DT0129
Design tip

BLE Module integration design guidelines

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Main components	
SPBTLE-RF0	Very low power module for Bluetooth Smart v4.1
SPBTLE-RF	Very low power module for Bluetooth Smart v4.1
SPBTLE-1S	Very low power application module for Bluetooth® Smart v4.2

Purpose and benefits

The SPBTLE-RF0 and SPBTLE-RF modules are very low power module for Bluetooth Smart v4.1. These are based on BlueNRG-MS chipset (Bluetooth Low Energy network processor) the entire Bluetooth Low Energy stack and protocols are embedded into these modules. The external host application processor, where the application resides, is connected to the SPBTLE-RF0 / -RF module through a standard SPI interface.

All the modules listed are certified, in particular:

SPBTLE-RF0, SPBTLE-RF: CE qualified, FCC, IC modular approval certified, TELEC (SPBTLE-RF0 only) BQE qualified;

SPBTLE-1S: EU (RED) type certificate, FCC, IC modular approval certification, SRRC Chinese Certification, BT SIG End Product QDID.

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 recommendation in order to preserve the module's RF performances.

Design guidelines - 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 recommended 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 it is recommended to place GND vias close to all module GND pins. (The figures below shows a recommended placement of a typical BLE module).

Figure 1. BLE Module recommended placement (into Motherboard) with Antenna portion overhang

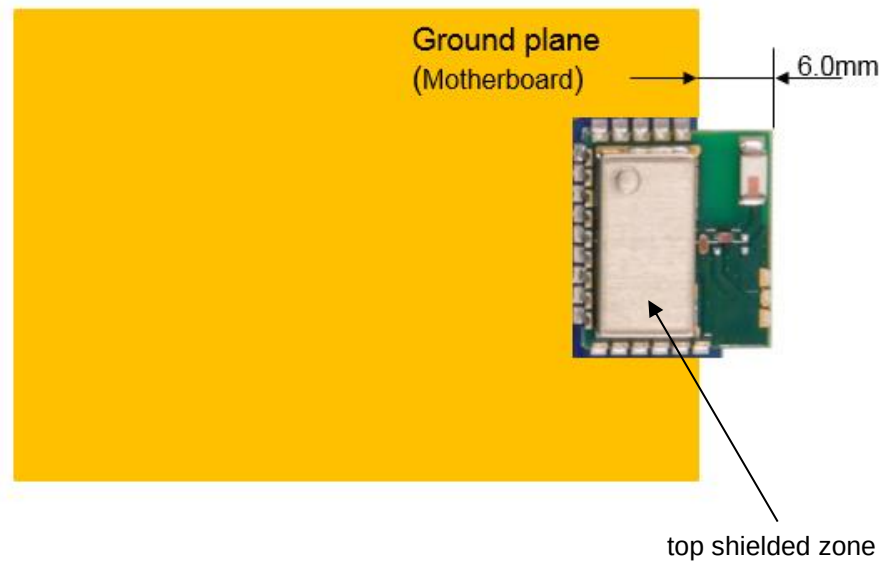
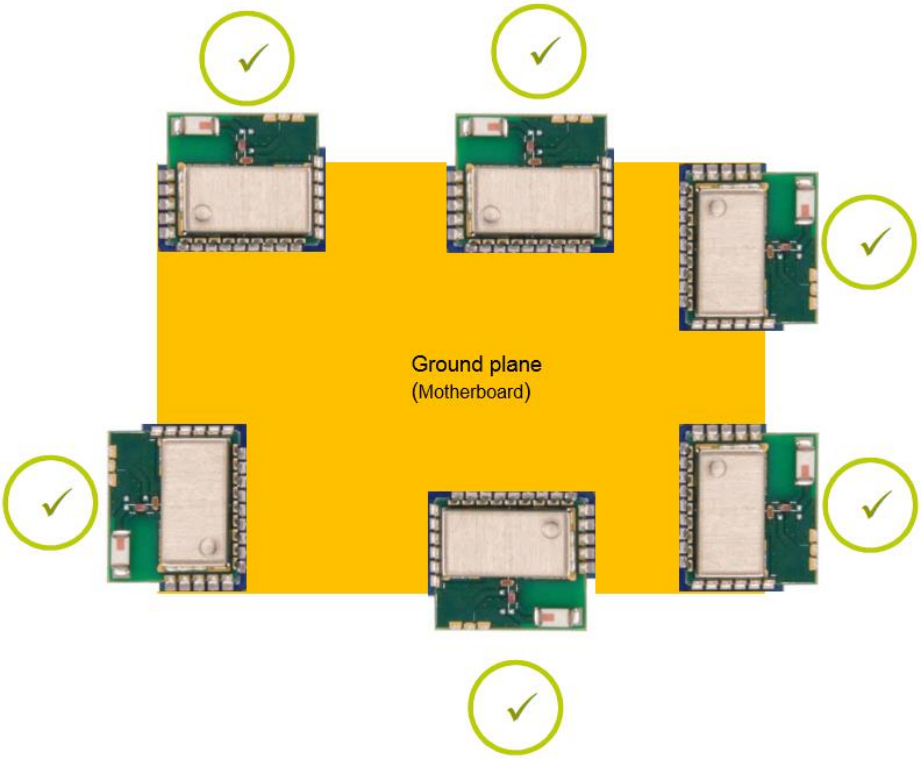


Figure 2. BLE Module recommended placement (into Motherboard) with Antenna portion overhang –Options



5.1 Module placement strategy

BLE/Sub-1GHz modules are RF devices that require 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 effects 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

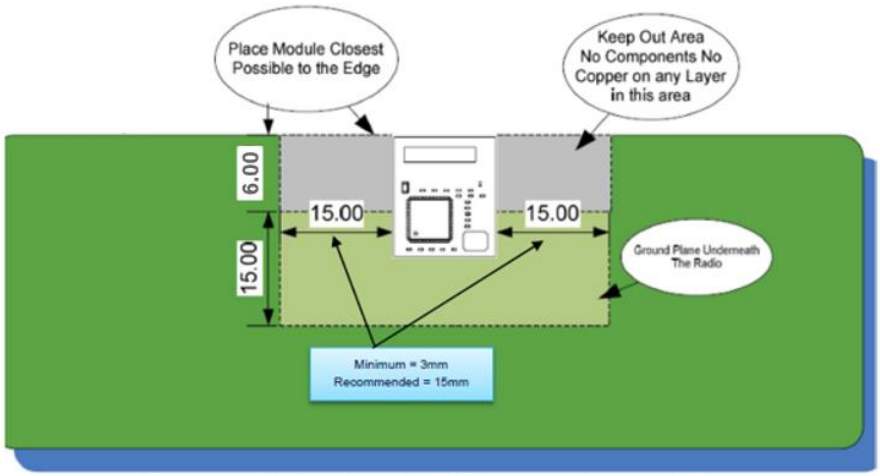
iv. Do not place the antenna in a metallic or metalized plastic enclosure

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 will allow 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)

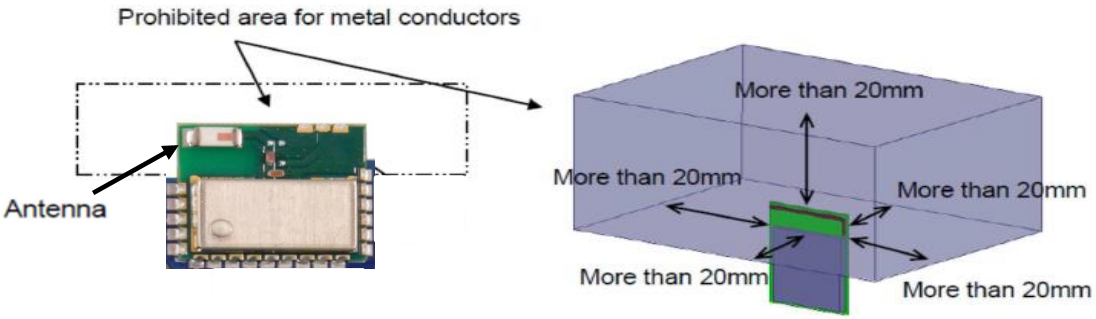
Figure 3. RF Module recommended placement (into Motherboard) with Antenna portion NOT overhang



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 causes in reducing communication distance significantly.
Keep the antenna away from metal conductors in accordance with below (see figure 4).

Figure 4. RF Module – antenna portion away from metal conductors



Support material

Related design support material
X-NUCLEO-IDB05A1: Bluetooth Low Energy expansion board based on SPBTLE-RF module for STM32 Nucleo
STEVAL-IDB006V1M: Bluetooth® Low Energy USB dongle based on the SPBTLE-RF module
STEVAL-FCU001V1: Flight controller unit evaluation board for toy drones
STEVAL-ILL083V1: Smart home lighting based on HVLED815PF and SPBTLE-RF
B-L475E-IOT01A: STM32L4 Discovery kit IoT node, low-power wireless, BLE(SPBTLE-RF), NFC, SubGHz, Wi-Fi
STEVAL-IDB007V1M: Evaluation platform based on the SPBTLE-1S module
STEVAL-BLUEMIC-1: Ultra-low power Bluetooth® low energy microphone based on SPBTLE-1S certified module
STEVAL-BLUEPLUG1: SPBTLE-1S Based Smart Plug
STEVAL-POEL45W1: 45 W PoE powered LED lighting with BLE control
Documentation
Datasheet DS12080: Very low power network processor module for Bluetooth® Low Energy v4.1 SPBTLE-RF0
Datasheet DS11045: Very low power network processor module for Bluetooth® low energy v4.1 SPBTLE-RF
Datasheet DS12065: Very low power application processor module for Bluetooth® Low Energy v4.2 SPBTLE-1S
Datasheet DS11481: Bluetooth® low energy wireless system-on-chip BlueNRG-1

Revision history

Date	Version	Changes
3-Dec-2018	1	Initial release

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