FSC-BT630

Bluetooth low energy 4.2 and 5 Specifications Module Datasheet

Version 1.0

1. INTRODUCTION

Overview

FSC-BT630 is a wireless microcontroller (MCU) targeting Bluetooth 4.2 and Bluetooth 5 low energy applications.

Very low active RF and MCU current and low-power mode current consumption provide excellent battery lifetime and allow for operation on small coin cell batteries and in energy-harvesting applications.

FSC-BT630 contains a 32-bit ARM® Cortex®-M4 core that runs at 64 MHz as the main processor and a rich peripheral feature set that includes a unique ultra-low power sensor controller. This sensor controller is ideal for interfacing external sensors and for collecting analog and digital data autonomously while the rest of the system is in sleep mode. Thus, FSC-BT630 is great for a wide range of applications where long battery lifetime, small form factor, and ease of use is important.

It supports GAP, ATT/GATT, SMP, L2CAP profiles. It integrates Baseband controller in a small package (Integrated Ceramic antenna), so the designers can have better flexibilities for the product shapes.

Features

- Support the Bluetooth 4.2 core specification and 5 Specifications
- Low power
- RSSI (1 dB resolution)
- UART programming and data interface (baudrate can up to 921600bps)
- I2S audio interface
- I2C/AIO/PIO/PWM control interfaces
- Type 2 near field communication (NFC-A) tag with wakeup-on-field and touch-to-pair capabilities
- Postage stamp sized form factor
- Temperature sensor
- Digital microphone interface (PDM)
- Up to 3x SPI master/slave(Max)
- Quadrature decoder (QDEC)
- Embedded Bluetooth stack profiles support: SPP/iAP, HID, GATT, ANCS etc
- 3x real-time counter (RTC)
- OTA upgrade support
- MFI Support
- Support External Antenna
- RoHS compliant

Application

- Internet of Things (IoT)
  - Home automation
  - Sensor networks
  - Building automation
  - Industrial
  - Retail
- Personal area networks
  - Health/fitness sensor and monitor devices
  - Medical devices
  - Key fobs and wrist watches
- Interactive entertainment devices
  - Remote controls
  - Gaming controllers
- Beacons
  - A4WP wireless chargers and devices
  - Remote control toys
  - Computer peripherals and I/O devices: Mouse/Keyboard/Multi-touch track pad/Gaming

Module picture as below showing

Figure 1: FSC-BT630 Picture

2. General Specification

Table 1: General Specifications

Categories	Features	Implementation
Wireless Specification	Bluetooth Version	Bluetooth low energy (BLE) 4.2 and 5 Specifications
	Frequency	2.402 - 2.480 GHz
	Transmit Power	+4 dBm (Maximum)
	Receive Sensitivity	-96 dBm sensitivity in Bluetooth low energy mode (Typical)
	Antenna	2dBi Ceramic antenna
	Raw Data Rates (Air)	2 Mbps Bluetooth low energy mode 1 Mbps, 2 Mbps supported data rates
Host Interface and Peripherals	UART Interface	TX,RX,CTS/RTS(with EasyDMA)
		General Purpose I/O
		Default 115200,N,8,1
		Baudrate support from 1200 to 921600
		5, 6, 7, 8 data bit character(TBD)
	GPIO	13 (maximum – configurable) lines
		O/P drive strength (2~10 mA)
		Pull-up resistor (13 KΩ) control
		Read pin-level
	I2C Interface	Up to 2x I2C compatible 2-Wire master/slave (configurable from GPIO total)
		Up to 400 kbps(master)
	I2S Interface	Supports Master or Slave mode operation
		Simultaneous bi-directional (TX and RX) audio streaming
		Original I2S and left- or right-aligned format
		8, 16 and 24-bit sample width
		Low-jitter Master Clock generator
		Various sample rates
	ADC Interface	Analog input voltage range: 0~ VDD (VDD=3.6V)
		8/10/12-bit resolution, 14-bit resolution with oversampling
		6 channels (configured from GPIO total)
		Up to 200 ksps conversion
	PWM	16-bit resolution
		8-bit prescaler and clock divider
		Supports PWM interrupts
		supports input capture function
	PDM	Up to two PDM microphones configured as a Left/Right pair using the same data input
		16 kHz output sample rate, 16-bit samples
		EasyDMA support for sample buffering
		HW decimation filters
	NFC-A	13.56 MHz input frequency

	listen mode operation	Bit rate 106 kbps
	SPI	3 SPI instances(configurable from GPIO total)
		SPI Slave and SPI Master
		Bit rates for SPI Slave and Master - 8 Mbps
	Temperature sensor	Temperature range is greater than or equal to operating temperature of the device
		Resolution is 0.25 degrees
Profiles	Classic Bluetooth	No Support
	Bluetooth Low Energy	GATT Client & Peripheral - Any Custom Services
		BT5 Specifications
		MFI Support
Maximum Connections	Classic Bluetooth	No Support
	Bluetooth Low Energy	1Clients(TBD)
FW upgrade		Over the Air
		Via UART
		J-link
Supply Voltage	Supply	1.7 ~ 3.6V
Power Consumption		5.3 mA peak current in TX (0 dBm)
		6.6 mA peak current in TX (4 dBm)(TBD)
		5.4 mA peak current in RX
		~0.3uA - System OFF current, no RAM retention
		~1.2uA - System ON base current, no RAM retention
		~20nA - Additional RAM retention current per 4 KB RAM section
	Power fail comparator	<4uA - Current consumption when enabled
Physical	Dimensions	10mm X 11.9mm X 1.7mm; Pad Pitch 1.1mm
Environmental	Operating	-40°C to +85°C
	Storage	-40°C to +125°C
Miscellaneous	Lead Free	Lead-free and RoHS compliant
	Warranty	One Year
	Flash memory	Endurance: 10000(Write/erase cycles)
		Retention: 10 years at 40°C
Humidity		10% ~ 90% non-condensing
MSL grade:		MSL 1
ESD grade:		ESD HBM: 2KV ESD CDM: 500V

3. HARDWARE SPECIFICATION

3.1 Block Diagram and PIN Diagram

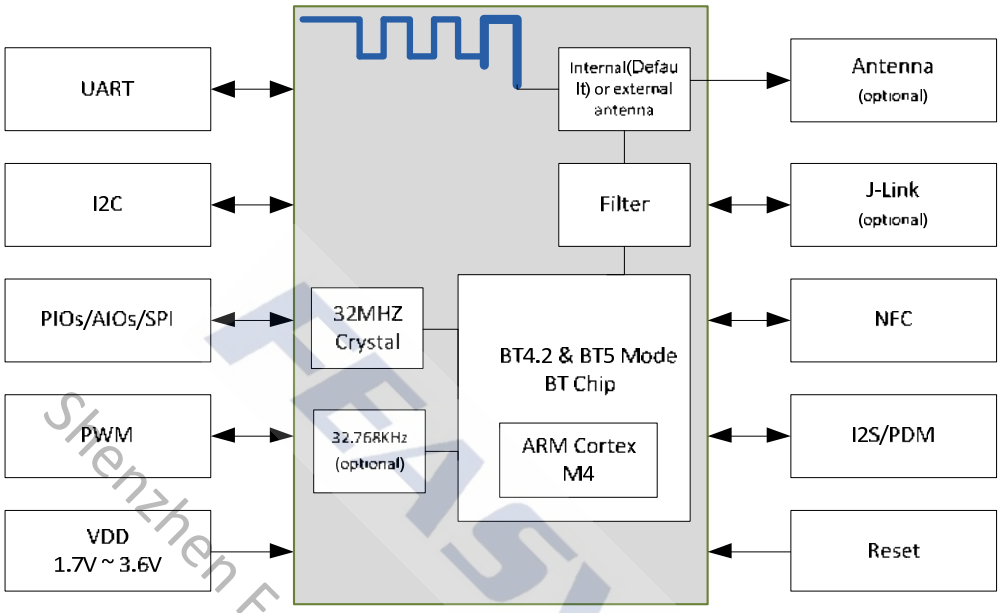


Figure 2: Block Diagram

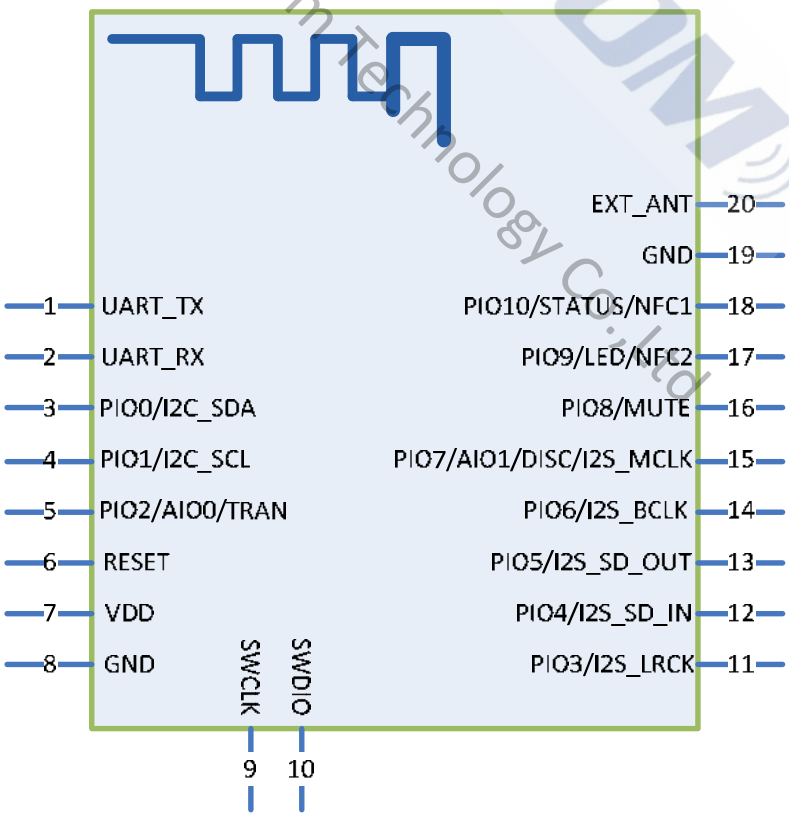


Figure 3: FSC-BT630 PIN Diagram(Top View)

3.2 PIN Definition Descriptions

Table 2: Pin definition

Pin	Pin Name	Type	Pin Descriptions	Notes
1	UART_TX	O	UART Data output	Note 1
2	UART_RX	I	UART Data input	Note 1
3	PIO0/I2C_SDA	I/O	Programmable input/output line	Note 2,3
4	PIO1/I2C_SCL	I/O	Programmable input/output line	Note 2,3
5	PIO2/AIO0/TRAN	I/O	Programmable input/output line Alternative Function 1: Analogue programmable I/O line. Alternative Function 2: Host MCU change UART transmission mode.	Note 2,4
6	RESET	I	External reset input: Active LOW, with an inter an internal pull-up. Set this pin low reset to initial state.	Note 3
7	VDD_3V3	Vdd	Power supply voltage 1.7 ~ 3.6V(default 3.3V)	
8	GND	Vss	Power Ground	
9	SWCLK	I	Serial wire debug clock input for debugand programming	
10	SWDIO	I/O	Serial wire debug I/O for debug and programming	
11	PIO3/I2S_LRCK	I/O	Programmable input/output line Alternative Function 1: I2S left right channel clock Alternative Function 2: Analogue programmable I/O line.	Note 2
12	PIO4/I2S_SD_IN	I	Programmable input/output line Alternative Function 1: I^2S data input Alternative Function 2: Analogue programmable I/O line.	Note 2
13	PIO5/I2S_SD_OUT	O	Programmable input/output line Alternative Function 1: I^2S data out Alternative Function 2: Analogue programmable I/O line.	Note 2
14	PIO6/I2S_BCLK	I/O	Programmable input/output line Alternative Function 1: I^2S bit clock pin Alternative Function 2: Analogue programmable I/O line.	Note 2
15	PIO7/AIO1/DISC/I2S_MCLK	I/O	Programmable input/output line Alternative Function 1: Analogue programmable I/O line. Alternative Function 2: I^2S Master clock pin. Alternative Function 3: Host MCU disconnect bluetooth. Alternative Function 4: Analogue programmable I/O line.	Note 2,5
16	PIO8/MUTE	I/O	Programmable input/output line Alternative Function: Mute Pin	Note 6
17	PIO9/LED/NFC2	I/O	Programmable input/output line Alternative Function 1: LED Alternative Function 2: NFC2	Note 7
18	PIO10/STATUS/NFC1	I/O	Programmable input/output line Alternative Function 1: BT Status	Note 8

			Alternative Function 2: NFC1	
19	GND	Vss	Power Ground	
20	EXT_ANT	O	RF signal output .	Note 9

Module Pin Notes:

Note 1	For customized module, this pin can be work as I/O Interface.
Note 2	I2C/PWM/SPI/PDM/UART(CTS/RTS) with EasyDMA (Support accomplishing the port mapping to other spare I/O Interface via modifying the firmware.)
Note 3	I2C Serial Clock and Data. It is essential to remember that pull-up resistors on both SCL and SDA lines are not provided in the module and MUST be provided external to the module.
Note 4	When bluetooth connection established, UART transmission mode will be determined by PIO2's level : High: Command Mode Low: Throughput Mode
Note 5	When bluetooth connection established,a riging edge of PIO7 will cause disconnection with remote device.
Note 6	Audio Mute Pin-- Mute ON: High Level; Mute OFF: Low Level.
Note 7	LED(Default)-- Power On: Light Slow Shinning ; Connected: Steady Lighting.
Note 8	BT Status(Default)-- Disconnected: Low Level; Connected: High Level.
Note 9	By default, this PIN is an empty feet. This PIN can connect to an external antenna to improve the Bluetooth signal coverage. If you need to use an external antenna, by modifying the module on the 0R resistance to block out the on-board antenna; Or contact Feasycom for modification.

4. PHYSICAL INTERFACE

4.1 Power Supply

The transient response of the regulator is important. If the power rails of the module are supplied from an external voltage source, the transient response of any regulator used should be 20μs or less. It is essential that the power rail recovers quickly.

This module has the following power supply features:

- On-chip LDO and DC/DC regulators
- Global System ON/OFF modes
- Individual RAM section power control for all system modes
- Analog or digital pin wakeup from System OFF
- Supervisor HW to manage power on reset, brownout, and power fail
- Auto-controlled refresh modes for LDO and DC/DC regulators to maximize efficiency
- Automatic switching between LDO and DC/DC regulator based on load to maximize efficiency

8. MECHANICAL DETAILS

8.1 Mechanical Details

- Dimension: 10mm(W) x 11.9mm(L) x 1.7mm(H) Tolerance: ±0.1mm
- Module size: 10mm X 11.9mm Tolerance: ±0.1mm
- Pad size: 0.9mmX0.6mm Tolerance: ±0.1mm
- Pad pitch: 1.1mm Tolerance: ±0.1mm

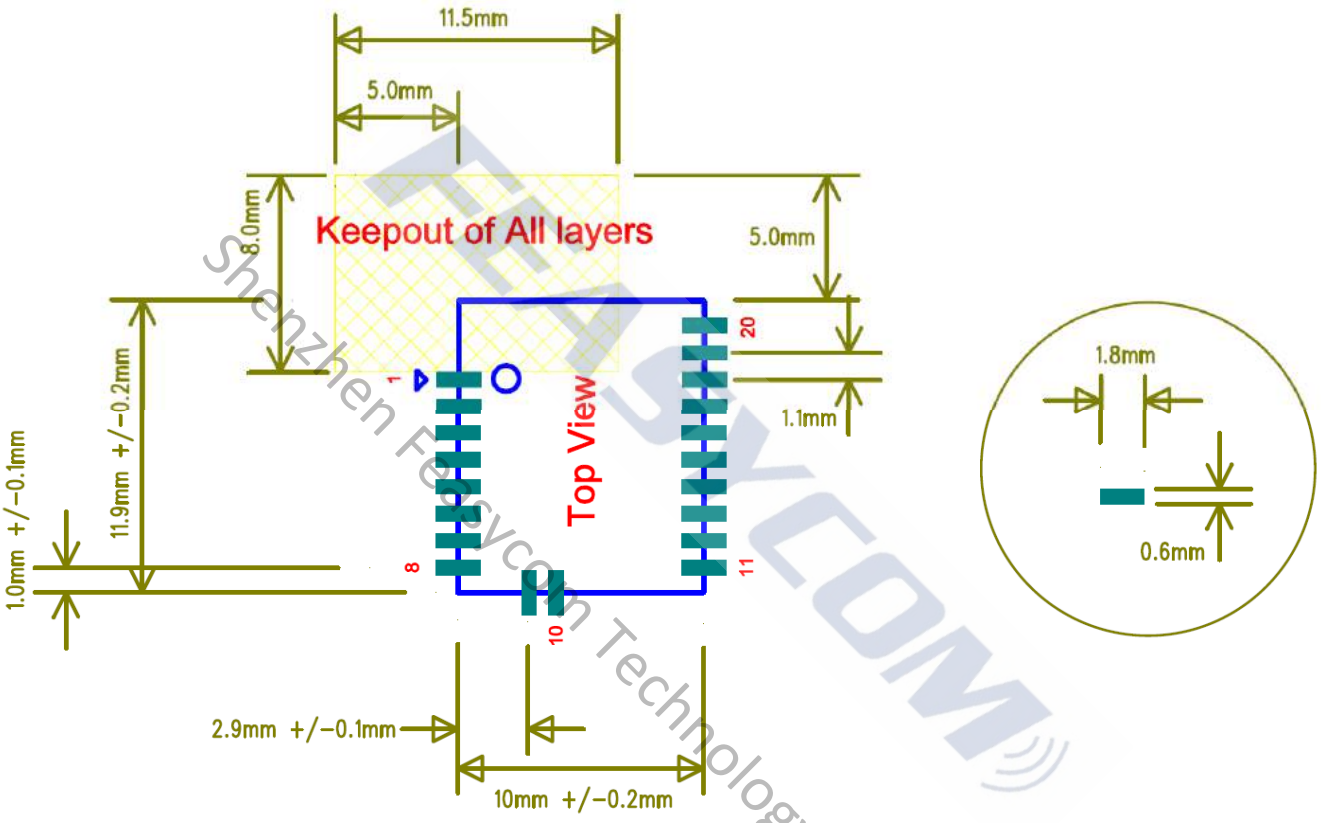


Figure 44: FSC-BT630 footprint

9. HARDWARE INTEGRATION SUGGESTIONS

9.1 Soldering Recommendations

FSC-BT630 is compatible with industrial standard reflow profile for Pb-free solders. The reflow profile used is dependent on the thermal mass of the entire populated PCB, heat transfer efficiency of the oven and particular type of solder paste used. Consult the datasheet of particular solder paste for profile configurations.

Feasycom will give following recommendations for soldering the module to ensure reliable solder joint and operation of the module after soldering. Since the profile used is process and layout dependent, the optimum profile should be studied case by case. Thus following recommendation should be taken as a starting point guide.

9.2 Layout Guidelines(Internal Antenna)

It is strongly recommended to use good layout practices to ensure proper operation of the module. Placing copper or any metal near antenna deteriorates its operation by having effect on the matching properties. Metal shield around the antenna will prevent the radiation and thus metal case should not be used with the module. Use grounding vias separated max 3 mm apart at the edge of grounding areas to prevent RF penetrating inside the PCB and causing an unintentional resonator. Use GND vias all around the PCB edges.

The mother board should have no bare conductors or vias in this restricted area, because it is not covered by stop mask print. Also no copper (planes, traces or vias) are allowed in this area, because of mismatching the on-board antenna.

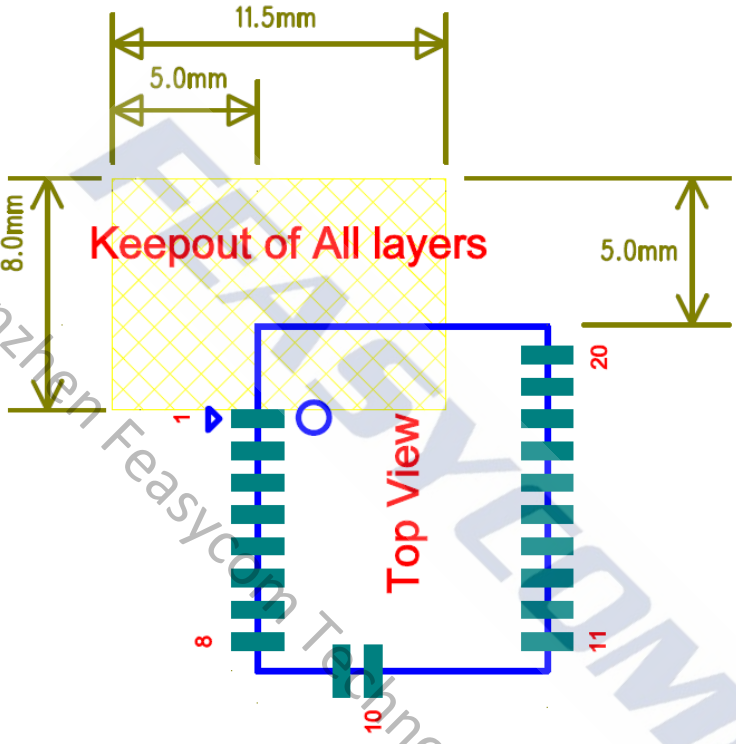


Figure 45: FSC-BT630 Restricted Area (keepout of all layers)

Following recommendations helps to avoid EMC problems arising in the design. Note that each design is unique and the following list do not consider all basic design rules such as avoiding capacitive coupling between signal lines. Following list is aimed to avoid EMC problems caused by RF part of the module. Use good consideration to avoid problems arising from digital signals in the design.

Ensure that signal lines have return paths as short as possible. For example if a signal goes to an inner layer through a via, always use ground vias around it. Locate them tightly and symmetrically around the signal vias. Routing of any sensitive signals should be done in the inner layers of the PCB. Sensitive traces should have a ground area above and under the line. If this is not possible, make sure that the return path is short by other means (for example using a ground line next to the signal line).

9.3 Layout Guidelines(External Antenna)

Placement and PCB layout are critical to optimize the performances of a module without on-board antenna designs. The trace from the antenna port of the module to an external antenna should be 50Ω and must be as short as possible to avoid any interference into the transceiver of the module. The location of the external antenna and RF-IN port of the module should be kept away from any noise sources and digital traces. A matching network might be needed in between the external antenna and RF-IN port to better match the impedance to minimize the return loss.

As indicated in **Figure 46** below, RF critical circuits of the module should be clearly separated from any digital circuits on the system board. All RF circuits in the module are close to the antenna port. The module, then, should be placed in this way that module digital part towards your digital section of the system PCB.

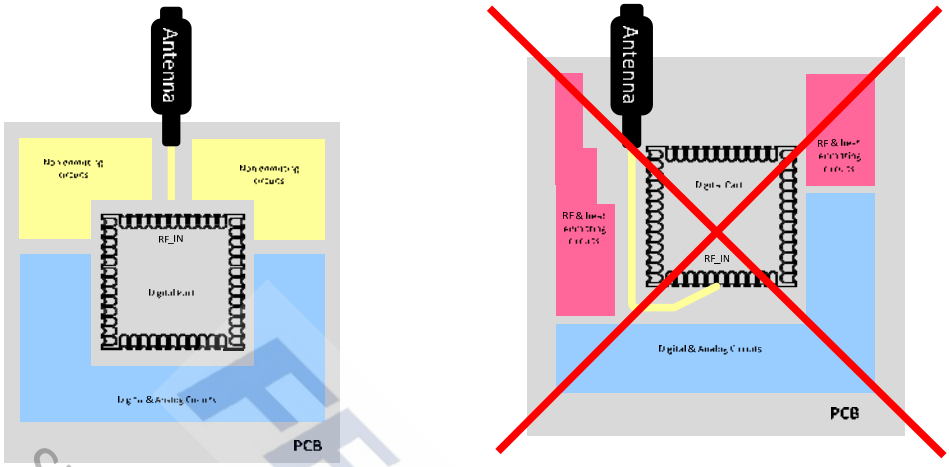


Figure 46: Placement the Module on a System Board

9.3.1 Antenna Connection and Grounding Plane Design

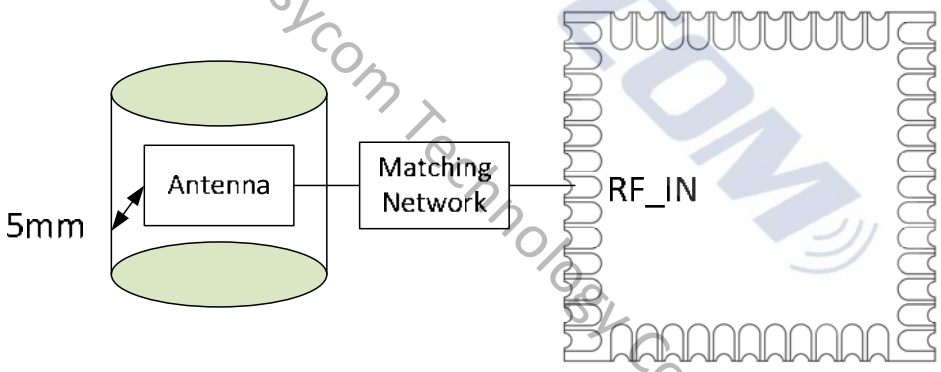


Figure 47: Leave 5mm Clearance Space from the Antenna

General design recommendations are:

- The length of the trace or connection line should be kept as short as possible.
- Distance between connection and ground area on the top layer should at least be as large as the dielectric thickness.
- Routing the RF close to digital sections of the system board should be avoided.
- To reduce signal reflections, sharp angles in the routing of the micro strip line should be avoided. Chamfers or fillets are preferred for rectangular routing; 45-degree routing is preferred over Manhattan style 90-degree routing.

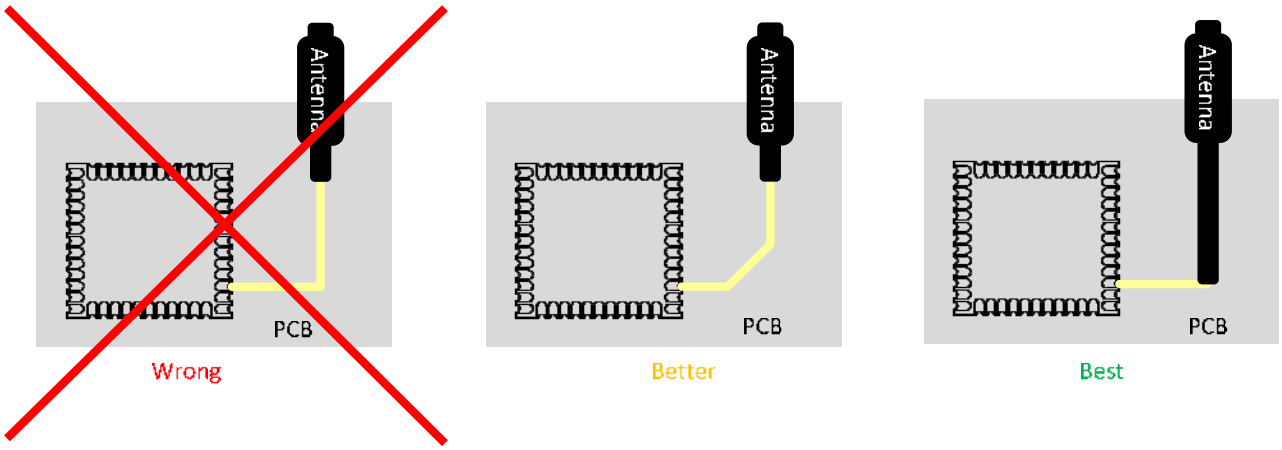


Figure 48: Recommended Trace Connects Antenna and the Module

- Routing of the RF-connection underneath the module should be avoided. The distance of the micro strip line to the ground plane on the bottom side of the receiver is very small and has huge tolerances. Therefore, the impedance of this part of the trace cannot be controlled.
- Use as many vias as possible to connect the ground planes.

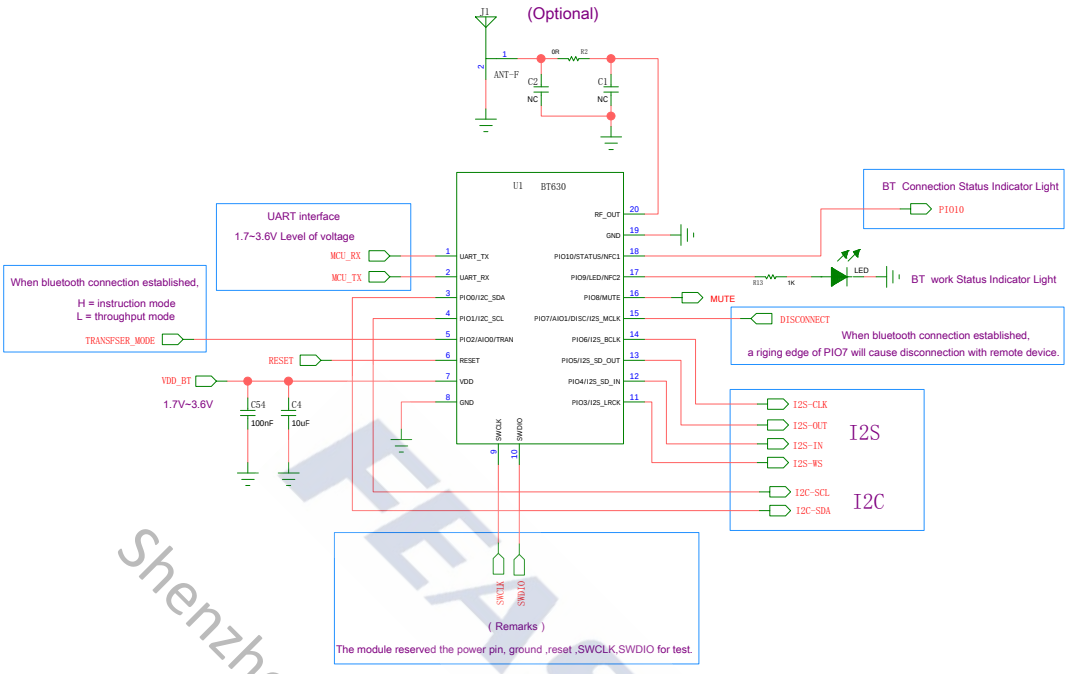
10. PRODUCT PACKAGING INFORMATION

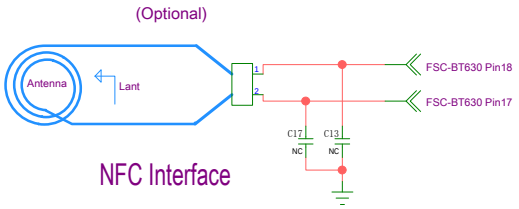
10.1 Default Packing

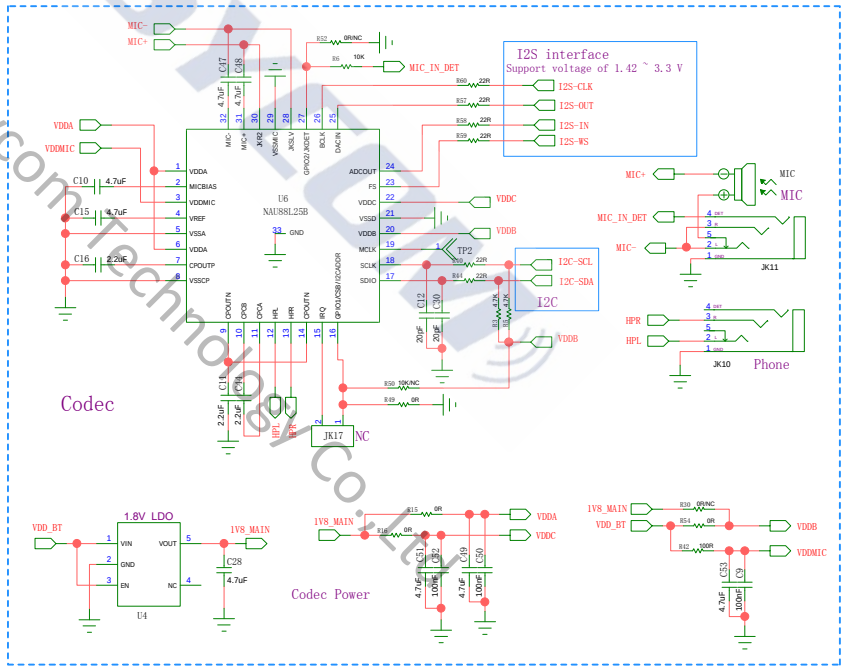
a, Tray vacuum

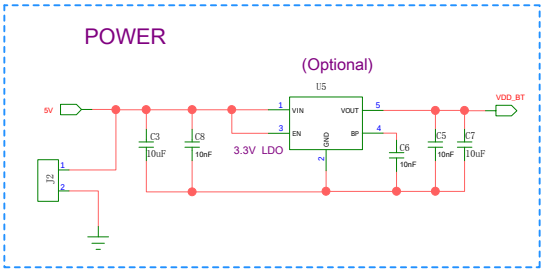
b, Tray Dimension: 180mm * 195mm

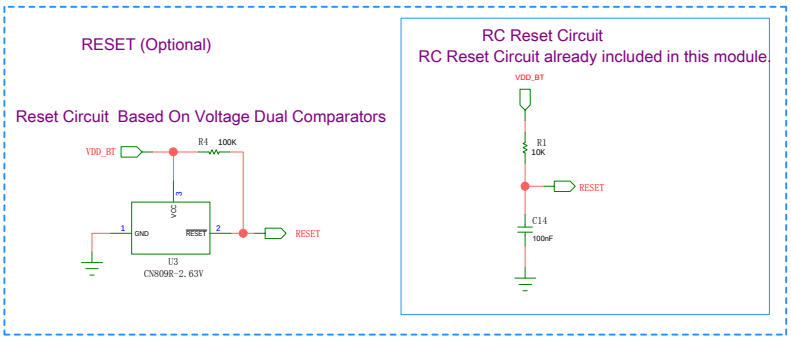
11. APPLICATION SCHEMATIC











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