DT00142
Design tip

BLE module integration design guidelines

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Main components	
BlueNRG-M2SA BlueNRG-M2SP	Very low power application processor module for Bluetooth® Low Energy v5.2
BlueNRG-M0A BlueNRG-M0L	Very low power network processor module for Bluetooth® Low Energy v4.2

Purpose and benefits

The BlueNRG-M0 is an easy-to-use Bluetooth® Low Energy master/slave network processor module, compliant with Bluetooth v4.2. The BlueNRG-M0 module supports multiple roles simultaneously and can act at the same time as Bluetooth Low Energy sensor and hub device.

The BlueNRG-M0 is based on the BlueNRG-MS network processor; the entire Bluetooth Low Energy stack and protocols are embedded into BlueNRG-M0 module. The external host application processor, where the application resides, is connected to the BlueNRG-M0 module through a standard SPI interface.

The BlueNRG-M2 is a Bluetooth® Low Energy system-on-chip application processor certified module, compliant with BT specifications v5.2. The BlueNRG-M2 module supports multiple roles simultaneously and can act at the same time as Bluetooth master and slave device.

The BlueNRG-M2 is based on the BlueNRG-2 system-on-chip and entire Bluetooth Low Energy stack and protocols are embedded into module. The BlueNRG-M2 module provides a complete RF platform in a tiny form factor. Radio, embedded antenna, and high frequency oscillators are integrated to offer a certified solution to optimize the time-to-market of the final applications.

All the modules listed are certified, in particular:

- BlueNRG-M2SA, BlueNRG-M2SP: CE qualified, FCC, IC modular approval certified, TYPE qualified, BQE qualified, WPC certification (BlueNRG-M2SP only), SRRC certification (BlueNRG-M2SA only)

- BlueNRG-M0A, BlueNRG-M0L: CE qualified, FCC, IC modular approval certified, TYPE qualified, BQE qualified, WPC certification (BlueNRG-M0L only)

The scope of this document is to provide the customer with a reference on how to position our modules inside his custom motherboard and some main board design recommendations to preserve the module RF performance.

Description

PCB layout recommendations:

1. PCB pad layout

Please refer to the specific module datasheet for a recommended pad footprint layout and solder mask definition.

2. PCB stack up

The module does not set specific requirements to the PCB stack up. A simple 2-layer PCB stack up may be used to keep the cost down (standard FR-4 material or cheaper).

3. Power supply

It is recommended to keep the power supply line for VCC as short and low impedance as possible.

4. Ground plane

It is recommended to have a copper ground plane under the top shielded zone of the module. The ground plane should be unbroken in the module bottom internal pin connections area.

5. Module placement

The antenna radiation pattern of the module with chip antenna is influenced by the ground planes of the PCB holding the module (motherboard).

It is suggested to place the module antenna outside the PCB edge. It is important that the module GND pins has a good connection to the PCB ground plane, therefore GND vias should be placed close to all module GND pins. (The figures below show a recommended placement of a typical BLE module).

Figure 1. BLE module recommended placement (into motherboard) with antenna portion overhang

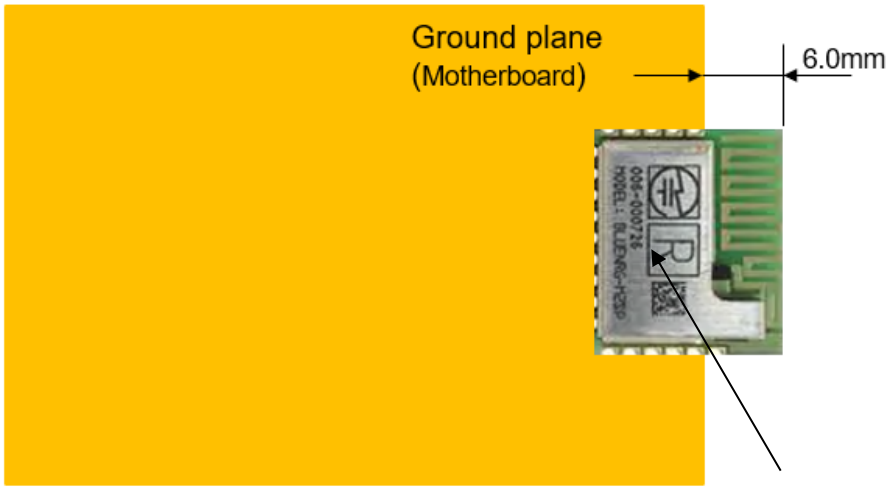
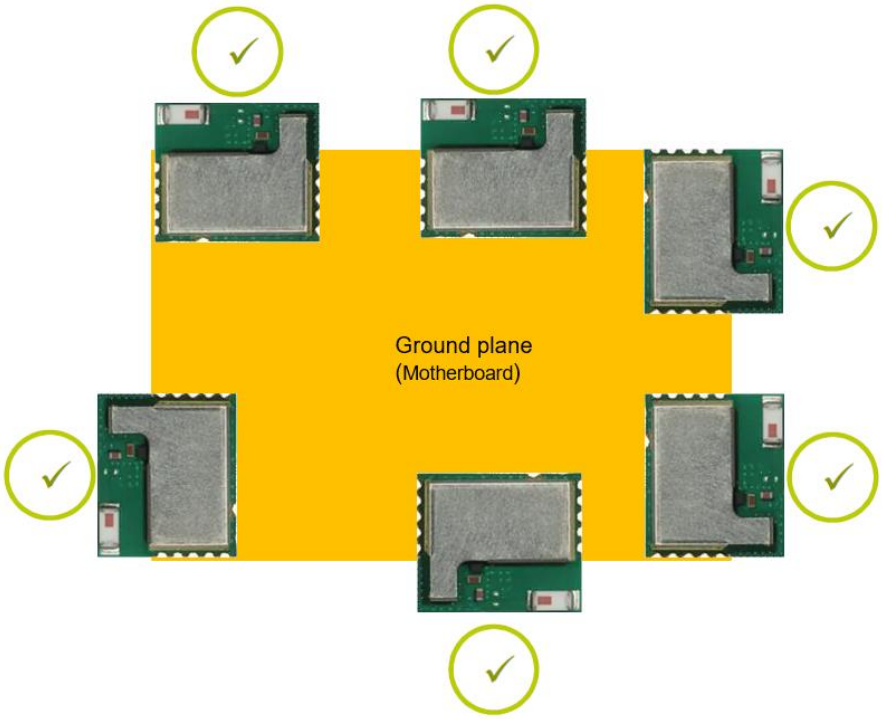


Figure 2. BLE module recommended placement (into motherboard) with antenna portion overhang –options



5.1 Module placement strategy

BLE modules are RF devices that require a proper placement on PCB to ensure optimal performance. The antenna on the PCB has (about) an omnidirectional radiation pattern. To maximize antenna efficiency, an adequate grounding plane must be provided under the module. However, the areas underneath and surrounding the antenna area must be free of copper.

The position of the module on the host board and overall design of the product enclosure contribute to antenna performance. Poor design affects radiation patterns and can result in reflection, diffraction, and/or scattering of the transmitted signal thus limiting the range.

Basic guidelines:

i. Never place the ground plane or route copper traces directly underneath the antenna portion of the module

ii. Never place the antenna close to metallic objects

iii. Keep wiring, components, and objects away from antenna

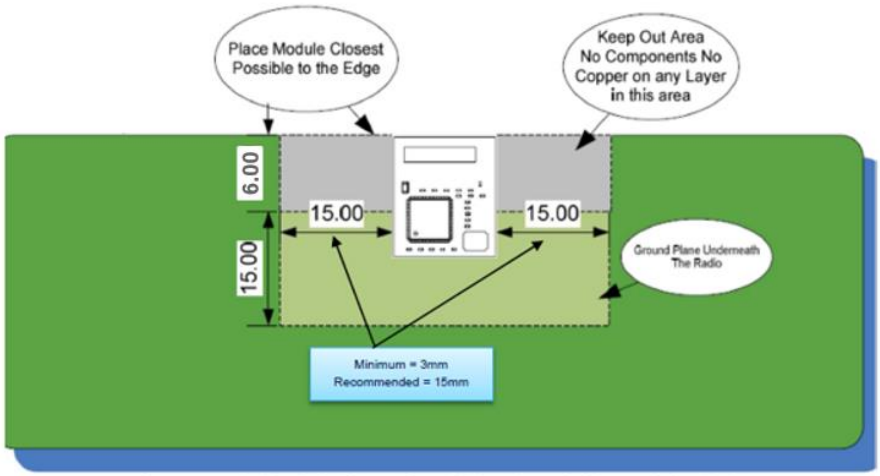
iv. Do not place the antenna in a metallic or metalized plastic enclosure

v. Enclosure walls should be 1cm or more away from the antenna in all directions

vi. If possible, mount antenna overhanging the edge of the host board (motherboard). Add an uninterrupted ground plane on host board, directly underneath the top shielded zone of the module, up to the PCB edge. Adding a ground plane allows traces to be run on the on the bottom side of the host board if required.

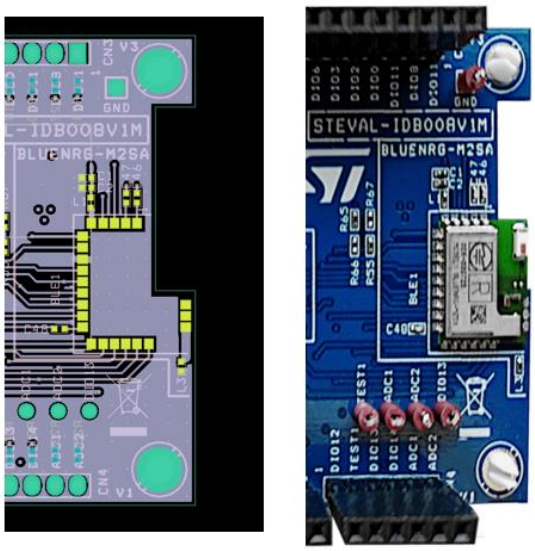
vii. If antenna cannot be mounted in overhanging position, then provisions must be made to keep area clear of copper as recommended in diagram (see Figure 3)

Figure 3. RF module recommended placement (into motherboard) with antenna portion NOT overhang



viii. Concerning the BlueNRG-M2SA module placement, a "hybrid" approach is possible to leave the module portion close to the chip antenna overhanging the host board edge and to connect the ground pin (module top right - pin21) to the board ground (see Figure 4).

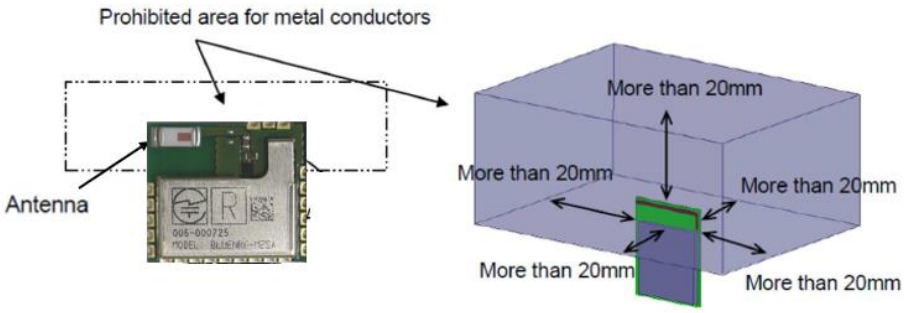
Figure 4. RF module placement (into motherboard) with antenna portion overhang (hybrid approach)



5.2 Layout of other components around antenna

If any components containing metal conductor or conductive substance are placed close to the antenna, it might obstruct radio wave radiation, which can reduce communication distance significantly.
Keep the antenna away from metal conductors in accordance with below (see figure 5).

Figure 5. RF module – antenna portion away from metal conductors



Support material

Related design support material
X-NUCLEO-BNRG2A1: Bluetooth Low Energy expansion board based on the BlueNRG-M2SP module for STM32 NUCLEO
STEVAL-IDB008V1M: Evaluation platform based on the BlueNRG-M2SA module
STEVAL-LLL012V1: Smart LED driver with high power factor using BLE Mesh network for indoor lighting (based on BlueNRG-M2SP module)
X-NUCLEO-IDB05A2: Bluetooth low energy expansion board based on the BlueNRG-M0AL module for STM32 NUCLEO
Documentation
BlueNRG-M2 Datasheet DS13053 (Rev.4): Very low power application processor module for Bluetooth® Low Energy v5.2
BlueNRG-2 Datasheet DS12166(Rev.7): Bluetooth® Low Energy wireless system-on-chip BlueNRG-2 (v5.2 certified)
BlueNRG-M0 Datasheet DS13023 (Rev.5): Very low power network processor module for Bluetooth® low energy v4.2
BlueNRG-MS Datasheet DS10691(Rev.9): Bluetooth® Low Energy wireless network processor BlueNRG-MS (v4.2 certified)

Revision history

Date	Version	Changes
11-Jun-2021	1	Initial release
02-Nov-2021	2	Updated section 5.1 (VIII) BlueNRG-M2SA hybrid placement solution

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