

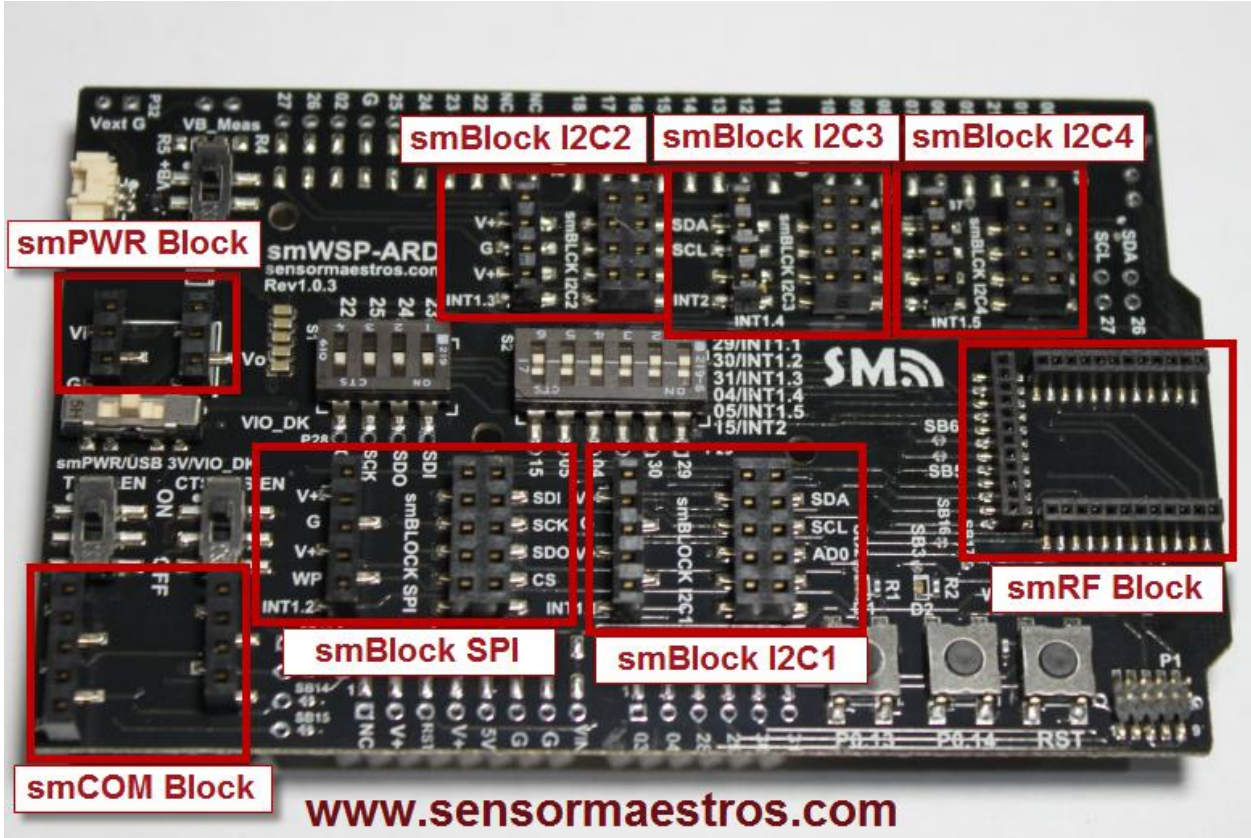


and battery configuration. Secondly all these components can then be un-plugged from the smWSP-ARD to be either used in a prototype of your own, in a bread-board application, or simply be replaced by a different smBLOCK compatible component.

- ❖ 4 I2C smBLOCKs: Can be used with any I2C based smSENSR, smMOTN, smXXX products
- ❖ 1 SPI smBLOCK: Can be used with SPI compatible smSENSR, smMOTN, smMEM, smXXXX products
- ❖ 1 USB-UART smBLOCK: Can be used with any smCOM products(smCOM-FT230).
- ❖ 1 RF smBLOCK: Can be used with any smRF products.
- ❖ 1 Power smBLOCK: Optional smPWR DC/DC and/or Linear Regulator products to provide Voltage regulation from LiPo, AA, AAA, or external Voltage Source.
- ❖ 1 1.25mm LiPo Battery Connector. Several smLiPo battery options to choose from.

### 4.1 smBLOCKs Overview

The concept of smBLOCKs is what makes the smWSP-ARD and smWSP Wireless Sensor Platforms so powerful. They provide the ability to plug in/out various components for Wireless/RF, Sensors, Power, Memory and communications. The picture below highlights the major blocks. Each block is further detailed later in this document.



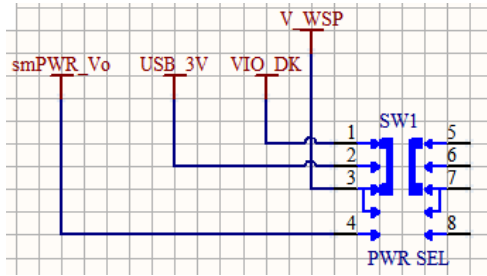
smBLOCK	Description
smBLOCK I2C1	Allows 10pin I2C SM Breakout boards to be plugged into the smWSP-ARD. Ex: CO2 Sensor Plugin, smMOTN-10 DOF IMU, smMOTN-BMI160, etc
smBLOCK SPI	Allows 10pin SPI based SM breakout boards to be plugged into the smWSP-ARD Ex: smMOTN-10 DOF IMU, smMEM-MX25R6435, smMEM-AT45DB641, etc
smBLOCK I2C 2, 3, 4	Allows 6 and 8pin I2C SM breakout boards to be plugged into the smWSP-ARD Ex: smSENSR-LTR303, smSENSR-Si7006, etc.
smPWR Block	Allows various DC/DC Regulators to be plugged into the smWSP-ARD Ex: smPWR-MP2148-ADJ
smCOM Block	Allows USB-UART SM devices such as the smCOM-FT230 to be plugged into the system to provide USB connectivity
smRF Block	The smRF block is a general purpose plugin for smRF wireless breakout boards



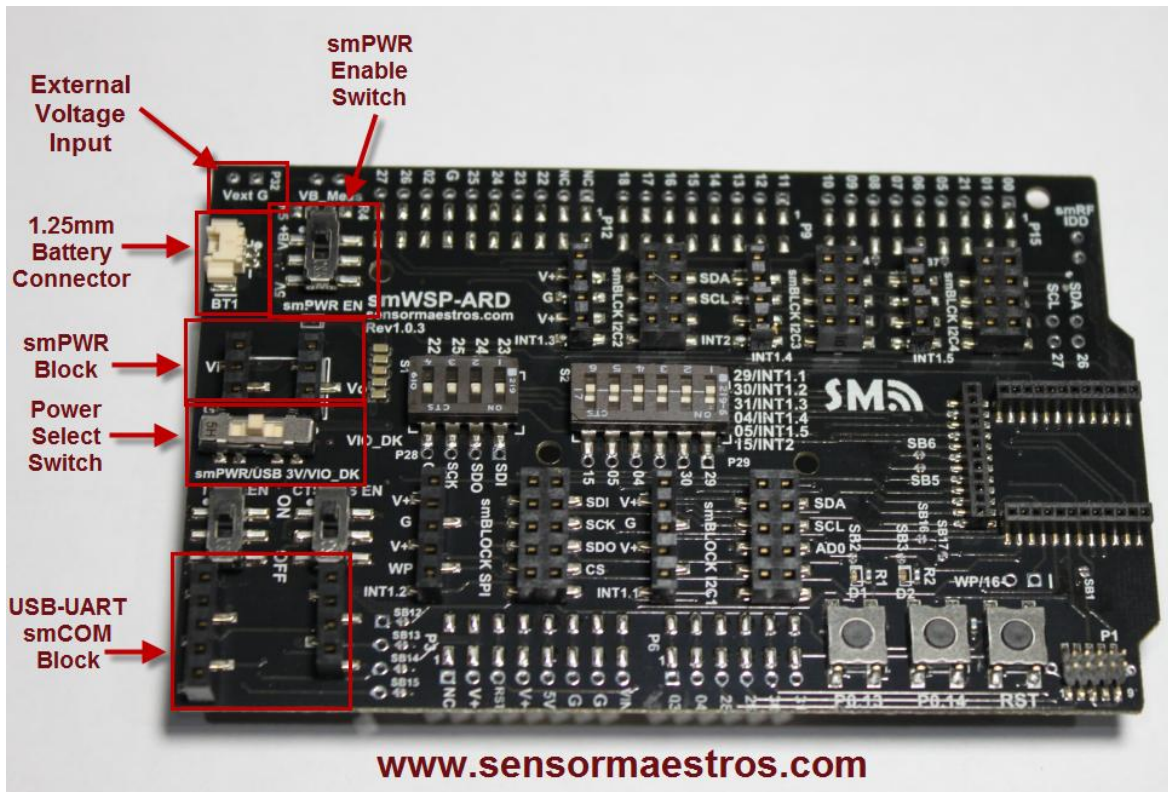
## 4.2 Power Switches

To provide un-paralleled flexibility for Rapid Prototyping a system the smWSP-ARD has several control switches to allow different power sources, individual interrupt lines, enable/disable SPI on the SPI smBLOCK, enable/disable USB-UART functionality, and user input via push-buttons. These control features are outlined below.

### 4.2.1 Power Selector Switch



NOTE: All selections map to V\_WSP voltage net on schematic/pcb.



The **Power Select Switch** selects the power source for the smWSP. There are 3 selections as shown below.

- ❖ **smPWR** => Output of smPWR Block. If a LiPO/Battery were plugged into the Battery connector BT1 a smPWR plugin such as the smPWR-MP2148 could be used to regulate from 4.1V to 3.3V or 1.8V. smPWR could be useful if there is an external voltage connected to P32 that is >3.6V. The last scenario is if 5V was being supplied to the smWSP-ARD from an Arduino Compatible base.
- ❖ **USB 3V** => Regulated 3.3V source from a USB-UART residing in the smCOM block such as a smCOM-FT230x. The smCOM-FT230 provides a regulated 3.3V source from 5V USB source.
- ❖ **VIO DK** => If the smWSP-ARD is plugged into a Nordic nRF52 DK or an identical pinout Nordic Semiconductor evaluation board this eval board can directly power the smWSP-ARD with 3.3V.

#### 4.2.2 smPWR Enable/Selector Switch

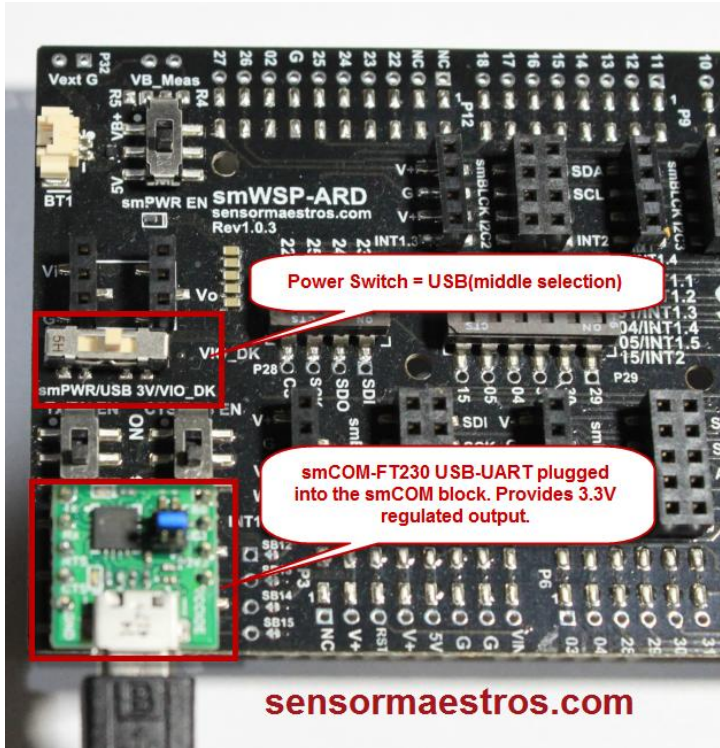
The voltage source desired to be regulated by the smPWR block can be selected between the following 2 voltage sources.

- ❖ VBAT => Battery source connected to BT1(1.25mm connector) OR External Voltage(P32)
- ❖ 5V => 5V source from a Arduino compatible base

**NOTE:** The V\_WSP net has 235uF of Bulk capacitance to assist with RF pulse currents

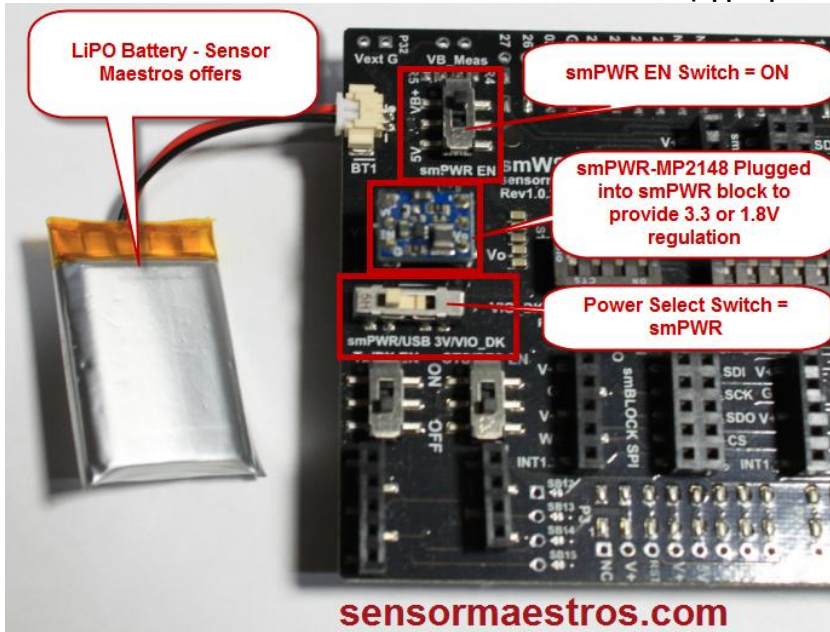
#### 4.2.3 USB Powered

Power Select Switch = USB (middle selection)



#### 4.2.4 Battery Powered

Power Select Switch = smPWR AND smPWR EN Switch = VB+ (upper position)



#### 4.2.5 External Power

**P32 = External Power Supply      smPWR EN Switch = VB+      AND      Power Selector Switch = smPWR**

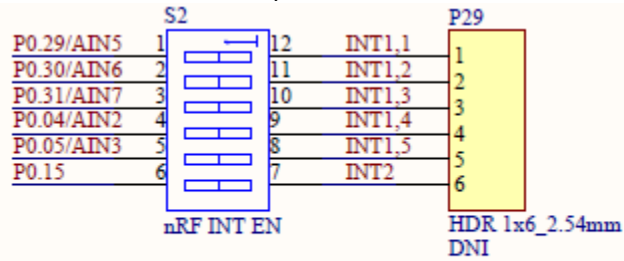




## 4.3 Control Switches

### 4.3.1 Interrupt Line Selector DIP Switch(S2)

S2 DIP Switch provides the ability to connect individual interrupt lines from either the Arduino base such as a nRF52 DK or to the smRF smBLOCK on the smWSP-ARD itself. There is also an unpopulated 2.54mm pitch header that can be used to directly wire in other GPIO's to act as an Interrupt Line.



- 1) DIP = Connect nRF Pins to smBLK INTs
- 2) HDR = Manually wire pins to smBLK INTs

Figure 1: S2 Interrupt DIP Switch 1

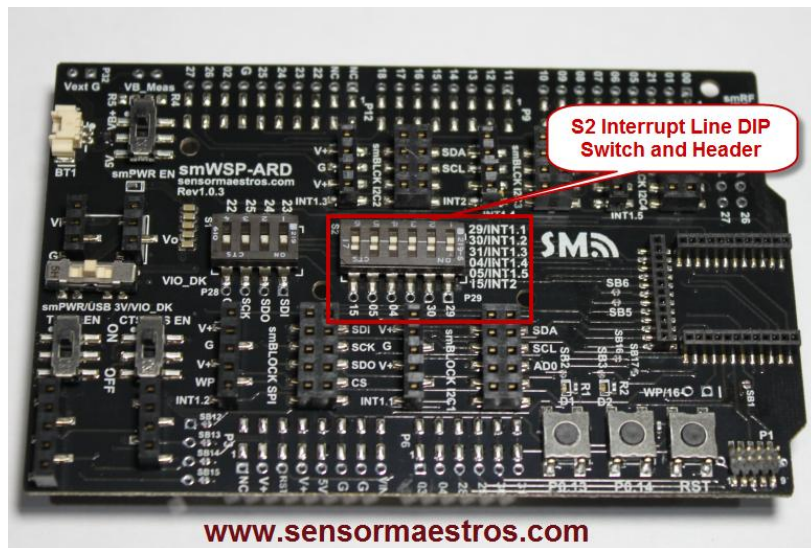


Figure 2: S2 DIP SW Image

DIP Selector	smBLOCK	GPIO nRF52 DK / smRF BLOCK	nRF 52 DK Notes	Arduino Rev 3 Mapping
1	smBLOCK I2C 1(INT1,1)	P0.29	No Conflicts	GPIO A2
2	smBLOCK SPI(INT1,2)	P0.30	No Conflicts	GPIO A4
3	smBLOCK I2C 2(INT1,3)	P0.31	No Conflicts	GPIO A5
4	smBLOCK I2C 3(INT1,4)	P0.04	No Conflicts	GPIO A1
5	smBLOCK I2C 4(INT1,5)	P0.05	Also tied to UART_RTS	Not Mapped. Can be mapped via header.
6	smBLOCK I2C 2,3,4(INT2)	P0.15	Also tied to Pushbutton 3 Used for sensors that have either 2 interrupts or interrupt on right-hand side of smBLOCK	GPIO D4

Table 1: Interrupt DIP SW



### 4.3.2 SPI Enable DIP Switch(S1)

The SPI Enable DIP Switch(S1) provides the capability to connect/disconnect GPIO lines to the **smBLOCK SPI**. This is useful if either these GPIO lines are desired to be used for something else OR if you want to use the headers on the edge of the smWSP-ARD to route these pins to an external device. Sliding the DIP switches to the ON position connects the individual GPIOs as shown below to the **smBLOCK SPI**. Alternatively any GPIO can be manually jumpered to provide SPI functionality by cutting the Solder Bridges and manually jumper-wiring the GPIOs into the header below S1.

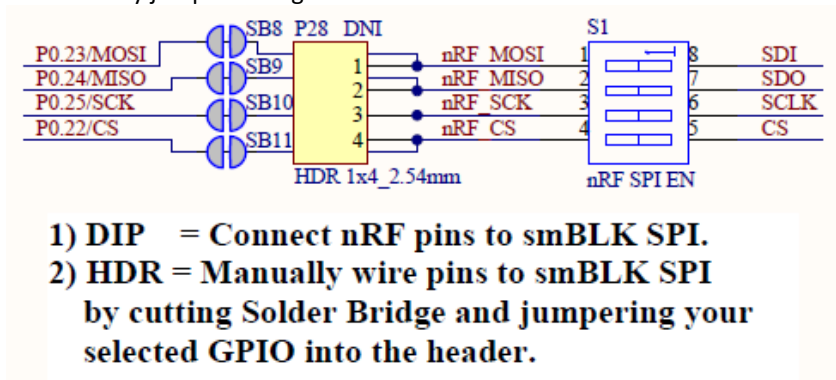


Figure 3: SPI Enable DIP Switch

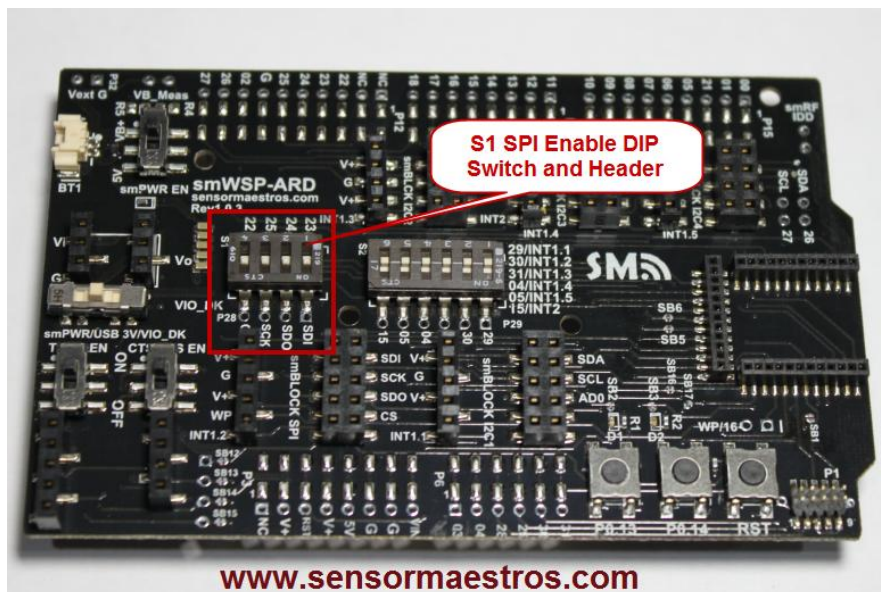


Figure 4: SPI Enable DIP(S1) Image

DIP Position	SPI Pin Name	GPIO on nRF52 DK or smRF BLOCK	DIP Position = ON	nRF 52 DK Notes	Arduino Mapping
1	SDI/MOSI	P0.23	Connected to smBLOCK SPI	No Conflicts	D11(MOSI, PWM)
2	SDO/MISO	P0.24	Connected to smBLOCK SPI	No Conflicts	D12(MISO)
3	SCK	P0.25	Connected to smBLOCK SPI	No Conflicts	D13(SCK)
4	CS	P0.22	Connected to smBLOCK SPI	No Conflicts	D10(SS, PWM)

**NOTE:** GPIO Pins are labeled on Silkscreen for the SPI Enable DIP Switch.

### 4.3.3 smCOM Block(USB-UART) Line Enable

To allow complete flexibility with using a USB-UART there are 2 slide switches that allow the UART Rx/Tx and CTS/RTS to be connected or disconnected to either a smRF plugin or an Arduino compatible base such as the nRF52 DK. As with the Interrupt and SPI lines these pins can be manually wired if desired by the un-populated 2.54mm header to the left of the smCOM Block.

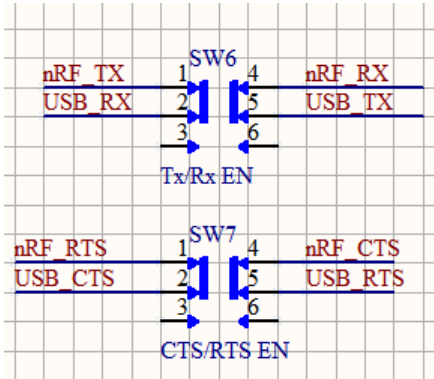


Figure 5: smCOM/UART Line Enable Switches, SCH

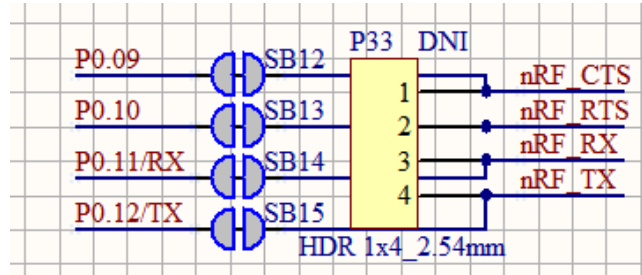


Figure 7: smCOM/UART Default GPIO Connections

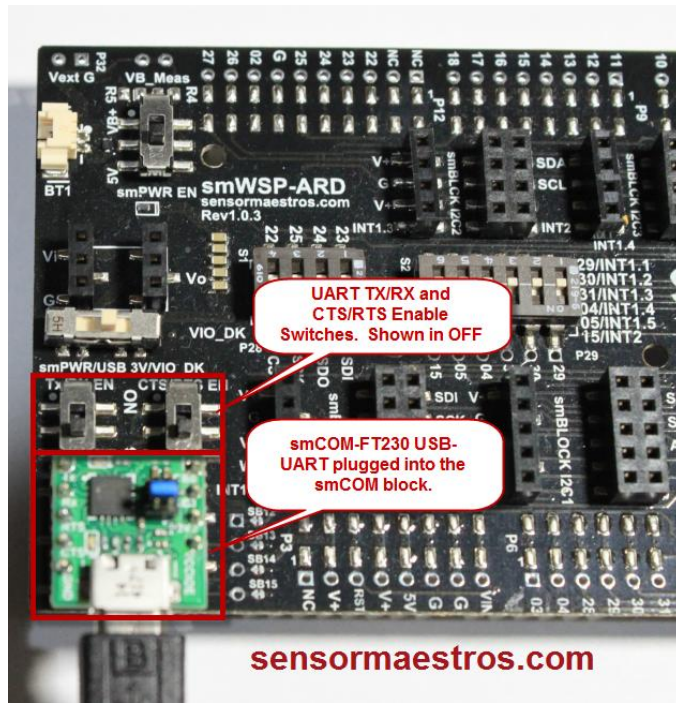


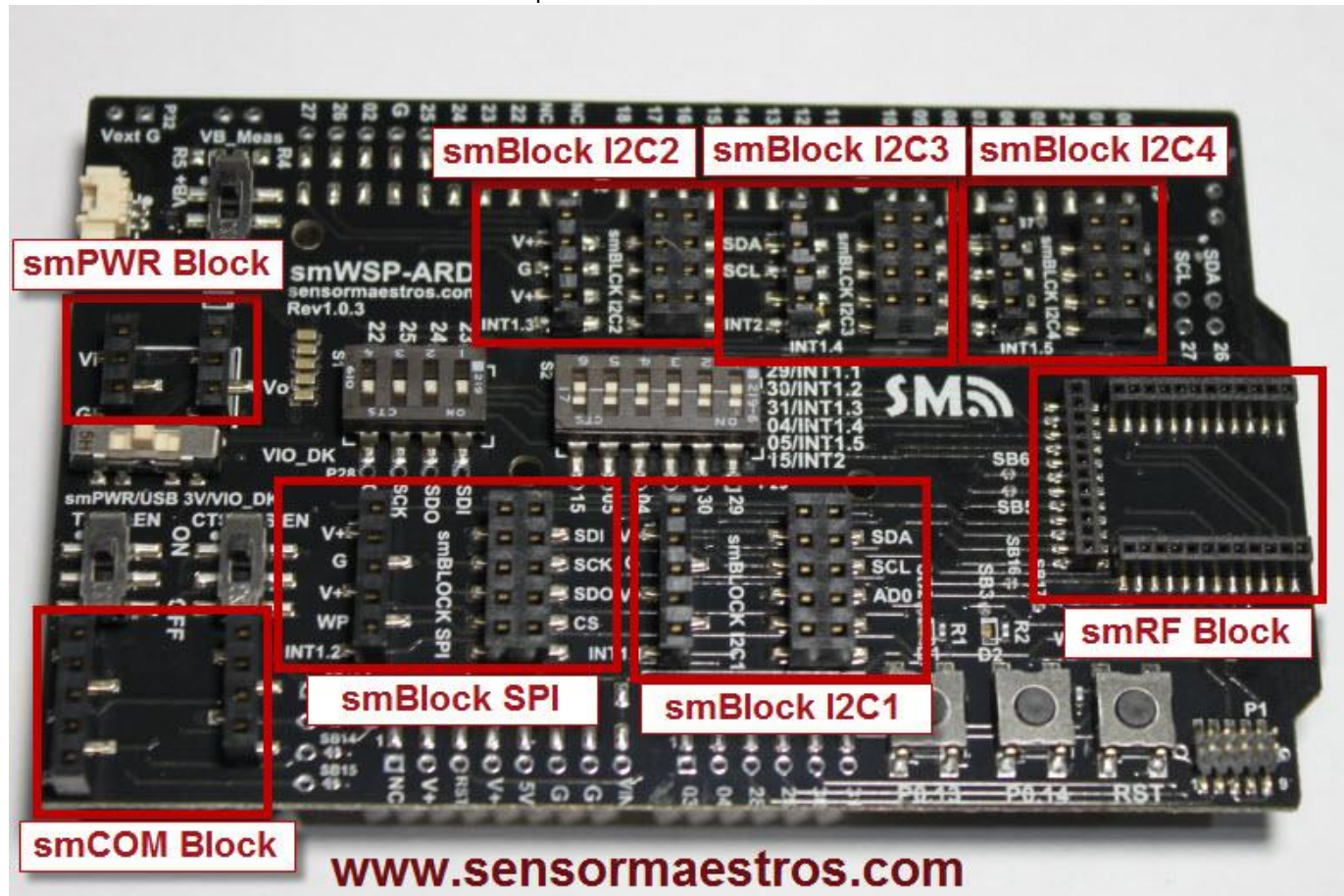
Figure 6: smCOM/UART Line Enable Switches with smCOM-FT230 plugged into smCOM Block.

UART Pin	nRF52 DK/smRF BLOCK GPIO	Switch Position = ON	nRF 52 DK Notes	Arduino Mapping
TX	P0.12	P0.12 connected to TX on smCOM	No Conflicts	D1(TX)
RX	P0.11	P0.11 connected to RX on smCOM	No Conflicts	D0(RX)
CTS	P0.10	P0.10 connected to CTS on smCOM	NFC2 Pin	NONE
RTS	P0.09	P0.09 connected to RTS on smCOM	NFC1 Pin	NONE

## 4.4 smBLOCKS

A key design aspect of the Wireless Sensor Platforms from Sensor Maestros, is the concept of smBLOCKs that provide plug in capability for numerous types of Sensors, Memory, Power, Communication, RF functionality that can be swapped/replaced by simply removing the particular smSENSR, smMOTN, smMEM, smPWR, smRF, smCOM device and plugging in another module to test for example a different sensor or increase memory size, or simply add another sensor into the system.

There are 8 total smBLOCKs on the smWSP-ARD platform and are described below.



### 4.4.1 smBLOCK Product Types

- 1) smSENSR = Environmental Sensors: Temperature, Pressure, Humidity, Light, etc.
- 2) smMOTN = Motion Sensors: 3/6/9 Axis Motion Sensors, Accelerometers, Gyroscopes, Magnetometers
- 3) smMEM = Memory: Serial Flash, Resistive Memory, etc.
- 4) smPWR = Power Modules: LDO, DC/DC Buck, Boost
- 5) smCHG = Battery Chargers
- 6) smCOM = Communication: USB-UART, etc.
- 7) smRF = Wireless/Radio(BLE, WiFi, LTE-M/NB-IoT, etc)



#### 4.4.2 smBLOCK SPI

The smBLOCK SPI can be used with any of the 10pin SPI based smBLOCK breakout boards such as the **smMEM**, **smMOTN**, **smSENSR**, etc. devices. This block can accept both 400 and 500mil spaced headers. To enable the smBLOCK use the [SPI Enable DIP Switch\(S1\)](#) to connect the respective GPIO lines to the smBLOCK SPI headers.

##### GPIO:

- 1) FSYNC/WP: FSYNC is an option on some smMOTN Sensors such as smMOTN-MPU9250. WP is for Write Protect on smMEM Serial Flash devices.
- 2) INT1,2: Interrupt connection 1,2. Refer to [Interrupt Line Selector DIP Switch\(S2\)](#).
- 3) SPI Lines: SDI, SCLK, SDO, CS

## smBLOCK SPI

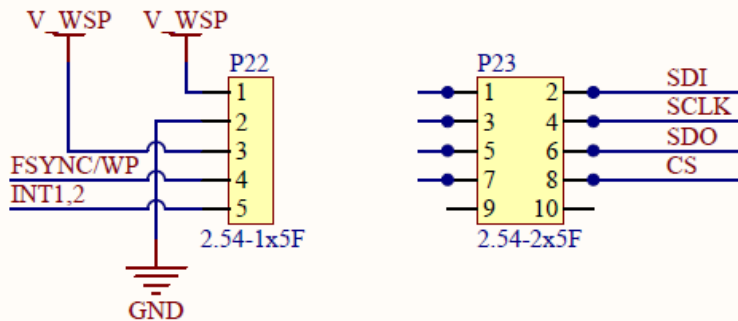


Figure 8: smBLOCK SPI Schematic

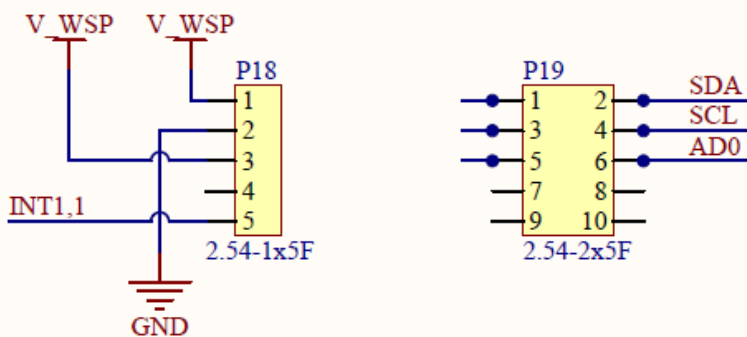
#### 4.4.3 smBLOCK I2C1

The smBLOCK I2C1 can be used with any of the 10pin I2C based smBLOCK breakout boards such as **smMEM**, **smMOTN**, **smSENSR**, etc. This block can accept both 400 and 500mil spaced headers.

##### GPIO:

- 1) INT1,1: Interrupt connection 1,1. Refer to [Interrupt Line Selector DIP Switch\(S2\)](#).
- 2) AD0: I2C Address 0. This is sometimes used as the LSB for the I2C Slave Address. Default on **smXXX** devices is LOW/Ground.
- 3) I2C Lines: SDA, SCL

## smBLOCK I2C 1



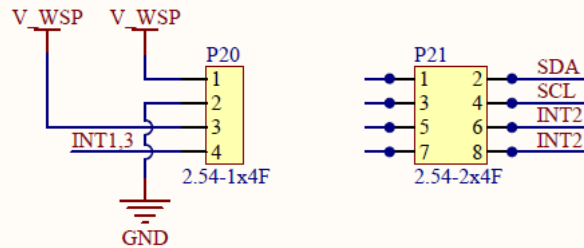
#### 4.4.4 smBLOCK I2C2,3,4

The smBLOCK I2C2,3,4 block locations can be used with any 6 or 8pin I2C based smBLOCK breakout boards such as *smMEM*, *smMOTN*, *smSENSR*, etc. These blocks are identical to each other though each blocks has one unique Interrupt line for each block. These blocks can accept 300 and 400mil spaced headers.

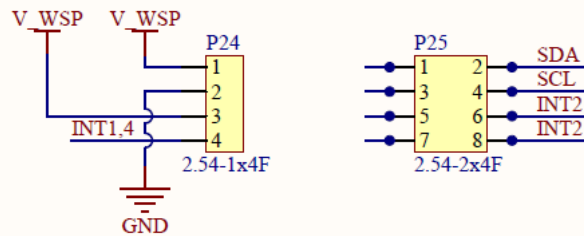
#### GPIO:

- 1) INT1,3/INT1,4/INT1,5: Unique Interrupt lines to the individual blocks. Refer to [Interrupt Line Selector DIP Switch\(S2\)](#).
- 2) INT2: Common Interrupt Line to all Blocks. Used on some smMOTN products that have 2 interrupt lines such as the *smMOTN-MMA8652*.
- 3) I2C Lines: SDA, SCL

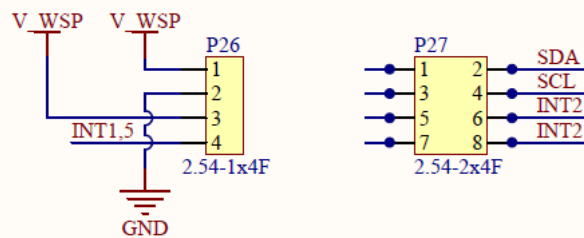
### smBLOCK I2C 2



### smBLOCK I2C 3

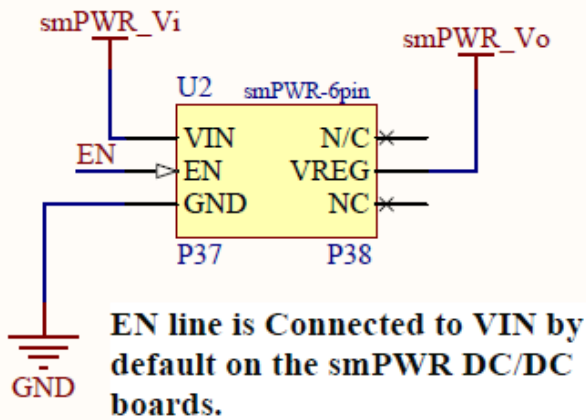


### smBLOCK I2C 4

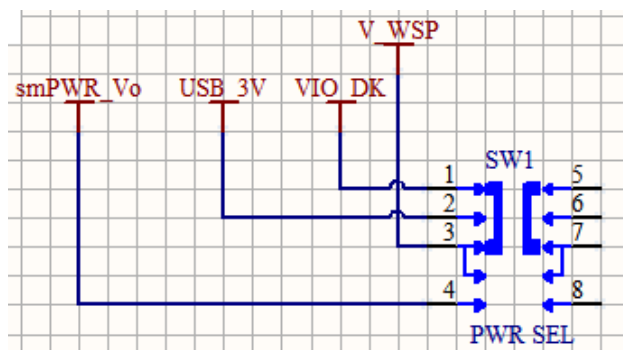
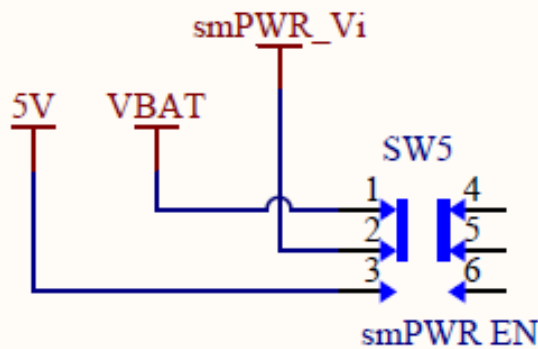


#### 4.4.5 smPWR

The smPWR block can be used to add Power Management functionality such as DC/DC converters to provide either Buck functionality from a LiPO or Boost Functionality from Alkalines or coin cells depending on what the intended system voltage is desired to be.



If the smPWR block is used you will need to make use of the [smPWR Enable/Selector Switch](#) and slide the [Power Selector Switch](#) to the smPWR selection(left-most position).



Some examples of possible uses of the smPWR block and use of the smPWR Enable/Selector Switch are provided below.

**Example 1:** smWSP-ARD is being used as an Arduino Shield and the desire is to power from the 5V supply on the Arduino compatible base. The 5V would need to be regulated to something 3.6V or less.

- 1) smPWR-MP2148-ADJ is plugged into the smPWR block(default is 3.0V but can be modified for 1.8V).
- 2) smPWR Enable/Selector Switch = 5V.

**Example 2:** A LiPO battery is connected to the Battery Connector(BT1). The ~4V LiPO voltage will need to be regulated to 3.6V or less.

- 1) smPWR-MP2148-ADJ is plugged into the smPWR block(default is 3.0V but can be modified for 1.8V).



- 2) smPWR Enable/Selector Switch = VB+ (Battery or External supply selection)

**Example 3:** An external power supply is connected to P32(Vext / G). This external supply needs to be regulated to 3.6V or less.

- 1) smPWR-MP2148-ADJ is plugged into the smPWR block(default is 3.0V but can be modified for 1.8V).
- 2) smPWR Enable/Selector Switch = VB+ (Battery or External supply)

**Example 4:** An external power supply or single cell Alkaline(1.5V) is connected to the smWSP-ARD either to the Battery Connector or wired to P32(Vext / G) that is desired to be 'Boosted' to 3.3V.

- 1) smPWR-MCP16251 or smPWR-MCP16252 is plugged into the smPWR block to 'Boost' the input voltage to 3.3V.
- 2) smPWR Enable/Selector Switch = VB+ (Battery or External supply)

## 5.0 smWSP-ARD Schematic

Please find smWSP-ARD Searchable PDF Schematic on the smWSP-ARD and the IAQ-LOGR application product pages on the Sensor Maestros website.

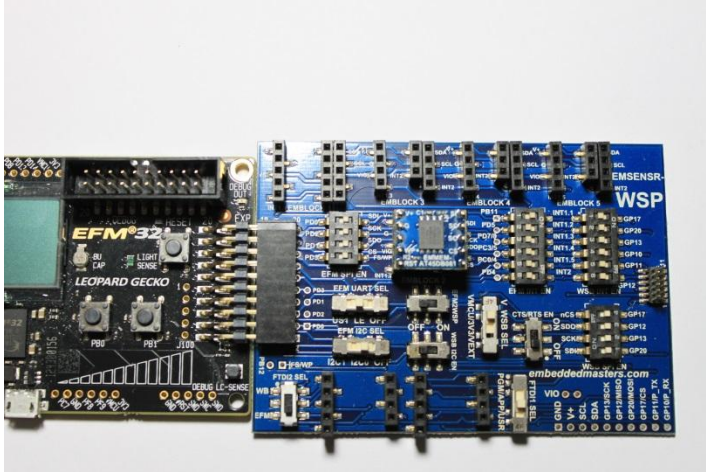
<https://sensormaestros.com/product-category/wireless-sensor-rapid-prototyping-platfomrs/smwsp-ard-arduino-compatible/>

## 6.0 Additional Wireless Sensor Platforms

### 7.0 smWSP (SiLabs EFM/EFR32 Compatible)

The **smWSP** is similar to the **smWSP-ARD** and is compatible with the Silicon Labs **EFM32/EFR32 Starter Kits** utilizing the 20pin female connector on the right-hand side of the PCBA. The **smWSP** also has a 12pin male header on the right-hand side of the PCBA that can be used as an expansion connector. Future expansion boards could include **smRF** or **smSENSR** products for example. The **smWSP** is compatible with the Sensor Maestros **smSENSR**, **smMEM**, **smCOM**, **smBAT** products to be plugged into the **smWSP** allowing Rapid Prototyping of a Sensor/Wireless Sensor system. The **smWSP** has been designed with a Slide Switch to accommodate the slight variations of the EFM/EFR32 Starter Kits.

#### 1) smWSP + EFM/EFR32 STK



#### 7.1.1 Features

- Allows use of all Sensor Maestros **smSENSR**, **smMEM**, **smCOM**, **smBAT** Products
  - I2C and SPI slots available
- Direct Connection with all Silicon Labs EFM/EFR32 Starter Kits
- 2 smCOM-FT230/USB-UART slots
- Selectable Voltage between: VMCU(EFM/EFR32 Starter Kits) or 3V3(from smCOM-FT230)
- Allows for UART, LPUART, and SPI serial communication from the EFM/EFR32 Starter kits to the 12pin male expansion header that could be used for Wireless/Radio Plugin. Selectable with Slide Switches and DIP switch selectors.
- GPIO can be directly connected between EFM32/EFR32 STK and Wireless/Radio expansion header.
- GPIO pins can individually be connected to Sensor INT lines for individual Interrupt control