

保密等级：机密

# **SPECIFICATION**

## **产品规格书**

**SKI.WB800D80U.2\_D40L**  
**IEEE 802.11 a/b/g/n/ac/ax 1T1R USB Wi-Fi**  
**Integrated BLE 5.4**

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## 1. Introduction (简介)

SKI.WB800D80U.2\_D40L module is based on AIC8800D40L solution. SKI.WB800D80U.2\_D40L is a WiFi6/BLE5.4 combo low-power, high-performance and high-integrated dual band wireless communication module which is designed for meeting the customers' needs of small size and low cost. This module supports both WLAN and BLE functions. Its WLAN function supports the USB2.0 interface, and the module meets the requirements of standard protocol IEEE 802.11 a/b/g/n/ac/ax. Such units as power management, power amplifier and low-noise amplifier are integrated in the main chip of the module. Its WLAN PHY rate is up to 286.8Mbps@TX. The module can be applied in smart sound boxes, set-top boxes, game machines, printers, IP cameras, tachographs, and other smart equipment. This documentation describes the engineering requirements specification.

SKI.WB800D80U.2\_D40L模块基于AIC8800D40L方案。SKI.WB800D80U.2\_D40L是一款Wi-Fi6/BLE5.4组合的低功耗、高性能、高集成度双频无线通信模块，专为满足客户小尺寸、低成本的需求而设计。该模块支持WLAN和BLE功能。WLAN功能支持USB2.0接口，满足IEEE 802.11 a/b/g/n/ac/ax标准协议要求。本文档描述了工程要求规范。

## 2. Features (特性)

<b>Reserving System</b> 接收制式	IEEE Std. 802.11a
	IEEE Std. 802.11b
	IEEE Std. 802.11g
	IEEE Std. 802.11n
	IEEE Std. 802.11ac
	IEEE Std. 802.11ax
	BLE5.4
<b>Chip Solution</b> 芯片方案	AIC8800D40L
<b>Band</b> 波段	2.4GHz/5G 注：中国大陆：2400-2483.5MHz、5150-5350MHz、5725-5850MHz
<b>Dimensions</b> 尺寸	13.0mm×12.2mm×1.8mm
<b>Antenna</b> 天线	Stamp Hole or IpeX
<b>Installation Mode</b> 安装方式	SMD
<b>Remark</b> 备注	

### 3. Block Diagram (结构框图)

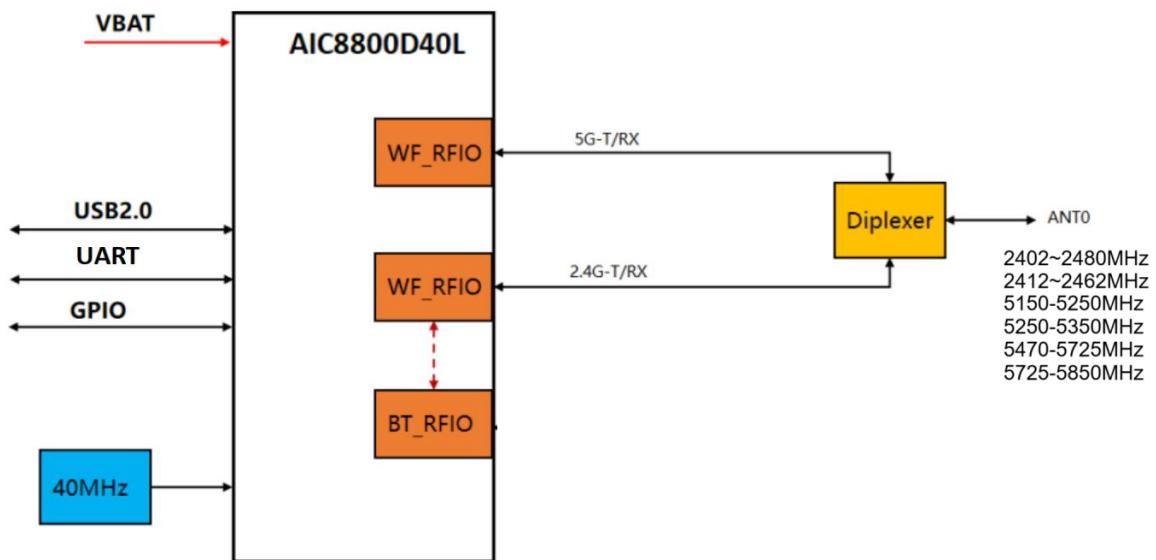
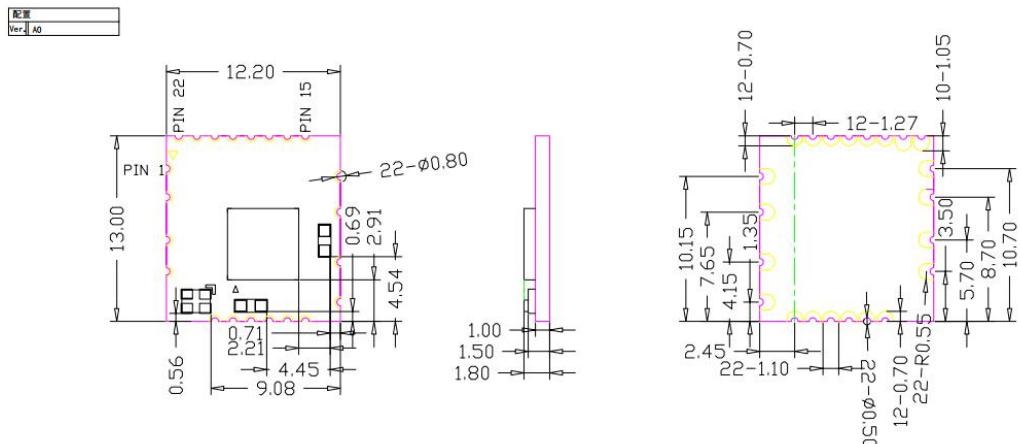


Figure 1 SKI.WB800D80U.2\_D40L Block Diagram

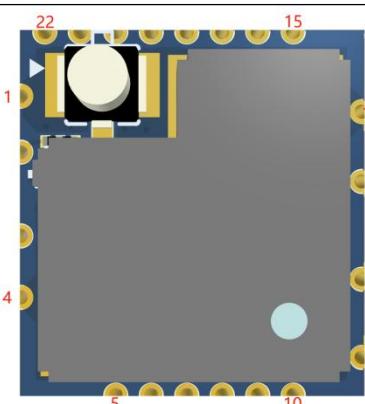
#### 4. Package Outline and Mounting (外形及安装尺寸)



模组俯视图 模组侧视图 模组底视图

注意：1、单位为mm；  
2、模组外形尺寸公差为 $\pm 0.2$ mm，板厚及未标注公差为 $\pm 0.2$ mm；  
3、平面度要求： $<0.15$ mm；  
4、上板封装制作：建议根据焊盘大小往外延长1mm；

## 5. Pin Definition (引脚定义)



PIN	SYMBOL	DESCRIPTION
1	GND	Ground
2	WLAN_BT_ANT	WIFI(2.4G+5G)(双天线) WIFI(2.4G+5G)&BT(单天线)
3	WLAN_ANT	BT(双天线) BT(NC)(单天线)
4	GND	Ground
5	UART1_RTS	UART1_RTS
6	UART1_CTS	UART1_CTS
7	UART1_TX	UART1_TX
8	UART1_RX	UART1_RX
9	HOST_WAKE_BT	HOST_WAKE_BT, High active
10	BT_WAKE_HOST	BT_WAKE_HOST, High active
11	VBAT	Voltage Input of Main Power Supply
12	USB_DM	USB_DM
13	USB_DP	USB_DP
14	GND	Ground
15	NC	Keep Floating
16	NC	Keep Floating
17	NC	Keep Floating
18	PWR_EN	Power Enable/Disable, High active
19	HOST_WAKE_WL	HOST_WAKE_WL, High active
20	WL_WAKE_HOST	WL_WAKE_HOST, High active
21	UART0_TX	UART0_TX
22	UART0_RX	UART0_RX

## 6. Product Pictures (实物图片)



正视图 (Top view)



背视图 (Bottom view)

丝印说明:

- (1) 红色方框内的字符为产品 PCB 型号;
- (2) 黄色方框内的字符为产品周期号;
- (3) 其他为非关键字符, 无须管控。

本产品的型号核准代码标识在产品后标牌上。

模块通过型号核准并不代表嵌入或使用该模块的最终设备符合相关无线电管理技术规定或标准, 最终设备厂商须对产品的技术特性是否符合无线电管理技术规定或标准负责。

## 7. Key Materials (关键物料)

序号	关键件名称	型号	规格/材料	备注
1	集成电路	AIC8800D40L	QFN48	AIC
2	PCB	SKI.WB800D80U.2 B23365	FR-4,4LAY	
3	晶体振荡器	40MHz,±10ppm, 2016	40MHz	JWT,MDH,TXC,Murata
4	双工器	1608 Dual-band, dual-mode 2.4GHz/5GHz WLAN	2.4GHz/5GHz	Sunlord,ACX,TDK,PSA

## 8. General Requirements (一般要求)

No.	Feature	Description
8-1	Operation Voltage 工作电压范围	3.3V±0.3
8-2	Current Consumption 最大电流	1000mA
8-3	Ripple 纹波	<10%
8-4	Operation Temperature 工作温度范围	-20°C to +60°C
8-5	Antenna Type 天线类型	External antenna
8-6	Interface	USB2.0/UART
8-7	Storage Temperature 存储温度	-40°C to +85°C

## 9. Electrical Characteristics (电气特性)

除非另有说明，电气规范试验都在下列条件下进行：

环境条件温度：25°C ± 5°C；

电源电压：模块输入电压 3.3V (±10%)；

The Test for electrical specification was performed under the following condition unless otherwise specified.

Ambient condition Temperature :25°C ± 5°C;

Power supply voltages: 3.3V (±10%) input power at the Module;

## 9.1 IEEE 802.11b Section (2.4GHz)

Items	Contents				
Specification	IEEE802.11b				
Mode	CCK				
Channel	CH1 to CH13				
Data rate	1, 2, 5.5, 11Mbps				
TX Characteristics	Min.	Typ.	Max.	Unit	Remark
1. Power Levels at each rate (1Mbps~11Mbps)	14	16	18	dBm	
2. Spectrum Mask @ target power					
1) $f_c \pm 11\text{MHz}$ to $\pm 22\text{MHz}$	-	-	-30	dBr	
2) $f_c > \pm 22\text{MHz}$	-	-	-50	dBr	
3. Constellation Error(EVM)@ target power					
1) 1Mbps	-	-	-9.11	dB	
2) 2Mbps	-	-	-9.11	dB	
3) 5.5Mbps	-	-	-9.11	dB	
4) 11Mbps	-	-	-9.11	dB	
4. Frequency Error	-20	-	20	ppm	
RX Characteristics	Min.	Typ.	Max.	Unit	
5. Minimum Input Level Sensitivity					
1) 1Mbps (FER $\leq 8\%$ )	-	-95	-83	dBm	
2) 2Mbps (FER $\leq 8\%$ )	-	-	-80	dBm	
3) 5.5Mbps (FER $\leq 8\%$ )	-	-	-79	dBm	
4) 11Mbps (FER $\leq 8\%$ )	-	-87	-76	dBm	
6. Maximum Input Level (FER $\leq 8\%$ )	-10	-	-	dBm	

## 9.2 IEEE 802.11g Section (2.4GHz)

Items	Contents				
Specification	IEEE802.11g				
Mode	OFDM				
Channel	CH1 to CH13				
Data rate	6, 9, 12, 18, 24, 36, 48, 54Mbps				
TX Characteristics	Min.	Typ.	Max.	Unit	Remark
1. Power Levels					
1) For antenna port (54M)	13	15	17	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	-	-	-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	-	-	-25	dB	
4 Frequency Error	-20	-	20	ppm	
RX Characteristics	Min.	Typ.	Max.	Unit	
5 Minimum Input Level Sensitivity					
1) 6Mbps (PER $\leq$ 10%)	-	-90	-85	dBm	
2) 9Mbps (PER $\leq$ 10%)	-	-	-84	dBm	
3) 12Mbps (PER $\leq$ 10%)	-	-	-82	dBm	
4) 18Mbps (PER $\leq$ 10%)	-	-	-80	dBm	
5) 24Mbps (PER $\leq$ 10%)	-	-	-77	dBm	
6) 36Mbps (PER $\leq$ 10%)	-	-	-73	dBm	
7) 48Mbps (PER $\leq$ 10%)	-	-	-69	dBm	
8) 54Mbps (PER $\leq$ 10%)	-	-74	-65	dBm	

### 9.3 IEEE 802.11n HT20/40 Section(2.4GHz)

Items	Contents				
Specification	IEEE802.11n HT20/40@2.4GHz				
Mode	OFDM				
Channel	HT20:CH1 to CH13 HT40:CH3 to CH11				
Data rate (MCS index)	MCS0/1/2/3/4/5/6/7				
TX Characteristics	Min.	Typ.	Max.	Unit	Remark
1. Power Levels (Calibrated)					
1) For antenna port (MCS7)	12	14	16	dBm	
2. Spectrum Mask @target power					
1) at fc +/-22MHz	-	-	-20	dBr	
2) at fc +/-40MHz	-	-	-28	dBr	
3) at fc > +/-60MHz	-	-	-45	dBr	
3. Constellation Error(EVM)@ target power					
1) MCS0	-	-	-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	-	-	-28	dB	
4. Frequency Error	-20	-	20	ppm	
RX Characteristics	Min.	Typ.	Max.	Unit	
5. Minimum Input Level Sensitivity			HT20	HT40	
1) MCS0 (PER $\leq 10\%$ )	-	-87	-82	-79	dBm
2) MCS1 (PER $\leq 10\%$ )	-	-	-79	-76	dBm
3) MCS2 (PER $\leq 10\%$ )	-	-	-77	-74	dBm
4) MCS3 (PER $\leq 10\%$ )	-	-	-74	-71	dBm
5) MCS4 (PER $\leq 10\%$ )	-	-	-70	-67	dBm
6) MCS5 (PER $\leq 10\%$ )	-	-	-66	-63	dBm
7) MCS6 (PER $\leq 10\%$ )	-	-	-65	-62	dBm
8) MCS7 (PER $\leq 10\%$ )	-	-70	-64	-61	dBm
6. Maximum Input Level (PER $\leq 10\%$ )	-20	-	-	dBm	

## 9.4 IEEE 802.11ax HE20/40 Section (2.4GHz)

Items	Contents				
Specification	IEEE802.11ax HE20/40@2.4GHz				
Mode	OFDMA				
Channel	HE20:CH1 to CH13 HE40:CH3 to CH11				
Data rate (MCS index)	MCS0/1/2/3/4/5/6/7/8/9/10/11				
TX Characteristics	Min.	Typ.	Max.	Unit	Remark
1. Power Levels (Calibrated)					
1) For antenna port (MCS11)	11	13	15	dBm	
2. Spectrum Mask @VHT20/VHT40/VHT80 target power					
1) at fc +/-11MHz/21MHz/41MHz	-	-	-20	dBr	
2) at fc +/-20MHz/40MHz/80MHz	-	-	-28	dBr	
3) at fc +/-30MHz/60MHz/120MHz	-	-	-40	dBr	
3. Constellation Error(EVM)@ target power					
1) MCS0	-	-	-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	-	-	-27	dB	
9) MCS8	-	-	-30	dB	
10) MCS9	-	-	-32	dB	
11) MCS10	-	-	-34	dB	
12) MCS11	-	-	-35	dB	
4. Frequency Error	-20	-	20	ppm	
RX Characteristics	Min.	Typ.	Max.	Unit	
5. Minimum Input Level Sensitivity			HE20	HE40	
1) MCS0 (PER $\leq 10\%$ )	-	-87	-82	-79	dBm
2) MCS1 (PER $\leq 10\%$ )	-	-	-79	-76	dBm
3) MCS2 (PER $\leq 10\%$ )	-	-	-77	-74	dBm
4) MCS3 (PER $\leq 10\%$ )	-	-	-74	-71	dBm
5) MCS4 (PER $\leq 10\%$ )	-	-	-70	-67	dBm
6) MCS5 (PER $\leq 10\%$ )	-	-	-66	-63	dBm
7) MCS6 (PER $\leq 10\%$ )	-	-	-65	-62	dBm
8) MCS7 (PER $\leq 10\%$ )	-	-	-64	-61	dBm
9) MCS8 (PER $\leq 10\%$ )	-	-	-59	-56	dBm

10) MCS9(PER $\leq 10\%$ )	-	-	-57	-54	dBm	
11) MCS10(PER $\leq 10\%$ )	-	-	-54	-51	dBm	
12) MCS11(PER $\leq 10\%$ )	-	-59	-51	-49	dBm	
6. Maximum Input Level (PER $\leq 10\%$ )	-30	-	-	-	dBm	

## 9.5 IEEE 802.11a Section (5GHz)

Items	Contents				
Specification	IEEE802.11a				
Mode	OFDM				
Channel	CH36 to CH165				
Data rate (MCS index)	6, 9, 12, 18, 24, 36, 48, 54Mbps				
TX Characteristics	Min.	Typ.	Max.	Unit	Remark
1. Power Levels (Calibrated)					
1) For antenna port (54M)	12	14	16	dBm	
2. Spectrum Mask @VHT20/VHT40/VHT80 target power					
1) at fc +/-11MHz/21MHz/41MHz	-	-	-20	dBr	
2) at fc +/-20MHz/40MHz/80MHz	-	-	-28	dBr	
3) at fc +/-30MHz/60MHz/120MHz	-	-	-40	dBr	
3. Constellation Error(EVM)@ target power					
4) MCS3	-	-	-16	dB	
5) MCS4	-	-	-19	dB	
6) MCS5	-	-	-22	dB	
7) MCS6	-	-	-25	dB	
8) MCS7	-	-	-27	dB	
9) MCS8	-	-	-30	dB	
10) MCS9	-	-	-32	dB	
4. Frequency Error	-20	-	20	ppm	
RX Characteristics	Min.	Typ.	Max.	Unit	
5. Minimum Input Level Sensitivity					
1) 6Mbps (PER $\leq 10\%$ )	-	-90	-82	dBm	
2) 9Mbps (PER $\leq 10\%$ )	-	-	-81	dBm	
3) 12Mbps (PER $\leq 10\%$ )	-	-	-79	dBm	
4) 18Mbps (PER $\leq 10\%$ )	-	-	-77	dBm	
5) 24Mbps (PER $\leq 10\%$ )	-	-	-74	dBm	
6) 36Mbps (PER $\leq 10\%$ )	-	-	-70	dBm	
7) 48Mbps (PER $\leq 10\%$ )	-	-	-66	dBm	
8) 54Mbps (PER $\leq 10\%$ )	-	-74	-65	dBm	
6. Maximum Input Level (PER $\leq 10\%$ )	-30	-	-	dBm	

## 9.6 IEEE 802.11n HT20/40 Section(5GHz)

Items	Contents				
Specification	IEEE802.11n HT20/40@5GHz				
Mode	OFDM				
Channel	HT20:CH36 to CH165 HT40:CH38 to CH163				
Data rate (MCS index)	MCS0/1/2/3/4/5/6/7				
TX Characteristics	Min.	Typ.	Max.	Unit	Remark
1. Power Levels (Calibrated)					
1) For antenna port (MCS7)	12	14	16	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	-	-	-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	-	-	-28	dB	
4. Frequency Error	-20	-	20	ppm	
RX Characteristics	Min.	Typ.	Max.	Unit	
6. Minimum Input Level Sensitivity (each chain)			HT20	HT40	
1) MCS0 (PER $\leq$ 10%)	-	-87	-82	-79	dBm
2) MCS1 (PER $\leq$ 10%)	-	-	-79	-76	dBm
3) MCS2 (PER $\leq$ 10%)	-	-	-77	-74	dBm
4) MCS3 (PER $\leq$ 10%)	-	-	-74	-71	dBm
5) MCS4 (PER $\leq$ 10%)	-	-	-70	-67	dBm
6) MCS5 (PER $\leq$ 10%)	-	-	-66	-63	dBm
7) MCS6 (PER $\leq$ 10%)	-	-	-65	-62	dBm
8) MCS7 (PER $\leq$ 10%)	-	-68	-64	-61	dBm
6. Maximum Input Level (PER $\leq$ 10%)	-30	-	-	-	dBm

## 9.7 IEEE 802.11ac VHT20/40 Section(5GHz)

Items	Contents				
Specification	IEEE802.11ac VHT20/40@5GHz				
Mode	OFDM				
Channel	VHT20:CH36 to CH165 VHT40:CH38 to CH163				
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) For antenna port (MCS9)	11	13	15	dBM	
2. Spectrum Mask @VHT20/VHT40/VHT80 target power					
1) at fc +/-11MHz/21MHz/41MHz	-	-	-20	dBr	
2) at fc +/-20MHz/40MHz/80MHz	-	-	-28	dBr	
3) at fc +/-30MHz/60MHz/120MHz	-	-	-40	dBr	
3. Constellation Error(EVM)@ target power					
1) MCS0	-	-	-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	-	-	-27	dB	
9) MCS8	-	-	-30	dB	
10) MCS9	-	-	-32	dB	
4. Frequency Error	-20	-	20	ppm	
RX Characteristics	Min.	Typ.	Max.	Unit	
5. Minimum Input Level Sensitivity (each chain)			VHT20	VHT40	
1) MCS0 (PER $\leq 10\%$ )	-	-87	-82	-79	dBM
2) MCS1 (PER $\leq 10\%$ )	-	-	-79	-76	dBM
3) MCS2 (PER $\leq 10\%$ )	-	-	-77	-74	dBM
4) MCS3 (PER $\leq 10\%$ )	-	-	-74	-71	dBM
5) MCS4 (PER $\leq 10\%$ )	-	-	-70	-67	dBM
6) MCS5 (PER $\leq 10\%$ )	-	-	-66	-63	dBM
7) MCS6 (PER $\leq 10\%$ )	-	-	-65	-62	dBM
8) MCS7 (PER $\leq 10\%$ )	-	-	-64	-61	dBM
9) MCS8 (PER $\leq 10\%$ )	-	-	-59	-56	dBM

10) MCS9(PER $\leq 10\%$ )	-	-61	-57	-54	dBm	
6. Maximum Input Level (PER $\leq 10\%$ )	-30	-	-	-	dBm	

## 9.8 IEEE 802.11ax HE20/40 Section(5GHz)

Items	Contents				
Specification	IEEE802.11ax HE20/40@5GHz				
Mode	OFDMA				
Channel	HE20:CH36 to CH165 HE40:CH38 to CH163				
Data rate (MCS index)	MCS0/1/2/3/4/5/6/7/8/9/10/11				
TX Characteristics	Min.	Typ.	Max.	Unit	Remark
1. Power Levels (Calibrated)					
1) For antenna port (MCS11)	11	13	15	dBm	
2. Spectrum Mask @VHT20/VHT40/VHT80 target power					
1) at fc $\pm 11\text{MHz}/21\text{MHz}/41\text{MHz}$	-	-	-20	dBr	
2) at fc $\pm 20\text{MHz}/40\text{MHz}/80\text{MHz}$	-	-	-28	dBr	
3) at fc $\pm 30\text{MHz}/60\text{MHz}/120\text{MHz}$	-	-	-40	dBr	
3. Constellation Error(EVM)@ target power					
1) MCS0	-	-	-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	-	-	-27	dB	
9) MCS8	-	-	-30	dB	
10) MCS9	-	-	-32	dB	
11) MCS10	-	-	-34	dB	
12) MCS11	-	-	-35	dB	
4. Frequency Error	-20	-	20	ppm	
RX Characteristics	Min.	Typ.	Max.	Unit	
5. Minimum Input Level Sensitivity			HE20	HE40	
1) MCS0 (PER $\leq 10\%$ )	-	-87	-82	-79	dBm
2) MCS1 (PER $\leq 10\%$ )	-	-	-79	-76	dBm
3) MCS2 (PER $\leq 10\%$ )	-	-	-77	-74	dBm
4) MCS3 (PER $\leq 10\%$ )	-	-	-74	-71	dBm
5) MCS4 (PER $\leq 10\%$ )	-	-	-70	-67	dBm
6) MCS5 (PER $\leq 10\%$ )	-	-	-66	-63	dBm

7) MCS6 (PER $\leq 10\%$ )	-	-	-65	-62	dBm	
8) MCS7 (PER $\leq 10\%$ )	-	-	-64	-61	dBm	
9) MCS8 (PER $\leq 10\%$ )	-	-	-59	-56	dBm	
10) MCS9 (PER $\leq 10\%$ )	-	-	-57	-54	dBm	
11) MCS10 (PER $\leq 10\%$ )	-	-	-54	-51	dBm	
12) MCS11 (PER $\leq 10\%$ )	-	-59	-51	-49	dBm	
6. Maximum Input Level (PER $\leq 10\%$ )	-30	-	-	-	dBm	

## 9.9 Bluetooth Section

Items	Contents				
Specification	BLE				
Number of Channel	0~39 Channels				
Frequency Band	2.402 GHz ~2.480GHz				
	Min.	Typ.	Max.	Unit	Remark
1. Output Power	-	7	-	dBm	
2. Gain step	-	1.0	-	dB	
3. Receiver sensitivity (BER $\leq 0.1\%$ )					
3). Bluetooth LE receiver specifications (PER $\leq 30.8\%$ )	-	-95	-80		
4. Maximum usable signal (BER $\leq 0.1\%$ )	-	-5	-		
5. C/I co-channel (BER<0.1%)	-	4	11	dB	
6. C/I 1MHz (BER<0.1%)	-	-14	0	dB	
7. C/I 2MHz (BER<0.1%)	-	-42	-30	dB	
8. C/I $\geq$ 3MHz (BER<0.1%)	-	-49	-40	dB	
9. C/I Image channel (BER<0.1%)	-	-25	-9	dB	
10. C/I Image 1MHz (BER<0.1%)	-	-50	-20	dB	
11. Inter-modulation	-	-13	-	dB	
12. Out-of-band blocking					
1). 30MHz to 2000MHz	-10	-	-	dBm	
2). 2000MHz to 2399MHz	-27	-	-	dBm	
3). 2498MHz to 3000MHz	-27	-	-	dBm	
4). 3000MHz to 12.75GHz	-10	-	-	dBm	
13. Modulation characteristics					
1). $\Delta f_{1avg}$				KHz	
2). $\Delta f_{2max}$ (For at least 99.9% of all $\Delta f_{2max}$ )	-	-	-	KHz	
3). $\Delta f_{1avg} / \Delta f_{2avg}$	-	-	-	KHz	
14. ICFT	-	-	-	KHz	
15. Carrier frequency drift					
1). One slot packet (DH1)	-25	$\pm 15$	+25	KHz	
2). Two slot packet (DH3)	-40	$\pm 15$	+40	KHz	
3). Five slot packet (DH5)	-40	$\pm 15$	+40	KHz	

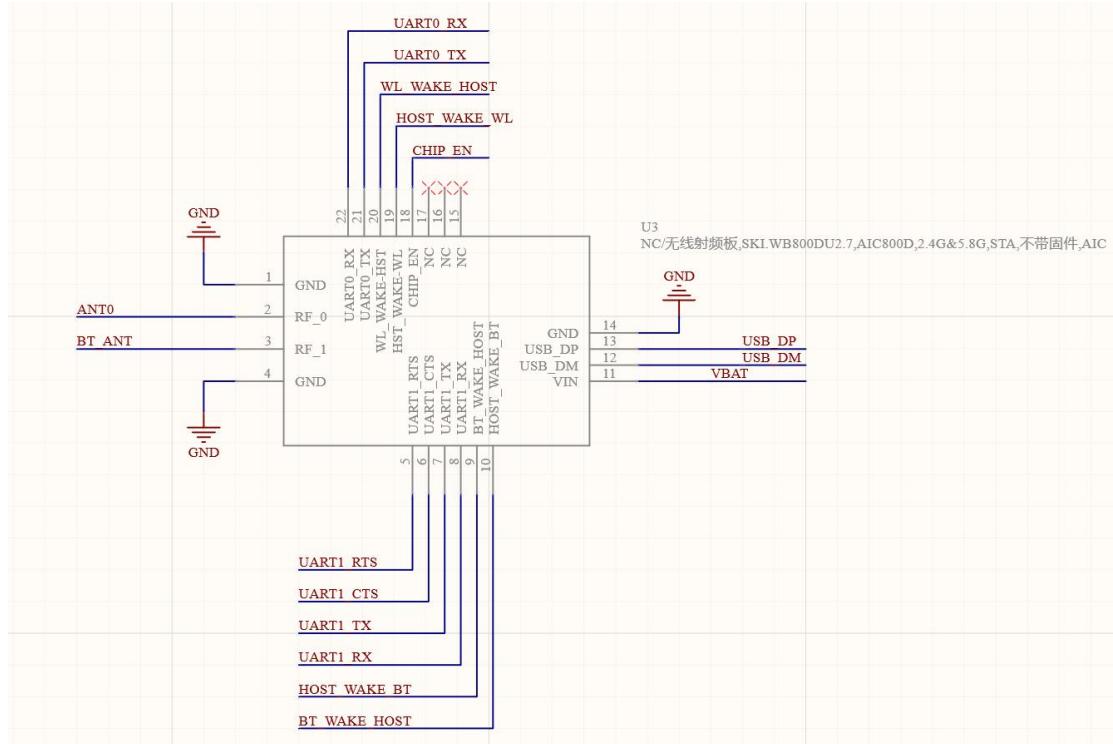
4). Max drift rate	-	6	20	KHz/50us	
16. TX output spectrum(20dB bandwidth)	-	922	1000	KHz	
17. In-Band spurious emission					
1). $\pm 2$ MHz offset	-	-45	-20	dBm	
2). $\pm 3$ MHz offset	-	-48	-40	dBm	
3). $>\pm 3$ MHz offset	-	-48	-40	dBm	

## 10. Reference Design (参考设计)

### 10.1 DC Electrical Characteristics (直流电气特性)

Symbol	Description	conditions	Min.	Typ.	Max.	Unit
VDD33	Power supplies	-	3.0	3.3	3.6	V
VDDIO	I/O input power supplies	-	3.0	3.3	3.6	V
IVDD33	Power supply current	-	-	-	800	mA
IVDDIO	I/O supply current	-	-	-	50	mA
Vih	High-level input voltage	VDDIO=3.3V	VDDIO*0.6 25	-	VDDIO+0.3	V
Vil	Low-level input voltage	VDDIO=3.3V	-0.3	-	VDDIO*0.25	V
Voh	High-level output voltage	VDDIO=3.3V	VDDIO-0.4	-	VDDIO+0.3	V
Vol	Low-level output voltage	VDDIO=3.3V	-0.3	-	0.4	V
Rpu	Internal pull-up resistor	VDDIO=3.3V	40	75	190	k $\Omega$
Rpd	Internal pull-down resistor	VDDIO=3.3V	40	75	190	k $\Omega$

## 10.2 Reference schematic (参考原理图)



## 11. Mechanical, Environmental and Reliability Tests

Test Items		Test Conditions	Qty	Criteria Condition
11-1	<b>Drop test</b>	The packed samples within 100Kg can be tested Drop height: Face Side: 800/600/450mm Edge line: 600/450/350mm Drop time: 1 each Face and edge.	1xBox	After drop test, the outer box and inner box will not be broken by appearance visual inspection.
11-2	<b>Vibration test</b>	X-Y-Z direction, first Frequency changing from 10Hz to 30Hz to 10Hz, amplitude 0.75mm, 5 times vibrations, then frequency Changing from 30Hz to 55 Hz to 30 Hz, amplitude 0.15mm, 5 time vibration.	3	After test, the Appearance, Power EVM and Frequency error shall be satisfied with the specification.
11-3	<b>Impact test</b>	Impact acceleration: 50m/sec <sup>2</sup> ; Impact duration: 16ms; Impact times: 1000.	3	After test, the Appearance, Power EVM and Frequency error shall be satisfied with the specification.
11-4	<b>Soldering ability test</b>	Soldering temperature: 235±5°C Soldering duration: 2±0.5S	3	1. After soldering, the soldered area must be covered by a smooth bright solder layer, some deficiencies such as a small amount of the pinhole, not wetting are allowed, but the deficiencies can not be in the same place; 2. At least 90% of soldered area shall be covered continuously by the soldering material.
11-5	<b>Humidity test</b>	Leave samples in 40±3°C, 93% RH @ 96 hours	3	Leave samples in standard test condition for 2 hours then test, the Appearance, Power, EVM and Frequency error functional parameter shall be satisfied with the test specification.

11-6	<b>High temperature load life test</b>	Thermostat cabinet temperature: $55\pm5^{\circ}\text{C}$ Applied voltage: 110% rated voltage Working duration: 200 hour (Supply Voltage Cycle 23h power on, 1h power off)	60	After test, leave samples in standard condition for 1 hour and test, Power, EVM and Frequency error shall be satisfied with the test specification.
11-7	<b>High temperature load test</b>	Temperature: $55\pm5^{\circ}\text{C}$ Samples work for 16 hours	3	After test, the Appearance, Power, EVM and Frequency error shall be Satisfied with the test specification.
11-8	<b>Low temperature storage test</b>	Leave the samples in $-25\pm3^{\circ}\text{C}$ @ 24 hours	3	Leave samples in standard test condition for 2 hours then test, the Appearance, Power, EVM and Frequency error shall be satisfied with the test specification.
11-9	<b>Low temperature load test</b>	Leave samples in $-15\pm3^{\circ}\text{C}$ @ 2 hours, samples' function shall be normal, the let samples work for 1 hour	3	After test, leave the samples in standard condition and tested the Appearance, Power, EVM and Frequency error shall be satisfied with the test specification.
11-10	<b>Temperature circle test</b>	One cycle duration $-10\pm3^{\circ}\text{C}$ @ 3H $40\pm3^{\circ}\text{C}$ @ 3H Total cycle: 10x	3	After test, leave the samples in standard condition and tested Power EVM and Frequency error shall be qualified and all the characters shall be satisfied with the test specification.
11-11	<b>Continuous TP test</b>	Twice cycle duration $-10\pm3^{\circ}\text{C}$ @ 4H $+60\pm3^{\circ}\text{C}$ @ 4H, $+25$ @ 2H @ 2H	3	During test, There will not been appeared signal disconnection or interruption between DUT and AP.
11-12	<b>ESD</b>	Discharge voltage: 1kV C: 150pF Discharge resistance: 330Ω Positive 10 times 1 time for each second	3	The products can recoverable smoothly after ESD test.

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## Requirement per KDB996369 D03

### 2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.<sup>3</sup>

**Explanation:** This module meets the requirements of FCC part 15C(15.247).

### 2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

**Explanation:** The EUT has a FPC Antenna, and the antenna use a permanently attached antenna which is not replaceable.

### 2.4 Limited module procedures

If a modular transmitter is approved as a "limited module," then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

**Explanation:** The module is not a limited module.

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## 2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects:

layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

- a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
- b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
- c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
- d) Appropriate parts by manufacturer and specifications;
- e) Test procedures for design verification; and
- f) Production test procedures for ensuring compliance.

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

**Explanation:** Yes, The module with trace antenna designs, and This manual has been shown the layout of trace design, antenna, connectors, and isolation requirements.

## 2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person’s body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

**Explanation:** This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment, This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is: 2AYHE-2404B

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## 2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an “omni-directional antenna” is not considered to be a specific “antenna type”)).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

**Explanation:** The EUT has FPC Antenna, and the antenna use a permanently attached antenna which is unique.

## 2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating “Contains FCC ID” with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

**Explanation:** The host system using this module, should have label in a visible area indicated the following texts: “Contains FCC ID: 2AYHE-2404B, Contains IC: 26839-2404B”

## 2.9 Information on test modes and additional testing requirements5

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer’s determination that a module as installed in a host complies with FCC requirements.

**Explanation:** Top band can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

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## **2.10 Additional testing, Part 15 Subpart B disclaimer**

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

**Explanation:** The module without unintentional-radiator digital circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B. The host shoule be evaluated by the FCC Subpart B.

## **FCC STATEMENT :**

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

**Warning:** Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna.

Increase the separation between the equipment and receiver.

Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

## **FCC Radiation Exposure Statement:**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

## ISED Statement

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

- (1) this device may not cause interference, and
- (2) this device must accept any interference, including interference that may cause undesired operation of the device."

This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

Cet équipement doit être installé et utilisé avec une distance minimale de 20 cm entre le radiateur et votre corps.

**MODIFICATION:** Any changes or modifications not expressly approved by the grantee of this device could void the user's authority to operate the device.

Toute modification non approuvée explicitement par le fournisseur de licence de l'appareil peut entraîner l'annulation du droit de l'utilisateur à utiliser l'appareil.

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada

The OEM must certify the final end product to comply with unintentional radiators (FCC Sections 15.107 and 15.109) before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID: 2AYHE-2402A". Additionally, the following statement should be included on the label and in the final product's user manual:

"This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interferences, and
- (2) this device must accept any interference received, including interference that may cause undesired operation."

The module is limited to installation in mobile or fixed applications. Separate approval is required for all other operating configurations, including portable configuration with respect to Part 2.1093 and different antenna configurations.

A module or modules can only be used without additional authorizations if they have been tested and granted under the same intended end - use operational conditions, including simultaneous transmission operations.

When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have the grantee responsible for the certification of at least one of the modules submit a permissive change application.

When having a module grantee file a permissive change is not practical or feasible, the following guidance provides some additional options for host manufacturers. Integrations using modules where additional testing and/or FCC application filing(s) may be required are: (A) a module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together.

This Module is full modular approval, it is limited to OEM installation ONLY.

Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change. (OEM) Integrator has to assure compliance of the entire end product include the integrated Module. Additional measurements (15B) and/or equipment authorizations (e.g. Verification) may need to be addressed depending on co-location or simultaneous transmission issues if applicable. (OEM) Integrator is reminded to assure that these installation instructions will not be made available to the end user

IC labeling requirement for the final end product:

The final end product must be labeled in a visible area with the following "Contains IC: 26839-2404B"

The Host Marketing Name (HMN) must be indicated at any location on the exterior of the host product or product packaging or product literature, which shall be available with the host product or online.

This radio transmitter [ IC:26839-2404B] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Frequency range	Manufacturer	Peak gain	Impedance	Antenna type
2402~2480MHz	Shenzhen Be-Comfortable Technology Co. Ltd	4.35dBi	50 Ω	FPC Antenna
2412~2462MHz	Shenzhen Be-Comfortable Technology Co. Ltd	4.35dBi	50 Ω	FPC Antenna
5150-5250 MHz	Shenzhen Be-Comfortable Technology Co. Ltd	4.17dBi	50 Ω	FPC Antenna
5250-5350 MHz	Shenzhen Be-Comfortable Technology Co. Ltd	4.43dBi	50 Ω	FPC Antenna
5470-5725 MHz	Shenzhen Be-Comfortable Technology Co. Ltd	4.43dBi	50 Ω	FPC Antenna
5725-5850 MHz	Shenzhen Be-Comfortable Technology Co. Ltd	4.19dBi	50 Ω	FPC Antenna