

# WISTRIO-LORA

## RAK5205 LoRa Tracker

### User's Manual v1.0

August 2018

*Note: All information contained in these materials represents information on the product at the time of publication and is subject to change without notice. Please visit Rakwireless website ([www.rakwireless.com](http://www.rakwireless.com)) for the latest update.*

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# 1 Overview

## 1.1 Introduction

LoRa tracker board WISTRIO-LORA RAK5205 is the best available prototyping sensor board with GPS module to connect LoRaWAN Network.

Features:

- Follows the 30pin's 96board specification and pin definition
- Built with SX1276 LoRa long range modem
- Built with L76-L GPS modem
- Integrated Ultra Low Power ARM Cortex-M3 STM32L1 microcontroller
- Supports programmable bit rate up to 300kbps
- Has integrated accelerometer and temperature sensor, which could help to reduce the battery usage in case of inactivity
- Has an integrated environmental sensor for gas, pressure, humidity and temperature.
- Supports latest LoRaWAN 1.0.2 protocol stack and allows user to choose any of working mode either Activation by Personalization (ABP) or Over the Air (OTA)
- 5V solar charging support
- Onboard antenna for LoRa modem and GPS
- Built-in battery support
- Supports all the frequency band defined for EU, North America, China, Korea, Japan and India
- I2C,GPIOs,uart,ADC interface support

It can be used as rapid prototype development sensor board to integrate IoT solutions with LoRaWAN Network. It provides capabilities to develop various Internet of Things applications such as assets tracking, smart vehicle management, location based services.

It supports various application development environment like CooCox IDE, Kiel. It is fully certified in compliance with FCC, CE, RoHS, WEE, JATE/TELEC (Japan).

## 1.2 Package Content

A full WISTRIO-LORA RAK5205 LoRa tracker board retail package includes:

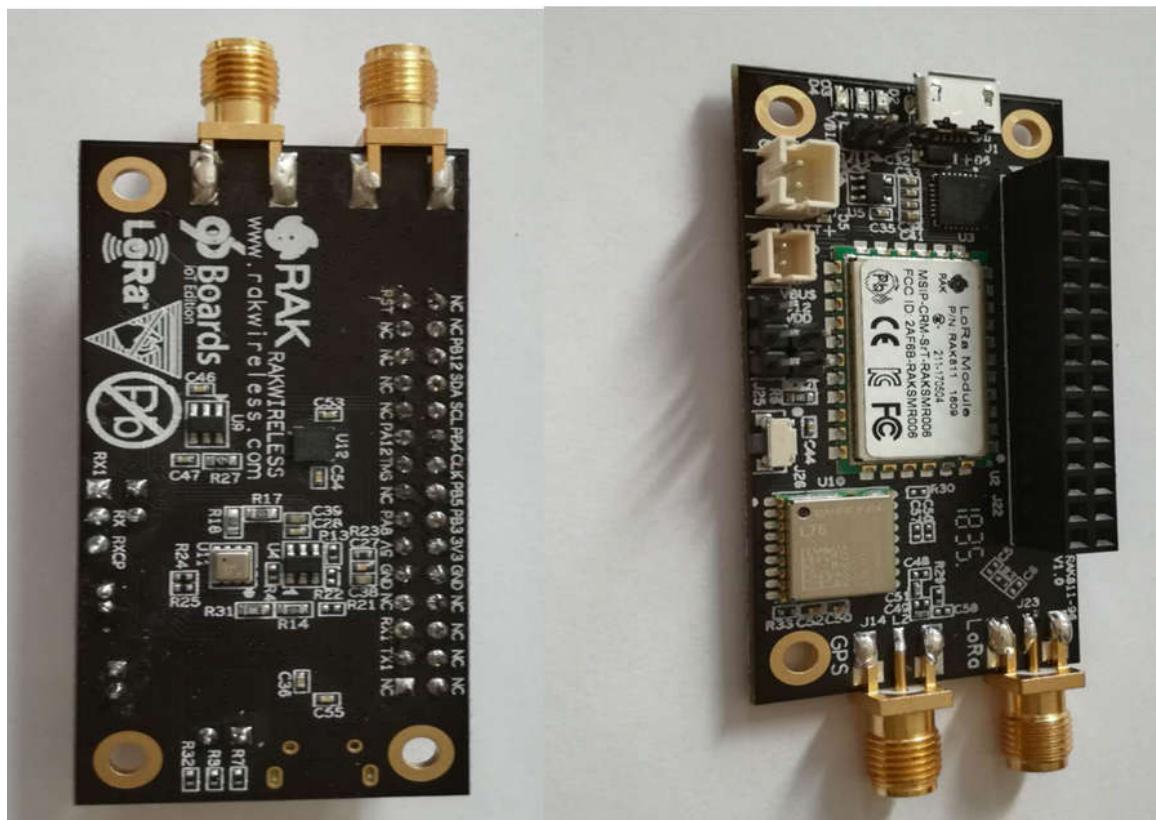
- WISTRIO-LORA RAK5205 LoRa tracker board
- Micro USB cable
- GPS antenna
- LoRa modem antenna

# 2 WISTRIO-LORA RAK5205 LoRa TrackerBoard

## 2.1 Overview

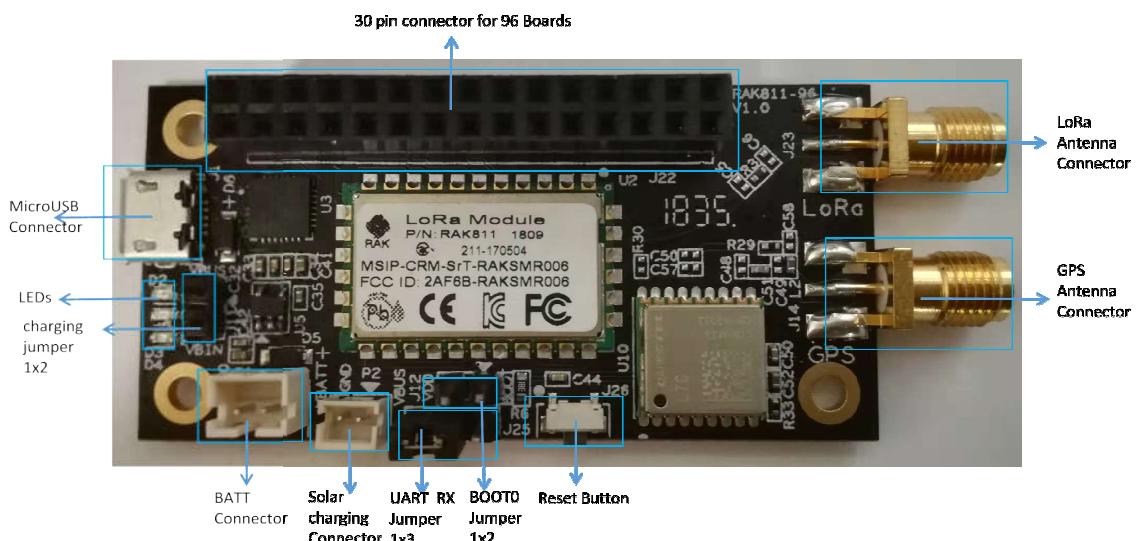
The picture below shows the top view of the WISTRIO-LORA RAK5205 LoRa tracker board.

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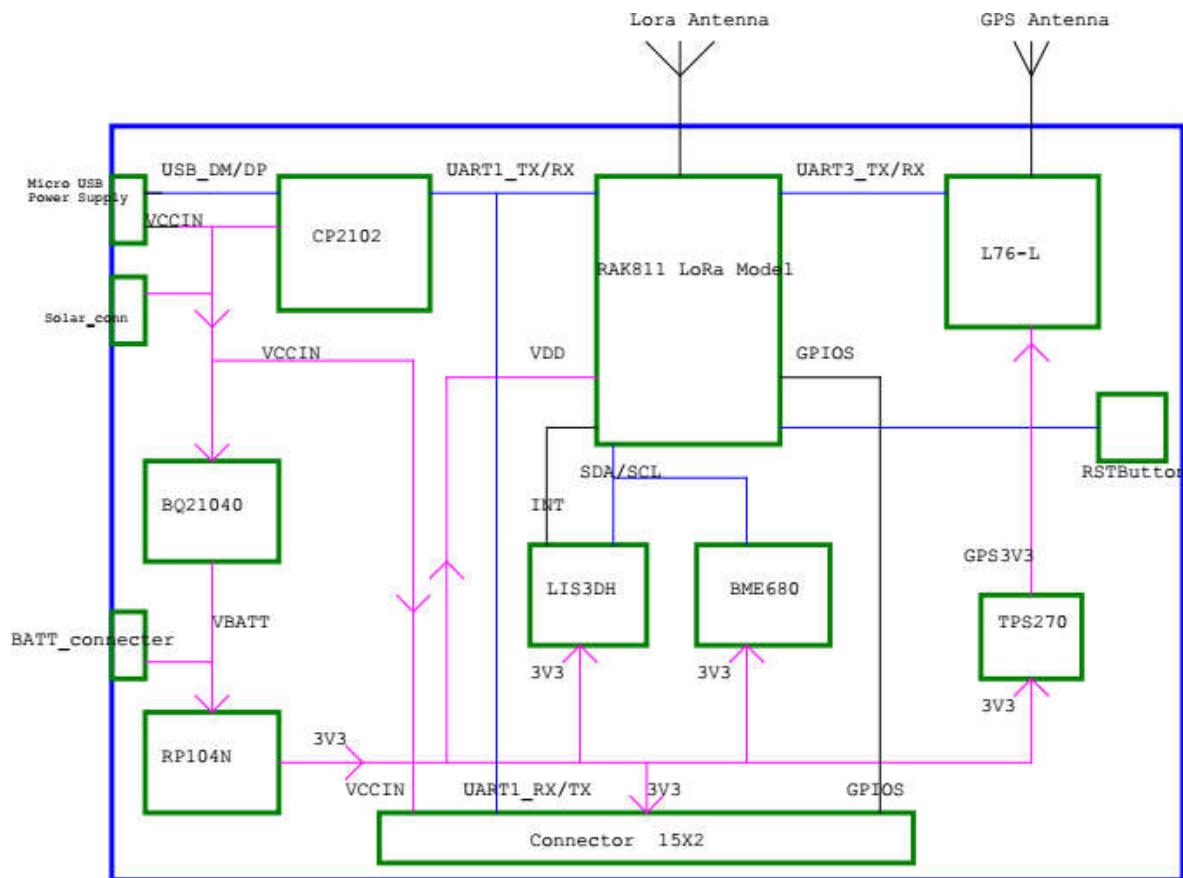
## 2.2 Functional Block Diagram

Block diagram below shows the external interfaces of WisTrio-Lora RAK5205



## 2.3 System Diagram

WISTRIO-LORA RAK5205 LoRa tracker board detailed component diagram.



## 2.4 Interfaces

WISTRIO-LORA RAK5205 LoRa tracker is built on SX1276 LoRaWAN modem with Low Power microcontroller STM32L1, integrated onboard GPS module. It provides various interfaces, headers, 30pin 96Borad's connector to develop featured applications.

- Micro-USB
- 30pins connector (uart,reset,gpios,i2c,5V ,3.3V,swd\_CLK,\_swd\_TMS)
- USB Boot jumper pins
- Reset Button
- Battery female socket
- Solar female socket

It has two SMA Antenna connectors

- GPS antenna
- LoRa antenna

## 2.5 Operating Frequencies

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WISTRIO-LORA RAK5205 LoRa tracker board support all LoRaWAN frequency channels as below. Which is easy to configure while building the firmware from the source code.

Region	Frequency ( MHz )
EU	868
AS	923
KR	920
AU	915
US	915
IN	865

## 2.6 Board Pin Out

WISTRIO-LORA RAK5205 tracker board has six connector J11,J12,J22,J25,P1,P2 and the pins are defined as bellow:

- J11(pin1 connected to VBUS,pin2 connected to VBIN)  
Without a battery connection, the J11 needs to be short-circuited with a jumper. Instead, the J11 needs to be kept open,
- J12(pin1 connected to BOOT0,pin2 connected to VDD)  
Enter flash mode through jumper short circuit and open into normal mode
- J22 (30pins ,follow the 96Board's pin definition)

J22					
Pi n	definition	discription	Pi n	definition	discription
1	NC	NC	2	NC	NC
3	UART1_TX	UART1_TX	4	NC	NC
5	UART1_RX1	UART1_RX1 (need to connect RX pin and RX1 pin of J25 via a jumper if want to use this uart interface)	6	NC	NC
7	NC	NC	8	NC	NC
9	GND	GND	10	GND	GND
11	VCCIN	5V OUT	12	VCC_3V3	3V3 OUT
13	PA8	GPIO Pin	14	PB3	GPIO Pin
15	NC	NC	16	PB5	GPIO Pin
17	SWD_TMS	GPIO Pin/R21, R22 pull-up 10K resistor can be used as JTAG interface	18	SWD_CLK	GPIO Pin/R21, R22 pull-up 10K resistor can be used as JTAG interface

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		interface			
19	LED1_PA12	GPIO Pin	20	LED2_PB4	GPIO Pin
21	NC	NC	22	SCL	I2C
23	NC	NC	24	SDA	I2C
25	NC	NC	26	PB12	ADC interface
27	NC	NC	28	NC	NC
29	RST	Reset pin	30	NC	NC

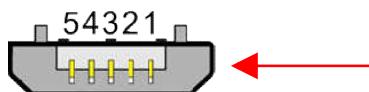
- J25 (RX1 ,RX,RXCP) J22 and USB UART share. If you use the UART of J22, you need to connect Rx and RX1 pin. If you use USB UART, you need to connect Rx and RXCP pin.
- P1 (pin1 connected to VBATT ,pin2 connected to GND) li-ion battery connector
- P2 (pin1 connected to VBUS,pin2 connected to GND) Solar cell interface

## 2.7 Micro-B USB Interface

A Standard Micro-B USB compliant with USB 2.0 standard specification is used to provide an interface to connect to a PC for control of WISTRIO-LORA RAK5205 tracker board and firmware upgrade.

The Micro-B USB pin definition is shown below:

Pin#	Definition
1	USB_VBUS (+5V)
2	USB_DM
3	USB_DP
4	N/C
5	GND



## 2.8 LEDs

Three LEDs are used to indicate operating status. The table below lists their detailed functions:

**GREEN: STATUS** - Define by user

**BLUE: STATUS** – Define by user

**RED: Charging status** - indicates the li-Battery is charging

## 2.9 Reset Push Button

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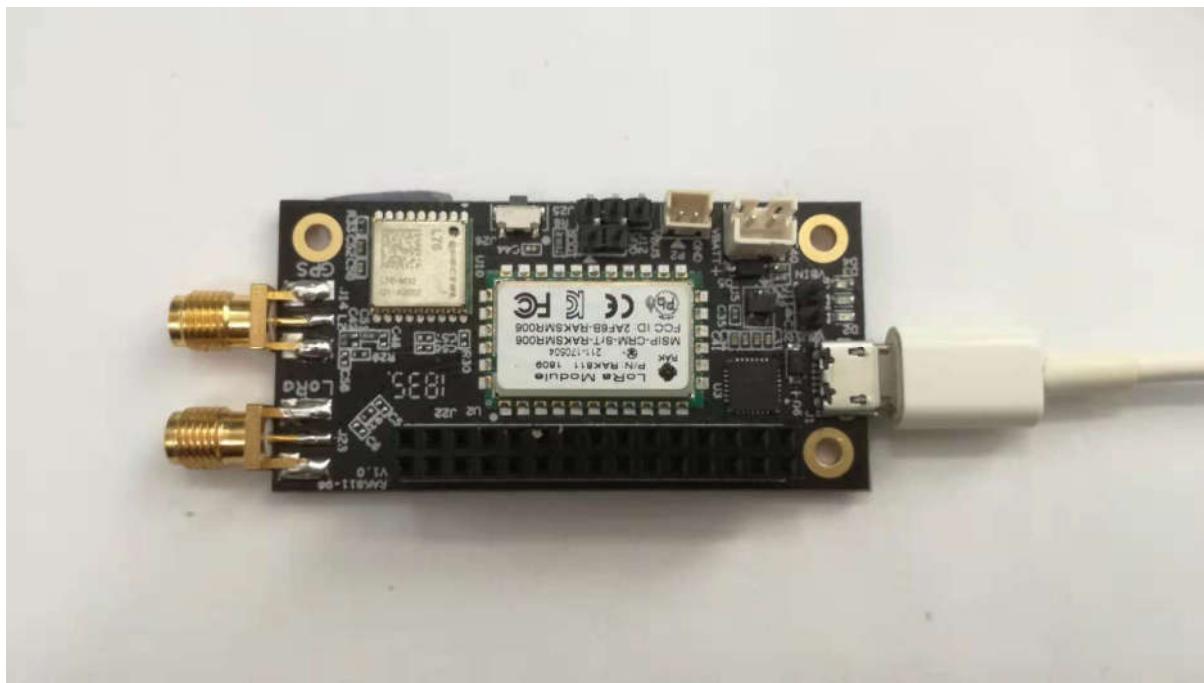
Reset Push Button is used to reset RAK811 module. To reset the module push the Reset Button within 1 seconds.

## 2.10 Power Requirements

WISTRIO-LORA RAK5205 tracker board can be powered by micro USB with max 5V. It has operating voltage is 3.7V.

It can also be powered up by 3.7V Li-Ion battery and support 5V solar charging for Li-Ion battery.

Powered by MicroUSB as below picture:



Powered by 3.7V Li-ion Battery as below picture:

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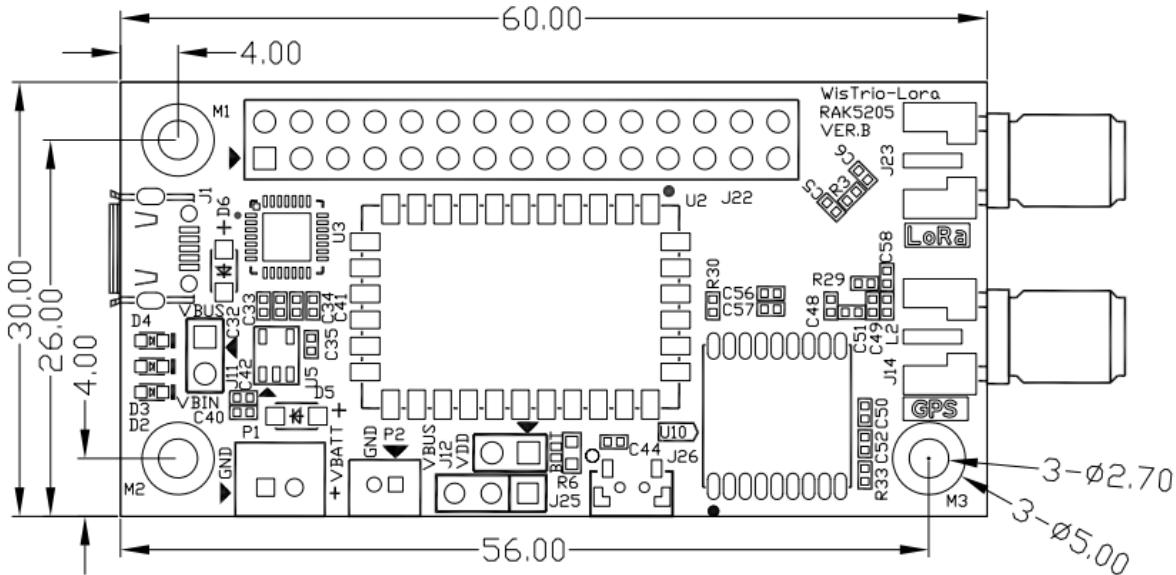
Charging for Li-ion Battery with 5V Solar as below picture:



## 2.11 Mechanical Dimensions

The mechanical dimension of WISTRIO-LORA RAK5205 tracker board can be found here:

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## 2.12 Environmental Requirements

The table below lists the operation and storage temperature requirements

Parameter	Minimum	Typical	Maximum
Operation Temperature Range	-20°C	+25°C	+60°C

## 3 Antenna

### 3.1 LoRa modem antenna

#### 3.1.1 overview

It covers working frequency band from 824MHz to 2690MHz.



#### 3.1.2 Lora Antenna Dimension

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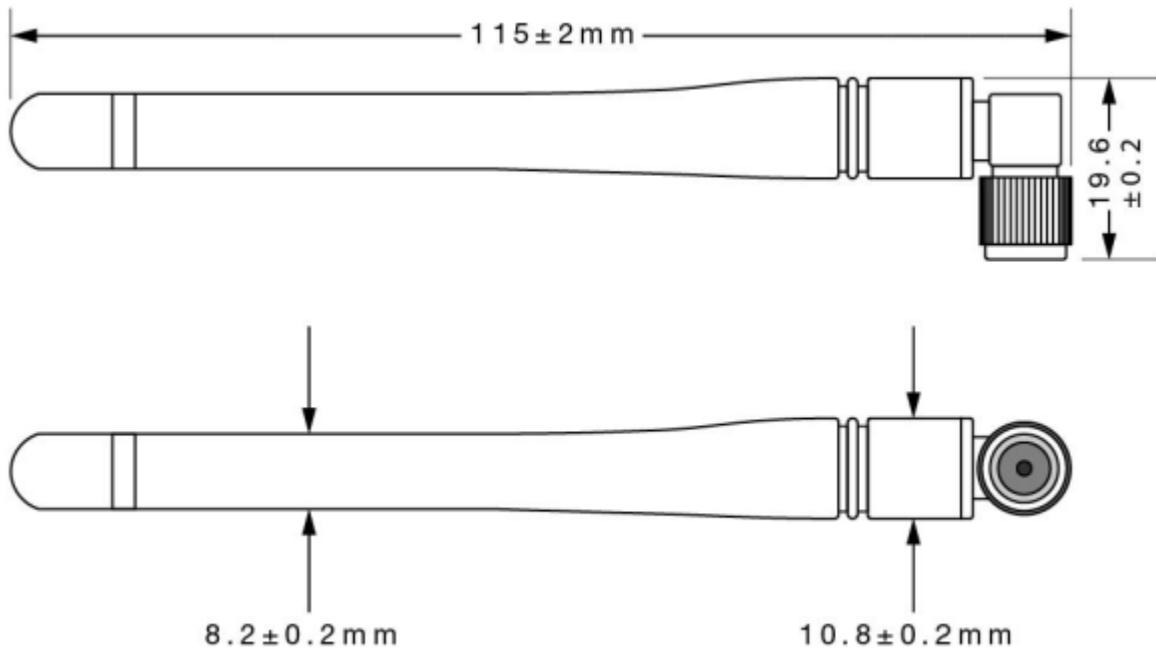
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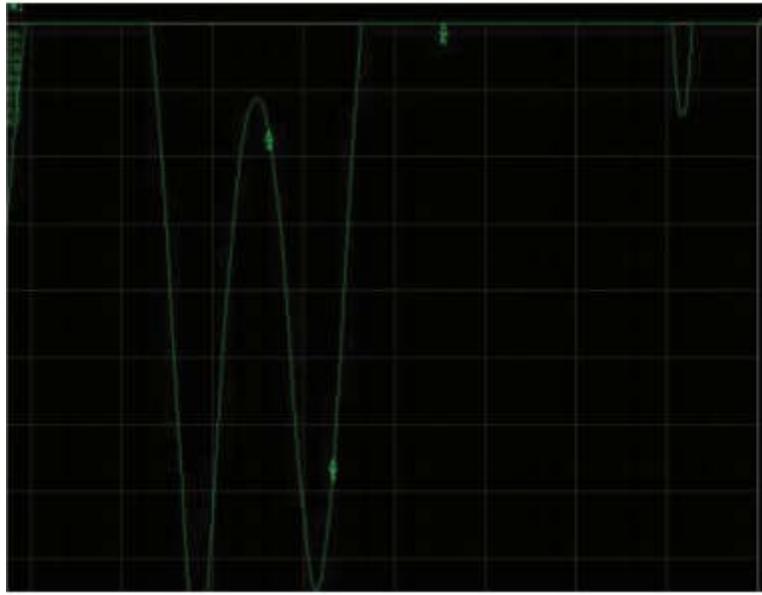
Reference

The antenna's mechanical dimension is shown below:



### 3.1.3 Lora Antenna parameter

Voltage Standard Wave Radio (VSWR) plot is shown below:



Freq. (MHz)	VSWR
700	9.3
800	4.6
880	3.6
960	4.9
1710	9.3
1880	4.4
2170	15

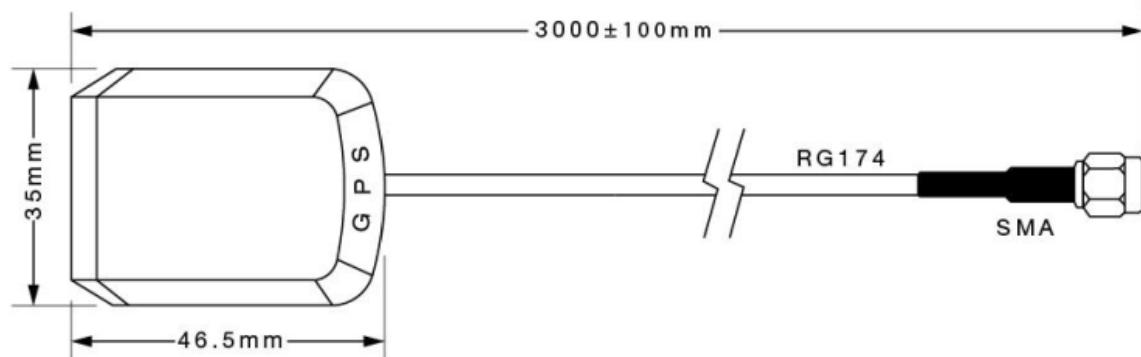
### 3.1.4 Ugain and Efficiency Table



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### 3.2.2 GPS Antenna Dimensions



### 3.2.3 GPS Environmental Requirements

The antenna environmental requirements are listed in the table below:

Conditions	Temperature	Humidity
Working	-35°C ~ +80°C	0% ~ 95%
Storage	-40°C ~ +85°C	0% ~ 95%

### 3.2.4 GPS Antenna Parameter

Antenna specifications are listed in the table below:

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Item	Specifications	Post Environmental Tolerance
Range of Receiving Frequency	1575.42±1.1	±2.5
Center Frequency (MHz) w/ 30mm <sup>2</sup> GND plane	1575.42	±3.0
Bandwidth (MHz) (Return Loss ≤ -10dB)	≥10	±0.5
VSWR (in Center Frequency)	≤2.0	±0.5
Gain (Zenith) (dBi Typ) w/ 70mm <sup>2</sup> GND Plane	4.5	±0.5
Axial Ratio (dB) w/ 70mm <sup>2</sup> GND Plane	3.0	±0.2
Polarization	Righ-Handed Circular	-
Impedance (Ω)	50	-
Frequency Temperature Coefficient (ppm/°C)	0±10	-

Amplifier Specifications are listed in the table below:

Item	Specifications
Frequency Range	1575.42MHz
Gain	27dB
VSWR	≤2.0V
Noise Coefficient	≤2.0dBm
DC Voltage	3 ~ 5V
DC Current	5 ± 2mA

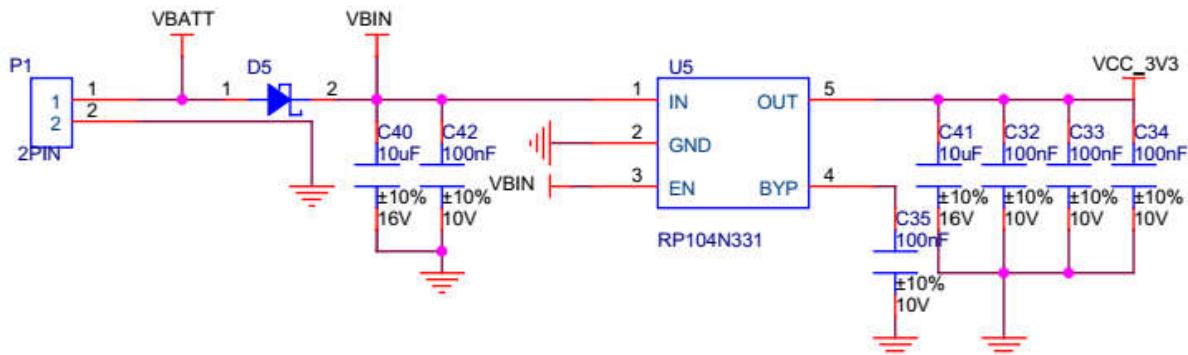
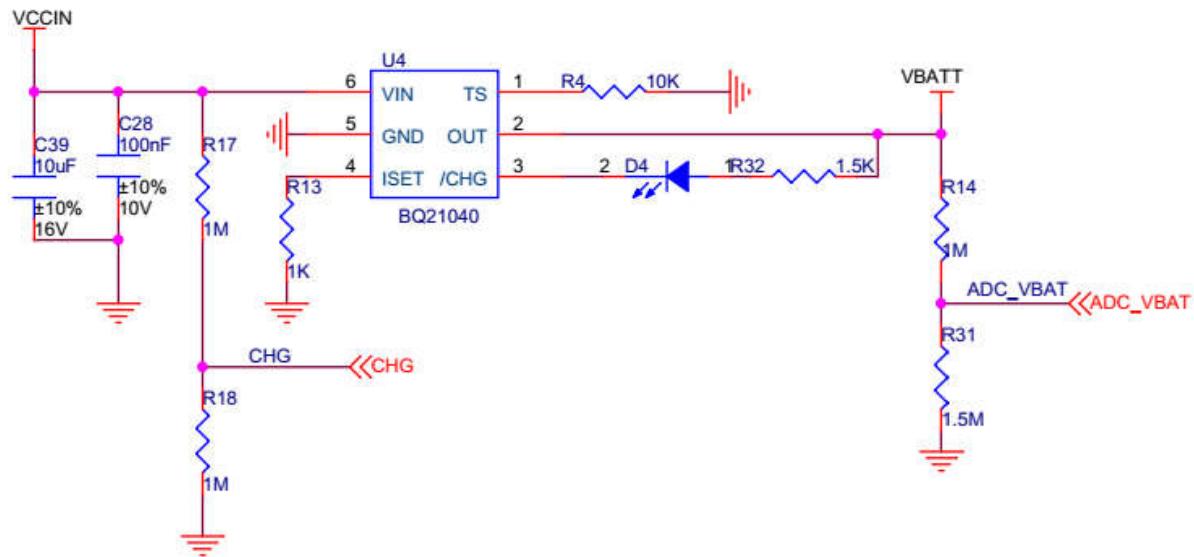
Environmental test performance specifications are listed below:

Item	Normal Temperature	High Temperature <sup>1</sup>	Low Temperature <sup>2</sup>
Amplifier Gain	27dB ± 2.0	27dB ± 2.0	27dB ± 2.0
VSWR	≤ 2.0	≤ 2.0	≤ 2.0
Noise Coefficient	≤ 2.0	≤ 2.0	≤ 2.0

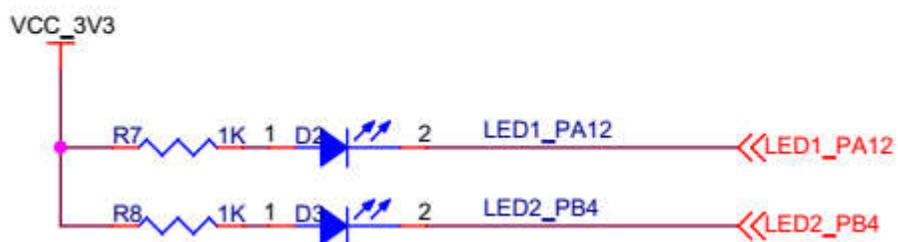
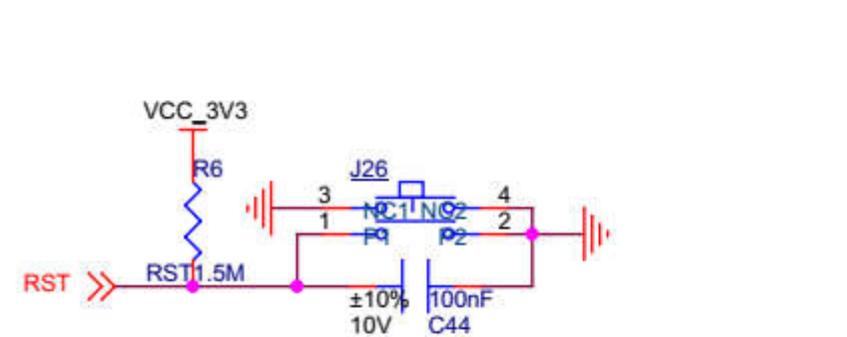
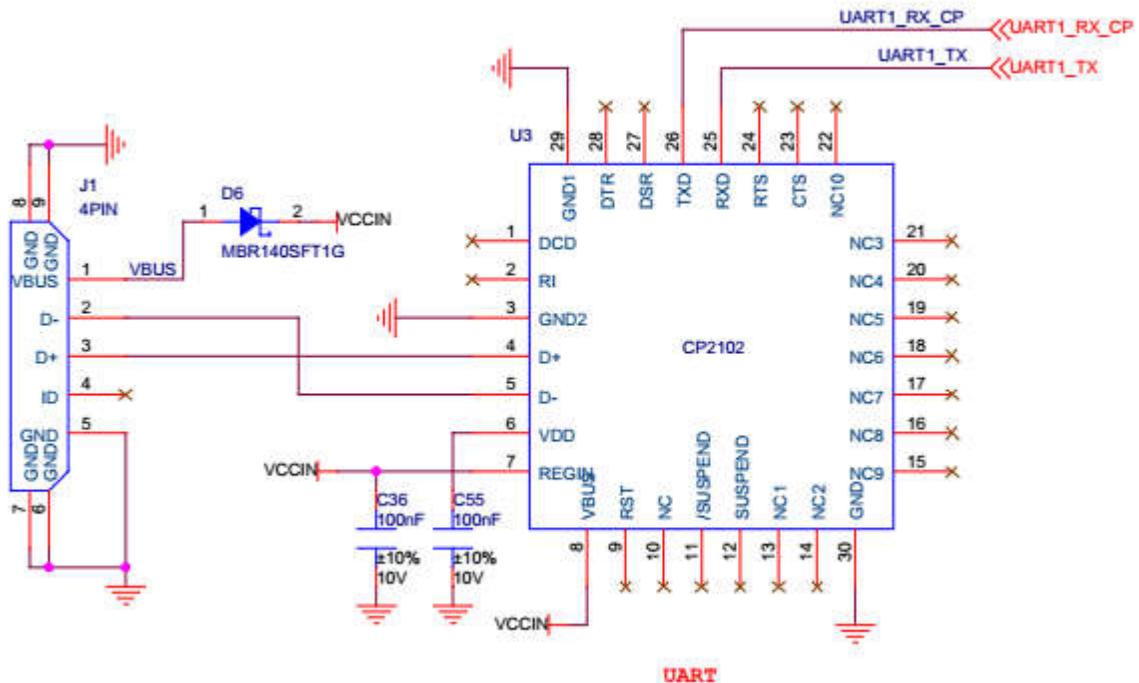
## 4 Schematics

WISTRIO-LORA RAK5205 component schematics diagram as follows:

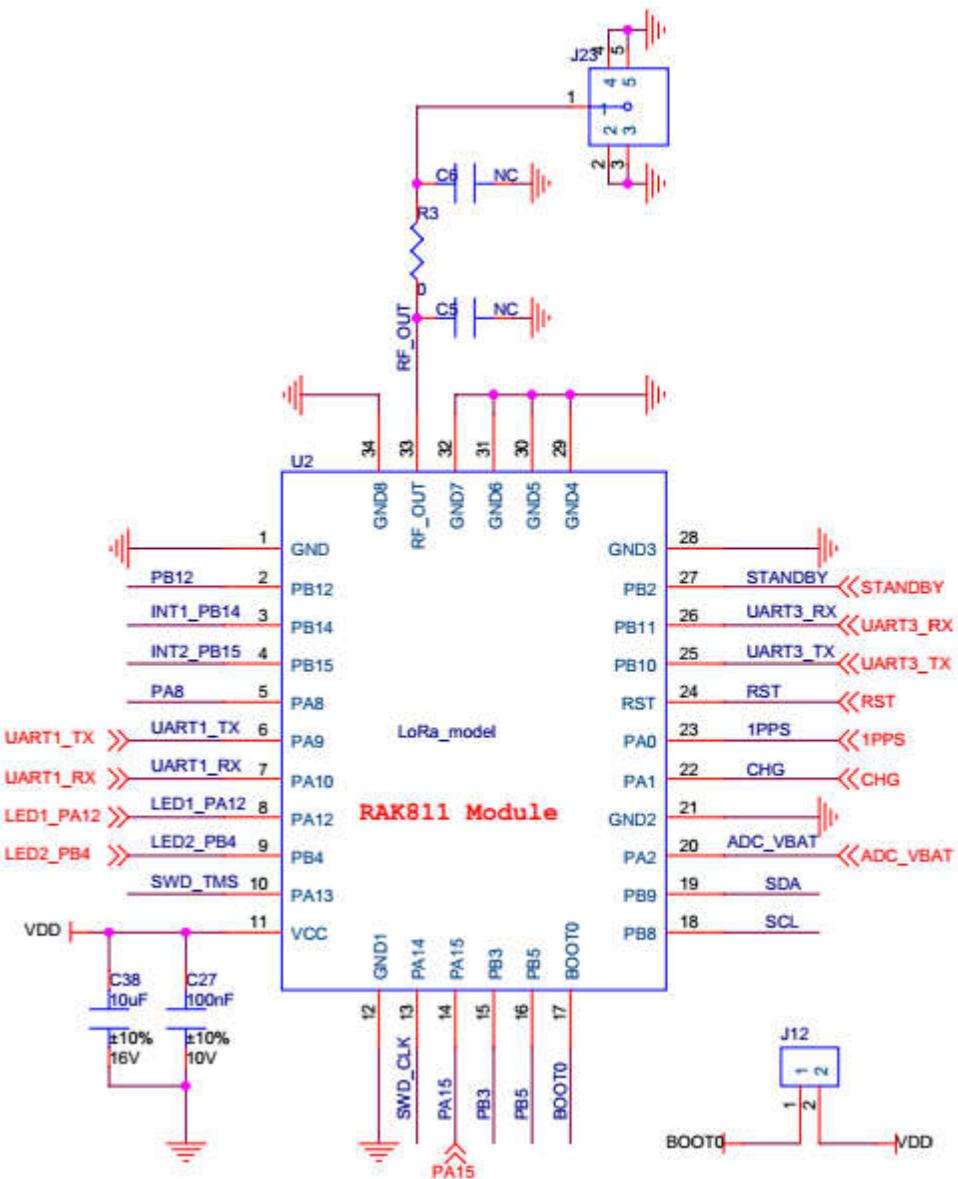
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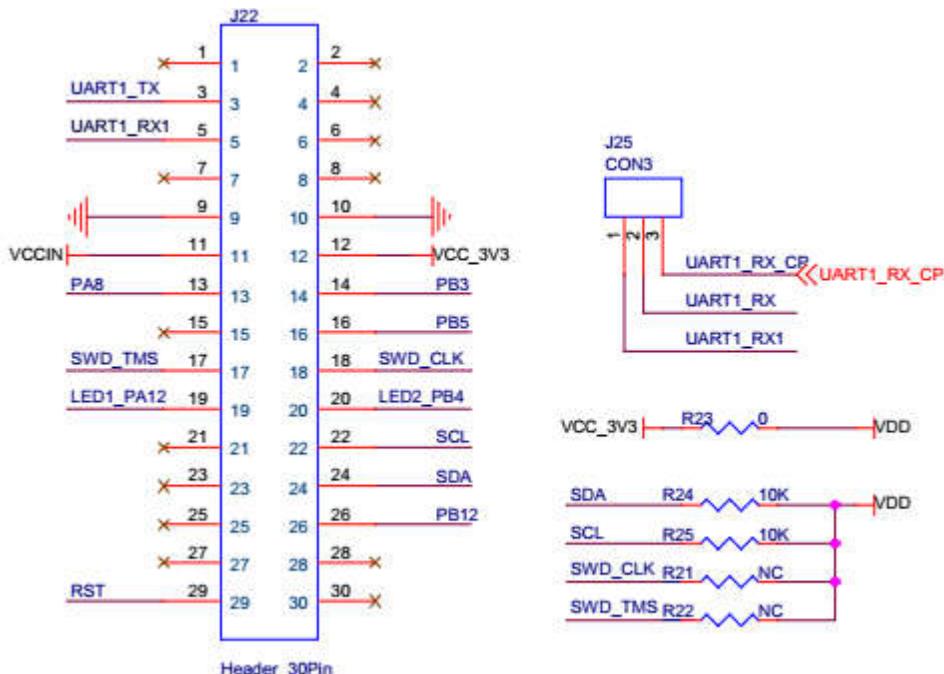
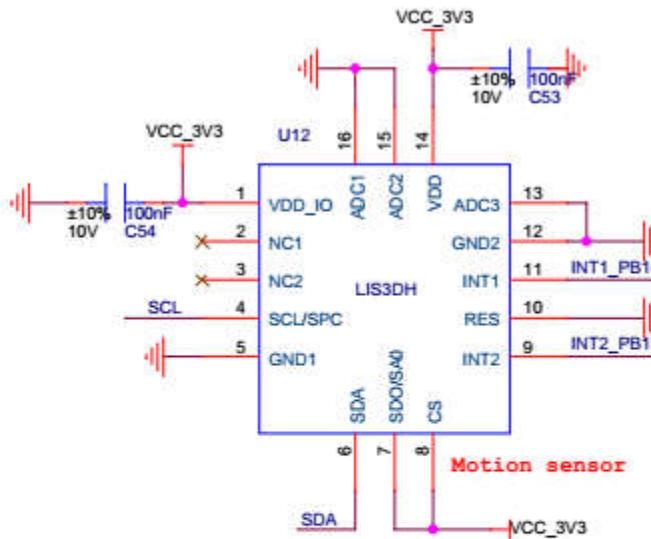
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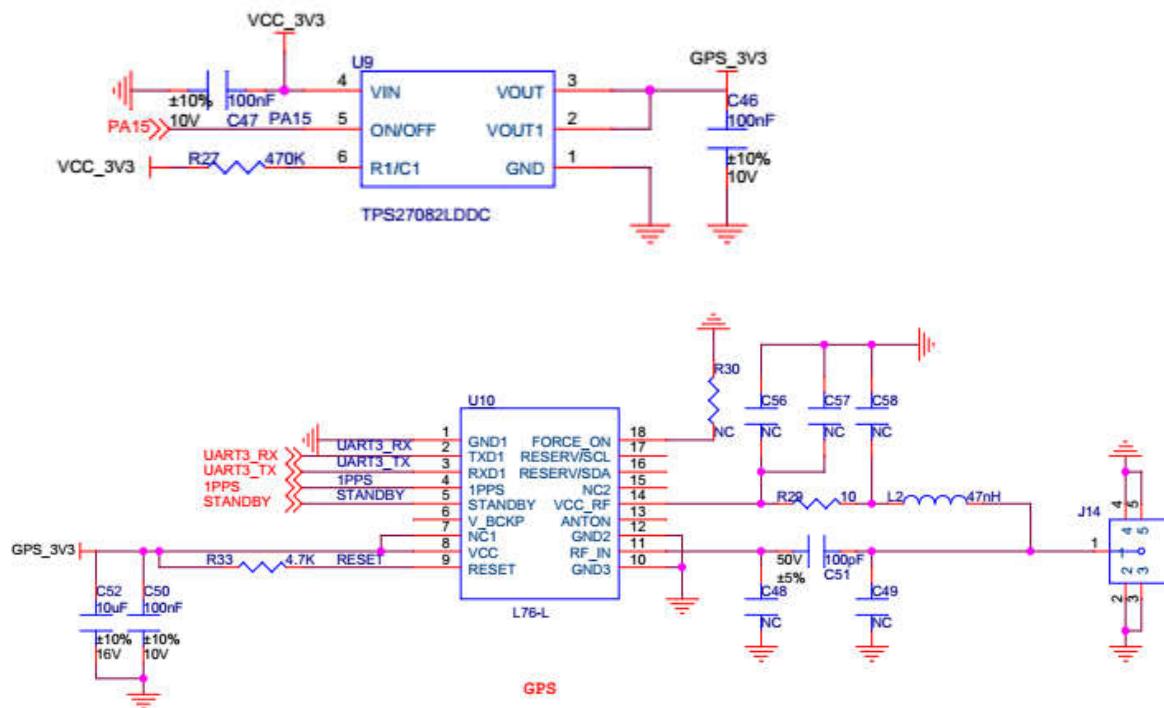
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## 5 Source Code

All the application source code are available on GIT repository. You can either download the source zip from the GIT repository or you can also clone.

[https://github.com/RAKWireless/WISTRIO-LORA\\_RAK5205\\_BreakBoard](https://github.com/RAKWireless/WISTRIO-LORA_RAK5205_BreakBoard)

## 6 Required Software

To start with the developing the application over WISTRIO-LORA RAK5205 LoRa tracker board you may need to download the following software. All the software provided below are based on Windows operating system.

### USB Driver

[http://docs.rakwireless.com/en/LoRa/WISTRIO-LORA\\_RAK5205%20TrackerBoard/Tools/CP210x\\_Windows\\_Drivers.zip](http://docs.rakwireless.com/en/LoRa/WISTRIO-LORA_RAK5205%20TrackerBoard/Tools/CP210x_Windows_Drivers.zip)

### CooCox IDE



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<http://docs.rakwireless.com/en/LoRa/WISTRIO-LORA><RAK5205%20TrackerBoard/Tools/CoIDE-V2Beta-20170117.exe>

### Flash Loader

<http://docs.rakwireless.com/en/LoRa/WISTRIO-LORA><RAK5205%20TrackerBoard/Tools/Flash%20Loader%20Demonstrator.zip>

### Tool chain

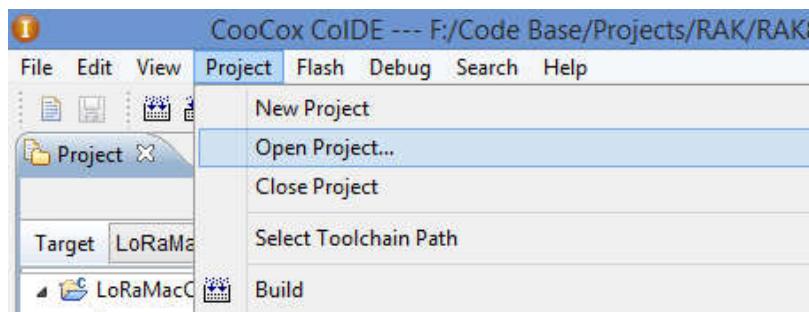
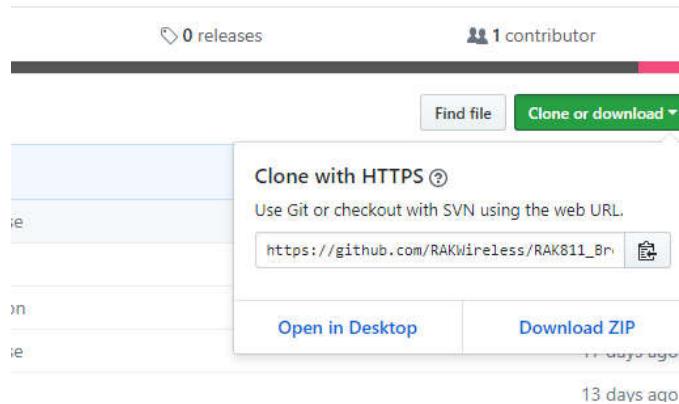
<http://docs.rakwireless.com/en/LoRa/WISTRIO-LORA>[RAK5205%20TrackerBoard/Tools/gcc-arm-none-eabi-5\\_4-2016q3-20160926-win32.exe](RAK5205%20TrackerBoard/Tools/gcc-arm-none-eabi-5_4-2016q3-20160926-win32.exe)

## 7 Usage & Examples

We are going to use CooCox IDE to view and build the firmware. All the necessary software should be installed earlier. Download the source code from the provided GIT repository and follow the below steps.

### 7.1 Importing Source Code

Open the GIT URL provided in the source code section and download the source as ZIP.



Extract the downloaded ZIP file. Now run CooCoxCoIDE and open project as follows

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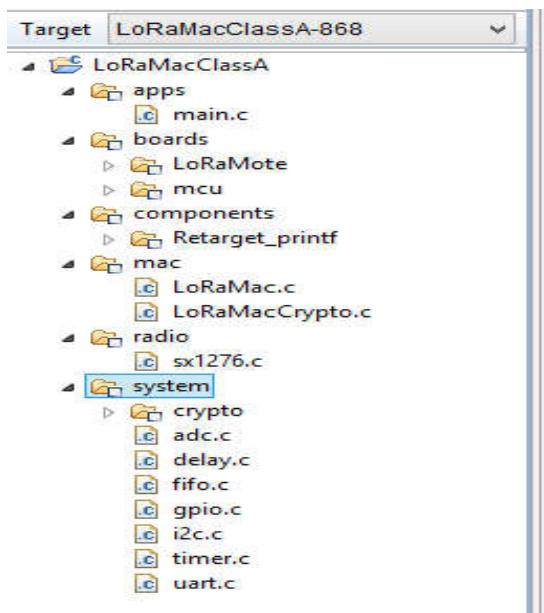
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Reference

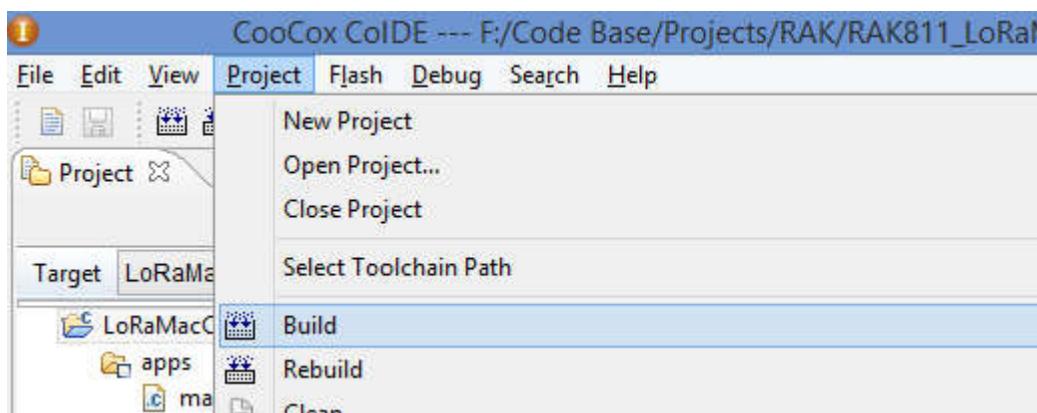
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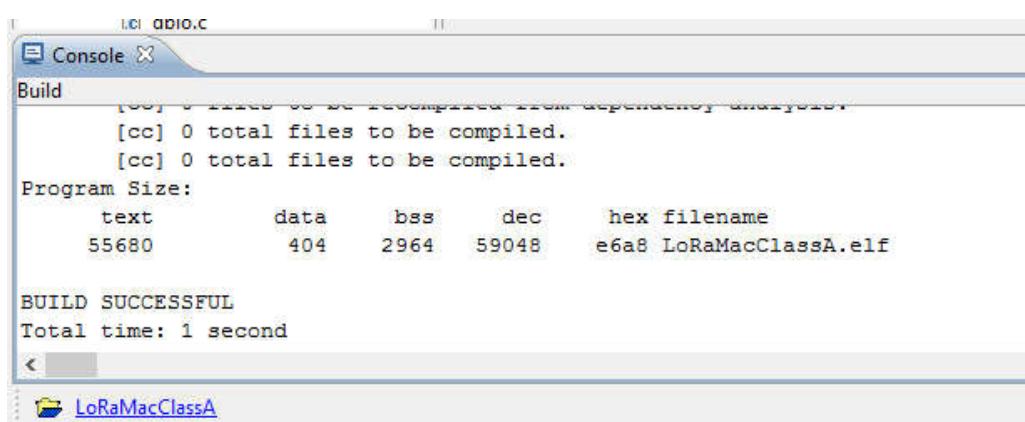
After importing the project, you would able to see the following project structure in CoIDE as follows



Now let's build the current project with the target frequency band 868MHz



The following window should be appear with the build status.



```

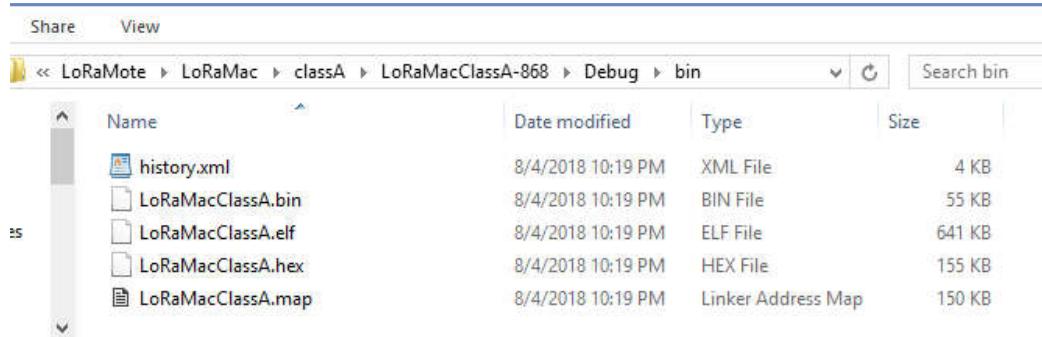
I:\LoRaMacClassA> apio.c
Console X
Build
[cc] 0 total files to be compiled.
[cc] 0 total files to be compiled.
Program Size:
    text      data      bss      dec      hex filename
  55680        404     2964   59048    e6a8 LoRaMacClassA.elf

BUILD SUCCESSFUL
Total time: 1 second
<
LoRaMacClassA

```

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Now to find the build the executable file click on the **LoRaMacClassA** folder shown. Follow the path to the bin directory where you can find the executable files.



## 7.2 Uploading Firmware

Note: The bootpin of the WisTrio-Lora RAK5205 tracker node needs to be raised to 3.3V when upgrading, so you need to connect boot0 and VDD pin of J12 via a jumper. Also, make sure the RX pin of J25 is connected to the RX1 pin. Disconnect the jumper of J12 when the upgrade is complete.

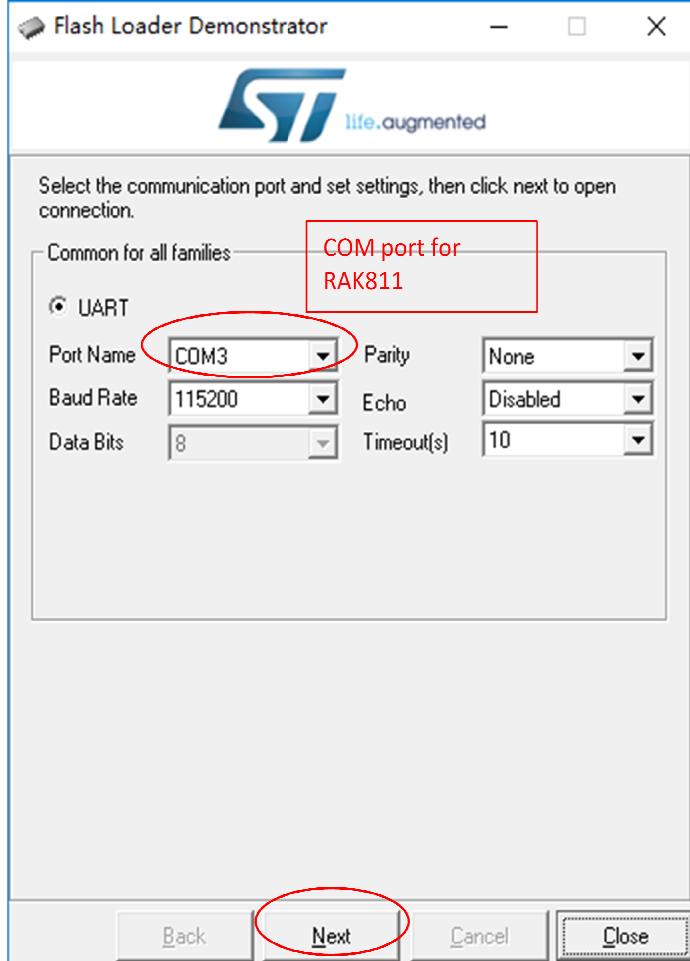
### 1. Install the “CP210x\_windows\_Drivers” driver

Connect the board to the computer via a tiny USB cable and you'll find the COM port for WISTRIO-LORA RAK5205 in the device manager.

### 2. Install the Flash Loader Demonstrator& upgrade the firmware

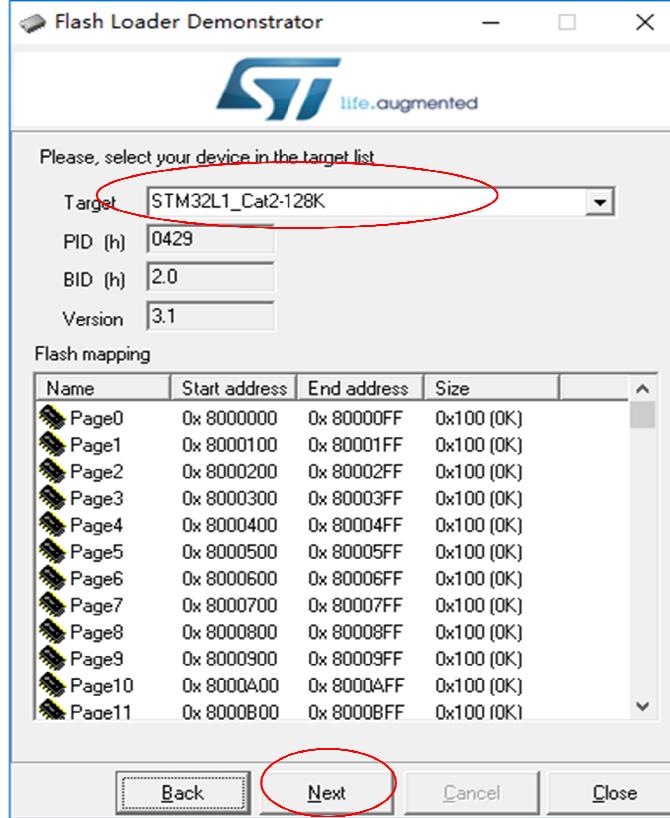
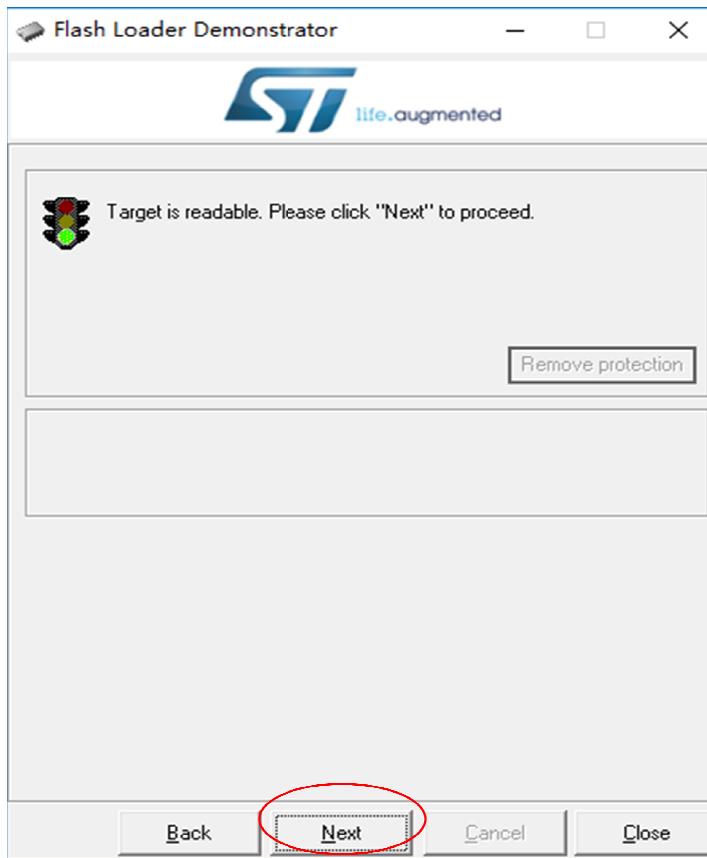
It is recommended to use Flash Loader Demonstrator to upgrade WISTRIO-LORA RAK5205 to the latest version

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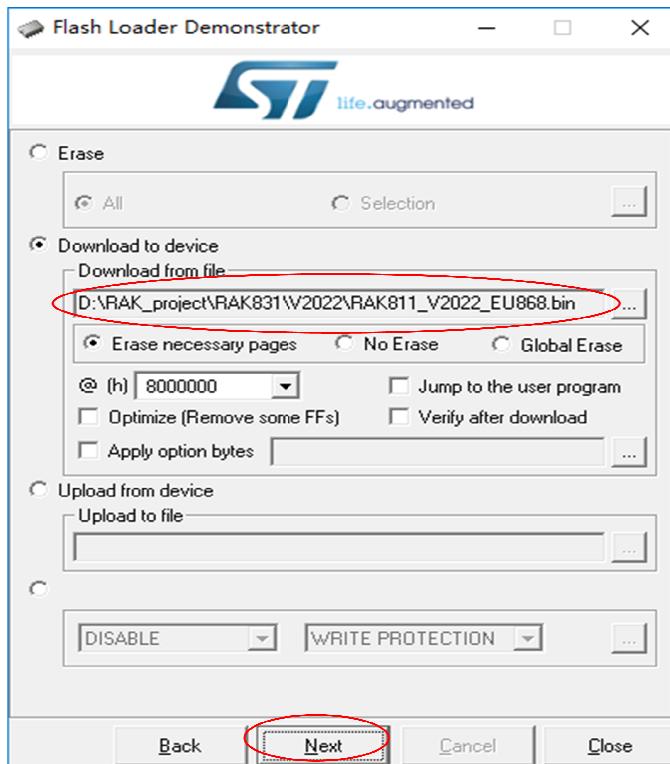
Reconnect WISTRIO-LORA RAK5205 or press the reset button if prompted incorrectly

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Select "STM32L1\_Cat2-128K" then "next"

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After loading, close the Demonstrator program, disconnect WISTRIO-LORA RAK5205 and remove the jumper of J12.

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## 8 Integrations

### 8.1 The Things Network

Please refer to the following website:

<https://www.rakwireless.com/cn/download/LoRa/RAK831%20LoRa%20Gateway>

## 9 Contact Information

### Shenzhen

Email: steven.tang@rakwireless.com  
Tel: 0755-26506594  
Fax: 0755-86152201  
Address: Room 802, Yongfu building, No.1s06, Yongfu road,  
Baoan district, Shenzhen, China

Website: <http://www.rakwireless.com/en>



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## Revision History

Revision	Description	Date
1.00	Initial version	2018-09-10