UM1982
User manual

Multi-Sensor RF 868 MHz platform

Introduction

The objective of this document is to demonstrate the workings of a 6LoWPAN (IPv6 over Low power Wireless Personal Area Networks) using ST's SPIRIT1 (Low data rate, low power Sub 1 GHz) RF transceiver at 868 MHz.

The evaluation platform is based on the STEVAL-IDI002V2 and STEVAL-IDI003V2. Together, the two boards together are known as the Multi Sensor-RF platform.

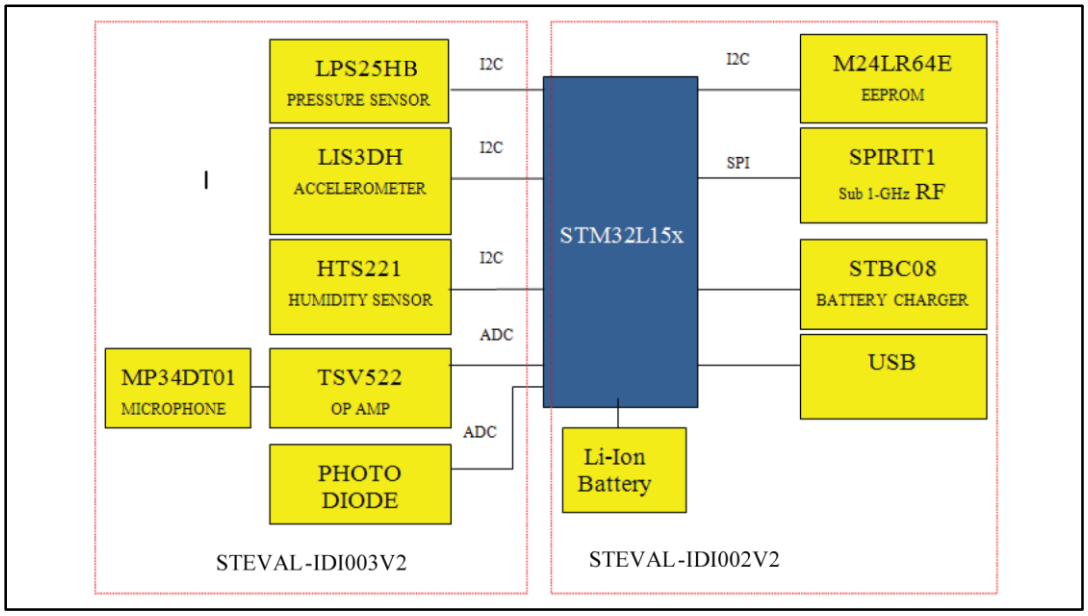
The STEVAL-IDI002V2 is the master board consisting of an STM32L152RBT6 Cotex-M3 microcontroller and Wireless Communication interface at 868 MHz frequency band. It runs the open source Contiki 6LoWPAN 3.x stack, and provides for a versatile platform for evaluating the 6LoWPAN solution in the context of the Internet of Things, where it can be interfaced with various sensors and or actuators.

The STEVAL-IDI003V2 consists of many MEMS sensors from ST. This board is connected to the STEVAL-IDI002V2 through GPIOs, ADC and I²C. The application firmware running on top of the Contiki 6LoWPAN stack interacts with these sensors and transmits the data over the 6LoWPAN network at 868 MHz.

The whole system can be powered by a single cell Li-Ion battery (3.7 V, any capacity > 200 mAh).

The following block diagram describes the whole system (STEVAL-IDI002V2 + STEVAL-IDI003V2):

Figure 1: Block diagram



Contents

1 Board schematics

Figure 2: STEVAL-IDI002V2 board photo

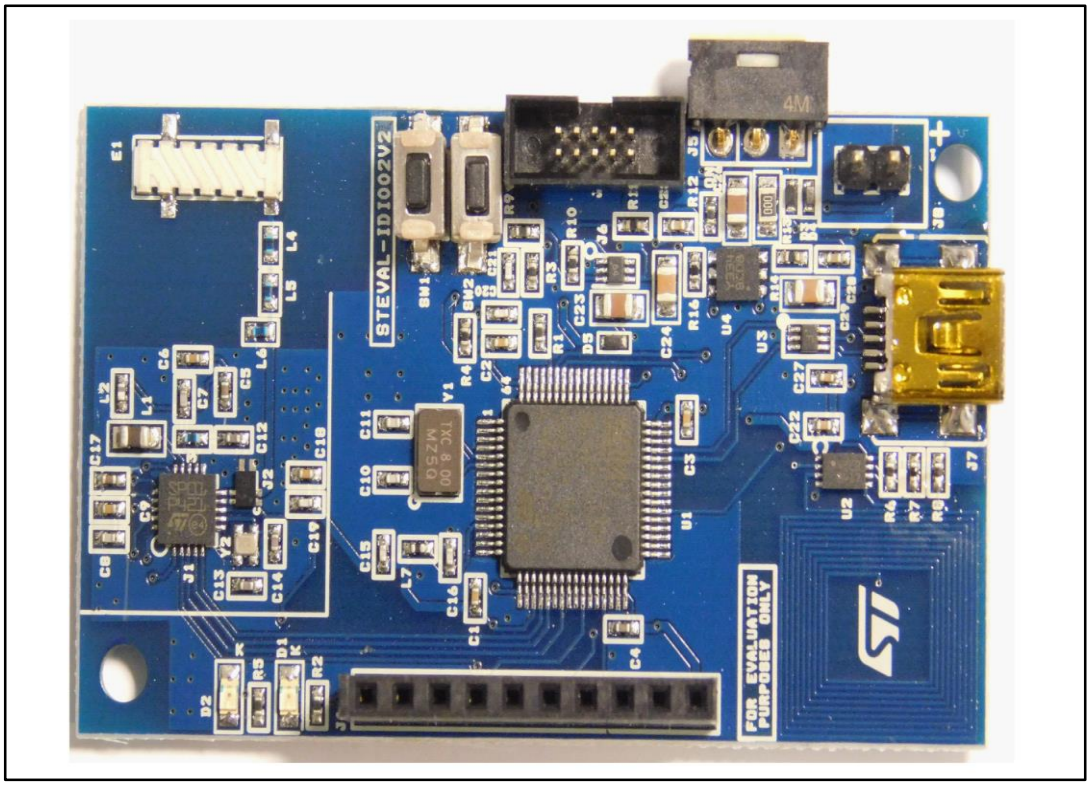
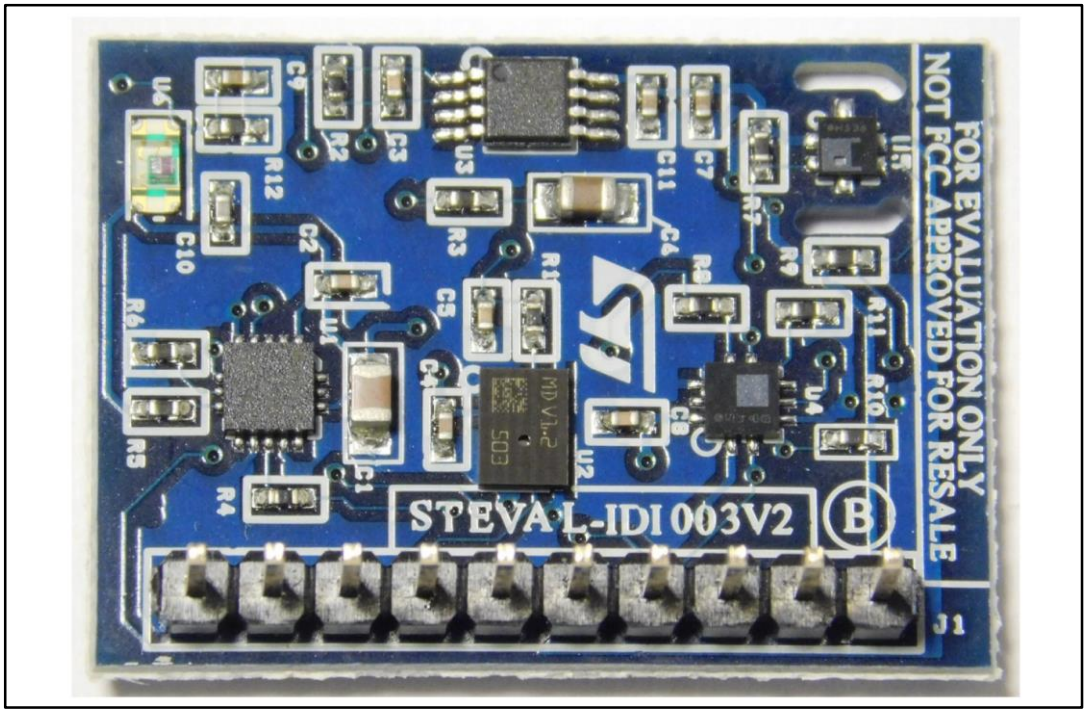
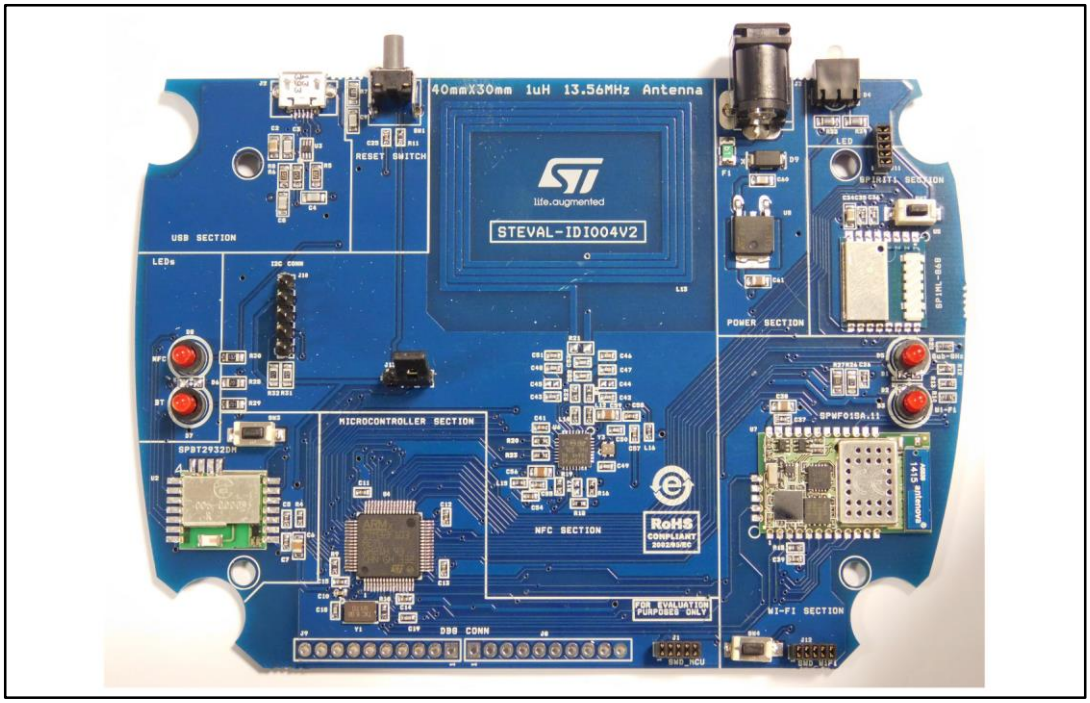


Figure 3: STEVAL-IDI003V2 board photo



The STEVAL-IDI004V2 pictured below is used to demonstrate the functions of the 6LoWPAN network based on the Multi sensor-RF platform.

Figure 4: STEVAL-IDI004V2 board photo



In the demo application, the STEVAL-IDI004V2 board acts as a Root Node in a 6LoWPAN network. The STEVAL-IDI004V2 and STEVAL-IDI002V2 boards together form a 6LoWPAN network. The STEVAL-IDI002V2 reads the data from the sensors present on the STEVAL-IDI003V2 and transmits to the Root Node through the 6LoWPAN network at 868 MHz frequency band.

The communication between the various nodes in this 6LoWPAN network is through the STMicroelectronics SPIRIT1 RF Transceiver, operating at the 868 MHz frequency band. The SPIRIT1 is a very low-power RF transceiver, intended for RF wireless applications in the sub-1 GHz band. It is designed to operate in both the license-free ISM and SRD frequency bands at 169, 315, 433, 868, and 915 MHz, but can also be programmed to operate at additional frequencies in the 300-348 MHz, 387-470 MHz, and 779-956 MHz bands.

The 6LoWPAN stack runs on the STM32L152RBT6 microcontroller on the Multisensor-RF platform. The STM32L series of microcontrollers are ultra-low power microcontrollers based on the Cortex-M3 core. In the Multisensor-RF platform, the microcontroller handles sensor data collection, interfacing, controlling the SPIRIT1 RF transceiver and executing the 6LoWPAN stack and application. The STEVAL-IDI002V2 also contains a dual-EEPROM M24LR64E from STMicroelectronics. This dual EEPROM enables the Multisensor RF platform to store the data from the sensors and allows the user to access this data using any NFC enabled smartphone.

As already mentioned, the STEVAL-IDI003V2 consists of a host of sensors from STMicroelectronics. It consists of the MEMS Accelerometer LIS3DH, the MEMS Pressure sensor LPS25HB, the MEMS Humidity sensor HTS221, MEMS Microphone MP34DT01. It also contains a light sensor from AVAGO technologies.

The PCB board that doesn't have (B) label close to [STEVAL-IDI003V2] is mounting LPS25H, instead the LPS25HB. In *Figure 3: "STEVAL-IDI003V2 board photo"* is showing PCB with (B) label mentioned and mounting LPS25HB.

Together, these sensors allow for a myriad of applications that can be developed on the Multisensor RF platform.

2 Getting started

2.1 System requirements

In order to use the Multi-sensor RF Platform, a Windows® operating system such as Windows XP or Windows 7 must be installed on the PC.

2.2 Package contents

The Multi-sensor RF Platform includes the following items:

- Hardware content:
  - Two STEVAL-IDI002V2 and STEVAL-IDI003V2 boards.
  - STEVAL-IDI004V2 Wireless Bridge Platform acting as the data collector or Root node.
- Software content:
  - GUI and android application for Multi-sensor RF platform
  - STEVAL-IDI002V2.hex file for programming into the STEVAL-IDI002V2.
- Documentation:
  - User manual of this board.

2.3 Software installation

- Wireless Bridge Configuration utility: Wireless Bridge ConfigUtil_1.0_140901.exe
- Android application: WirelessBridge_1.0.2.apk

2.4 Hardware installation

Connecting STEVAL-IDI002V2 and STEVAL-IDI003V2

The two boards are connected using the 10-pin male connector J4 on STEVAL-IDI002V2 and 10-pin female connector J1 on the STEVAL-IDI003V2.

These 10-pin connector is for connecting some I²C, ADC & GPIO pins from the STM32L152RBT6 on the STEVAL-IDI002V2 with the various sensors on the STEVAL-IDI003V2. The STEVAL-IDI003V2 derives power from the STEVAL-IDI002V2 through this 10-pin connector.

Below is a table describing the pins of the J4 connector on the STEVAL-IDI002V2.

Table 1: J4 connector

Pin	J4	Description
1	3V3	VDD connection for the daughter board (STEVAL-IDI003V2)
2	I2C1_SCL	I2C1 Clock pin
3	I2C1_SDA	I2C1 Data pin
4	I2C2_SCL	I2C2 Clock pin
5	I2C2_SDA	I2C2 Data pin
6	GPIO0	PA3 pin of the STM32L152RBT6
7	GPIO1	PB0 pin of the STM32L152RBT6
8	ADC0	PA0 pin of the of the STM32L152RBT6 connected to the photo diode output in the STEVAL-IDI003V2
9	ADC1	PA1 pin of the STM32L152RBT6 connected to the Microphone amplifier output on the STEVAL-IDI003V2

Pin	J4	Description
10	GND	Ground connection for the daughter board (STEVAL-IDI003V2)

Power supply

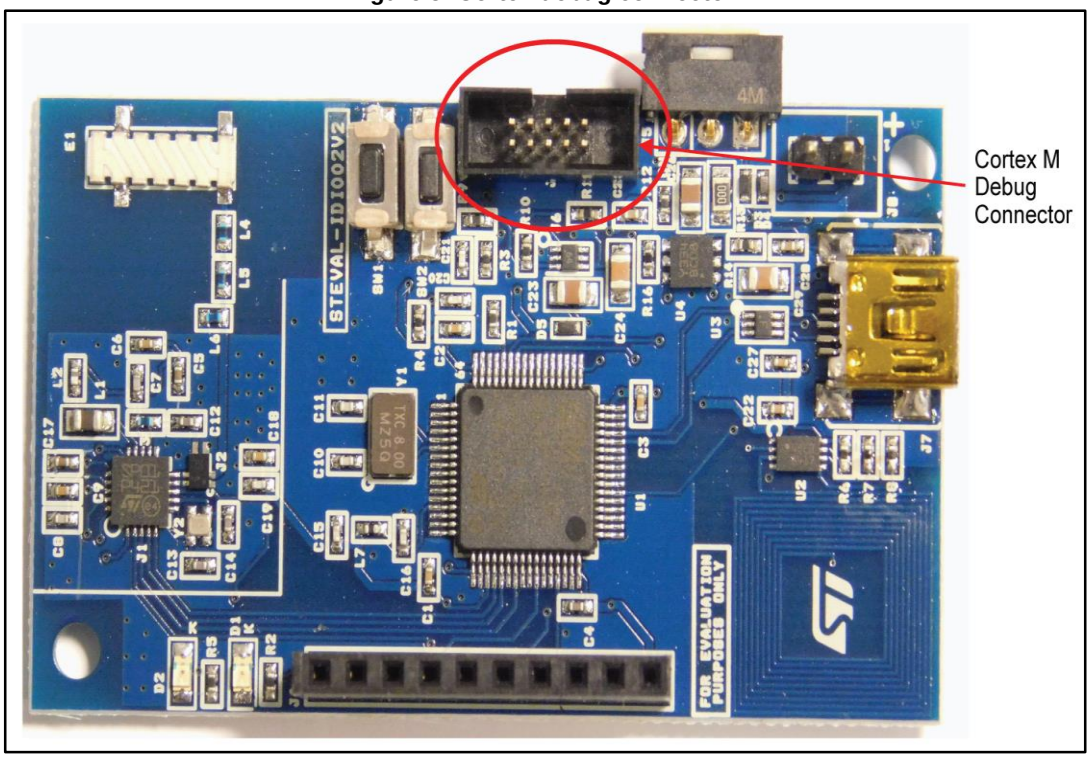
The STEVAL-IDI002V2 board can be powered from the PC via the USB min B-type connector J7. It can also be powered by a Li-Ion battery connected to the J8 2-pin connector.The J5 3-pin SPDT switch turns the board ON and OFF.

As mentioned above, the STEVAL-IDI003V2 derives power from the STEVAL-IDI002V2 through the 10 pin connector.

Programing connector:

The STM32L152RBT6 on the STEVAL-IDI002V2 is programmed through the 10 pin Cortex Debug Connector. The Debug Connector is shown in the figure below.

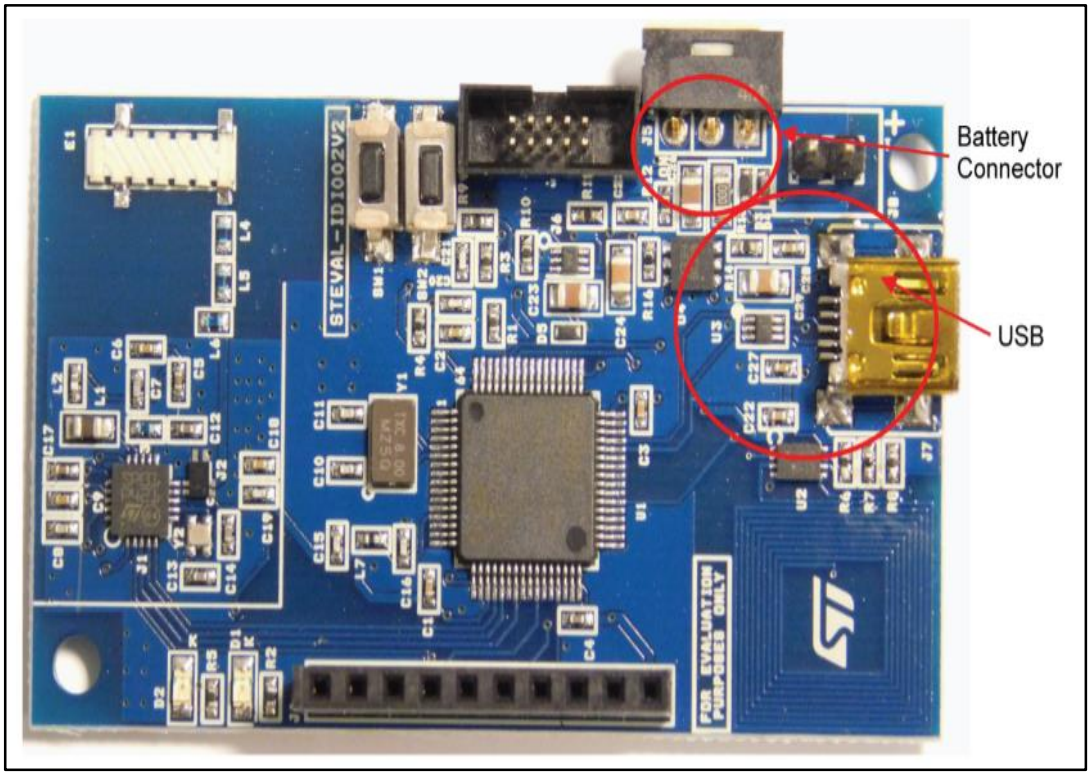
Figure 5: Cortex debug connector



3 Running the evaluation platform

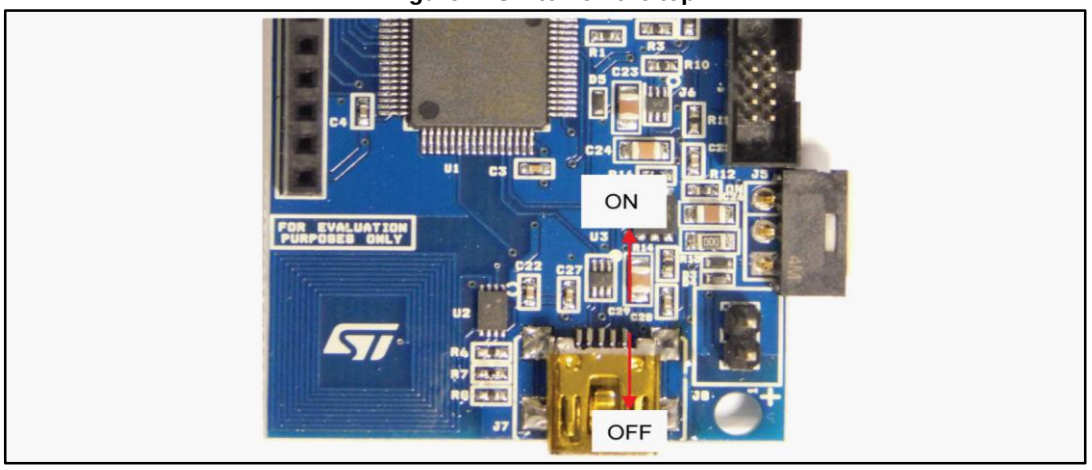
- Now the Multi-sensor RF system needs to be connected together. Connect the STEVAL-IDI002V2 and the STEVAL-IDI003V2 using the 10 pin connector on both boards, as shown in the picture below.
- To power up the Multi-sensor RF system, connect the single cell Li-Ion battery to the board on the correct positive and negative terminals or connect a USB cable to the USB mini-B type connector on the STEVAL-IDI002V2 board.

Figure 6: Battery connector



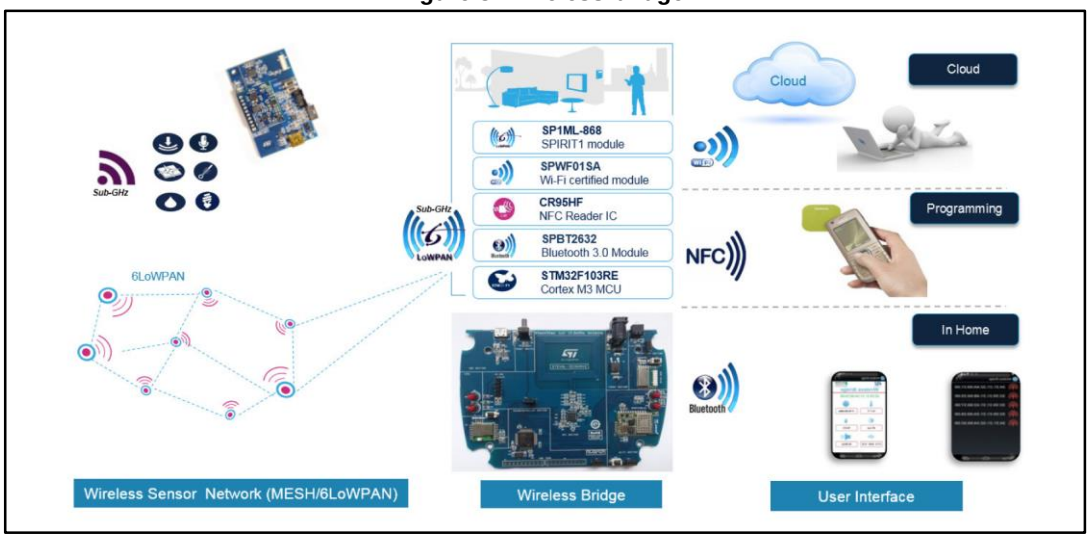
- Start the multi-sensor RF board using the switch on the top right side of the above figure

Figure 7: Switch on the top



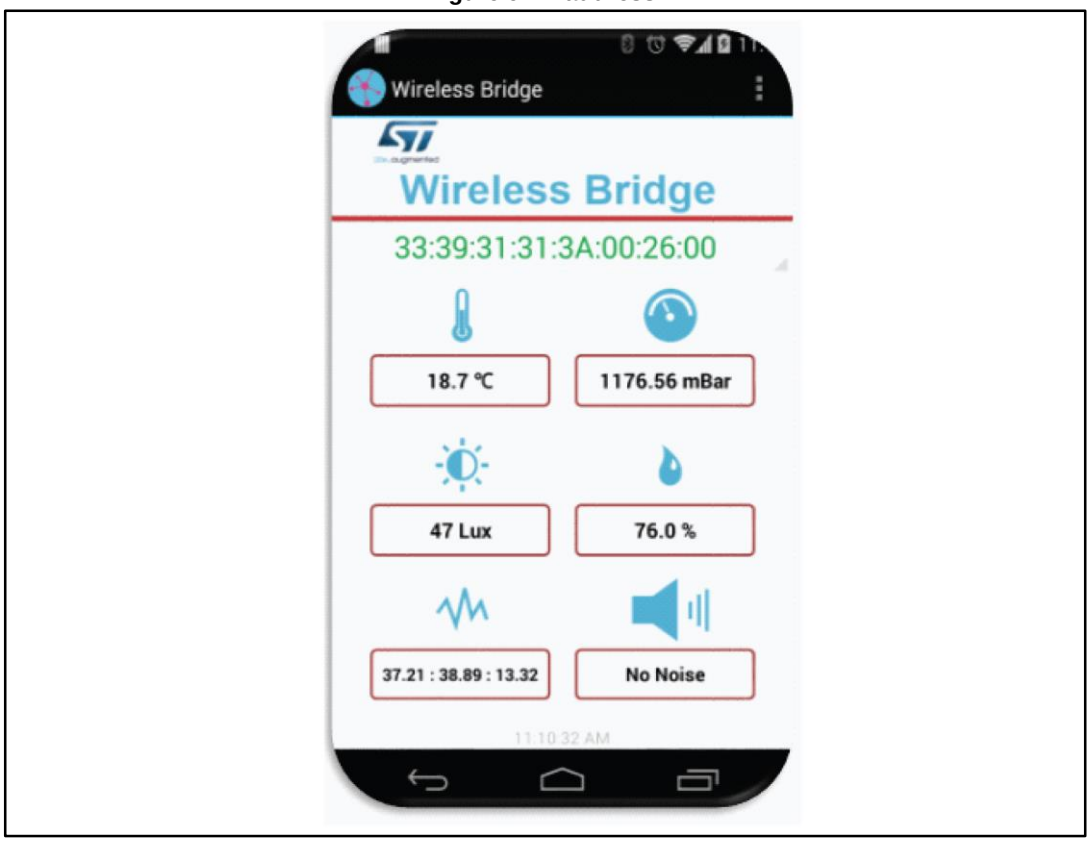
- With respect to the board picture above, switch to the 'ON' condition by moving the switch up.
- The same steps also apply to the other multi-sensor RF board.
- The Red LED on STEVAL-IDI002V2 toggles twice in 4 seconds and then goes ON permanently to indicate the Multi-Sensor RF platform is powered on.
- Once the 6LoWPAN network is formed, the Multisensor-RF platform starts sending data to the STEVAL-IDI004V2.
- The Green LED on the STEVAL-IDI002V2 toggles every time it sends data to the STEVAL- IDI004V2.
- Once the STEVAL- IDI004V2 starts receiving the data from the Multi-Sensor RF platform boards, the Sub GHz led (D5) on the board starts toggling every time it receives a data packet. Note that typically it takes 10-15 seconds to form this network.
- Connect an android phone to the Wireless Bridge device via Bluetooth.
- The Wireless Bridge provides nodes connected with 6LoWPAN and NFC connectivity.
- When the user selects the 6LoWPAN nodes, the application lists the nodes connected to the Wireless Bridge shown in the figure.

Figure 8: Wireless bridge



- The user needs to select a node's IP address to view the sensor values for that node, as shown in the below figure:

Figure 9: IP address



- For each node, the following data is shown.
  - Temperature in °C
  - Pressure in mbar
  - Acceleration for X, Y and Z Axis in m/ sec2
  - Noise status: "Noise Detected" or "No Noise"
  - Brightness in Lux.

4 Schematic diagram (STEVAL-IDI002V2)

Figure 10: STEVAL-IDI002V2 circuit schematic (1 of 6)

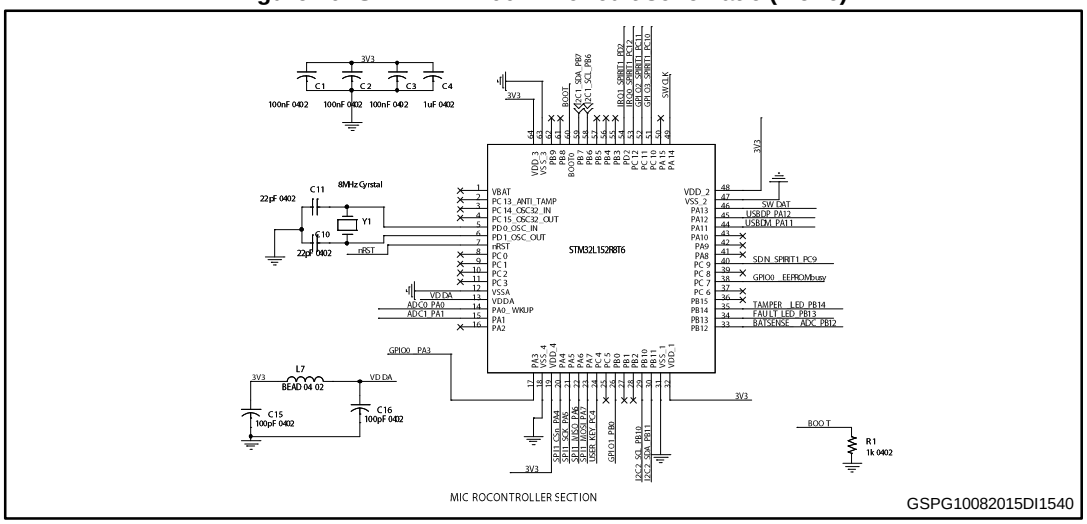


Figure 11: STEVAL-IDI002V2 circuit schematic (2 of 6)

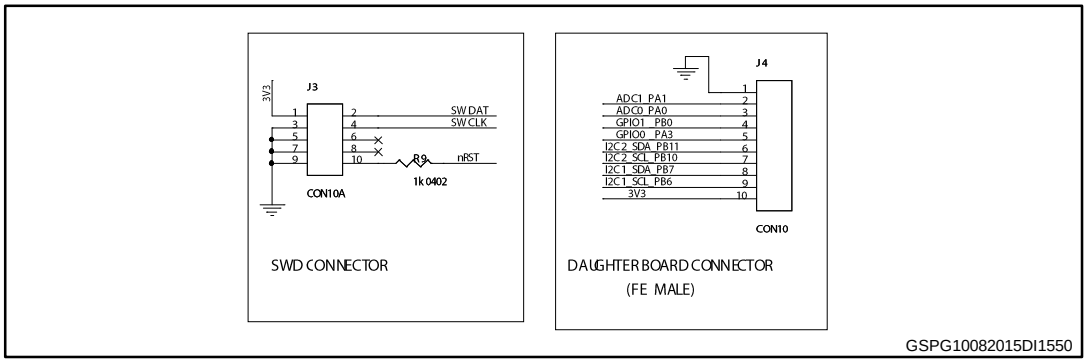


Figure 12: STEVAL-IDI002V2 circuit schematic (3 of 6)

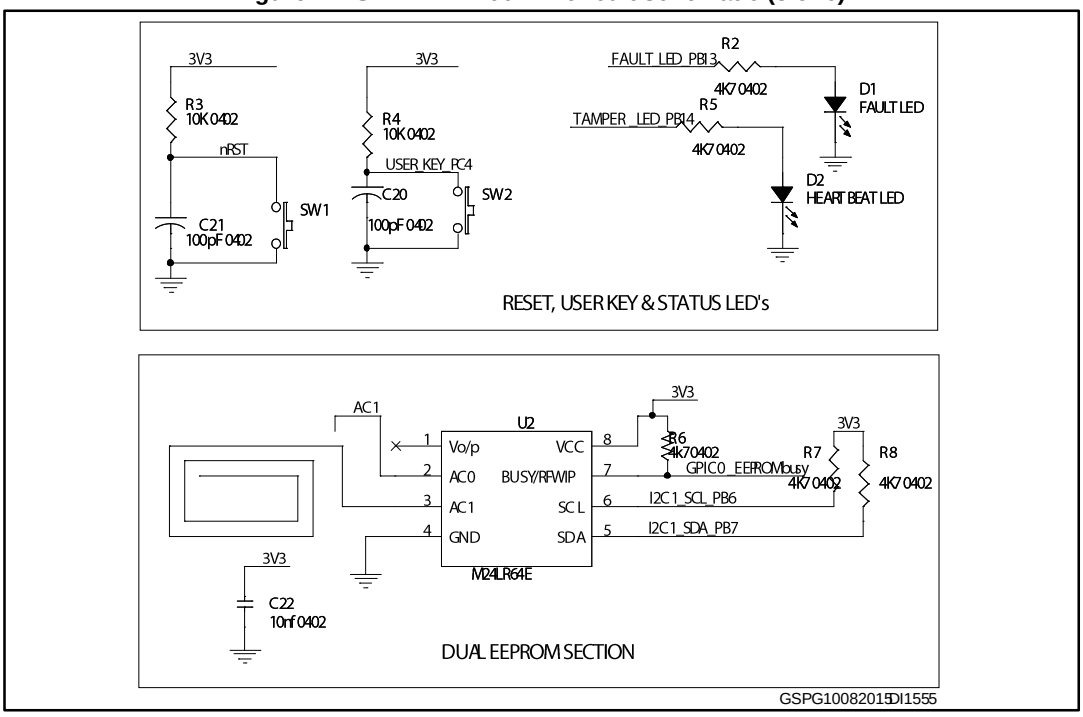


Figure 13: STEVAL-IDI002V2 circuit schematic (4 of 6)

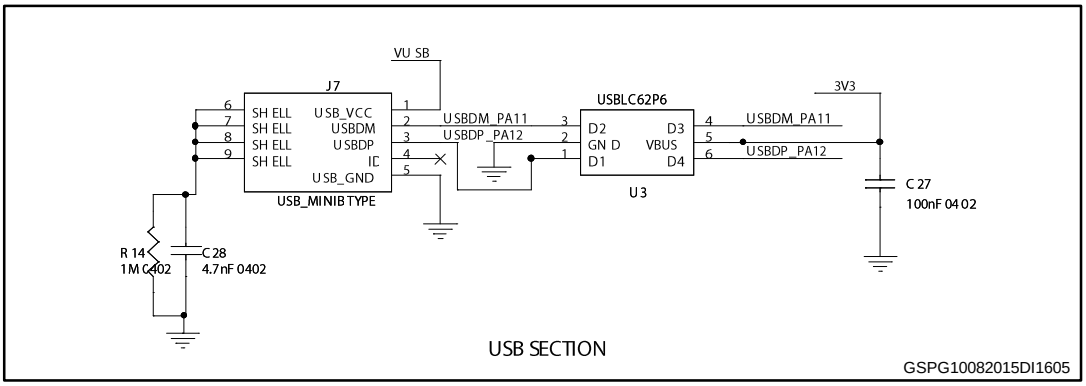


Figure 14: STEVAL-IDI002V2 circuit schematic (5 of 6)

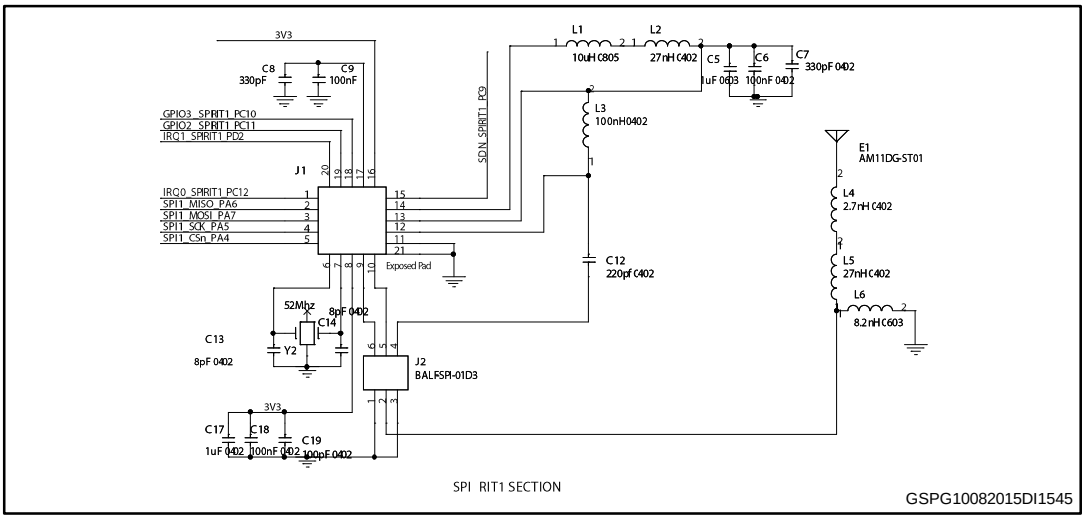
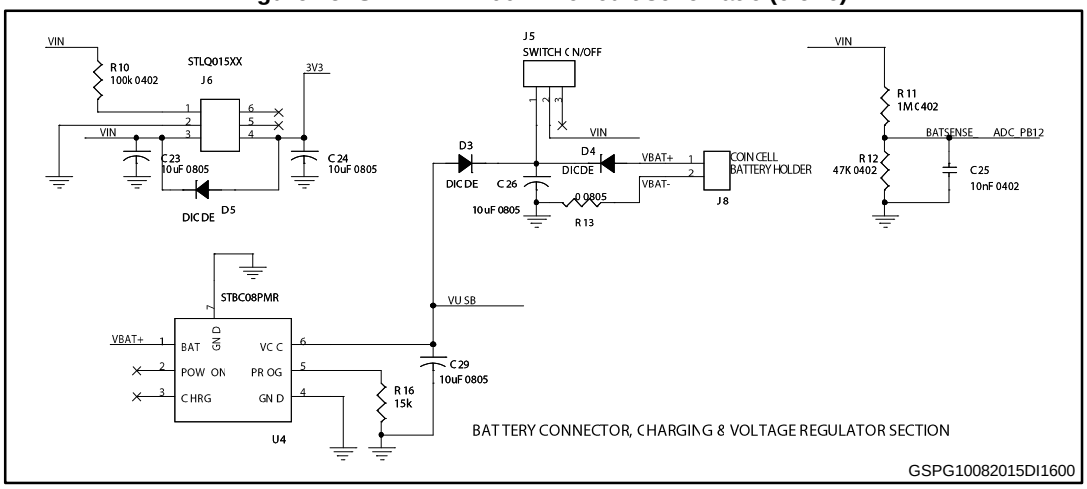


Figure 15: STEVAL-IDI002V2 circuit schematic (6 of 6)



5 Schematic diagram (STEVAL-IDI003V2)

Figure 16: STEVAL-IDI003V2 circuit schematic (1 of 5)

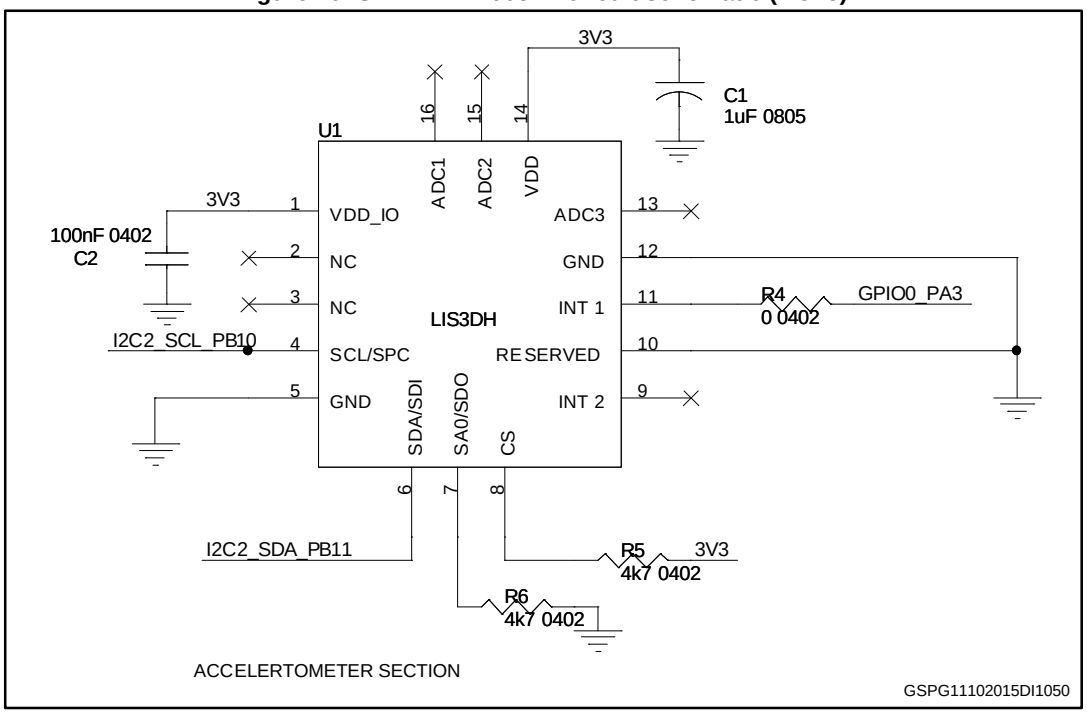


Figure 17: STEVAL-IDI003V2 circuit schematic (2 of 5)

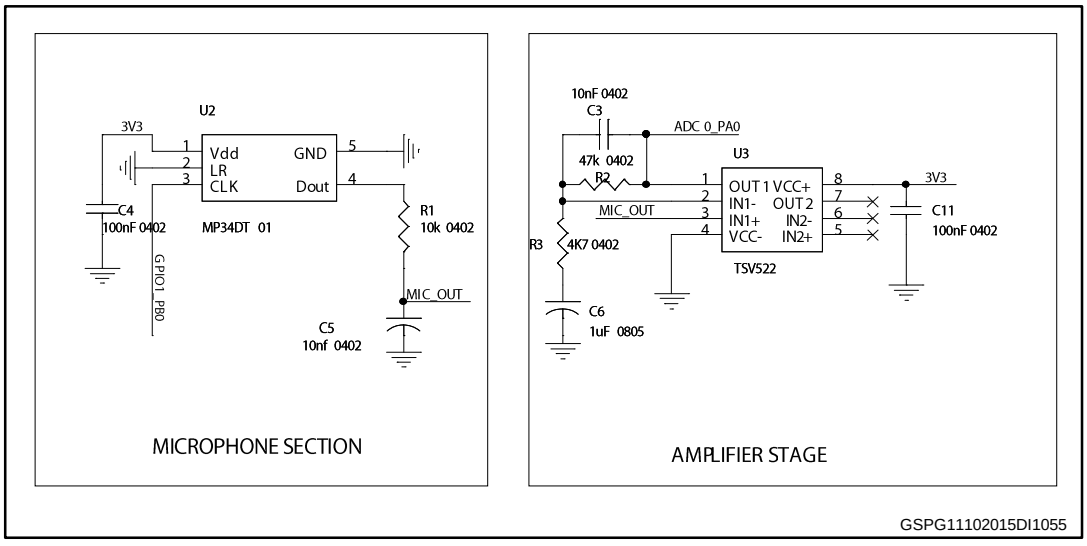


Figure 18: STEVAL-IDI003V2 circuit schematic (3 of 5)

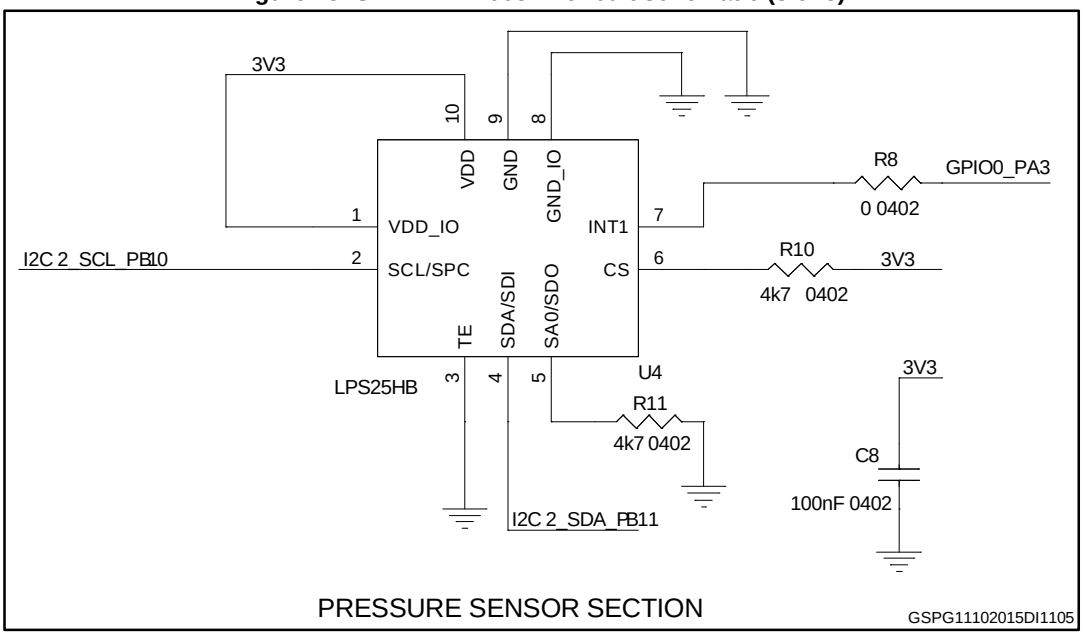


Figure 19: STEVAL-IDI003V2 circuit schematic (4 of 5)

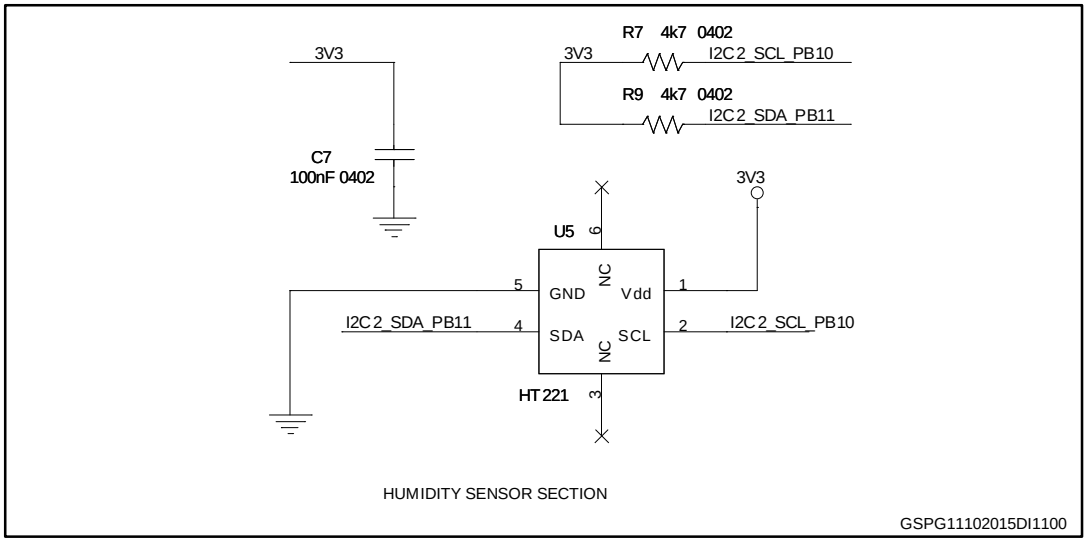
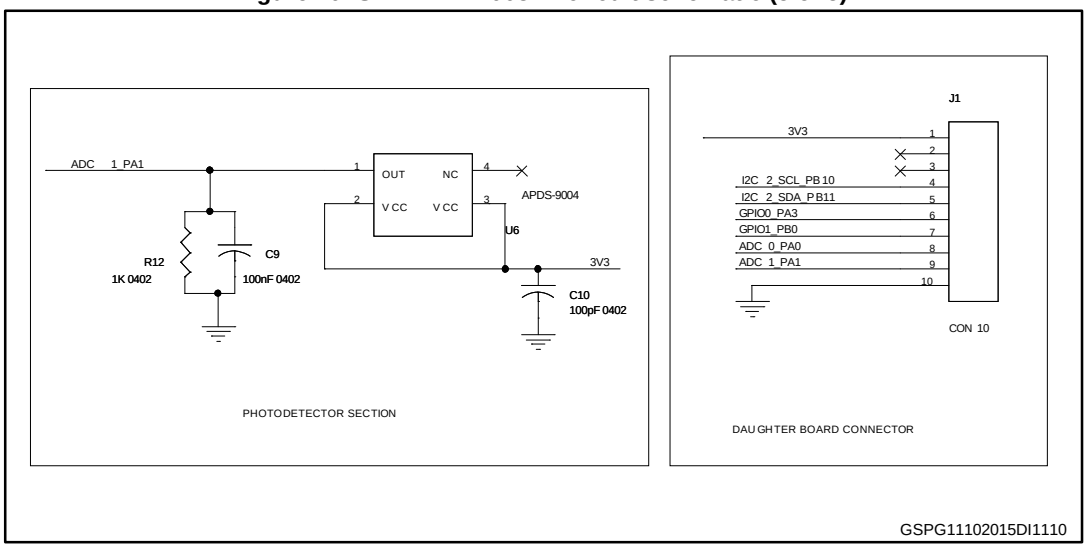


Figure 20: STEVAL-IDI003V2 circuit schematic (5 of 5)



6 Revision history

Table 2: Document revision history

Date	Revision	Changes
11-Dec-2015	1	Initial release.
06-May-2016	2	Updated: *Figure 3: "STEVAL-IDI003V2 board photo"*

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