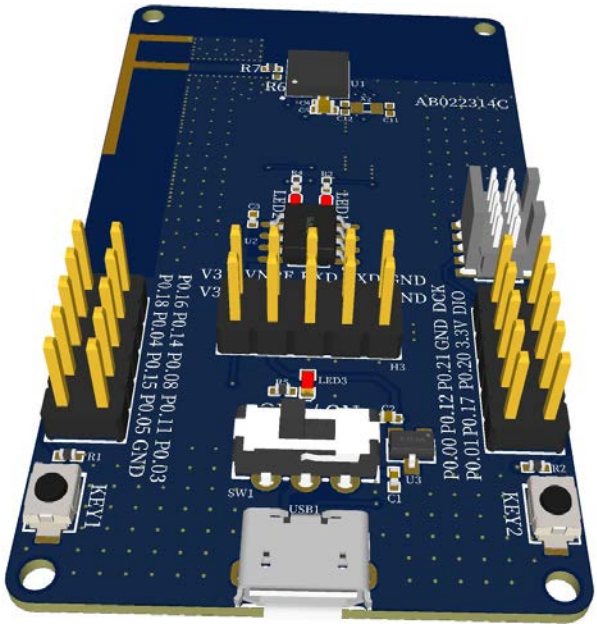
STR10 Application Note

Integrate an STR10 SIP module into a custom design



Abstract

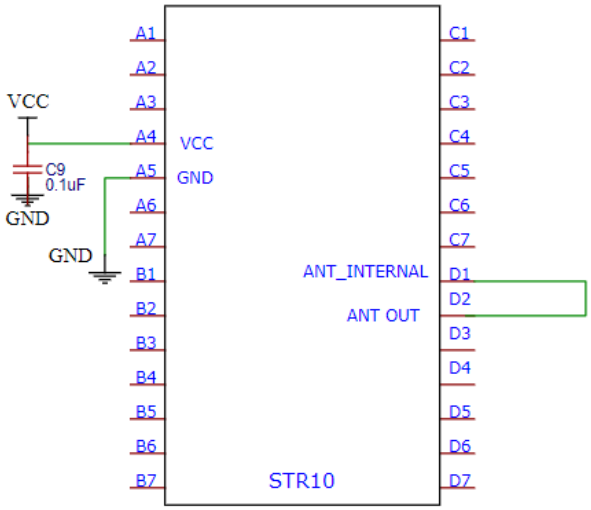
This application note is intended for hardware and system designers that integrate an STR10 Bluetooth Low Energy module SiP module into a custom design. It describes best practices for STR10 hardware integration into their target application.

RF design notes

Build-in antenna/external antenna selection:

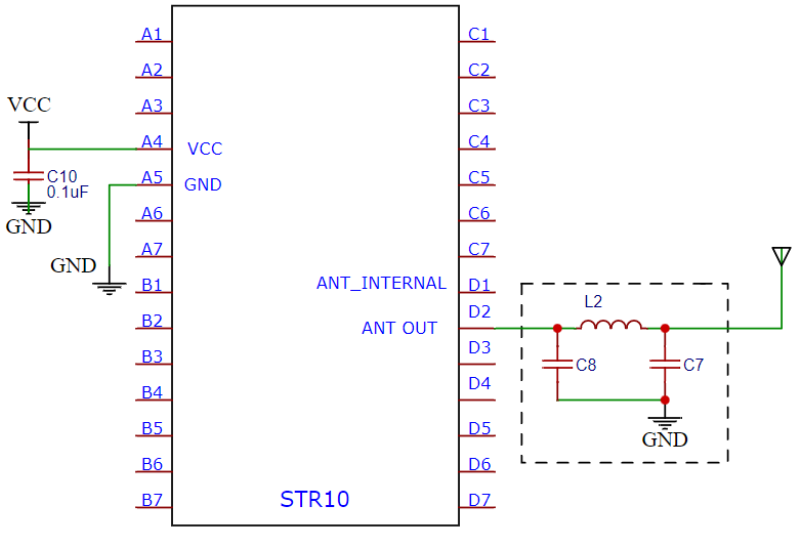
The module provides a flexible design, which can choose to use on-board antenna or external antenna according to the application.

（1）Using Build-in antenna



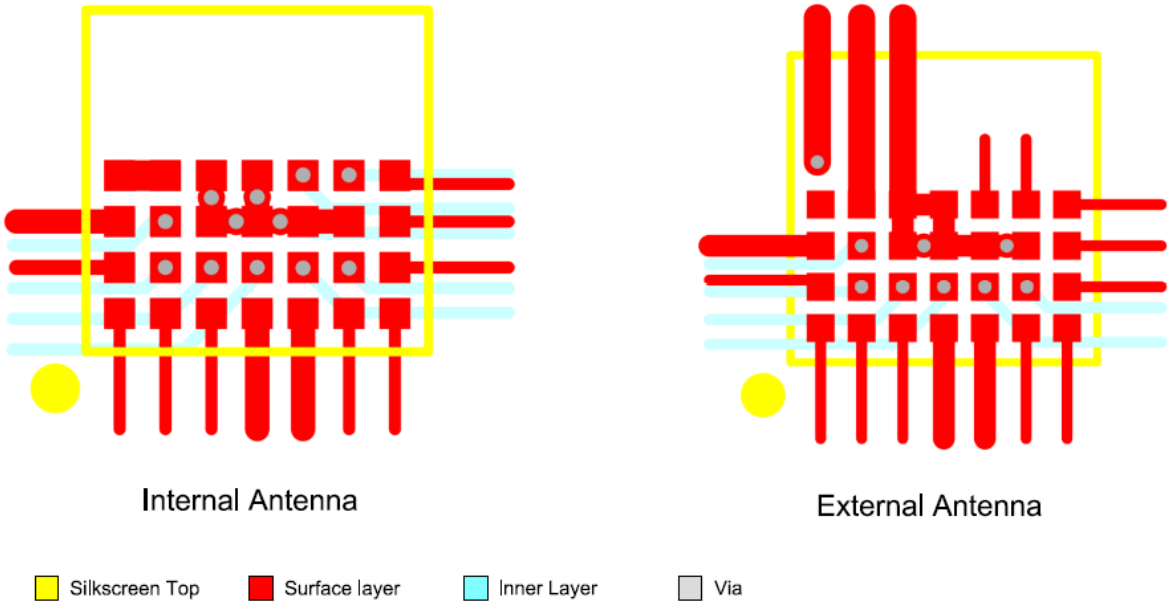
The on board high-gain antenna, if you need to use the onboard antenna, you should short the ANT_OUT and ANT_INTERNAL pins.

（2）Using external antenna



For longer distance application, use the ANT_OUT pin to connect an external antenna. In the case, pi-network is a very flexible way to tune an antenna, which can be used to adjust the RF matching parameters .This is optional circuit, but recommended to use.

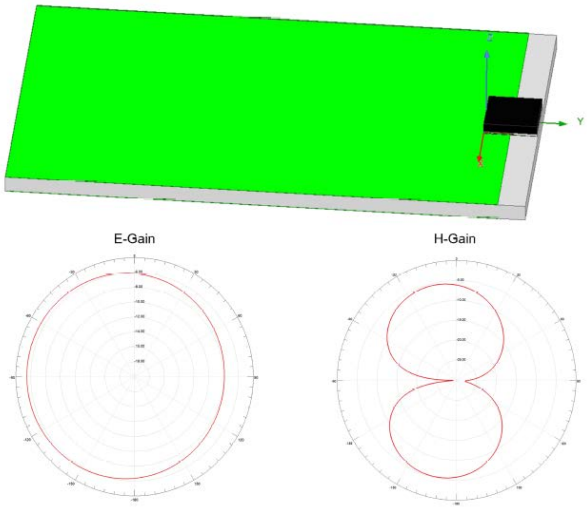
Recommended Layout For Internal Antenna/External Antenna Application



1. For Surface layer, you can fan out directly through the pads, and after fanning out, you can change layers through vias.
2. For inner layer, it is best to fan out through vias in the pads.

For longer distance application, use the ANT_OUT pin to connect an external antenna. In this case, pi-network is a very flexible way to tune an antenna, which can be used to adjust the RF matching parameters .This is optional circuit, but recommended to use.

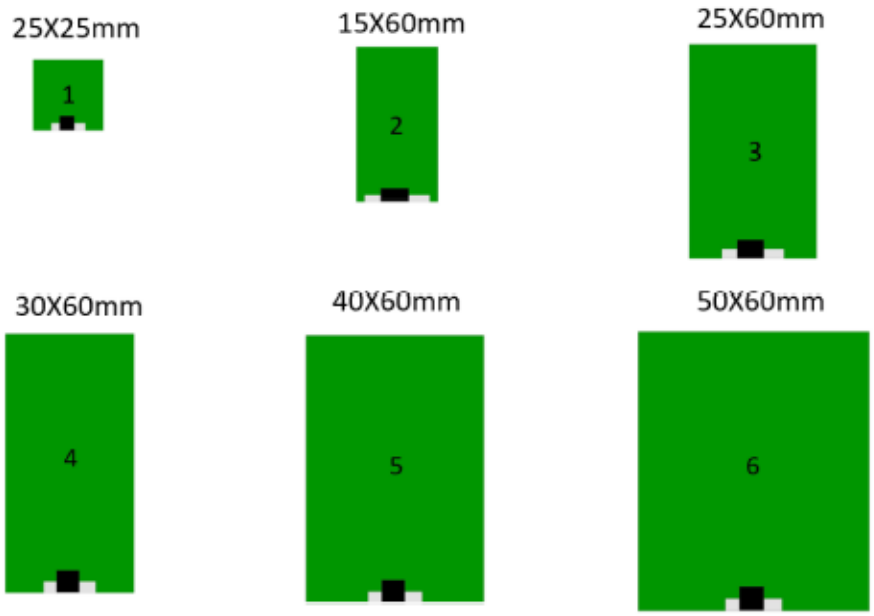
Radiation Pattern



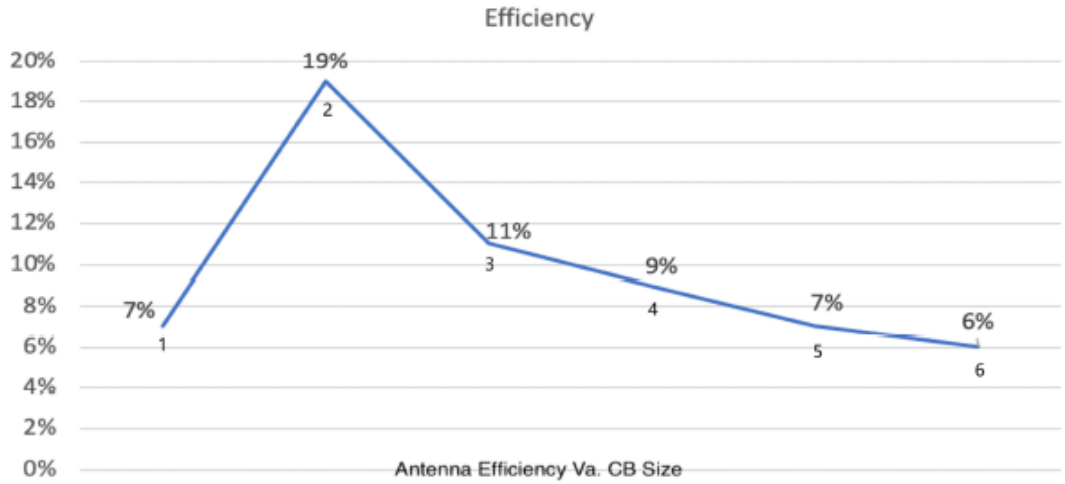
Notes:
1.PCB size：33x55mm，thickness：0.8mm
2.E Plane：XOZ ； H Plane：XOY

Efficiency Effect by Ground Plane

The build-in antenna performance of the STR10 SIP depends on the size of the ground plane on which it is mounted.



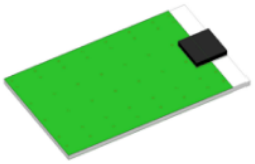
PCB ground planes:
1) 25x25, 2) 15x60, 3) 25x60, 4) 30x60, 5) 40x60, 6)50x60
All sizes in mm



Antenna Return Losses by Different Ground Plane Sizes

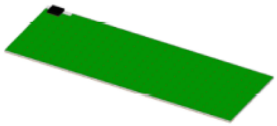
The antenna performance of the STR10 SIP depends on the size of the ground plane on which it is mounted. Figure below shows an overview of different ground plane sizes with expected antenna return losses.

Cell phone config 1 ground plane
（size：40X100mm）



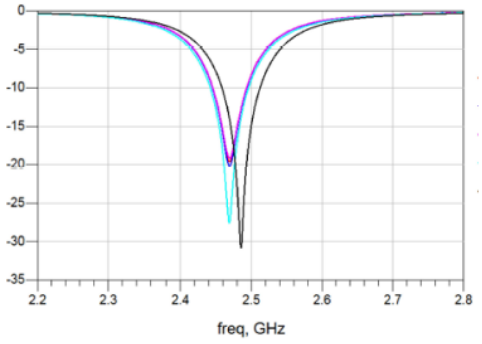
USB dongle ground plane
（size：18X30mm）

Cell phone config 1 with side ground plane
（size：40X100mm）



Cell phone config 2 with side ground plane
（size：40X100mm）

Cell phone config 3 with side ground plane
（size：40X100mm）

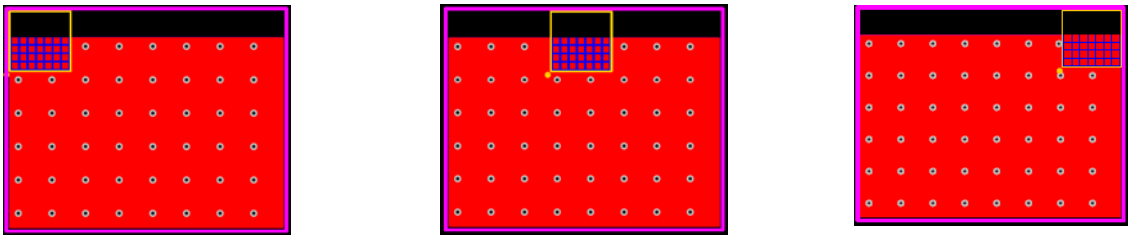


——Cell phone config 1 ground plane
——Cell phone config 1 with side ground plane
——Cell phone config 2 with side ground plane
——Cell phone config 3 with side ground plane
——USB dongle ground plane

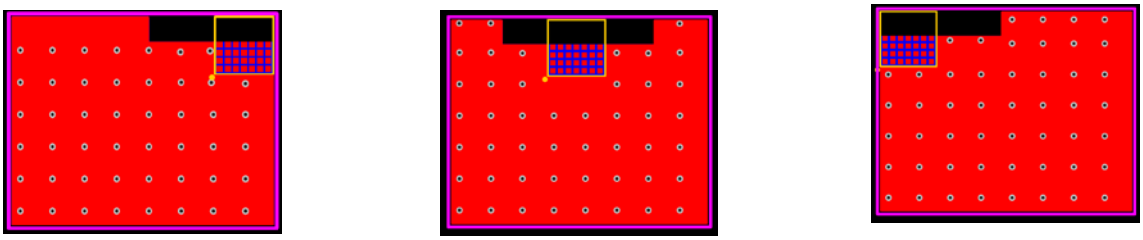
Recommended Module Placement

For optimal antenna performance, it is recommended to respect a metal exclusion zone to the edge of the board: no metal, no traces and no components on any application PCB layer except mechanical LGA pads.

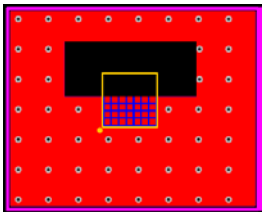
Good:



Acceptable:



Not Recommended:



Plastic Enclosures

As most products will be enclosed by a plastic, it is important to understand the impact that a plastic enclosure will have on the performance of the antenna.

A typical antenna can be represented by an LC resonating circuit. An antenna provides best performance when it is resonating in the bandwidth of interest. Such frequency depends as follows:

$$f = 1 / (2 \pi \sqrt{(LC)})$$

Therefore, any increase in the inductance L or Capacitance C will result in lowered frequency, which makes the antenna radiate less power.

When a plastic enclosure is introduced to the electric field of the antenna it will have the effect of increasing the effective capacitance and ultimately the frequency will go down. The best approach is to place as much clearance as possible between the plastic and the antenna to reduce this effect.

As most RF modules are tuned in free air, the plastic will reduce the frequency if located too close. The best performance is obtained when the RF circuit and antenna is tuned to the actual system taking into account the plastic and all other elements in the environment. However, such tuning is not possible in a module since it will result of a change that will invalidate the FCC, IC and other certifications.

If your system has unique requirements, please contact us for guidance on customizing the module for your system.

Effect of Metals Nearby

Another significant source of issues for RF is the presence of metal near the antenna. Metal also produces an effect on the electric field and change the radiation pattern or create nulls where no signal is received. Any nearby metal may affect the antenna significantly and reduce the range. It's therefore critical to keep any metal way at least 7 to 8mm from the module. Your design should place any metal as far away as possible.

Mechanical Enclosure

Care should be taken when designing and placing the module into an enclosure. Metal should be kept clear from the antenna area, both above and below. Any metal around the module can negatively impact RF performance.

The module is designed and tuned for the antenna and RF components to be in free air. Any potting, epoxy fill, plastic over-molding, or conformal coating can negatively impact RF performance and must be evaluated by the customer.

Effects of Large Ground plane

In some cases, the product may contain or may be placed on top of a large ground metallic plane. If this plane is significant enough it may significantly affect the antenna and its efficiency. In this case it is best to place the module so that it is perpendicular to the plane. This will help reduce the effect the ground plane has. As we've noted, it's important to keep the module as far away from these metallic objects.

Other Recommendations

- No traces or wires should get near the antenna because they will interfere with the field.
- Check that any metallic screws or items are far away from the antenna and module
- If any metallic pain is used, ensure that it is not painted near the antenna or enclosing the antenna.

Recommended Documentation:

The following Nordic Semiconductor documents and Software Dev Kits are required to understand the complete setup and programming methods.

Nordic Semiconductor Documents

▪ nRF52 Development kit User Guide.
▪ nRF52 Series Reference Manual.
▪ nRF528xx Product Specification – make sure you have the last document version updated.
▪ S100 series SoftDevice Specification.
▪ nRF5 SDK for software development on nRF52 Series.

To access documentation, information, go to:

▪ Nordic Semi website http://www.nordicsemi.com
▪ The Nordic Semiconductor Infocenter is a “comprehensive library” containing technical documentation for current and legacy solutions and technologies http://infocenter.nordicsemi.com/index.jsp
▪ Ask any Nordic related question and get help https://devzone.nordicsemi.com/questions
▪ For any question, you can also open a case on the http://www.nordicsemi.com

Software Dev kits

▪ nRF Connect.
▪ nRF5 Software Development Kit (SDK) which includes precompiled HEX files, source code as well as SES and Keil ARM project files.
▪ S100 series SoftDevice, namely S112, S113, S122, S132 and S140(S112 is a memory-optimized Bluetooth 5 protocol stack developed specifically for the nRF52810.).
▪ nRF Connect application for Smartphone.
▪ nRF Toolbox application for Smartphone.

To access these files, go to www.nordicsemi.com and download the files.

Other documents

To complete the above, following documents are available on Abluetech website or/and on request:

▪ STR10-EK user manual.
▪ STR10 module data sheet.
▪ STR10 application note.

Important Notice:

- **Reserves the right to make corrections, modifications, and/or improvements to the product and/or its specifications at any time without notice.**
- **Assumes no liability for the user’s product and/or applications.**
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