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BL-M8822CS5

IEEE 802.11 a/b/g/n/ac 2T2R SDIO WIFI Module
Integrated Bluetooth 2.1/3.0/4.2/5.0

特性 Features：

- **接收制式 Supported WLAN Standard**
  IEEE Std. 802.11b
  IEEE Std. 802.11g
  IEEE Std. 802.11n
  IEEE Std. 802.11a
  IEEE Std. 802.11ac
  Bluetooth 2.1/3.0/4.2/5.0
- **芯片方案 Chip Solution**
  Realtek：RTL8822CS-VS-CG
- **结构大小 Size**
  13.0mmx 15.0mm x 1.8mm

型号	安装方式	支持标准	速率	频段	天线接口	备注
BL-M8822CS5	SMD	IEEE802.11 a/b/g/n/ac	866.7Mbps	2.4G/5G	外置天线	3.3V 供电
		BT 2.1/3.0/4.2/5.0	3 Mbps	2.4G		

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ADD：Shenzhen Guangming sightseeing road Huaqiang Creative Industry Park A1 building 11 floor

公司：深圳市必联电子有限公司

Factory：Shenzhen BILIAN Electronics Co., Ltd.

批准 Approved	审核 Checked	拟制 Designed	产品 Product	无线模块 WiFi Module
			型号 Model	**BL-M8822CS5**
			日期 Date	**2020-03-23**

更改记录 Record of Modification

版本 Version	更改日期 Date of modification	主要更改内容 Main content of modification	更改原因 Reason of modification	更改通知编号 Serial number of modification	确认 Confirm
V0.1	2020.03.23	初版			黄伟

1. Introduction

BL-M8822CS5 module design is based on RTL8822CS-VS-CG solution, The Realtek RTL8822CS-VS-CG is a highly integrated single-chip that support 2-stream 802.11ac solutions with Multi-user MIMO(Multiple-Input, Multiple-Output) with integrated Bluetooth 2.1/3.0/4.2/5.0 controller,SDIO (SDIO 1.1/2.0/3.0) interface, and HS-UART mixed interface. It combines a WLAN MAC, a 2T2R capable WLAN baseband, and RF in s single chip. The RTL8822CS-VS-CG provides a complete solution for a high-performance integrated wireless and Bluetooth device.

1.1 RF module Overview

The general HW architecture for the module is shown in Figure 1.

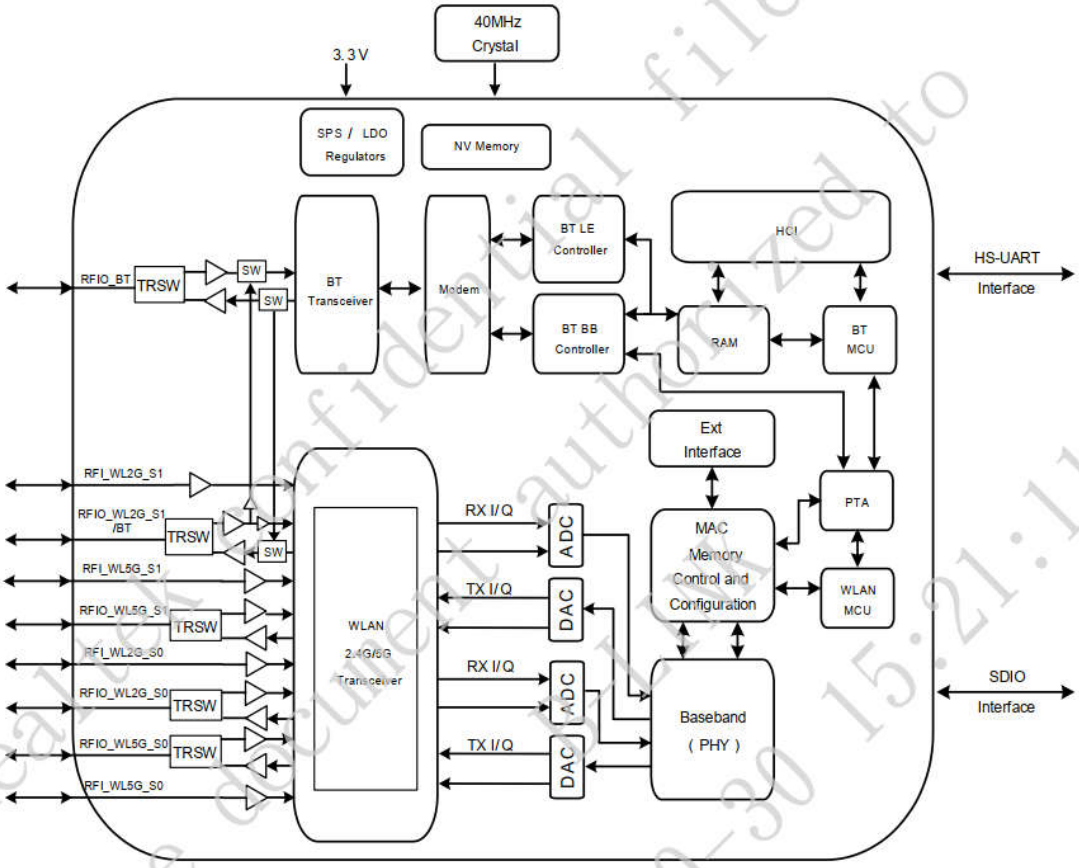


Figure 1. Dual-Band MIMO 2x2 Solution (11ac 2x2 MAC/BB/RF + PA) and Integrated Bluetooth Controller Solution --- RTL8822CS-VS-CG

Figure 1

1.2 Specification reference

This specification is based on additional references listed below.

_ IEEE Std. 802.11b
_ IEEE Std. 802.11g
_ IEEE Std. 802.11n
_ IEEE Std. 802.11a
_ IEEE Std. 802.11ac
_ BT 2.1/3.0/4.2/5.0

1.3 System Functions

Table1: General Specification as below:

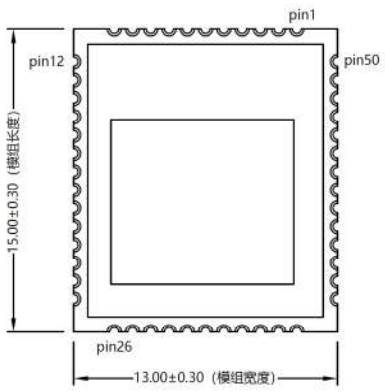
Main Chipset	RTL8822CS-VS-CG
Operating Frequency	2.4G/5G
WIFI Standard	802.11a/b/g/n/ac (2x2)
Bluetooth	2.1/3.0/4.2/5.0
Modulation	WIFI:11b: DBPSK, DQPSK and CCK and DSSS 11a/g: BPSK, QPSK, 16QAM, 64QAM and OFDM 11n: BPSK, QPSK, 16QAM, 64QAM and OFDM 11ac：BPSK, QPSK, 16QAM, 64QAM,256QAM and OFDM BT:FSHH,GFSK,DPSK,DQPSK
Data rates	11b: 1, 2, 5.5 and 11Mbps 11g: 6, 9, 12, 18, 24, 36, 48 and 54 Mbps 11n: MCS0~15, up to 300Mbps 11ac:MCS0~9,Nss=2,up to 866.7Mbps BT2.0:up to 3Mbps BT4.2: up to 1Mbps BT5.0: up to 2Mbps
Form factor	50pins
Host Interface	SDIO/UART/PCM
PCB Stack	4-layers design
Dimension	Typical，13.0mmx 15.0mm x 1.8mm
Antenna	External Antennas Design
Operation Temperature	-10℃ to +70℃
Storage Temperature	-10℃ to +125℃
Operation Voltage	3.0V~3.6V

2. Mechanical Specification

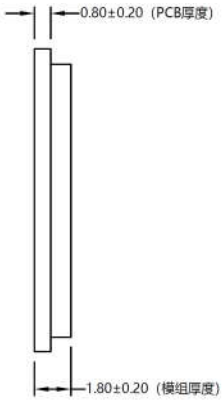
2.1 Mechanical Outline Drawing

Typical Dimension (W x L): 13.0mmx 15.0mm x 1.8mm

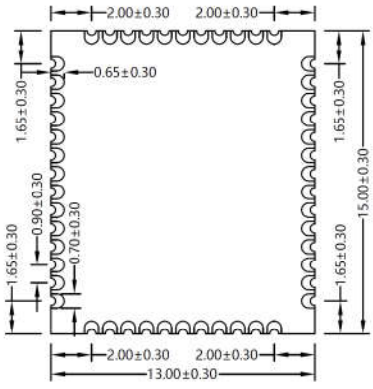
General tolerance: ±0.2mm；



主视图



侧视图



背视图

2.2 Pin define：（引脚对应正面视图）

Pin	Define	Description	Pin	Define	Description
1	GND	GND	26	Not connect	Not connect
2	S1	WIFI ANTB/BT ANT	27	PCM_SYNC	PCM Synchronization control, shared with GPIO2
3	GND	GND	28	PCM_IN	PCM data Input, shared with GPIO0
4	GND	GND	29	PCM_OUT	PCM data Out, shared with GPIO1
5	GND	GND	30	PCM_CLK	PCM Clock, shared with GPIO3
6	GND	GND	31	SUSCLK	Shared with EECS. External 32K or RTC clock input
7	GND	GND	32	GND	GND
8	GND	GND	33	Not connect	Not connect
9	S0	WIFI ANTA	34	VDD_GPIO	3.3V/1.8V Supply for GPIO(3.3V Recommended First)
10	GND	GND	35	Not connect	Not connect
11	GND	GND	36	VDD_3.3V	VDD INPUT(3.3V)
12	BT_RF	NC	37	Not Connect	Not Connect
13	GPIO6	Debug，Not Connect	38	BT_DIS_N	Shared with GPIO11. This pin can externally shut down the RTL8822CS-VS-CG 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
14	G_BT	Debug，Not Connect	39	GND	GND
15	WL_DIS_N	Shared with GPIO15. This pin can be defined as the WLAN Radio-off function with host interface remaining connected. When this pin is pulled low, WLAN Radio will be disabled	40	UART_TX	High-Speed UART Data Out
16	SD_WAKE	SDIO WAKE	41	UART_RX	High-Speed UART Data In
17	SD_CMD	SDIO Command Input	42	UART_RTS	UART_RTS
18	SD_CLK	SDIO Clock Input	43	UART_CTS	High-Speed UART CTS
19	SD_D3	SDIO Data Line 3	44	SD_RESET	SDIO RESET
20	SD_D2	SDIO Data Line 2	45	G_WL	Debug，Not Connect
21	SD_D0	SDIO Data Line 0	46	GND	GND
22	SD_D1	SDIO Data Line 1	47	Not Connect	Not Connect
23	GND	GND	48	GND	GND
24	SD_WAKE	SD_WAKE	49	BT_WAKE	BT WAKE
25	GPIO7	Debug，Not Connect	50	UART_WAKE	UART WAKE

2.3 SDIO Bus Speed Mode Choose：

Bus Speed Mode*1	Max. Bus Speed [MB/s]	Max. Clock Frequency [MHz]	Signal Voltage [V]	Max. Current*2 [mA/3.6V VDD]		
				SDSC*3	SDHC*4	SDXC*5
SDR104	104	208	1.8	-	800*6	800*6
SDR50	50	100	1.8	-	400	400
DDR50	50	50	1.8	-	400	400
SDR25	25	50	1.8	-	200	200
SDR12	12.5	25	1.8	-	100	100/150*7
High Speed	25	50	3.3	200	200	200
Default Speed	12.5	25	3.3	100	100	100/150*7

2.4 Product Picture

TOP VIEW

BOTTOM VIEW

丝印说明：

1、 红色框内字符为PIN1脚标识；

2、 其余字符为PCB厂家管控字符；

3. Electrical Specification

This Specification is based-on conductive DVT testing result. The extreme condition include overall temperature (0℃,+25℃,+40℃) and overall voltage (3.0V,3.3V,3.6V).

3. 1 IEEE 802.11g /a Section:

Items	Contents				
Specification	IEEE802.11g & IEEE802.11a				
Mode	BPSK, QPSK, 16QAM, 64QAM and OFDM				
Channel	CH1 to CH13 @ 11g CH36 to CH165 @ 11a				
Data rate	6, 9, 12, 18, 24, 36, 48, 54Mbps				
TX Characteristics	Min.	Typ.	Max.	Unit	Remark
1. Power Levels					
1) 18dBm Target (For Each antenna port) @ 11g 54M	16.5	18	19.5	dBm	
2) 17dBm Target (For Each antenna port) @ 11a 54M	15.5	17	18.5	dBm	
2. Spectrum Mask @ Target Power					
1) at fc +/-11MHz	-	-	-20	dBr	
2) at fc +/-20MHz	-	-	-28	dBr	
3) at fc > +/-30MHz	-	-	-40	dBr	
3. Constellation Error(EVM) @ Target Power					
1) 6Mbps	-	-30	-5	dB	
2) 9Mbps	-	-	-8	dB	
3) 12Mbps	-	-	-10	dB	
4) 18Mbps	-	-	-13	dB	
5) 24Mbps	-	-	-16	dB	
6) 36Mbps	-	-	-19	dB	
7) 48Mbps	-	-	-22	dB	
8) 54Mbps	-	-37	-25	dB	
4. Frequency Error					
1) IEEE802.11g	-10	-	10	ppm	
2) IEEE802.11a	-10		10	ppm	
RX Characteristics	Min.	Typ.	Max.	Unit	
5. Minimum Input Level Sensitivity(each chain)					
1) 6Mbps (PER ≦10%)	-	-93	-90	dBm	
2) 9Mbps (PER ≦10%)	-	-	-89	dBm	
3) 12Mbps (PER ≦10%)	-	-	-87	dBm	
4) 18Mbps (PER ≦10%)	-	-	-84	dBm	
5) 24Mbps (PER ≦10%)	-	-	-81	dBm	
6) 36Mbps (PER ≦10%)	-	-	-78	dBm	
7) 48Mbps (PER ≦10%)	-	-	-74	dBm	
8) 54Mbps (PER ≦10%)	-	-76	-73	dBm	
6. Maximum Input Level (PER ≦10%)					
1) IEEE802.11g	-20	-2	-	dBm	
2) IEEE802.11a	-20	-2		dBm	

3.2 IEEE 802.11b Section:

Items	Contents				
Specification	IEEE802.11b				
Mode	DBPSK, DQPSK and CCK and DSSS				
Channel	CH1 to CH13				
Data rate	1, 2, 5.5, 11Mbps				
TX Characteristics	Min.	Typ.	Max.	Unit	Remark
1. Power Levels(Calibrated)					
1) 19dBm Target (For Each antenna port) @1Mbps~11Mbps	17.5	19	20.5	dBm	
2. Spectrum Mask @ Target Power					
1) fc +/-11MHz to +/-22MHz	-	-	-30	dBr	
2) fc > +/-22MHz	-	-	-50	dBr	
3. Constellation Error(EVM) @ Target Power					
1) 1Mbps	-	-23	-10	dB	
2) 2Mbps	-	-23	-10	dB	
3) 5.5Mbps	-	-23	-10	dB	
4) 11Mbps	-	-23	-10	dB	
4. Frequency Error	-10	-	10	ppm	
RX Characteristics	Min.	Typ.	Max.	Unit	
5. Minimum Input Level Sensitivity(each chain)					
1) 1Mbps (FER ≦8%)	-	-94	-91	dBm	
2) 2Mbps (FER ≦8%)	-	-	-88	dBm	
3) 5.5Mbps (FER ≦8%)	-	-	-87	dBm	
4) 11Mbps (FER ≦8%)	-	-89	-86	dBm	
6. Maximum Input Level (FER ≦8%)	-10	10	-	dBm	

3.3 IEEE 802.11n HT20 Section:

Items	Contents				
Specification	IEEE802.11n HT20 @ 2.4G/5G				
Mode	BPSK, QPSK, 16QAM, 64QAM and OFDM				
Channel	CH1 to CH13 @ 2.4G CH36 to CH165 @ 5G				
Data rate (MCS index)	MCS0/1/2/3/4/5/6/7/8/9/10/11/12/13/14/15				
TX Characteristics	Min.	Typ.	Max.	Unit	Remark
1. Power Levels					
1) 14dBm Target (For Each antenna port) @ 2.4G/MCS7	15.5	17	18.5	dBm	
2) 13dBm Target (For Each antenna port) @ 5G/ MCS7	14.5	16	17.5	dBm	
2. Spectrum Mask @ Target Power					
1) at fc +/-11MHz	-	-	-20	dBr	
2) at fc +/-20MHz	-	-	-28	dBr	
3) at fc > +/-30MHz	-	-	-45	dBr	
3. Constellation Error(EVM) @ Target Power					
1) MCS0	-	-30	-5	dB	
2) MCS1	-	-	-10	dB	
3) MCS2	-	-	-13	dB	
4) MCS3	-	-	-16	dB	
5) MCS4	-	-	-19	dB	
6) MCS5	-	-	-22	dB	
7) MCS6	-	-	-25	dB	
8) MCS7	-	-37	-28	dB	
4. Frequency Error					
1) IEEE802.11n HT20 @ 2.4G/5G	-10	-	10	ppm	
RX Characteristics	Min.	Typ.	Max.	Unit	
5. Minimum Input Level Sensitivity(each chain)					
1) MCS0 (PER ≦10%)	-	-93	-90	dBm	
2) MCS1 (PER ≦10%)	-	-	-85	dBm	
3) MCS2 (PER ≦10%)	-	-	-83	dBm	
4) MCS3 (PER ≦10%)	-	-	-77	dBm	
5) MCS4 (PER ≦10%)	-	-	-72	dBm	
6) MCS5 (PER ≦10%)	-	-	-71	dBm	
7) MCS6 (PER ≦10%)	-	-	-70	dBm	
8) MCS7 (PER ≦10%)	-	-72	-69	dBm	
6. Maximum Input Level (PER ≦10%)					
1) IEEE802.11n HT20 @ 2.4G/5G	-20	-2	-	dBm	

3.3 IEEE 802.11n HT40 Section:

Items	Contents				
Specification	IEEE802.11n HT40 @ 2.4G/5G				
Mode	BPSK, QPSK, 16QAM, 64QAM and OFDM				
Channel	CH3 to CH11 @ 2.4G CH38 to CH163 @ 5G				
Data rate (MCS index)	MCS0/1/2/3/4/5/6/7/8/9/10/11/12/13/14/15				
TX Characteristics	Min.	Typ.	Max.	Unit	Remark
1. Power Levels					
1) 14dBm Target (For Each antenna port) @ 2.4G/MCS7	15.5	17	18.5	dBm	
2) 13dBm Target (For Each antenna port) @ 5G/MCS7	14.5	16	17.5	dBm	
2. Spectrum Mask @ Target Power					
1) at fc +/-11MHz	-	-	-20	dBr	
2) at fc +/-20MHz	-	-	-28	dBr	
3) at fc > +/-30MHz	-	-	-45	dBr	
3. Constellation Error(EVM) @ Target Power					
1) MCS0	-	-30	-8	dB	
2) MCS1	-	-	-13	dB	
3) MCS2	-	-	-16	dB	
4) MCS3	-	-	-19	dB	
5) MCS4	-	-	-22	dB	
6) MCS5	-	-	-25	dB	
7) MCS6	-	-	-28	dB	
8) MCS7	-	-37	-30	dB	
4. Frequency Error					
1) IEEE802.11n HT40 @ 2.4G/5G	-10	-	10	ppm	
RX Characteristics	Min.	Typ.	Max.	Unit	
5. Minimum Input Level Sensitivity(each chain)					
1) MCS0 (PER ≦10%)	-	-90	-87	dBm	
2) MCS1 (PER ≦10%)	-	-	-82	dBm	
3) MCS2 (PER ≦10%)	-	-	-80	dBm	
4) MCS3 (PER ≦10%)	-	-	-76	dBm	
5) MCS4 (PER ≦10%)	-	-	-72	dBm	
6) MCS5 (PER ≦10%)	-	-	-71	dBm	
7) MCS6 (PER ≦10%)	-	-	-69	dBm	
8) MCS7 (PER ≦10%)	-	-71	-68	dBm	
6. Maximum Input Level (PER ≦10%)					
1) IEEE802.11n HT40 @ 2.4G/5G	-20	-6	-	dBm	

3.4 IEEE 802.11 ac Section:

Items	Contents								
Specification	IEEE802.11ac								
Mode	BPSK, QPSK, 16QAM, 64QAM ,256QAM and OFDM								
Channel	CH36 to CH165 VHT20 CH38 to CH163 VHT40 CH42 to CH157 VHT80								
Data rate (MCS index)	MCS0/1/2/3/4/5/6/7/8/9								
TX Characteristics	Min.	Typ.			Max.			Unit	Remark
1. Power Levels (Calibrated)									
1) 13dBm Target (For Each antenna port) @VHT20/VHT40/VHT80 MCS9	13.5	15			16.5			dBm	
2. Spectrum Mask @ Target Power									
1) at fc +/-11MHz /20MHz/30MHz	-	-			-20			dBr	
2) at fc +/-21MHz /40MHz/60MHz	-	-			-28			dBr	
3) at fc +/-41MHz /80MHz/120MHz	-	-			-40			dBr	
3. Constellation Error(EVM) @ Target Power									
1) MCS0	-	-			-8			dB	
2) MCS1	-	-			-13			dB	
3) MCS2	-	-			-16			dB	
4) MCS3	-	-			-19			dB	
5) MCS4	-	-			-22			dB	
6) MCS5	-	-			-25			dB	
7) MCS6	-	-			-28			dB	
8) MCS7	-	-			-30			dB	
9) MCS8					-32			dB	
10) MCS9		-36			-33			dB	
4. Frequency Error	-10	-			10			ppm	
RX Characteristics	Min.	Typ.			Max.			Unit	
5. Minimum Input Level Sensitivity(each chain)		VHT 20	VHT 40	VHT 80	VHT 20	VHT 40	VHT 80		
1) MCS0 (PER ≦10%)	-	-92	-90	-87	-89	-87	-84	dBm	
2) MCS1 (PER ≦10%)	-	-	-	-	-84	-85	-79	dBm	
3) MCS2 (PER ≦10%)	-	-	-	-	-82	-79	-77	dBm	
4) MCS3 (PER ≦10%)	-	-	-	-	-78	-76	-73	dBm	
5) MCS4 (PER ≦10%)	-	-	-	-	-75	-72	-69	dBm	
6) MCS5 (PER ≦10%)	-	-	-	-	-70	-70	-65	dBm	
7) MCS6 (PER ≦10%)	-	-	-	-	-69	-68	-64	dBm	
8) MCS7 (PER ≦10%)	-	-	-	-	-68	-66	-63	dBm	
9) MCS8 (PER ≦10%)	-	-	-	-	-67	-63	-61	dBm	
10) MCS9 (PER ≦10%)	-	-69	-64	-61	-66	-61	-58	dBm	
6. Maximum Input Level(PER ≦10%)	-30	-2	-2	-2	-			dBm	

3.5 Bluetooth Specification

3.5.1 BR Specification

Items	Contents				
Host Interface	UART				
Antenna Reference	Small antennas with 0~2 dBi peak gain				
Channel	CH0 to CH78				
Modulation	GFSK				
	Min.	Typ.	Max.	Unit	
TX Characteristics					
1.Output Average Power	-3		6	dBm	
2.Modulation Characteristics					
1)Delta f1(Avg)		157		kHz	
2)Delta f2max(For at least 99.9% of all Delta f2max)		121		kHz	
3)Delta f2/ Delta f1		0.85		kHz	
3.Initial Carrier Frequency Tolerance		+/-20	-	kHz	
4. Carrier Frequency Drift					
1) One Slot packet drift (DH1)		+/-15		kHz	
2) Three Slot packet drift (DH3)		+/-15		kHz	
3) Five Slot packet drift (DH5)		+/-15		kHz	
4) Max Drift Rate		+/-15		kHz/50us	
RX Characteristics					
1. Receiver Sensitivity (BER<0.1%)		-92		dBm	
2. Maximum usable signal (BER<0.1%)		-5		dBm	

3.5.2 EDR Specification

Items	Contents				
Host Interface	UART				
Antenna Reference	Small antennas with 0~2 dBi peak gain				
Channel	CH0 to CH78				
Modulation	π/4-DQPSK 、8PSK				
	Min.	Typ.	Max.	Unit	
TX Characteristics	-3		6		
1.Relative Transmit Power					
1) π/4-DQPSK		-1.5		dBm	
2) 8PSK		-1.5		dBm	
2. Frequency Stability				kHz	
1) Omega-i		+/-4		kHz	
2) Omega-0		+/-4	-	kHz	
3) Omega-0 + Omega-i		+/-4			
3. Modulation Accuracy					
1) RMS DEVM					
π/4-DQPSK		+/-9		%	
8PSK		+/-9		%	
2) Peak DEVM					
π/4-DQPSK		+/-28		%	
8PSK		+/-21		%	
3) 99% DEVM					
π/4-DQPSK		+/-15		%	
8PSK		+/-12		%	
RX Characteristics					
1. Receiver Sensitivity (BER<0.01%)					
1) π/4-DQPSK		-91		dBm	
2) 8PSK		-85		dBm	
2. Maximum usable signal (BER<0.1%)					
1) π/4-DQPSK		-5		dBm	
2) 8PSK		-5		dBm	

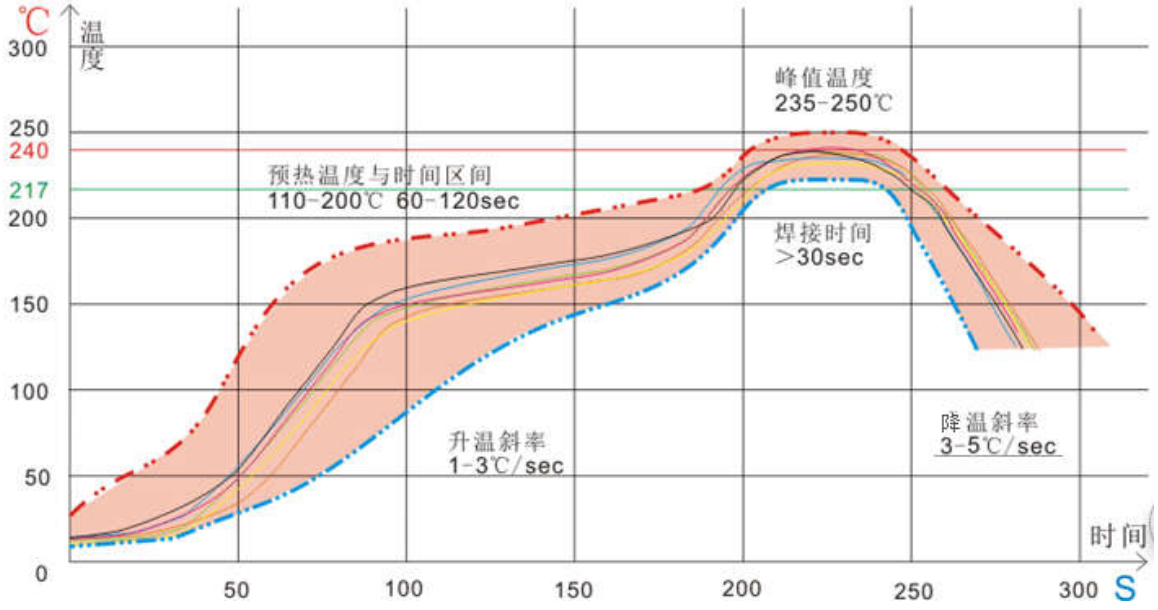
3.5.3 LE Specification

Items	Contents				
Host Interface	UART				
Antenna Reference	Small antennas with 0~2 dBi peak gain				
Channel	CH0 to CH39				
	Min.	Typ.	Max.	Unit	
TX Characteristics					
1. Output power at NOC	-3		6	dBm	
2. Modulation Characteristics					
1)Delta f1(Avg)	225		275	kHz	
2)Delta f2max(For at least 99.9% of all Delta f2max)	185			kHz	
3)Delta f2/ Delta f1	0.8	0.94		Hz/Hz	
3. Carrier frequency offset and drift					
1) Frequency Offset	-150		150	kHz	
2) Frequency Drift	-50		50	kHz	
3) Max Drift Rate	-20		20	Hz/us	
4.In-band Spurious Emissions					
1)+/-2M offset			-20	dBm	
2)>+/-3MHz offset			-30	dBm	
RX Characteristics					
1. Receiver Sensitivity (BER<30.8%)		-95		dBm	
2. Maximum usable signal (BER<30.8%)		-5		dBm	

4. Software Requirements

The driver supports the following operating systems: Linux, Microsoft Windows XP, Vista and Win7.
Mfg. software tool. software tool version is XP_MP_Kit_RTL11ac_8822CS_SDIO_v0.21 or later.

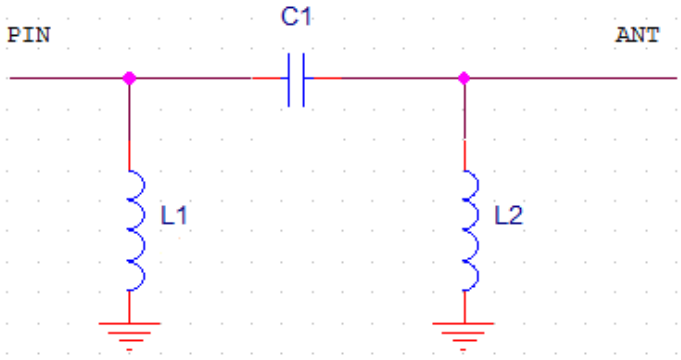
5. Refelow Standard Condition



升　温　区：温度：**<150**℃，时间：**60**～**90** 秒之间，斜率控制在 **1**～**3**℃**/S** 之间。
预热恒温区：温度：**150**℃～**200**℃，时间：**60-120** 秒之间，斜率在 **0.3-0.8** 之间。
回流焊接区：峰值温度 **235**℃**~250**℃**(**建议峰值温度＜**245**℃**)**，时间 **30-70** 秒。
冷　却　区：温度：**217**℃**~170**℃，斜率在 **3**～**5**℃**/S** 之间。
焊料为锡银铜合金无铅焊料**/ Sn&Ag&Cu Lead-free solder(SAC305)**。

6. Antenna matching

The 2th and 9th Pin connect to antenna, please refer to design demand

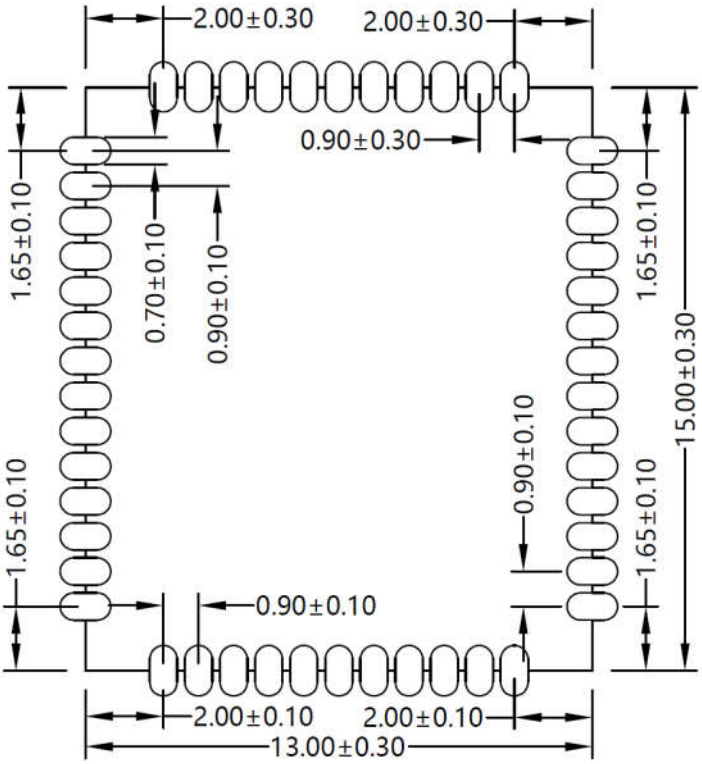


a). 模块和天线要求远离干扰源，模块地和天线地要求为一个整体。
b). PIN2和PIN9为WIFI模组的RF接口，与天线之间布线要求共面阻抗为50Ω，建议使用弧线和直线，长度尽可能短。
c). L1, L2, C1 组成π型匹配网络并靠近天线接口设计，具体根据天线推荐及排版设计的实测效果进行调整。

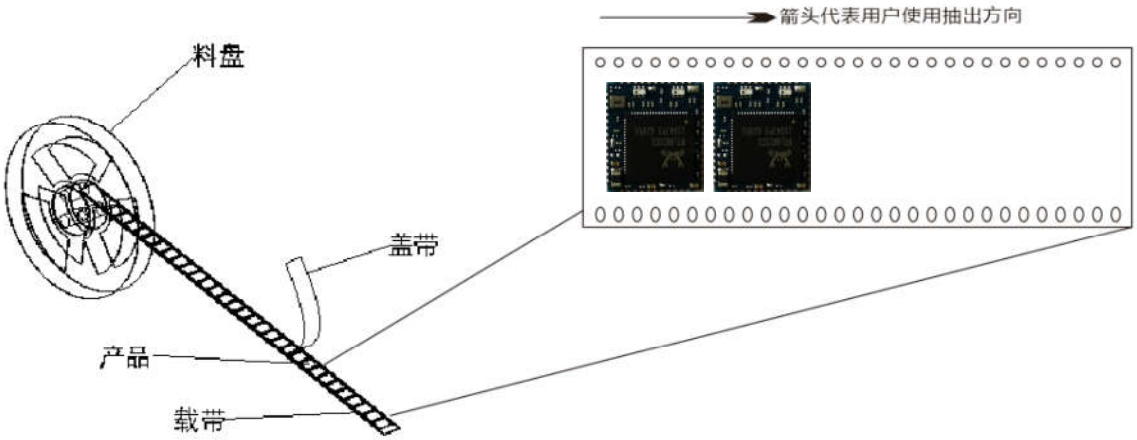
7. Key component List

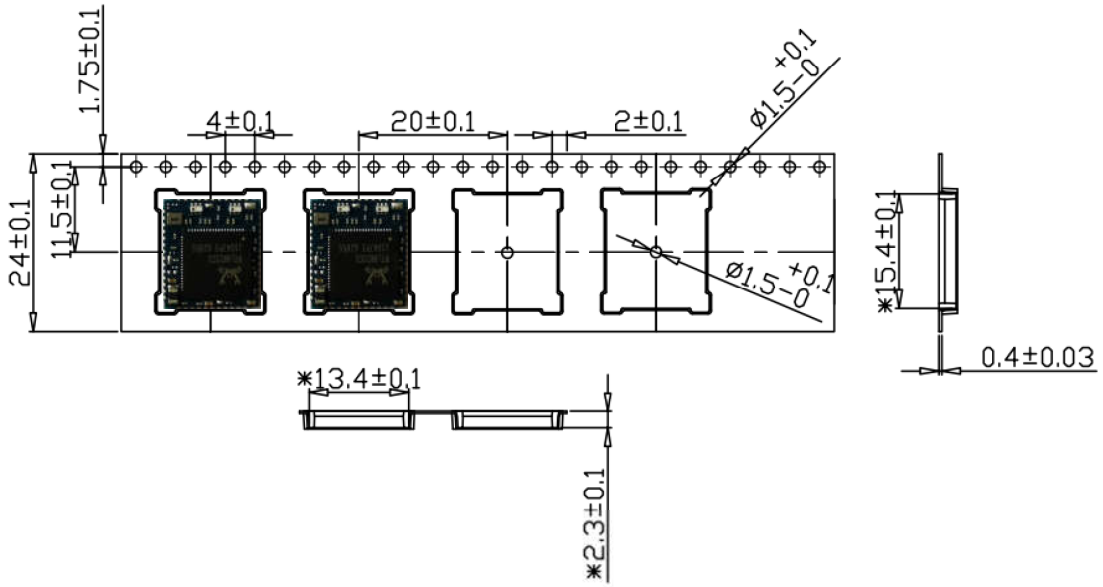
序号	关键件名称	型号	规格/材料	生产者	备注
1	集成电路	RTL8822CS-VS-CG		REALTEK	
2	PCB	JUI7.820.0398系列	FR-4,4LAY，0.8mm	昌盛亿龙 顺　　络 英创力 信利 科翔	
3	晶体振荡器		2016 40M	TXC Hosonic 加高 晶威特	
4	双工器		1608	ACX 顺络 TDK 华新科 村田 佳利	

8、Recommend PCB Layout Decal



9.Package








1、产品放置方向、标签粘贴位置、包装按示意图进行；
2、每卷放1300只产品，每小盒放1卷，大箱共8装个小盒，产品数量共10400只/箱;
3、外箱尺寸：370mm*300mm*370mm，小盒尺寸：355mm*355mm*55mm;
4、真空包内放置2g干燥剂2袋，6色湿度卡1张;
5、其它未尽事宜按客户的包装要求执行。