Radiocontrolli
Wireless Modules

Lora Wireless Module STM32WLE5 based

R**C-WLE5-868** is an ultra low power long range device designed by RadioControlli. The module is based on STM32WLE5JC device from STMicroelectronics.
The STM32WLE5 long-range wireless and ultra-low-power devices embed a powerful and ultra-low-power LPWAN-compliant radio solution, enabling the following modulations:
LoRa®, (G)FSK, (G)MSK, and BPSK.
These devices are designed to be extremely low-power and are based on the high-performance Arm® Cortex®-M4 32-bit RISC core operating at a frequency of up to 48 MHz. This core implements a full set of DSP instructions and an independent memory protection unit (MPU) that enhances the application security.
The devices embed high-speed memories (flash memory up to 256 Kbytes, SRAM up to 64 Kbytes), and an extensive range of enhanced I/Os and peripherals.

The main applications of this module are Internet of Things devices and wireless sensor networks , especially battery powered low power consumption long range.
Operative Frequency bands : 868MHz.

Ready for use SMD mounting (13 x 14.5mm) - Metal shield.

For more information and details, please refer to the STM32WLE5J datasheet (www.st.com).

Module Information :

RC-WLE5-868 ⟶ **Standard Version (UFL Connector)**

RC-WLE5-868-HA ⟶ **Helical Antenna Version**

RC-WLE5-868 is designed to be easily integrated into your hardware application, we provide 2 versions:

1) Standard version with UFL connector
You can use the UFL connector where you can directly connect the antenna. The RF output signal is also present on a 50 ohm pin (pin 15) in case you want to create your own antenna project on your pcb.

2) Version with helical antenna (full version)

Applications:

- Smart meters
- Wireless security systems
- Home and Building automation
- 6LoWPAN systems
- Automatic Measure Reading
- Low-Power Wireless Systems
- Wireless Sensor Networks
- Remote Control
- Street Lights System
- Parking Sensors
- Environmental Sensors
- Smart Grid and Automatic Meter Reading

DESCRIPTION

The **RC-WLE5-XXX** long-range wireless and ultra-low-power devices embed a powerful and ultra-low-power radio compliant LPWAN radio solution : LORA (only available in STM32WLE5) , (G(FSK,(H)MSK and BPSK.

The devices embed high-speed memories (Flash memory up to 256 Kbytes, SRAM up to 64 Kbytes), and an extensive range of enhanced I/Os and peripherals.
The devices also embed several protection mechanisms for embedded Flash memory and SRAM: readout protection, write protection and proprietary code readout protection.
These devices offer a 12-bit ADC, a 12-bit DAC low-power sample-and-hold, two ultra-low-power comparators associated with a high-accuracy reference voltage generator. The devices embed a low-power RTC with a 32-bit sub-second wakeup counter, one 16-bit single-channel timer, two 16-bit four-channel timers (supporting motor control), one 32-bit four-channel timer and three 16-bit ultra-low-power timers.

CORE : STM32WLE5JC
SIZE : 14.5 x 13 x 2.8mm

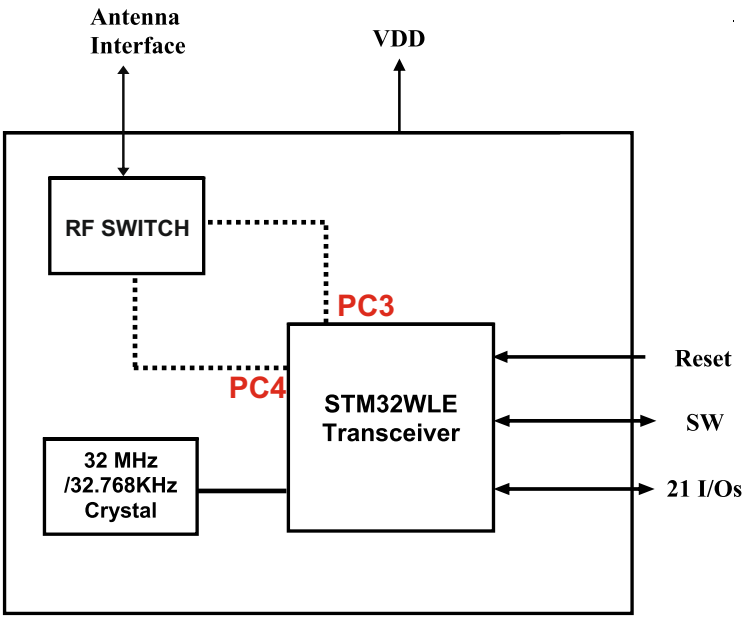
TECHNICAL CHARACTERISTICS

	Characteristics	MIN	TYP	MAX	UNIT
V_{CC}	Supply Voltage	2.5	3.3	3.7	Vdc
I_S	Supply Current (Sleep mode)		2.0		uA
I_{S1}	Supply Current (Receive mode)		5.0		mA
I_{S2}	Supply Current (Transmit mode)		120.0		mA
F	Frequency		868.0		Mhz
T	RF TX Power			18.5	dBm
S	RX Sensitivity		140		dBm
TE	Operating Temperature Range	-20		+70	°C

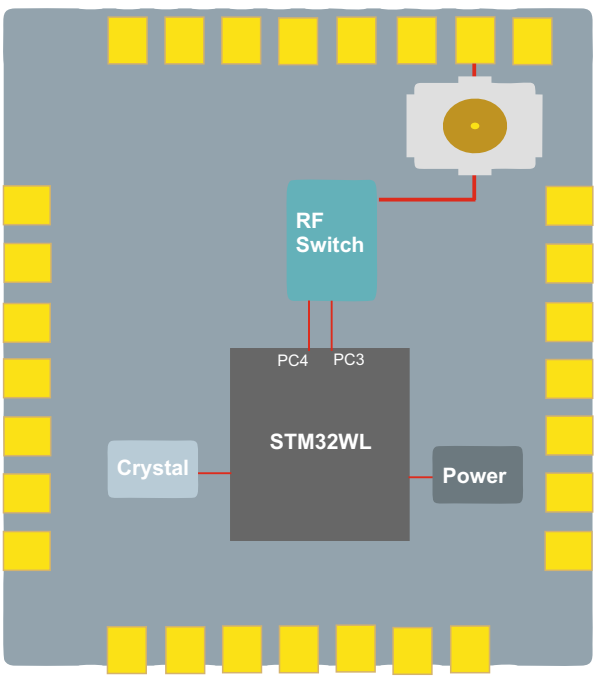
BLOCK DIAGRAM

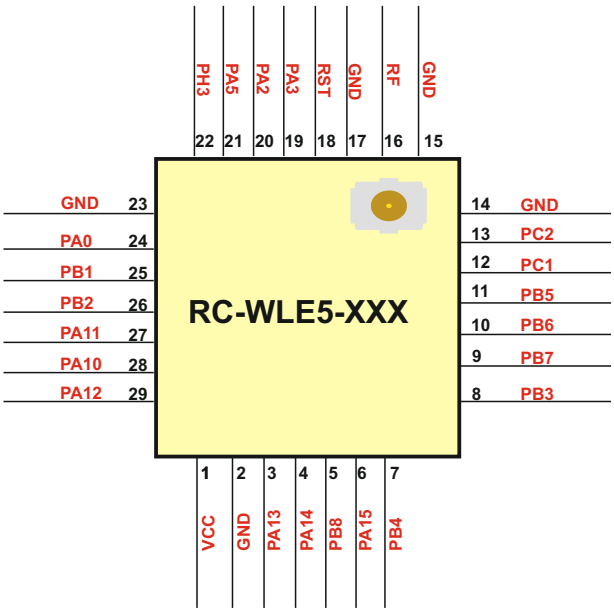
The module denominated RC-WLE5-XXX is based on STM32WL5Jx device which integrates :
- ARM Cortex M4 processor
- Sx126x LoRa transceiver

on the same chip.



RF Switch Control	PC3	PC4	RF Mode
	1	0	TX
	0	1	RX





Electrical Parameters about the crystal XTAL used (32MHz)

No.	Item	Symb.	Electrical Specification				Remark
			Min.	Typ.	Max.	Units	
1	Nominal Frequency	F0	32.000000			MHz	
2	Mode of Vibration		Fundamental				
3	Frequency Tolerance	△F/F0	-10	-	10	ppm	At 25℃±3℃
4	Operating Temperature Range	T_{OPR}	-40	-	85	℃	
5	Frequency Stability (over operating temperature)	TC	-20	-	20	ppm	Ref. to 25℃
6	Storage Temperature	T_{STG}	-55	-	125	℃	
7	Load capacitance	CL	-	10	-	pF	
8	Equivalent Series Resistance	ESR	-	-	60	Ω	
9	Drive Level	DL	-	50	100	μW	
10	Insulation Resistance	IR	500	-	-	MΩ	At 100V_{DC}
11	Shunt Capacitance	C0	-	-	3	pF	
12	Aging Per Year	Fa	-2	-	2	ppm	First Year
13	Package type	HCX-1SB					

Electrical Parameters about the crystal XTAL used (32.768KHz)

Electrical Specifications

Item / Type	9H T11
Norminal Frequency	32.768 KHz
Frequency Tolerance(at 25 ℃)	± 20 ppm , or specify
Operation Temperature Range	– 40 ~ + 85 ℃
Shunt Capacitance (C0)	1.3pF typical
Motional Capacitance (C1)	6.4fF typical
Insulation Resistance (IR)	500 MΩ Min.
Drive Level (DL)	0.5 μW Max.
Load Capacitance(CL)	12.5 pF , other spec.
Turnover Temperature (Ti)	25 ℃ ± 5 ℃
Parabolic Coefficient (B)	(- 0.03 ± 0.01) * 10^{-6} / ℃^{2}
Aging (at 25 ℃)	± 3 ppm at first year
Storage Temperature Range	– 55 ~ +125 ℃

Equivalent Series Resistance(ESR)

T11
90 KΩ Max

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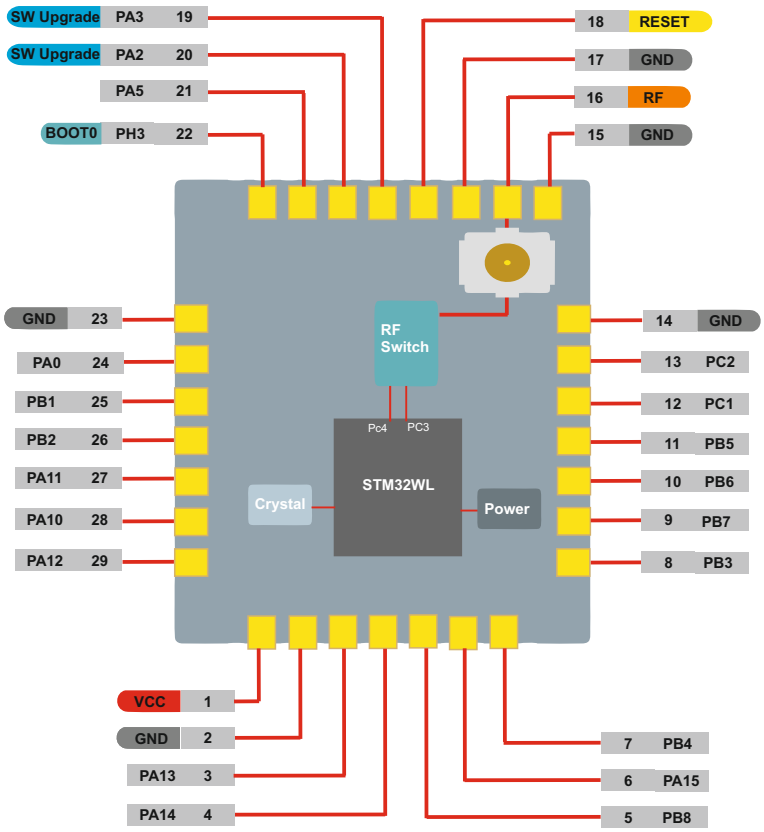
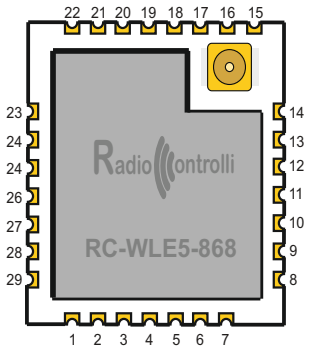
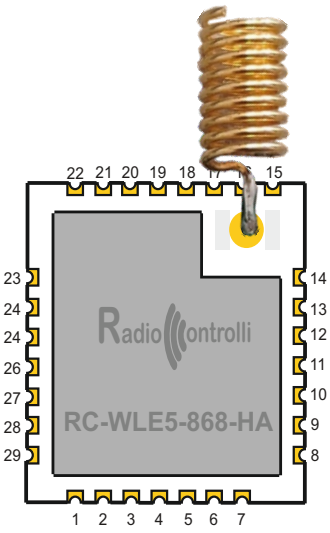
PINOUT Main System Peripherals and GPIOs



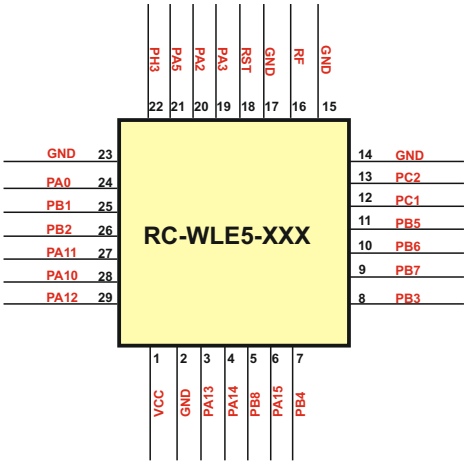


Standard Version



Helical Antenna Version

Pin Descriptions			
Pin Number	Name	I/O	Description
01	VCC	-	Supply Voltage
02,14,15,17,23	GND	-	Ground
03	PA13	I/0	Input / Output pin
04	PA14	I/0	Input / Output pin
05	PB8	I/0	Input / Output pin
06	PA15	I/0	Input / Output pin
07	PB4	I/0	Input / Output pin
08	PB3	I/0	Input / Output pin
09	PB7	I/0	Input / Output pin
10	PB6	I/0	Input / Output pin
11	PB5	I/0	Input / Output pin
12	PC1	I/0	Input / Output pin
13	PC2	I/0	Input / Output pin
16	RF	O	Antenna RF Out
18	RST	I	Reset trigger input
19	PA3	I/0	USART2 RX - Input / Otput / firmware upgrade
20	PA2	I/0	USART2 TX - Input / Otput / firmware upgrade
21	PA5	I/0	Input / Output pin
22	PH3	I/0	BOOT0 - Startup Mode Selection
24	PA0	I/0	Input / Output pin
25	PB1	I/0	Input / Output pin
26	PB2	I/0	Input / Output pin
27	PA11	I/0	Input / Output pin
28	PA10	I/0	Input / Output pin
29	PA12	I/0	Input / Output pin



REFERENCE SCHEMATICS

Software Upgrade through USART

Normally BOOT0 (PH3) must be connected to GND
When is necessary to make an USART firmware upgrade, the BOOT0 (PH3) must be connected to VCC.

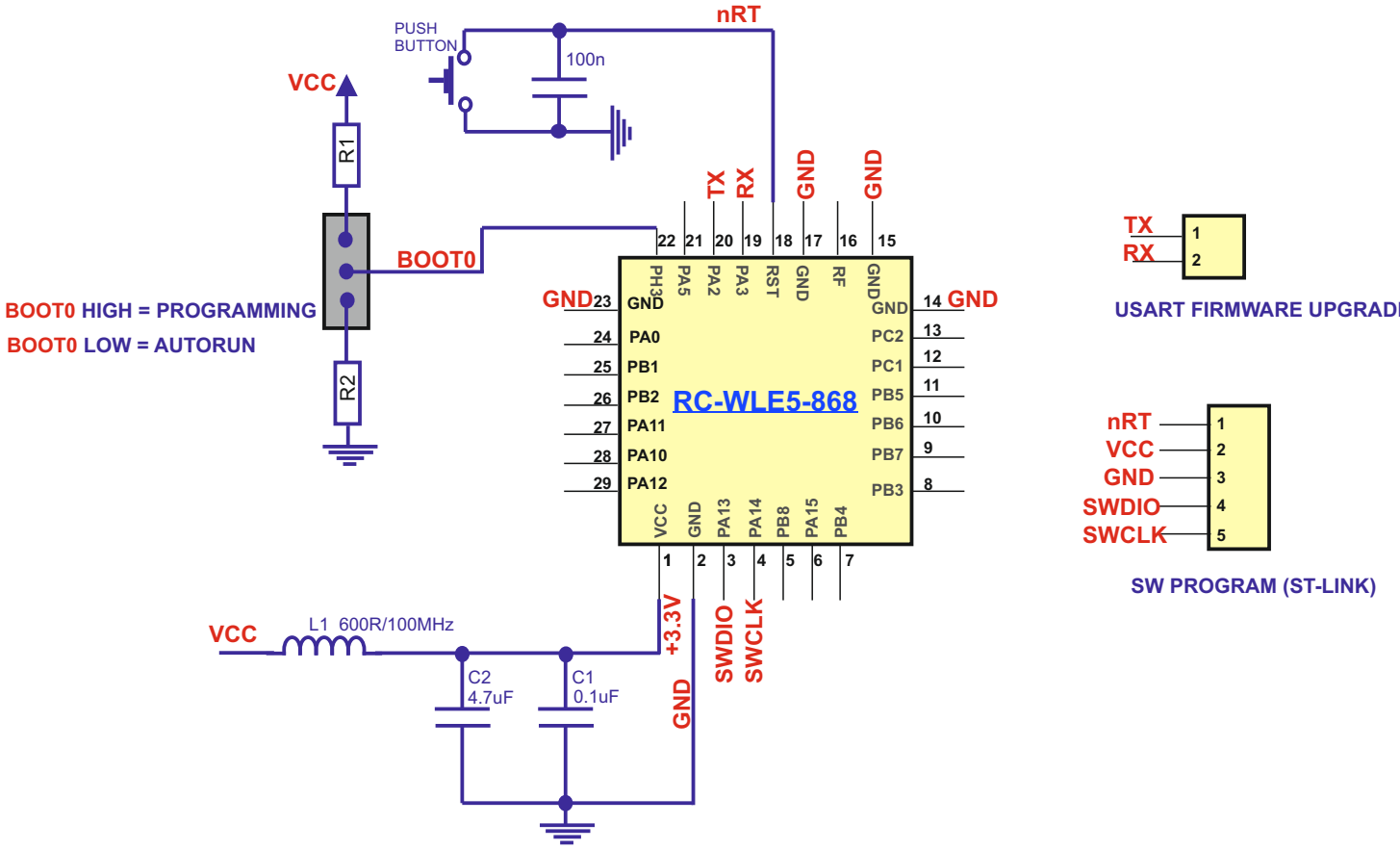
Software Program through ST-LINK

While programming through ST-LINK it's not necessary to connect BOOT0 to VCC.

RF Switch Control

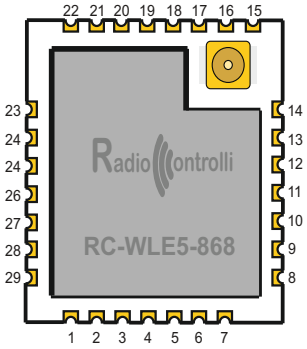
The RF Switch that select the TX/RX of the module is controlled by the STM32WL5 using two GPIO (PC3 and Pc4). These GPIO aren't output in the module footprint, must be driven through the firmware (see table below).

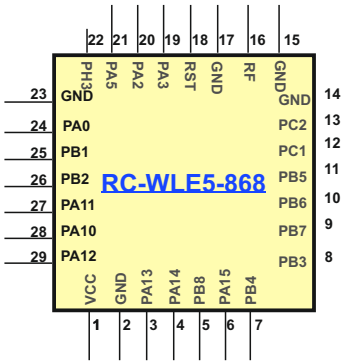
	PC3	PC4	RF Mode
RF Switch Control	1	0	TX
	0	1	RX



VERSIONS:

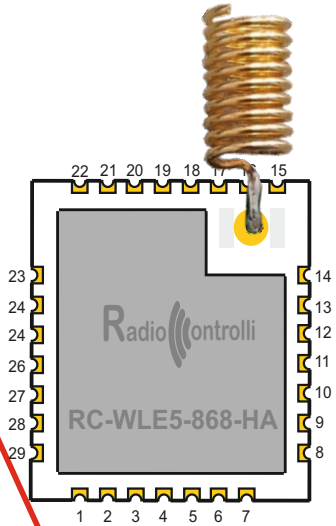
STANDARD Version = **RC-WLE5-868**

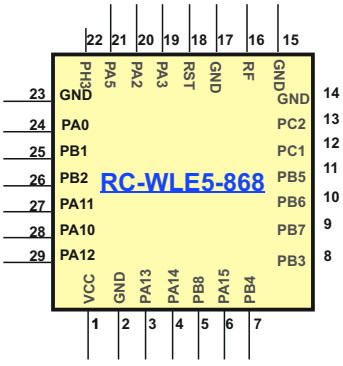




Antenna Connection throught UFL connector

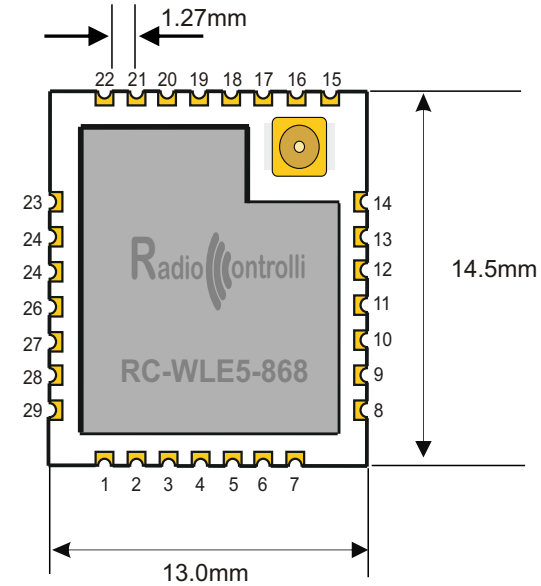
ANTENNA VERSION = **RC-WLE5-868-HA**

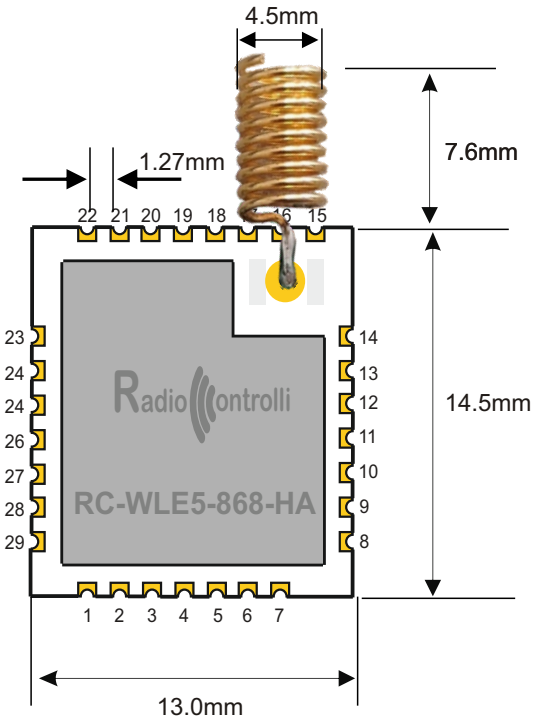


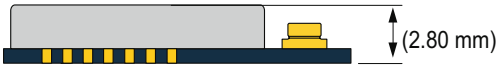


868MHz Helical Antenna

MECHANICAL DIMENSIONS:

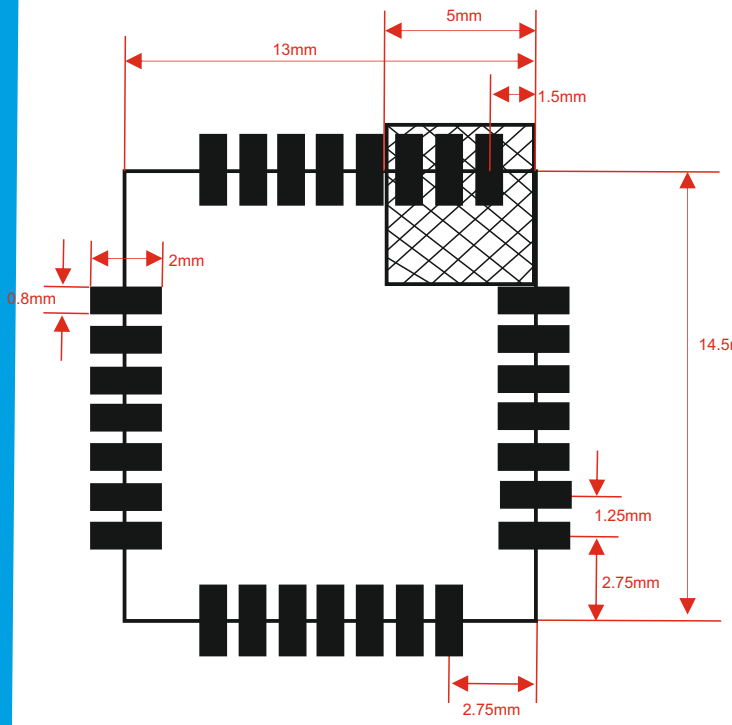


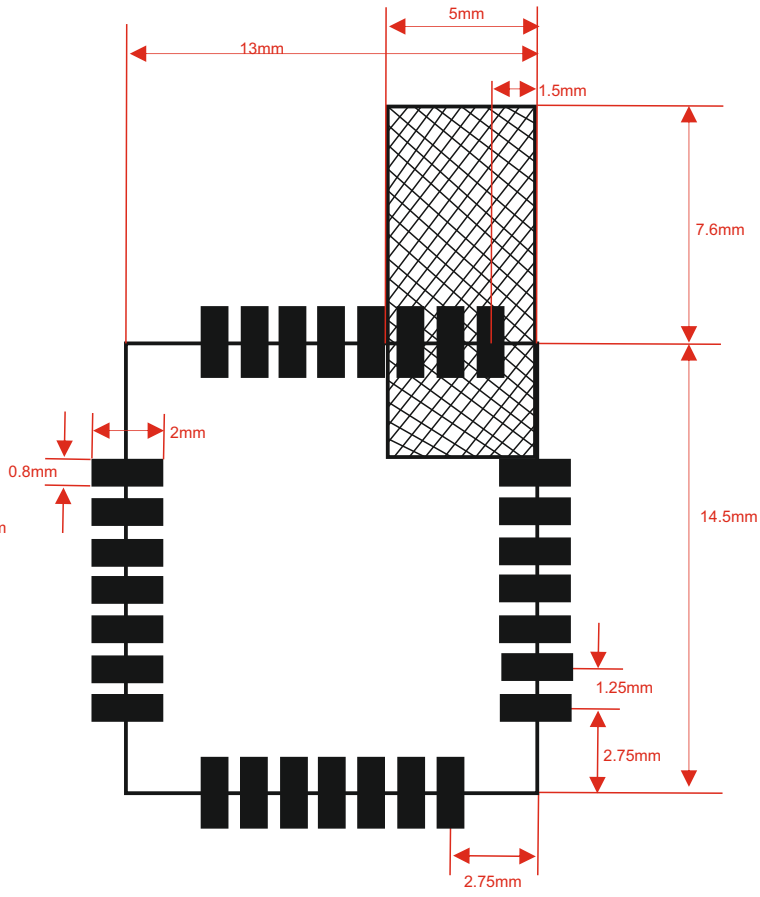




Tolerance ±0.5mm

RECOMMENDED PCB LAYOUT:





Note :
Make sure in the shadow area shall without any wiring or ground.

RECOMMENDED HARDWARE DESIGN:

1) Hardware

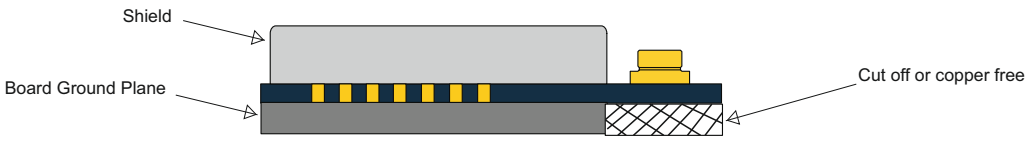
All unused pins should be left floating; do not ground.
All GND pins must be well grounded.
Traces should not be routed underneath the module.

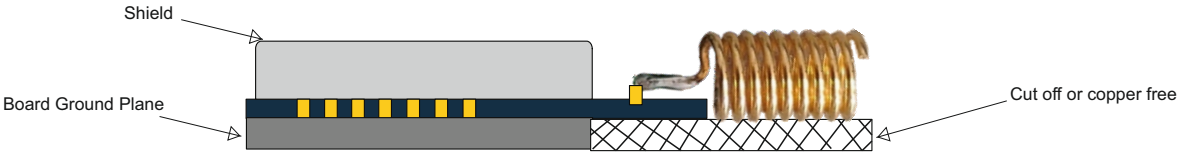
2) Power Supply

The transceiver module must be powered from a regulated voltage.
It is recommended to keep the power supply line for VCC as short and low impedence as possible. Near the power pins it is recommended to insert a ceramic the decoupling capacitor (100nF).

3) Ground Plane

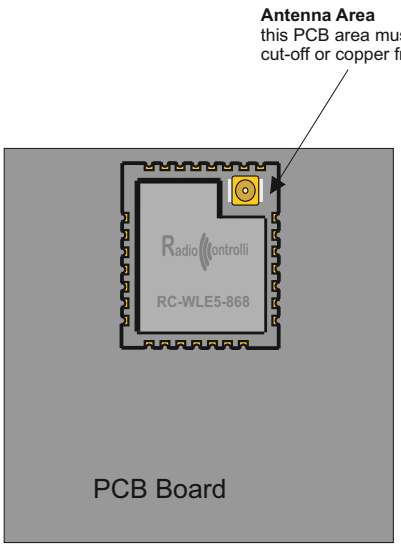
It is recommended to have a copper ground plane under the shielded zone of the module. The ground plane should be unbroken and unifed flood as possible especially on top and botton layer.
Use a a lot of grounding vias as possible.
Make sure there are no wires or earth in the shaded area, even better if this part isn't there (it's cut off).



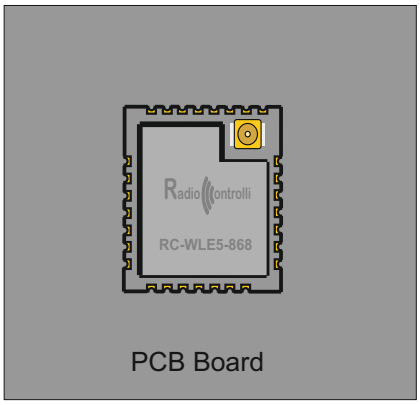


4) Module Placement

The antenna on the PCB has an omnidirectional radiation pattern. To maximize antenna efficiency, an adequate grounding plane must be provided under the module. Instead the areas underneath and surrounding the antenna area must be free of copper.

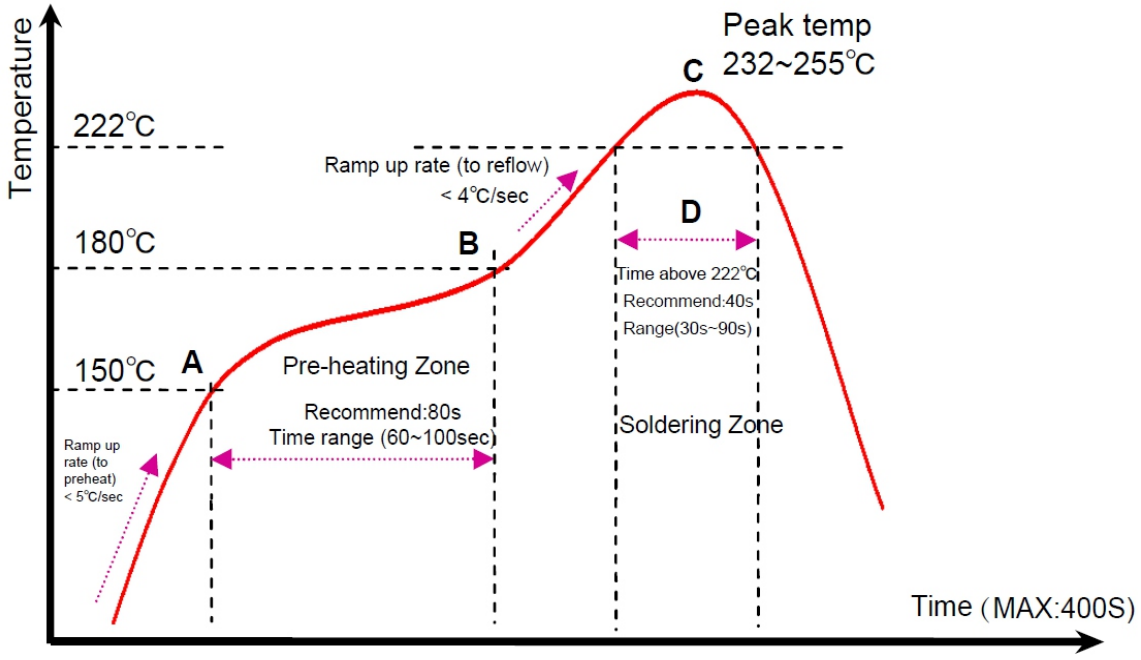


Recommended location XY plane

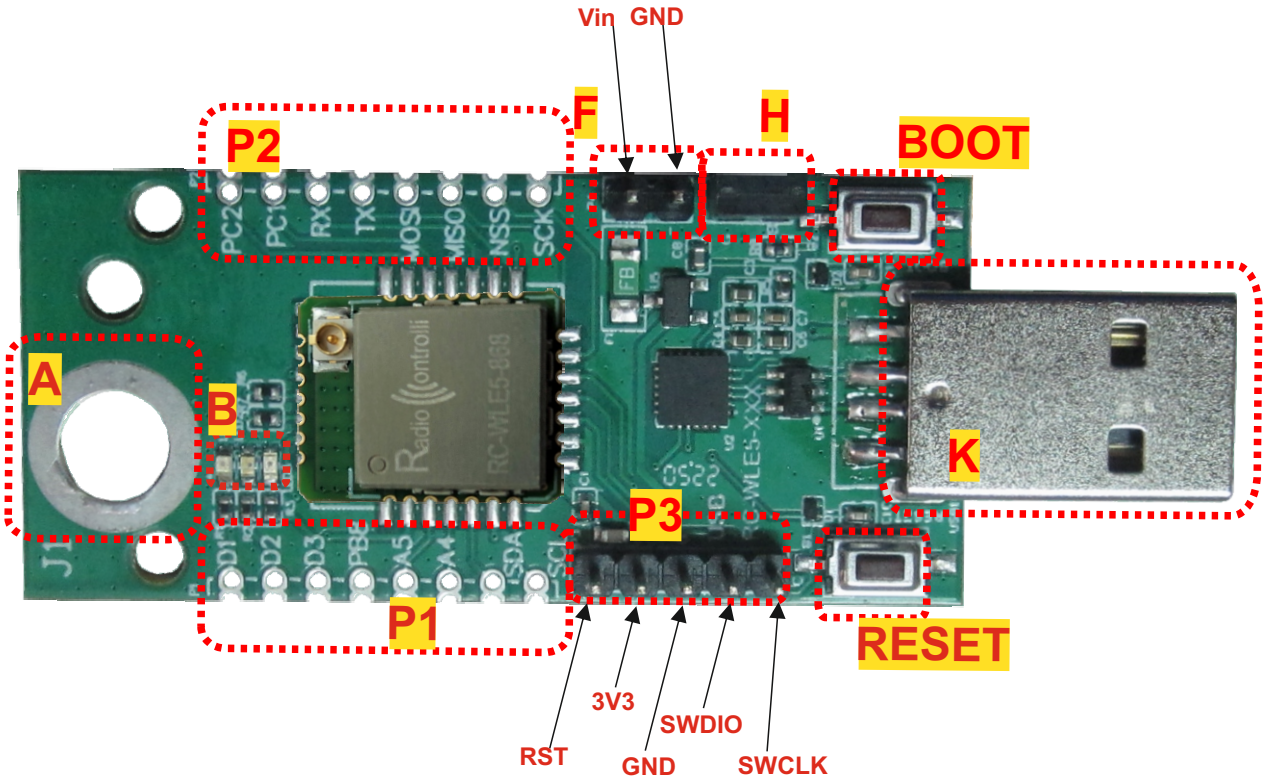


Not Recommended location XY plane

RECOMMENDED REFLOW PROFILE (LEAD FREE SOLDER)



Evaluation Board



A When the customer will need the SMA connector, he can put it on, and inserted the cable (see picture below).

B Led Indicator, LED1 (Blue) , LED2(Green), LED3 (Red)

P1 Connector D1,D2,D3,PB8,A5,A4,SDA,SCI

P2 Connector PC2,PC1,RX,TX,MOSI,MISO,NRS,SCK

P3 Programming Connector, connect to ST-LINK to program the module

F Connector used to power on the board, VIN = 3.7-5.0Vdc

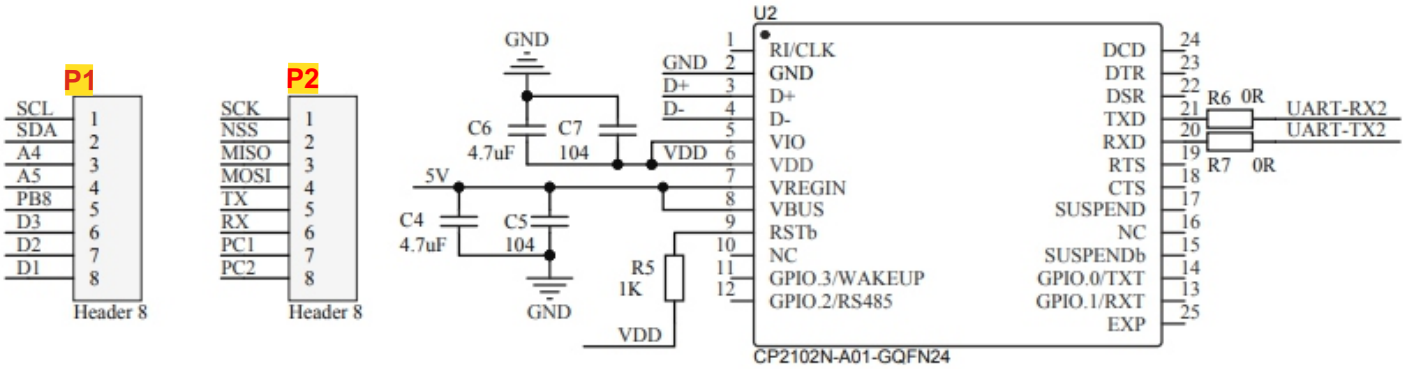
H Jumper used to pull down PH3 (boot), for default the jumper must be done.

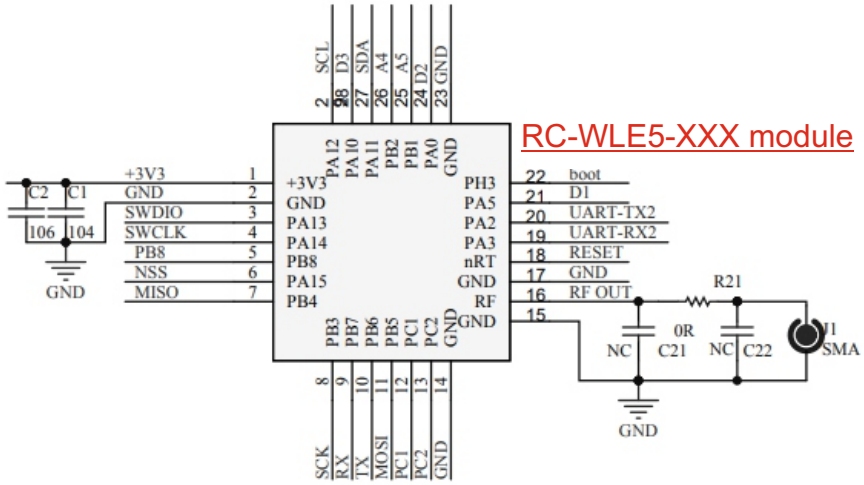
RESET Push-button- Push the button to reset the module.

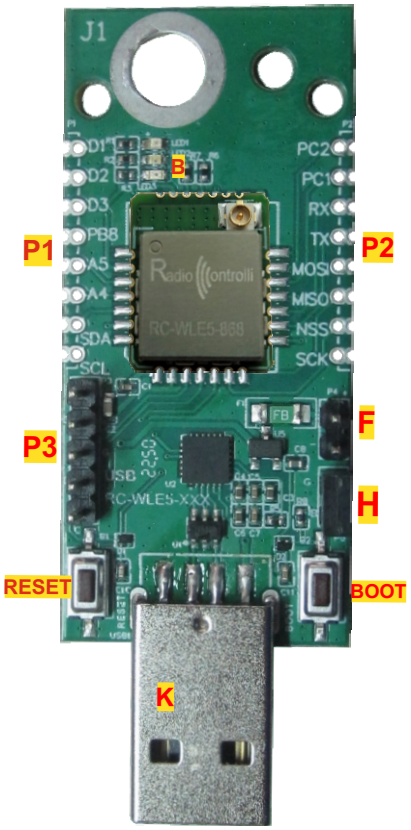
BOOT Push-button- Push the button and you can program th module with a serial port. Jumper H must be removed.

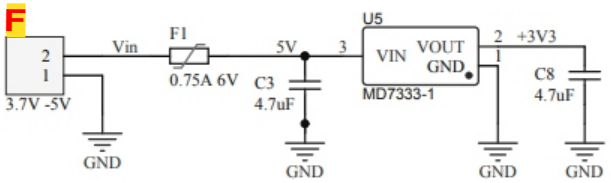
Evaluation Board with module onboard and Antenna

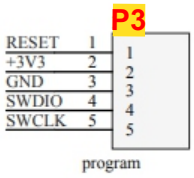
Evaluation Board Schematics

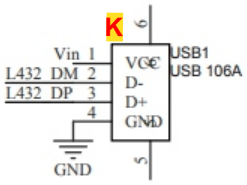


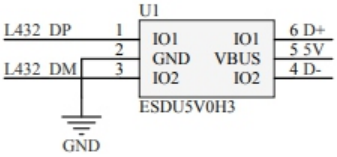


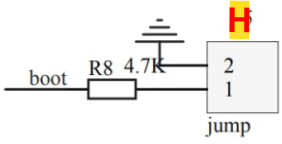


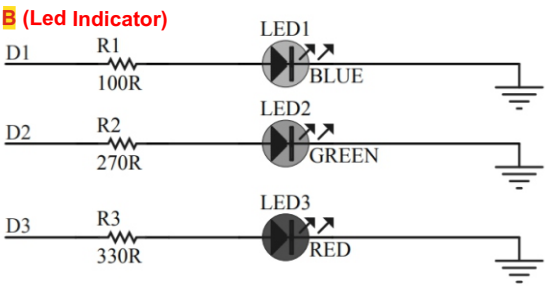


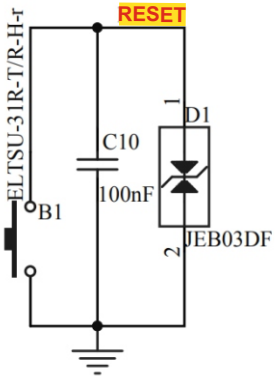


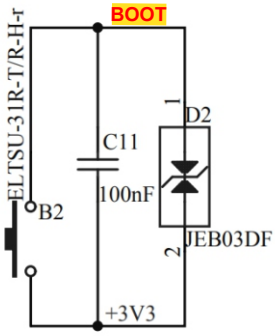












PACKAGE

TAPE AND REEL (Helical Antenna module exception)

Note : For package, we have three package types :
- Reel
- Tray
- Simple way for choosing

depend on customer's request or quantity request.