

## BLE & LoRa Multi Sensor

This small Multi Sensor demonstrator provides an example of the tremendous capabilities of the ISP4520 module based on the nRF52832 BLE Chip and the SX126x LoRa transceiver. With several sensors around a powerful Cortex™ M4 CPU, flash and RAM memory combined with optimized antennas, ISP4580 offers the best-in-class Bluetooth and LoRa performance with low power consumption.



### Key Features

- Bluetooth v5.0 - 2.4GHz low energy RF Transceiver
- Based on Insight SiP 4520 Module
- 32bit ARM Cortex M4F CPU with 512KB Flash and 128KB RAM
- Fully integrated RF matching and Antennas
- Integrated 32 MHz and 32.768 kHz Clocks
- Low Power 3-Axis Accelerometer Detection
- Low Power Temperature/Humidity Detection
- Low Power Barometer Detection
- Low Power Light Detection
- Programmable controlled mini LEDs
- USB port interface
- Power supply on coin cell battery CR2032 or with USB interface
- Overall Size 43.5 x 30 mm<sup>2</sup>
- Temperature -25 to 85 °C

### Applications

- Sport and fitness sensors
- Health care sensors
- Industrial sensors
- Gaming sensors
- Motion detection and transmission



### Certifications

- FCC certification pending
- CE certification pending
- IC certification pending
- TELEC certification pending
- Bluetooth SIG certification pending
- RoHS compliant

## Revision History

Revision	Date	Ref	Change Description
R0	19/12/2019	jf pg	Initial release

## Contents

1. <b>Block Diagram</b> .....	3
2. <b>Specifications</b> .....	4
2.1. Sensor Performances.....	4
2.2. RF Specifications .....	4
3. <b>Electrical Schematic</b> .....	6
4. <b>Product Development Tools</b> .....	9

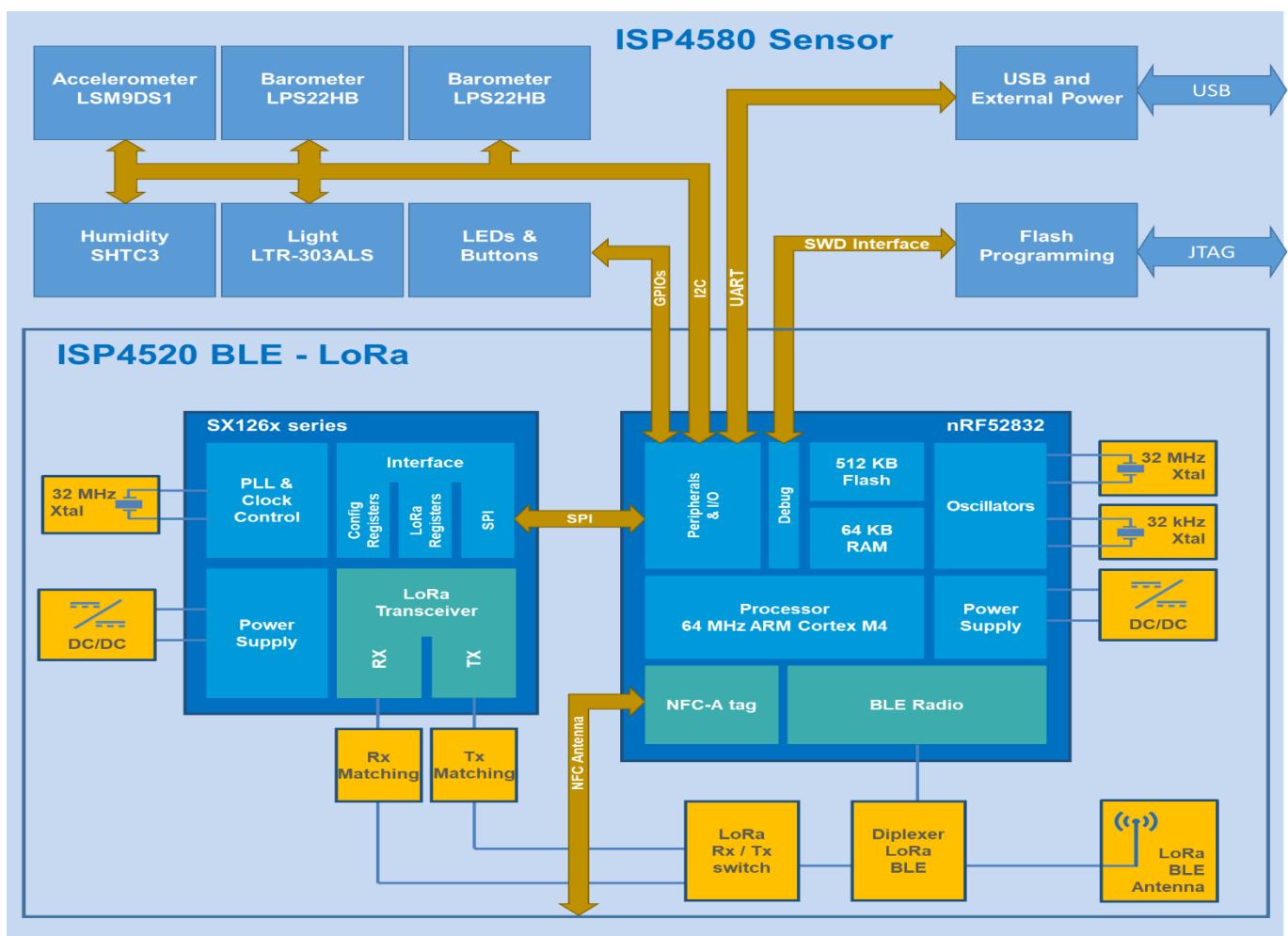
## 1. Block Diagram

ISP4580 is an autonomous low-power device for wireless acceleration, temperature, humidity, barometer and light detection and transmission. Overall size of the device is 43.5 x 30 mm<sup>2</sup> (74.8 x 55.3 mm<sup>2</sup> if using extended ground plane).

The complete device makes use of Insight SiP ISP4520 BLE & LoRa module together with low power 3-axis Accelerometer, Temperature / Humidity and Barometer and Light sensors connected to a primary button cell battery CR2032.

The host processor that handles the autonomous sensor application, the BLE protocol stack, the LoRa drivers and the communication with the sensors is a low power 32-bit MCU (ARM Cortex-M4F based), integrating 512 KB Flash memory and 128 KB RAM.

The ST Micro LSM9DS1 3-axis linear accelerometer / magnetometer is used to detect acceleration and is combined with the ST Micro LPS22HB Barometer, the LITEON LTR-303ALS Light sensor and the SHTC3 Sensirion Humidity / Temperature sensors. 3 mini-LEDs are also part of the board and are available to be controlled by software.



## 2. Specifications

### 2.1. Sensor Performances

This chart summarizes main sensor ranges, sensitivities and accuracies. For more detailed information, please refer to the manufacturer datasheet.

Parameter	Min	Typ	Max	Unit
Linear Acceleration range	±2		±16	g (9.81m/s <sup>2</sup> )
Linear Acceleration sensitivity	0.061		0.732	mg/LSB
Linear Acceleration accuracy @ ±8g range		±90		mg
Magnetic measurement range	±4		±16	Gauss
Magnetic measurement sensitivity	0.14		0.58	mG/LSB
Angular rate range	±245		±2000	dps
Angular rate sensitivity	8.75		70	mdps/LSB
Barometer range	800		1100	hPa
Barometer sensitivity		4096		LSB/hPa
Barometer accuracy		±0.1		hPa
Relative Humidity range	0		100	%RH
Relative Humidity accuracy		±2		%RH
Temperature range	-25		+85	°C
Temperature accuracy		±0.2		°C

### 2.2. RF Specifications

The performance of Bluetooth radio is related to the ISP4520 specification.

Parameter	Min	Typ	Max	Unit
BLE Frequency Range	2402		2480	Mhz
BLE Channel 0 to 39 Spacing		2		Mhz
BLE Output Power Channels 0 to 39	-20		4	dBm
BLE Rx sensitivity Level for BER <0,1% ideal Tx		-96		dBm
BLE Antenna Gain		-3.6		dBi
BLE EIRP	-23.6		0.4	dBm
BLE Range Open field @1m height		70		m

The performance of LoRa radio is related to the ISP4520 specification.

Parameter – EU version	Min	Typ	Max	Unit
LoRa Frequency Band (EU)	863		870	Mhz
LoRa Rx sensitivity Level for BER <1% <sup>(3)</sup>	-137			dBm
LoRa Output Power at transceiver output		+14		dBm
LoRa Antenna Gain in band <sup>(1) (5)</sup>		-2.6		dBm
LoRa Load impedance		50		Ω
LoRa Range Open field @ 1 m height <sup>(1) (3) (5)</sup>		15		km
LoRa Range Open field @ 1 m height <sup>(2) (3)</sup>		20		km

Parameter – US version	Min	Typ	Max	Unit
LoRa Frequency Band (US)	902		928	Mhz
LoRa Rx sensitivity Level for BER <1% <sup>(3)</sup>	-137			dBm
LoRa Output Power at transceiver output		+22		dBm
LoRa Antenna Gain in band <sup>(1) (5)</sup>		-1.9		dBm
LoRa Load impedance		50		Ω
LoRa Range Open field @ 1 m height <sup>(1) (3) (5)</sup>		17		km
LoRa Range Open field @ 1 m height <sup>(2) (3)</sup>		20		km

Parameter – JP version	Min	Typ	Max	Unit
LoRa Frequency Band (JP)	920		923	Mhz
LoRa Rx sensitivity Level for BER <1% <sup>(3)</sup>	-137			dBm
LoRa Output Power at transceiver output		+14		dBm
LoRa Antenna Gain in band <sup>(1) (5)</sup>		-1.9		dBm
LoRa Load impedance		50		Ω
LoRa Range Open field @ 1 m height <sup>(1) (3) (5)</sup>		13		km
LoRa Range Open field @ 1 m height <sup>(2) (3)</sup>		16		km

(1) With internal LoRa antenna / Outdoor

(2) With external LoRa antenna / Outdoor

(3) Lower data rate DR0 SF12/125kHz, Rx boosted gain(EU & JP)

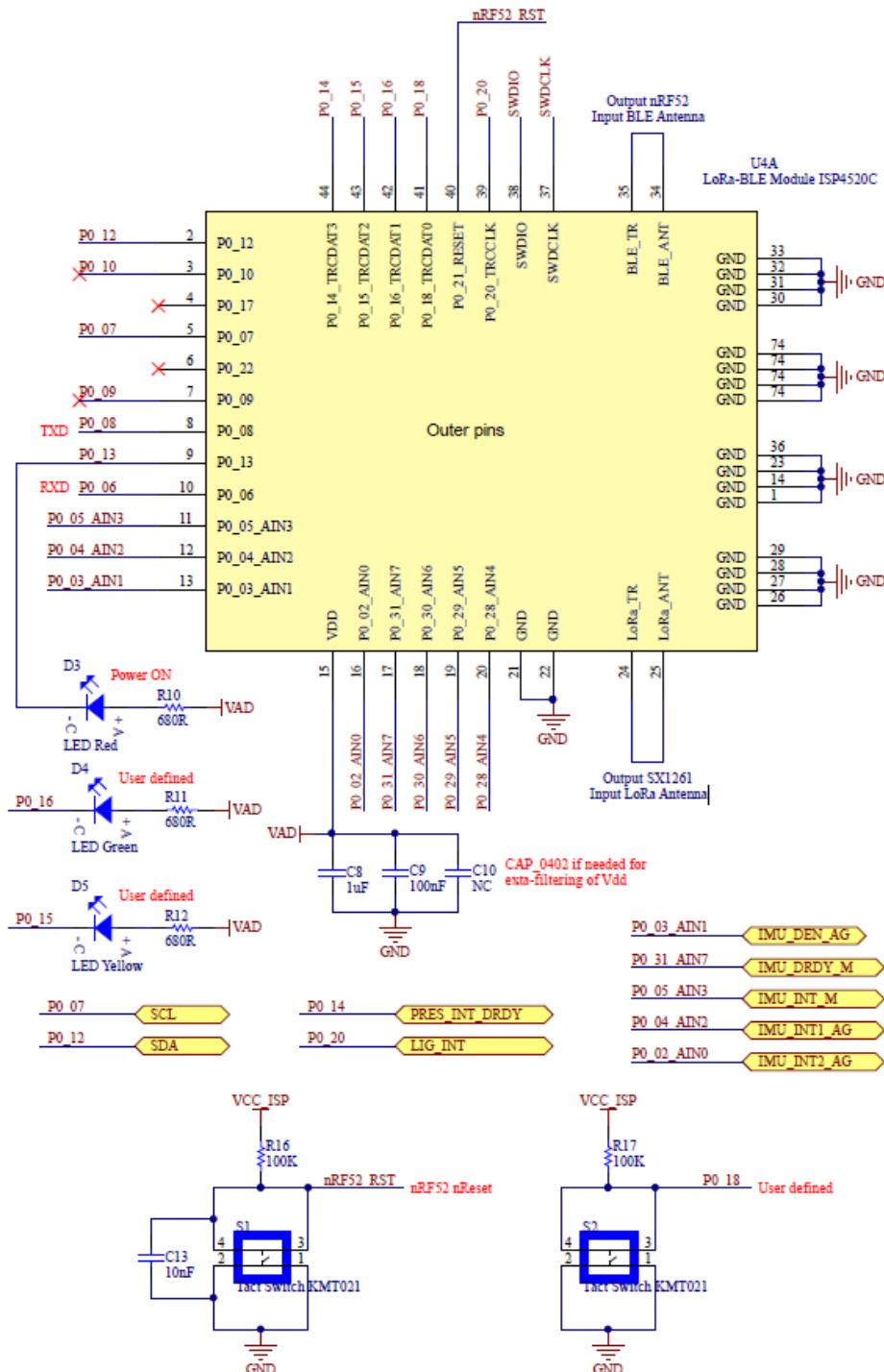
(4) Lower data rate DR0 SF10/125kHz, Rx boosted gain(US)

(5) Measured Front side of ISP4520



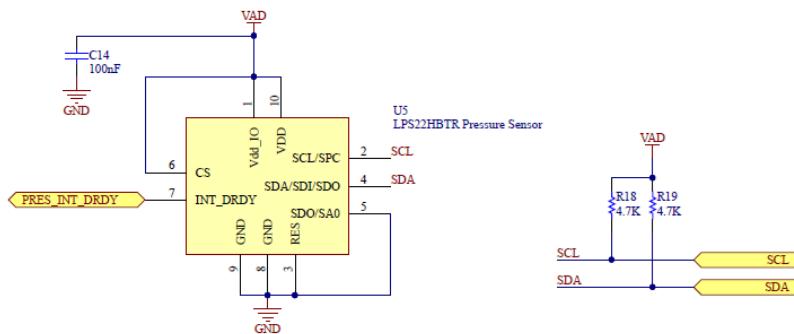
### 3. Electrical Schematic

#### ISP4520 Connections

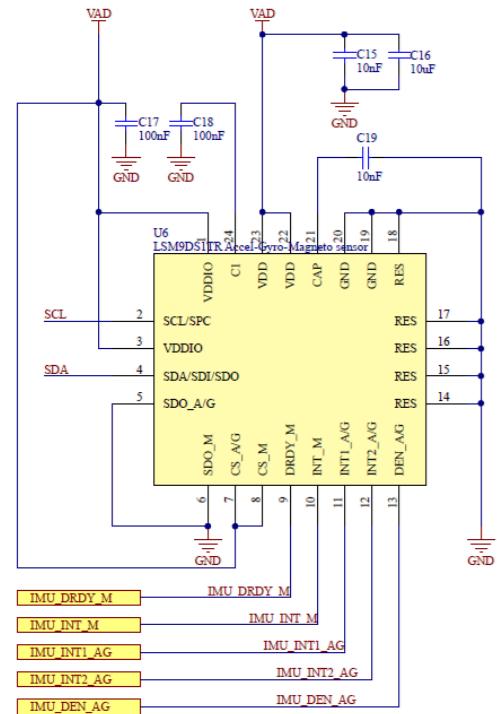


## Sensor connections

Barometer sensor



Magneto - Accelero - Gyrometer sensor



Humidity / Temperature sensor

Light sensor

Magneto - Accelero - Gyrometer sensor

Barometer sensor

Humidity / Temperature sensor

Light sensor

Magneto - Accelero - Gyrometer sensor

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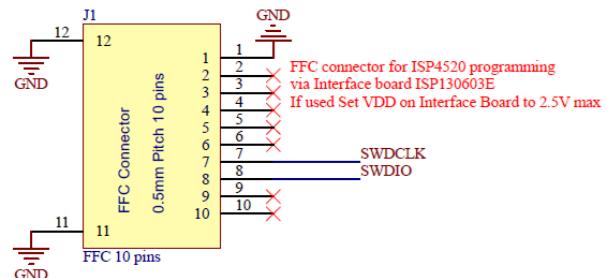
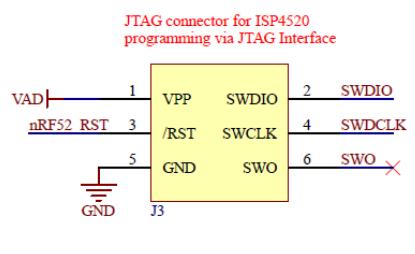
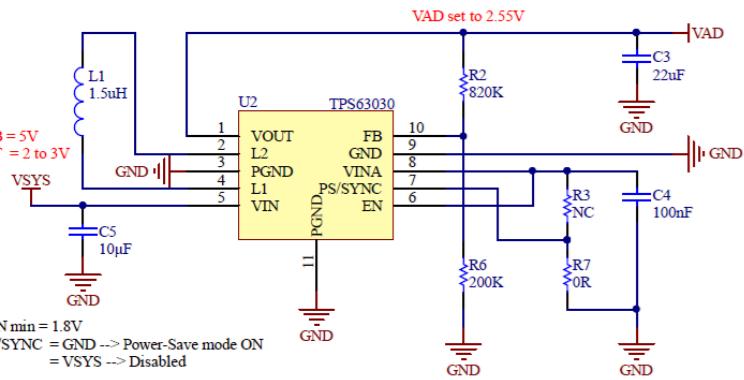
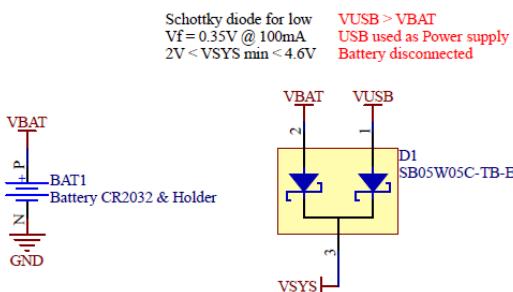
Light sensor

Magneto - Accelero - Gyrometer sensor

Barometer sensor

Humidity / Temperature sensor

## Power Supply & SWD



## 4. Product Development Tools

### Hardware

For further specific development, it is also possible to acquire an Evaluation Board containing:

- ✚ One Interface Board with J-Link Seeger integrated
- ✚ One ISP4520 Tx Test Board / Mote
- ✚ One ISP4520 Rx Test Board / Gateway
- ✚ Cables

Using this evaluation board, product developers can use a working solution as starting point to develop their own applications. Please refer to the documentation for more information:

[http://www.insightsip.com/fichiers\\_insightsip/pdf/ble/ISP4520/isp\\_lora\\_DS4520\\_DK.pdf](http://www.insightsip.com/fichiers_insightsip/pdf/ble/ISP4520/isp_lora_DS4520_DK.pdf)  
[http://www.insightsip.com/fichiers\\_insightsip/pdf/ble/ISP4520/isp\\_lora\\_AN190301.pdf](http://www.insightsip.com/fichiers_insightsip/pdf/ble/ISP4520/isp_lora_AN190301.pdf)

### Firmware

ISP4520 supports Bluetooth Low Energy protocol stack S132 SoftDevice. It also provides extensive software support for ANT and THREAD applications as well as 2.4 GHz protocol stacks, including Gazell. All are available as downloads at [www.nordicsemi.com](http://www.nordicsemi.com).

Additional development tools and software are recommended for using and testing ISP4520:

- ✚ Nordic Semiconductor nRFgo Studio or nRF Connect for Desktop:  
Downloadable at:  
<https://www.nordicsemi.com/Software-and-Tools/Development-Tools/nRFgo-Studio> or  
<https://www.nordicsemi.com/Software-and-tools/Development-Tools/nRF-Connect-for-desktop>
- ✚ Debugging and IDE:  
SEGGER Embedded Studio (SES):  
Downloadable from <https://www.segger.com/products/development-tools/embedded-studio/>
- ✚ Segger J-Link:  
Downloadable from <http://www.segger.com/jlink-software.html>
- ✚ nRF52 Software Development Kit (SDK). It can be downloaded after registering at [www.nordicsemi.com](http://www.nordicsemi.com). It contains example applications and provides source codes, precompiled HEX files, SES, Keil and IAR project files
- ✚ LoRa and LoRaWan examples:  
Downloadable from  
[https://www.insightsip.com/fichiers\\_insightsip/pdf/ble/ISP4520/ISP4520\\_Source\\_Code.zip](https://www.insightsip.com/fichiers_insightsip/pdf/ble/ISP4520/ISP4520_Source_Code.zip)