BL-M8821CS1

802.11ac 433Mbps WLAN + BT v4.2

Combo SDIO Module Specification

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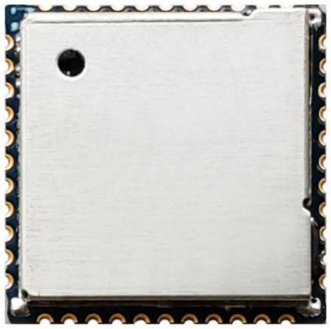


(Top View)

(Bottom View)

Module Name: BL-M8821CS1	
Module Type: 802.11a/b/g/n/ac 433Mbps WLAN + BT v4.2 Combo SDIO 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	2020-01-16	
1.0	Official release	2023-03-21	Update the specification version

1. Introduction

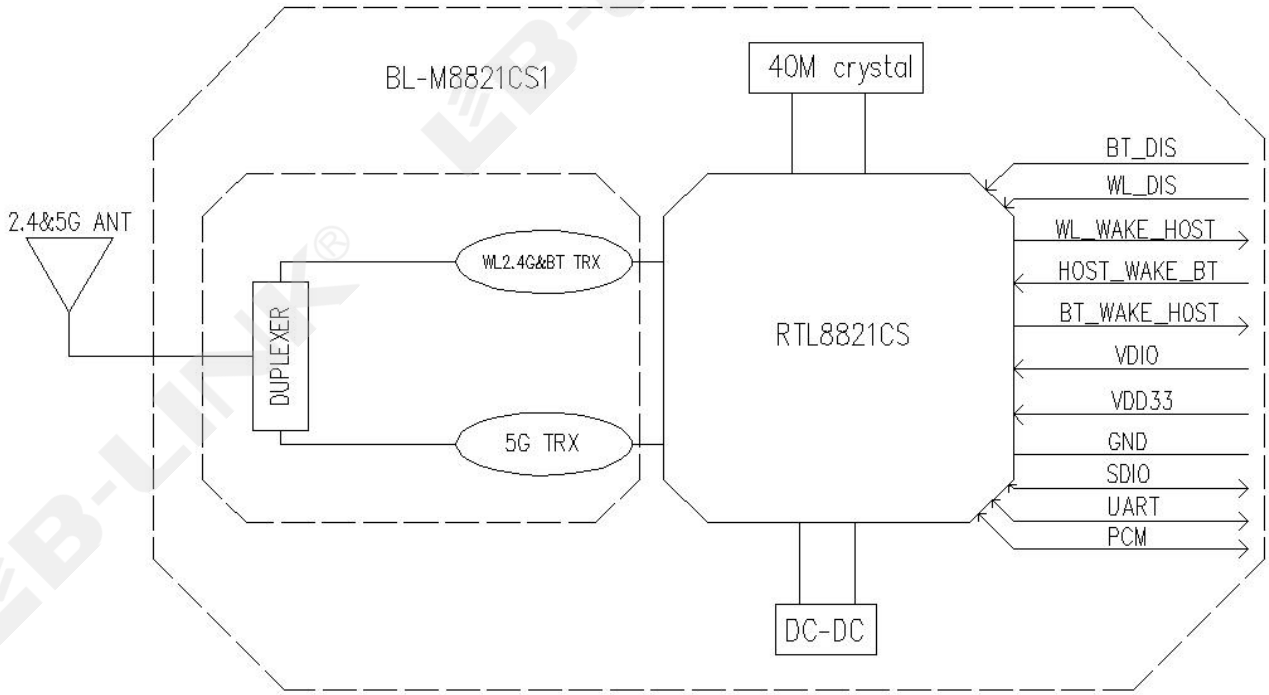
BL-M8821CS1 is a highly integrated Dual-band WLAN + Bluetooth v4.2 Combo module. It compatible IEEE802.11a/b/g/n/ac standard and provides the maximum PHY rate up to 433.3Mbps, and supports Bluetooth dual mode with BT v4.2/4.0/2.1 compliant, offering feature-rich wireless connectivity at high standards, and delivering reliable, cost-effective, high throughput from an extended distance.

1.1 Features

- Operating Frequencies: 2.4~2.4835GHz or 5.15~5.85GHz
- Host Interface is SDIO and UART
- IEEE Standards: IEEE 802.11a/b/g/n/ac, wireless PHY rate can reach up to 433Mbps
- Support Bluetooth v4.2/4.0/2.1 with Simultaneous LE and BR / EDR
- Connect to external antenna through half hole

Power Supply: DC3.3V for main power, DC3.3V or 1.8V for I/O power

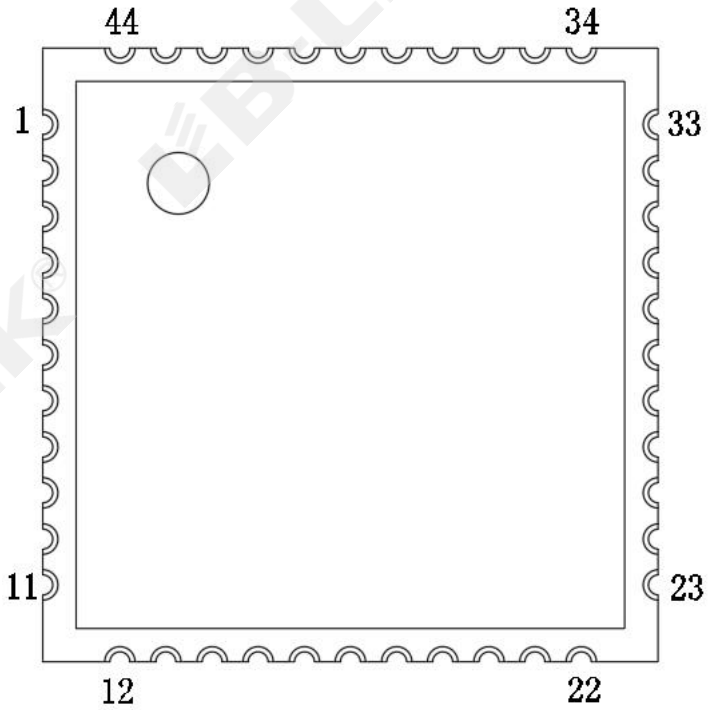
1.2 Block Diagram



1.3 General Specifications

Module Name	BL-M8821CS1 WLAN + BT4.2 SDIO Module
Chipset	RTL8821CS-CG
WLAN Standard	IEEE802.11a/b/g/n/ac
BT Specification	Bluetooth Core Specification v4.2/4.0/2.1
Host Interface	SDIO3.0/SDIO2.0 for WLAN & UART for Bluetooth
Antenna	Connect to the external antenna through half hole
Dimension	12.0*12.0*2.4mm (L*W*H)
Power Supply	3.3V±0.2V main power supply @500 mA (Max) 3.3V±0.2V or 1.8V±0.1V I/O power supply
Operation Temperature	-20℃ to +70℃
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
2	WLAN/BT_ANT	RF		WLAN/BT_ANT
3	GND	RF		RF Ground
4	NC	--		NC
5	NC	--		NC
6	HOST_WAKE_BT	I/O	VDIO	Function1. General Purpose Input / Output Pin GPIO13 Function2. Host to wake-up this Bluetooth device input
7	BT_HOST_WAKE	I/O	VDIO	Function1. General Purpose Input / Output Pin GPIO14 Function2. Bluetooth device to wake-up HOST
8	NC	--		NC
9	VDD33	P		3.3V Main Power Supply
10	NC	--		NC
11	NC	--		NC
12	WL_DIS#	I/O	VDIO	Shared with GPIO9, This Pin Can Externally Shutdown the RTL8821CS WLAN function when WL_DIS# is pulled low input. When this pin pulled low, SDIO interface will be disabled.
13	WL_HOST_WAKE	I/O	VDIO	Function1. General Purpose Input / Output Pin GPIO10 Function2. WLAN to wake-up Host output
14	SD_D2	I/O	VDIO	SDIO data line 2
15	SD_D3	I/O	VDIO	SDIO data line 3
16	SD_CMD	I/O	VDIO	SDIO command line
17	SD_CLK	I	VDIO	SDIO CLK line
18	SD_D0	I/O	VDIO	SDIO data line 0
19	SD_D1	I/O	VDIO	SDIO data line 1
20	GND	P		Ground
21	NC	--		NC
22	VDIO	P		Supply voltage for digital IO, 3.3V or 1.8V is alternative; VDDIO 3.3V for SDIO default speed and high-speed modes, 1.8V for SDR12/SDR25/SDR50/DDR50 modes.

23	NC	--		NC
24	SUSCLK_IN	I	VDIO	External 32K or RTC clock input
25	PCM_DOUT	I/O	VDIO	Function1. General Purpose Input / Output Pin GPIO1 Function2. PCM Data output
26	PCM_CLK	I/O	VDIO	Function1. General Purpose Input / Output Pin GPIO3 Function2. PCM Clock input
27	PCM_DIN	I/O	VDIO	Function1. General Purpose Input / Output Pin GPIO0 Function2. PCM data input
28	PCM_SYNC	I/O	VDIO	Function1. General Purpose Input / Output Pin GPIO2 Function2. PCM sync I/O signal
29	NC	--		NC
30	NC	--		NC
31	GND	p		Ground
32	NC	--		NC
33	GND	p		Ground
34	BT_DIS#	I/O	VDIO	Shared with GPIO11, This Pin Can Externally Shutdown the RTL8821CS BT function when BT_DIS# is pulled low input. When this pin pulled low, UART interface will be also disabled.
35	NC	--		NC
36	GND	P		Ground
37	NC	--		
38	NC	--		
39	NC	--		
40	NC	--		
41	UART_RTS	O	VDIO	UART RTS
42	UART_OUT	O	VDIO	UART Data Out
43	UART_IN	I	VDIO	UART Data In
44	UART_CTS	I	VDIO	UART CTS

P: Power, I: Input, O: Output, I/O: In/Output, A I/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	℃
External Antenna VSWR			1.7	2.0	/
Supply Voltage	VDD33	3.1	3.3	3.5	V
	VDIO	3.1	3.3	3.5	V
		1.7	1.8	1.9	V

3.2 Digital 3.3V I/O DC Specifications

Symbol	Parameter	Min	Typ	Max	Units
VIH	Input High Voltage	2.0	3.3	3.6	V
VIL	Input Low Voltage	--	0	0.9	V
VOH	Output High Voltage	2.97	--	3.3	V
VOL	Output Low Voltage	0	--	0.33	V

3.3 Digital 1.8V I/O DC Specifications

Symbol	Parameter	Min	Typ	Max	Units
VIH	Input High Voltage	1.3	1.8	2.0	V
VIL	Input Low Voltage	--	0	0.8	V
VOH	Output High Voltage	1.62	--	1.8	V
VOL	Output Low Voltage	0	--	0.18	V

3.4 Current Consumption

Conditions : VDD33=3.3V ; VDIO=3.3V Ta:25℃			
Use Case	VDD33 Current (average)		
	Typ	Max	Units

WLAN and BT Unassociated (Linux)	130	160	mA
2.4G 11Mbps TX @16.5dBm (RF test)	330	400	mA
2.4G 11n HT40 MCS7 TX @14.5dBm (RF test)	280	320	mA
5G 11ac VHT80MCS0TX @12dBm (RF test)	338	372	mA
5G 11ac VHT80 MCS9 TX @12dBm (RF test)	304	364	mA
2.4G 11n HT40 MCS7 RX (RF test)	140	165	mA
5G 11ac VHT80 MCS9 RX (RF test)	160	185	mA
BT BR 1M TX@5dBm (RF test)	160	188	mA
BT LE 1M TX@5dBm (RF test)	148	188	mA
BT LE 1M RX (RF test)	129	156	mA

4. WLAN & Bluetooth RF Specifications

4.1 2.4G WLAN RF Specification

Conditions: VDD33=3.3V; Ta:25℃	
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(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;
Frequency Tolerance	≦ ±20ppm

2.4G Transmitter Specifications (ANT0 & ANT1. TX power of some rates is calibrated, customers can define the target TX power of other rates 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	TX Power (dBm)	TX Power Tolerance(dBm)	EVM (dB)
802.11b@1Mbps	Recommended Target TX Power =18.5dBm	±1.5	≦-15
802.11b@11Mbps	Calibrated TX Power =16.5dBm	±1.5	≦-15

802.11g@6Mbps	Recommended Target TX Power =17dBm	±1.5	≦-15
802.11g@54Mbps	Calibrated TX Power =15dBm	±1.5	≦-25
802.11n@HT20_MCS0	Recommended Target TX Power =17dBm	±1.5	≦-10
802.11n@HT20_MCS7	Calibrated TX Power =15dBm	±1.5	≦-28
802.11n@HT40_MCS0	Recommended Target TX Power =16.5dBm	±1.5	≦-10
802.11n@HT40_MCS7	Calibrated TX Power =14.5dBm	±1.5	≦-28
2.4G Receiver Specifications (WLAN_ANT0&WLAN_ANT1)			
RX Rate	**Min Input Level (Typ.dBm)**	**Max Input Level**	**PER**
802.11b@1Mbps	-93	-5	< 8%
802.11b@11Mbps	-86	-5	< 8%
802.11g@6Mbps	-91	-5	< 10%
802.11g@54Mbps	-73	-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	-67	-5	< 10%

4.2 5G WLAN RF Specification

Conditions: VDD33=3.3V; Ta:25℃	
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;
Data 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;
Frequency Tolerance	≦ ±20ppm

5G Transmitter Specifications （ANT0 & ANT1. 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	TX Power （dBm）	TX Power Tolerance	EVM （dB）
802.11a@6Mbps	Recommended Target TX Power =15dBm	±2	≦-10
802.11a@54Mbps	Calibrated TX Power =13dBm	±2	≦-25
802.11n@HT20_MCS0	Recommended Target TX Power =15dBm	±2	≦-10
802.11n@HT20_MCS7	Calibrated TX Power =13dBm	±2	≦-28
802.11n@HT40_MCS0	Recommended Target TX Power =15dBm	±2	≦-10
802.11n@HT40_MCS7	Calibrated TX Power =13dBm	±2	≦-28
802.11ac@VHT80_MCS0	Recommended Target TX Power =14dBm	±2	≦-10
802.11ac@VHT80_MCS9	Calibrated TX Power =12dBm	±2	≦-30

5G Receiver Specifications(WLAN_ANT0&WLAN_ANT1)

RX Rate	Min Input Level （Typ.dBm）	Max Input Level	PER
802.11a@6Mbps	-89	-5	< 10%
802.11a@54Mbps	-72	-5	< 10%

802.11n@HT20_MCS0	-87	-5	< 10%
802.11n@HT20_MCS7	-69	-5	< 10%
802.11n@HT40_MCS0	-86	-5	< 10%
802.11n@HT40_MCS7	-67	-5	< 10%
802.11ac@VHT80_MCS0	-82	-5	< 10%
802.11ac@VHT80_MCS9	-57	-5	< 10%

4.3 Bluetooth RF Specification

Conditions: VDD33=3.3V; Ta:25℃			
Features	**Description**		
Bluetooth Specification	Bluetooth Core Specification v4.2/4.0/2.1		
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: π/4-DQPSK; EDR_3Mbps: 8DPSK; LE_1Mbps: GFSK (Uncoded);		
Bluetooth Transmitter Specifications (BT_ANT)			
Items	**Min**	**Typ**	**Max**
TX Power			
BR_1M	2dBm	5dBm	8dBm
EDR_2/3M	2dBm	5dBm	8dBm
LE_1M	2dBm	5dBm	8dBm

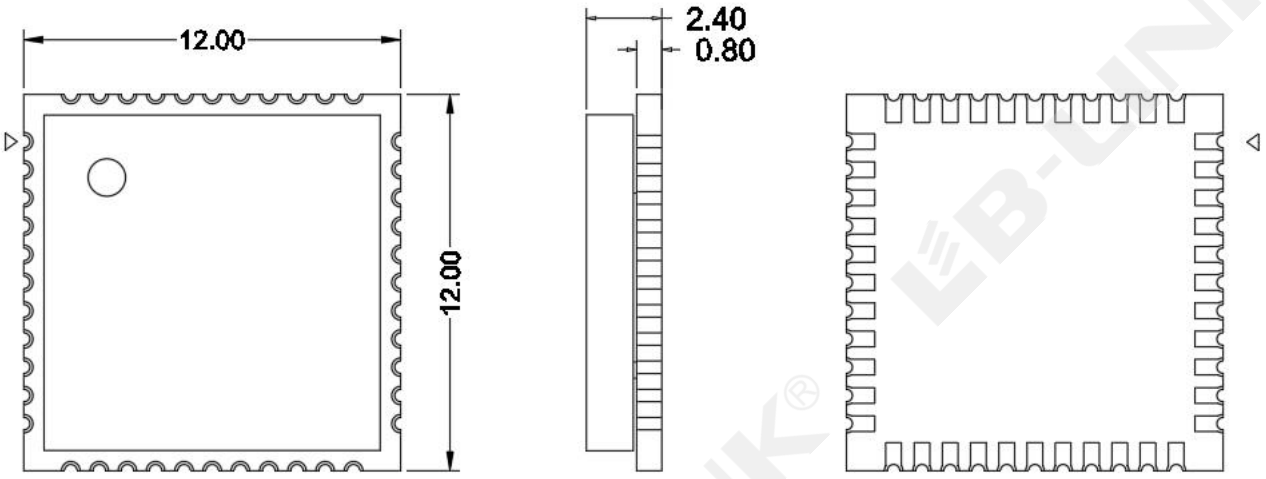
Items	Min	Typ	Max
BR_1M (DH1) Modulation Characteristics			
Δf1avg	140KHz	164.91KHz	175KHz
Δf2avg	115KHz	165.46KHz	/
Δf2max	115KHz	166.83KHz	/
Δf2avg/Δf1avg	0.8	1	/
BR_1M (DH1) Initial Carrier Frequency Tolerance			
Init Freq Error	-75kHz	-2.5kHz	+75kHz
EDR_3M(3DH5) EDR Carrier Frequency Stability and Modulation Accuracy			
ωi	-75KHz	10.49KHz	+75KHz
ωi+ωo	-75KHz	13.32KHz	+75KHz
ωo	-10KHz	2.83KHz	+10KHz
8DPSK RMS DEVM	/	0.0915	0.13
8DPSK Peak DEVM	/	0.0455	0.25
LE_1M Modulation Characteristics			
Δf1avg	225KHz	252.08KHz	275KHz
Δf2avg	185KHz	229.77KHz	/
Δf2max	185KHz	222.07KHz	/
Δf2avg/Δf1avg	0.8	0.91	/

Bluetooth Receiver Specifications (BT_ANT)

Items	Sensitivity		Maximum Input Level	
	Input Level(Typ)	BER	Input Level(Typ)	BER
BR_1M (DH1)	-88dBm	≦ 0.1%	-10dBm	≦ 0.1%
EDR_3M (3DH5)	-84dBm	≦ 0.01%	-10dBm	≦ 0.1%
Items	Input Level (Typ)	PER	Input Level (Typ)	PER
LE_1M	-90dBm	≦ 5%	-10dBm	≦ 5%

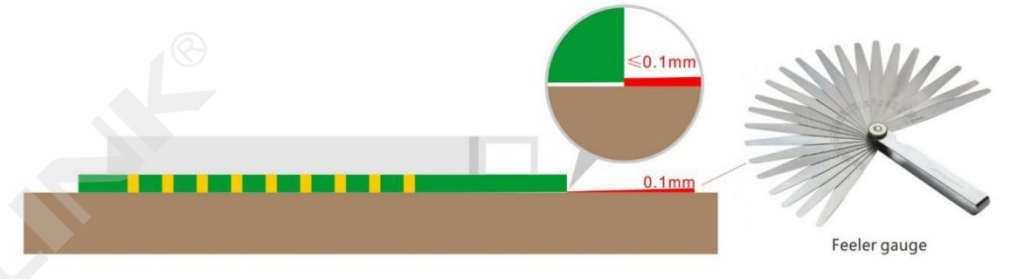
5 Mechanical Specifications

5.1 Module Outline Drawing



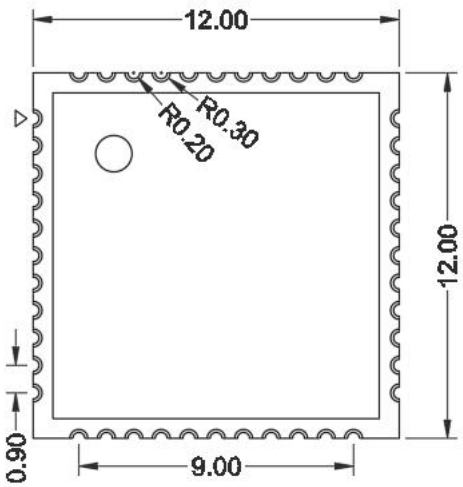
(Top View) (Side View) (Bottom View)

Module dimension: 12.0mm*12.0mm*2.4mm (L*W*H ; Tolerance: ±0.15mm)

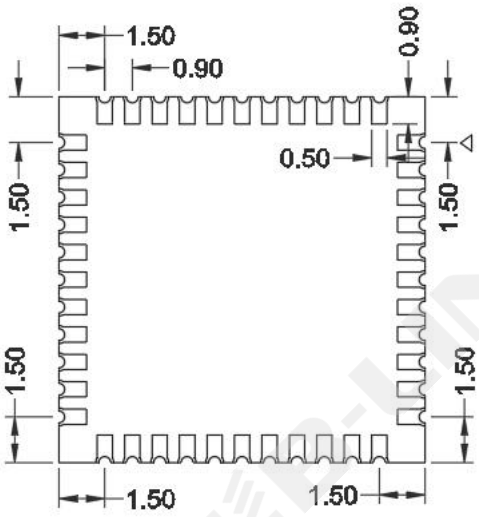


Module Bow and Twist: ≤0.1mm

5.2 Mechanical Dimensions



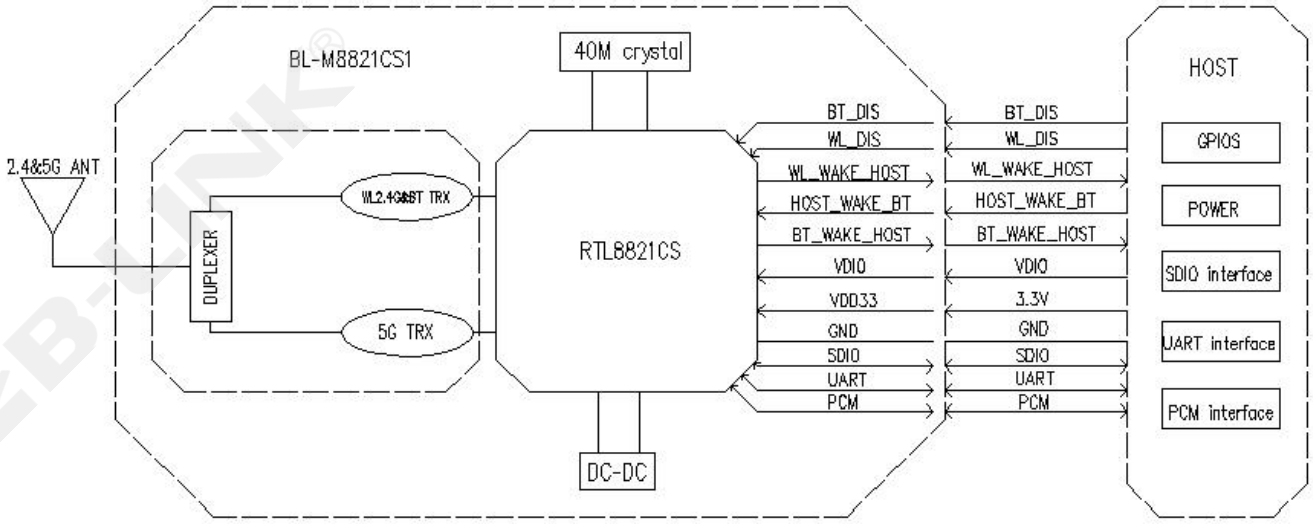
(Top View)



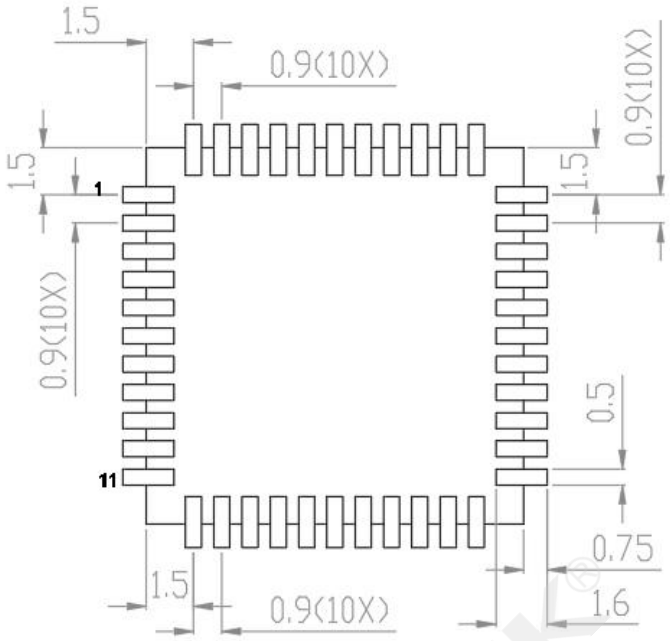
(Bottom View)

6.Application Information

6.1 Typical Application Circuit

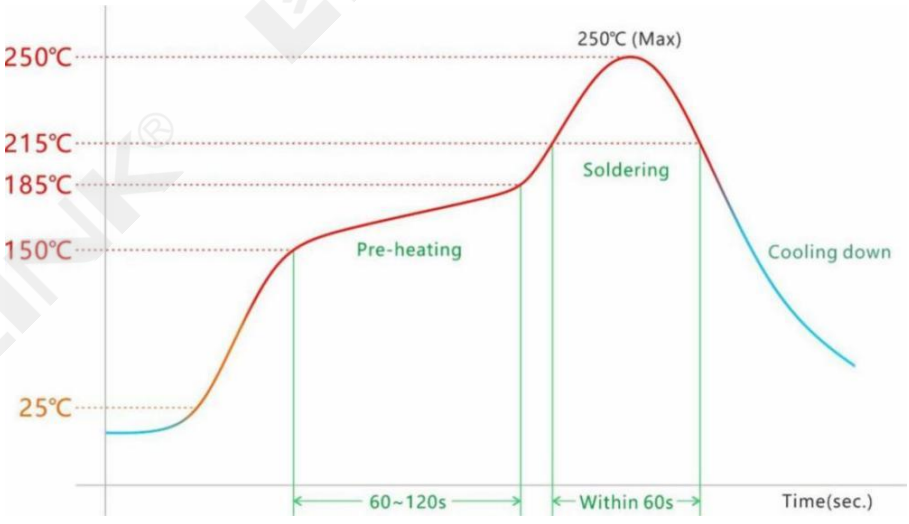


6.2 Recommend PCB Layout Footprint



(Design Unit: mm)

6.3 Reflow Soldering Standard Condition



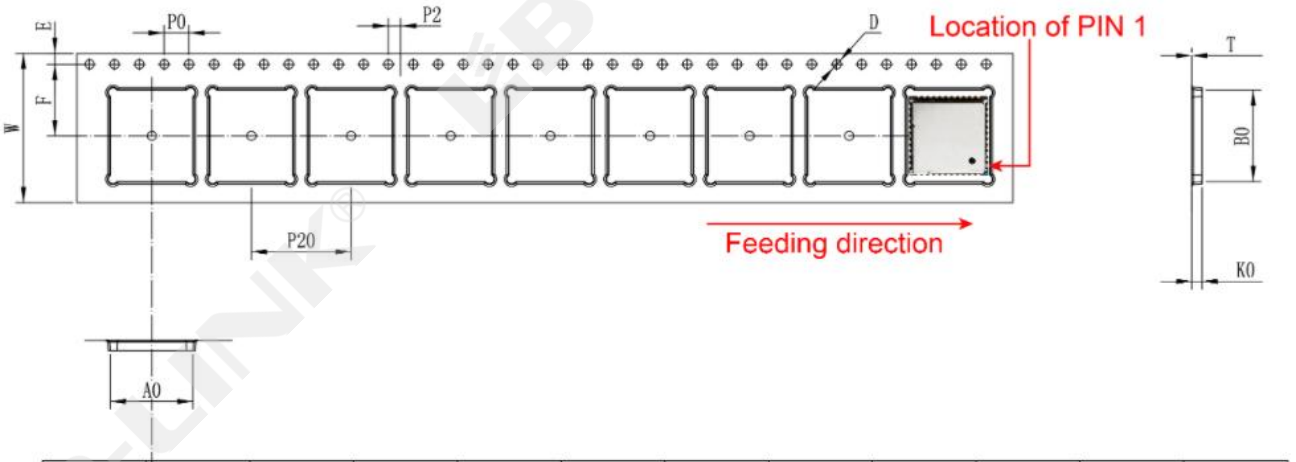
Please use the reflow within 2 times.
Set up the highest temperature within 250℃.

7.Key Components Of Module

No.	Parts	Specification	Manufacturer	Note
1	Chipset	RTL8821CS-CG	Realtek Semiconductor Corp.	
2	PCB	BL-M8821CS1	ShenZhen Tie Fa Technology Limited	
			Quzhou Sunlord Electronics Co.,Ltd	
			SHEN ZHEN QILI ELECTRON CO.,LTD	
3	Crystal	40MHz-2016	HOSONIC ELECTRONIC CO.,LTD	
			SHENZHEN KAIYUEXIANG ELECTRONICS CO.,LTD	
			Chengde oscillator Electronic Technology CO.,LTD	
4	Diplexer	DP1005	Advanced Ceramic X Corp.	
			Dongguan Hekang Electronics 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	12.40±0.1	12.40±0.1	2.90±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、 1,000 modules per roll and 5,000 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 28mm (with a width of 24mm 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 5 boxes.

4.3 Storage Conditions

Absolute Maximum Ratings:
Storage temperature: -40℃ to +85℃,
Storage humidity: 10% to 95 (Non-Condensing)
Recommended Storage Conditions:
Storage temperature: 5℃ to +40℃,
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℃, 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