

PRODUCT SPECIFICATION

6251B-SRB

Wi-Fi Dual-band 1T1R 11ax + Bluetooth 5.3

Combo Module

Version:v1.0

Customer: _____

Customer P/N: _____

Signature: _____

Date: _____

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6251B-SRB Module Datasheet

Ordering Information	Part NO.	Description
	FG6251BSRB-00	RTL8851BS-CG,a/b/g/n/ac/ax,Wi-Fi,1T1R,BT5.3,13*15mm,SD IO+UART,2 天线,TVS 带屏蔽盖



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1. General Description

1.1 Introduction

6251B-SRB is a highly integrated module that support 1-stream 802.11ax solutions with Wireless LAN (WLAN) SDIO (SDIO 1.1/2.0/3.0) interface controller with integrated Bluetooth 5 HS-UART interface controller. It combines a WLAN MAC, a 1T1R capable WLAN baseband, and RF in a single chip. Module provides a complete solution for a high-performance integrated wireless and Bluetooth device.

1.2 Description

Model Name	6251B-SRB
Product Description	Support Wi-Fi/Bluetooth functionalities
Dimension	L x W x H: 15 x 13 x 2.35mm
Wi-Fi Interface	Support SDIO V1.0/V2.0/V3.0
BT Interface	UART / PCM
OS supported	Android /Linux/Windows
Operating temperature	0°C to 70°C
Storage temperature	-40°C to 85°C

2. Features

General

- CMOS MAC, Baseband PHY and RF in a single chip for IEEE 802.11a/b/g/n/ac/ax compatible WLAN.
- Support 802.11ax 1x1, with OFDMA, by 4 types PPDU format, such as HE-SU-PPDU, HE-ER-SU-PPDU, HE-MU-PPDU, and HE-TB-PPDU.

PHY Features

- IEEE 802.11a/b/g/n/ac/ax compatible WLAN.
- Supports 20/40MHz at 2.4GHz and supports 20/40/80MHz at 5GHz, and 600Mbps using 80MHz with 11ax.
- IEEE 802.11i (WPA, WPA2, WPA3). Open, shared key, and pair-wise key authentication services.
- Transmit Beamforming.

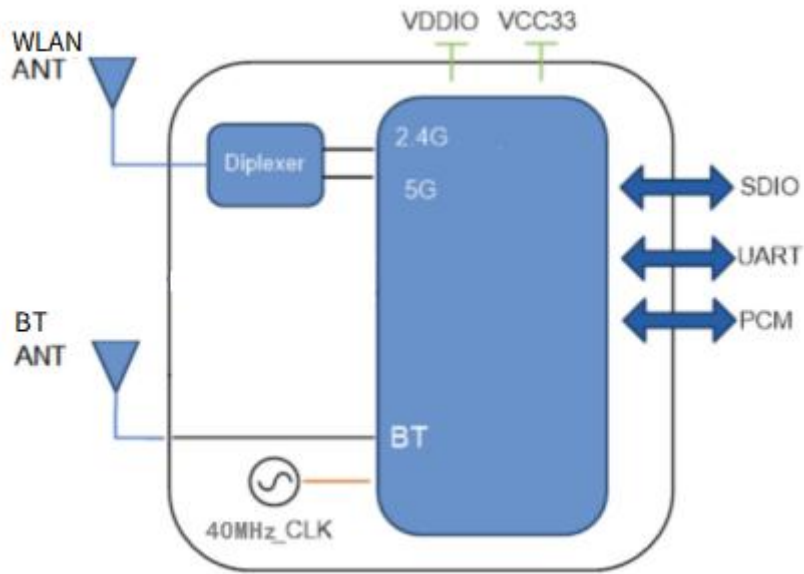
Host Interface

- Complies with SDIO 1.1/2.0/3.0 for with clock rate up to 208MHz
- UART/PCM interface for Bluetooth.

Bluetooth Features

- Supports Bluetooth system (BT5.3 Logo Compliant)
- Supports WLAN/Bluetooth coexistence
- Compatible with Bluetooth v2.1+EDR.
- Dual Mode support: Simultaneous LE and BR/EDR
- BT host digital interface:
 - HCI UART
 - PCM for audio data

3. Block Diagram



4. General Specification

4.1 WI-FI 2.4GHz Specification

Feature	Description		
WLAN Standard	IEEE 802.11 b/g/n/ax Wi-Fi compliant		
Frequency Range	2.400 GHz ~ 2.4835 GHz (2.4 GHz ISM Band)		
Number of Channels	2.4GHz: Ch1 ~ Ch14		
Test Items	Typical Value		EVM
Output Power ¹	802.11b /11Mbps : 19dBm ± 2 dB		EVM ≤ -10dB
	802.11g /54Mbps : 17dBm ± 2 dB		EVM ≤ -25dB
	802.11n HT20 MCS7 : 17dBm ± 2 dB		EVM ≤ -27dB
	802.11n HT40 MCS7 : 17dBm ± 2 dB		EVM ≤ -27dB
	802.11ax HE20 MCS11: 13dBm ± 2 dB		EVM ≤ -35dB
	802.11ax HE40 MCS11: 13dBm ± 2 dB		EVM ≤ -35dB
Spectrum Mask	Meet with IEEE standard		
Freq. Tolerance	± 20ppm		
SISO Receive Sensitivity (11b,20MHz) @8% PER	- 1Mbps	PER @ -94 dBm	≤-83
	- 11Mbps	PER @ -85 dBm	≤-76
SISO Receive Sensitivity (11g,20MHz) @10% PER	- 6Mbps	PER @ -90 dBm	≤-85
	- 54Mbps	PER @ -71 dBm	≤-65
SISO Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0	PER @ -90 dBm	≤-85
	- MCS=7	PER @ -69 dBm	≤-64

SISO Receive Sensitivity (11n,40MHz) @10% PER	- MCS=0	PER @ -87 dBm	≤-82
	- MCS=7	PER @ -66 dBm	≤-61
SISO Receive Sensitivity (11ac,20MHz) @10% PER	- MCS=0	PER @ -90 dBm	≤ -82
	- MCS=8	PER @ -66 dBm	≤ -59
SISO Receive Sensitivity (11ac ,40MHz) @10% PER	- MCS=0	PER @ -87 dBm	≤ -79
	- MCS=9	PER @ -59 dBm	≤ -55
SISO Receive Sensitivity (11ax,20MHz) @10% PER	- MCS=0	PER @ -90 dBm	≤-74
	- MCS=11	PER @ -60 dBm	≤-52
SISO Receive Sensitivity (11ax ,40MHz) @10% PER	- MCS=0	PER @ -87 dBm	≤-71
	- MCS=11	PER @ -57 dBm	≤-49
Maximum Input Level	802.11b : -10 dBm		
	802.11g/n : -20 dBm		
Antenna Reference	Small antennas with 0~2 dBi peak gain		

4.2 WI-FI 5GHz Specification

Feature	Description		
WLAN Standard	IEEE 802.11a/n/ac/ax, Wi-Fi compliant		
Frequency Range	5.15 GHz ~ 5.850 GHz(5.0 GHz ISM Band)		
Test Items	Typical Value		EVM
Output Power ¹	802.11a /54Mbps: 18 dBm ± 2 dB		EVM ≤ -25dB
	802.11n /MCS7: 17dBm ± 2 dB		EVM ≤ -27dB
	802.11ac vHT20 MCS8: 16 dBm ± 2 dB		EVM ≤ -30dB
	802.11ac vHT40 MCS9: 15 dBm ± 2 dB		EVM ≤ -32dB
	802.11ac vHT80 MCS9: 15 dBm ± 2 dB		EVM ≤ -32dB
	802.11ax HE20 MCS11: 13 dBm ± 2 dB		EVM ≤ -35dB
	802.11ax HE40 MCS11: 13 dBm ± 2 dB		EVM ≤ -35dB
	802.11ax HE80 MCS11: 13 dBm ± 2 dB		EVM ≤ -35dB
Spectrum Mask	Meet with IEEE standard		
Freq. Tolerance	± 20ppm		
SISO Receive Sensitivity (11a,20MHz) @10% PER	- 6Mbps	PER @ -90 dBm	≤-85
	- 54Mbps	PER @ -71 dBm	≤-65
SISO Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0	PER @ -90 dBm	≤-85
	- MCS=7	PER @ -69 dBm	≤-64
SISO Receive Sensitivity (11n,40MHz) @10% PER	- MCS=0	PER @ -87 dBm	≤-82
	- MCS=7	PER @ -66 dBm	≤-61
SISO Receive Sensitivity	- MCS=0, NSS1	PER @ -90 dBm	≤ -82

(11ac,20MHz) @10% PER	- MCS=8, NSS1 PER @ -66 dBm	≤ -59
SISO Receive Sensitivity	- MCS=0, NSS1 PER @ -87 dBm	≤ -79
(11ac ,40MHz) @10% PER	- MCS=9, NSS1 PER @ -59 dBm	≤ -54
SISO Receive Sensitivity	- MCS=0, NSS1 PER @ -84 dBm	≤ -79
(11ac,80MHz) @10% PER	- MCS=9, NSS1 PER @ -56 dBm	≤ -51
SISO Receive Sensitivity	- MCS=0 PER @ -90 dBm	≤ -74
(11ax,20MHz) @10% PER	- MCS=11 PER @ -60 dBm	≤ -52
SISO Receive Sensitivity	- MCS=0 PER @ -87 dBm	≤ -71
(11ax ,40MHz) @10% PER	- MCS=11 PER @ -57 dBm	≤ -49
SISO Receive Sensitivity	- MCS=0 PER @ -84 dBm	≤ -68
(11ax,80MHz) @10% PER	- MCS=11 PER @ -54 dBm	≤ -46
Maximum Input Level	802.11a/n: -30 dBm	
Antenna Reference	Small antennas with 0~2 dBi peak gain	

1. 2.4G,5G output power control by firmware power by rate table.

Note: The Wi-Fi RF specification data will be updated in future version.

4.3 Bluetooth Specification

Feature	Description
General Specification	
Bluetooth Standard	BDR,EDR(1Mbps & 2Mbps & 3Mbps),LE(1Mbps),2LE(2Mbps)
Host Interface	UART
Frequency Band	2400 MHz ~ 2483.5 MHz
Number of Channels	79 channels for classic,40 channels for BLE
Modulation	GFSK, $\pi/4$ -DQPSK,8DPSK
RF Specification	
Output Power , tolerance ± 2 dB	
	CL1(dBm)
BDR Output Power	5
EDR Output Power	5
BLE Output Power	5
Sensitivity, tolerance : /	
Sensitivity @ BER=0.1%	PER @ -92
	≤ -70

for GFSK (1Mbps)		
Sensitivity @ BER=0.01% for $\pi/4$ -DQPSK (2Mbps)	PER @-86	≤ -70
Sensitivity @ BER=0.01% for 8DPSK (3Mbps)	PER @-85	≤ -70
Sensitivity @ BLE=30.8% for LE (1Mbps)	PER @-95	≤ -70
Sensitivity @ BLE=30.8% for 2LE (2Mbps)	PER @-93	≤ -70
Maximum Input Level	GFSK (1Mbps):-20dBm	
	$\pi/4$ -DQPSK (2Mbps) :-20dBm	
	8DPSK (3Mbps) :-20dBm	

Note: The Bluetooth Specification may updated in future version.

5. ID setting information

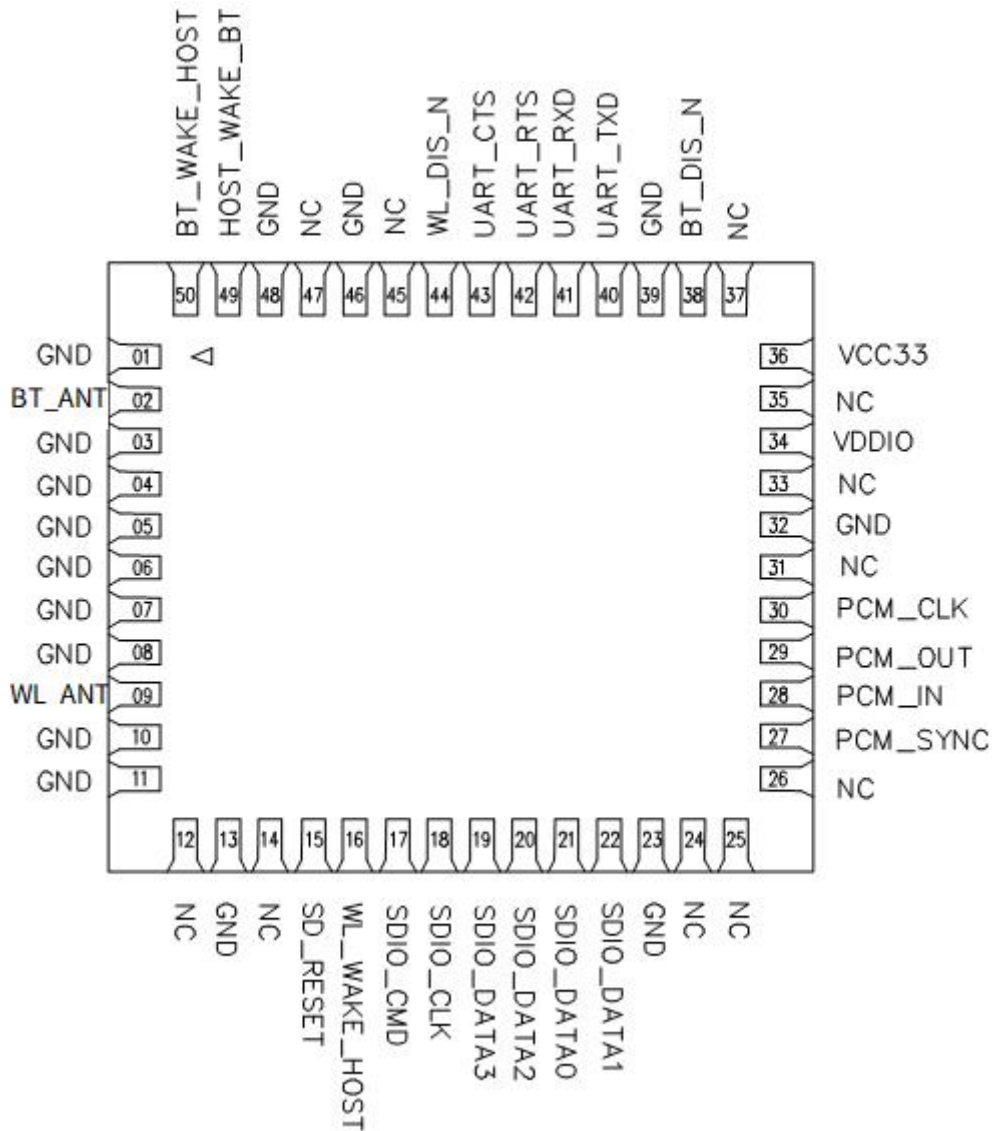
WI-FI

Vendor ID	024C
Product ID	B851

6. Pin Definition

6.1 Pin Outline

< TOP VIEW >



6.2 Pin Definition details

NO.	Name	Type	Description	Voltage
1	GND	—	Ground connections	
2	BT_ANT	I/O	BT RF I/O port	
3	GND	—	Ground connections	
4	GND	—	Ground connections	
5	GND	—	Ground connections	
6	GND	—	Ground connections	
7	GND	—	Ground connections	
8	GND	—	Ground connections	
9	WL_ANT	I/O	WLAN RF I/O port	
10	GND	—	Ground connections	
11	GND	—	Ground connections	

12	NC	—	No connect	
13	GND	—	Ground connections	
14	NC	—	No connect	
15	SD_RESET	I	Shared with GPIO9. This pin can externally shut down WLAN function when SD_RESET is pulled low. When this pin is pulled low, SDIO interface will be disabled.	VDDIO
16	WL_WAKE_HOST	O	GPIO10. WLAN to wake-up HOST	VDDIO
17	SDIO_CMD	I/O	SDIO command line	VDDIO
18	SDIO_CLK	I/O	SDIO clock line	VDDIO
19	SDIO_DATA3	I/O	SDIO data line 3	VDDIO
20	SDIO_DATA2	I/O	SDIO data line 2	VDDIO
21	SDIO_DATA0	I/O	SDIO data line 0	VDDIO
22	SDIO_DATA1	I/O	SDIO data line 1	VDDIO
23	GND	—	Ground connections	
24	NC	—	No connect	
25	NC	—	No connect	
26	NC	—	No connect	
27	PCM_SYNC	I/O	PCM sync signal	VDDIO
28	PCM_IN	I	PCM data input	VDDIO
29	PCM_OUT	O	PCM Data output	VDDIO
30	PCM_CLK	I/O	PCM clock	VDDIO
31	NC	—	No connect	
32	GND	—	Ground connections	
33	NC	—	No connect	
34	VDDIO	P	I/O Voltage supply input 1.8V or 3.3V	1.8V or 3.3V
35	NC	—	No connect	
36	VCC33	P	Main power voltage source input 3.3V	3.3V
37	NC	—	No connect	
38	BT_DIS_N	I	Shared with GPIO11. This pin can externally shut down BT function when BT_DIS# is pulled Low. When this pin is pulled low, UART interface will be also disabled. This pin can be also defined as the BT Radio-off function with host interface remaining connected.	VDDIO
39	GND	—	Ground connections	

40	UART_TXD	O	Bluetooth UART interface	VDDIO
41	UART_RXD	I	Bluetooth UART interface	VDDIO
42	UART_RTS	O	Bluetooth UART interface	VDDIO
43	UART_CTS	I	Bluetooth UART interface	VDDIO
44	WL_DIS_N	—	Shared with GPIO16. This pin can be defined as the WLAN Radio-offfunction with host interface remaining coninected. When this pin is pulled low, WLAN Radio will be disabled.	VDDIO
45	NC	—	No connect	
46	GND	—	Ground connections	
47	NC	—	No connect	
48	GND	—	Ground connections	
49	HOST_WAKE_BT	I	HOST wake-up Bluetooth device	VDDIO
50	BT_WAKE_HOST	O	Bluetooth device to wake-up HOST	VDDIO

P:POWER I:INPUT O:OUTPUT VDDIO:3.3V

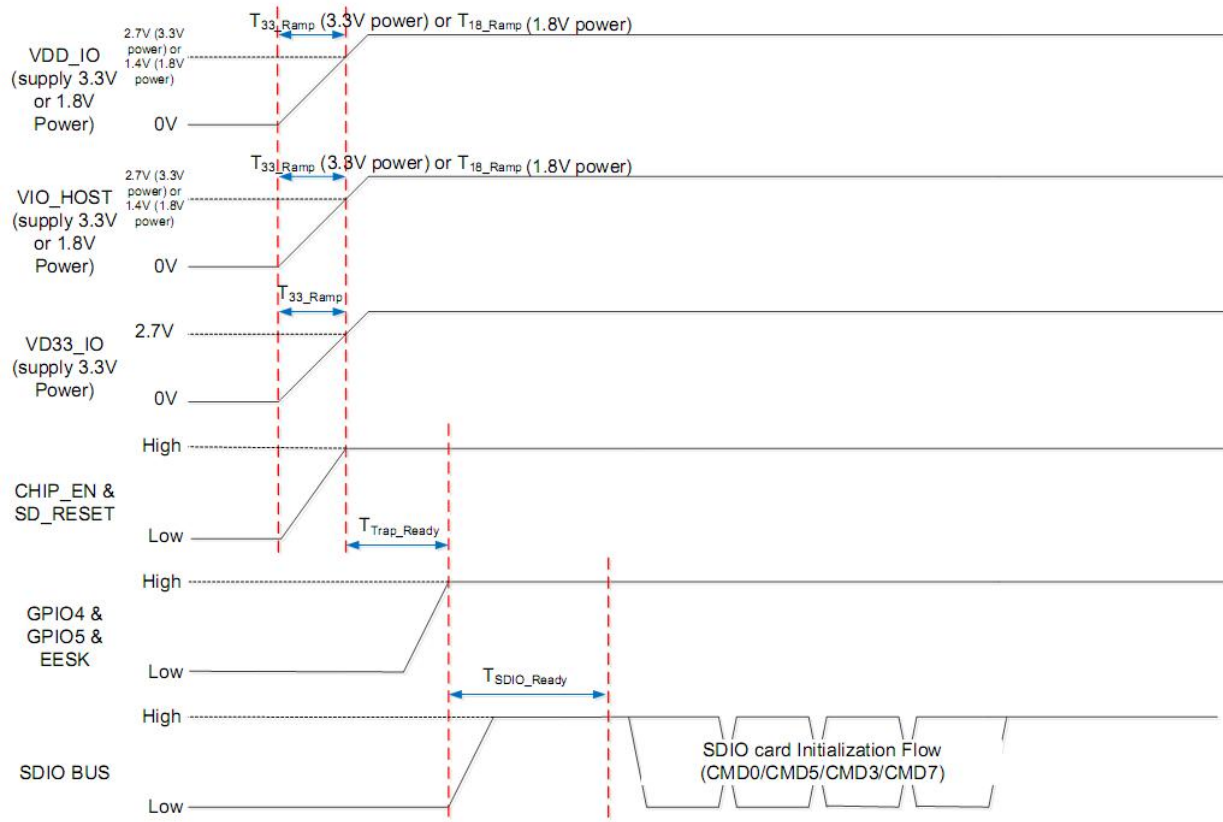
7. Electrical Specifications

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 (3.3V)	3.0	3.3	3.6	V
VDDIO (1.8V)	1.7	1.8	1.9	V

7.2 Interface Circuit time series

7.2.1 Power on sequence



	Min.	Typical	Max.	Unit	Description
T18_Ramp	0.5	1.5	5	ms	The 1.8V power ramp up duration.
T33_Ramp	0.5	1.5	5	ms	The 3.3V power ramp up duration.
TTrap_Ready	400	500	X	ms	WLAN eFuse autoloading. TTrap_Ready = 500ms (Typical)
TSDIO_Ready	10	20	X	ms	SDIO Not Ready Duration.

					In this state, the RTL8851BS-CG may respond to commands without the ready bit being set. After the ready bit is set, the host will initiate complete card detection procedure.
--	--	--	--	--	--

7.2.2 SDIO Pin Description

Module supports SDIO version 3.0. SDIO Pin Description as below.

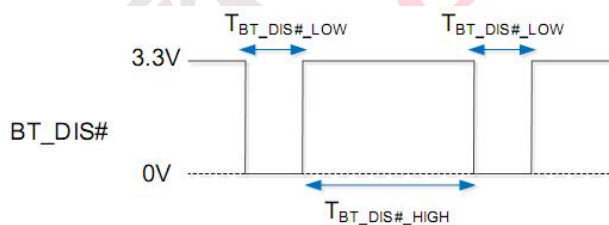
SDIO Pin Description

SD 4-Bit Mode	
DATA0	Data Line 0
DATA1	Data Line 1 or Interrupt
DATA2	Data Line 2 or Read Wait
DATA3	Data Line 3
CLK	Clock
CMD	Command Line

7.2.3 SDIO Timing Diagram

For timing criteria, please check specification in “SD specification Part1 Physical Layer Specification Version 3.01”

7.2.4 BT_DIS Timing Diagram



	Min.	Typical	Max.	Unit	Description
BT_DIS#_LOW	200	--	--	ms	BT_DIS# low duration
BT_DIS#_HIGH	500	--	--	ms	BT_DIS# high duration

7.2.5 WLAN radio on/off Timing Diagram

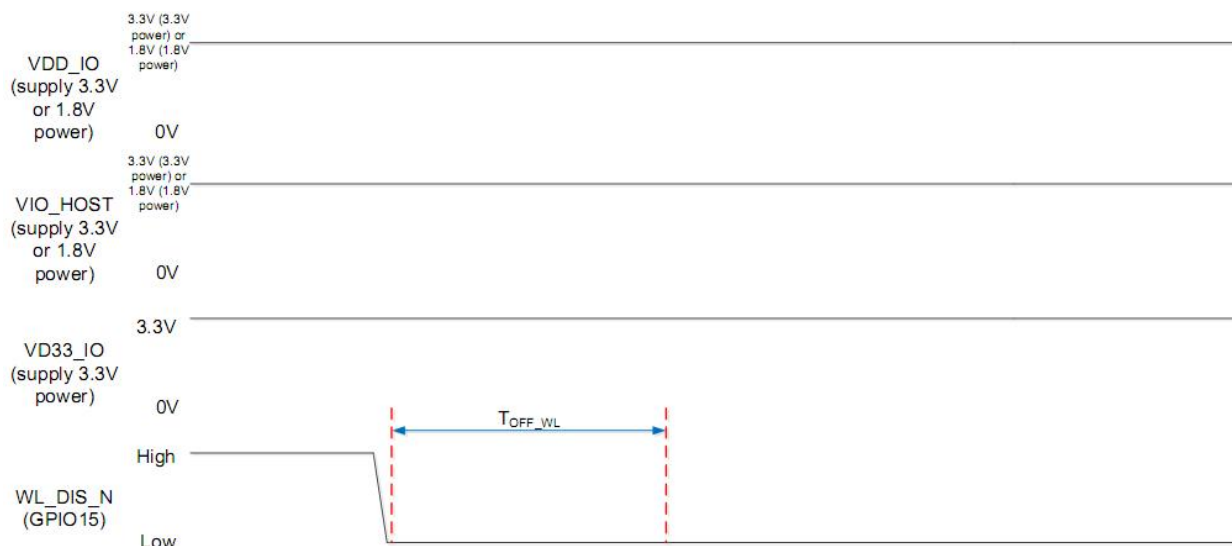


Figure 7. WLAN Radio Off Sequence

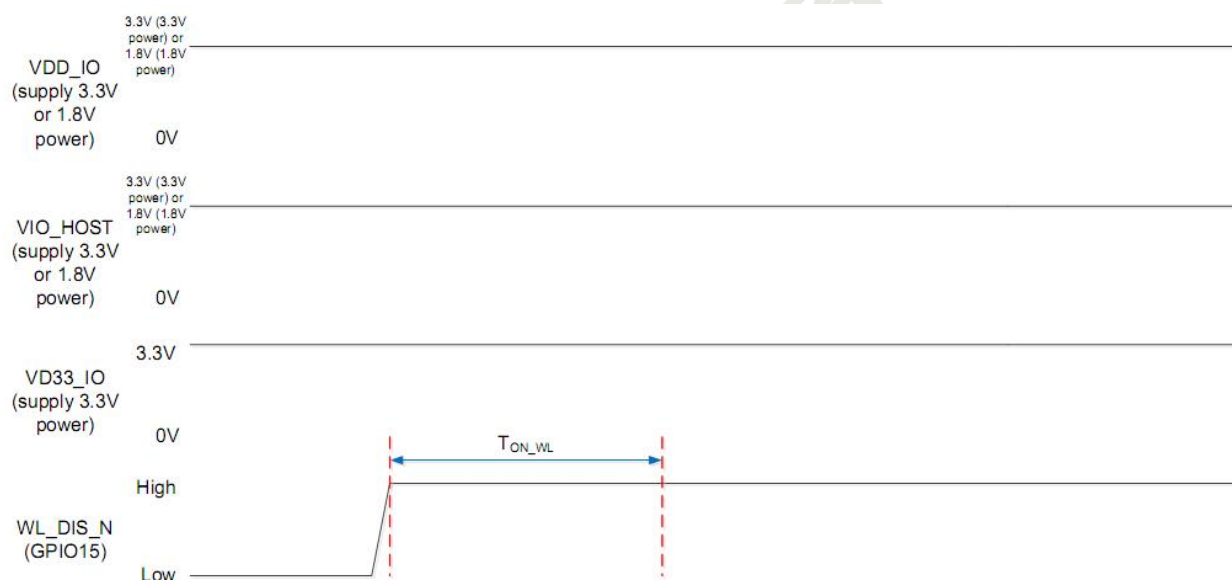


Figure 8. WLAN Radio On Sequence

WL_DIS_N can be defined as the WLAN Radio-off function with host interface remaining connected. When WL_DIS_N is pulled low, WLAN Radio will be disabled. The keeping low duration must be more than T_{OFF_WL}. When WL_DIS_N is pulled high, WLAN Radio will be enabled. The keeping high duration must be more than T_{ON_WL}.

Table 21. WLAN Radio On/Off Timing Parameters

	Min.	Typical	Max.	Unit	Description
T _{OFF_WL}	100	100	X	ms	WL_DIS_N keep low duration
T _{ON_WL}	100	100	X	ms	WL_DIS_N keep high duration

7.2.6 System off Timing Diagram

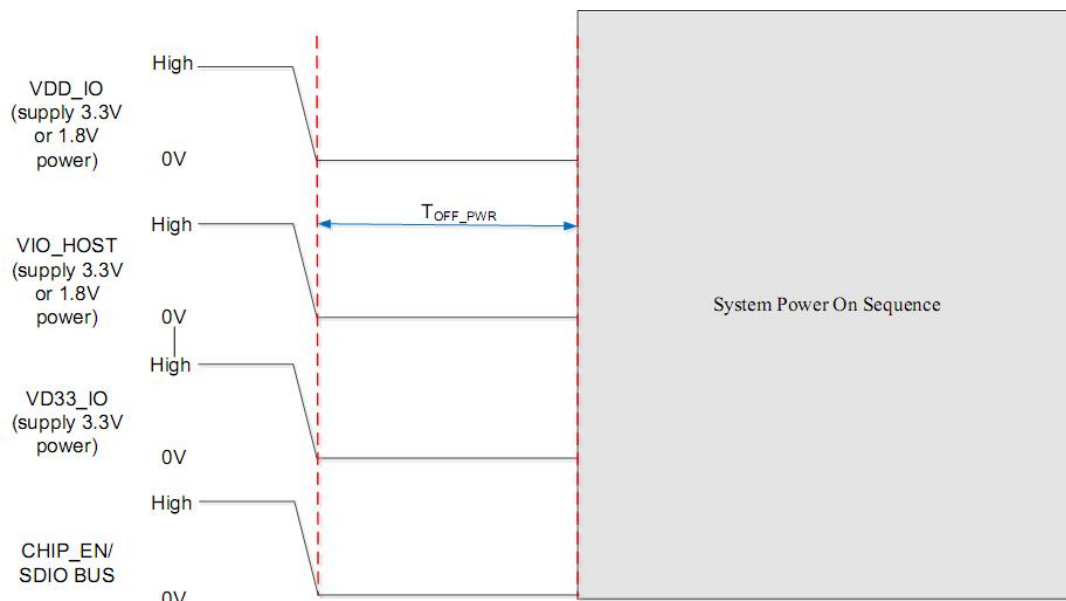


Figure 9. System Power off Reset Sequence

The 3.3V/1.8V power should keep low at least TOFF_PWR before calling system power on Sequence. CHIP_EN should be pulled high during power reset sequence.

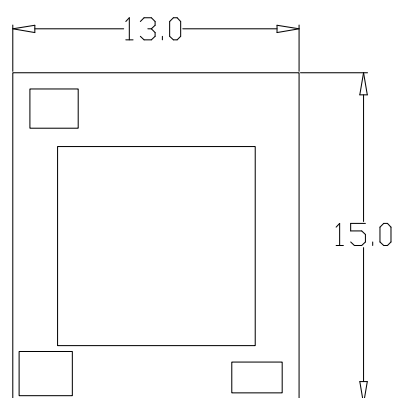
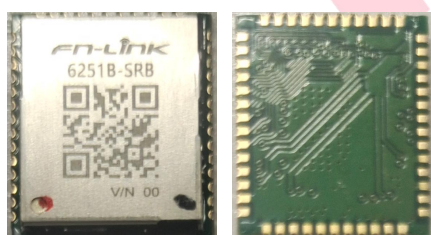
Table 22. System Power off Reset Timing Parameters

	Min.	Typical	Max.	Unit	Description
TOFF_PWR	100	100	X	ms	3.3V/1.8V power keep low duration

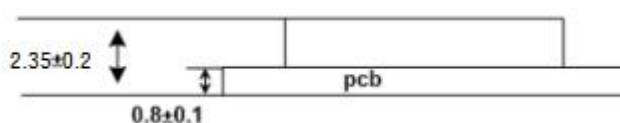
8. Size reference

8.1 Module Picture

L x W : 15 x 13 (±0.25) mm



H: 2.35 (±0.2) mm



Weight

0.84g

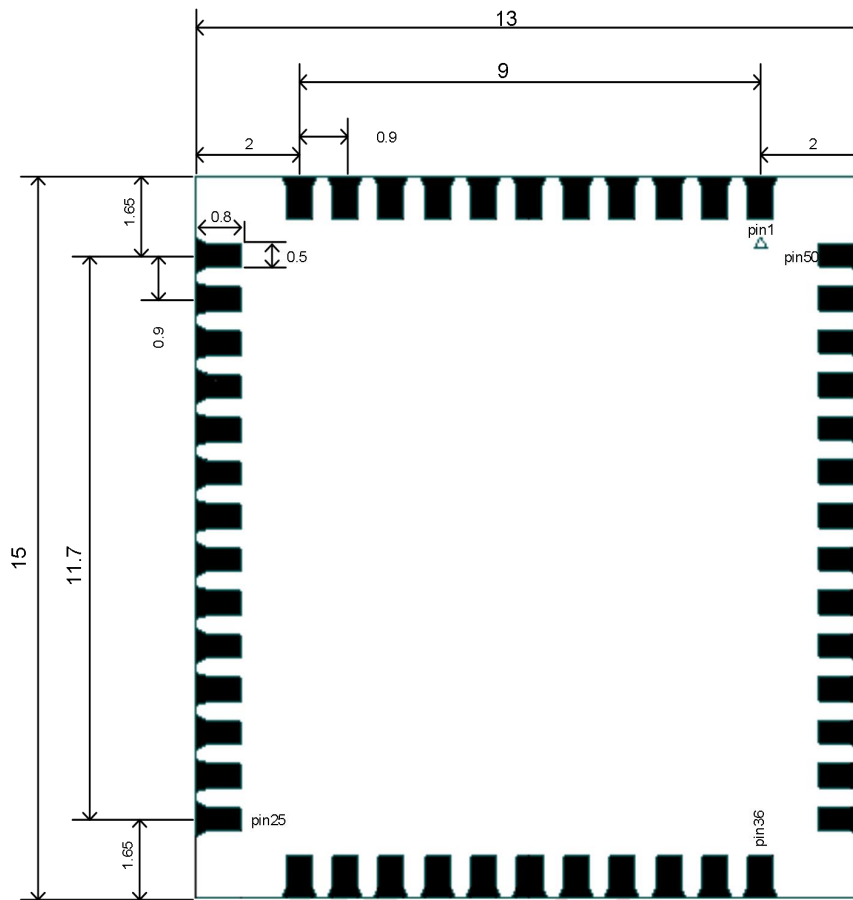
8.2 Marking Description



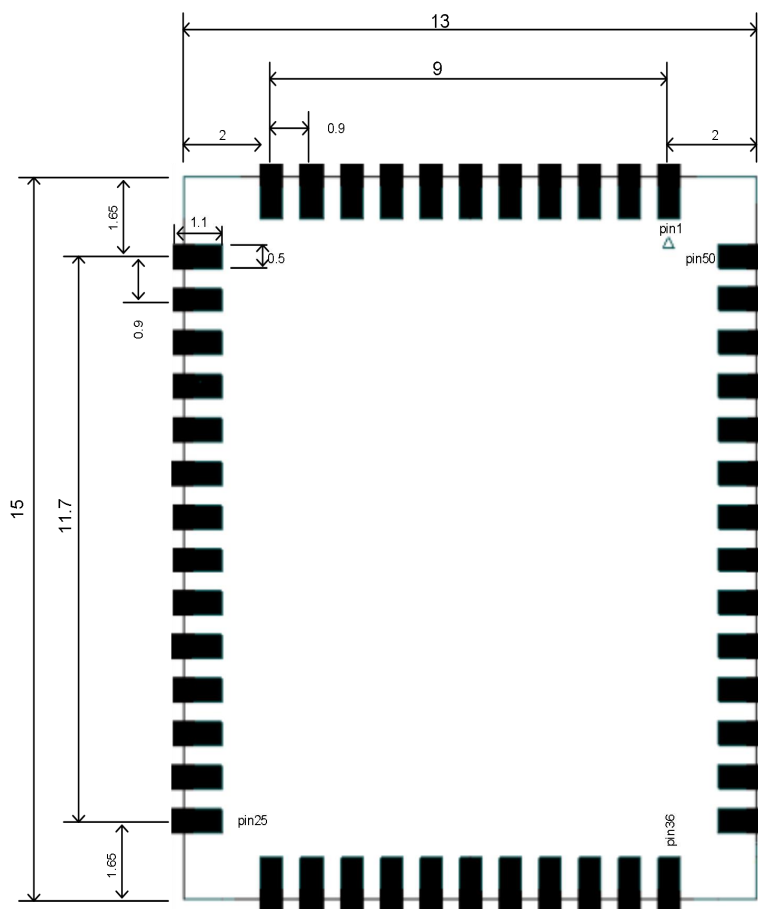
编码规则为 “wifi mac 地址;成品料号

8.3 Physical Dimensions

<TOP View>



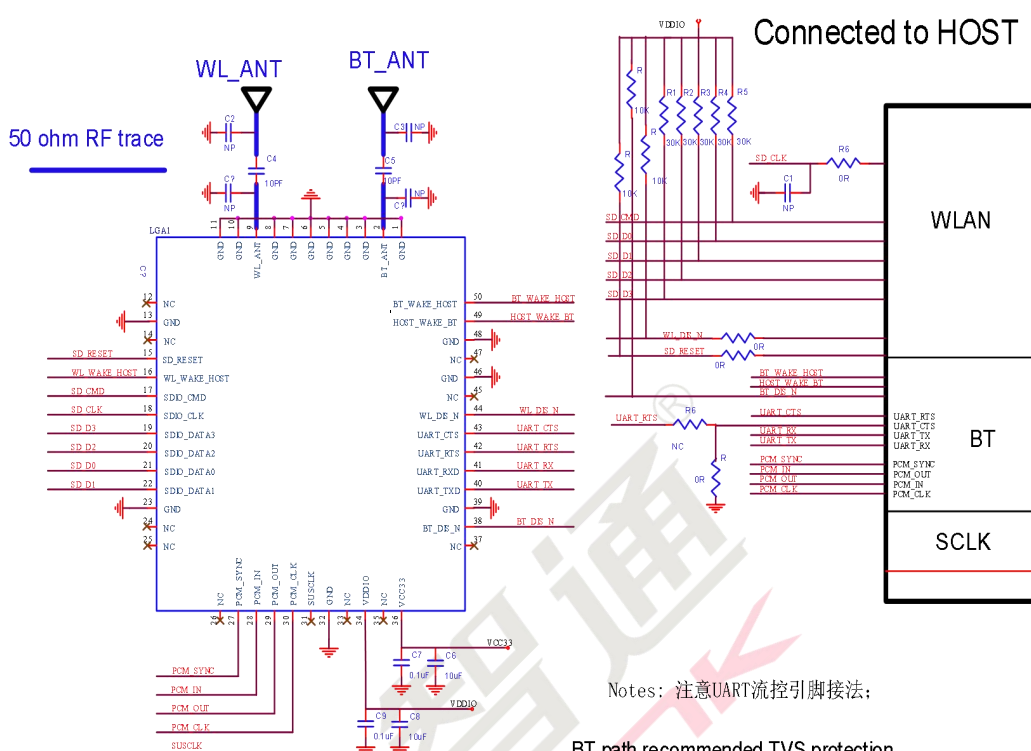
8.4 Layout Recommendation



9. The Key Material List

Chipset	RTL8851BS-CG	Realtek
PCB	13x15-0.8mm, FR4, 4 LAYER, GREEN	XY-PCB, Sunlord, ZLPCB, TRULY, 美捷森
Crystal	2016 40MHz ± 10 ppm	ECEC, TKD, JWT, MDH, TROQ
Inductor	2016, 1.0uH, $\pm 20\%$	Sunlord, Ceaiya, Cenker, Chilisin, INPA Q, Scientific
Inductor	2016, 2.2uH, $\pm 20\%$, I=2A	Sunlord, Ceaiya, Cenker, Chilisin, INPA Q, Scientific
Diplexer	1608 Dual-band, dual-mode 2.4GHz/5GHz WLAN	Glead, Walsin, ACX, Murata, MAG.LAYERS, TDK, FTR
Shielding	6251B-SRB-V1.0, 洋白铜	信太, 精力通, 卓益, 晶赛

10. Reference Design



C6, C7 caps should be closed to pin36 of the module

C8, C9 caps should be closed to pin34 of the module

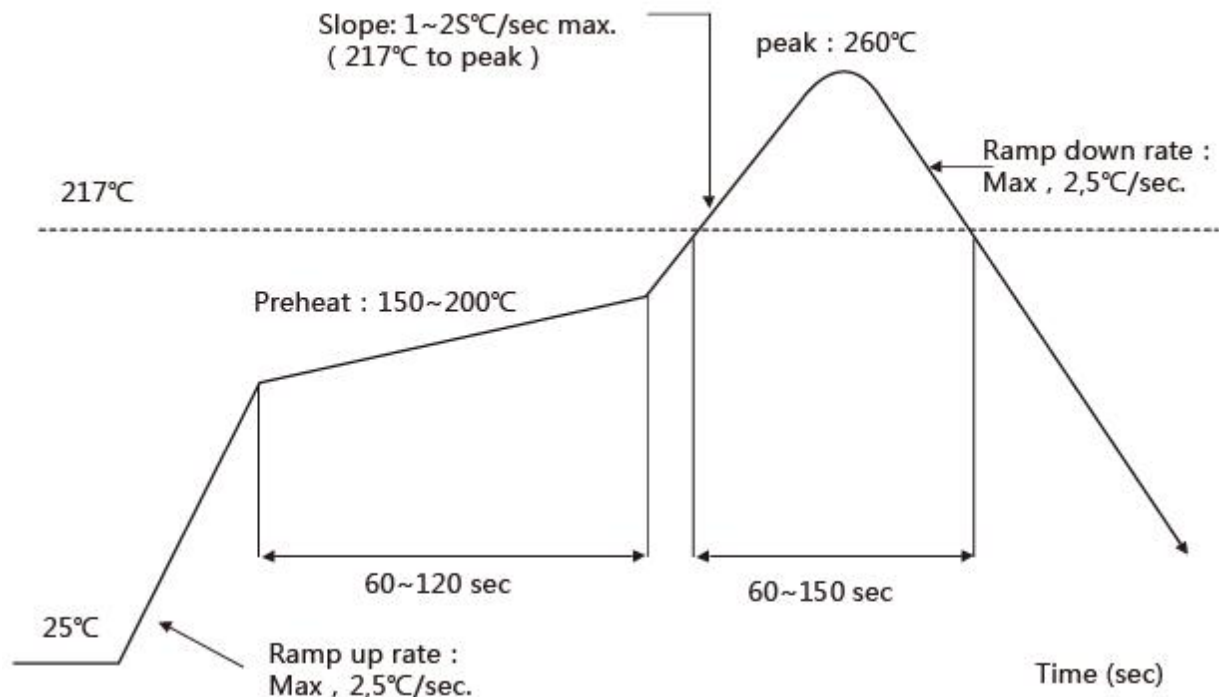
11. Recommended Reflow Profile

Referred to IPC/JEDEC standard.

Peak Temperature : <260°C

Time within 5° C of peak temperature: ≥10s

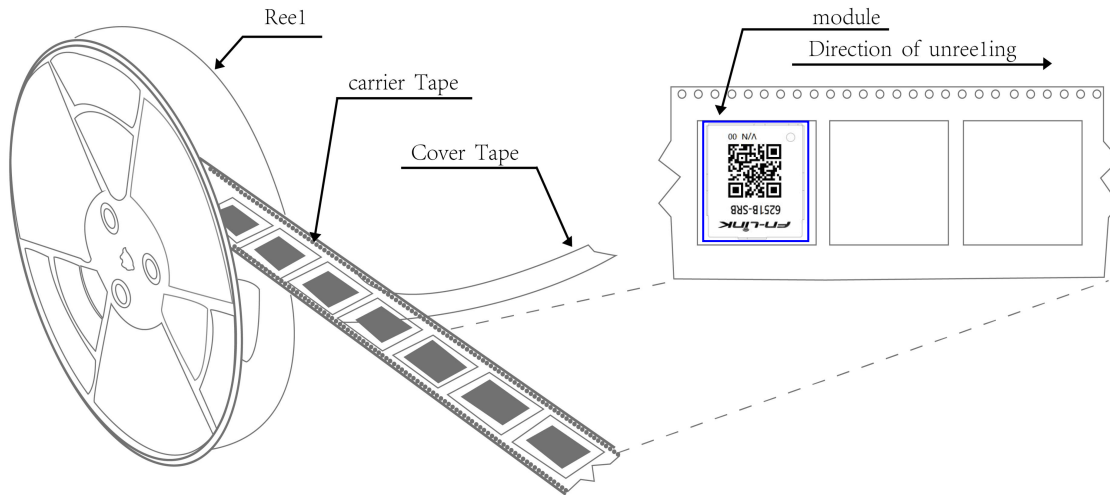
Number of Times : ≤2 times



12. Package

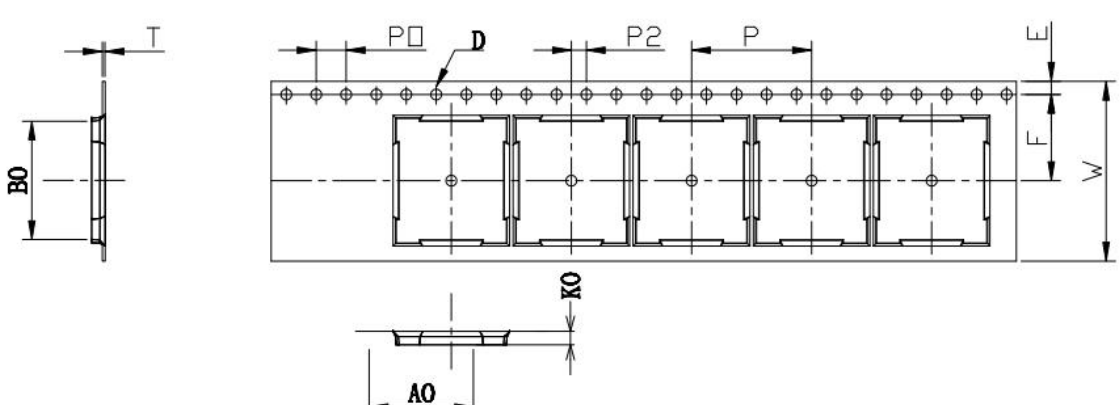
12.1 Reel

A roll of 1500pcs



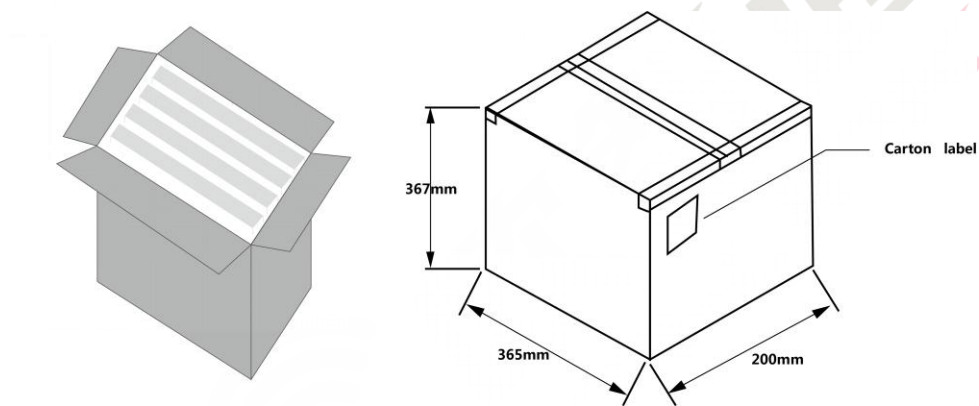
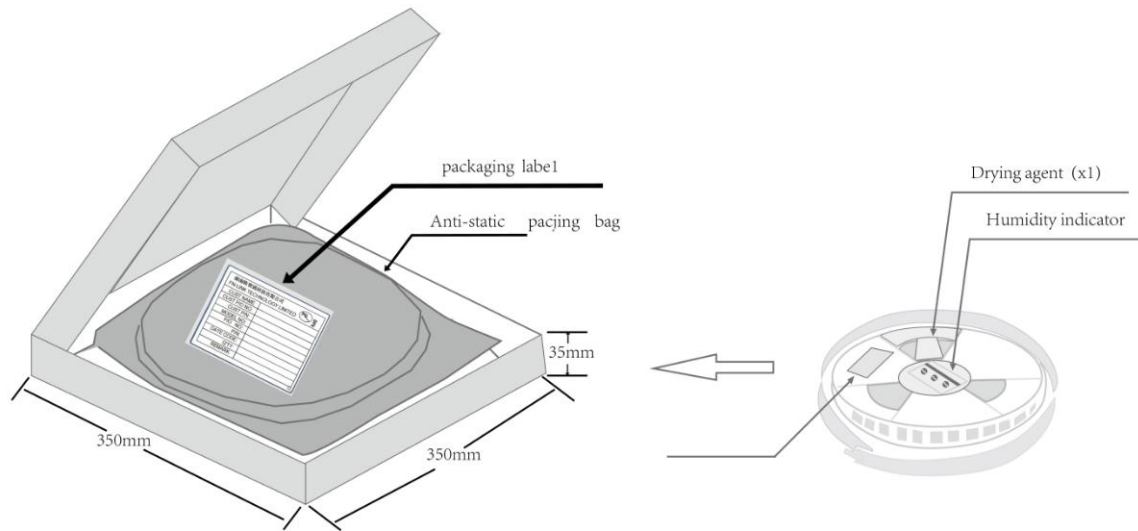
12.2 Carrier Tape Detail

ITEM	W	A0	B0	D	F	E	K0	P0	P2	P	T
DIM	24	13.40	15.40	1.50	11.5	1.75	2.65	4.0	2.0	16.0	0.30
TOLE	$\begin{smallmatrix} +0.3 \\ -0.3 \end{smallmatrix}$	± 0.15	± 0.15	$\begin{smallmatrix} +0.1 \\ -0.0 \end{smallmatrix}$	$\begin{smallmatrix} +0.1 \\ -0.1 \end{smallmatrix}$	± 0.1	± 0.10	± 0.1	± 0.1	± 0.1	± 0.05



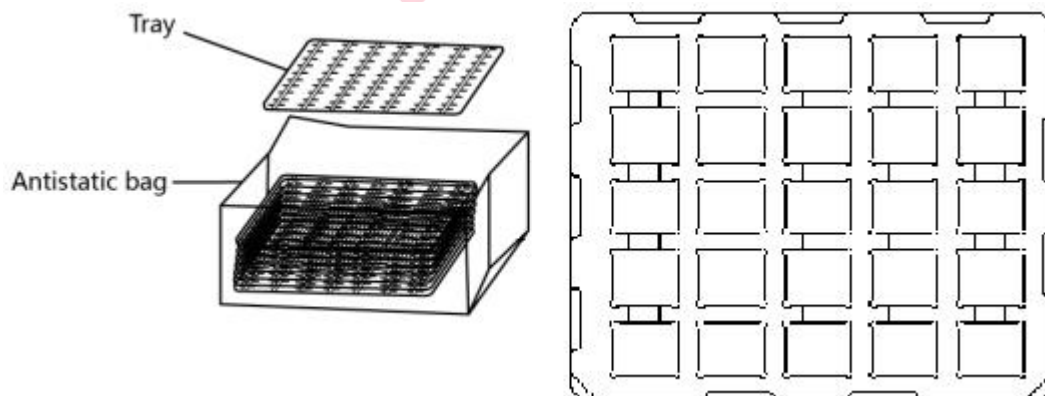
12.3 Packaging Detail

the take-up package



12.4 Tray

Use pallet packaging for less than 300 pieces



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 <40°C and <90% relative humidity (RH).
- b) Environmental condition during the production: 30°C / 60% RH 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 5.2” 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