

# SPNYL01-x

## High Efficiency 2.4GHz

### Wireless Module

**NAME: 2.4GHz Wireless IOT Module**  
**MODEL NO: SPNYL01-P/SPNYL01-E**  
**VERSION: P01**

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# 1. Product Description

SPNYL01 series is a powerful, highly flexible, ultra-low power wireless module using Nordic nRF52833 SoCs made for IOT applications. It was designed for high data rate wireless communication in the 2.4GHz ISM band. With an 32bit ARM®Cortex M4 MCU, available 512KB flash, 128KB RAM, embedded 2.4GHz multi-protocol transceiver.

SPNYL01 series brings out all nRF52833 hardware features and capabilities including USB, up to +8dBm transmit power, 5.5v Supply considerations and NFC tag implementation. Complete regulatory certifications enable faster time to market and reduced development risk

SPNYL01 supports an extensive range of wireless protocols. It supports BLE® (Bluetooth Low Energy),and is capable of Bluetooth® Direction Finding in addition Long Range and 2 Mbps. Bluetooth mesh,802.15.4, Thread, Zigbee, proprietary 2.4 GHz protocols and NFC-A are also supported.

## 2. Key Features

### Bluetooth® 5

- Direction Finding
- 2Mbps
- CSA#2
- Advertising Extensions
- Long Range

### IEEE 802.15.4 radio support

- Thread
- Zigbee

### Supported data rates

- Bluetooth®: 2 Mbps, 1 Mbps, 500 kbps, and 125 kbps
- IEEE 802.15.4-2006: 250 kbps
- Proprietary 2.4 GHz: 2 Mbps, 1 Mbps

Wide supply voltage range: 1.7 V to 5.5V

518kB Flash and 128kB RAM

Full set of digital interfaces including: SPI, TWI, UART, PDM, PWM, QDEC

12-bit, 200ksps ADC

128-bit AES ECB/CCM/AAR co-processor

Individual power management for all peripherals

On-chip DC/DC buck converter

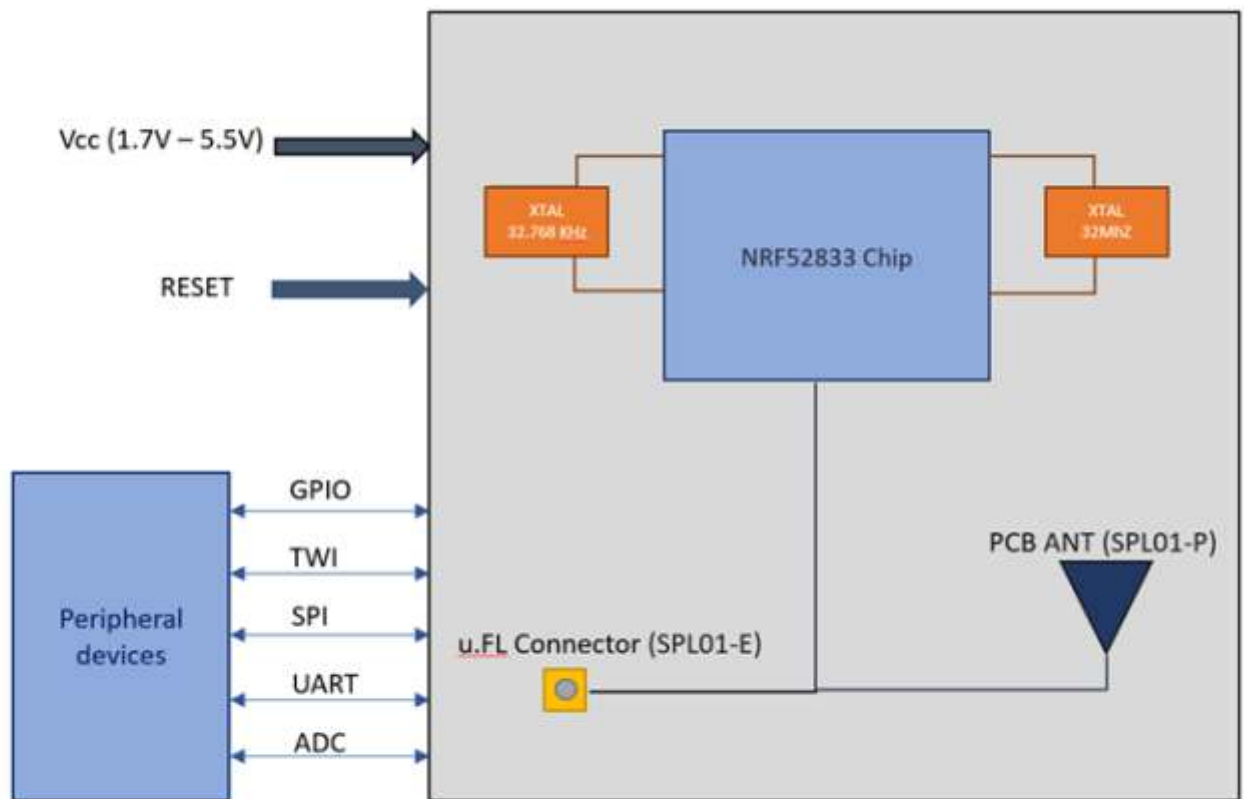
Dimension: 21.0 x 13.8 x 2.3mm (with shield)

40 GPIOs

## 3. Applications

- Internet of things (IoT)
  - Smart home sensors and controllers
  - Industrial IoT sensors and controllers
- Advanced wearables
  - Health/fitness sensor and monitor devices
  - Wireless payment enabled devices
- Advanced computer peripherals and I/O devices
  - Mouse
  - Keyboard
  - Multi-touch trackpad
- Interactive entertainment devices
  - Remote controls
  - Gaming controllers

## 4. Module Block Diagram



**Figure 1: SPNYL01 Block diagram**

## 5. Product Specifications

Details	Description
<b>Bluetooth</b>	
Feature	Bluetooth® Low Energy Bluetooth® Mesh Bluetooth® Direction Finding 1M LE PHY 2M LE PHY Coded LE PHY (Long Range) Advertising Extensions CSA #2
<b>Security</b>	
LE connections	<b>AES-128</b> Concurrent central, observer, peripheral, and broadcaster roles with up to twenty concurrent connections along with one observer and one broadcaster.
<b>Radio</b>	
Frequency	2360MHz - 2500MHz
Modulations	GFSK at 1 Mbps/2 Mbps 250kbps (IEEE 802.15.4-2006) and Long range (125kbps and 500kbps) data rates
Antenna	SPNYL01-P: PCB trace antenna SPNYL01-E: External 2.4Ghz antenna
<b>Current Consumption</b>	
TX only (DCDC enabled, 3V) @+8dBm / +4dBm / 0dBm / -4dBm/-20dBm/-40dBm	14.2mA / 9.6mA / 4.9mA / 3.8mA / 2.7mA / 2.3mA
TX only @ +8dBm / +4dBm / 0dBm / -4dBm / -20dBm / -40dBm	30.4mA / 20.7mA / 10.3mA / 8.0mA / 5.5mA / 4.5mA
RX only (DCDC enabled, 3V) @1Msps / 1Msps BLE	4.6mA
RX only @ 1Msps / 1Mbps BLE	9.6mA
RX only (DCDC enabled, 3V)@2Msps / 2Msps BLE	5.2mA
RX only @ 2Msps / 2Mbps BLE	10.7mA

System OFF mode (3V)	0.6uA
System OFF mode with full 64kB RAM retention (3V)	1.3uA
System ON mode, no RAM retention, wake on RTC (3V)	1.5uA
<b>Mechanical</b>	
Dimensions	Length: 21mm±0.2mm Width: 13.8mm±0.2mm Height: 2.3mm+0.1mm/-0.15mm
Package	34 diameters of Half-holes + 20 LGA pads
PCB material	FR-4
Impedance	50Ω
<b>Hardware</b>	
CPU	ARM® Cortex®-M4 32-bit processor with FPU, 64 MHz
Memory	512kB flash, 128kB RAM
Interfaces	4x SPI master/3x SPI slave with EasyDMA 2x I2C compatible two-wire master/slave 2x UART (CTS/RTS) with EasyDMA 3x real-time counter (RTC) 5x 32-bit timer with counter mode 4x 4-channel pulse width modulator (PWM) unit with EasyDMA 40 GPIOs 8x 12bit, 200ksps ADC Audio peripherals – I 2 S, digital microphone interface (PDM)
Power supply	1.7V to 5.5V
Operating temperature range	-40 to 85 °C (-40 to +105 °C can be customized)
Clock control	32.768 kHz +/-20 ppm crystal oscillator
Power regulator	DC/DC regulator setup

## 6. Module Pinout and Pin Description

### 6.1 Module Pinout

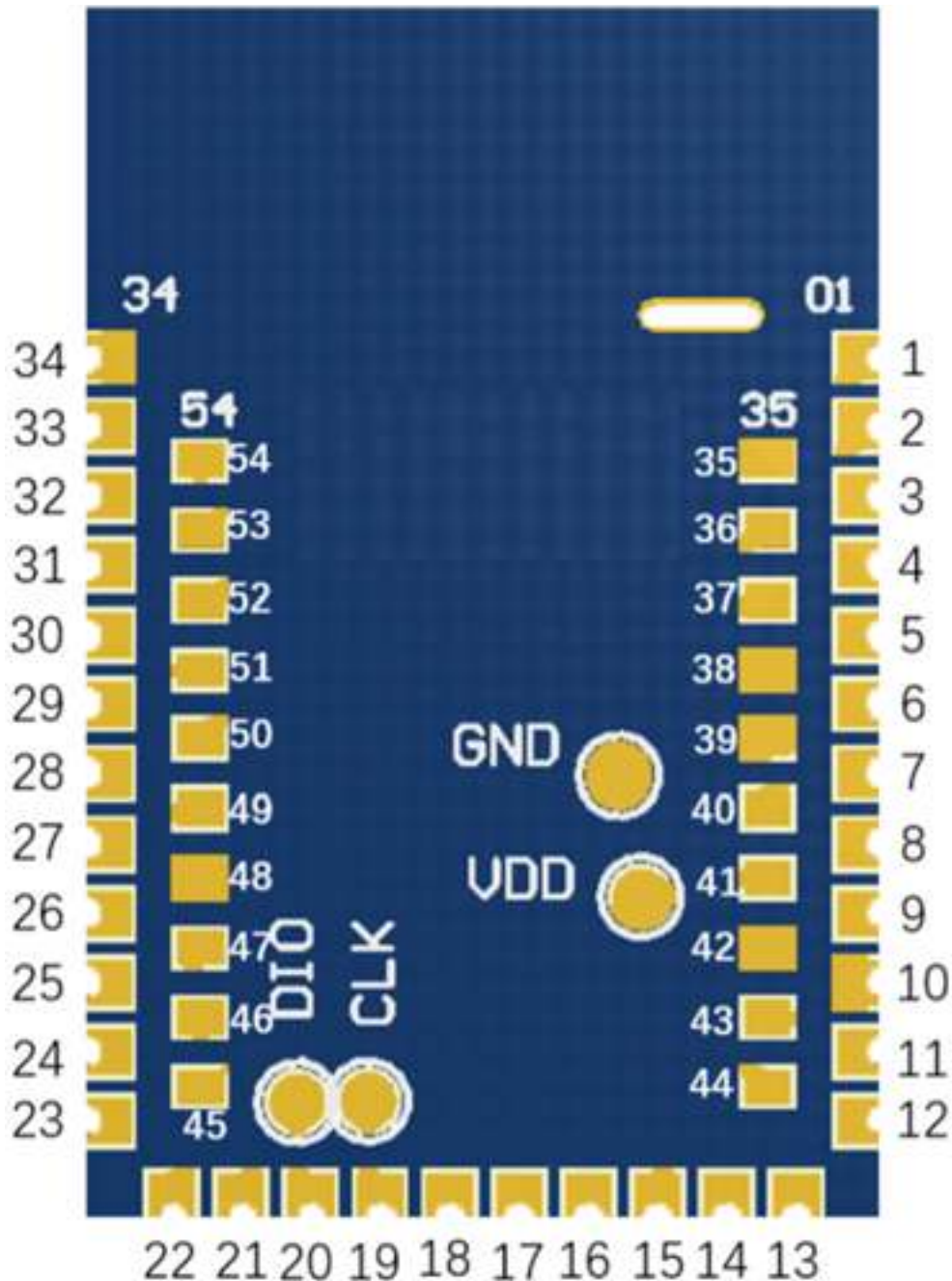


Figure 2:SPNYL01Module Pinout



## 6.2 Pin Assignment

Module Pin Number	Module Pin Name	Description
1	P0.25	General Purpose I/O
2	P0.23	General Purpose I/O
3	P0.03 AIN1	General Purpose I/O, SAADC/COMP/LPCOMP input
4	P0.02 AIN0	General Purpose I/O, SAADC/COMP/LPCOMP input
5	P0.28 AIN4	General Purpose I/O, SAADC/COMP/LPCOMP input
6	P0.29 AIN5	General Purpose I/O, SAADC/COMP/LPCOMP input
7	P0.30 AIN6	General Purpose I/O, SAADC/COMP/LPCOMP input
8	P0.31 AIN7	General Purpose I/O, SAADC/COMP/LPCOMP input
9	VDD	Power Supply
10	GND	Ground
11	P0.27	General Purpose I/O
12	P0.26	General Purpose I/O
13	P0.04 AIN2	General Purpose I/O, SAADC/COMP/LPCOMP input
14	P0.06	General Purpose I/O
15	P0.05 AIN3	General Purpose I/O, SAADC/COMP/LPCOMP input
16	P0.08	General Purpose I/O
17	P0.09 NFC1	General purpose I/O, NFC antenna connection
18	P0.10 NFC2	General purpose I/O, NFC antenna connection
19	SWDCLK	Serial wire debug clock input for debug and programming
20	SWDIO	Serial wire debug I/O for debug and programming
21	P0.07 TRACECLK	General Purpose I/O, Trace buffer clock
22	PO.11 TRACEDATA[2]	General Purpose I/O, Trace buffer TRACEDATA
23	PO.12 TRACEDATA[1]	General Purpose I/O, Trace buffer TRACEDATA
24	P0.13	General Purpose I/O
25	P0.14	General Purpose I/O
26	P0.15	General Purpose I/O

27	P0.16	General Purpose I/O
28	P0.17	General Purpose I/O
29	P0.18 nRESET	General purpose I/O, Configurable as pin reset
30	P0.20	General Purpose I/O
31	P0.21	General Purpose I/O
32	P0.22	General Purpose I/O
33	P0.24	General Purpose I/O
34, 35	GND	Ground
36	P1.05	General Purpose I/O
37	P1.03	General Purpose I/O
38	GND	Ground
39	GND	Ground
40	P0.19	General Purpose I/O
41	VDDH	High Voltage Power supply
42	GND	Ground
43	P1.08	General Purpose I/O
44	P1.09 TRACEDATA[3]	General Purpose I/O, Trace buffer TRACEDATA
45	VBUS	5V input for USB 3.3v Regulator
46	D-	USB D-
47	D+	USB D+
48	GND	Ground
49	P1.00 TRACEDATA[0]/ SWO	General Purpose I/O, Trace buffer TRACEDATA/ Serial Wire Output
50	P1.01	General Purpose I/O
51	P1.02	General Purpose I/O
52	P1.04	General Purpose I/O
53	P1.06	General Purpose I/O
54	P1.07	General Purpose I/O

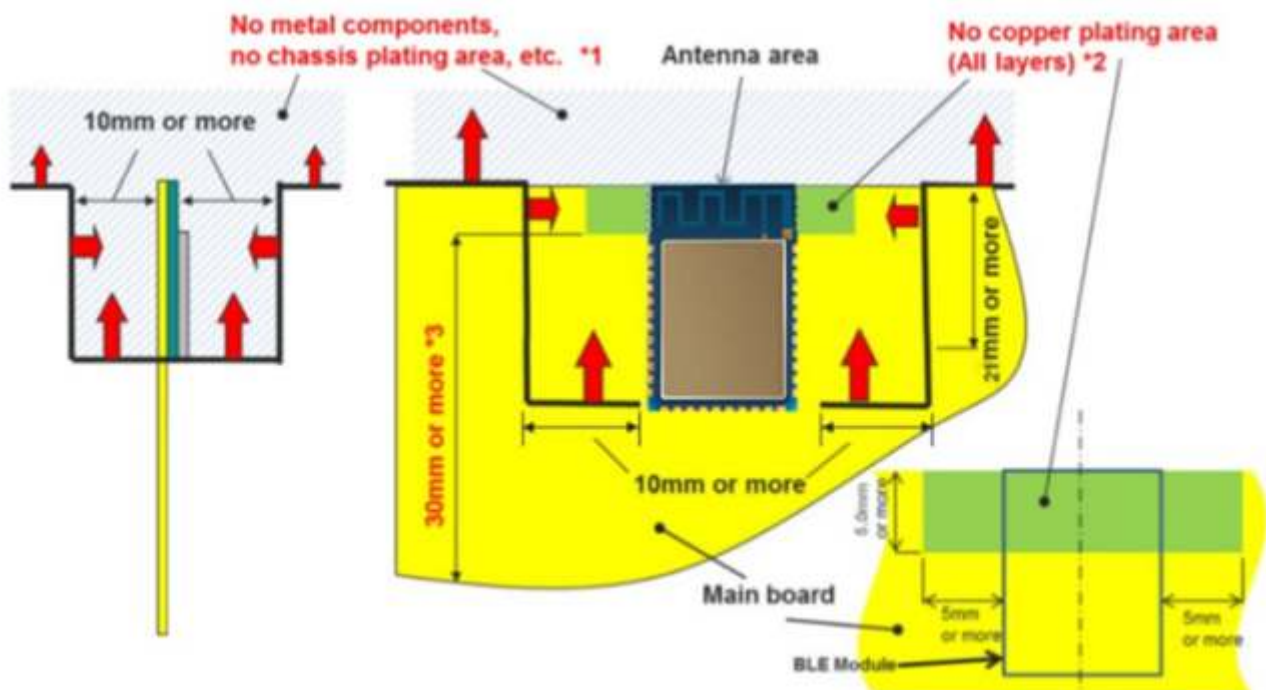
## 7. PCB Design Guide

### 7.1 Layout notes

You can refer to the following references for the mounting design of the module with on-board antenna (SPNYL01-P with PCB antenna).

For external antenna modules (SP01L-E needs to connect an external antenna to the u.FLconnector), you need to refer to the external antenna design requirements.

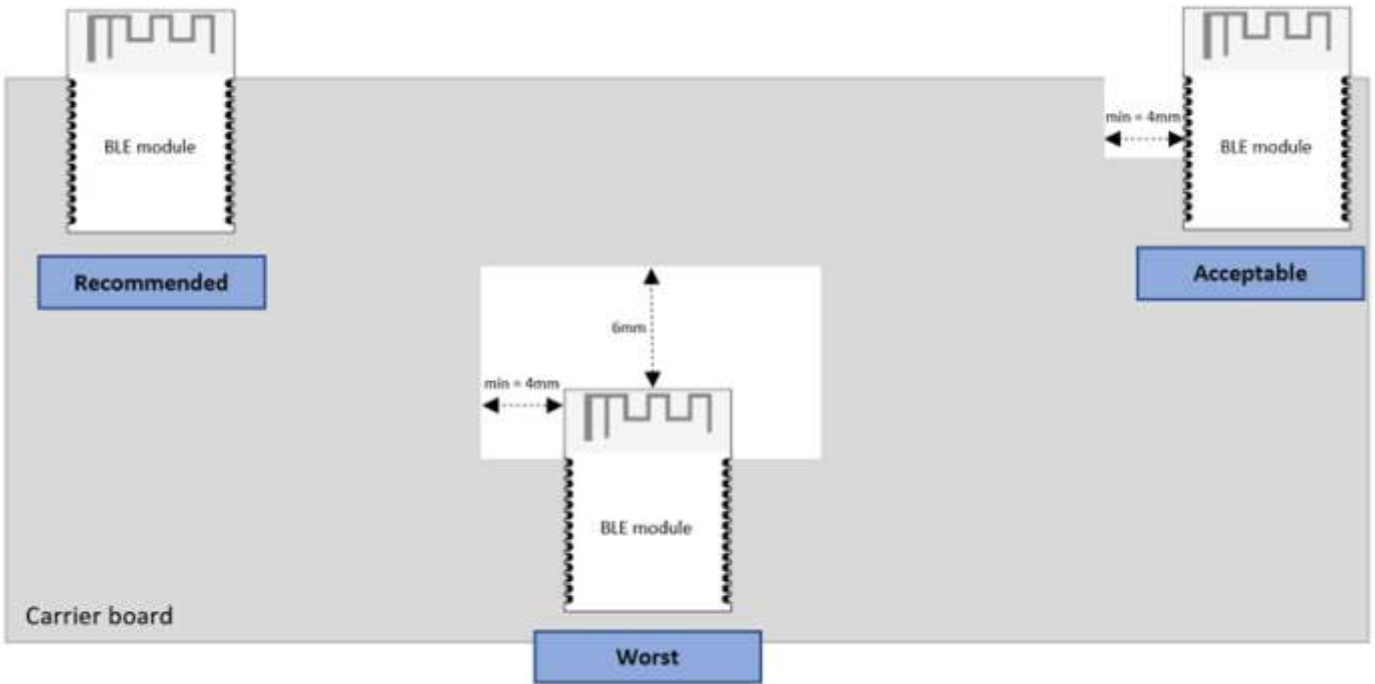
#### Recommended module mounting example:



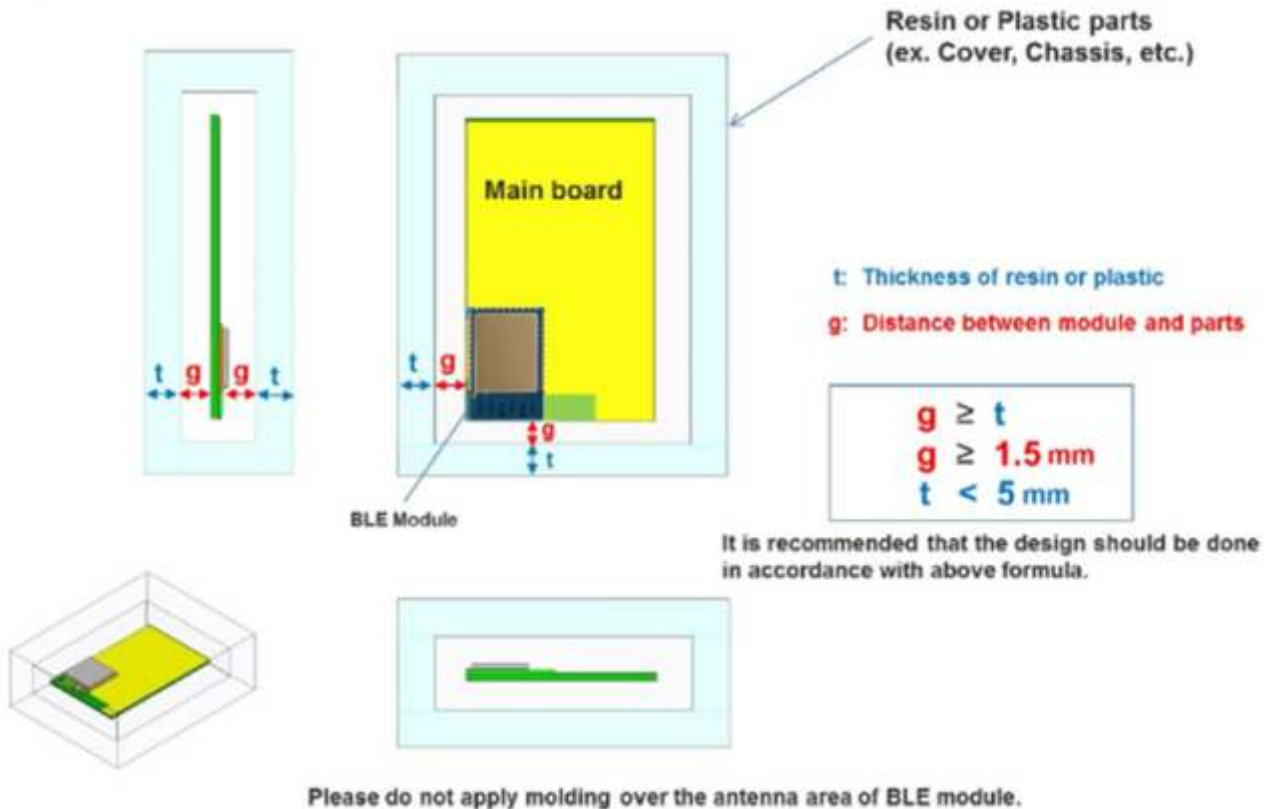
Please do not place any metal components in blue shaded space (\*1), such as signal line and metal chassis as possible except for main board while mounting the components in \*1 space on the main board is allowed except for no copper plating area (\*2).

- (\*2) This area is routing prohibited area on the main board. Please do not place copper on any layer.
- (\*3) Characteristics may deteriorate when GND pattern length is less than 30mm. It should be 30 mm or more as possible.
- For the best Bluetooth range performance, the antenna area of module shall extend 3 mm outside the edge of main board, or 3 mm outside the edge of a ground plane. Ground plane shall be at least 5 mm from the edge of the antenna area of module.
- All module GND pins MUST be connected to main board GND. Place GND vias close to module GND pads as possible. Unused PCB area on surface layer can be flooded with copper but place GND vias regularly to connect copper flood to inner GND plane. If GND flood copper under side the module then connects with GND vias to inner GND plane.
- Even when above mentioned condition is satisfied, communication performance may be significantly deteriorated depending on the structure of the product. Bluetooth range performance is degraded if a module is placed in the middle of the main board.

- For main board layout:
  - Avoid running any signal line below module whenever possible.
  - No ground plane below antenna.
  - If possible, cut-off the portion of main board below antenna.



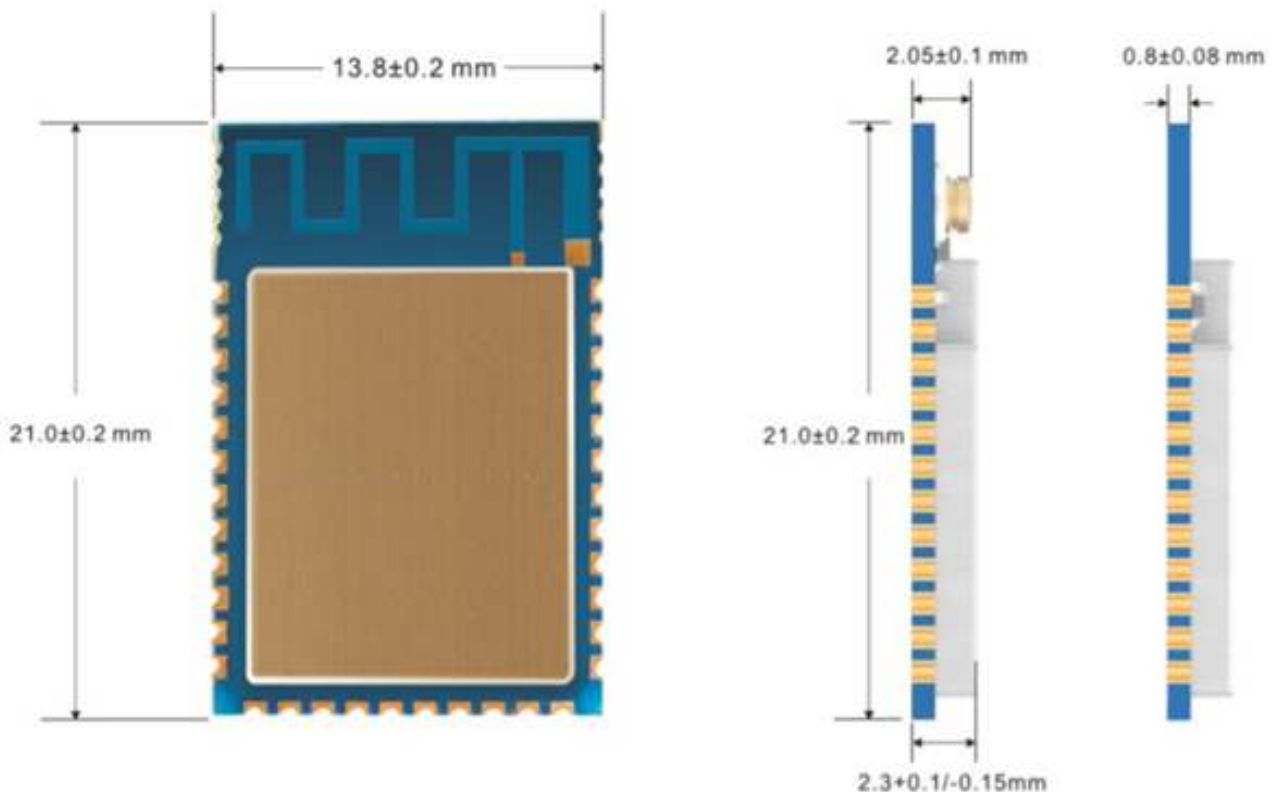
**Placement of resin or plastic parts:**



**Placement of metal parts:**

- Minimum safe distance for metal parts without seriously compromising the antenna (tuning) is 40 mm top/bottom and 30 mm left or right.
- Metal close to the module antenna (bottom, top, left, right, any direction) will have degradation on the antenna performance. The amount of that degradation is entirely system dependent, meaning you will need to perform some testing with your host application.
- Any metal closer than 20 mm will begin to significantly degrade performance (S11, gain, radiation efficiency).
- It is best that you test the range with a mock-up (or actual prototype) of the product to assess effects of enclosure height (and materials, whether metal or plastic).

## 8. Mechanical Dimensions



Symbol	Min.	Typ.	Max.
Length	-0.2mm	21mm	+0.2mm
Width	-0.2mm	13.8mm	+0.2mm
Height (PCB only)	-0.08mm	0.8mm	+0.08mm
Height (with shield)	-0.15mm	2.3mm	+0.1mm

## 9. PCB Footprint and Dimensions

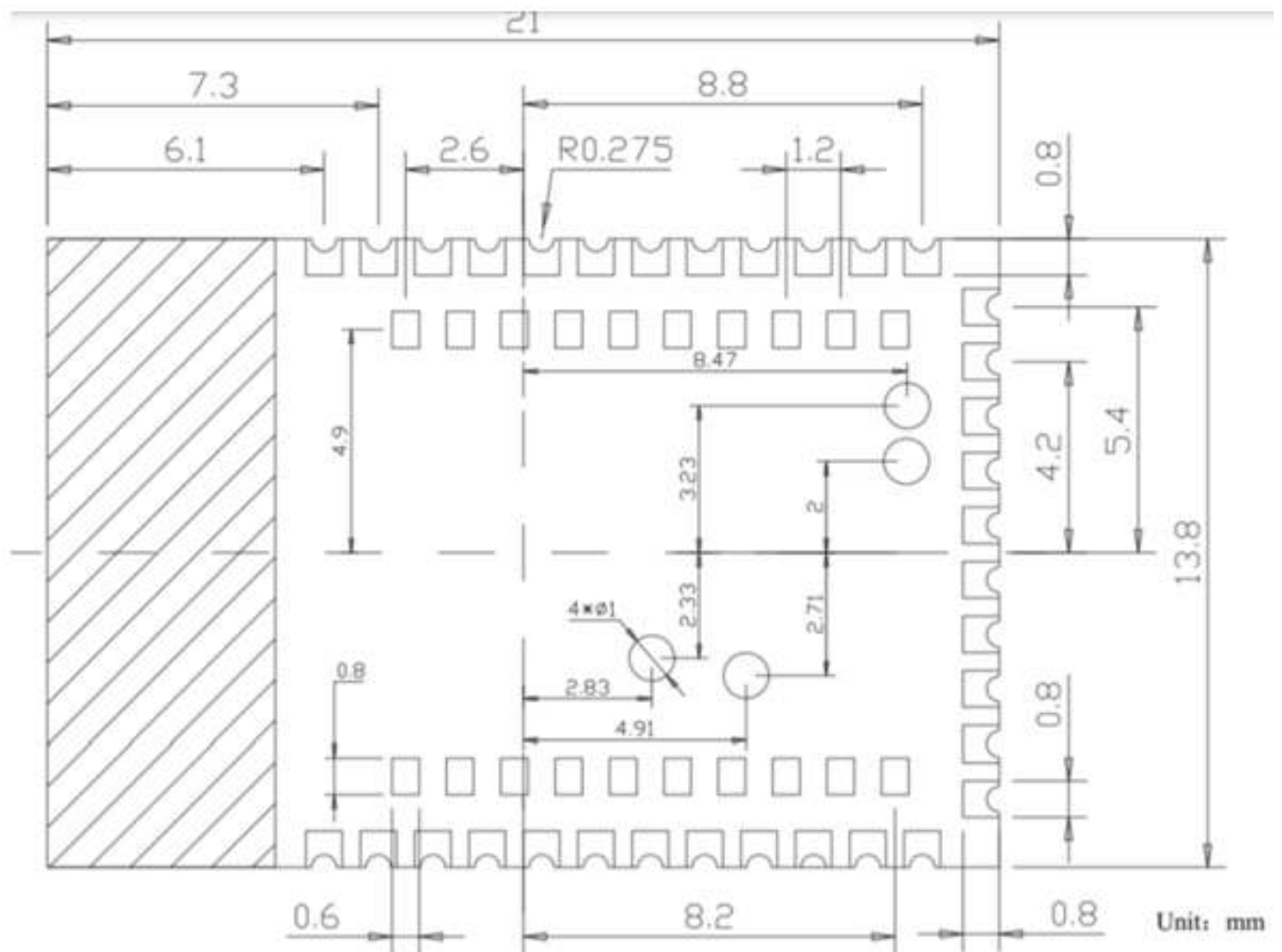


Figure 7: SPNYL01 PCB Footprint and Dimensions

# 10. Cautions

## 10.1 Reflow soldering

Reflow soldering is a vitally important step in the SMT process. The temperature curve associated with the reflow is an essential parameter to control to ensure the correct connection of parts. The parameters of certain components will also directly impact the temperature curve selected for this step in the process.

### Temperature-Time Profile for Reflow Soldering:



- The standard reflow profile has four zones: ①preheat, ②soak, ③reflow, ④cooling. The profile describes the ideal temperature curve of the top layer of the PCB.
- During reflow, modules should not be above 260°C and not for more than 30 seconds.

Specification	Value
Temperature Increase Rate	<2.5°C/s
Temperature Decrease Rate	Free air cooling
Preheat Temperature	0-150°C
Preheat Period (Typical)	40-90s
Soak Temp Increase Rate	0.4-1°C/s
Soak Temperature	150-200°C
Soak Period	60-120s
Liquidus Temperature (SAC305)	220°C
Time Above Liquidus	45-90s
Reflow Temperature	230-250°C
Absolute Peak Temperature	260°C

**Note:** The module is LGA package. Please be careful of the amount of solder paste. The module may be lifted due to excess solder.

## 10.2 Usage Condition Notes

- Follow the conditions written in this specification, especially the recommended condition ratings about the power supply applied to this product.
- The supply voltage has to be free of AC ripple voltage (for example from a battery or a low noise regulator output). For noisy supply voltages, provide a decoupling circuit (for example a ferrite in series connection and a bypass capacitor to ground of at least 47uF directly at the module).
- Take measures to protect the unit against static electricity. If pulses or other transient loads (a large load applied in a short time) are applied to the products, check and evaluate their operation before assembly on the final products.
- The supply voltage should not be exceedingly high or reversed. It should not carry noise and/or spikes.
- This product away from other high frequency circuits.
- Keep this product away from heat. Heat is the major cause of decreasing the life of these products.
- Avoid assembly and use of the target equipment in conditions where the product's temperature may exceed the maximum tolerance.
- This product should not be mechanically stressed when installed.
- Do not use dropped products.
- Do not touch, damage or soil the pins.
- Pressing on parts of the metal shield or fastening objects to the metal shield will cause damage.

## 10.3 Storage Notes

- The module should not be stressed mechanically during storage.
- Do not store these products in the following conditions or the performance characteristics of the product, such as RF performance will be adversely affected:
  - Storage in salty air or in an environment with a high concentration of corrosive gas.
  - Storage in direct sunlight
  - Storage in an environment where the temperature may be outside the range specified.
  - Storage of the products for more than one year after the date of delivery storage period.
- Keep this product away from water, poisonous gas and corrosive gas.
- This product should not be stressed or shocked when transported.



## 11. Package information

Details	Tape and Reel
Quantity (module)	400 pcs
Single module Weight	45.0g
Dimension	23 x 16.5 x 3.2 mm (L x W x H)

## 12. Ordering information

Model No	Antenna	Module	
		SoC	Flash/RAM
SPNYL01-P	SPNYL01-E	nRF52833-QIAA	512KB/128KB
SPNYL01-E	u.FL Connector	nRF52833-QIAA	512KB/128KB

## Revision History

Revision	Description	Author	Date
V1.0	Initial Release	Brosnan	2021.10.04

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