

# 6221B-UUC

**Wi-Fi Dual-band 1x1 11ac + Bluetooth 4.2  
Combo Module Datasheet**



## 6221B-UUC Module Datasheet

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Date  
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## Revision History

Version	Date	Revision Content	Draft	Approved
1.0	2019/10/29	Initial Release	Wesley	Stone
1.1	2019/11/08	Update section 4, 5 and 7 for CHIP_EN pin and thermal pad.	Wesley	Stone
1.2	2019/12/06	Update RF spec, add consumption data.	Wesley	Stone
1.3	2020/03/10	Refine section 2.	Wesley	Stone
1.4	2020/03/11	Modify freq. tolerance spec.	Wesley	Stone
1.5	2021/07/22	Correct typo of section 1.1.	Wesley	Stone

# CONTENTS

<b>1 Overview</b> .....	<b>1</b>
1.1 Introduction.....	1
1.2 Features.....	1
1.3 Block Diagram.....	2
1.4 General Specification.....	2
1.5 Recommended Operating Rating.....	2
※1.6 EEPROM Information.....	3
<b>2 Wi-Fi RF Specification</b> .....	<b>4</b>
2.1 Wi-Fi 2.4GHz RF Specification.....	4
2.2 Wi-Fi 5GHz RF Specification.....	4
<b>3 Bluetooth Specification</b> .....	<b>6</b>
3.1 Bluetooth Specification.....	6
<b>4 Pin Assignments</b> .....	<b>7</b>
4.1 Pin Outline.....	7
4.2 Pin Definition.....	7
<b>5 Dimensions</b> .....	<b>9</b>
5.1 Physical Dimensions and Module Photo.....	9
5.2 Marking Description.....	9
5.3 Module Physical Dimensions.....	10
5.4 Layout Recommendation.....	11
<b>6 Interface Timing Specification</b> .....	<b>12</b>
6.1 USB Bus Timing during Power On Sequence.....	12
<b>7 Reference Design</b> .....	<b>13</b>
<b>8 Ordering Information</b> .....	<b>13</b>
<b>9 The Key Material List</b> .....	<b>14</b>
<b>10 Recommended Reflow Profile</b> .....	<b>14</b>
<b>11 Package Information</b> .....	<b>15</b>
11.1 Reel.....	15
11.2 Packaging Details.....	15
11.3 Moisture Sensitivity.....	16

# 1 Overview

## 1.1 Introduction

The 6221B-UUC is a low-cost and low-power consumption module which has all of the Wi-Fi functionalities. It is based on Realtek RTL8821CU chipset, a highly-integrated IEEE 802.11a/b/g/n/ac MAC/Baseband/RF WLAN and Bluetooth Baseband/RF single chip. For Wireless LAN (WLAN) operation, this module supports 1-stream 802.11ac solution with USB2.0 network interface controller. For Bluetooth operation, it supports Bluetooth 2.1/4.2.

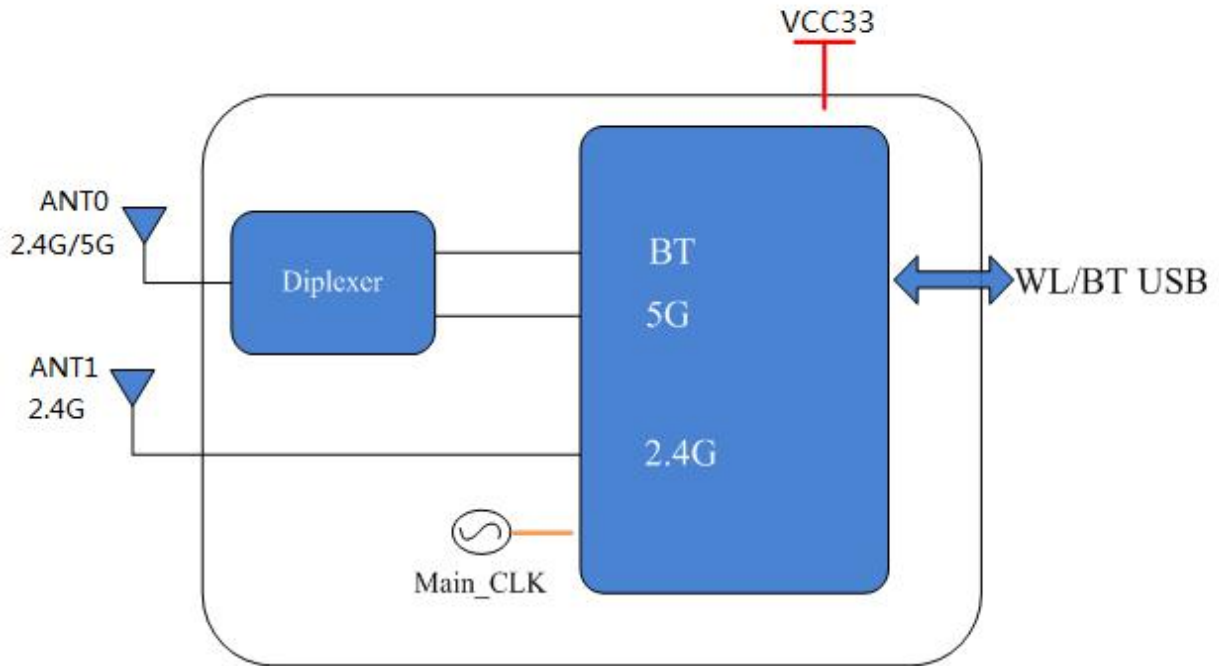
6221B-UUC complies with IEEE 802.11a/b/g/n/ac standard and it can achieve up to a speed of 433.3Mbps with single stream in 802.11ac to connect to the WLAN.

This compact module is a total solution for a combination of Wi-Fi and BT technologies.

## 1.2 Features

- Highly-integrated module for 5G 802.11ac, or 2.4G/5G 802.11n WLAN applications.
- Maximum PHY data rate up to 86.7MHz using 20MHz bandwidth, 200Mbps using 40Mhz bandwidth and 433.3Mbps using 80Mhz bandwidth.
- Backward compatible with 802.11a/b/g device.
- Support IEEE 802.11e QoS Enhancement and 802.11i (WPA, WPA2).
- Support IEEE 802.11h DFS.
- Wi-Fi Direct supports wireless peer to peer applications.
- Supports Bluetooth 4.2 and backward compatible with Bluetooth 2.1 + EDR.
- Bluetooth 4.0 Dual Mode support: Simultaneous LE and BR/EDR.
- Supports Bluetooth Low Energy.
- Integrated internal Class 1, Class 2 and Class 3 PA for Bluetooth.
- Enhanced BT/Wi-Fi Coexistence Control to improve transmission quality in different profiles.
- USB Multi-Function for both BT and WLAN.
- Single external power source 3.3V only.

### 1.3 Block Diagram



### 1.4 General Specification

Model Name	6221B-UUC
Product Description	Support Wi-Fi/Bluetooth functionalities
Dimension	L x W x H: 15 x 13 x 2.35 mm
Wi-Fi Interface	USB 2.0
BT Interface	USB 2.0
Operating temperature	0°C to 70°C
Storage temperature	-40°C to 125°C
RoHS	All hardware components are fully compliant with EU RoHS directive

### 1.5 Recommended Operating Rating

	Min.	Typ.	Max.	Unit
Operating Temperature	0	25	70	°C
Power Supply (VCC)	3.135	3.3	3.465	V

Typical Power Consumption (VCC=3.3V; BT on if no other statement)	Condition	Current Consumption(mA)
	WLAN/BT Disabled	2
	Wi-Fi 5G associated	93
	TX throughput (5G 11ac VHT80)	264
	RX throughput (5G 11ac VHT80)	136
	TX throughput (5G 11n HT20)	320
	RX throughput (5G 11n HT20)	107
	TX throughput (5G 11a OFDM54)	266
	RX throughput (5G 11a OFDM54)	130
	TX throughput (2.4G 11n HT40)	291
	RX throughput (2.4G 11n HT40)	115
	TX throughput (2.4G 11b CCK11)	283
	RX throughput (2.4G 11b CCK11)	141

**※1.6 EEPROM Information**

Wi-Fi

Vendor ID	
Product ID	

## 2 Wi-Fi RF Specification

### 2.1 Wi-Fi 2.4GHz RF Specification

Feature	Description
WLAN Standard	IEEE 802.11b/g/n, Wi-Fi compliant
Frequency Range	2.400 GHz ~ 2.497 GHz (2.4 GHz ISM Band)
Channels	2.4GHz : Ch1 ~ Ch14
Output Power	802.11b /11M : 16 ± 1.5 dBm @ EVM ≤ -9dB 1M : 17 ± 1.5 dBm @MASK compliant
	802.11g /54M : 15 ± 1.5 dBm @ EVM ≤ -26dB 6M : 17 ± 1.5 dBm @MASK compliant
	802.11n /MCS7 : 14 ± 1.5 dBm @ EVM ≤ -29dB MCS0 : 17 ± 1.5 dBm @MASK compliant
	Other data rate TX power control by 'power by rate'
Spectrum Mask	IEEE compliant
Freq. Tolerance	± 15 ppm
Receive Sensitivity (11b) @8% PER	- 1Mbps: ≤ -92 dBm
	- 11Mbps: ≤ -85 dBm
Receive Sensitivity (11g) @10% PER	- 6Mbps: ≤ -89 dBm
	- 54Mbps: ≤ -71 dBm
Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0: ≤ -89 dBm
	- MCS=7: ≤ -69 dBm
Receive Sensitivity (11n,40MHz) @10% PER	- MCS=0: ≤ -87 dBm
	- MCS=7: ≤ -67 dBm

### 2.2 Wi-Fi 5GHz RF Specification

Feature	Description
WLAN Standard	IEEE 802.11a/n/ac, Wi-Fi compliant
Frequency Range	4.900 GHz ~ 5.845 GHz (5.0 GHz ISM Band)
Number of Channels	5.0GHz: Please refer to the table <sup>1</sup>
Modulation	802.11a/n: 64-QAM, 16-QAM, QPSK, BPSK 802.11ac: 256-QAM, 64-QAM, 16-QAM, QPSK, BPSK
Output Power	802.11a /54M: 14 dBm ± 1.5 dB @ EVM ≤ -27dB
	6M: 16 dBm ± 1.5 dB @ MASK compliant



	802.11n /MCS7: 13 dBm ± 1.5 dB @ EVM ≤ -29dB MCS0: 16 dBm ± 1.5 dB @ MASK compliant
	802.11ac/MCS7: 13 dBm ± 1.5 dB @ EVM ≤ -29dB MCS0: 16 dBm ± 1.5 dB @ MASK compliant
	802.11ac/MCS9: 10 dBm ± 1.5 dB @ EVM ≤ -33dB
	For other rate, Tx power is controlled by 'power by rate'
Receive Sensitivity (11a) @10% PER	- 6Mbps: ≤ -86 dBm
	- 54Mbps: ≤ -70 dBm
Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0: ≤ -85 dBm
	- MCS=7: ≤ -67 dBm
Receive Sensitivity (11n,40MHz) @10% PER	- MCS=0: ≤ -83 dBm
	- MCS=7: ≤ -64 dBm
Receive Sensitivity (11ac,20MHz) @10% PER	- MCS=0: ≤ -86 dBm
	- MCS=8: ≤ -63 dBm
Receive Sensitivity (11ac,40MHz) @10% PER	- MCS=0: ≤ -83 dBm
	- MCS=9: ≤ -59 dBm
Receive Sensitivity (11ac,80MHz) @10% PER	- MCS=0: ≤ -80 dBm
	- MCS=9: ≤ -56 dBm

**15GHz Channel table**

Band (GHz)	Operating Channel Number	Channel Center Frequency(MHz)
5.15GHz~5.25GHz	36	5180
	40	5200
	44	5220
	48	5240
5.25GHz~5.35GHz	52	5260
	56	5280
	60	5300
	64	5320
5.5GHz~5.7GHz	100	5500
	104	5520
	108	5540
	112	5560
	116	5580
	120	5600
	124	5620
	128	5640
132	5660	

	136	5680
	140	5700
5.725GHz~5.825GHz	149	5745
	153	5765
	157	5785
	161	5805
	165	5825

### 3 Bluetooth Specification

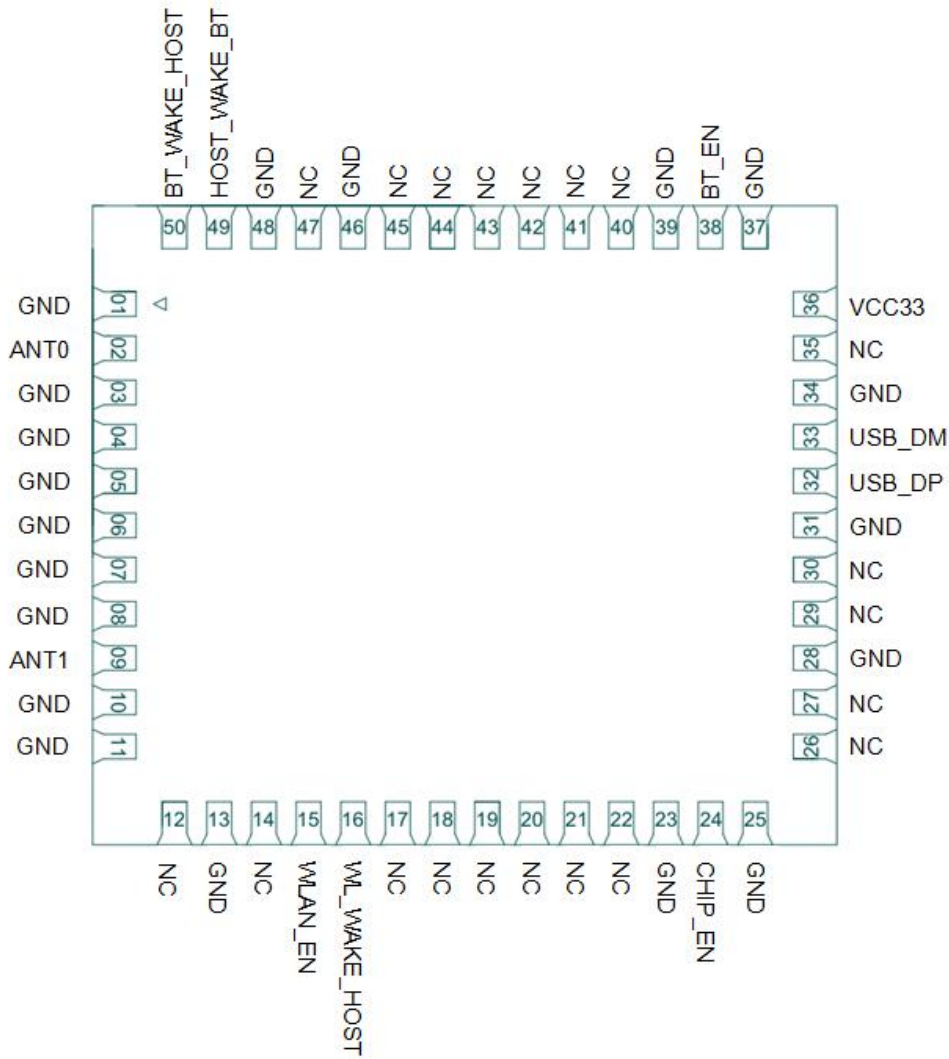
#### 3.1 Bluetooth Specification

Feature	Description		
<b>General Specification</b>			
Bluetooth Standard	Bluetooth V4.2 of 1, 2 and 3 Mbps.		
Antenna Reference	Small antenna with 0~2 dBi peak gain		
Frequency Band	2402 MHz ~ 2480 MHz		
Number of Channels	79 channels		
Modulation	GFSK, $\pi/4$ -DQPSK, 8DPSK		
<b>RF Specification</b>			
	<b>Min.</b>	<b>Typical.</b>	<b>Max.</b>
Output Power (Class 1.5)	4 dBm	8 dBm	12 dBm
Sensitivity @ BER=0.1% for GFSK (1Mbps)		-88 dBm	
Sensitivity @ BER=0.01% for $\pi/4$ -DQPSK (2Mbps)		-85 dBm	
Sensitivity @ BER=0.01% for 8DPSK (3Mbps)		-81 dBm	
Maximum Input Level	GFSK (1Mbps):-20dBm		
	$\pi/4$ -DQPSK (2Mbps) :-20dBm		
	8DPSK (3Mbps) :-20dBm		

## 4 Pin Assignments

### 4.1 Pin Outline

< TOP VIEW >



### 4.2 Pin Definition

PIN	Name	Type	Description	Voltage
1	GND	—	Ground connections	
2	ANT0	I/O	RF I/O chain0, Wi-Fi 5GHz and BT	
3~8	GND	—	Ground connections	
9	ANT1	I/O	RF I/O chain1, Wi-Fi 2.4GHz	
10~11	GND	—	Ground connections	
12	NC	—	Not connected	
13	GND	—	Ground connections	

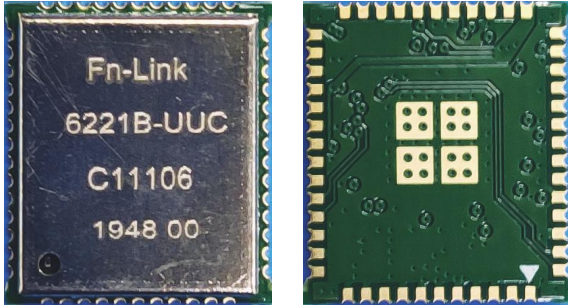
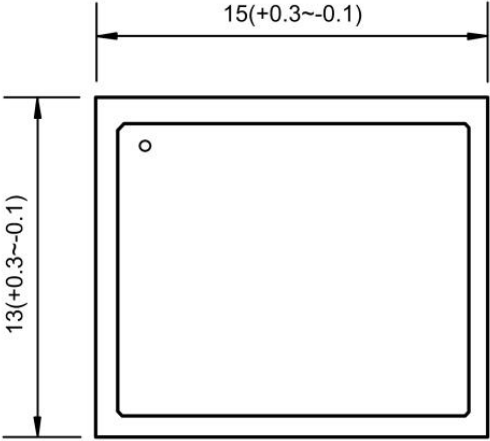
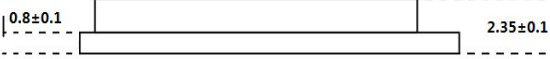
14	NC	—	Not connected	
15	WLAN_EN	I	Enable pin for WLAN device ON: pull high ; OFF: pull low	3.3V
16	WL_WAKE_HOST	O	WLAN to wake-up HOST	3.3V
17~22	NC	—	Not connected	
23	GND	—	Ground connections	
24	CHIP_EN	I/O	Enable pin for chipset. Pull low to shut down RTL8821CU. (Internal 47Kohm pull-high to 3.3V)	3.3V
25	GND	—	Ground connections	
26~27	NC	—	Not connected	
28	GND	—	Ground connections	
29~30	NC	—	Not connected	
31	GND	—	Ground connections	
32	USB_DP	I/O	USB2.0 differential pair D+ for WLAN and Bluetooth	
33	USB_DM	I/O	USB2.0 differential pair D- for WLAN and Bluetooth	
34	GND	—	Ground connections	
35	NC	—	Not connected	
36	VCC33	P	Main power input 3.3V	3.3V
37	GND	—	Ground connections	
38	BT_EN	I	Enable pin for Bluetooth device ON: pull high ; OFF: pull low	3.3V
39	GND	—	Ground connections	
40~45	NC	—	Not connected	
46	GND	—	Ground connections	
47	NC	I	Not connected	
48	GND	—	Ground connections	
49	HOST_WAKE_BT	I	HOST to wake-up Bluetooth device	3.3V
50	BT_WAKE_HOST	O	Bluetooth device to wake-up HOST	3.3V

P: POWER    I: INPUT    O: OUTPUT

## 5 Dimensions

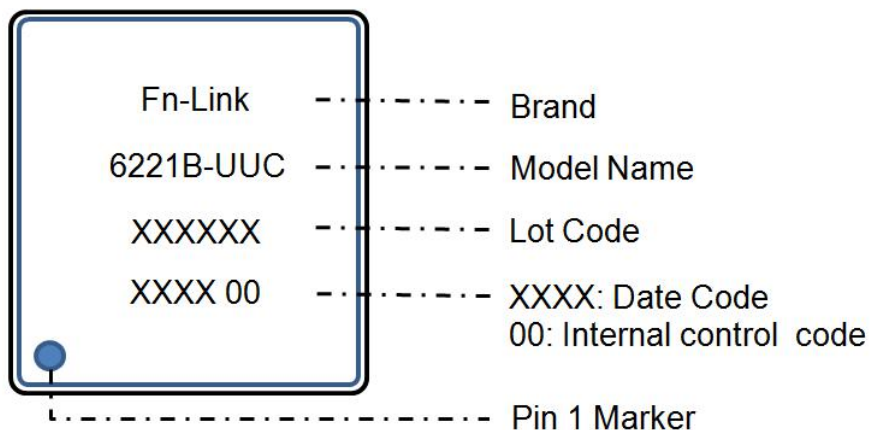
### 5.1 Physical Dimensions and Module Photo

(Unit: mm)

<p>L x W : 15 x 13 mm</p> 	<p>&lt; TOP VIEW &gt;</p> 
<p>H: 2.35 mm</p>	<p>&lt; Side View &gt;</p> 
<p>Weight</p>	<p>0.92g</p>

### 5.2 Marking Description

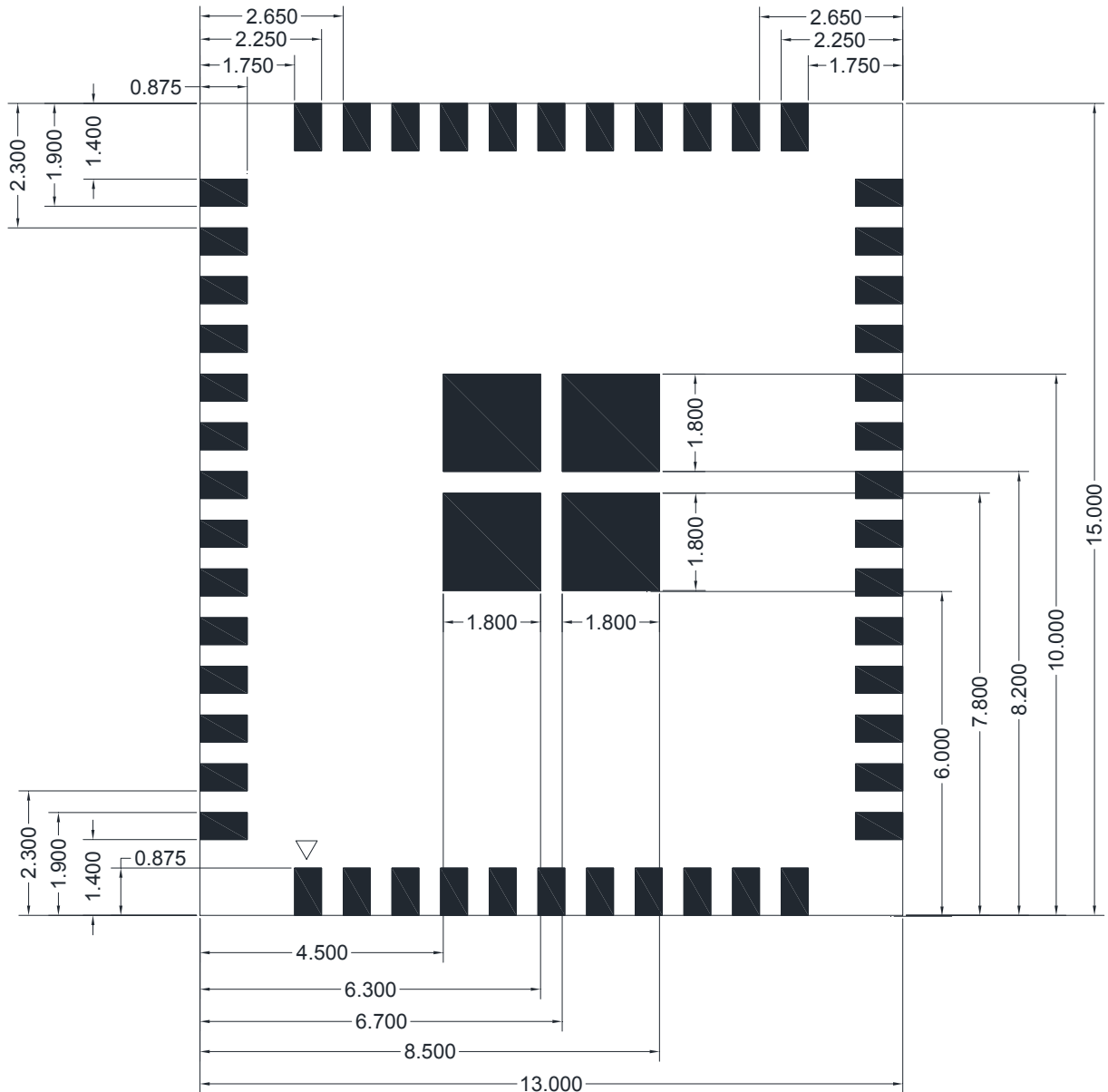
< TOP VIEW >



### 5.3 Module Physical Dimensions

(Unit: mm)

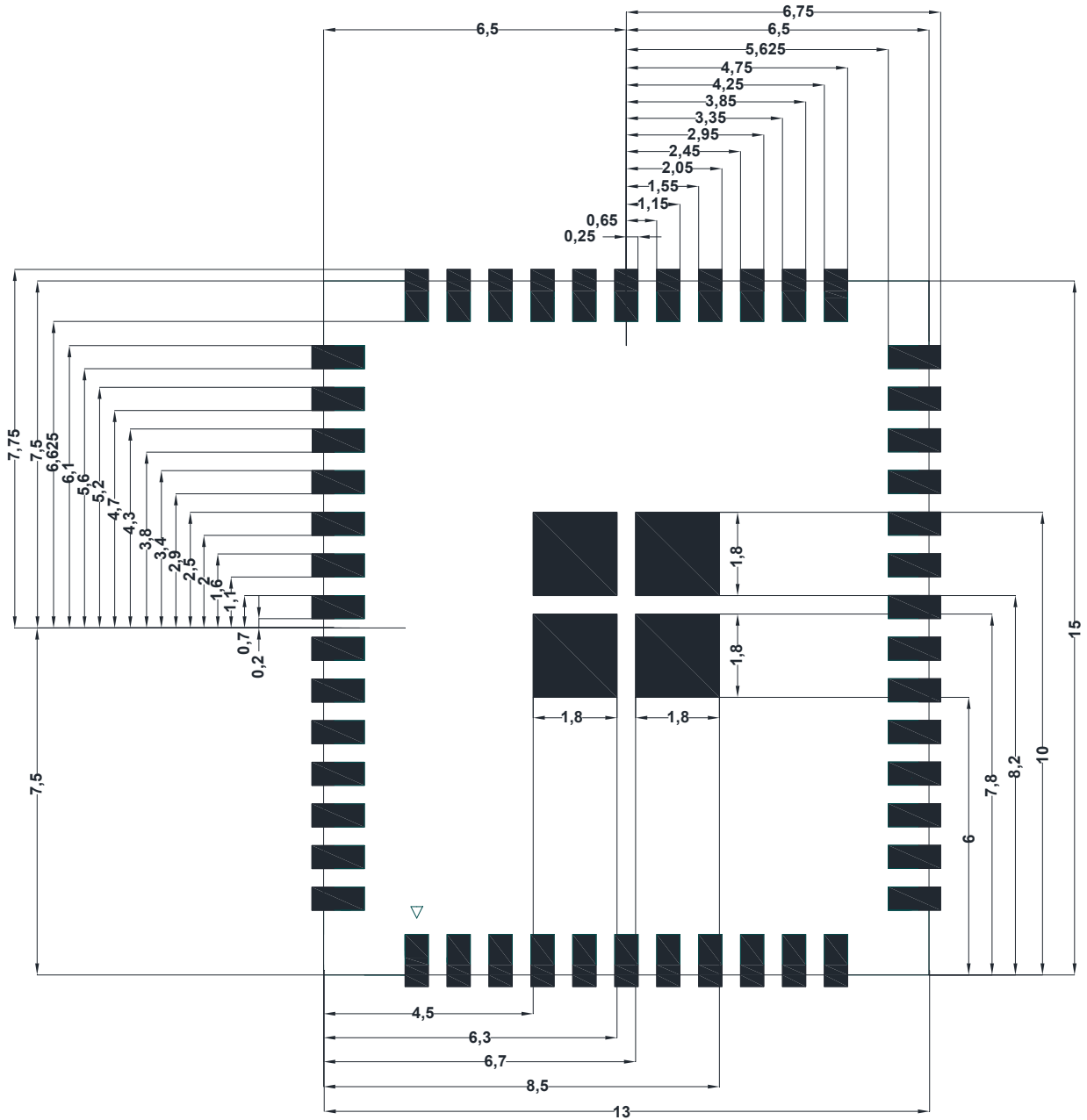
< TOP VIEW >



### 5.4 Layout Recommendation

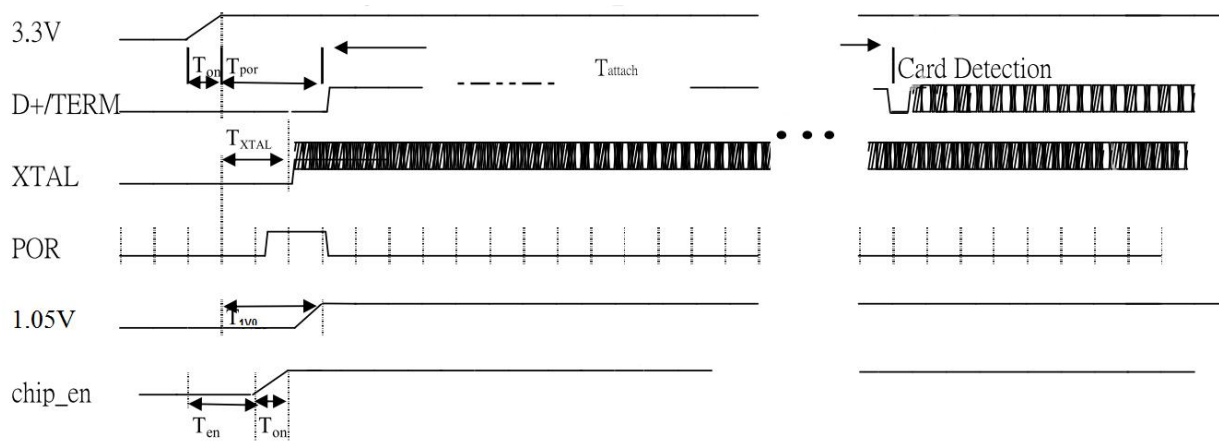
(Unit: mm)

< TOP VIEW >



## 6 Interface Timing Specification

### 6.1 USB Bus Timing during Power On Sequence



$T_{on}$ : the main power ramp on duration

$T_{por}$ : the power on reset releases and power management unit executes power on tasks

$T_{attach}$ : USB attach state

$T_{xtal}$ : XTAL starts

$T_{en}$ : interval between the rising point of 3.3V and chip\_en

#### **The power on flow description:**

After main 3.3V ramp up, the internal power on reset is released by power ready detection circuit and the power management unit will be enabled. The power management unit enables the internal regulator and clock circuits.

The power management unit also enables the USB circuits.

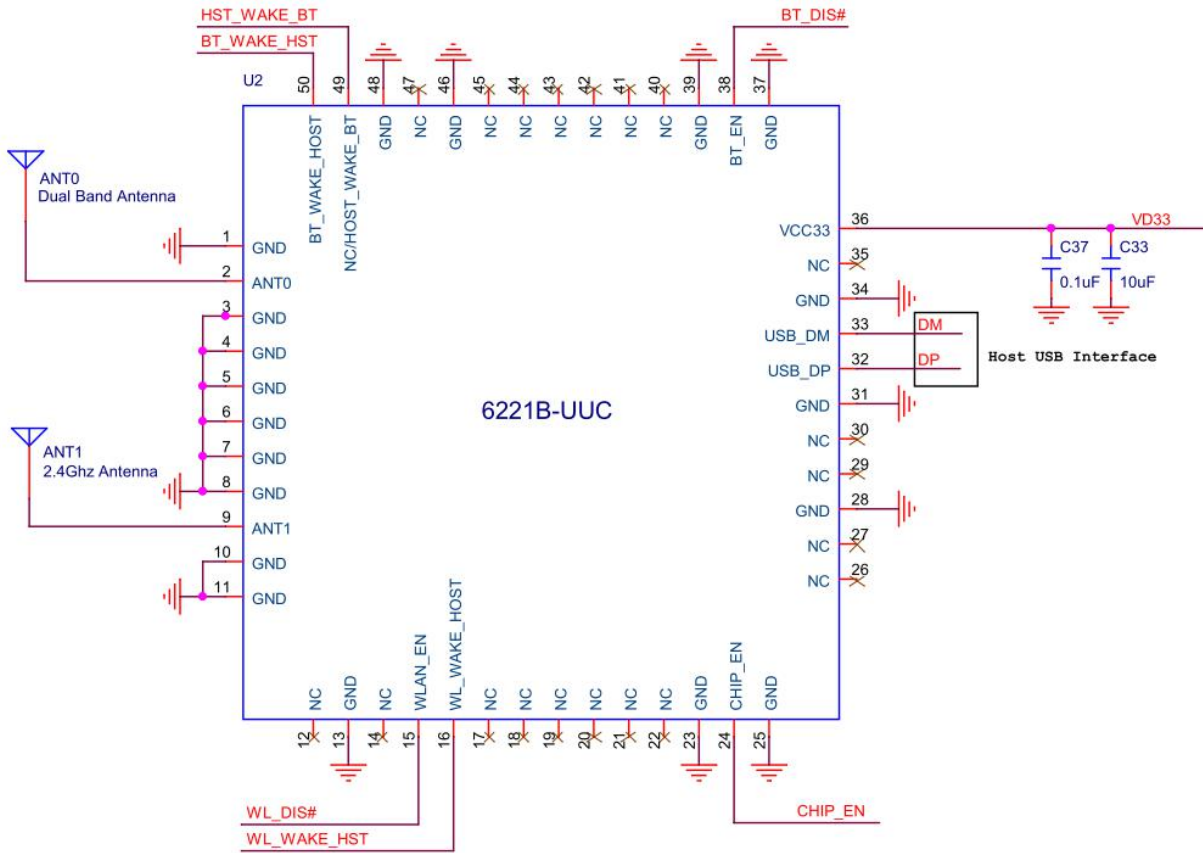
USB analog circuits attach resistors to indicate the insertion of the USB device.

#### **The typical timing range:**

	Unit	Min	Typical	Max
$T_{on}$	ms	--	1.5	5
$T_{por}$	ms	--	2	20
$T_{xtal}$	ms	--	1.5	8
$T_{attach}$	ms	100	250	--
$T_{1v0}$	ms	--	3	11
$T_{en}$	ms	0	0	5



## 7 Reference Design



Note: Module requires independent power supply , supply capacity  $\geq$  600mA and ripple less than 100mV; Do not share power with amplifier, infrared device, camera, etc.

## 8 Ordering Information

Part No.	Description
FG6221BUUC-00	RTL8821CU, 802.11a/b/g/n/ac, Wi-Fi 1T1R, BT v4.2, USB2.0, 15x13mm, dual antennae (external)

## 9 The Key Material List

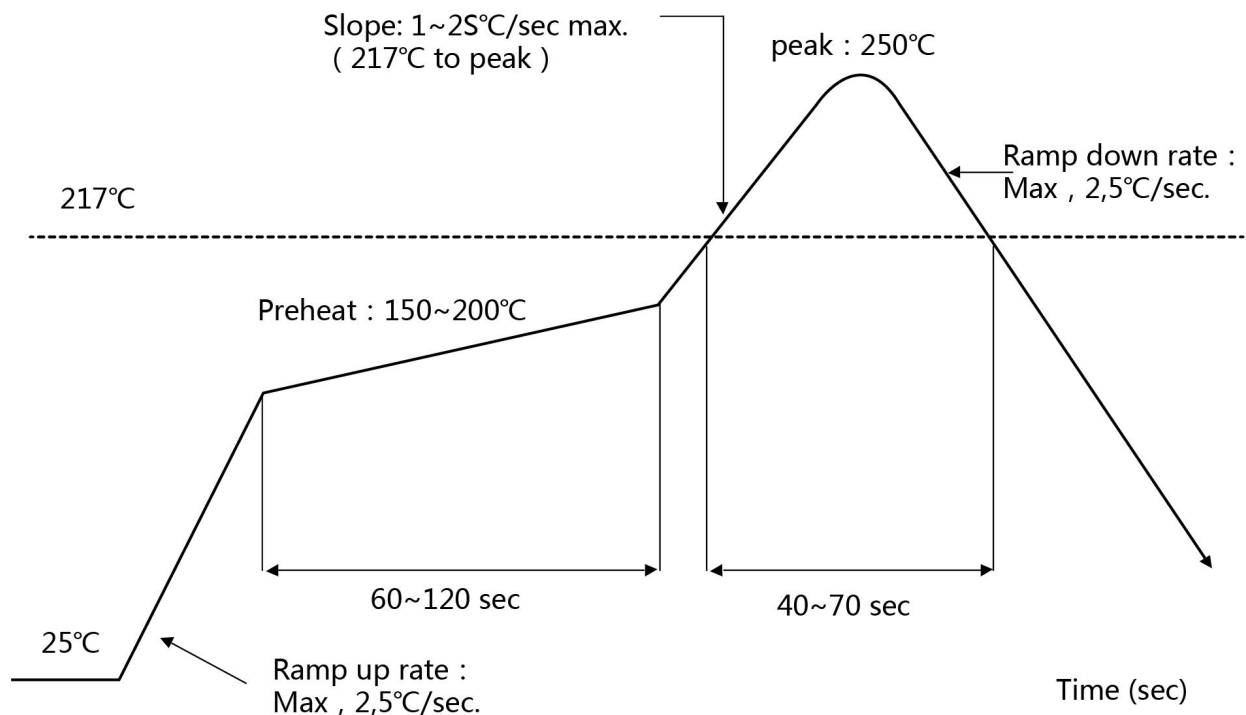
Main	Inductor	0603 2.2UH,±20% 850mA MPH160809S2R2MT (Sunlord)
Alternative	Inductor	0603, 2.2UH, 20%, 850mA, MGFL1608F2R2MT-LF (Microgate)
Main	Diplexer	DP1005-E2455FBT/LF (ACX)
Main	Crystal	2520 40MHZ 15PF, 10ppm SX25Y040000BF1T-C (TKD)
Alternative	Crystal	2520 40MHZ 15PF, 10ppm (TST)
Alternative	Crystal	2520 40MHZ 15PF, 10ppm -30+85°C E2SB40E00001AE (HOSONIC)
Alternative	Crystal	2520 40MHZ 15PF, 10ppm 8Z40000022 (TXC)
Main	Chipset	RTL8821CU-CG, QFN56 (Realtek)

## 10 Recommended Reflow Profile

Referred to IPC/JEDEC standard.

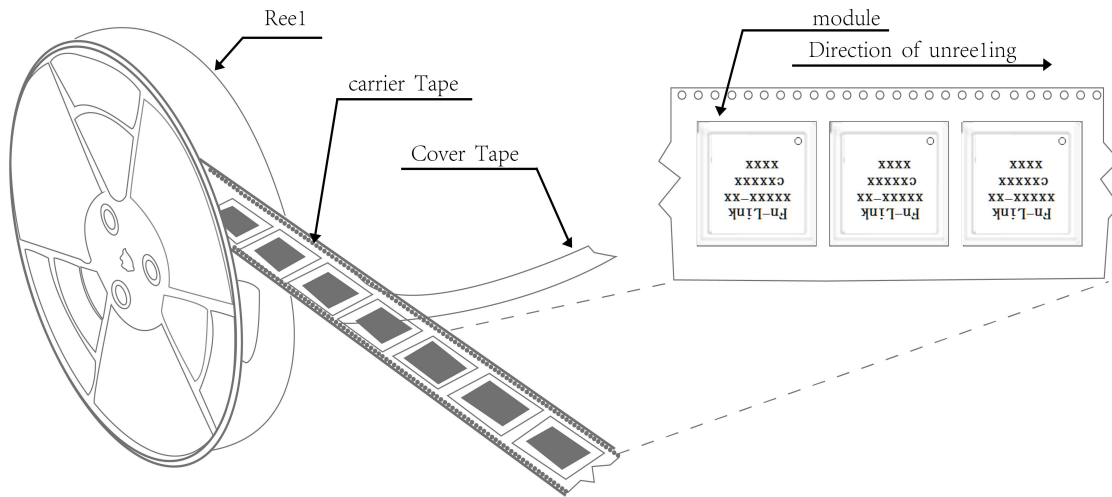
Peak Temperature : <250°C

Number of Times : ≤2 times



# 11 Package Information

## 11.1 Reel



## 11.2 Packaging Details

The take-up package:



Using self-adhesive tape  
 Color of plastic disc: blue



NY bag size: TBD



Internal box size: TBD



Carton size: TBD

### 11.3 Moisture Sensitivity

The modules is a Moisture Sensitive Level 3 device, in according with standard IPC/JEDEC J-STD-020, take care of all the requirements for this kind of components.

Moreover, please pay attention to following conditions:

- a) Calculated shelf life in sealed bag: 12 months at <math><40^{\circ}\text{C}</math> and <math><90\% \text{ RH}</math>
- b) Environmental condition during the production: <math>30^{\circ}\text{C}</math> / <math>60\% \text{ RH}</math> according to IPC/JEDEC J-STD-033A paragraph 5
- c) The maximum time between the opening of the sealed bag and the reflow process must be 168 hours if condition
- b) IPC/JEDEC J-STD-033A paragraph 5 is respected
- d) Baking is required if conditions b) or c) are not respected
- e) Baking is required if the humidity indicator inside the bag indicates 10% RH or more