



BL-M8733BU2-L

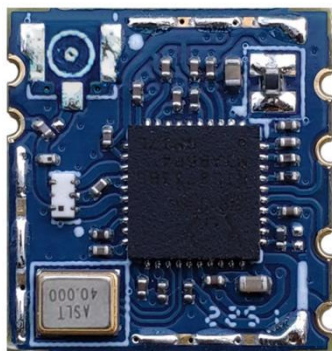
802.11n 150Mbps WLAN + BT v4.2

USB2.0 Module Specification

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(Top View)



(Bottom View)

Module Name: BL-M8733BU2-L

Module Type: 802.11a/b/g/n 150Mbps WLAN + Bluetooth v4.2 Combo USB2.0 Module

Revision: V1.0

Customer Approval:

Company:

Title:

Signature:

Date:

LB-link Approval:

Title:

Signature:

Date:

Revision History

Revision	Summary	Release Date	Revised By
0.1	Initial release	2023-01-31	Qx
1.0	Official release	2023-07-27	Drq

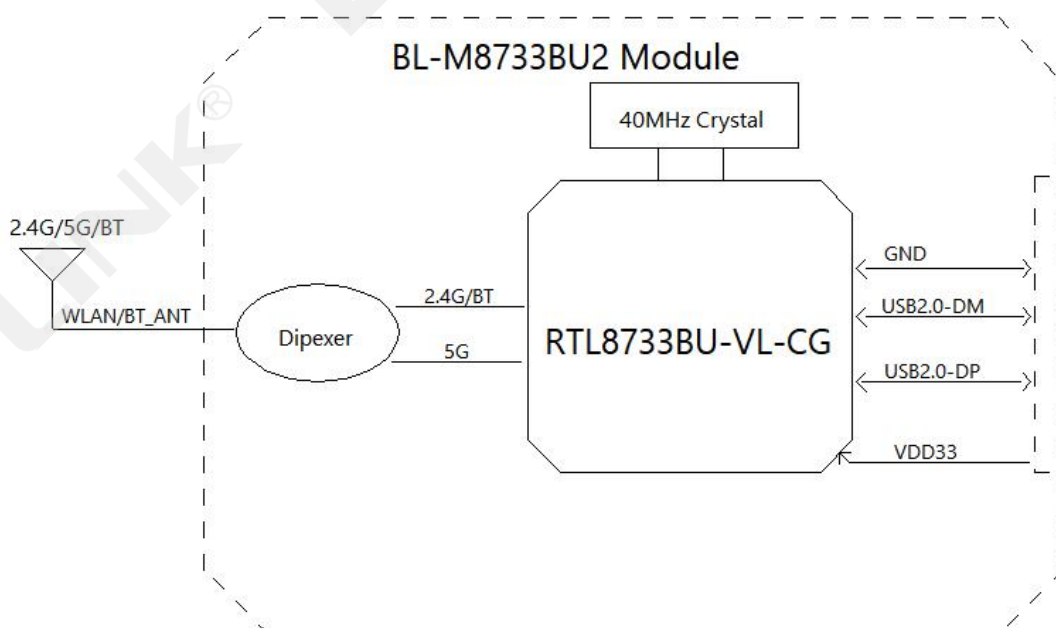
1. Introduction

BL-M8733BU2-L is a highly integrated Dual-band WLAN + Bluetooth v4.2 Combo module. It combines a 1T1R Dual-band WLAN subsystem and a Bluetooth v4.2 subsystem. This module compatible IEEE 802.11 a/b/g/n standard and provides the maximum PHY rate up to 150Mbps, it supports BT / BLE dual mode with BT v4.2/v2.1 compliant, offering feature-rich wireless connectivity at high standards, and delivering reliable, cost-effective throughput from an extended distance.

1.1 Features

- Operating Frequency: 2.4~2.4835GHz and 5.15~5.85GHz
- Host Interface is USB2.0
- IEEE Standards: IEEE 802.11a/b/g/n
- Wireless PHY rate can reach up to 150Mbps
- Connect to external antenna through half hole pad
- Power Supply: VDD3.3V±0.2V main power supply

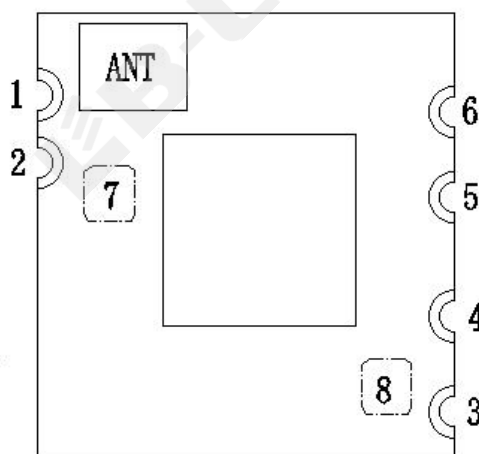
1.2 Block Diagram



1.3 General Specifications

Module Name	BL-M8733BU2-L
Chipset	RTL8733BU-VL-CG
WLAN Standard	IEEE 802.11a/b/g/n
BT Specification	Bluetooth Core Specification v4.2/2.1
Host Interface	USB2.0 for WLAN&BT
Antenna	Connect to the external antenna through half hole pad
Dimension	13.0*12.3*1.6mm (L*W*H)±0.15mm
Power Supply	DC 3.3V±0.2V @900 mA (Max)
Operation Temperature	-20°C to +70°C
Operation Humidity	10% to 95% RH (Non-Condensing)

2. Pin Assignments



(Top View)

2.1 Pin Definition

No	Pin Name	Type	I/O Level	Description
1	GND	RF		RF Ground for ANT
2	WLAN/BT_ANT	RF		RF pad for 2.4G&5G WLAN_ANT and BT_ANT
3	VDD33	P		VDD 3.3V Power Supply

4	USB2.0_DM	AI/O		USB Transmitter/Receiver Differential Pair
5	USB2.0_DP	AI/O		USB Transmitter/Receiver Differential Pair
6	GND	P		Ground connections for power and USB Differential Pair
7	GND	RF		Auxiliary RF Ground connection PAD for ANT (It can be left floating, but grounding is strongly recommended to enhance ground connectivity and avoid RF interference)
8	GND	P		Auxiliary Ground connection PAD for power and USB (It can be left floating, but grounding is strongly recommended to reduce the power loop area and avoid interference with RF)
	ANT			NC (Reserved 2.4G & 5G RF PAD for WLAN_ANT and BT_ANT)

P: Power, I: Input, O: Output, AI/O: Analog In/Output; RF: Analog RF Port

3. Electrical and Thermal Specifications

3.1 Recommended Operating Conditions

Parameters		Min	Typ	Max	Units
Ambient Operating Temperature		-20	25	70	°C
External Antenna VSWR		--	1.7	2.0	/
Supply Voltage	VDD33	3.1	3.3	3.5	V

3.2 Current Consumption

Conditions : VDD33=3.3V ; Ta:25°C			
Use Case	VDD33 Current		
	Typ(I _{RMS})	Max(I _{peak})	Units
WLAN Unassociated (Linux Driver)	78	140	mA
2.4G WLAN associated (Linux Driver)	245	460	mA
2.4G WLAN TCP throughput TX 90Mbps (Linux Driver, BT disable)	480	780	mA
2.4G WLAN TCP throughput RX 90Mbps (Linux Driver, BT disable)	270	850	mA

5G WLAN TCP throughput TX 90Mbps (Linux Driver, BT disable)	300	560	mA
5G WLAN TCP throughput RX 100Mbps (Linux Driver, BT disable)	200	800	mA
2.4G 11b@11Mbps TX 20dBm (RF-Test)	400	432	mA
2.4G 11b@6Mbps TX 20dBm (RF-Test)	475	530	mA
2.4G 11g@54MbpsTX 19dBm (RF-Test)	250	450	mA
2.4G 11n@HT20_MCS0 20dBm TX (RF-Test)	480	520	mA
2.4G 11n@HT20_MCS7 TX 18dBm (RF-Test)	240	400	mA
2.4G 11n@HT40_MCS0 TX 20dBm (RF-Test)	450	470	mA
2.4G 11n@HT40_MCS7 TX 18dBm (RF-Test)	220	400	mA
2.4G 11b@11M RX (RF-Test)	50	80	mA
2.4G 11n@HT40_MCS0 RX (RF-Test)	50	80	mA
2.4G 11n@HT40_MCS7 RX (RF-Test)	50	80	mA
5G 11a@6Mbps TX 19dBm (RF-Test)	420	430	mA
5G 11a@54Mbps TX 17dBm (RF-Test)	240	400	mA
5G 11n@HT20_MCS0 TX 18dBm (RF-Test)	400	420	mA
5G 11n@HT20_MCS7 TX 16dBm (RF-Test)	240	370	mA
5G 11n@HT40_MCS0 TX 18dBm (RF-Test)	370	400	mA
5G 11n@HT40_MCS7 TX 16dBm (RF-Test)	210	352	mA
5G 11a@6M RX (RF-Test)	50	80	mA
5G 11n@HT40_MCS0 RX (RF-Test)	50	80	mA
5G 11n@HT40_MCS7 RX (RF-Test)	50	80	mA
BR_1M@TX 5dBm(RF-Test)	100	180	mA
BR_1M RX	30	80	mA
EDR_2M@TX 5dBm(RF-Test)	130	180	mA
EDR_2M RX	30	80	mA
EDR_3M@TX 5dBm(RF-Test)	125	182	mA
EDR_3M RX	30	80	mA
LE_1M@TX 5dBm(RF-Test)	101	130	mA
LE_1M RX	30	80	mA

4. WLAN & Bluetooth RF Specifications

4.1 2.4G WLAN RF Specification

Conditions: VDD33=3.3V; Ta:25°C			
Features	Description		
WLAN Standard	IEEE 802.11b/g/n		
Frequency Range	2.4~2.4835GHz (2.4GHz ISM Band)		
Channels	Ch1~Ch13 (For 20MHz Channels)		
Modulation	802.11b (DSSS): DBPSK, DQPSK, CCK; 802.11g (OFDM): BPSK, QPSK, QAM16, QAM64; 802.11n (OFDM): BPSK, QPSK, QAM16, QAM64;		
Data Rate	802.11b: 1, 2, 5.5, 11Mbps; 802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps; 802.11n (HT20): MCS0~MCS7 6.5~72.2Mbps; 802.11n (HT40): MCS0~MCS7 13.5~150Mbps;		
Frequency Tolerance	≤ ±20ppm		
2.4G Transmitter Specifications (TX power tolerance calibrated, customers can define the target TX power by modifying configuration file of the driver software. Customers must define the TX power same or lower than recommended Target TX Power as below)			
TX Rate	Recommended Target TX Power (dBm)	TX Power Tolerance (dBm)	EVM(dB)
802.11b@1~11Mbps	20	±2	≤ -10
802.11g@6Mbps	20	±2	≤ -10
802.11g@54Mbps	19	±2	≤ -25
802.11n@HT20_MCS0	20	±2	≤ -10
802.11n@HT20_MCS7	18	±2	≤ -28
802.11n@HT40_MCS0	20	±2	≤ -10
802.11n@HT40_MCS7	18	±2	≤ -28
2.4G Receiver Specifications			
RX Rate	Min Input Level (Typ)	Max Input Level (Typ)	PER
802.11b@1Mbps	-96dBm	-5dBm	< 8%
802.11b@11Mbps	-87dBm	-5dBm	< 8%
802.11g@6Mbps	-93dBm	-5dBm	< 10%

802.11g@54Mbps	-74dBm	-5dBm	< 10%
802.11n@HT20_MCS0	-92dBm	-5dBm	< 10%
802.11n@HT20_MCS7	-72dBm	-5dBm	< 10%
802.11n@HT40_MCS0	-90dBm	-5dBm	< 10%
802.11n@HT40_MCS7	-69dBm	-5dBm	< 10%

4.2 5G WLAN RF Specification

Conditions: VDD33=3.3V; Ta:25°C			
Features	Description		
WLAN Standard	IEEE 802.11a/n		
Frequency Range	5.15~5.25GHz; 5.25~5.35GHz; 5.47~5.73GHz; 5.735~5.835GHz (5GHz ISM Band)		
Channels	Ch36, Ch40, Ch44, Ch48; Ch52~Ch64; Ch100~Ch140; Ch149~Ch165(For 20MHz Channels)		
Modulation	802.11a (OFDM): BPSK, QPSK, QAM16, QAM64; 802.11n (OFDM): BPSK, QPSK, QAM16, QAM64;		
Data Rate	802.11a: 6, 9, 12, 18, 24, 36, 48, 54Mbps; 802.11n (HT20): MCS0~MCS7 6.5~72.2Mbps; 802.11n (HT40): MCS0~MCS7 13.5~150Mbps;		
Frequency Tolerance	≤ ±20ppm		
5G Transmitter Specifications (TX power tolerance calibrated, customers can define the target TX power by modifying configuration file of the driver software. Customers must define the TX power same or lower than recommended Target TX Power as below)			
TX Rate	Recommended Target TX Power (dBm)	TX Power Tolerance (dBm)	EVM(dB)
802.11a@6Mbps	19	±2	≤ -10
802.11a@54Mbps	17	±2	≤ -25
802.11n@HT20_MCS0	18	±2	≤ -10
802.11n@HT20_MCS7	16	±2	≤ -28
802.11n@HT40_MCS0	18	±2	≤ -10

802.11n@HT40_MCS7	16	± 2	≤ -28
5G Receiver Specifications			
RX Rate	Min Input Level (Typ)	Max Input Level (Typ)	PER
802.11a@6Mbps	-91dBm	-5dBm	< 10%
802.11a@54Mbps	-73dBm	-5dBm	< 10%
802.11n@HT20_MCS0	-90dBm	-5dBm	< 10%
802.11n@HT20_MCS7	-71dBm	-5dBm	< 10%
802.11n@HT40_MCS0	-89dBm	-5dBm	< 10%
802.11n@HT40_MCS7	-68dBm	-5dBm	< 10%

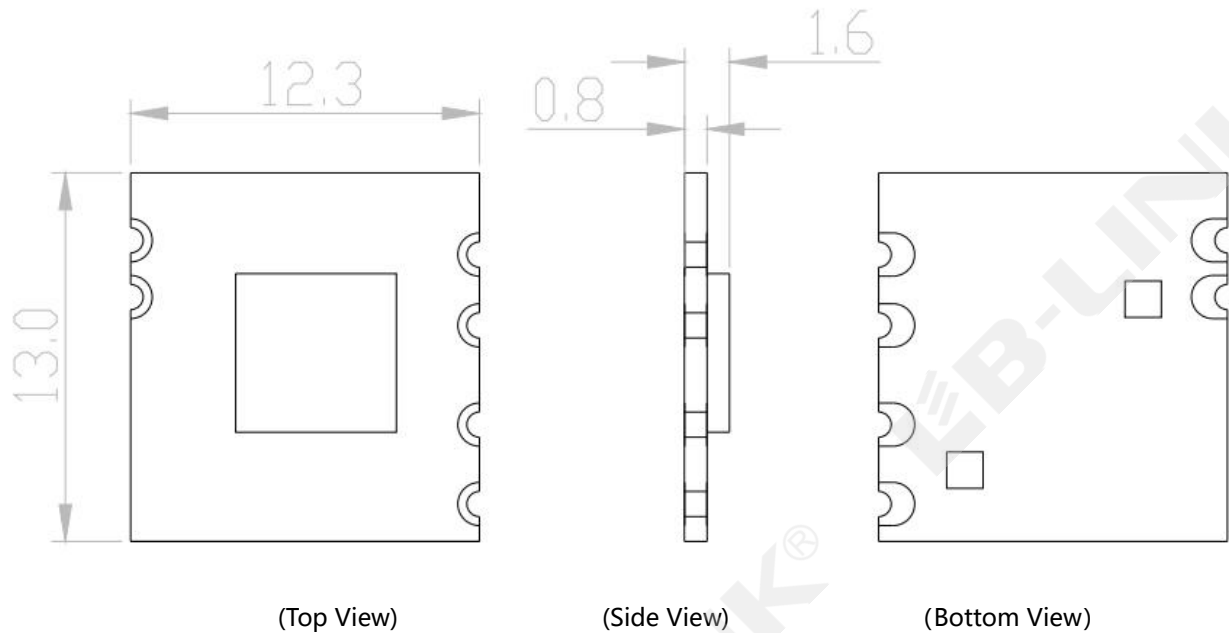
4.3 Bluetooth RF Specification

Conditions: VDD33=3.3V; Ta:25°C			
Features	Description		
Bluetooth Specification	Bluetooth Core Specification v4.2/2.1		
Frequency Range	2.4~2.4835GHz (2.4GHz ISM Band)		
Channels	Bluetooth Classic: Ch0~Ch78 (For 1MHz Channels); Bluetooth Low Energy: Ch0~Ch39 (For 2MHz Channels);		
Power Classes	Bluetooth Classic: Class1; Bluetooth Low Energy: Class1.5;		
Data Rate & Modulation	BR_1Mbps: GFSK; EDR_2Mbps: $\pi/4$ -DQPSK; EDR_3Mbps: 8DPSK; LE_1Mbps: GFSK (Uncoded);		
Bluetooth Transmitter Specifications			
Items	Min	Typ	Max
TX Power			
BR_1M	2dBm	5dBm	8dBm
EDR_2/3M	2dBm	5dBm	8dBm
LE_1M	2dBm	5dBm	8dBm
Items	Min	Typ	Max

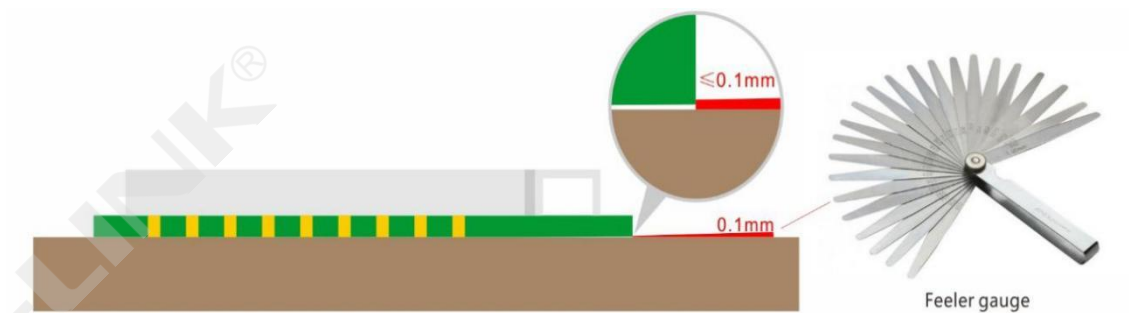
BR_1M (DH1) Modulation Characteristics				
Δf1avg	140KHz	164.20KHz	175KHz	
Δf2avg	115KHz	152.74KHz	/	
Δf2max	115KHz	143.54KHz	/	
Δf2avg/Δf1avg	0.8	0.93	/	
BR_1M (DH1) Initial Carrier Frequency Tolerance				
Init Freq Error	-75kHz	10.32kHz	+75kHz	
EDR_3M(3DH5) EDR Carrier Frequency Stability and Modulation Accuracy				
ωi	-75KHz	12.92KHz	+75KHz	
ωi+ωo	-75KHz	-9.63KHz	+75KHz	
ωo	-10KHz	1.57KHz	+10KHz	
8DPSK RMS DEVM	/	0.0888	0.13	
8DPSK Peak DEVM	/	0.0432	0.25	
LE_1M Modulation Characteristics				
Δf1avg	225KHz	252.26KHz	275KHz	
Δf2avg	185KHz	229.84KHz	/	
Δf2max	185KHz	221.45KHz	/	
Δf2avg/Δf1avg	0.8	0.91	/	
Bluetooth Receiver Specifications				
Items	Sensitivity		Maximum Input Level	
	Input Level(Typ)	BER	Input Level(Typ)	BER
BR_1M (DH1)	-90dBm	≦ 0.1%	-10dBm	≦ 0.1%
EDR_2M	-88dBm	≦ 0.01%	-10dBm	≦ 0.1%
EDR_3M	-83dBm	≦ 0.01%	-10dBm	≦ 0.1%
Items	Input Level (Typ)	PER	Input Level (Typ)	PER
LE_1M	-92dBm	≦ 5%	-10dBm	≦ 5%

5. Mechanical Specifications

5.1 Module Outline Drawing

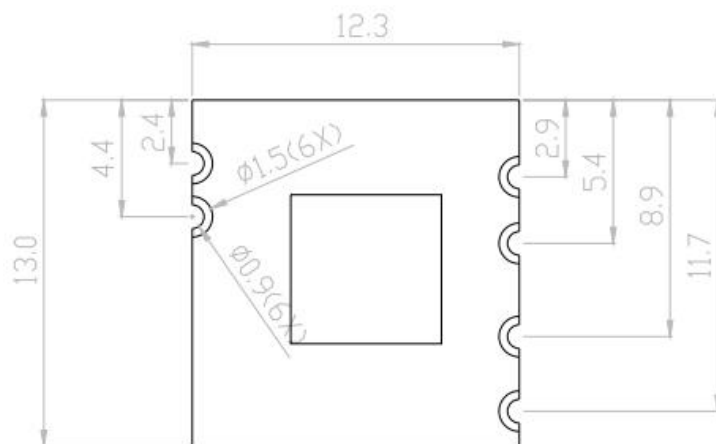


Module dimension: 13.0*12.3*1.6mm(L*W*H; Tolerance: $\pm 0.15\text{mm}$)

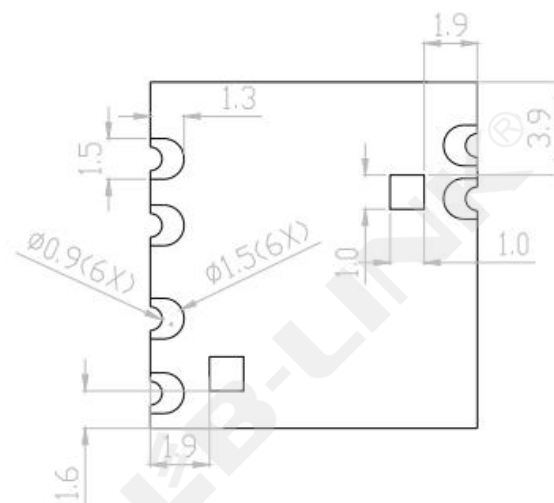


Module Bow and Twist: $\leq 0.1\text{mm}$

5.2 Mechanical Dimensions



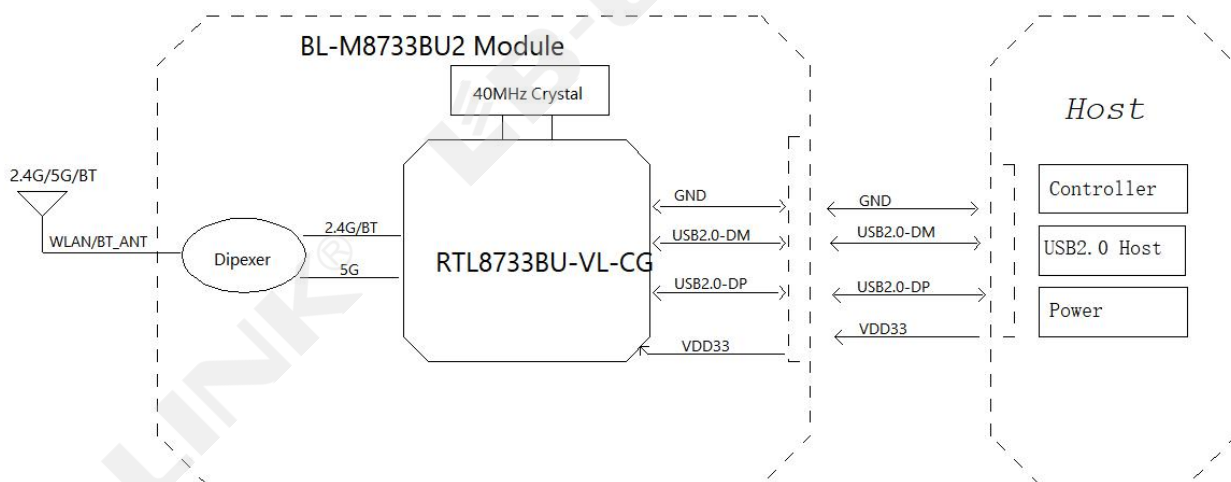
(Top View)



(Bottom View)

6. Application Information

6.1 Typical Application Circuit



6.2 HW Application Note

The module uses general packaging of USB_13.0*12.3mm, which has the defect that GND Pins are too far away from RF/USB/Power Pins. Therefore, in the application of RF from half hole PAD, the power loop may interfere with the RF loop and cause RF performance derating, customers must be careful to design RF, USB and Power circuits of the module on their motherboard!

6.2.1 VDD33 Power requirement:

- A、DC 3.1~3.5V & Ripple Voltage <100mV power supply input, Maximum RMS current $\geq$ 0.6A and Maximum Peak current $\geq$ 0.9A.
- B、For achieve fast transient response, a current mode buck converter recommended.
- C、Use 10uF and 100nF MLCC capacitors close to the module's VDD33 Pin for power input decoupling. Each GND Pin has three close vias to ensure connectivity and thermal conductivity.

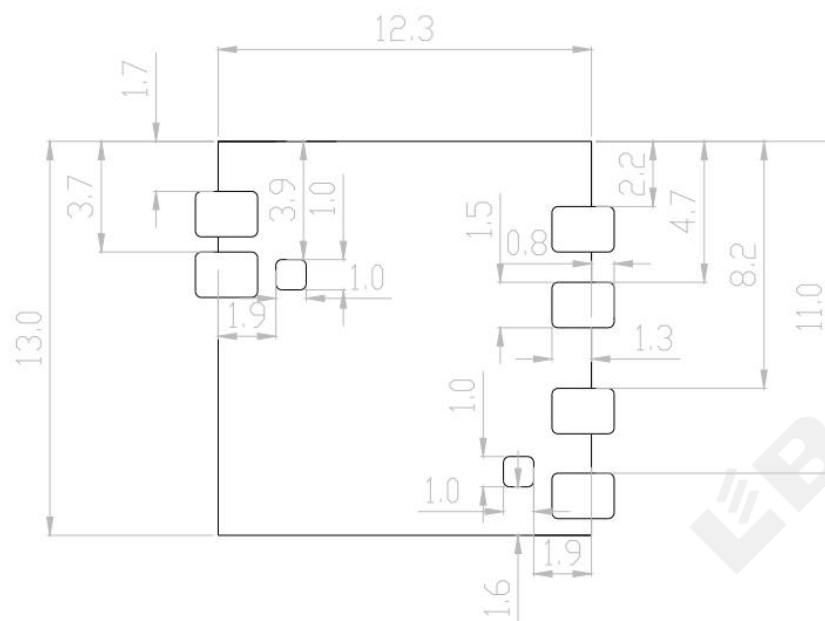
6.2.2 USB interface Design Guidelines:

- A、BL-M8733BU2-L provides a USB device interface which is compatible with USB2.0 specification, High-Speed mode supports data transmission rate up to 480Mbps.
- B、PCB traces of the USB high-speed signal pair should be maintain 90Ω differential impedance, structure of "Differential Coated Coplanar Waveguide With Ground" with the advantages of impedance control and GND surrounding isolation interference may be an ideal choice. To avoid interference, USB signal pair must be far away from power, RF and other signals, GND copper can be used to surround and isolate them.
- C、PCB traces of the USB high-speed signal pair as short as possible, as far away from other signal as possible, minimize the length mismatch of signal pair, avoid layer change and maintain a complete reference layer to reduces signal reflections and impedance changes.
- D、If It is necessary to change layers for USB signal pair routing, use GND vias close to signal pair's vias as the shortest return path.

6.2.3 RF Path Design Guidelines:

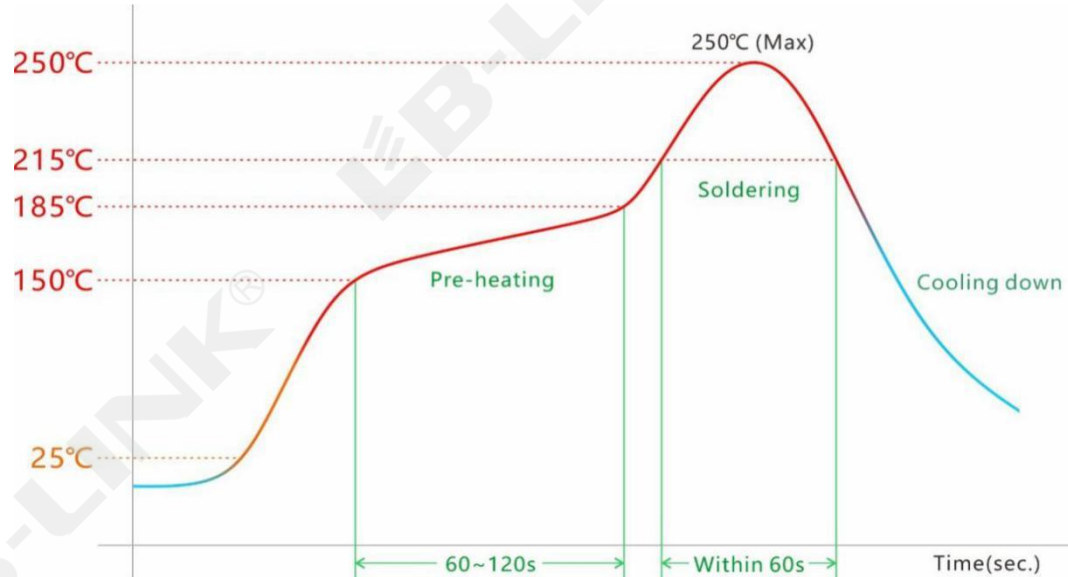
- A、Soldering two auxiliary grounding PADs at the bottom of module to customer's motherboard can significantly improve RF performance derating especially the poor RX sensitivity.
- B、On customer's motherboard, keep complete GND copper area under and around the module, do not route Power, RF, USB and other signals there to avoid interfering with the module causing RF performance derating problem.
- C、PCB traces of the RF path as short as possible, as far away from other signal as possible, avoid layer change, and should be maintain continuous 50Ω characteristic impedance, structure of "Coated Coplanar Waveguide With Ground" with the advantages of impedance control and GND surrounding isolation interference may be an ideal choice. It is necessary to maintain a complete GND reference layer below the RF path area.
- D、RF Pin and antenna PAD/RF connector PAD on customer's motherboard are significantly wider than PCB traces of the RF path, which will cause RF impedance discontinuity. To improve this problem, in addition to adjusting the local impedance of these PADs, a " π " circuit can be reserved near the antenna/RF connector which can match both RF path impedance and antenna impedance.

6.3 Recommend PCB Layout Footprint



(Design Unit: mm)

6.4 Reflow Soldering Standard Condition



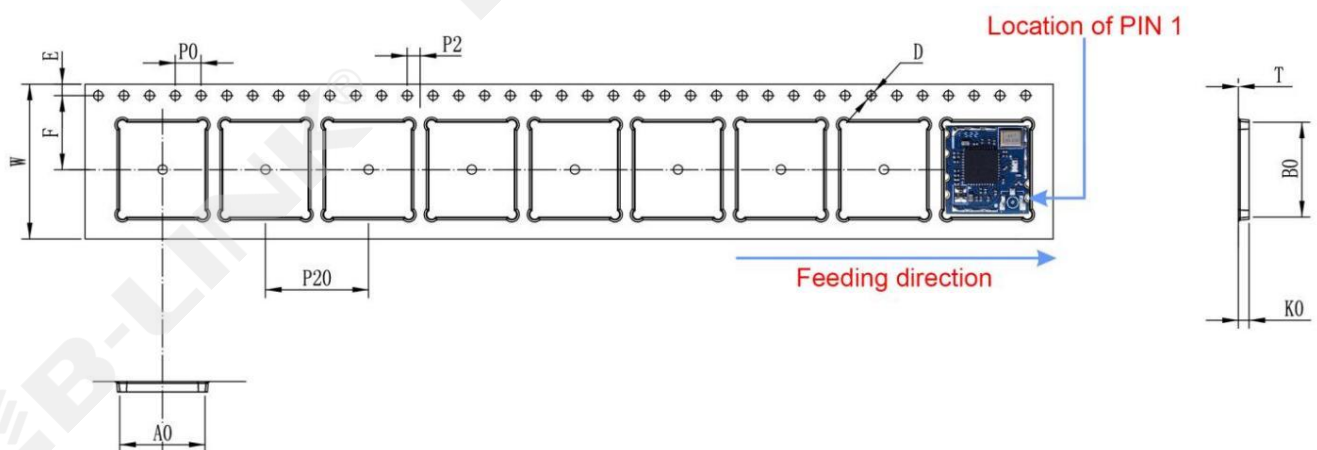
Please use the reflow within 2 times.
Set up the highest temperature within 250°C.

7. Key Components Of Module

No.	Parts	Specification	Manufacturer	Note
1	Chipset	RTL8733BU-VL-CG	Realtek Semiconductor Corp.	
2	PCB	BL-M8733BU2-L	SHEN ZHEN QILI ELECTRON CO.,LTD	
			ShenZhen Tie Fa Technology Limited	
			MILLION SOURCE PRINTED CIRCUIT BOARD CO.,LTD	
			Quzhou Sunlord Electronics Co.,Ltd	
3	Crystal	40MHz-3225	Chengde oscillator Electronic Technology CO.,LTD	
			LUCKI CM ELECTRONICS CO.,LTD	
			JinHua East Crystal Electronic CO.,LTD	
4	Diplexer	DIP1608	Dongguan Hekang Electronics Co.,LTD	
			Walsin Technology Corporation	
			Shenzhen Feite Technology Co., Ltd	

8. Package and Storage Information

8.1 Package Dimensions



ITEM	W	A0	B0	K0	E	F	P	P0	P2	D	T
DIM	24.00±0.3	12.70±0.1	13.60±0.1	2.50±0.1	1.75±0.1	11.5±0.1	20.00±0.1	4.00±0.1	2.00±0.1	Ø1.5±0.1	0.30±0.05



Package specification:

- 1,000 modules per roll and 5,000 modules per box.
- Outer box size: 37.5*36*29cm.
- The diameter of the blue environment-friendly rubber plate is 13 inches, with a total thickness of 28mm (with a width of 24mm carrying belt).
- Put 1 package of dry agent (20g) and humidity card in each anti-static vacuum bag.
- Each carton is packed with 5 boxes.

8.2 Storage Conditions

Absolute Maximum Ratings:

- Storage temperature: -40°C to +85°C,
- Storage humidity: 10% to 95 (Non-Condensing)

Recommended Storage Conditions:

- Storage temperature: 5°C to +40°C,
- Storage humidity: 20% to 90% RH

Please use this Module within 12month after vacuum-packaged.

The Module shall be stored without opening the packing.

After the packing opened, the Module shall be used within 72hours.

When the color of the humidity indicator in the packing changed, the Module shall be baked before soldering.

Baking condition: 60°C, 24hours, 1time.

ESD Sensitivity:

ESD Protection: 2KV(HBM, Maximum rating)

The Module is a static-sensitive electronic device.

Do not operate or store near strong electrostatic fields.

Take proper ESD precautions!



ESD CAUTION