



BL-M5623DU1

**802.11ac 867Mbps WLAN + BT v5.1
USB Module Specification**

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(Top View)



(Bottom View)

Module Name: BL-M5623DU1	
Module Type: 802.11a/b/g/n/ac 867Mbps WLAN + Bluetooth v5.1 Combo USB Module	
Revision: V1.0	
Customer Approval:	
Company:	
Title:	
Signature:	Date:
BL-link Approval:	
Title:	
Signature:	Date:

Revision History

Revision	Summary	Release Date	Revised By
1.0	Official release	2023-3-20	Garry

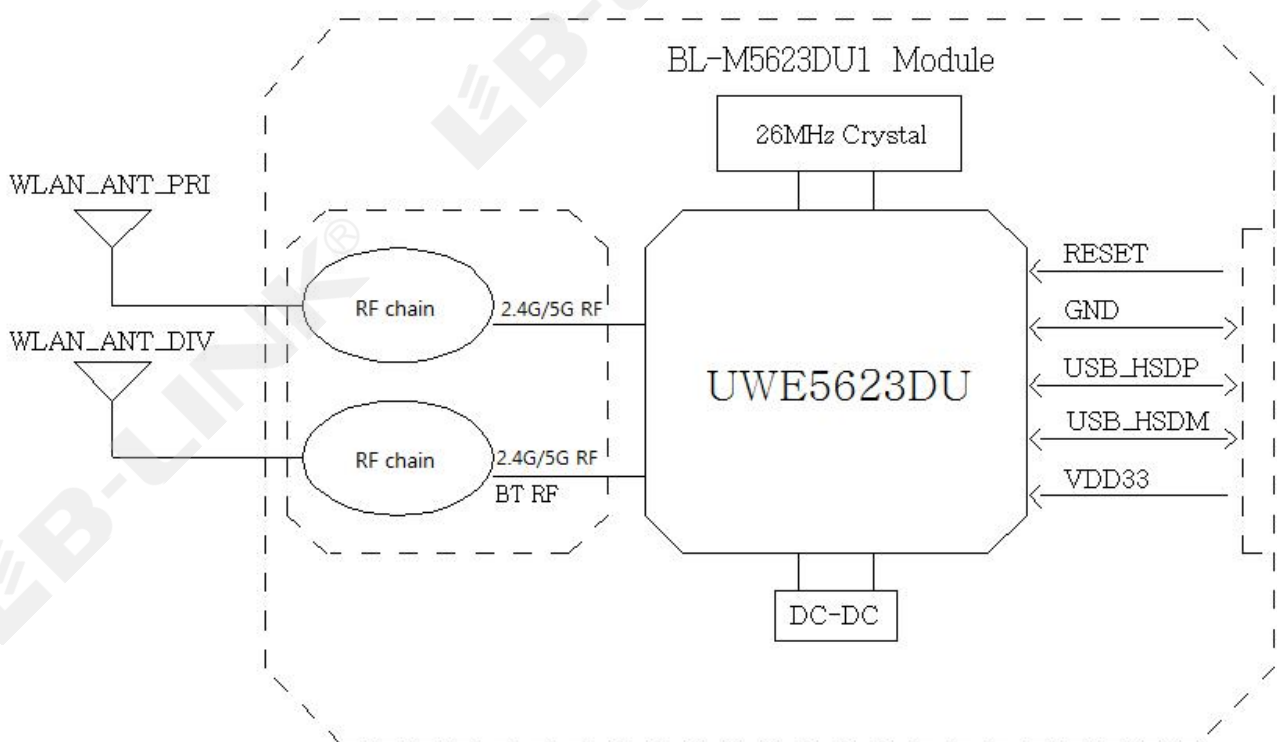
1. Introduction

BL-M5623DU1 is a highly integrated Dual-band WLAN + Bluetooth v5.1 Combo module. It combines a 2T2R Dual-band WLAN subsystem and a Bluetooth v5.1 subsystem. This module compatible IEEE 802.11 a/b/g/n/ac standard and provides the maximum PHY rate up to 867Mbps, it supports BT / BLE dual mode with BT v5.1/v4.2/v2.1 compliant, offers feature-rich and lower cost for STB、OTT、IOT and automotive applications.

1.1 Features

- Operating Frequency: 2.4~2.4835GHz or 5.15~5.85GHz
- Host Interface is USB 2.0
- IEEE Standards: IEEE 802.11a/b/g/n/ac
- Wireless PHY rate can reach up to 867Mbps
- Support BT Classic and BT Low Energy dual mode concurrent operation
- Connect to external antenna through IPEX connectors
- Power Supply: 3.3V±0.2V main power supply

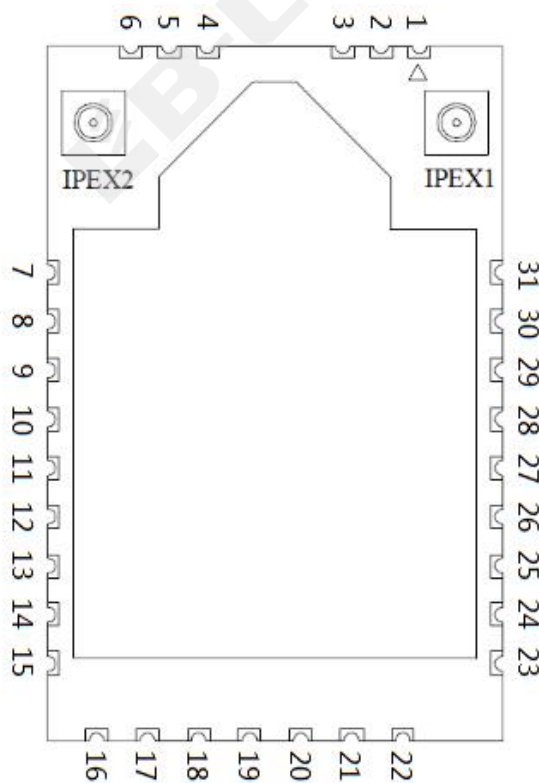
1.2 Block Diagram



1.3 General Specifications

Module Name	BL-M5623DU1
Chipset	UWE5623DU
WLAN Standards	IEEE 802.11 a/b/g/n/ac
Bluetooth Standards	Bluetooth Core Specification v5.1/4.2/2.1
Host Interface	USB2.0
Antenna	Connect to external antenna through IPEX connectors
Dimension	27.0*17.8*3mm (L*W*H)
Power Supply	DC 3.3V±0.2V @ 1A (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	Level	Description
1	GND	P		Ground connections
2	NC			NC (Reserved 2.4G / 5G RF PAD for WLAN_ANT_PRI)
3	GND	P		Ground connections
4	GND	P		Ground connections
5	NC			NC (Reserved 2.4G / 5G RF PAD for WLAN_ANT_DIV & Bluetooth_ANT)
6	GND	P		Ground connections
7	GND	P		Ground connections
8	NC			No connection
9	NC			NC (Reserved Uart0_TXD, 1.8V digital I/O)
10	GND	P		Ground connections
11	NC			NC (Reserved Uart0_RXD, 1.8V digital I/O)
12	NC			NC (Reserved GPIO40 use for WLAN wake up Host, 1.8V digital I/O)
13	GND	P		Ground connections
14	NC			NC (Reserved USB30_TXN, analog I/O)
15	NC			NC (Reserved USB30_TXP, analog I/O)
16	NC			NC (Reserved USB30_RXN, analog I/O)
17	NC			NC (Reserved USB30_RXP, analog I/O)
18	GND	P		Ground connections
19	HSDP	A I/O		USB 2.0 differential signal positive
20	HSDM	A I/O		USB 2.0 differential signal negative
21	VDD33	P		DC 3.3V power supply
22	RESET	I	3.3V	System reset input, this Pin can externally reset the Module, internal pull up, Active Low
23	NC			NC (Reserved GPIO41 use for Bluetooth wake up Host, 1.8V digital I/O)
24	NC			NC (Reserved Uart0_RTS, 1.8V digital I/O)
25	NC			NC (Reserved Uart0_CTS, 1.8V digital I/O)
26	NC			No connection
27	NC			NC (Reserved Uart2_TXD, 1.8V digital I/O)
28	NC			NC (Reserved Uart2_RXD, 1.8V digital I/O)
29	GND	P		Ground connections

30	NC			NC (Reserved RF PAD for Bluetooth)
31	GND	P		Ground connections
IPEX/MHF-1 Connector				
	IPEX1	RF		IPEX connector for 2.4G & 5G WLAN_ANT_PRI
	IPEX2	RF		IPEX connector for 2.4G & 5G WLAN_ANT_DIV & Bluetooth_ANT

P: Power or Ground; I/O: In/Output; I: Input; O: Output; A I/O: Analog In/Output; AI: Analog Input; AO: Analog 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 (Bluetooth over USB)			
Use Case	VDD33 Current (average)		
	Typ	Max	Units
2.4G 11b 1Mbps TX @ 18dBm (1TX RF test)	253	287	mA
2.4G 11b 11Mbps TX @ 18dBm (1TX RF test)	240	269	mA
2.4G 11g 6Mbps TX @ 17dBm (1TX RF test)	230	260	mA
2.4G 11g 54Mbps TX @ 15dBm (1TX RF test)	171	211	mA
2.4G HT20 MCS0 TX@ 17dBm (1TX RF test)	220	256	mA
2.4G HT20 MCS7 TX@ 14dBm (1TX RF test)	166	203	mA
2.4G HT40 MCS0 TX@ 17dBm (1TX RF test)	211	247	mA
2.4G HT40 MCS7 TX@ 14dBm (1TX RF test)	147	180	mA
2.4G HT40 MCS0 RX (1RX RF test)	68	78	mA
2.4G HT40 MCS7 RX (1RX RF test)	67	78	mA

5G 11a 6Mbps TX @ 17dBm (1TX RF test)	357	388	mA
5G 11a 54Mbps TX @ 14dBm (1TX RF test)	257	287	mA
5G HT20 MCS0 TX @ 16dBm (1TX RF test)	356	385	mA
5G HT20 MCS7 TX @ 13dBm (1TX RF test)	245	275	mA
5G HT40 MCS0 TX @ 16dBm (1TX RF test)	342	379	mA
5G HT40 MCS7 TX @ 13dBm (1TX RF test)	213	252	mA
5G 11ac VHT80 MCS0 TX @ 15dBm (1TX RF test)	305	348	mA
5G 11ac VHT80 MCS9 TX @ 12dBm (1TX RF test)	181	221	mA
5G 11ac VHT80 MCS0 RX (1RX RF test)	85	96	mA
5G 11ac VHT80 MCS9 RX (1RX RF test)	85	96	mA
BT BR_1M TX @ 8dBm (BT RF test, WLAN disable)	47	60	mA
BT EDR_2M TX @ 6dBm (BT RF test, WLAN disable)	45	58	mA
BT EDR_3M TX @ 6dBm (BT RF test, WLAN disable)	46	60	mA
BT LE_1M TX @ 4dBm (BT RF test, WLAN disable)	45	60	mA
BT LE_2M TX @ 4dBm (BT RF test, WLAN disable)	47	61	mA
BT LE_125K TX @ 4dBm (BT RF test, WLAN disable)	55	72	mA
BT LE_500K TX @ 4dBm (BT RF test, WLAN disable)	65	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): CCK, DQPSK, DBPSK; 802.11g (OFDM): BPSK, QPSK, QAM16, QAM64; 802.11n (OFDM): BPSK, QPSK, QAM16, QAM64;
Date Rate	802.11b: 1, 2, 5.5, 11Mbps; 802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps; 802.11n (HT20): MCS0~MCS7(1T1R_SISO) 6.5~72.2Mbps; 802.11n (HT20): MCS8~MCS15(2T2R_MIMO) 13~144.4Mbps; 802.11n (HT40): MCS0~MCS7(1T1R) 13.5~150Mbps; 802.11n (HT40): MCS8~MCS15(2T2R) 27~300Mbps;
Frequency Tolerance	≤±20ppm

2.4G Transmitter Specifications (WLAN_ANT_PRI & WLAN_ANT_DIV. 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 TX Power (dBm)	TX Power Tolerance (dBm)	EVM (dB)
802.11b@1~11Mbps	18	±2	≤-10
802.11g@6Mbps	17	±2	≤-10
802.11g@54Mbps	15	±2	≤-25
802.11n@HT20_MCS0	17	±2	≤-10
802.11n@HT20_MCS7	14	±2	≤-28
802.11n@HT40_MCS0	17	±2	≤-10
802.11n@HT40_MCS7	14	±2	≤-28

2.4G Receiver Specifications (WLAN_ANT_PRI & WLAN_ANT_DIV)

RX Rate	Min Input Level (Typ dBm)	Max Input Level (Typ dBm)	PER
802.11b@1Mbps	-95	-5	< 8%
802.11b@11Mbps	-86	-5	< 8%
802.11g@6Mbps	-90	-5	< 10%
802.11g@54Mbps	-74	-5	< 10%
802.11n@HT20_MCS0	-89	-5	< 10%
802.11n@HT20_MCS7	-69	-5	< 10%
802.11n@HT40_MCS0	-87	-5	< 10%
802.11n@HT40_MCS7	-66	-5	< 10%

4.2 5G WLAN RF Specification

Conditions: VDD33=3.3V; Ta:25°C

Features	Description
WLAN Standard	IEEE 802.11a/n/ac
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; 802.11ac (OFDM): BPSK, QPSK, QAM16, QAM64, QAM256;

Date Rate	802.11a: 6, 9, 12, 18, 24, 36, 48, 54Mbps; 802.11n (HT20): MCS0~MCS7(1T1R_SISO) 6.5~72.2Mbps; 802.11n (HT20): MCS8~MCS15(2T2R_MIMO) 13~144.4Mbps; 802.11n (HT40): MCS0~MCS7(1T1R) 13.5~150Mbps; 802.11n (HT40): MCS8~MCS15(2T2R) 27~300Mbps; 802.11ac (VHT20): MCS0~MCS8(1T1R) 6.5~86.7Mbps; 802.11ac (VHT20): MCS0~MCS8(2T2R) 13~173.3Mbps; 802.11ac (VHT40): MCS0~MCS9(1T1R)13.5~200Mbps; 802.11ac (VHT40): MCS0~MCS9(2T2R)27~400Mbps; 802.11ac (VHT80): MCS0~MCS9(1T1R)29.3~433.3Mbps; 802.11ac (VHT80): MCS0~MCS9(2T2R)58.5~866.7Mbps;
Frequency Tolerance	$\leq \pm 20\text{ppm}$

5G Transmitter Specifications (WLAN_ANT_PRI & WLAN_ANT_DIV. 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 TX Power (dBm)	TX Power Tolerance (dBm)	EVM (dB)
802.11a@6Mbps	17	± 2	≤ -10
802.11a@54Mbps	14	± 2	≤ -25
802.11n@HT20_MCS0	16	± 2	≤ -10
802.11n@HT20_MCS7	13	± 2	≤ -28
802.11n@HT40_MCS0	16	± 2	≤ -10
802.11n@HT40_MCS7	13	± 2	≤ -28
802.11ac@VHT80_MCS0	15	± 2	≤ -10
802.11ac@VHT80_MCS9	12	± 2	≤ -32

5G Receiver Specifications (WLAN_ANT_PRI & WLAN_ANT_DIV)

RX Rate	Min Input Level (Typ dBm)	Max Input Level (Typ dBm)	PER
802.11a@6Mbps	-91	-5	< 10%
802.11a@54Mbps	-74	-5	< 10%
802.11n@HT20_MCS0	-90	-5	< 10%
802.11n@HT20_MCS7	-70	-5	< 10%
802.11n@HT40_MCS0	-88	-5	< 10%

802.11n@HT40_MCS7	-67	-5	< 10%
802.11ac@VHT80_MCS0	-86	-5	< 10%
802.11ac@VHT80_MCS9	-58	-5	< 10%

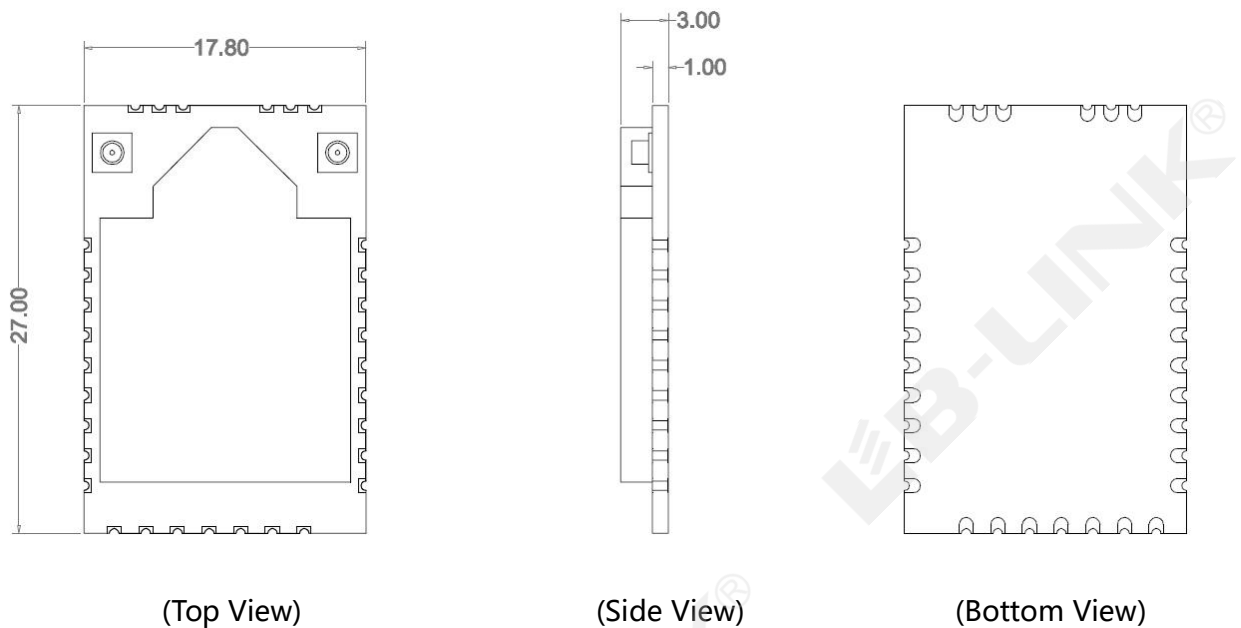
4.3 Bluetooth RF Specifications

Conditions: VDD33=3.3V; Ta:25°C			
Features	Description		
Bluetooth Specification	Bluetooth Core Specification v5.1/4.2/2.1		
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;		
Date Rate & Modulation	BR_1Mbps: GFSK; EDR_2Mbps: $\pi/4$ -DQPSK; EDR_3Mbps: 8DPSK; LE_125Kbps: GFSK (Coded_S=8); LE_500Kbps: GFSK (Coded_S=2); LE_1Mbps / 2Mbps: GFSK (Uncoded);		
Bluetooth Transmitter Specifications (Bluetooth_ANT. 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)			
Items	Min (dBm)	Typ (dBm)	Max (dBm)
TX Power			
BR_1M (Recommended TX Power:8dBm)	4	8	12
EDR_2/3M (Recommended TX Power:6dBm)	2	6	10
LE_125K/500K/1M/2M(Recommended TX Power:4dBm)	0	4	8
Items	Min	Typ	Max
BR_1M (DH1) Modulation Characteristics			

Δf1avg	140KHz	164.9KHz	175KHz	
Δf2avg	115KHz	146.7KHz	/	
Δf2max	115KHz	153.5KHz	/	
Δf2avg/Δf1avg	0.8	0.89	/	
EDR_3M(3DH5) EDR Carrier Frequency Stability and Modulation Accuracy				
ωi	-75KHz	-1.79KHz	+75KHz	
ωi+ω0	-75KHz	-1.95KHz	+75KHz	
ω0	-10KHz	0.04KHz	+10KHz	
8DPSK RMS DEVM	/	0.022	0.13	
8DPSK Peak DEVM	/	0.057	0.25	
LE_1M Modulation Characteristics				
Δf1avg	225KHz	251.6KHz	275KHz	
Δf2avg	185KHz	220.2KHz	/	
Δf2max	185KHz	227.9KHz	/	
Δf2avg/Δf1avg	0.8	0.87	/	
LE_2M Modulation Characteristics				
Δf1avg	450KHz	502.3KHz	550KHz	
Δf2avg	370KHz	439KHz	/	
Δf2max	370KHz	446.8KHz	/	
Δf2avg/Δf1avg	0.8	0.874	/	
Bluetooth Receiver Specifications				
Items	Sensitivity		Maximum Input Level	
	Input Level(Typ)	BER	Input Level(Typ)	BER
BR_1M (DH1)	-90 dBm	≤ 0.1%	-5 dBm	≤ 0.1%
EDR_3M (3DH5)	-80 dBm	≤ 0.01%	-5 dBm	≤ 0.1%
	Input Level (Typ)	PER	Input Level (Typ)	PER
LE_125K	-93 dBm	≤ 5%	-5 dBm	≤ 5%
LE_1M	-91 dBm	≤ 5%	-5 dBm	≤ 5%
LE_2M	-88 dBm	≤ 5%	-5 dBm	≤ 5%

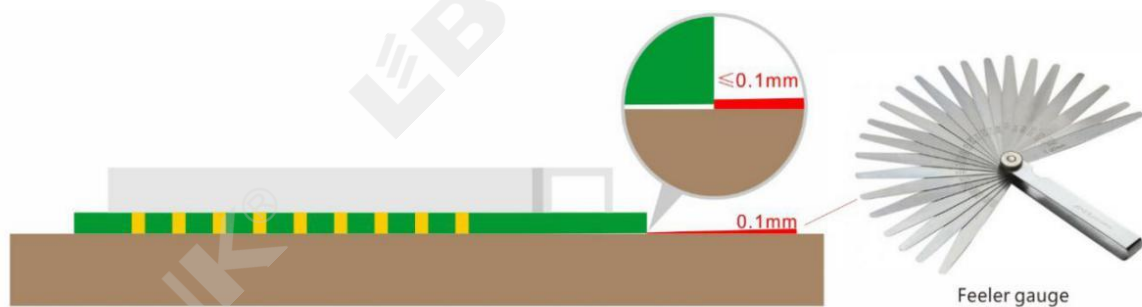
5. Mechanical Specifications

5.1 Module Outline Drawing



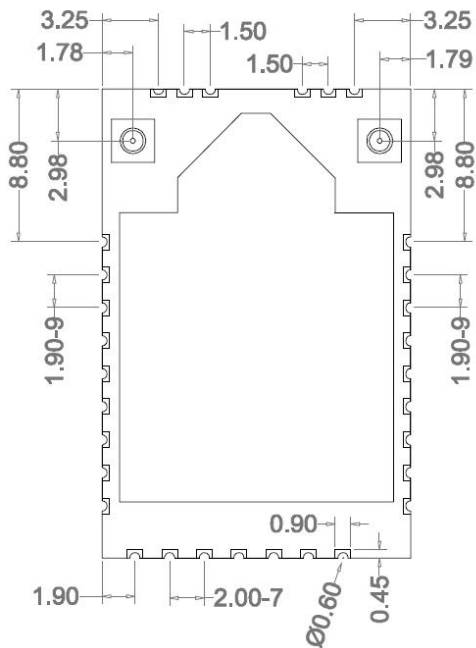
Module dimension: 27.0mm*17.8mm*3mm (L*W*H; Tolerance: $\pm 0.15\text{mm}$)

IPEX / MHF-1 connector dimension: 2.6*3.0*1.2mm (L*W*H, $\varnothing 2.0\text{mm}$)

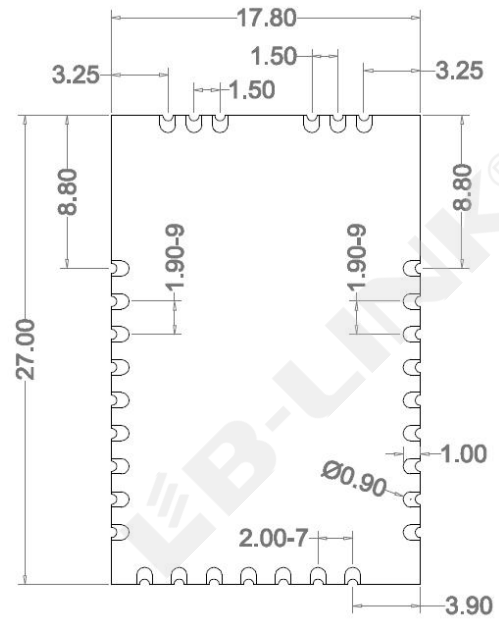


Module Bow and Twist: $\leq 0.1\text{mm}$

5.2 Mechanical Dimensions



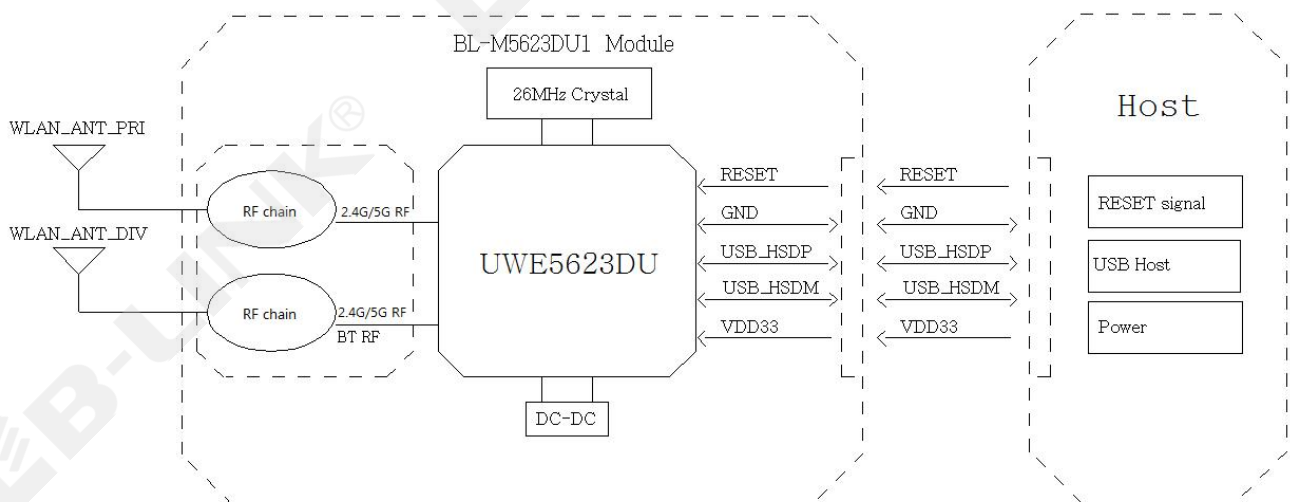
(Top View)



(Bottom view)

6. Application Information

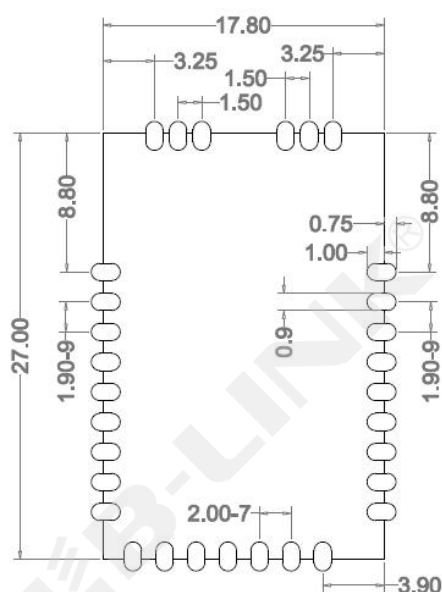
6.1 Typical Application Circuit



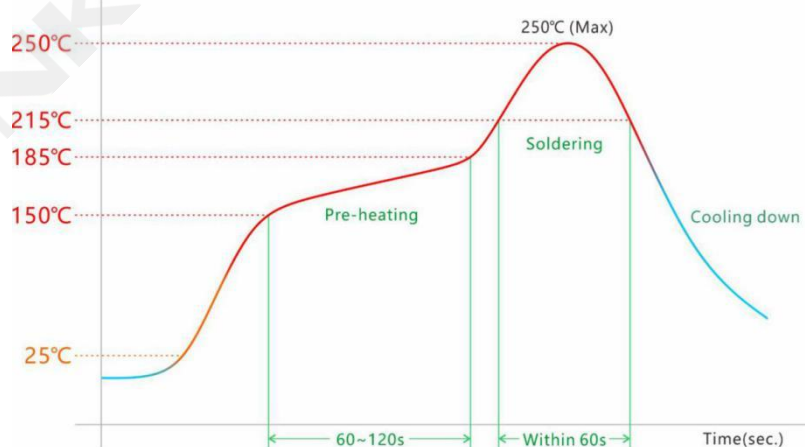
6.2 HW Application Note

1. Supply Voltage requirement: DC 3.1~3.5V & Ripple Voltage <80mV;
2. Supply Current requirement: Maximum RMS current $\geq 800\text{mA}$ and Maximum Peak current $\geq 1\text{A}$, for achieve fast transient response, a current mode buck converter recommended;
3. USB differential pair needs to maintain 90 ohm impedance and minimize the distance between the host and the module. Make sure USB differential lines has a good ground reference;

6.3 Recommend PCB Layout Footprint



6.4 Reflow Soldering Standard Conditions



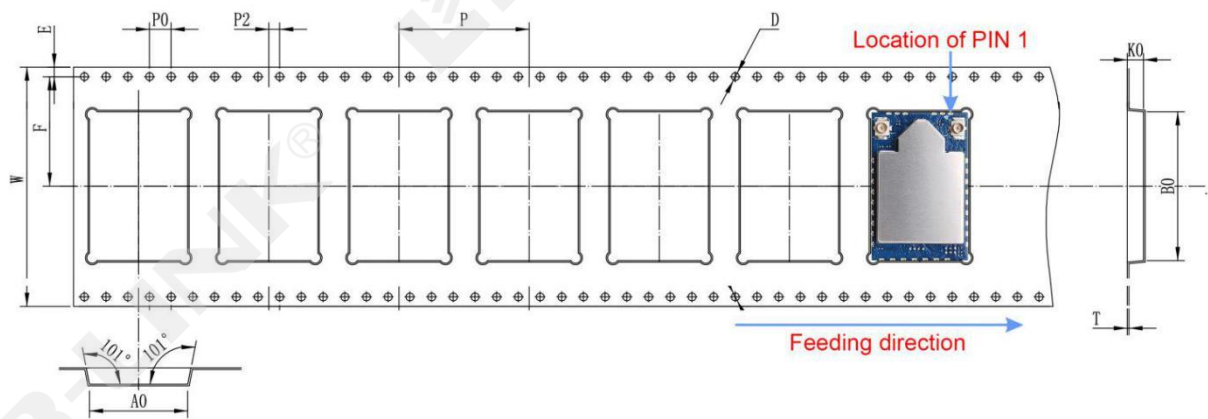
Please use the reflow within 2 times.
Set up the highest temperature within 250°C.

7. Key Components Of Module

No.	Parts	Specification	Manufacturer	Note
1	Chipset	UWE5623DU	UNISOC Technologies Inc.	
2	PCB	BL-M5623DU1	ShenZhen Tie Fa Technology Limited	
			MILLION SOURCE PRINTED CIRCUIT BOARD CO.,LTD	
			Quzhou Sunlord Electronics Co.,Ltd	
3	Crystal	26MHz-2016	LUCKI CM ELECTRONICS CO.,LTD	
			JinHua East Crystal Electronic CO.,LTD	
			Chengde oscillator Electronic Technology CO.,LTD	
4	Diplexer	DIP1608	Shenzhen Sunlord Electronics Co.,Ltd	
			Walsin Technology Corporation	
			Advanced Ceramic X Corp.	

8. Package and Storage Information

8.1 Package Dimensions



ITEM	W	A0	B0	K0	E	F	P	P0	P2	D	T
DIM	44.00±0.3	18.1±0.1	27.4±0.1	2.5±0.1	1.75±0.1	21.5±0.1	24.00±0.1	4.00±0.1	2.00±0.1	Ø1.5±0.1	0.30±0.05

**Package specification:**

1. 900 modules per roll and 3,600 modules per box.
2. Outer box size: 37.5*36*29cm.
3. The diameter of the blue environment-friendly rubber plate is 13 inches, with a total thickness of 48mm (with a width of 44mm carrying belt).
4. Put 1 package of dry agent (20g) and humidity card in each anti-static vacuum bag.
5. Each carton is packed with 4 boxes.

8.2 Storage Conditions**Absolute Maximum Ratings:**

Storage temperature: -40°C to +85°C

Storage humidity: 10% to 95% RH (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**

<http://www.b-link.net.cn>