SPECIFICATIONS

IEEE 802.11b/g/n 1T1R WLAN and Bluetooth 2.1/4.2 Single-Chip Controller with USB 2.0 Multi-Function Interface

TY-RM23-DU
8723DU-V1.0
Version 1.0

Contents

Change History of Revision

Revisio	Date	Contents of Revision Change	Remark
1.0	2018-01-15	首次发布产品规格书.	2018-01-15

1. General Description

The Realtek RTL8723DU is a highly integrated single-chip 802.11b/g/n 1T1R WLAN, and an integrated Bluetooth 2.1/4.2 single chip with USB 2.0 multi-function. It combines a WLAN MAC, a 1T1R capable WLAN baseband, BT Protocol Stack (LM, LL, and LE), BT Baseband, modem, and WLAN/BT RF in a single chip. The RTL8723DU provides a complete solution for a high-performance integrated wireless LAN and Bluetooth controller. The RTL8723DU WLAN baseband implements Orthogonal Frequency Division Multiplexing (OFDM) with 1 transmit and 1 receive path and is compatible with the 802.11n specification. Features include one spatial stream transmission, short guard interval (GI) of 400ns, spatial spreading, and transmission over 20MHz and 40MHz bandwidth.

For legacy compatibility, Direct Sequence Spread Spectrum (DSSS), Complementary Code Keying (CCK) and OFDM baseband processing are included to support all 802.11b and 802.11g data rates. Differential phase shift keying modulation schemes, DBPSK and DQPSK with data scrambling capability, are available, and CCK provides support for legacy data rates, with long or short preamble. The high-speed FFT/IFFT paths, combined with BPSK, QPSK, 16QAM, and 64QAM modulation of the individual subcarriers and rate compatible punctured convolutional coding with coding rate of 1/2, 2/3, 3/4, and 5/6, provide higher data rates of 54Mbps and 150Mbps for 802.11g and 802.11n OFDM respectively.

A built-in enhanced signal detector, adaptive frequency domain equalizer, and a soft-decision Viterbi decoder help to alleviate multi-path effects and mutual interference in the reception of multiple streams. Robust interference detection and suppression are provided to protect against Bluetooth, cordless phone, and microwave oven interference.

Efficient IQ-imbalance, DC offset, phase noise, frequency offset, and timing offset compensations are provided for the radio frequency front-end. Selectable digital transmit and receive FIR filters are provided to meet transmit spectrum mask requirements and to reject adjacent channel interference, respectively.

The RTL8723DU WLAN Controller supports fast receiver Automatic Gain Control (AGC) with synchronous and asynchronous control loops among antennas, antenna diversity functions, and adaptive transmit power control function to obtain better performance in the analog portions of the transceiver.

The RTL8723DU WLAN MAC supports 802.11e for multimedia applications, 802.11i for security, and 802.11n for enhanced MAC protocol efficiency. Using packet aggregation techniques such as A-MPDU with BA and A-MSDU, protocol efficiency is significantly improved. Power saving mechanisms such as Legacy Power Save, and U-APSD, reduce the power wasted during idle time, and compensate for the extra power required to transmit OFDM. The RTL8723DS-VC provides simple legacy and 20MHz/40MHz co-existence mechanisms to ensure backward and network compatibility.

The RTL8723DU Bluetooth controller complies with Bluetooth core specification v4.2, and supports dual mode (BR/EDR + Low Energy Controllers). It is backward compatible with previous versions

including v2.1 + EDR. For BR/EDR, it can support scatternet topology up to four active links in slave mode, and active links in master mode. For Low Energy, it supports multiple states and allows active links in master mode. Both BR/EDR and LE can operate simultaneously.

RTL8723DU also integrates RF/PA/LNA/Balun/DPDT for both 802.11n and Bluetooth to reduce the number of external components.

2. Features

General
- 802.11b/g/n 1T1R WLAN and Bluetooth single chip

Host Interface
- Complies with USB2.0 for WLAN and BT controller
- USB Multi-Function for both BT (USB function 0) and WLAN (USB function 1)
- USB LPM and USB Selective Suspend supported

WLAN Controller
- CMOS MAC, Baseband PHY, and RF in a single chip for 802.11b/g/n compatible WLAN
- Integrated Balun and DPDT
- Complete 802.11n solution for 2.4GHz band
- 72.2Mbps receive PHY rate and 72.2Mbps transmit PHY rate using 20MHz bandwidth
- 150Mbps receive PHY rate and 150Mbps transmit PHY rate using 40MHz bandwidth
- Backward compatible with 802.11b/g devices while operating in 802.11n mode
- I 802.11b/g/n compatible WLAN
- 802.11e QoS Enhancement (WMM)

WLAN PHY Features
- 802.11n OFDM
- One Transmit and one Receive path (1T1R)

- 802.11i (WPA, WPA2). Open, shared key, and pair-wise key authentication services
- WAPI supported

WLAN MAC Features
- Frame aggregation for increased MAC efficiency (A-MSDU, A-MPDU)
- Low latency immediate High-Throughput Block Acknowledgement (HT-BA)
- PHY-level spoofing to enhance legacy compatibility
- Power saving mechanism
- Multi MACID support with Fast Channel switch
- Channel management and co-existence
- Transmit Opportunity (TXOP) Short Inter-Frame Space (SIFS) bursting for higher multimedia bandwidth
- WiFi Direct supports wireless peer to peer applications
- Supports Wake-On-WLAN via Magic Packets and Wake-up frame
- Support S3/S4 AES/TKIP group key update
- Support Win8 Network List Offload
- Support TCP/UDP/IP checksum offload

- Integrated MCU to execute Bluetooth protocol stack
- Supports all packet types in basic rate and enhanced data rate

- 20MHz and 40MHz bandwidth transmission
- Support 2.4GHz band channels
- Short Guard Interval (400ns)
- DSSS with DBPSK and DQPSK, CCKmodulation with long and short preamble
- OFDM with BPSK, QPSK, 16QAM, 64QAM modulation. Convolutional Coding Rate: 1/2, 2/3, 3/4, and 5/6
- Maximum data rate 54Mbps in 802.11g; and 150Mbps in 802.11n
- Switch diversity for DSSS/CCK
- Packet based hardware antenna diversity
- Selectable receiver FIR filters
- Programmable scaling in transmitter and receiver to trade quantization noise against increased probability of clipping
- Fast receiver Automatic Gain Control (AGC)
- On-chip ADC and DAC

Bluetooth Controller
- Compatible with Bluetooth v2.1, v4.2Systems
- Supports Bluetooth 4.0 Low Energy(BLE)
- Flexible XTAL frequency selection(52, 48, 40, 38.4, 27, 26, 25, 24, 20, 19.2, 17.664, 16, 14.318, 13 and 12MHz)

- Supports piconets in a scatternet
- Supports Secure Simple Pairing
- Supports Low Power Mode (Sniff/Sniff Sub-rating)
- Enhanced BT/WIFI Coexistence Control to improve transmission quality in different profiles
- Bluetooth 4.0 Dual Mode support: Simultaneous LE and BR/EDR
- Supports multiple Low Energy states

Bluetooth Transceiver
- Fast AGC control to improve receiving dynamic range
- Supports AFH to dynamically detect channel quality to improve transmission quality
- Integrated internal Class 1, Class 2, and Class 3 PA
- Supports Enhanced Power Control
- Supports Bluetooth Low Energy
- Integrated 32K oscillator for power management

Peripheral Interfaces
- General Purpose Input/Output (14 pins)
- Three configurable LED pins

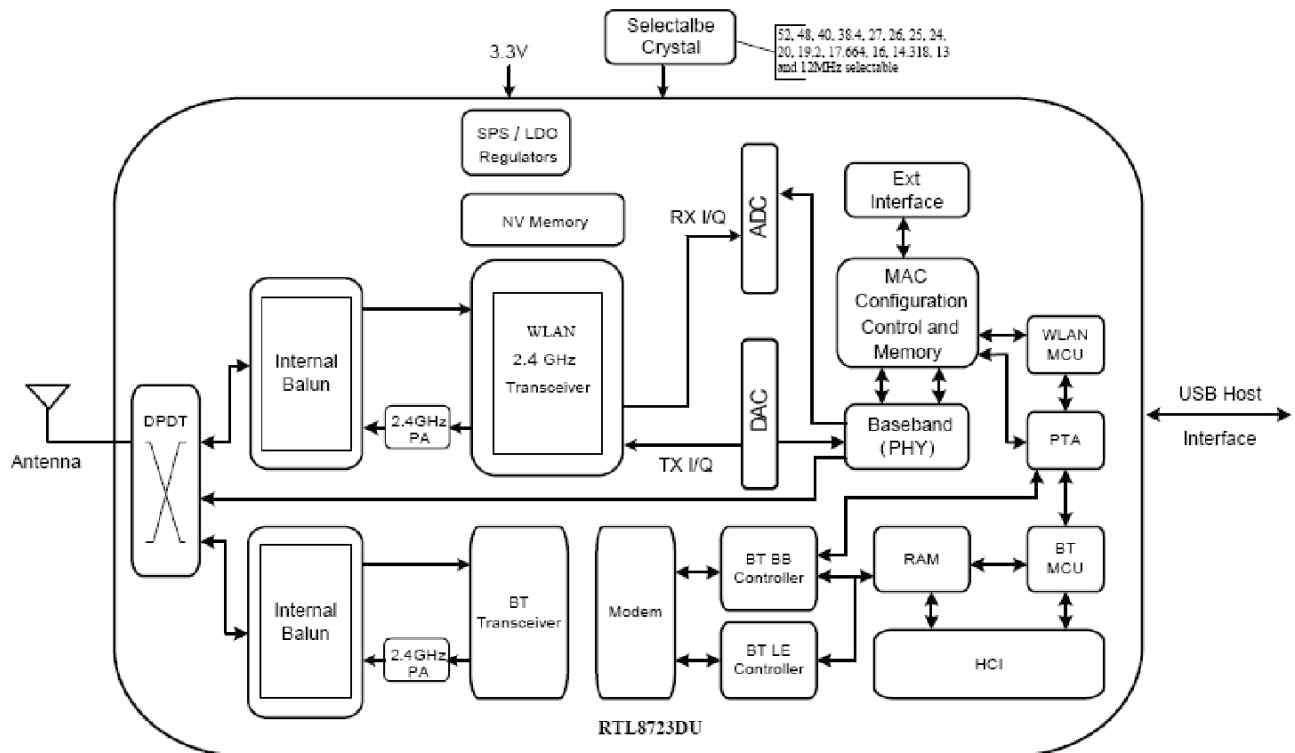- Support XTAL or external clock input

3.Block Diagram

Figure 1. Single-Band 11n (1x1) and Integrated Bluetooth Controller Solution with Single Antenna

4. General Specification

Model	TY-RM23-DU-V1.0
Product Name	802.11b/g/n WLAN USB module
Major Chipset	Realtek RTL8723DU
Standards	WiFi: IEEE 802.11b/g/n/e/i
	BT: v2.1 and v4.2
Bus Interface	WiFi/BT: USB

Data Rate	802.11b: 11, 5.5, 2, 1 Mbps
	802.11g: 54, 48, 36, 24, 18, 12, 9, 6 Mbps
	802.11n: MCS 0 to 7 for HT20MHz ;MCS 0 to 7 for HT40MHz
	BT:
	    1 Mbps for Basic Rate
	    2,3 Mbps for Enhanced Data Rate
	    6,9,12,18,24,36,48,54 Mbps for High Speed

Modulation Method	DSSS, DBPSK, DQPSK, CCK OFDM, BPSK, QPSK, 16QAM, 64QAM

Operating Channel	WiFi 2.4GHz:
	    11: (Ch. 1-11) – United States
	    13: (Ch. 1-13) – Europe
	    14: (Ch. 1-14) – Japan
	BT 2.4GHz:
	    Ch. 0 ~78

Frequency Range	2.4GHz
OS supported	Windows xp 32/64 vista 32/64 win7 32/64 Linux
Operating Voltage	3.3 V ±0.2 I/O supply voltage
Operating Temperature	0 ~ +70° C ambient temperature
Storage Temperature	-40 ~ 85°C ambient temperature
Humidity	5 to 90 % maximum (non-condensing)
Dimension	12.9 x 12.2 x1.6 mm (LxWxH) ±0.2MM

5.Power Supply DC Characteristics

Symbol	Parameter	Minimum	Typical	Maximum	Units
VA33, VA33_PAD_S0, VA33_PA_S0, VA3_PAD_S1 VA33_PA_S1 VA33_BT_SYN VA33_WL_SYN, VA33_AFE, VD33D	3.3V Supply Voltage	3.0	3.3	3.6	V
IDD33	3.3V Rating Current	-	-	600	mA

DC Characteristics

Module	Voltage	Current Consumption (linking)
RM23-DU-V1.0	3.3V	80MA (上网或者看电影时的功耗)

6. Electrical Specifications

1) RF Characteristics for IEEE802.11b   (11Mbps mode unless otherwise specified)

Items	Contents
Specification	IEEE802.11b
Mode	CCK 11 Mbps
Channel frequency	2412 ~ 2484 MHz
RX (per≤85 dBm@8%)	-85 dBm

Freq err limit	±13PPM			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (±1.5 dBm)		17		dBm
EVM (≤-18)		-23		dB

2) RF Characteristics for IEEE802.11g   (54Mbps mode unless otherwise specified)

Items	Contents			
Specification	IEEE802.11g			
Mode	OFDM 54 Mbps			
Channel frequency	2412 ~ 2484 MHz			
RX (per≤70 dBm@10%)	-70 dBm			
Freq err limit	±13PPM			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (±1.5dBm)		14		dBm
EVM (≤-25)		-28		dB

3) RF Characteristics for IEEE802.11n (BW20_MCS7)

Items	Contents			
Specification	IEEE802.11n (BW20_MCS7)			
Mode	BW20_MCS7 65 Mbps			
Channel frequency	2412 ~ 2484 MHz			
RX (per≤65 dBm@10%)	-65 dBm			
Freq err limit	±13PPM			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (±1.5 dBm)		13		dBm
EVM (≤-28)		-30		dB

4) RF Characteristics for IEEE802.11n (BW40_MCS7)

Items	Contents			
Specification	IEEE802.11n (BW40_MCS7)			
Mode	BW40_MCS7 135 Mbps			
Channel frequency	2412 ~ 2484 MHz			
RX (per≤65 dBm@10%)	-65 dBm			
Freq err limit	±13PPM			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (±1.5 dBm)		13		dBm
EVM (≤-28)		-30		dB

7.Bluetooth Specification

Feature	Description		
General Specification			
Bluetooth Standard	Bluetooth V2.1/V4.2		
Host Interface	USB 2.0		
Antenna Reference	Small antennas with 0~2 dBi peak gain		
Frequency Band	2.400 GHz ~ 2483.5 GHz		
Number of Channels	79 channels		
Modulation	FHSS, GFSK, DPSK, DQPSK		
RF Specification			
	Min	Typical	Max
Output Power (Class 1.5)		6	
Output Power (Class 2)		2	
Sensitivity @ BER=0.1% for GFSK (1Mbps)		-92	
Sensitivity @ BER=0.01% for π/4-DQPSK (2Mbps)		-92	
Sensitivity @ BER=0.01% for 8DPSK (3Mbps)		-85	
Maximum Input Level	GFSK (1Mbps):-20dBm		
	π/4-DQPSK (2Mbps) :-20dBm		
	8DPSK (3Mbps) :-20dBm		

8. Pin Definition
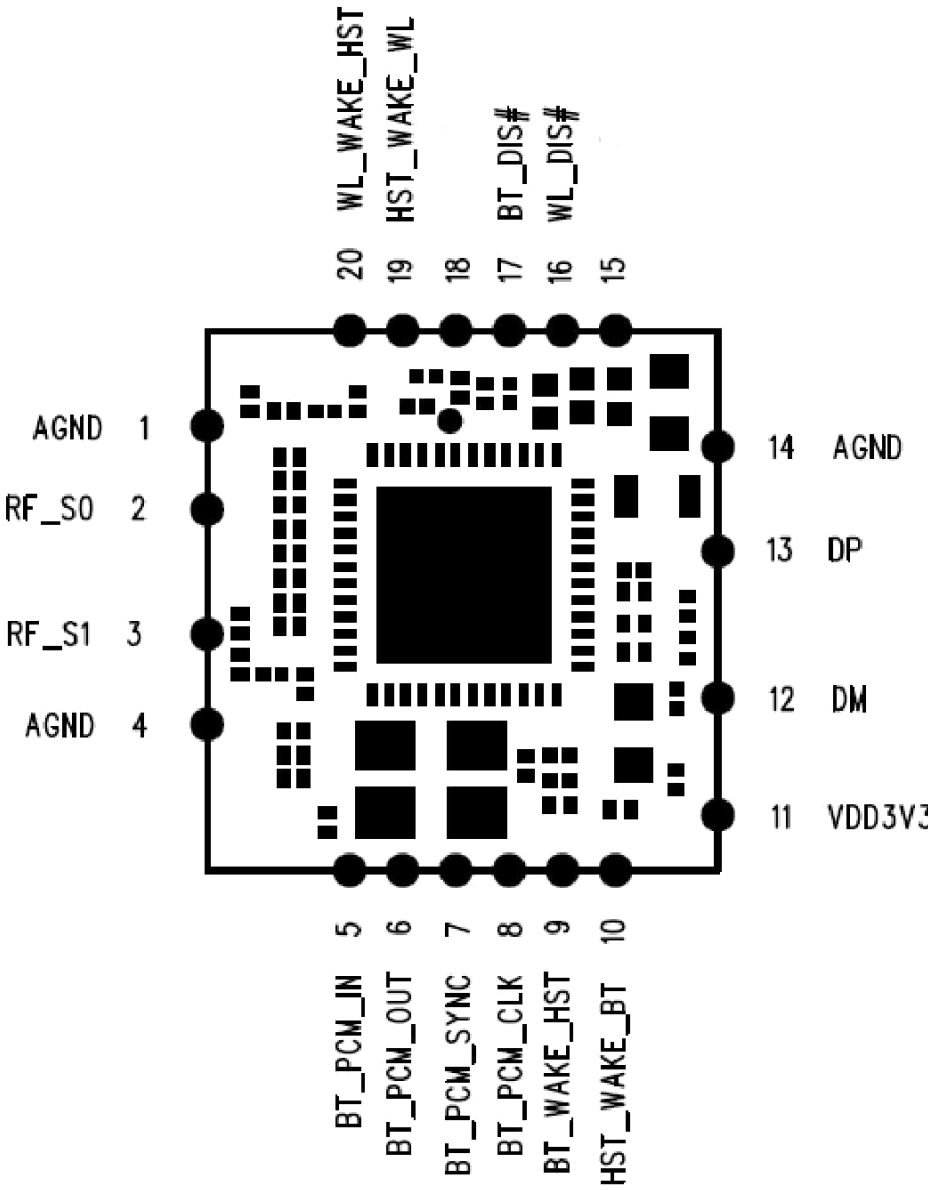
PIN	Definition	Description
1	AGND	Ground
2	RF_S0	RF
3	RF_S1	NC
4	AGND	Ground
5	BT_PCM_IN	BT_PCM_IN
6	BT_PCM_OUT	BT_PCM_OUT
7	BT_PCM_SYNC	BT_PCM_SYNC

8	BT_PCM_CLK	BT_PCM_CLK
9	BT_WAKE_HST	Shared with GIPO14. Chip wakeup host pin
10	HST_WAKE_BT	Shared with GIPO13. Host wakeup chip pin
11	VDD	VDD3.3V
12	HSDM	High-Speed USB D- Signal
13	HSDP	High-Speed USB D+ Signal
14	AGND	Ground
15	3DD_SEL	General Purpose Input/Output Pin
16	WL_DIS#	Shared with GPIO9 This Pin Can Externally Shutdown the RTL8723DU-VC WLAN function when WL_DISn is Pulled Low. When This pin deasserted, USB interface will be disabled. This pin can also support the WLAN Radio-off function with host interface remaining connected.
17	BT_DIS#	Shared with GPIO11. This Pin Can Externally Shutdown the RTL8723DU-VC BT function when BT_DISn is Pulled Low. This pin can also support the BT Radio-off function with host interface Remaining connected.
18	VBAT_EN	VBAT_EN
19	HST_WAKE_WL	HST_WAKE_WL
20	WL_WAKE_HST	WL_WAKE_HST

PIN
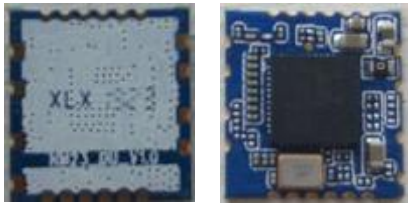
       Bottom   **top**

9. Size reference

Dimensions (mm)	Length	Width	Height
	13 (Tolerance:±0.2mm)	12 (Tolerance:±0.2mm)	1.6 (Tolerance:±0.2mm)

The PCB tolerances within + / -0.2 or so

10.USB interface electrical characteristics

注：1.USB 数据线需要做 90Ohm 的阻抗。

　　2.建议电源输入端留一个电源开关，每次开关卡时可以做一个上电断电的作用，

　　　一定要在 3.3V 端（靠近模组）增加 2 个 22UF 的电容，

　　　可以使用 wifi 复位，就不会有打不开 wifi 的错误现象出现。

11. Recommended Reflow Profile

Referred to IPC/JEDEC standard.
Peak Temperature : <250°C
Number of Times : ≤2 times
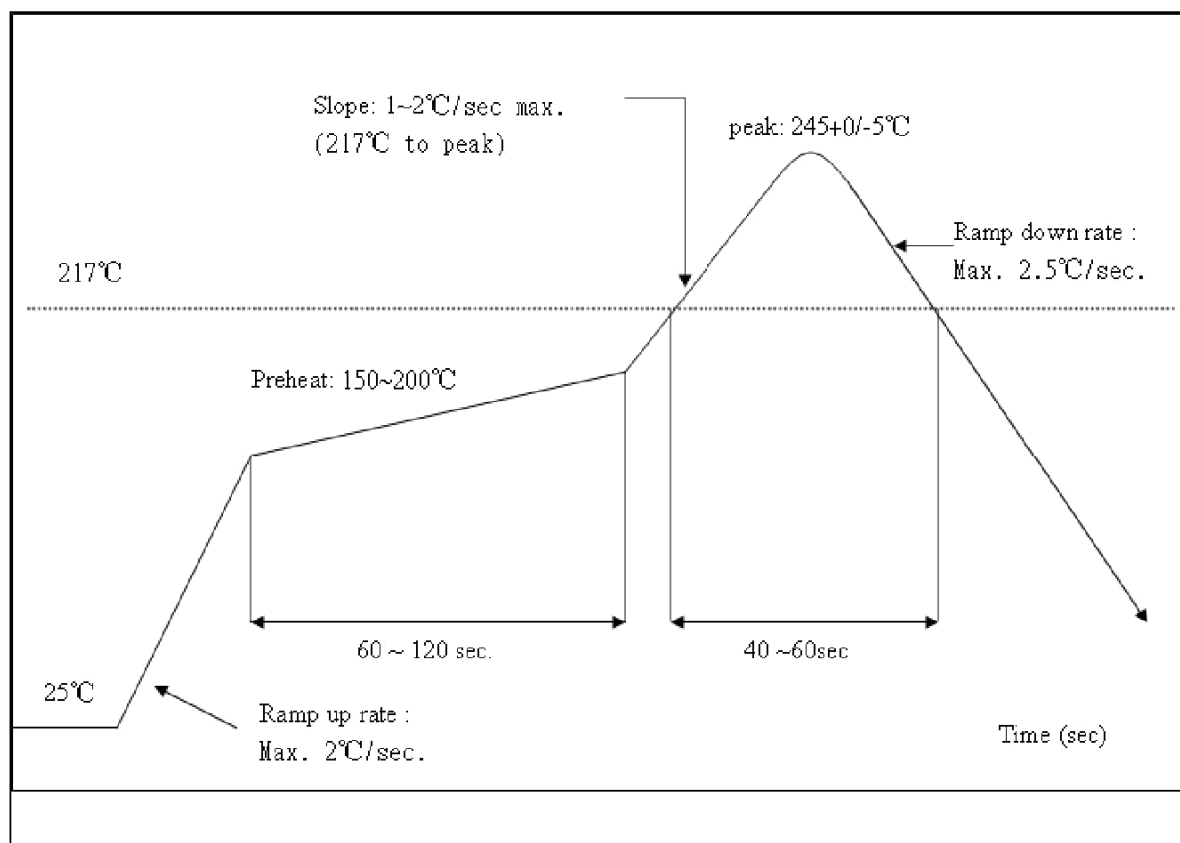
ENVIRONMENTAL

Operating
Operating Temperature:	0°C to +70 °C
Relative Humidity:	5-90% (non-condensing)

Storage
Temperature:	-40°C to +85°C (non-operating)
Relevant Humidity:	5-95% (non-condensing)

12. RoHS compliance.

This product is RoHS compliance.

13.Wireless module before the SMT note:

1.When customers Open stencil must be sure the hole bigger to the Wireless module plate, please press 1 to 1 and 0.7 mm is widened to open outward, the thickness of 0.12 mm.

2.Can't get the wifi module bare hands when needs,must we wear the gloves and static ring.

3.The furnace temperature according to the size of the customer the mainboard ,generally like to stick on a tablet standard temperature of 250 + - 5,can do 260 + - 5.

Storage and use Wifi module control should pay attention to the following matters:

1.Module of the storage life of vacuum packaging:
1-1.Storage life ： 12 months. Storage conditions:<40℃. Relative humidity:<90%R.H.

1-2.After this bag is opened , devices that will be subjected to infrared reflow, vapor-phase reflow, or equivalent processing must be :

1-3.Check the humidity card :stored at ≦20%RH.If :30%~40%(pink)or greater than 40%(red).Labeling module has moisture absorption.
　① Mounthed within 168 hours at factory conditions of:
t≦30%℃，≦60%R.H.
　② Once opened, the workshop the preservation of life for 168 hours.
1-4.If baking is required,devices may be baked for:
　① Modules must be to remove module moisture problem.
　② Baking temperature: 125 ℃, 8 hours.
　③ After baking, put proper amount of desiccant to seal packages.

1-5. The actual number of module vacuum packing which is based on the actual number of packages to the customer requirements, vacuum packing of picture<1>
2.Module reel packaging items as follows.
2-1.Storage life ： 12 months. Storage conditions:<40℃. Relative humidity:<90%R.H.

2-2.Module apart packing after 168 hours，To launch patch need to bake, to remove the module hygroscopic, baking temperature conditions：125℃，8hours.

2-3. The actual number of module reel packing which is based on the actual number of packages to the customer requirements, Reel packing of picture<2>

3.Module pallet packaging items as follows：
3-1.Storage life ： 3 months. Storage conditions:<40℃. Relative humidity:<90%R.H.

3-2.Module if not used within 48 hours, before launch the need for baking, baking temperature: 125 ℃, 8 hours.
3-3. Pallet packaging each plate is 100 PCS.The actual number of module pallet packing which is based on the actual number of packages to the customer requirements

13.Wifi 模块贴片装机前注意事项：

1.客户在开钢网时一定要将 wifi 模块焊盘的孔开大，请按 1 比 1 再向外扩大 0.7mm 比例开钢网，厚度按 0.12mm.

2.有需要拿 wifi 模块时不可以光手去拿，一定要戴上手套以及静电环.

3.过炉温度要根据客户主板的大小而定，一般像平板电脑上的标准温度为 250+-5°，也可以做到 260+-5°

Wifi 模块储存及使用管制应注意事项如下：

1.模块的真空包装之储存期限：
1-1.保存期限：12 个月，储存环境条件：温度在：<40℃，相对湿度：<90%R.H.
1-2.模块包装被拆后，SMT 组装之时限：
1-3.检查湿度卡：显示值应小于 30%（蓝色），如：30%~40%(粉红色）或者大于 40%（红色）表示模块已吸湿气.
　① 工厂环境温度湿度管制：≦30%℃，≦60%R.H.
　② 拆封后，车间的保存寿命为 168 小时.
1-4.如在拆封后的 168 个小时内未使用完，需要烘烤，烘烤条件如下：
　① 模块须重新烘烤，以除去模块吸湿问题.
　② 烘烤温度条件：125℃，8 小时.
　③ 烘烤后，放入适量的干燥剂再密封包装.
1-5. 模块真空包装数量以客户要求的实际包装数量为准，真空包装图片<1>

2.模块卷盘包装事项如下：
2-1.保存期限：12 个月，储存环境条件：温度在：<40℃，相对湿度：<90%R.H.

2-2.模块拆开包装 168 小时后，如要上线贴片需要重新烘烤，以除去模块吸湿问题，烘烤温度条件：125℃，8 小时。
2-3. 模块卷盘包装以客户要求的实际包装数量为准,卷盘包装图片<2>

3.模块托盘包装事项如下：

3-1.保存期限：3 个月，储存环境条件：温度在：<40℃，相对湿度：<90%R.H.

3-2.模块如在 48 小时内未使用，在上线之前需要进行烘烤，烘烤温度条件：125℃，8 小时。

3-3. 托盘包装每盘为 100pcs，模块托盘包装以客户要求的实际包装数量为准.

注：以上包装方式根据客户要求而定，包装以实际出货为准。