ShenZhen World Elite Electronic Co.,LTD.

WB-8815R1

(REV:0.5)

2.4-GHz Bluetooth ® Multi-Standard Wireless Soc Module

1 Introduction

The WB-8815R1 Module supports standards and industrial alliance specifications including Bluetooth 5.2,Basic data rate (BR), Enhanced data rate (EDR),LE, indoor positioning and BLE Mesh standard.

The WB-8815R1 Module combines the features and functions needed for high quality wireless audio equipments into a

single SoC.

1.1 Key Features

General Features

General features are as follows:

1. Support unique ID (UID)
2. 32-bit RISC-V micro-controller

• Better power-balanced performance than ARM M4

• Instruction and Data cache controller

• Maximum running speed up to 96 MHz

• Integrated DSP extensions instructions

• Integrated "F" standard extensions for single-precision floating-point

3. Memory architecture

• Program memory: up to 1 MB Flash

• Up to 256 KB SRAM including up to 64 KB retention SRAM

4. RTC and other timers

• Clock source: 24 MHz/32.768 kHz Crystal and 32 kHz/24 MHz embedded RC oscillator

• Three general 32-bit timers with four selectable modes in active mode

• Watchdog timer

• A low-frequency 32 kHz timer available in low power mode

5. A rich set of digital and analog interfaces

• Up to 28 GPIOs

• Configurable to select 2-wire SDP or 5-wire JTAG debug interface

• Dual DMIC (Digital Mic)

• Support AMIC (Analog Mic), 24 bit 192 kHz I2S

• Stereo audio codec

• SPI, I2C, USB 2.0, Swire, UART with hardware flow control

• Up to 6 channels of differential PWM

• IR transmitter with DMA

• 2-channel (only GPIO input), 14-bit Auxiliary ADC

• Low power comparator

6. Embedded hardware AES and AES-CCM

7. Embedded hardware acceleration for Elliptical curve cryptography (ECC)

8. Embedded Random Number Generator (TRNG)

9. Hardware OTA upgrade and multiple boot switch, allowing convenient product feature roll outs and

upgrades

10. Operating temperature range: -40°C~+85°C

11. Completely RoHS-compliant package

• TLSR9515H, 56-pin QFN 7x7mm

12. Supports Bluetooth 5.2, BLE Mesh

RF Features

RF features include:

1. Bluetooth RF transceiver in worldwide 2.4 GHz ISM band

2. Bluetooth Compliant, BR, EDR 2 Mbps and 3 Mbps,BLE 1 Mbps and 2 Mbps, Long Range 125 kbps and 500

kbps,250 kbps

3. Rx Sensitivity: -92 dBm @ BR mode, -92.5 dBm @ EDR 2 Mbps mode, -86 dBm @ EDR 3 Mbps mode,-96

dBm@BLE 1 Mbps, -92.5 dBm @ BLE 2 Mbps mode, -99.5 dBm @ Long Range 125 kbps, -98.5 dBm @

Long Range 500 kbpsTx output power: up to +10 dBm @ BR/BLE mode, +1.5 dBm @ EDR mode

4. 50 Ω matched single-pin antenna input

5. RSSI monitoring with +/-1 dB resolution

6. Auto acknowledgment, retransmission and flow control

7. Support PTA (Packet Traffic Arbitrator) for Wi-Fi co-existence

Features of Power Management Module

Features of power management module include:

1. Power supply

• VBAT (battery): 1.8 V~4.3 V

2. Battery monitor for low battery voltage detection

3. Brownout detection/shutoff and Power-On-Reset

4. Multiple-power-state to optimize power consumption

5. Supports USB BC1.2 Battery Charging

6. Power consumption:

• Whole Chip, RX EDR mode: 5 mA @ 4.2 V DCDC

• Whole Chip, TX EDR mode: 13 mA @ 0 dBm, 4.2 V DCDC

• Whole Chip, BLE RX mode: 5 mA @ 4.2 V DCDC

• Whole Chip, BLE TX mode, 5.5 mA @ 0 dBm, 4.2V DCDC

• Deep sleep with external wakeup (without SRAM retention): 0.7 µA

• Deep sleep with 32K SRAM retention: 1.7 µA

Bluetooth Features

Bluetooth features include:

1. Bluetooth support with BR, EDR, and BLE

2. Long range support with 125 kbps and 500 kbps data rate

3. Bluetooth SIG Mesh support

4. Bluetooth based location and indoor positioning support

5. Bluetooth ISO channel support (a.k.a Bluetooth 5.2) with broadcast and unicast mode

Wireless Audio Features

Wireless audio features include:

1. High performance Stereo Audio Codec with SNR over 96dB and sampling rate up to 192 kHz

2. 24-bit ADC/DAC for Codec

3. Telink-patented technology for true wireless stereo and 1+N hearable devices with synchronized playback

and balanced power on all devices

4. Support audio codec for SBC, OPUS, LC3

5. Support voice codec such as G.711, A-Law, u-Law, CVSD, mSBC

6. Support HFP 1.7, HSP 1.2, A2DP 1.3, AVRCP 1.6, SPP 1.2, and PBAP 1.0, ANCS, DIS

7. Support Apple iAP2

8. Support EDR+BLE dual mode operation

9. Support noise suppression and echo cancellation

10. Support Packet Loss Concealment (PLC) for voice processing

Concurrent Mode Feature

In concurrent mode, the chip supports multiple standards working concurrently.
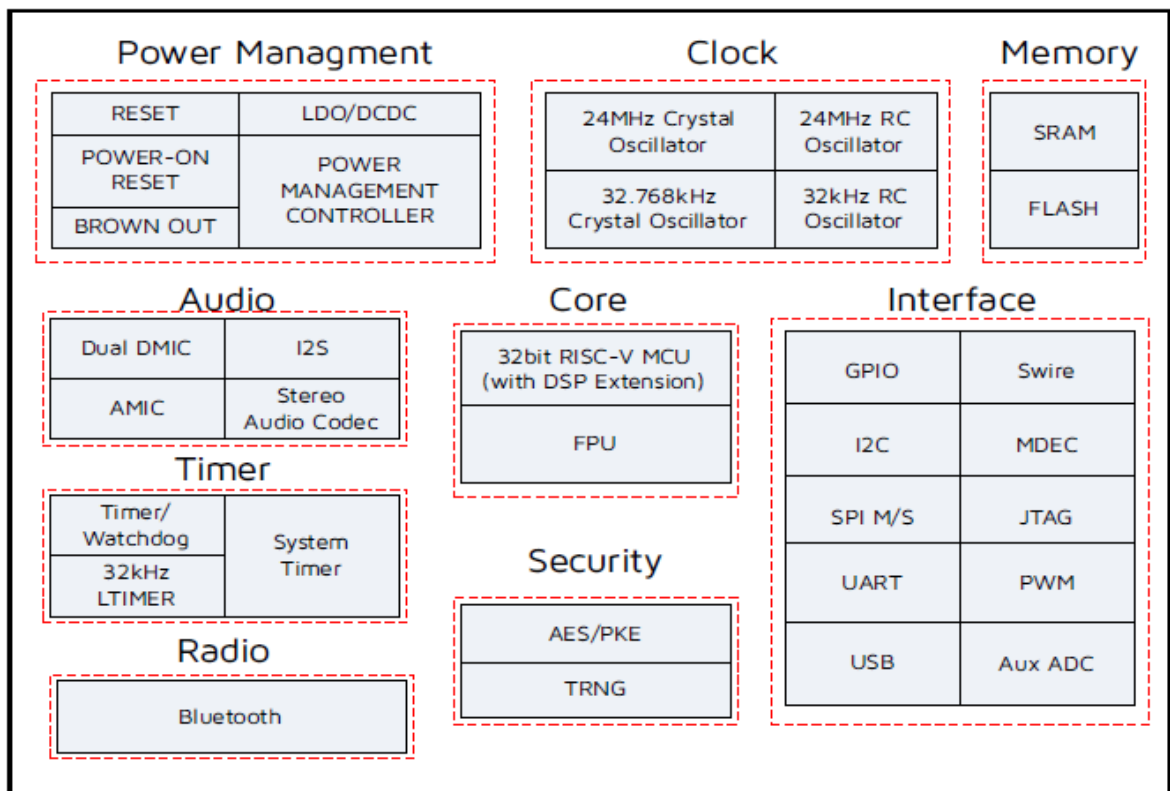
Typical Applications

The WB-8815R1 Module advanced wireless audio solutions. Its typical applications include, but are not limited to the following:

• Wearable devices

º Augmented reality glasses

º Smart watches

º Smart trackers

º Wristband

• Audio Solutions

º Wireless headsets

º Earbuds

1.2 Block Diagram

Block Diagram of the System

1.3 Key Electrical Specifications

NOTE: The electrical characteristics currently listed in this section are target specifications and only supplied
for reference. Some data may be updated according to actual test results.

1.4 Absolute Maximum Rating

Table 2-1 Absolute Maximum Rating

Characteristics	Sym.	Min.	Max.	Unit	Test Condition
Supply Voltage	VBAT	-0.3	4.3	V	-
Voltage on Input Pin	V_{in}	-0.3	VDD+0.3	V	-
Output Voltage	V_{out}	0	VDD	V	-
Storage Temperature Range	T_{Str}	-65	150		-
Soldering Temperature	T_{Sld}	-	260		-

NOTE: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the
device. This is a stress only rating and operation of the device at these or any other conditions above those
indicated in the operational sections of this specification is not implied.

1.5 Recommended Operating Conditions

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
Power Supply Voltage	VBAT	1.8	3.7	4.3	V	-
Supply Rise Time from 1.6 V to 1.8 V)	T_R	-	-	10	ms	-
Operating Temperature Range	T_{Opr}	-40	-	85	°C	-

1.6 DC Characteristics

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
RX Current	I_{Rx}	-	5	-	mA	Whole Chip, EDR mode
TX Current	I_{Tx}	-	13	-	mA	whole chip @ 0 dBm with 4.2 V DCDC, EDR mode

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
RX Current	I_{Rx}	-	5	-	mA	Whole Chip, BLE mode
TX Current	I_{Rx}	-	5.5	-	mA	Whole Chip @0 dBm, BLE mode
Deep sleep with 32kB SRAM retention	I_{Deep1}	-	1.7	-	µA	-
Deep sleep with 64kB SRAM retention		-	TBD	-	µA	-
Deep sleep without SRAM retention	I_{Deep2}	-	0.7	-	µA	-

1.7 AC Characteristics

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
Input high voltage	VIH	0.7VDD	-	VDD	V	-
Input low voltage	VIL	VSS	-	0.3VDD	V	-
Output high voltage	VOH	0.9VDD	-	VDD	V	-
Output low voltage	VOL	VSS	-	0.1VDD	V	-

NOTE:

• The data is test result of engineering sample and may verify for mass production. VDD stands for IO voltage, e.g, AVDD3, VDD3, or VDD3_DCDC, the range of the IO voltage is 1.8 V ~ 3.6 V, and typical value is 3.3V

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Data Rate	Item	Sym.	Min.	Typ.	Max.	Unit	Condition
BLE 2 Mbps RF_RX performance (±500kHz deviation)	Sensitivity	2 Mbps	-	-92.5	-	dBm	-
	Frequency Offset Tolerance	-	-300	-	300	kHz	Wanted signal at -67dBm
	Co-channel rejection	-	-	8	-	dB	-
	In-band blocking rejection (Equal Modulation Interference)	+2/-2 MHz offset	-	-7/-7	-	dB	
		+4/-4 MHz offset	-	-37/-38	-	dB	Wanted signal at -67dBm
		>=4 MHz offset	-	-44/-44	-	dB	
	Image rejection	-	-	-25	-	dB	Wanted signal at -67dBm
BLE 2 Mbps RF_TX performance	Output power, maximum setting	-	-	10	-	dBm	-
	Output power, minimum setting	-	-	-24	-	dBm	-
	Programmable output power range	-		34		dB	-
	Modulation 20dB bandwidth	-	-	2.4	-	MHz	-

USB Characteristics

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
Output Signal Cross-over Voltage	V_{Crs}	1.3	-	2.0	V	-

RSSI Characteristics

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
RSSI Range	-	-100	-	10	dBm	-
Resolution	-	-	±1	-	dB	-

24MHz Crystal Characteristics

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
Nominal frequency (parallel resonant)	f_{NOM}	-	24	-	MHz	-
Frequency tolerance	f_{TOL}	-20		+20	ppm	-
Load capacitance	C_L	5	12	18	pF	Programmable on chip load cap
Equivalent series resistance	ESR	-	50	100	ohm	-

ADC Characteristics

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
Differential nonlinearity	DNL	-	-	1	LSB	10bit resolution mode
Integral nonlinearity	INL	-	-	2	LSB	10bit resolution mode
Signal-to-noise and distortion ratio	SINAD	-	70	-	dB	fin=1 kHz, fS=16 kHz
Effective Number of Bits	ENOB	-	10.5	-	bits	-
Sampling frequency	Fs	-	-	200	ksps	-

1.8 Analog Input to Digital Output

Measurement conditions: Input sine wave with a frequency of 1kHz, measurement bandwidth 20Hz–Fs / 2 for Fs = 8 to 32 kHz, measurement bandwidth 20 Hz – 20 kHz for Fs = 44.1 kHz to 96 kHz, unless otherwise specified.

Analog Microphone / Line Input to ADC Path

Parameter	Test conditions	Min.	Typ	Max.	Unit
Input level[a]	Full Scale, Gain = 0 dB, boost gain = 20 dB	0.189	0.212	0.239	Vpp
SNR	A-weighted, 1 kHz sine wave @ Full Scale and gain = 0 dB, boost gain = 0 dB	85	90	-	dB
	A-weighted, 1 kHz sine wave @ Full Scale and gain = 0 dB, boost gain = 20 dB	75	80	-	dB
THD	1 kHz sine wave @ Full Scale - 1 dB and gain = 0 dB, boost gain = 0 dB	-	-80	-70	dB
	1 kHz sine wave @ Full Scale - 1 dB and gain = 0 dB, boost gain = 20 dB	-	-70	-60	dB
THD+N[b]	A-weighted, 1 kHz sine wave @ Full Scale -60 dB and gain = 0 dB, boost gain = 0 dB	85	90	-	dB
	A-weighted, 1 kHz sine wave @ Full Scale -60 dB and gain = 0 dB, boost gain = 20 dB	75	80	-	dB
Dynamic Range	A-weighted, 1 kHz sine wave @ Full Scale -60 dB and gain = 0 dB, boost gain = [0-20] dB	-	100	-	dB
PSRR	100 mVpp 1 kHz sine wave is applied to AVD, input data is 0 and gain = 0 dB, boost gain = 20 dB	-	90	-	dB

Parameter	Test conditions	Min.	Typ	Max.	Unit
Boost gain	When activated	0	-	20	dB
Boost gain step	@1 kHz	-	4	-	dB
Boost gain accuracy	@1 kHz	-1		+1	dB
Input resistance	Boost gain = 0 dB, differential configuration	132	160	200	kOhm
	Boost gain = 20 dB, differential configuration	20	26	30	kOhm
Input resistance	Boost gain = 0 dB, single-ended configuration	92	115	138	kOhm
	Boost gain = 20 dB, single-ended configuration	19	24	29	kOhm
Input capacitance	Includes 10 pF for ESD, bonding and package pins cap	-	-	25	pF
Input capacitance	Cbyline	-	1	-	µF

a. The Full Scale input voltage scales with embedded reference: VCAP

b. The specified value is extrapolated by adding 60 dB to the measured SNR

1.9 Digital Input to Analog Output

Measurement conditions: input sine wave with a frequency of 1 kHz, measurement bandwidth 20 Hz–20 kHz, unless otherwise specified.

Audio DAC to Headphone Output Path

Parameter	Test conditions	Min.	Typ	Max.	Unit
Output level	1 kHz sine wave @ Full Scale -1 dB and gain GOL/R= +6 dB, GODL/R= 0 dB, 10 kOhms load	3.78	3.69	4.78	Vpp
	Full Scale and gain GOL/R= -3 dB, GODL/R= 0 dB, 16 Ohms load	1.35	1.5	1.65	Vpp
	Full Scale and gain GOL/R= +6 dB, GODL/R=0 dB, 16 Ohms load	-	3.5	-	Vpp
Maximum output power	16 Ohms load	-	-	95	mW
SNR	A-weighted, 1 kHz sine wave @ Full Scale and gain GOL/R = +6 dB, GODL/R= 0 dB, 10 kOhms load	90	97	-	dB
SNR	A-weighted, 1 kHz sine wave @ Full Scale and gain GOL/R= +6 dB, GODL/R = 0 dB, 16/32 Ohms load	90	-	97	dB
Dynamic Range	A-weighted, 1 kHz sine wave @ Full Scale and gain GOL/R = [-10 + 6] dB, GODL/R = 0 dB, 16 Ohms load	-	106	-	dB

Parameter	Test conditions	Min.	Typ	Max.	Unit
Idle Noise	A-weighted with no signal and gain GOL/R = -10 dB, GODL/R = 0 dB, 16 Ohms load	-	-104.5	-98	dBV
THD	1 kHz sine wave @ Full Scale -1 dB and gain GOL/R = +6 dB, GODL/R = 0 dB, 10 kOhms load	-	-85	-75	dB
	1 kHz sine wave @ Full Scale -1 dB and gain GOL/R = -3 dB, GODL/R = 0 dB, 16 Ohms load	-	-70	-65	dB
THD+N[a]	A-weighted, 1 kHz sine wave @ Full Scale -60 dB and gain GOL/R = +6 dB, GODL/R = 0 dB, 10 kOhms load	90	95	-	dB
Wide Band	Noise1 kHz sine wave @ Full Scale and gain GOL/R = +6 dB, GODL/R = 0 dB, 10 kOhms load, measurement on 20 kHz - 100 kHz	-	75	-	dB
PSRR	100 mVpp 1 kHz is applied to AVD, input data is 0 and gain GOL/R = 0 dB, GODL/R = 0 dB, 10 kOhms load	-	90	-	dB
Analog gain	Gain GOL/R	-19	-	+12	dB
Digital gain	Gain GODL/R	-31	-	+32	dB
Gain step	GOL/R, GODL/R @ 1 kHz	-	1	-	dB
Gain accuracy	GOL/R, GODL/R @ 1 kHz	-0.5	-	+0.5	dB
Pop-up Noise	Active < - > Inactive, 10 kOhms load	-	-60	-	dBV
	Active < - > Inactive, 16 Ohms load	-	-60	-	dBV
Output load resistance (Rl)	-	16	-	-	Ohm
Output load capacitance (Cp)	-	-	-	200	pF

a. The specified value is extrapolated by adding 60 dB to the measured SNR.

2.0 MICBIAS Characteristics

Measurement conditions: input sine wave with a frequency of 1 kHz, measurement bandwidth 20 Hz–20 kHz, unless otherwise specified.

Parameter	Test Condition	Min.	Typ.	Max.	Unit
MICBIAS Output Level	MICBIAS_V = 0	-	2.08	-	V
	MICBIAS_V = 1	-	1.66	-	
MICBIAS Output Current	-	-	-	4	mA
MICBIAS Output Noise	A-Weighted	-	20	40	uVrms
MICBIAS Decoupling Capacitor	Cmic	0.75	1	1.25	nF
VREFP_CODEC Output Voltage	-	-	2.5	-	V
VCAP Output Voltage	-	-	2	-	V

2.1 Digital Microphone Interface Characteristics

Measurement conditions: Input sine wave with a frequency of 1kHz, MCLK = 12 MHz or 13 MHz, DMIC_CLK = Fmclk/4, measurement bandwidth 20 Hz - Fs/2 for Fs = 8 to 32 kHz, measurement bandwidth 20 Hz – 20 kHz for Fs = 44.1 kHz to 96 kHz, unless otherwise specified.

Parameter	Test Condition	Min.	Typ.	Max.	Unit
Input Level[a]	Full Scale max value, Gain GID = 0 dB	84.5	85.6	86.7	%
	Full Scale min value, Gain GID = 0 dB	15.5	14.4	13.3	%
SNR	A-weighted, 1 kHZ sine wave@ Full Scale and gain GIDL, GIDR = 0 dB		100		dB
THD+N	1 kHZ sine wave@ Full Scale - 1 dB and gain GIDL, GIDR = 0 dB		90		dB
THD+N[b]	A-weighted, 1 kHZ sine wave@ Full Scale -60 dB and gain GID = 0 dB		100		dB
Digital Gain	Gain GID when activated	0	-	43	dB
Gain Step	GID @ 1 kHz	-	1	-	dB
Gain Accuracy	GID @ 1 kHz	-0.25	-	+0.25	dB

a. The Full Scale input corresponds to a modulation density of the PDM input
b. The specified value is extrapolated by adding 60 dB to the measured SNR

2.2 Storage Condition

The Module is applicable to Moisture Sensitivity Level 3 (based on JEDEC Standard).
1. Calculated shelf life in sealed moisture barrier bag (MBB): 12 months at <40°C and <90% relative humidity (RH)
2. Peak package body temperature: 260°C
3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must

be

• Mounted within: 168 hours of factory conditions <=30°C/60% RH, or

• Stored at <10% RH

4. Devices require bake, before mounting, if:

• Humidity Indicator Card reads >10% when read at 23 ± 5°C

• Both of the conditions in 3 are not met

5. If baking is required, devices may be baked for 24 hours at 125 ±5°C

Note: If device containers cannot be subjected to high temperature or shorter bake times are desired, please

refer to IPC/JEDEC J-STD-033 for bake condition.

2.3 Package Information

Pin	Signal
27	GND
1	VBAT
2	GND
3	MCLK_PA0_M
4	PA7_SWS_M_update
5	PD0_M_ADC
6	PD1_M_ADC
7	PD2_M_PWM2N
8	PD4_M_PWM4N
9	PD5_M_PWN5N
10	PD6_M_used by I2C
11	GND
12	GND
13	PB2_M_UTX0
14	PB3_M_URX0
15	USB_D+_PA6_M
16	USB_D-_PA5_M
17	RESET
18	I2C_SCL_PE0_M_UTX1
19	I2C_SDA_PE2_M_URX1
20	PB0
21	PB1
22	I2S_LRCK_PC4/PC6
23	GND
24	I2S_BCK_PC3
25	PB4
26	I2S_SDIO_0_PC5/PC7_M
28	

Size： 47x26±0.3mm

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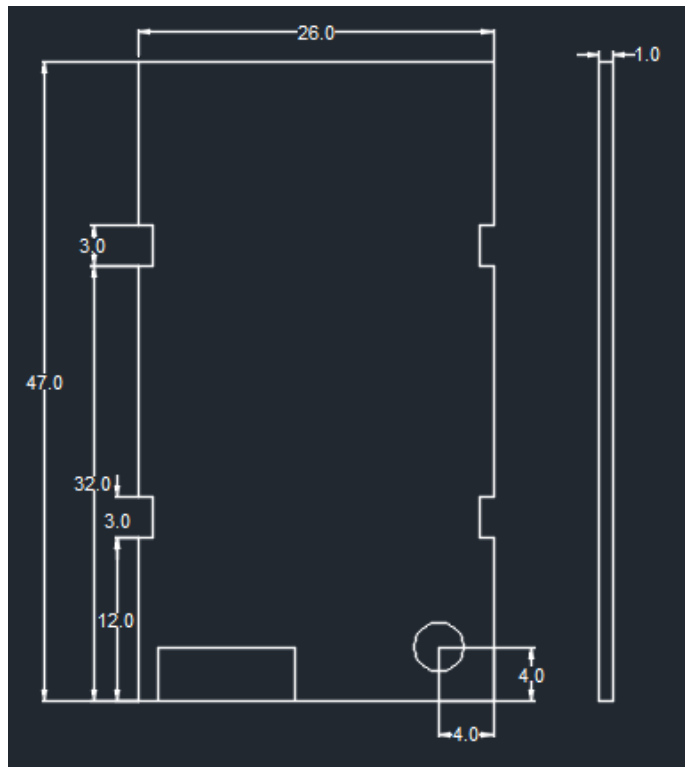
2.4   Pin Function Descriptions

Pin	Pin Name	PIN TYPE	Description
1	VBAT	PWR	Lion-Battery power supply
2,11,12,23	GND	PWR	GROUND
3	MCLK_PA0_M	I/O	GPIO PA[0]
4	PA7_SWS_M_updata	I/O	GPIO PA[7]
5	PD0_M_ADC	I/O	GPIO PD[0]
6	PD1_M_ADC	I/O	GPIO PD[1]
7	PD2_M_PWM2N	I/O	GPIO PB[2]
8	PD4_M_PWM4N	I/O	GPIO PD[4]
9	PD5_M_PWM5N	I/O	GPIO PD[5]
10	PD6_M_used by I2C	I/O	GPIO PD[6]
13	PB2_M_UTX0	I/O	GPIO PB[2]
14	PB3_M_URX0	I/O	GPIO PB[3]
15	USB_D+_PA6_M	I/O	GPIO PA[6]
16	USB_D-_PA5_M	I/O	GPIO PA[5]
17	RESET	RESET	Power on reset, active low
18	I2C_SCL_PE0_M_UTX1	I/O	GPIO PE[0]
19	I2C_SDA_PE2_M_URX1	I/O	GPIO PE[2]
20	PB0	I/O	GPIO PB[0]
21	PB1	I/O	GPIO PB[1]
22	I2S_LRCK_PC4	I/O	GPIO PC[4] I2S DAC LR CLOCK
24	I2S_BCK_PC3	I/O	GPIO PC[3] I2S BIT CLOCK
25	PB4	I/O	GPIO PB[4]
26	I2S_SDIO_0_PC5_M	I/O	GPIO PC[5] I2S DAC DATA OUTPUT

2.5 Standard Packing Information

Module packing Box (Max 1600pcs module per box)

40 pcs per tray, 10trays per ESD bag, sealed in ESD PE bag.
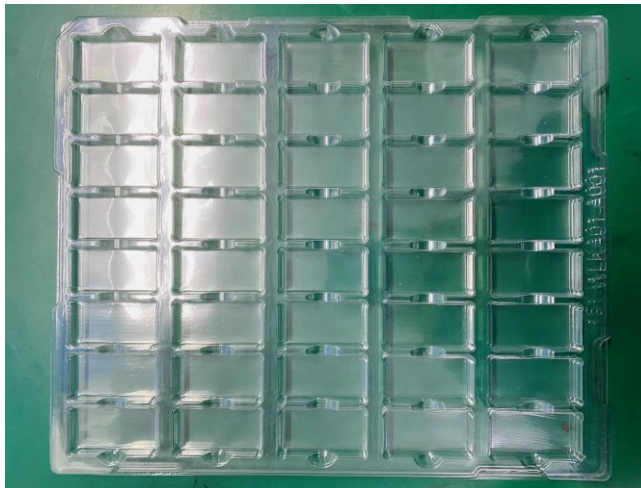
Maximum modules per ESD bag is 400pcs

Module packing bag dimension: 480mm x 380mm

Delivering carton box

To hold Four units of module carton boxes for shipment (Max 1600pcs modules per box)

Delivery Carton Box dimension: 380 mm x 320 mm x 200 mm (W x D x H)

ESD tray dimension: 340 mm x 280 mm x 8 mm(W x D x H)
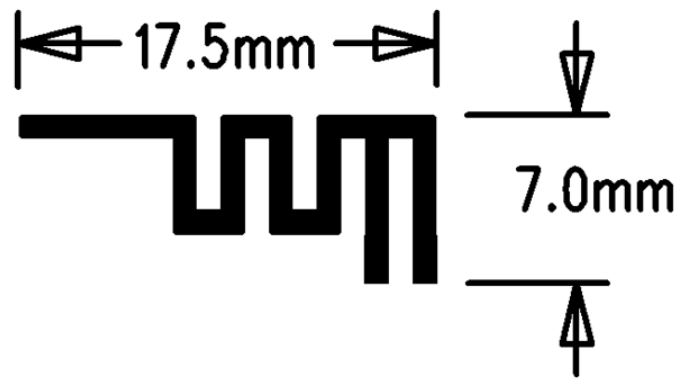

ESD tray (to be packed in ESD PE bag)

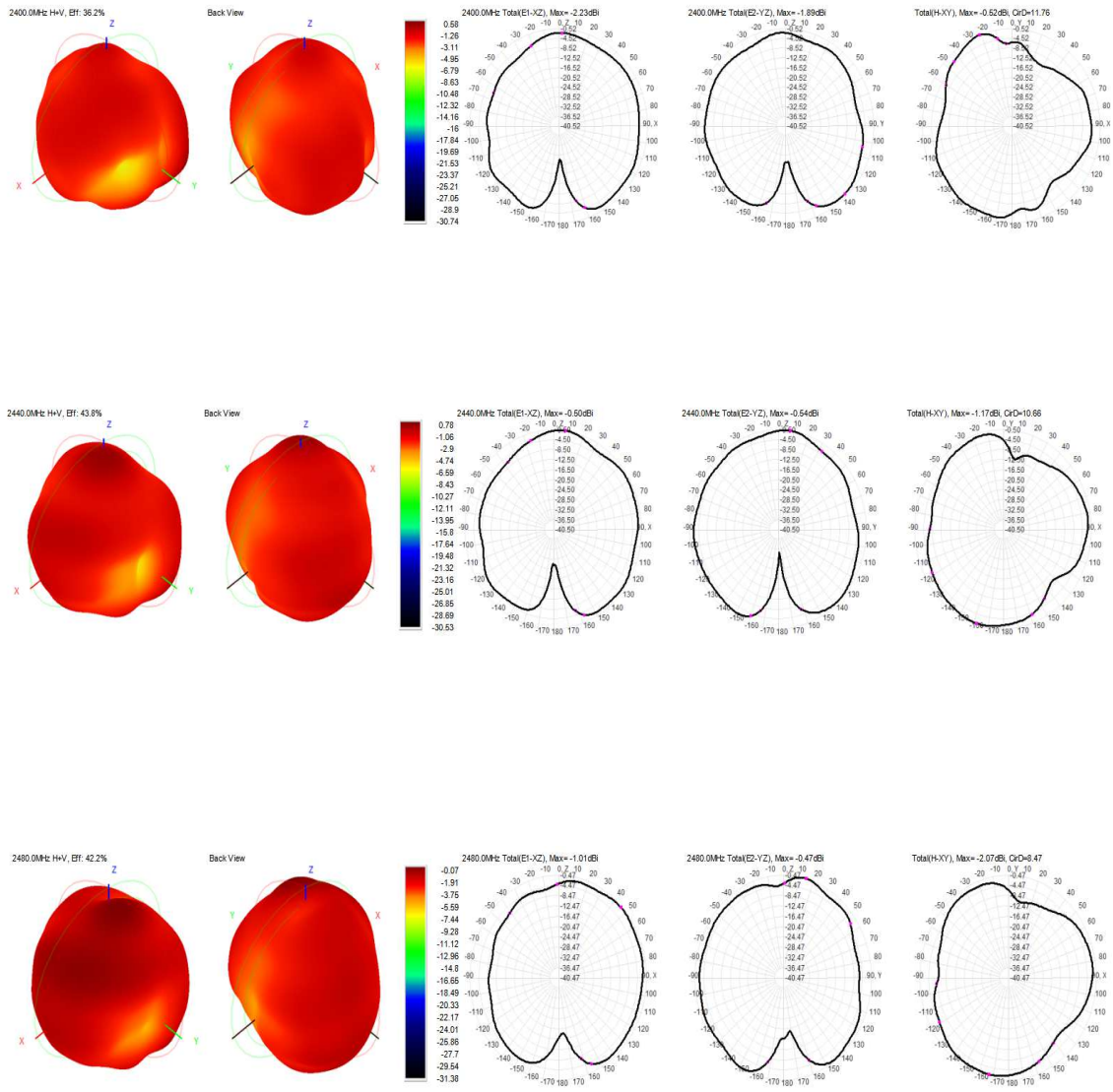ESD PE bag size: 480 mm x 380 mm

2.6 ANTENNA SPECIFICATION

1. Antenna Sise

2. Antenna test parameter

Frequency(MHz)	Efficiency (dBi)	Gain (dBi)	Efficiency (%)
2400	-4.42	0.58	36.16
2410	-4.13	0.87	38.62
2420	-3.89	1.10	40.86
2430	-3.73	0.85	42.41
2440	-3.59	0.78	43.78
2450	-3.54	0.61	44.28
2460	-3.63	0.54	43.36
2470	-3.69	0.17	42.80
2480	-3.75	-0.07	42.18
2490	-3.91	-0.35	40.61
2500	-4.17	-0.69	38.27

3. Antenna 2D/3D drawing

2400.0MHz H+V, Eff: 36.2%   Back View   2400.0MHz Total(E1-XZ), Max=-2.23dBi   2400.0MHz Total(E2-YZ), Max=-1.89dBi   Total(H-XY), Max=-0.52dBi, CirD=11.76

2440.0MHz H+V, Eff: 43.8%   Back View   2440.0MHz Total(E1-XZ), Max=-0.50dBi   2440.0MHz Total(E2-YZ), Max=-0.54dBi   Total(H-XY), Max=-1.17dBi, CirD=10.66

2480.0MHz H+V, Eff: 42.2%   Back View   2480.0MHz Total(E1-XZ), Max=-1.01dBi   2480.0MHz Total(E2-YZ), Max=-0.47dBi   Total(H-XY), Max=-2.07dBi, CirD=8.47

2.7 Content of the sticker

1.Module name   WB-8815R1   RX

2.TCL Part Number   **07-WLWB88-15R1V1**

3.Sequential number   WLT0000000   serial number

4.UUID   A4C135 XXXXXX   The first six digits are fixed, and the last

six digits are hex production addresses

5.FW   v21.51.2.1   Confirm the burned version,Change according to the burned version

6.Date Code   2202   World Eilte Production cycle

QR code display content:TCL Part Number,sequential number,UUID

TX module sticker color is white

RX module sticker color is green

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Document History

Revision	Data	History
V0.0	20210307	First Release
V0.1	20210408	Second Release
V0.2	20210512	Third Release
V0.3	20211213	Fourth Release
V0.4	20220105	Adding packaging information
V0.5	20220214	Adding Dimensional tolerance

Contact Information

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