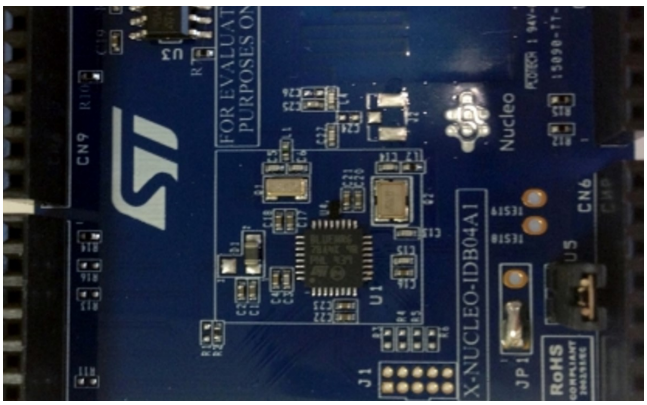


ST UM2667 BlueNRG-M2SP module User Manual

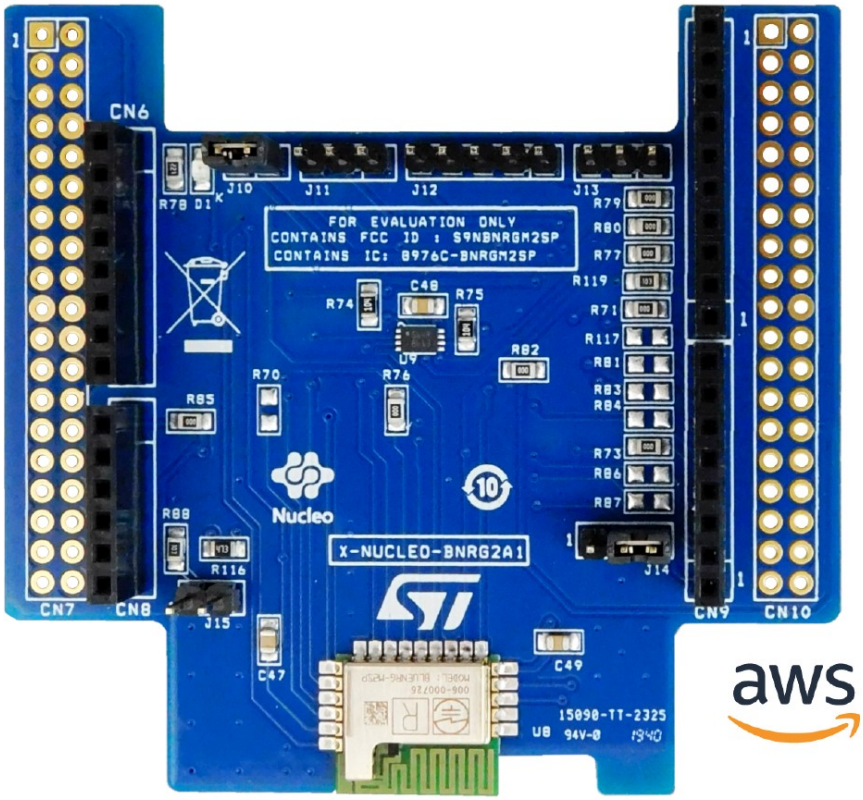
Contents

ST UM2667 BlueNRG-M2SP module

Introduction

The X-NUCLEO-BNRG2A1 expansion board provides Bluetooth low energy connectivity for developer applications and can be plugged onto an STM32 Nucleo development board (e.g., NUCLEO-L476RG with ultra-low power STM32 microcontroller) through its Arduino UNO R3 connectors.
The expansion board features the Bluetooth® v5.2 compliant and FCC certified BlueNRG-M2SP application processor module based on the ST BlueNRG-2 System-on-Chip. This SoC manages the complete Bluetooth low energy stack and protocols on its Cortex-M0 core and programmable Flash, which can accommodate custom applications developed using the SDK. The BlueNRG-M2SP module supports master and slave modes, increased transfer rates with data length extension (DLE), and AES-128 security encryption.
The X-NUCLEO-BNRG2A1 interfaces with the STM32 Nucleo microcontroller via SPI connections and GPIO pins, some of which can be configured by the hardware.

X-NUCLEO-BNRG2A1 expansion board



aws qualified device FreeRTOS

Typical Applications

The X-NUCLEO-BNRG2A1 expansion board can be used for the evaluation of the BlueNRG-M2 device in many applications, such as:

- point-to-point communication
- sensor application
- home automation and lighting
- direct test mode (DTM)

Acronyms and Abbreviations

List of Acronyms

Acronym	Description
EEPROM	Electrically erasable programmable read only memory
GHz	Giga Hertz
GUI	Graphical user interface
LED	Light emitting diode
MCU	Microcontroller unit
P2P	Point-to-point communication
RF	Radio frequency communication
SPI	Serial peripheral interface
SWD	Serial wire debug

Getting Started

Overview

The X-NUCLEO-BNRG2A1 expansion board main features are:

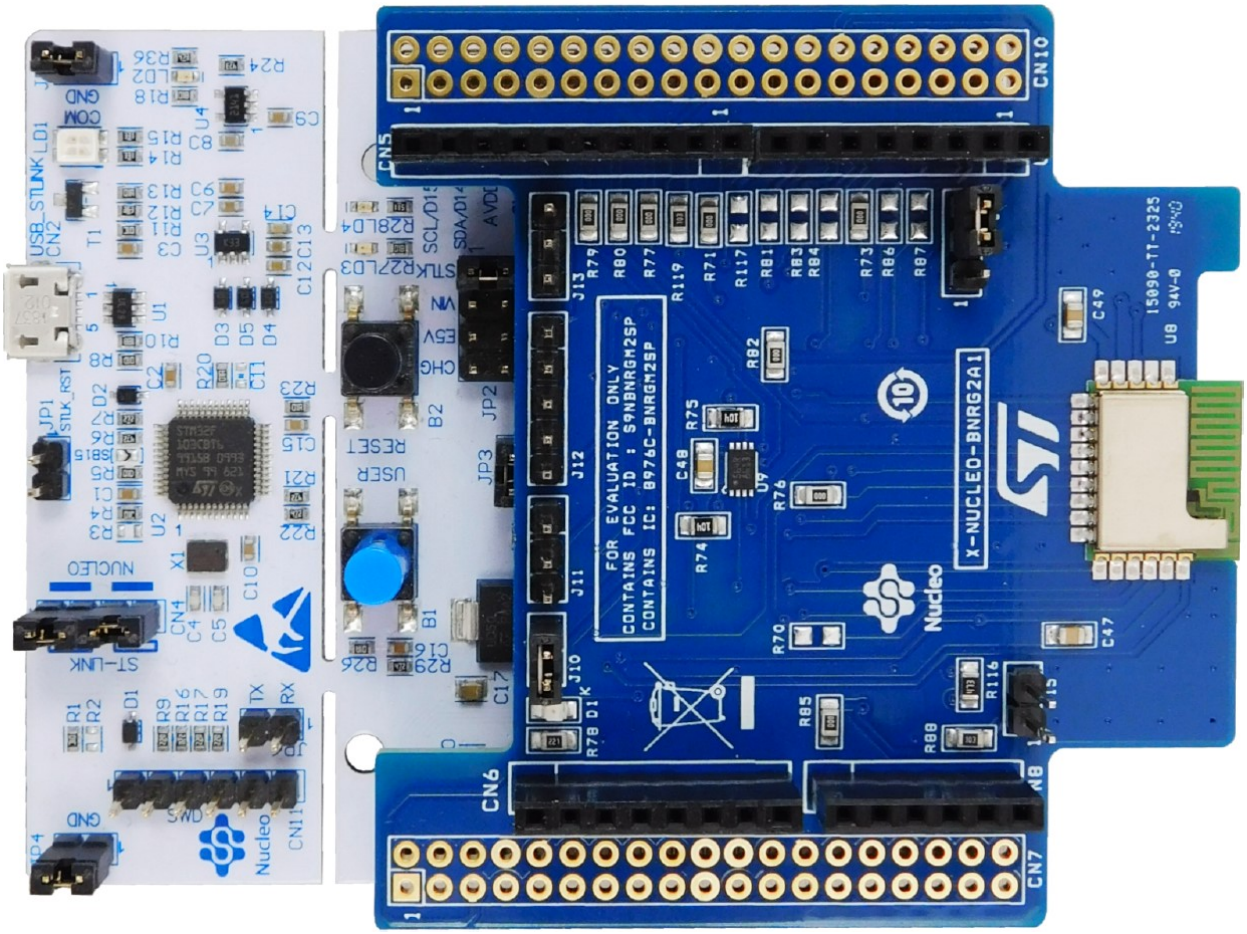
- Based on the BlueNRG-M2SP module FCC certified module (FCC ID: S9NBNRGM2SP and IC: B976C-BNRGM2SP)
- Compatible with STM32 Nucleo boards
- Equipped with Arduino UNO R3 connector
- Amazon AWS qualified
- Scalable solution, capable of cascading multiple boards for larger systems
- Free comprehensive development firmware library and examples for BlueNRG-2 compatible with STM32Cube
- BlueNRG-M2SP:
    - Bluetooth v5.2 compliant
    - Supports master and slave modes

    - BLE data packet length extension
    - Embedded BALF-NRG-02D3 integrated matched balun with harmonic filter
- Interfaces:
    - 1 UART, 1 I²C, 1 SPI, 14 GPIOs, 2 multifunction timers, 10-bit ADC, Watchdog & RTC, DMA controller, PDM stream processor, SWD debug interface
- Small form factor: 11.5mmx13.5mm
- Complemented with Bluetooth low energy protocol stack library (GAP, GATT, SM, L2CAP, LL)
- AES security co-processor
- Bluetooth low energy SDK with a wide range of profiles
- Embedded BlueNRG-2 BLE SoC:
    - High performance, ultra-low power Cortex-M0 32-bit based core
    - Programmable embedded 256 KB Flash
    - 24 KB embedded RAM with data retention
    - Up to +8 dBm available output power
    - Down to -88 dBm Rx sensitivity
    - Up to 96 dB link budget with excellent link reliability

Hardware and Software Requirements

To use STM32 Nucleo development boards with the X-NUCLEO-BNRG2A1 expansion board, connect the boards as shown below.

X-NUCLEO-BNRG2A1 expansion board connected to an STM32 Nucleo development board



The X-NUCLEO-BNRG2A1 can be connected to any STM32 Nucleo development board. The following software and hardware specifications are required:

- a PC/laptop with Microsoft Windows (7 and above) to install the software package (X-CUBE-BLE2).
- DTM project to be flashed in the module
- a type A USB to mini-B USB cable to connect the STM32 Nucleo to the PC/laptop
- a 5-pin connector programming wire to program the X-NUCLEO-BNRG2A1 using the STM32 Nucleo

Board Setup

- **Step 01:** Check that the jumper on J10 connector is connected to provide the required voltage to the board devices.
- **Step 02:** Connect the X-NUCLEO-BNRG2A1 to the STM32 Nucleo board as shown in Figure 2.
- **Step 03:** Connect jumper J14 to select the SPI clock for the SPI.
- **Step 04:** Program the STM32 Nucleo with the corresponding firmware to use the X-NUCLEO-BNRG2A1 as a network coprocessor.

The evaluation kit is ready-to-use.

Hardware Description and Configuration

Interconnection Details

The X-NUCLEO-BNRG2A1 expansion board and the NUCLEO-L476RG development board connection details are listed in the table below.
X-NUCLEO-BNRG2A1 and NUCLEO-L476RG connection details (left connector)

Signal name													
NC	IOREF	RESET	+3V3	+5 V	GND	GNDS	VIN	A0	A1	A2	A3	A4	A5
Connector name													
CN6 Power								CN8 Analog					
Pin number													
1	2	3	4	5	6	7	8	1	2	3	4	5	6
NUCLEO-L476RG MCU port													
								PA0	PA1	PA4	PB0	PC1	PC0
X-NUCLEO-BNRG2A1 expansion board signals													
NC	IOREF	RESET	+3V3	+5 V	GND	GND	VIN	DIO7 / BOOT	DIO1 / SPI_CS	–	–	–	–

X-NUCLEO-BNRG2A1 and NUCLEO-L476RG connection details (right connector)

Signal name																
D15	D14	–	–	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Connector name																
CN5 Digital										CN9 Digital						
Pin number																
10	9	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
NUCLEO-L476RG MCU port																
PB8	PB9	AVDD	GND	PA5	PA6	PA7	PB6	PC7	PA9	PA8	PB10	PB4	PB5	PB3	PA10	PA2	PA3
X-NUCLEO-BNRG2A1 expansion board signals																
–	–	AREF	GND	DIO0/ SPI_CLK	DIO2	DIO3	–	–	DIO4	–	DIO6	DIO12	DIO14	DIO0/ SPI_CLK	DIO5	DIO11 / SPI_CS	DIO8

Note:

- To use PA1 as SPI_CS with DIO1 mount resistor R70.
- To use PA1 as SPI_CS with DIO11 mount resistor R76.
- To use PA2 as SPI_CS with DIO11 mount resistor R86.
- To take control of RESET in the STM32 application with PA8, mount resistor R117.

SPI and GPIO Connection Options

The SPI and GPIO connection options between the STM32 Nucleo and BlueNRG-M2 on the X-NUCLEO-BNRG2A1 expansion board can be used to enable different configurations in case a signal conflict occurs when using other expansion boards.

X-NUCLEO-BNRG2A1 interface with STM32 Nucleo development board

X-NUCLEO-BNRG2A1	BlueNRG-M2SP	Default STM32 port	Optional STM32 port
PA0_SPI_IRQ_PB14_BNRG1BOOT	DIO7/BOOT	PA0(1) PB14(2)	–
DIO1_SPI_CS	DIO1	PA1	–
DIO11_SPI_CS	DIO11	PA1	PA2 To use the optional port, mount R86 and unmount R76
SPI_CLK	DIO0	PA5 JP14: pins 1-2 shorted	PB3 To use the optional port, short J14 pins 2 and 3

1. To use PA0 for another purpose (for example, to plug another shield that uses PA0), unsolder R85.
2. To use PB14, physically connect PB14 of the X-NUCLEO-BNRG2A1 to PB14 of the Nucleo-64 development board and change the code from STM32CubeMX so that it uses PB14 instead of PA0. This requires:
    - to assign pin PB14 to GPIO_EXTI14
    - to enable interrupts for “EXTI Line[15:10]” in NVIC
    - to set “Exti Line” to PB14 in the BlueNRG-M2SP software package

X-NUCLEO-BNRG2A1 jumpers

Jumper	Signals	Description
J10	3.3 V	Power connector
J11		User application
J12	SWD	For SWD debugging/programming
J13		User application
J14	SPI_CLK	To select the SPI clock pin PA5 or PB3 Default: pins 1-2 shorted
J15	PA0_SPI_IRQ_PB14_BNRG1BOOT	This jumper is connected to DIO7 of the BlueNRG-2 and must be shorted for boot pin high. DIO7 can be used for Bootloader activation.

Current Measurement

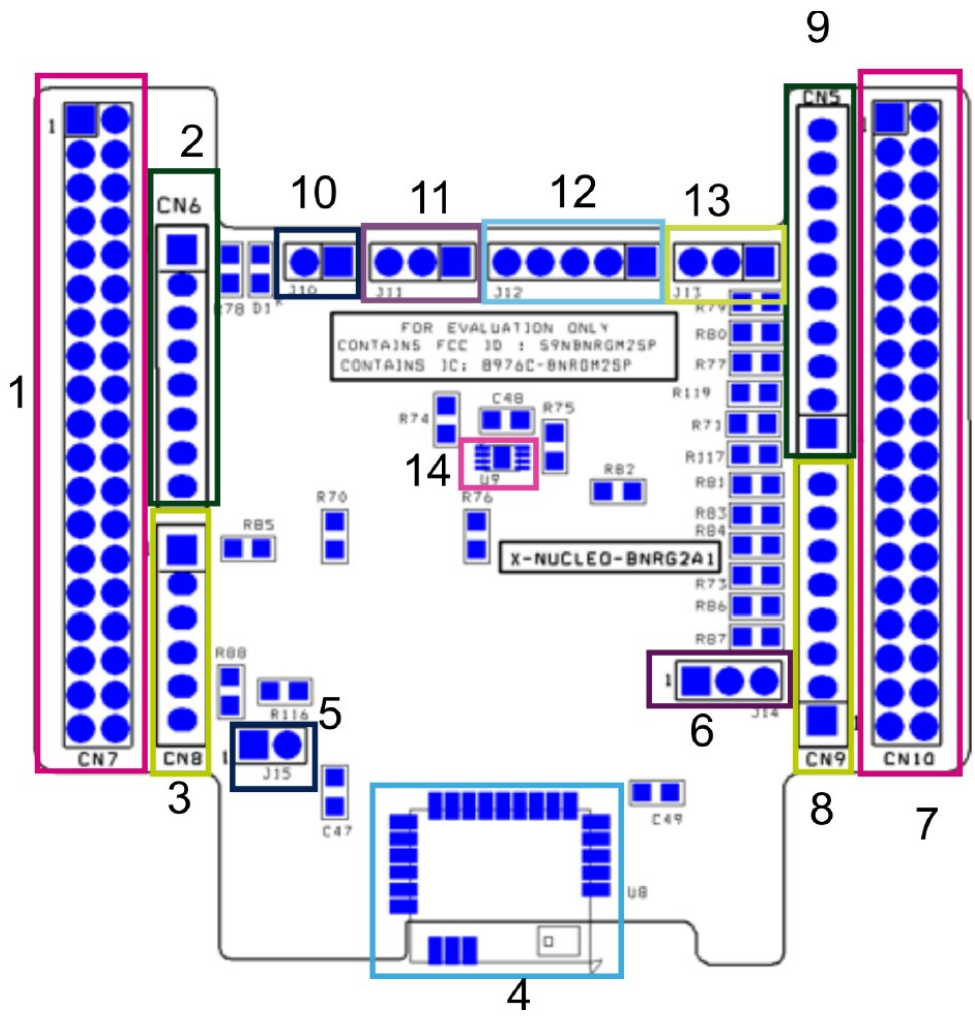
To monitor the X-NUCLEO-BNRG2A1 expansion board power consumption, insert an ammeter probe between pin 1 and 2 of the jumper J10 connector.

X-NUCLEO-BNRG2A1 Component Placement Details

The figure below shows the component placement on the X-NUCLEO-BNRG2A1 expansion board.

X-NUCLEO-BNRG2A1 on-board Device Placement

1. ST morpho connector (not mounted by default)
2. Arduino UNO R3 connector
3. Arduino UNO R3 connector
4. BlueNRG-M2SP
5. J15 – boot pin jumper
6. J14 – SPI_CLK select jumper
7. ST morpho connector (not mounted by default)
8. Arduino UNO R3 connector
9. Arduino UNO R3 connector
10. J10 – power jumper
11. J11 – user application jumper
12. J12 – SWD jumper
13. J11 – user application jumper



X-NUCLEO-BNRG2A1 on-board Device Description

BlueNRG-M2SP Module

The BlueNRG-M2SP is a Bluetooth® low Energy System-on-Chip application processor certified module (FCC ID: S9NBNRGM2SP, IC ID: 8976C-BNRGM2SP), compliant with BT specifications v5.2 and BQE qualified. The module supports multiple roles simultaneously and can simultaneously act as a Bluetooth Smart master and slave device.
The BlueNRG-M2SP is based on BlueNRG-2 System-on-Chip and includes Bluetooth Low Energy stack and protocols.
The device interfaces with STM32 Nucleo boards through SPI and GPIOs.

BlueNRG-M2SP device details

Description	Features
BlueNRG-M2SP	Order code
SMD 23 pin	Package
1.7- 3.6 V	Operating Voltage

SPI EEPROM

The M95640-RMC6TG 64 Kbit serial SPI bus EEPROM with high-speed clock interface can be mounted on the X-NUCLEO-BNRG2A1 expansion board.
It can be used to store the configuration parameters related to application or settings of the BlueNRG-2 RF device.
Its main features are:

- Compatible with the Serial Peripheral Interface (SPI) bus
- Memory array – 64 Kb (8 Kbytes) of EEPROM – Page size: 32 bytes
- Write (byte write within 5 ms, page write within 5 ms)
- Additional Write lockable page (identification page)
- Write Protect: quarter, half or whole memory array
- High-speed clock: 20 MHz

M95640-RMC6TG connection with NUCLEO-L476RG development board

M95640-RMC6TG EEPROM	NUCLEO-L476RG	Pin no.	Connector name	Signal name
D (PA7_SPI_MOSI)	PA7	4	CN5	D11
Q(PA6_SPI_MISO)	PA6	5	CN5	D12
C(SPI_CLK)	PB3/PA5	4/6	CN9/CN5	D3/D13
/S(PB6_SPI_CSN)	PB6	3	CN5	D10

Note:

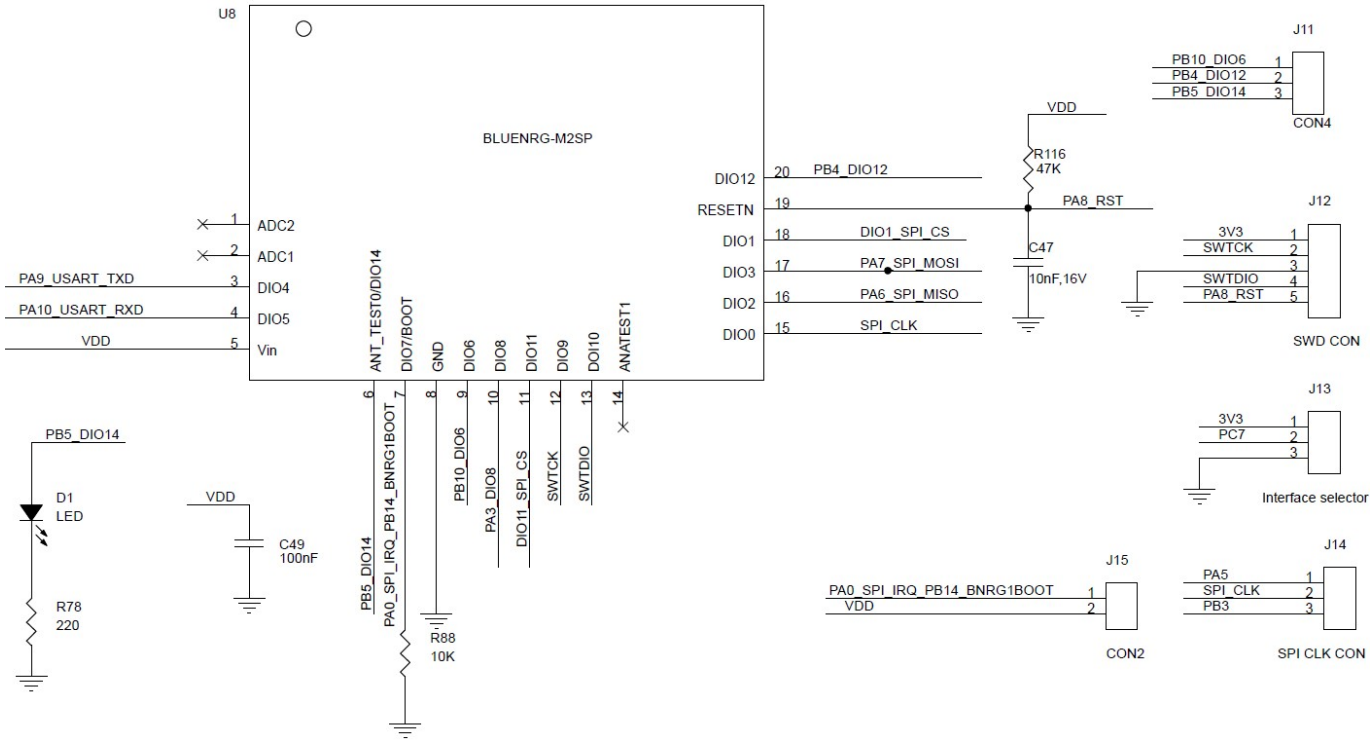
- The SPI EEPROM IC is not mounted on the board.
- To use PB3 or PA5 with C(SPI_CLK), select jumper J14.
- To use PB6 as SPI_CSN, mount resistor R77.

M95640-RMC6TG device details

Description	Features
M95640-RMC6TG	Order code
MLP8	Package
1.8 to 5.5 V	Operating voltage

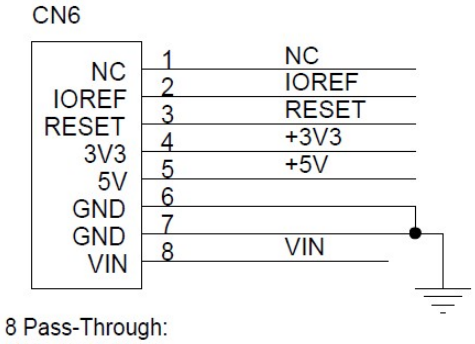
Schematic Diagrams

X-NUCLEO-BNRG2A1 schematic diagram – BlueNRG-M2SP



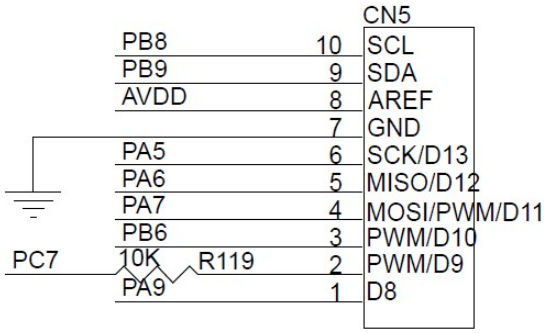
X-NUCLEO-BNRG2A1 schematic diagram – Arduino connectors

Arduino UNO R3 SX Connector

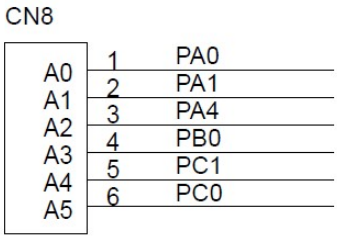


8 Pass-Through:
Male on Bottom
and Female on
Top

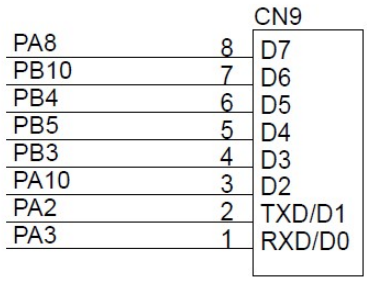
Arduino UNO R3 DX Connector



Pass-Through:
Male on Bottom
and Female on
Top



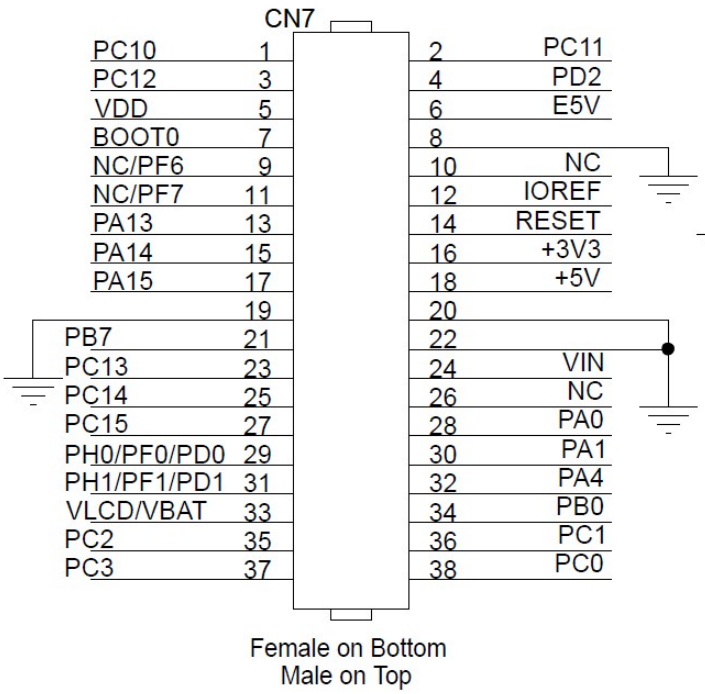
6 Pass-Through:
Male on Bottom
and Female on
Top



Pass-Through:
Male on Bottom
and Female on
Top

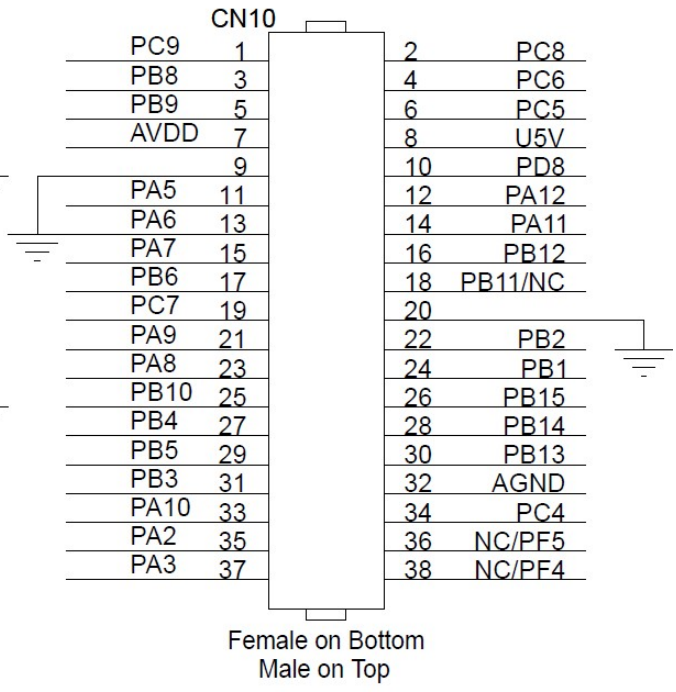
X-NUCLEO-BNRG2A1 schematic diagram – morpho connectors

ST morpho SX Connector



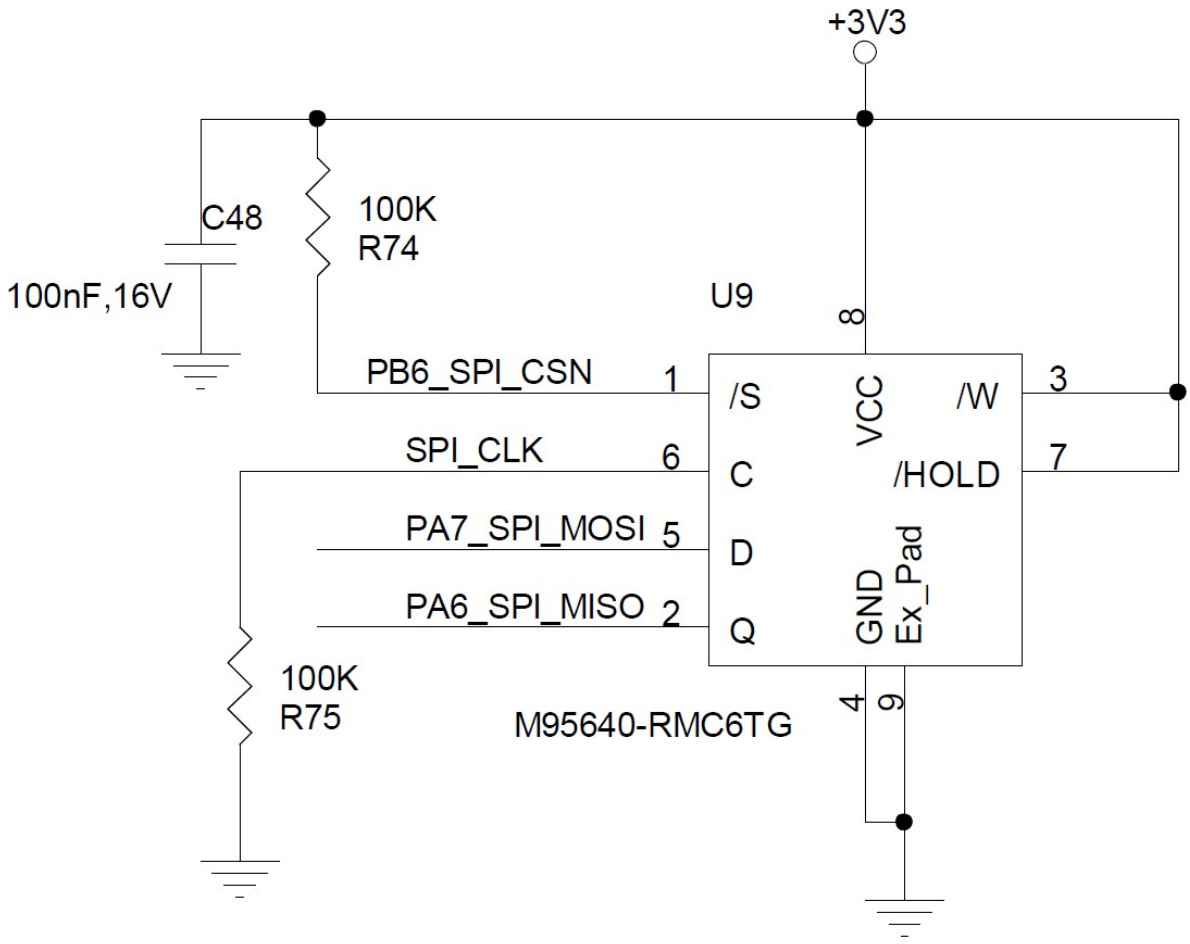
Female on Bottom
Male on Top

ST morpho DX Connector

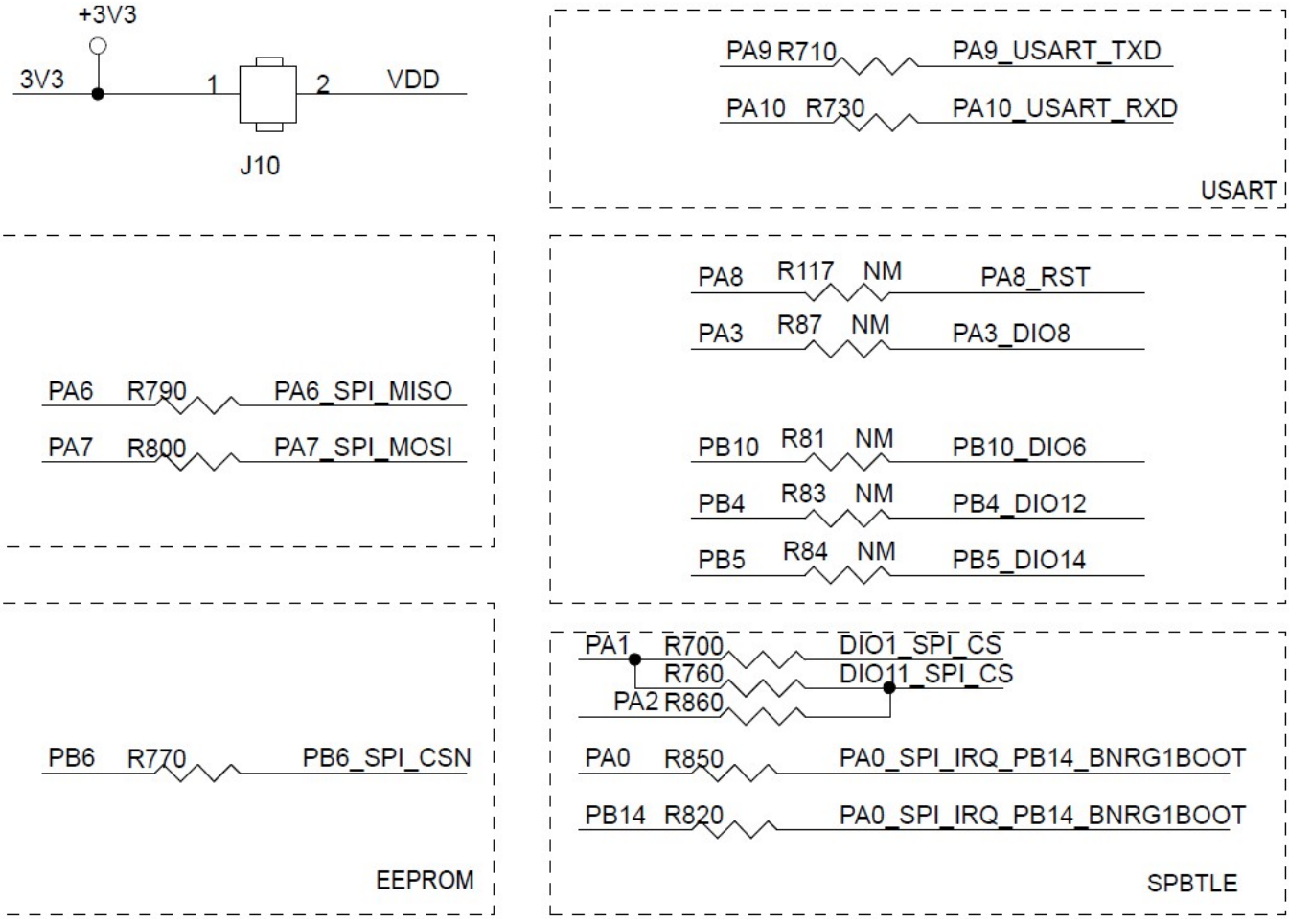


Female on Bottom
Male on Top

X-NUCLEO-BNRG2A1 schematic diagram – M95640-RMC6TG



X-NUCLEO-BNRG2A1 schematic diagram – resistor mapping



Bill of Materials

X-NUCLEO-BNRG2A1 bill of materials

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	U8	SMD 20 PIN	Very low power application processor module for Bluetooth® low energy v5.2	ST	BlueNRG-M2SP
2	2	U9	UFDFPN8 (MC) 2 x 3 mm	64 Kbit SPI bus EEPROM with high-speed clock	ST	M95640-RMC6TG
1	1	CN5	Pass-through: male on bottom, female on top. 10×1 2.54 mm pitch	Arduino connector CN5 10 pins	SAMTEC	SSQ-110-03-F-S
2	2	CN6, CN9	Pass-through: male on bottom, female on top. 8×1 2.54 mm pitch	Arduino connectors CN6 and CN9 8 pins	SAMTEC	SSQ-108-03-F-S

3	3	CN7, CN10	Pass-through: female on bottom, male on top. 19×22.54 mm pitch	ST morpho connectors CN7 and CN10 38 pins (not mounted)	SAMTEC	
4	4	CN8	Pass-through: male on bottom, female on top. 6×1 2.54 mm pitch	Arduino connector CN8 6 pins	SAMTEC	SSQ-106-03-G-S
5	5	J10	2 pin connector, 2.54mm pitch	Power supply connector to module VDD	Any	Any
6	6	J11	3 pin connector, 2.54mm pitch	Jumper	Any	Any
7	7	J12	5 pin connector, 2.54mm pitch	SWD programming connector	Any	Any
8	8	J13	3 pin connector, 2.54mm pitch	Interface selector	Any	Any

9	9	J14	3 pin connector , 2.54mm pitch	SPI1_CLK sele ction between D13 and D3 pi n of Arduino co nnector	Any	Any
10	10	J15	2pin connector, 2.54mm pitch	Boot pin conne ct to VDD , for wake up device when in sleep	Any	Any
1	1	C47	10 nF,16 V SM D 0805	Capacitor	Any	Any
2	2	C48	100 nF,16 V ‘S MD 0805	Capacitor	Any	Any
3	3	C49	100 nF,16 V S MD 0805	Capacitor	Any	Any
1	1	R71, R73, R76 , R77, R79, R8 0, R82, R85	SMD 0805	Resistors	Any	Any

2	2	R74, R75	SMD 0805	100K	Any	Any
3	3	R78	220, ‘SMD 080 5	Resistors	Any	Any
4	4	R81,R83,R84, R8 7,R117,R70,R8 6	SMD 0805	Resistor (not m ounted)	Any	Any
5	5	R88, R119	10 K, SMD 080 5	Resistors	Any	Any
6	6	R116	47 K, ‘SMD 08 05	Resistor	Any	Any
1	1	D1	SMD 0805	Yellow LED	Dialight	598-8150-107f

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-BNRG2A1 contains FCC certified module BlueNRG-M2SP (FCC ID: S9NBNRGM2SP).

Formal notices required by the Industry Canada (“IC”)

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.

Documents / Resources

	ST UM2667 BlueNRG-M2SP module [pdf] User Manual UM2667, BlueNRG-M2SP module