

Getting started with X-NUCLEO-IDB05A1 BLE expansion board based on the SPBTLE-RF module for STM32 Nucleo

Introduction

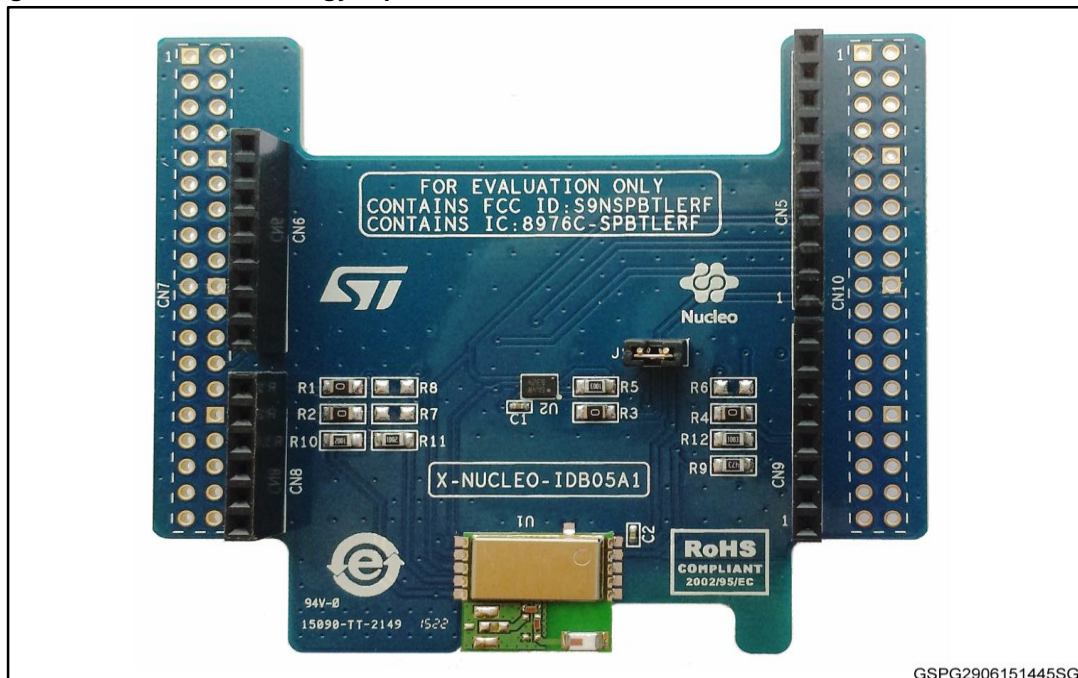
The X-NUCLEO-IDB05A1 is a Bluetooth Low Energy evaluation board based on BlueNRG-MS RF module, SPBTLE-RF, to allow expansion of the STM32 Nucleo boards. The SPBTLE-RF module is FCC (FCC ID: S9NSPBTLERF) and IC certified (IC: 8976C-SPBTLERF). The BlueNRG-MS is a very low power Bluetooth Low Energy (BLE) single-mode network processor, compliant with Bluetooth specification v4.1. X-NUCLEO-IDB05A1 is compatible with the ST Morpho and Arduino UNO R3 connector layout.

This expansion board can be plugged into the Arduino UNO R3 connectors of any STM32 Nucleo board. The user can mount the ST Morpho connectors if required. The different expansion boards can be easily stacked to allow evaluation of different devices with Bluetooth Low Energy connectivity.

The board has the following features:

- On-board SPBTLE-RF module based on the BlueNRG-MS single mode BLE network processor
- SPI EEPROM for parameter saving
- Jumper at 3V3 for checking the current consumption of STM32 expansion board

Figure 1: Bluetooth Low Energy expansion board based on SPBTLE-RF module for STM32 Nucleo



Contents

1	Getting started	3
1.1	Hardware requirements.....	3
1.2	System requirements	3
1.3	Setting up the board.....	4
2	Hardware description	5
2.1	X-NUCLEO-IDB05A1 board.....	5
2.2	SPI and GPIO connection options.....	6
2.3	Current measurement	7
2.4	X-NUCLEO-IDB05A1 component placement.....	7
3	Component description	8
3.1	SPBTLE-RF module.....	8
3.2	SPI EEPROM.....	8
4	Formal notices required by the U.S. Federal Communications Commission ("FCC")	9
5	Formal notices required by the Industry Canada ("IC")	10
6	Hardware schematic diagrams	11
7	Bill of material	13
8	Revision history	15

1 Getting started

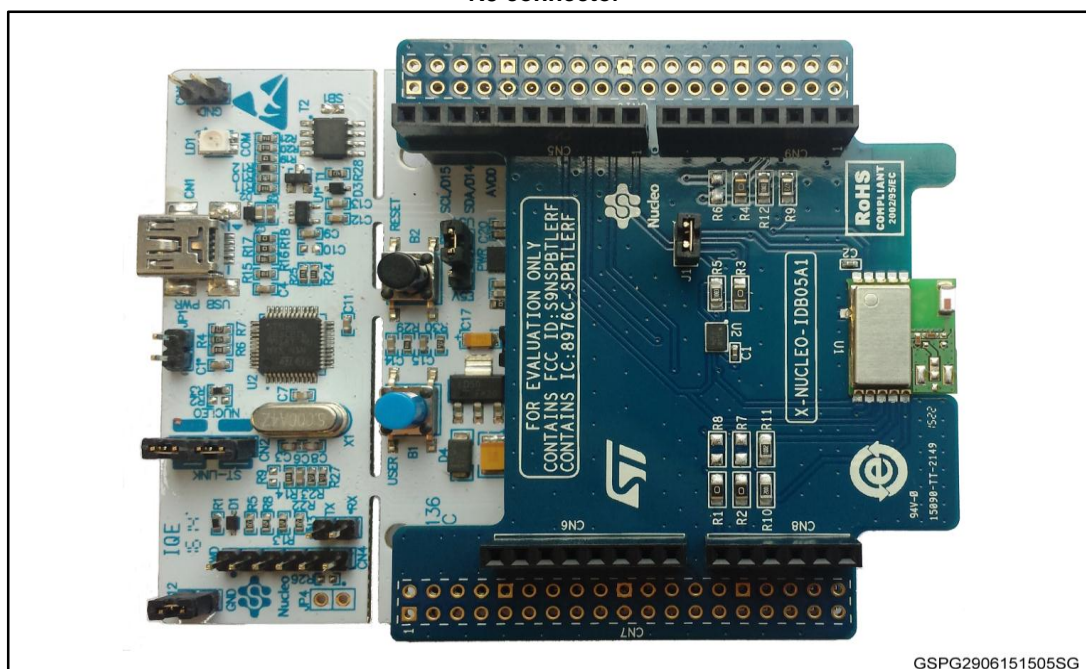
This section describes the hardware requirements for the X-NUCLEO-IDB05A1 evaluation board.

1.1 Hardware requirements

The X-NUCLEO-IDB05A1 is an expansion board for use with STM32 Nucleo boards. To function correctly, the X-NUCLEO-IDB05A1 must be connected to the STM32 Nucleo board as shown in [Figure 2: "X-NUCLEO-IDB05A1 plugged into an STM32 Nucleo board through the Arduino UNO R3 connector"](#) below.

The STM32 Nucleo firmware and related documentation is available at <http://www.st.com/stm32nucleo>

Figure 2: X-NUCLEO-IDB05A1 plugged into an STM32 Nucleo board through the Arduino UNO R3 connector



The interconnection between the STM32 Nucleo and the X-NUCLEO-IDB05A1 has been designed to permit the use of any STM32 Nucleo board, although complete testing has been performed using the NUCLEO-L053R8 hosting the ultra-low power STM32, and the NUCLEO-F401RE hosting the dynamic efficiency STM32.

1.2 System requirements

Using the Nucleo boards with the X-NUCLEO-IDB05A1 expansion board requires the following software and hardware:

- Windows PC (XP, Vista, 7, 8) to install the firmware package
- USB type A to Mini-B USB cable to connect the Nucleo board to the PC

Installation of the board firmware package (order code: X-CUBE-BLE1) and the BlueNRG graphical user interface utility on the user's PC requires the following:

- 128 MB of RAM
- 40 MB of hard disk space

The X-CUBE-BLE1 firmware and related documentation is available on www.st.com

1.3 Setting up the board

To set up the board, perform the following steps:

1. Check that the jumper on the J1 connector is connected. This jumper provides the required voltage to the devices on the board
2. Connect the X-NUCLEO-IDB05A1 on the Nucleo board from the top as shown in [Figure 2: "X-NUCLEO-IDB05A1 plugged into an STM32 Nucleo board through the Arduino UNO R3 connector"](#)
3. Power the Nucleo board using the Mini-B USB cable
4. Program the firmware in the STM32 on the Nucleo board using the firmware example provided
5. Reset the MCU board using the reset button available on the Nucleo board
6. The evaluation kit is ready to be used

2 Hardware description

This section describes the X-NUCLEO-IDB05A1 features and provides information which could be useful to understand the board schematic diagrams.

2.1 X-NUCLEO-IDB05A1 board

The board allows the user to test the functionality of the SPBTLE-RF module. The SPBTLE-RF hosts the BlueNRG-MS, a very low power Bluetooth Low Energy (BLE) single-mode network processor, compliant with Bluetooth specification v4.1. The module also embeds the innovative BALF-NRG-01D3 (balun with integrated harmonic filter) and a chip antenna.

Its functionality can be exploited using the firmware package contained in the X-CUBE-BLE1. It is fundamental to program the microcontroller on the STM32 Nucleo board. Please refer to user manuals UM1724 and UM1725, available on www.st.com.

The SPBTLE-RF module and the STM32 Nucleo board are connected through connectors CN5, CN6, CN8 and CN9 (see [Table 1: "Interconnection between STM32 Nucleo board and X-NUCLEO-IDB05A1 left-side connectors"](#) for details). The pins indicated with an asterisk (*) allow an alternative pin for that specific function, i.e. SPI_IRQ could be moved from CN8.1 to CN5.2.

Table 1: Interconnection between STM32 Nucleo board and X-NUCLEO-IDB05A1 left-side connectors

Signal Name	NC	IOREF	RESET	3V3	5V	GND	GND	VIN		A0	A1	A2	A3	A4	A5
	Left connector														
Connector Name	CN6 Power								CN8 Analog						
Pin#	1	2	3	4	5	6	7	8		1	2	3	4	5	6
NUCLEO-L053R8 (MCU Port)										PA0	PA1	PA4	PB0	PC1/ PB9	PC0/ PB8
X-NUCLEO-IDB05A1 expansion board				3V3		GND	GND			SPI_IRQ (*)	SPI_CSN (*)				

Table 2: Interconnection between STM32 Nucleo board and X-NUCLEO-IDB05A1 right-side connectors

Signal Name	D15	D14	AREF	GND	D13	D12	D11	D10	D9	D8		D7	D6	D5	D4	D3	D2	D1	D0
	Right connector																		
Connector Name	CN5 Digital										CN9 Digital								
Pin#	10	9	8	7	6	5	4	3	2	1		8	7	6	5	4	3	2	1
NUCLEO-L053R8 (MCU Port)	PB8	PB9			PA5	PA6	PA7	PB6	PC7	PA9		PA8	PB10	PB4	PB5	PB3	PA10	PA2	PA3
X-NUCLEO-IDB05A1 expansion board				GND	SPI_CLK (Opt)	SPI_MISO	SPI_MOSI	SPI_CSN (Opt)	SPI_IRQ (Opt)	SPI_EEPROM_nS		BlueNRG_RST				SPI_CLK(*)			



Opt = Optional connection.

2.2 SPI and GPIO connection options

Table 3: "BlueNRG-MS interface (optional) with the STM32 Nucleo board" shows the SPI and GPIO connection options between the STM32 and BlueNRG-MS hosted on the SPBTLE-RF module. These can be used for operation of the board in different configurations in cases where different expansion boards are utilized and there is a conflict of signals.

Table 3: BlueNRG-MS interface (optional) with the STM32 Nucleo board

BlueNRG-MS Signal	SPBTLE-RF Pin	Default STM32 port	Optional STM32 port
BlueNRG-MS_IRQ	4 – SPI_IRQ	PA0	PC7 To use optional connection mount R8, demount R1

BlueNRG-MS Signal	SPBTLE-RF Pin	Default STM32 port	Optional STM32 port
BlueNRG-MS_CS _n	10 – SPI_CS	PA1	PB6 To use optional connection mount R7, demount R2
BlueNRG-MS_SCLK	7 – SPI_CLK	PB3	PA5 To use optional connection mount R6, demount R4

Refer to the schematic diagrams for details.

For the optional connections, modify the firmware for the correct use of the STM32 resources to be used.

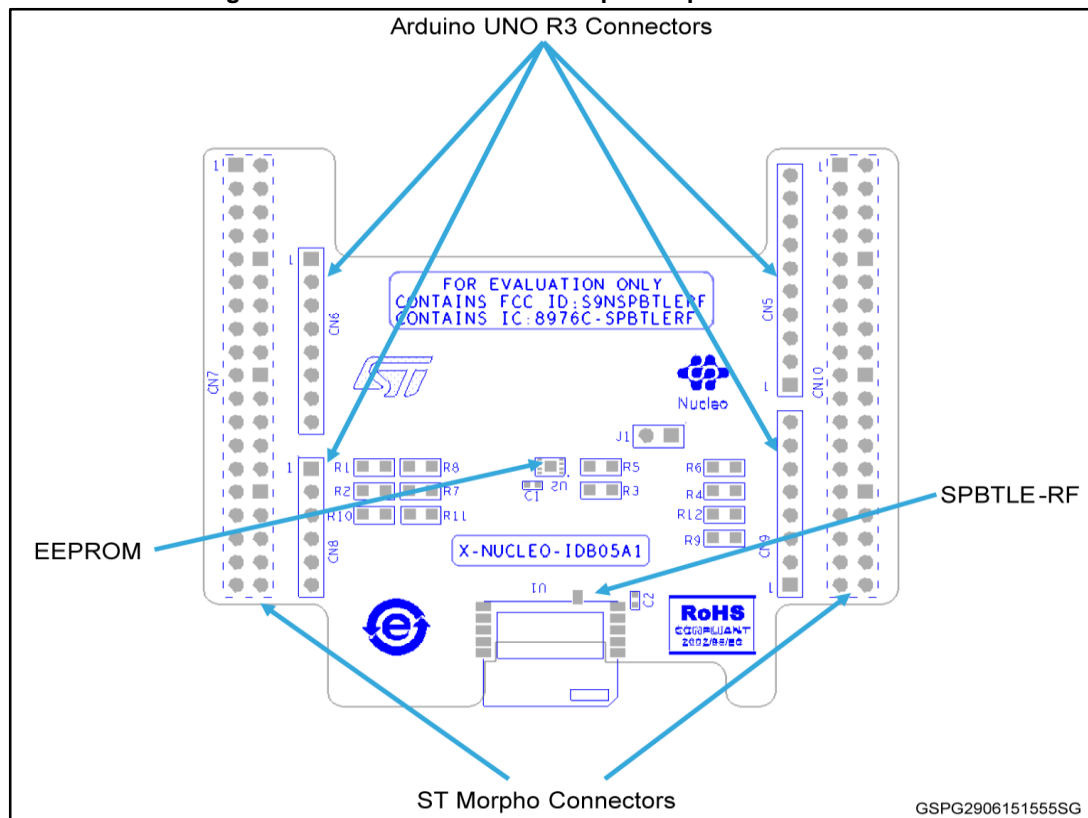
2.3 Current measurement

To monitor the power consumption of the BlueNRG-MS X-NUCLEO-IDB05A1 board, insert an ammeter probe between pins 1 and 2 of the jumper on the J1 connector. Since the power consumption of BlueNRG-MS is very low during most of its operating time, an accurate instrument in the range of a few μ A may be required.

2.4 X-NUCLEO-IDB05A1 component placement

The following diagram shows the component placement on the X-NUCLEO-IDB05A1 board.

Figure 3: X-NUCLEO-IDB05A1 component placement details



3 Component description

The board has the following devices.

3.1 SPBTLE-RF module

The SPBTLE-RF is an easy-to-use Bluetooth Low Energy module. It is based on the BlueNRG-MS device, which is a very low power Bluetooth Low Energy (BLE) single-mode network processor, compliant with Bluetooth specification v4.1. The SPBTLE-RF has the following certifications:

- FCC (FCC ID: S9NSPBTLERF)
- IC (IC: 8976C-SPBTLERF)

The interface of the device to the STM32 Nucleo boards is through SPI interface and GPIOs.

The SPBTLE-RF integrates a balun BALF-NRG-01D3 and a chip antenna. It embeds 32 MHz and 32.768 kHz crystal oscillators for the BlueNRG-MS.

The part numbers used to develop this application are shown in [Table 4: "SPBTLE-RF details"](#).

Table 4: SPBTLE-RF details

Feature	Description
Sales type	SPBTLE-RF
Package	SMD 11 pin
Operating voltage	2 to 3.6 V

3.2 SPI EEPROM

The M95640-R is a 64 Kbit serial SPI bus EEPROM with high-speed clock interface. The device can be used to store the configuration parameters related to applications or settings of the SPBTLE-RF module

The part numbers used to develop this application are shown in [Table 5: "SPI EEPROM details"](#).

Table 5: SPI EEPROM details

Feature	Description
Sales type	M95640-RMC6TG
Package	MLP8
Operating voltage	1.8 to 5.5 V

4 Formal notices required by the U.S. Federal Communications Commission ("FCC")

Any changes or modifications to this equipment not expressly approved by STMicroelectronics may cause harmful interference and void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including any interference that may cause undesired operation.

This device uses, generates and radiated radio frequency energy. The radio frequency energy produced by this device is well below the maximum exposure allows by Federal Communications Commission (FCC).

The X-NUCLEO-IDB05A1 contains FCC certified module SPBTLE-RF (FCC ID: S9NSPBTLERF).

5 Formal notices required by the Industry Canada ("IC")

English:

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

French:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

The X-NUCLEO-IDB05A1 contains IC certified module SPBTLE-RF (IC: 8976C-SPBTLERF).

6 Hardware schematic diagrams

Figure 4: Nucleo connectors

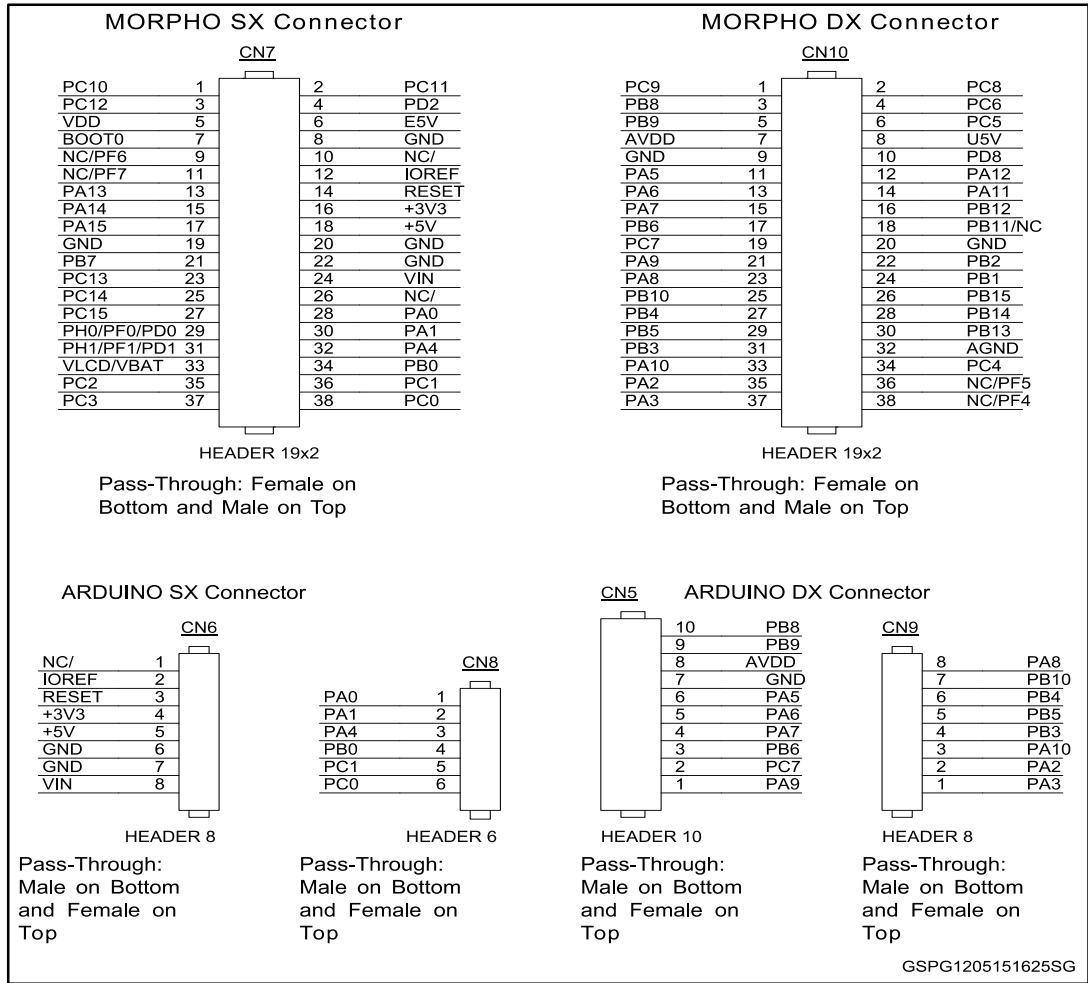


Figure 5: SPBTLE-RF

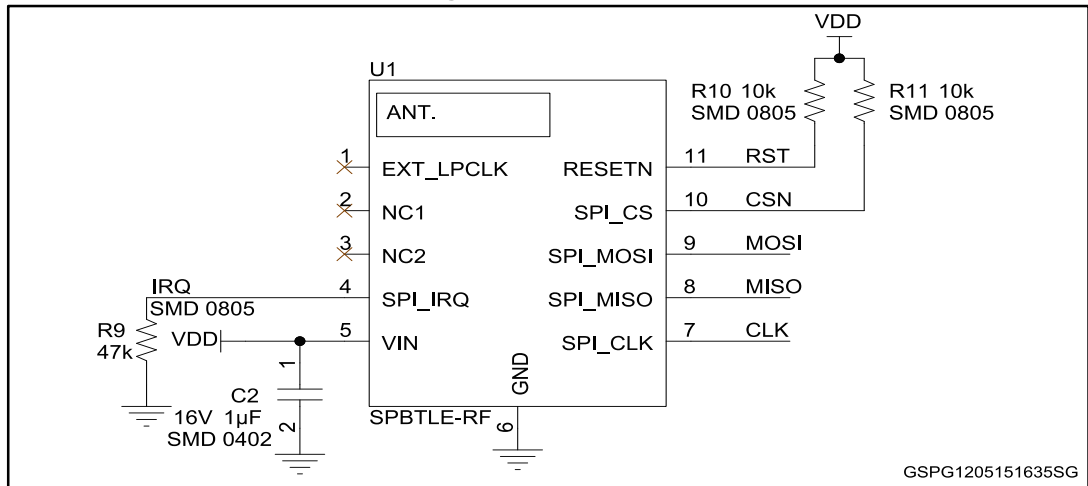


Figure 6: Nucleo connections

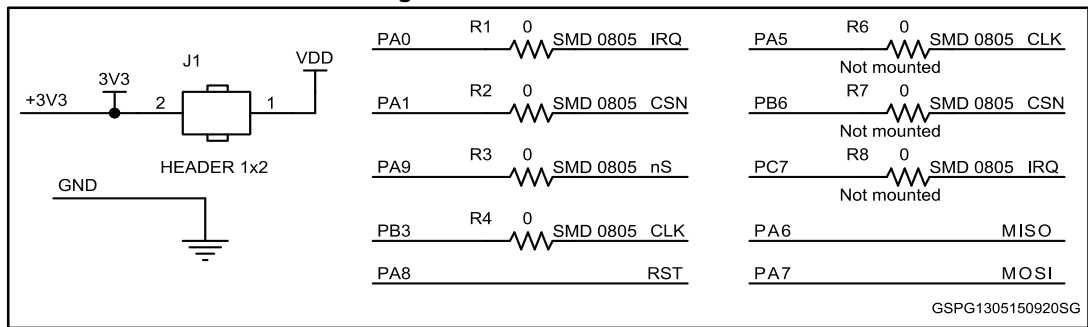
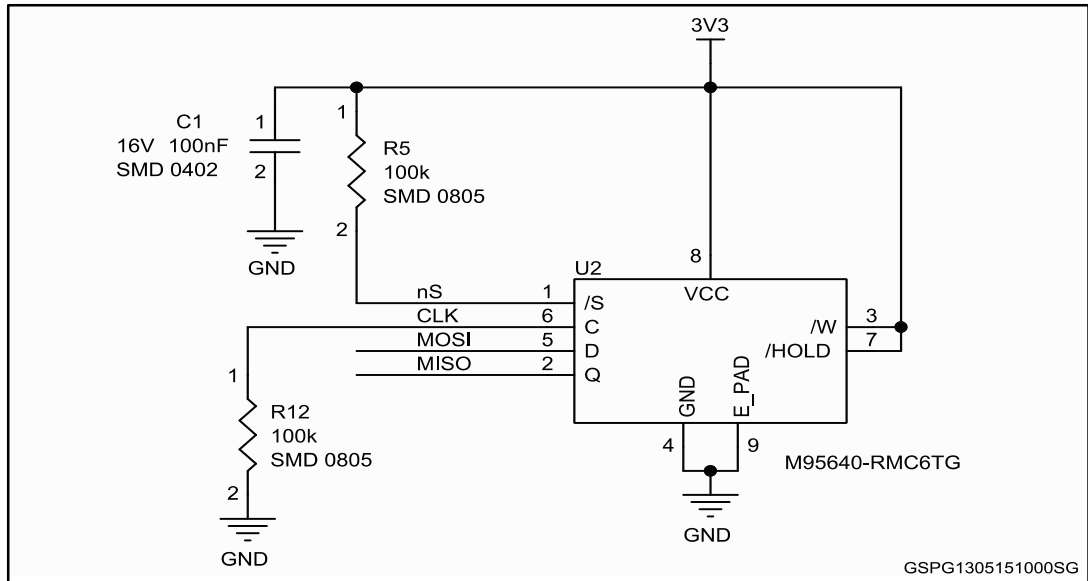


Figure 7: EEPROM



7 Bill of material

Table 6: BOM list (part 1)

Item	Q.ty	Reference	Part/Value	Type/Additional notes	Tolerance
1	1	CN5	Arduino connector CN5 10 pins		
2	2	CN6, CN9	Arduino connectors CN6 and CN9 8 pins		
3	2	CN7, CN10	MORPHO connectors CN7 and CN10 38 pins	Not mounted	
4	1	CN8	Arduino connector CN8 6 pins		
5	1	C1	100 nF 16 V	Ceramic X7R	± 10%
6	1	C2	1 µF 16 V	Ceramic X5R	± 10%
7	1	J1	Jumper		
8	7	R1, R2, R3, R4, R6, R7, R8	0	R6, R7, R8 not mounted	± 1%
9	2	R5, R12	100 k		± 1%
10	1	R9	47 k		± 1%
11	2	R10, R11	10 k		± 1%
12	1	U1	SPBTLE-RF		
13	1	U2	M95640-RMC6TG		

Table 7: BOM list (Part 2)

Item	Package	Manufacturer	Manuf. order code part number	Supplier	Supplier's order code
1	Pass-through: male on bottom, female on top. 10x1 2.54 mm pitch	SAMTEC	SSQ-110-03-F-S	Farnell	2283783
2	Pass-through: male on bottom, female on top. 8x1 2.54 mm pitch	SAMTEC	SSQ-108-03-F-S	Farnell	2283782
3	Pass-through: female on bottom, male on top. 19x2 2.54 mm pitch				
4	Pass-through: male on bottom, female on top. 6x1 2.54 mm pitch	SAMTEC	SSQ-106-03-G-S	Farnell	2283759
5	SMD 0402	Murata	GRM155R71C104KA88		
6	SMD 0402	TDK	C1005X5R1C105K050BC	Farnell	2112701
7	Through hole 26x1 2.54 mm pitch	ANY	ANY		
8	SMD 0805	ANY	ANY		
9	SMD 0805	ANY	ANY		

Bill of material**UM1912**

Item	Package	Manufacturer	Manuf. order code part number	Supplier	Supplier's order code
10	SMD 0805	ANY	ANY		
11	SMD 0805	ANY	ANY		
12	SMD 11 pins	ST	SPBTLE-RF	ST SUPPLY	SPBTLE-RF
13	UFDFPN8 (MLP8)	ST	M95640-RMC6TG	ST SUPPLY	M95640-RMC6TG

8 Revision history

Table 8: Document revision history

Date	Revision	Changes
21-Jul-2015	1	Initial release.

IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2015 STMicroelectronics – All rights reserved