DT0130
Design tip

SubGHz Module integration design guidelines

By Sergio Rossi

Main components	
SPSGRF-868	Low power sub-GHz module based on the SPIRIT1 RF transceiver operating in the 868 MHz SRD band.
SPSGRF-915	Low power sub-GHz module based on the SPIRIT1 RF transceiver operating in the 915 MHz ISM band.
SPSGRFC-433	Low power sub-GHz module with ufl connector based on the SPIRIT1 RF transceiver operating in the 433 MHz band.
SPSGRFC-868	Low power sub-GHz module with ufl connector based on the SPIRIT1 RF transceiver operating in the 868 MHz band.
SPSGRFC-915	Low power sub-GHz module with ufl connector based on the SPIRIT1 RF transceiver operating in the 915 MHz band.

Purpose and benefits

The **SPSGRF-868** and **SPSGRF-915** are easy-to-use, low power sub-GHz certified modules based on the SPIRIT1 RF transceiver, operating respectively in the 868 MHz SRD and 915 MHz ISM bands. The SPSGRF series enables wireless connectivity in electronic devices, requiring no RF experience or expertise for integration into the final product. These modules included a high efficient **chip antenna**, filter and balun, 4wires SPI interface to external host, shutdown line and 4 programmable GPIOs

The **SPSGRFC-433**, **SPSGRFC-868 and SPSGRFC-915** are easy-to-use sub-1 GHz transceiver certified modules with many programmable features. These modules can operate at the 433, 868 or 915 MHz frequency band. The SPSGRFC RF modules integrates wireless connectivity in target electronic devices without requiring particular RF experience or expertise. These modules included a **U.FL connector (for external) antenna**, filter and balun. 4wires SPI interface to external host, shutdown line and 4 programmable GPIOs

This certified solution optimizes the time to market of the final applications, in particular all the modules listed are: CE/RED qualified, FCC and IC modular approved certified

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 figure 1 below shows a recommended placement of a typical **SPSGRF** module).

Figure 1: Sub-1GHz Module recommended placement (into Motherboard) with Antenna portion overhang

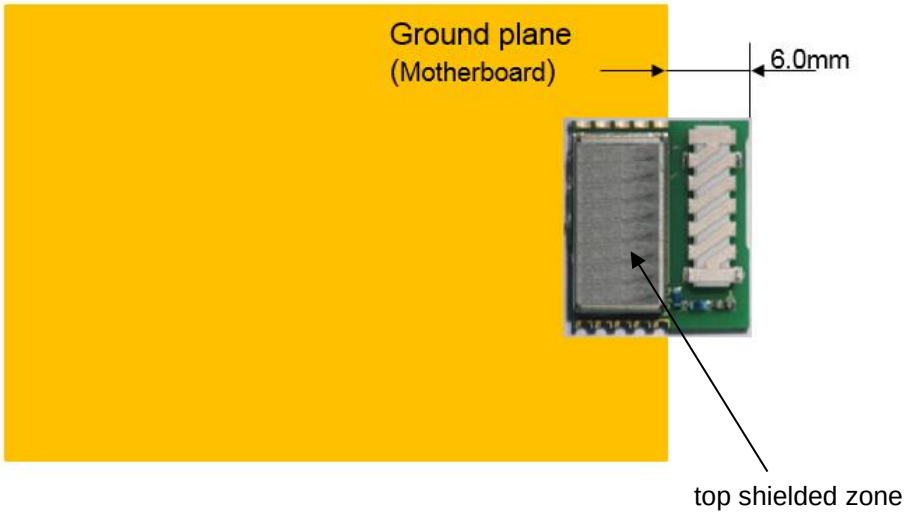
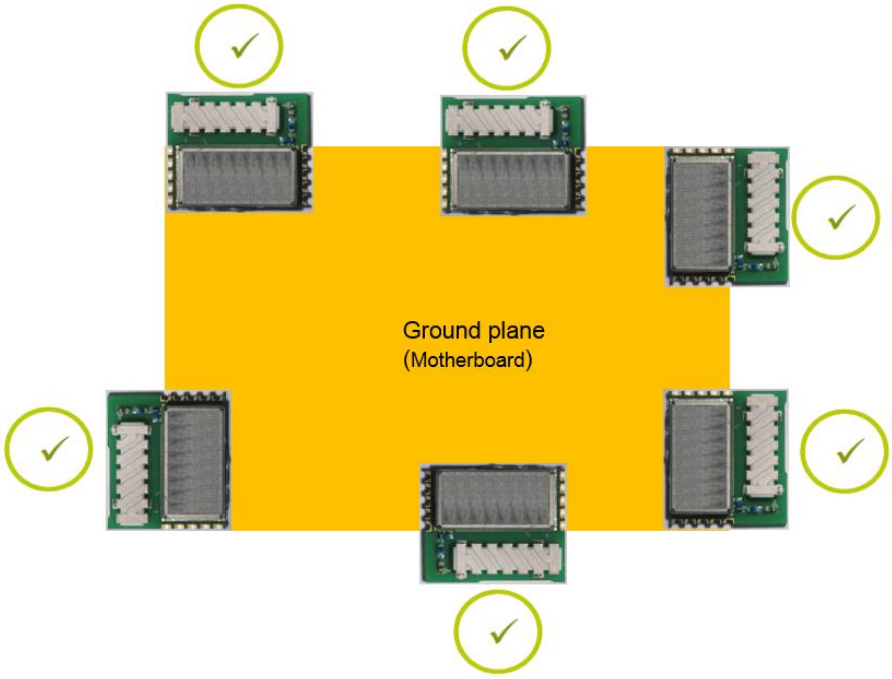


Figure 2: Sub-1GHz Module recommended placement (into Motherboard) with Antenna portion overhang –Options



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

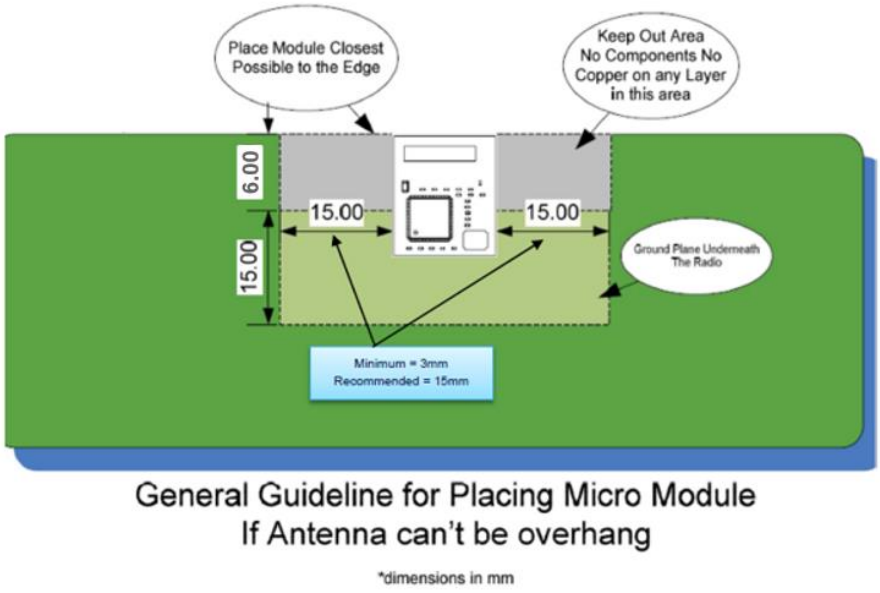
v. Enclosure walls should be 1cm or more away from the antenna in all directions

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)

viii. For designs that require external antenna and U.FL connector, use recommended antenna. The rules for placement on edge are not required. (i.e. SPSGRFC-433/868/915) However, a ground plane is necessary underneath the top shielded zone of the module.

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

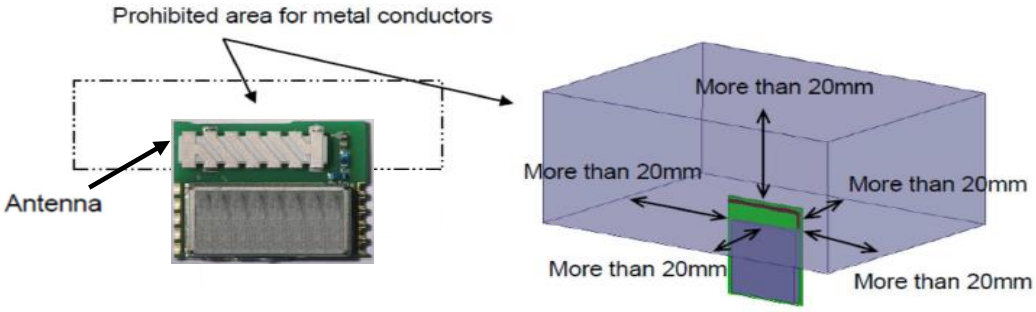


5.2 Layout of other components around antenna

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



6. RF module with EX Antenna connector

When an external antenna is preferred, the SPSGRFC-433/868/915 modules supports the U.FL connector option.

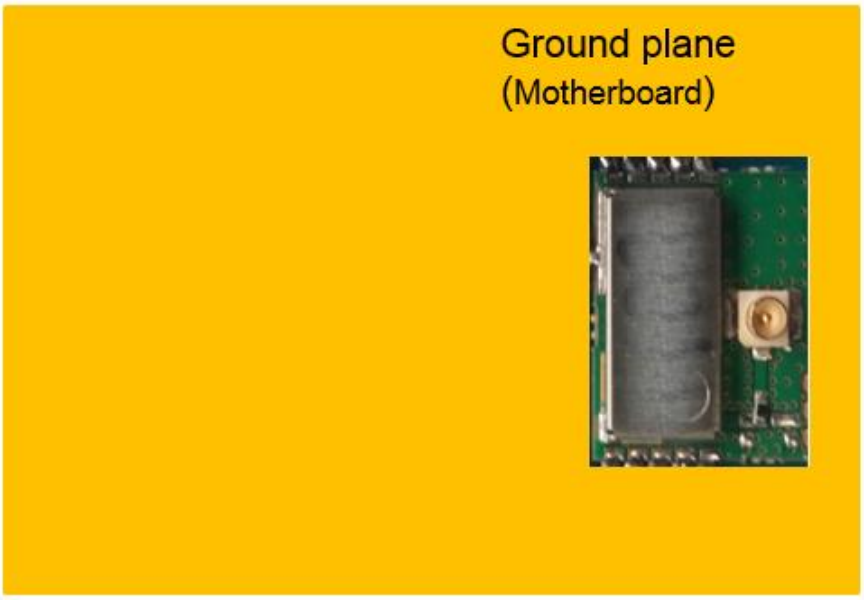
Using this option there is no need for matching networks as long as a 50 Ohm antenna is used.

In order to use the regulatory certifications done for Sub-1GHz module we recommend some specific Antenna part number (see SPSGRFC module datasheet, Chapter 8 – Regulatory compliance, reported also in section 7).

As alternative the customer can choose a different external antenna with the same RF performances of the recommended one.

Figure 5 shows a recommended placement of the RF module with External UF.L connector

Figure 5 RF module with EX Antenna connector recommended PCB layout



7. External antenna recommendations

We recommend the certified Antennas for modules that require an external antenna. These antenna has been qualified and approved for use by regulatory agencies in the US, Canada and European Union under the Modular Approval certification.

The use of any antenna that does not meet the same parameters as the recommended antenna voids the Modular Approval grant.

For SPSGRFC-915, the approved antenna is the TAOGLASS TI.19.2113

For SPSGRFC-868, the approved antenna is the LINX ANT-868-CW-QW

For SPSGRFC-433 the approved antenna is the LINX ANT-433-CW-QW

Please follow the recommended rules for optimal performance:

Place the antenna vertically to obtain the longest range and best communication

Allow 75-130 mm of clearance from the antenna to any metallic objects

Support material

Related design support material
X-NUCLEO-IDS01A4: Sub-1 GHz RF expansion board based on the SPSGRF-868 module for STM32 Nucleo
X-NUCLEO-IDS01A5: Sub-1 GHz RF expansion board based on the SPSGRF-915 module for STM32 Nucleo
STEVAL-IDS001V4M: 868 MHz RF USB dongle based on the SPIRIT1 SPSGRF-868 module
STEVAL-ILL082V1: Smart home lighting based on HVLED815PF and SPSGRF
B-L475E-IOT01A: STM32L4 Discovery kit IoT node, low-power wireless, BLE, NFC, SubGHz (SPSGRF-868 or SPSGRF-915), Wi-Fi
Documentation
Datasheet DS10955: Sub-GHz (868 or 915 MHz) low power programmable RF transceiver modules
Datasheet DS11951: Sub-GHz (433, 868 or 915 MHz) programmable transceiver module
Datasheet DS8870: Low data rate, low power sub-1GHz transceiver

Revision history

Date	Version	Changes
4-Dec-2018	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.