

PRODUCT SPECIFICATION

6221M-PUC

Wi-Fi Dual-band 1T1R 11a/b/g/n/ac + Bluetooth 5.0

Combo Module

Version:v1.4



6221M-PUC Module Datasheet

Ordering Information	Part NO.	Description
	FG6221MPUC-00	RTL8821CE, a/b/g/n/ac Wi-Fi, 1T1R, BT5.0, 22.0*30.0mm, PCIe, USB, PCB V1.0
	FG6221MPUC-01	RTL8821CE-CG, a/b/g/n/ac Wi-Fi, 1T1R, BT5.0, 22.0*30.0mm, PCIe, USB, PCB V1.0
	FG6221MPUC-02	RTL8821CE-CG, a/b/g/n/ac Wi-Fi, 1T1R, BT5.0, 22.0*30.0mm, PCIe, USB, PCB V2.0
	FG6221MPUC-04	RTL8821CE-VC, a/b/g/n/ac Wi-Fi, 1T1R, BT5.0, 22.0*30.0mm, PCIe, USB, PCB V2.0

Customer: _____

Customer P/N: _____

Signature: _____

Date: _____

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1. General Description

1.1 Introduction

FN-Link Technology would like to announce a low-cost and low-power consumption module which has all of the Wi-Fi functionalities. It is a highly-integrated IEEE 802.11 a/b/g/n/ac MAC/Baseband/RF WLAN single chip. For Wireless LAN(WLAN)operation. The integrated module provides PCI-e interface for Wi-Fi . The module provides simple legacy and 20MHz/40MHz/80MHz co-existence mechanisms to ensure backward and network compatibility

The wireless module complies with IEEE 802.11 a/b/g/n/ac 1x1 SISO standard and it can achieve up to a speed of 433Mbps to connect the wireless LAN. The integrated module provides PCI-e interface for Wi-Fi, USB interface for Bluetooth.

This compact module is a total solution for a combination of Wi-Fi and Bluetooth V5.0 technologies. The module is specifically developed for all portable devices.

1.2 Description

Model Name	6221M-PUC
Product Description	Support Wi-Fi/Bluetooth functionalities
Dimension	L x W x H: 22x 30x 2.2 (typical) mm
Wi-Fi Interface	Support PCI-e
BT Interface	USB
OS supported	Android /Linux/ Win CE /iOS /XP/WIN7/WIN10
Operating temperature	0°C to 70°C
Storage temperature	-55°C to 85°C

2. Features

General

- Highly integrated wireless local area network (WLAN) system-on-chip (SoC) for 5 GHz 802.11ac, or 2.4G/5G 802.11n WLAN applications
- Supports 20/40MHz at 2.4GHz and supports 20/40/80MHz at 5GHz

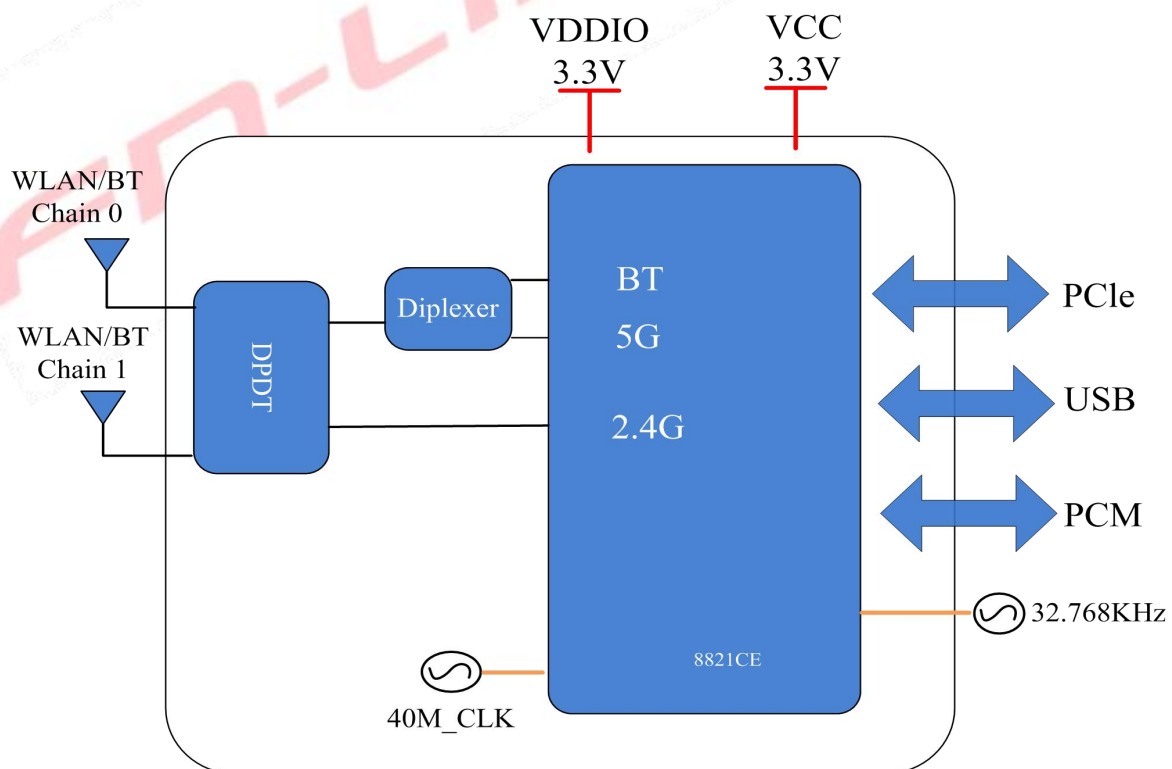
Host Interface

- Supports low power PCI-e interface for WLAN and USB interface for Bluetooth
- Supports WLAN-Bluetooth coexistence and ISM-LTE coexistence

Bluetooth Features

- Supports Bluetooth V5.0
- Support bluetooth 4.2system, compatible with BT v2.1+EDR
- Supports Bluetooth for class1 and class2 power level transmissions without requiring an external PA.
- BT host digital interface:
 - USB1.1

3. Block Diagram



4. General Specification

4.1 2.4GHz WI-FI Specification

Feature	Description		
WLAN Standard	IEEE 802.11 b/g/n Wi-Fi compliant		
Frequency Range	2.400 GHz ~ 2.4835 GHz (2.4 GHz ISM Band)		
Number of Channels	2.4GHz: Ch1 ~ Ch13		
Test Items	Typical Value		EVM
Output Power	802.11b /11Mbps : 17dBm ± 2 dB		EVM ≤ -9dB
	802.11g /54Mbps : 15dBm ± 2 dB		EVM ≤ -25dB
	802.11n /MCS7 : 14dBm ± 2 dB		EVM ≤ -28dB
Spectrum Mask	Meet with IEEE standard		
Freq. Tolerance	± 20ppm		
Receive Sensitivity (11b,20MHz) @8% PER	- 1Mbps	PER @ -95 dBm	≤-83
	- 11Mbps	PER @ -87 dBm	≤-76
Receive Sensitivity (11g,20MHz) @10% PER	- 6Mbps	PER @ -88 dBm	≤-85
	- 54Mbps	PER @ -72 dBm	≤-68
Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0	PER @ -91 dBm	≤-85
	- MCS=7	PER @ -70 dBm	≤-67
Receive Sensitivity (11n,40MHz) @10% PER	- MCS=0,	PER @ -83 dBm	≤-82
	- MCS=7,	PER @ -66 dBm	≤-64
Maximum Input Level	802.11b : -10 dBm		
	802.11g/n : -20 dBm		
Antenna Reference	Small antennas with 0~2 dBi peak gain		

4.2 5GHz WI-FI Specification

Conditions : VBAT=3.3V ; VDDIO=3.3V ; Temp:25°C

Feature	Description	
WLAN Standard	IEEE 802.11 a/n/ac, Wi-Fi compliant	
Frequency Range	4.900 GHz ~ 5.850 GHz (5.0 GHz ISM Band)	
Number of Channels	5.0GHz: Please see the table1	
Output Power	802.11a /54Mbps : 13 dBm ± 2 dB	EVM ≤ -25dB
	802.11n /MCS7 : 12 dBm ± 2 dB	EVM ≤ -28dB
	802.11ac /MCS9 : 11 dBm ± 2 dB	EVM ≤ -32dB

Test Items	Test Value	Standard Value
Receive Sensitivity (11a, 20MHz) @10% PER	- 6Mbps PER ≤ -87 dBm	≤-85
	- 54Mbps PER ≤ -71 dBm	≤-68
Receive Sensitivity (11n, 20MHz) @10% PER	- MCS=0 PER ≤ -86 dBm	≤-85
	- MCS=7 PER ≤ -68 dBm	≤-67
Receive Sensitivity (11n, 40MHz) @10% PER	- MCS=0 PER ≤ -83 dBm	≤-82
	- MCS=7 PER ≤ -65 dBm	≤-64
Receive Sensitivity (11ac, 20MHz) @10% PER	- MCS=0, NSS1 PER ≤ -83 dBm	≤-82
	- MCS=8, NSS1 PER ≤ -64 dBm	≤-60
Receive Sensitivity (11ac, 40MHz) @10% PER	- MCS=0, NSS1 PER ≤ -82 dBm	≤-79
	- MCS=9, NSS1 PER ≤ -60 dBm	≤-55
Receive Sensitivity (11ac, 80MHz) @10% PER	- MCS=0, NSS1 PER ≤ -81 dBm	≤-79
	- MCS=9, NSS1 PER ≤ -56 dBm	≤-54
Maximum Input Level	802.11a/n : -30 dBm	
Antenna Reference	Small antennas with 0~2 dBi peak gain	

15GHz(20MHz) Channel table

Band range	Operating Channel Numbers	Channel center frequencies(MHz)
5180MHz~5240MHz	36	5180
	40	5200
	44	5220
	48	5240
5260MHz~5320MHz	52	5260
	56	5280
	60	5300
	64	5320
5550MHz~5700MHz	100	5500
	104	5520
	108	5540
	112	5560
	116	5580
	120	5600
	124	5620
	128	5640
	132	5660
	136	5680
5745MHz~5825MHz	140	5700
	149	5745
	153	5765
	157	5785
	161	5805
	165	5825

4.3 Bluetooth Specification

Feature	Description		
General Specification			
Bluetooth Standard	Bluetooth V5.0 of 1, 2 and 3 Mbps.		
Host Interface	USB		
Antenna Reference	Small antennas with 0~2 dBi peak gain		
Frequency Band	2402 MHz ~ 2480 MHz		
Number of Channels	79 channels		
Modulation	GFSK, $\pi/4$ -DQPSK, 8-DPSK		
RF Specification			
	Min(dBm)	Typical(dBm)	Max(dBm)
Output Power (Class 1)		4	
Sensitivity @ BER=0.1% for GFSK (1Mbps)		-92	
Sensitivity @ BER=0.01% for $\pi/4$ -DQPSK (2Mbps)		-92	
Sensitivity @ BER=0.01% for 8DPSK (3Mbps)		-85	
Maximum Input Level	GFSK (1Mbps):-20dBm		
	$\pi/4$ -DQPSK (2Mbps) :-20dBm		
	8DPSK (3Mbps) :-20dBm		

5. ID setting information

WI-FI

Vendor ID	10EC
Product ID	C821

6. Pin Definition

6.1 Pin Outline

< TOP VIEW >

Pin	Signal	Signal	Pin
		GND	75
74	3.3 V	RESERVED/REFCLKn1	73
72	3.3 V	RESERVED/REFCLKp1	71
70	UIM_POWER_SRC/GPIO_1/PEWAKE1#	GND	69
68	UIM_POWER_SNK/CLKREQ1#	RESERVED/PETn1	67
66	UIM_SWP/PERST1#	RESERVED/PETp1	65
64	RESERVED	GND	63
62	ALERT# (O)(0/1.8 V)	RESERVED/PERn1	61
60	I2C_CLK (I)(0/1.8 V)	RESERVED/PERp1	59
58	I2C_DATA (I/O)(0/1.8 V)	GND	57
56	W_DISABLE1# (I)(0/3.3V)	PEWAKE0# (I/O)(0/3.3V)	55
54	W_DISABLE2# (I)(0/3.3V)	CLKREQ0# (I/O)(0/3.3V)	53
52	PERST0# (I)(0/3.3V)	GND	51
50	SUSCLK(32kHz) (I)(0/3.3V)	REFCLKn0	49
48	COEX_RXD (I)(0/1.8V)	REFCLKp0	47
46	COEX_TXD (O)(0/1.8V)	GND	45
44	COEX3 (I/O)(0/1.8V)	PETn0	43
42	VENDOR DEFINED	PETp0	41
40	VENDOR DEFINED	GND	39
38	VENDOR DEFINED	PERn0	37
36	UART_CTS (I)(0/1.8V)	PERp0	35
34	UART_RTS (O)(0/1.8V)	GND	33
32	UART_RXD (I)(0/1.8V)	ADD-IN CARD KEY E	
	ADD-IN CARD KEY E	ADD-IN CARD KEY E	
	ADD-IN CARD KEY E	ADD-IN CARD KEY E	
	ADD-IN CARD KEY E	ADD-IN CARD KEY E	
22	UART_TXD (O)(0/1.8V)	SDIO RESET#/Tx_BLANKING (I)(0/1.8V)	23
20	UART_WAKE# (O)(0/3.3V)	SDIO_WAKE# (O)(0/1.8V)	21
18	GND	SDIO_DATA3 (I/O)(0/1.8V)	19
16	LED_2# (O)(OD)	SDIO_DATA2 (I/O)(0/1.8V)	17
	ADD-IN CARD KEY A	ADD-IN CARD KEY A	
	ADD-IN CARD KEY A	ADD-IN CARD KEY A	
	ADD-IN CARD KEY A	ADD-IN CARD KEY A	
	ADD-IN CARD KEY A	ADD-IN CARD KEY A	
6	LED_1# (O)(OD)	GND	7
4	3.3 V	USB_D-	5
2	3.3 V	USB_D+	3
		GND	1

6.2 Pin Definition details

NO	Name	Type	Description	Voltage
1	GND	-	Ground	
3	USB_D+	I/O	USB differential line for BT	
5	USB_D-	I/O		
7	GND	-	Ground	
9	NC	-	No connect	
17	NC	-	No connect	
19	NC	-	No connect	
21	NC	-	No connect	
23	NC	-	No connect	
33	GND	-	Ground	
35	PERP0	I	PCIe RX differential signals	
37	PERN0	I		
39	GND	-	Ground	
41	PETP0	O	PCIe TX differential signals	
43	PETN0	O		
45	GND	-	Ground	
47	REFCLKP0	I	PCIe clock differential input signal	
49	REFCLKN0	I		
51	GND	-	Ground	
53	CLKREQ0	O	PCIe reference clock request signal, open drain, active low	3.3V
55	PEWAKE0	O	PCIe wake up host, open drain, active low	3.3V
57	GND	-	Ground	
59	NC	-	NC	
61	NC	-	NC	
63	GND	-	Ground	
65	NC	-	NC	
67	NC	-	NC	
69	GND9	-	Ground	
71	RESERVED	-	NC or GPIO2 Reserved	3.3V
73	RESERVED	-	NC or GPIO3 Reserved	3.3V
75	GND10	-	Ground	

Bottom side

NO	Name	Type	Description	Voltage
2	3_3V	P	Power supply	3.3V
4	3_3V	P	Power supply	3.3V
6	LED_1#	O	WLAN LED signal	3.3V
8	NC	-	NC	
10	NC	-	NC	
12	NC	-	NC	
14	NC	-	NC	
16	LED_2#	O	BT LED signal	3.3V
18	GND	-	NC	
20	NC	-	NC	
22	NC	-	NC	
32	NC	-	NC	
34	NC	-	NC	
36	NC	-	NC	
38	NC	-	NC	
40	NC	-	NC	
42	NC	-	NC	
44	COEX3	I/O	LTE coexistence signal	3.3V
46	LTE_COEX_TXD	O	LTE coexistence signal	3.3V
48	LTE_COEX_RXD	I	LTE coexistence signal	3.3V
50	SUSCLK	I	Sleep clock input	3.3V
52	PERST0	I	PCIe reset signal, active low	3.3V
54	BT_DIS_N	I	Bluetooth enable signal, pull low to disable BT function, default high.	3.3V
56	WL_DIS_N	I	WLAN enable signal, pull low to disable BT function, default high.	3.3V
58	NC	-	NC	
60	NC	-	NC	
62	NC	-	NC	
64	NC	-	NC	
66	NC	-	NC	
68	NC	-	NC	
70	NC	-	NC	
72	NC	-	NC	
74	NC	-	NC	

P:POWER I:INPUT O:OUTPUT PD: PULL-DOWN

7. Electrical Specifications

7.1 Power Supply DC Characteristics

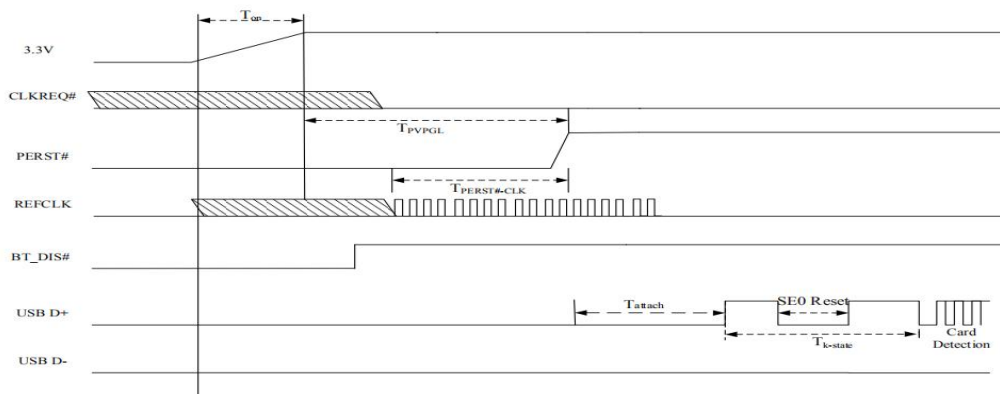
	MIN	TYP	MAX	Unit
Operating Temperature	0	25	70	deg.C
VCC33	3.0	3.3	3.6	V
VDDIO	3.0	3.3	3.6	V

7.2 Power Consumption

	VCC33 = 3.3V(Unit:mA)	
	Power Consumption	Wi-Fi on Mode
	TX (2.4G HT40)	275
	RX (2.4G HT40)	134
	TX (5G vHT80)	264
	RX (5G vHT80)	139
	BT on	23

7.3 Interface Circuit time series

7.3.1 PCIe Bus during Power On Sequence



T_{on} : The main power ramp up duration;

$T_{PV PGL}$: Power valid to PERST# input inactive;

$T_{PERST\#-CLK}$: Reference clock stable before PERST# inactive;

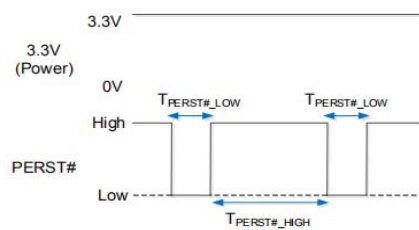
T_{attach} : The interval to turn on BT after PERST# de-asserted;

$T_{k-state}$: the duration from resistor attached to USB host starting card detection procedure;

The typical timing range

Symbol	Unit	Min	Typical	Max
T_{on}	ms	0.5	1.5	5
$T_{PV PGL}$	ms	Implementation specific; recommended 50ms		--
$T_{PERST\#-CLK}$	us	100		--
T_{attach}	ms	0.5	2	5
$T_{k-state}$	ms	50	250	--

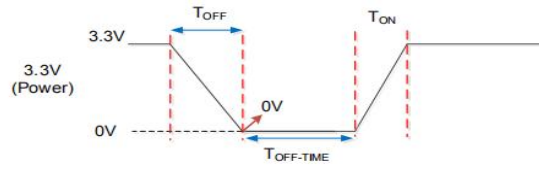
7.3.2 PCIe PERST# Timing Sequence



RTL8821CE-CG PCIE PERST# Timing Parameters

	Min	Typical	Max	Unit	Description
$T_{PERST\#_LOW}$	6	10	X	ms	PERST# low duration
$T_{PERST\#_HIGH}$	400	500	X	ms	PERST# high duration

7.3.3 Power Off Sequence



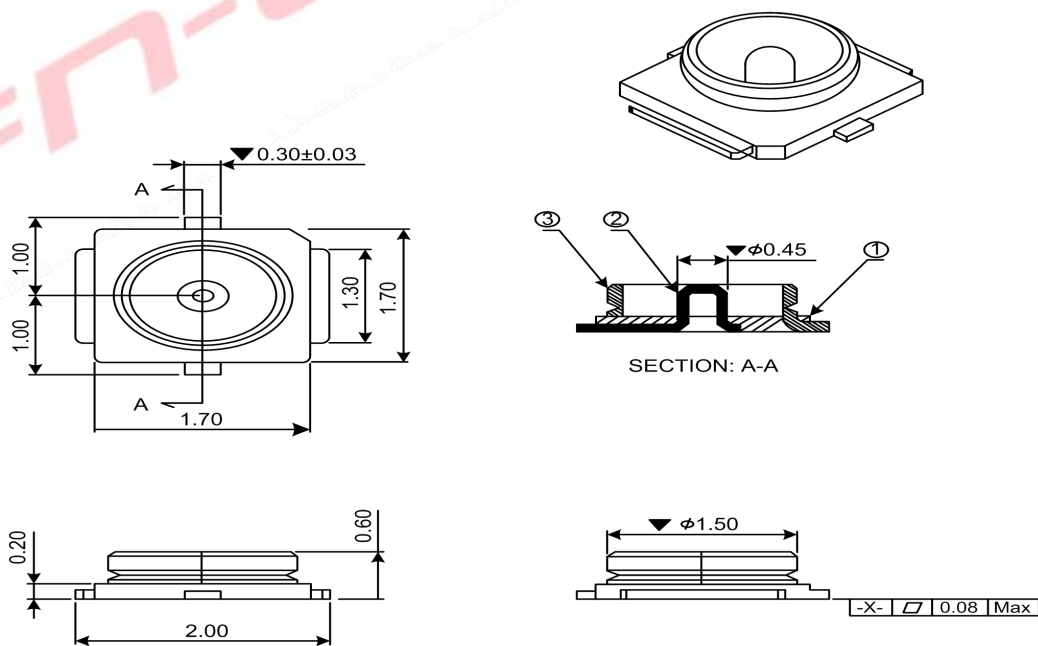
RTL8821CE-CG Power Off Sequence
RTL8821CE-CG Power Off Timing Parameters

Symbol	Unit	Min	Typical	Max
T_{OFF}	ms	5	20	50
$T_{OFF-TIME}$	ms	500	--	--
T_{ON}	ms	0.5	1.5	5

7.4 M.2 Connector

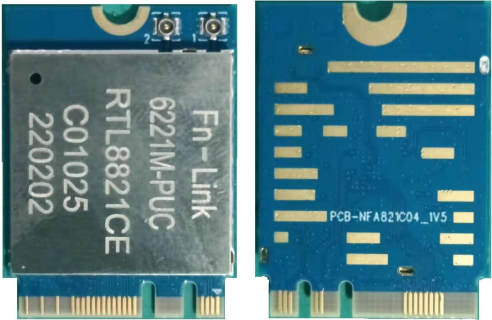
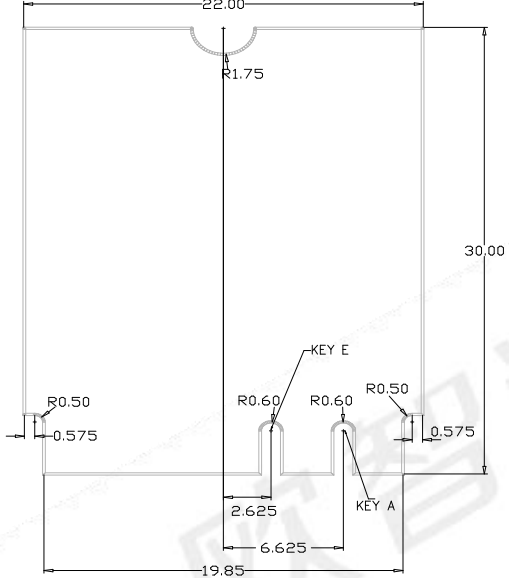
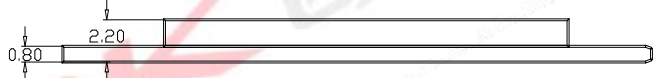
The module is standard M.2 2230 Key A and Key E single sided module. It complies with the standard M.2 2230 Key A and Key E slot.

7.5 RF Connector Specification



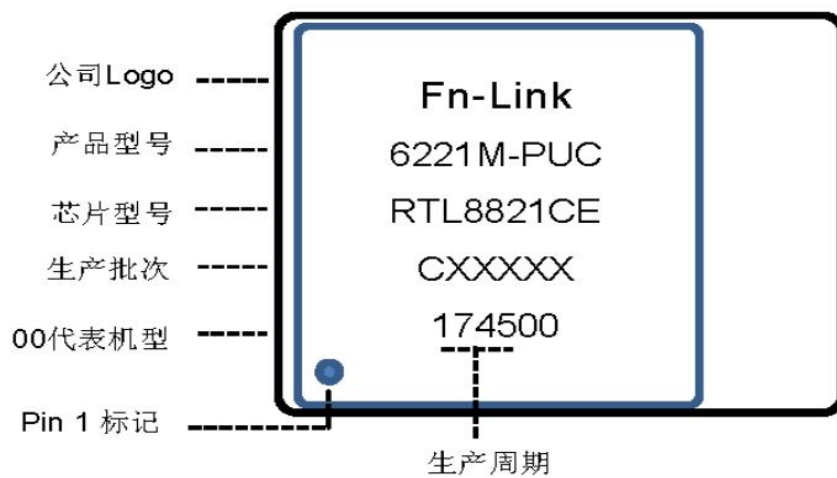
8. Size reference

8.1 Module Picture

<p>L x W : 22 x 30 (+0.3/-0.1) mm</p> 	
<p>H: 2.2 (±0.2) mm</p>	
<p>Weight</p>	<p>2.6g</p>

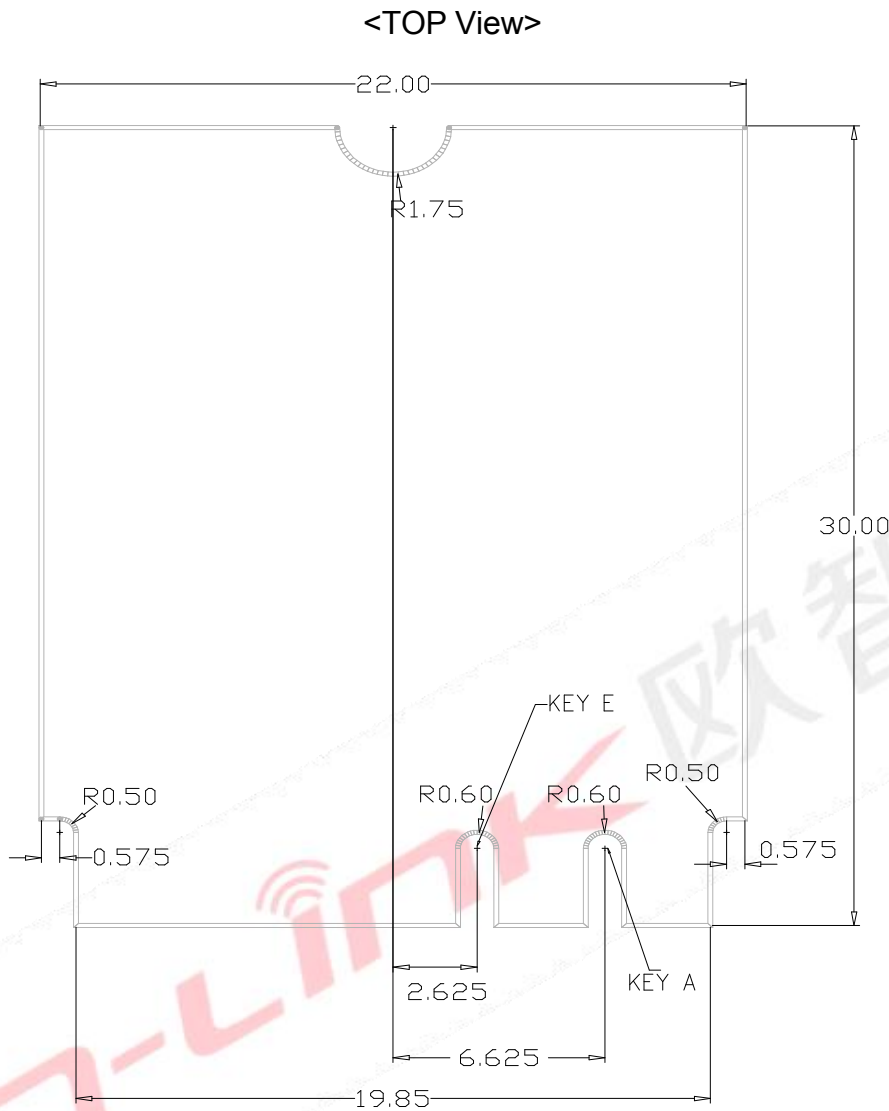
8.2 Marking Description

< TOP VIEW >



模组尺寸: 22x30mm
屏蔽盖尺寸: 21.11x21.08mm

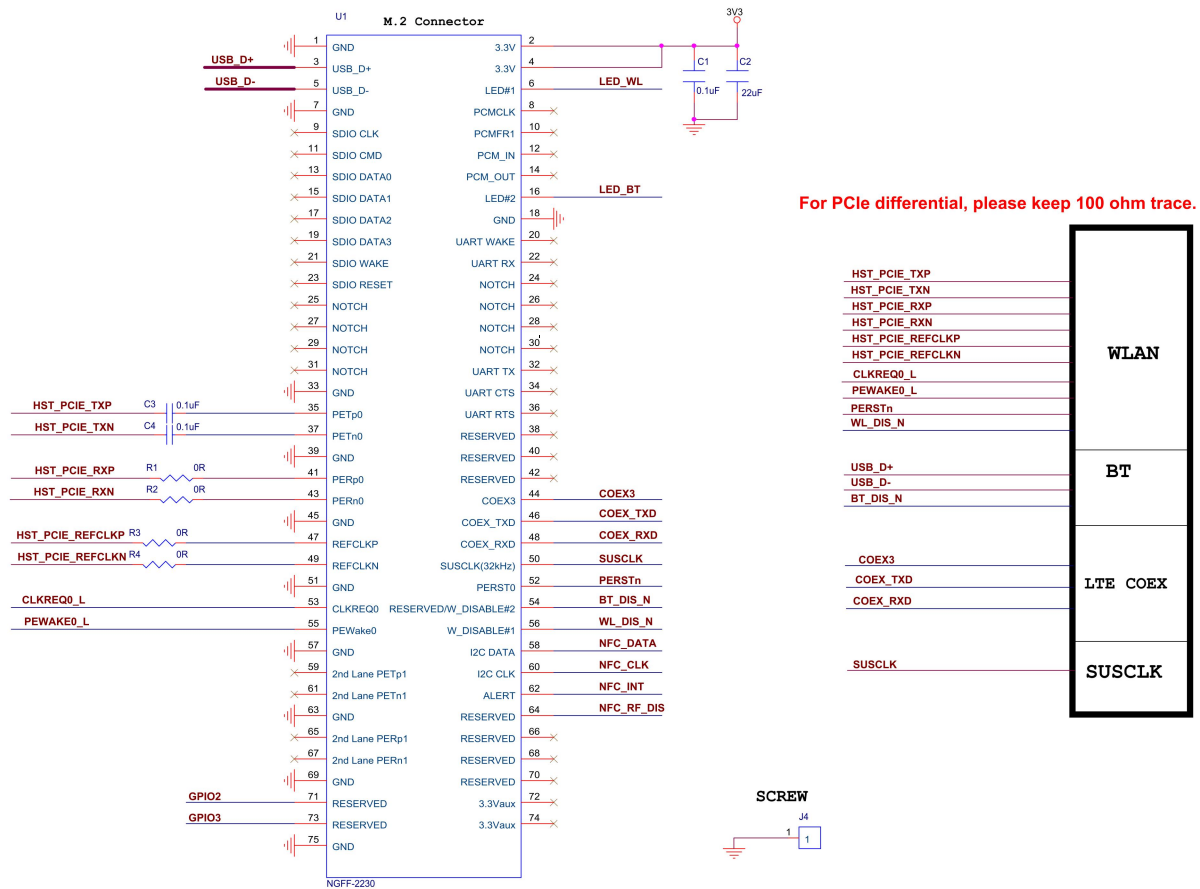
8.3 Physical Dimensions



9. The Key Material List

Item	Part Name	Description	Manufacturer
1	Inductor	2016 2.2uH,±20%	Sunlord, Ceaiya, Cenker
2	Diplexer	1005 Dual-band, dual-mode 2.4GHz/5GHz WLAN	Glead, Walsin, ACX, Murata, MAG.LAYERS,ftgroup
3	Crystal	2520 40MHz	ECEC, TKD, Hosonic, JWT, TXC
4	Chipset	RTL8821CE	Realtek
5	PCB	FR4, 4 LAYER	XY-PCB, GDKX, Sunlord, SLPCB

10. Reference Design



Note:

1. Both of the 2 ANT's are all support 2.4G/5G/BT function.
2. 6221M-PUC antenna port is control by driver if diversity function is enabled.
3. C1, C2 placed close to module side.
4. PCIe differential keep 100 ohm trace.
5. USB differential keep 90 ohm trace.

11. RoHS compliance

All hardware components are fully compliant with EU RoHS directive

12. Package

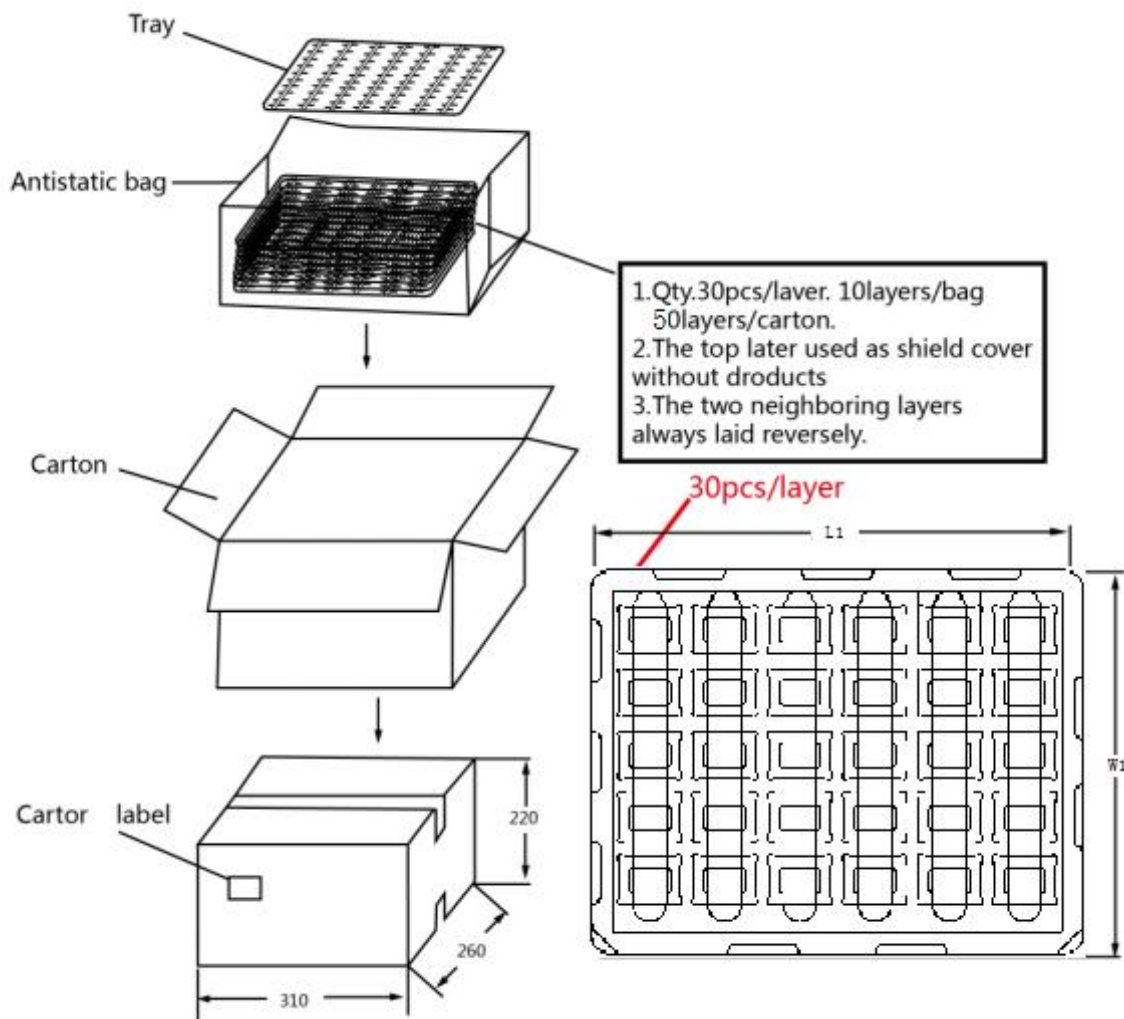
12.1 Tray

Layer size: L1=250mm, W1=190mm

Layer material: PVC

Carton size: L310.0*W260.0*H220.0 mm

Carton material: A=A



13. Moisture sensitivity

The Modules is a Moisture Sensitive Device level 3, in according with standard IPC/JEDEC J-STD-020, take care

all the relatives requirements for using this kind of components.

Moreover, the customer has to take care of the following conditions:

- a) Calculated shelf life in sealed bag: 12 months at <math><40^{\circ}\text{C}</math> and <math><90\%</math> relative humidity (RH)
- b) Environmental condition during the production: - c) The maximum time between the opening of the sealed bag and the reflow process must be 168 hours if condition
- d) "IPC/JEDEC J-STD-033A paragraph 5.2" is respected
- e) Baking is required if conditions b) or c) are not respected
- f) Baking is required if the humidity indicator inside the bag indicates 10% RH or more