FSC-BW5028MV

DATASHEET V1.0

Revision History

Version	Data	Notes	Author
V1.0	2025-11-06	Initial Version	Liu

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1 INTRODUCTION

Overview

FSC-BW5028MV is a highly integrated module that features a low power 2x2 802.11a/b/g/n/ac/ax/ be dual-band Wi-Fi subsystem and a Bluetooth v5.4 subsystem, offering feature-rich wireless connectivity at high standards, and delivering reliable, cost-effective throughput from an extended distance.

Optimized RF architecture and baseband algorithms provide superb performance and low power consumption. Intelligent MAC design deploys a high-efficiency offload engine and hardware data processing accelerators which fully offload Wi-Fi tasks of the host processor. FSC-BW5028MV is designed to support standard based features in the areas of security, quality of service and international regulations giving end users the greatest performance at any time and under any circumstances.

FSC-BW5028MV is designed to support high data throughput over Wi-Fi. The host interface PCIe 2.1 is integrated to provide stable bandwidth between the host platform and FSC-BW5028MV. The clock rate of the internal bus fabric can also support the throughput requirement. The clock rate of MCU is also configurable for different kinds of scenarios.

FSC-BW5028MV supports low power requirement. Multiple power domains are implemented on-chip. It defines a deep sleep mode, in which only the AON domain is powered on, while other OFF domains are shut off by the power switches integrated on chip. In deep sleep mode, the PMU could be further configured to be in a low power state to save the power consumption.

FSC-BW5028MV has the Wi-Fi MAC, BBP, and the RF subsystems, which provide the best-in-class radio and low power performance, integrates coexistence with 4G.

The FSC-BW5028MV offers automotive Grade 3 (–40°C to +85°C) ambient operating temperature performance, while being AEC-Q100 Group A Grade 3 compliant.

General Features

- 32-bit RISC MCU for Wi-Fi/Bluetooth protocols and Wi-Fi offload
- Embedded SRAM/ROM
- Programmable and multiplexed GPIO pins
- USB device fully compliant with USB v2.0 specification
- PCIe device fully compliant with PCIe v2.1 specification
- Advanced FDD/TDD mode Wi-Fi/Bluetooth coexistence scheme

WLAN Features

- IEEE 802.11 a/b/g/n/ac/ax/be compliant
- Support 20/40 MHz bandwidth in 2.4GHz
- Support 20/40/80/160 MHz bandwidth in 5GHz and 6GHz
- Support MU-MIMO RX
- Support STBC, LDPC, TX Beamformer and RX Beamformer
- Greenfield, mixed mode, and legacy modes support

- IEEE 802.11 d/e/h/i/j/k/mc/r/v/w support
- Security support for WFA WPA/WPA2/WPA3 personal/enterprise. WPS2.0, FIPS
- QoS support of WFA WMM, WMM PS
- Integrated LNA, PA, and T/R switch
- Interface: PCIE2.1

Bluetooth Features

- Bluetooth v5.4 with BLE (BT low energy)
- Supports BT/BLE dual mode
- Supports 7 BT links and 16 BLE link
- Supports SCO and eSCO link with re-transmission
- Supports wide-band speech
- Supports wide-band speech and hardware accelerated SBC(Sub-Band Codec) for A2DP streaming
- Supports Packet Loss Concealment (PLC) function for better voice quality
- Supports LE Isochronous channels
- Supports secure connection with AES128
- Channel quality-driven data rate adaptation
- Channel assessment and WB RSSI for AFH

2 General Specifications

Table 2-1：General Specifications

Categories	Features	Implementation
Bluetooth		
	Chip	MT7925VEN
	Bluetooth Standard	Support Bluetooth 5.4
	Frequency Band	2.402GHz ~ 2.480GHz
	RF Input Impedance	50 ohms
	Interface	USB, PCM/I2S
	Antenna	External
	Support mode	Slave and Master
	Profiles	HFP/A2DP/AVRCP/PBAP/SPP/PAN/FTP/GATT/ANCS/HID
WLAN		
	Wi-Fi feature	2.4GHz: IEEE802.11 b/g/n/ax/be radio 5GHz: IEEE802.11 a/n/ac/ax/be radio 6GHz: IEEE802.11 ax/be radio
	Frequency Band	2.4GHz /5GHz/6GHz
	RF Input Impedance	50 ohms
	Interface	PCIe
	Antenna	External
	Profiles	AP/Station/P2P
	Security	WAPI STA, WPA, WPA2, AES, TKIP, WPA3
Operate Condition		Max. (mA)@25°
	VDD	3.3V 2A
	VDD_IO	1.8V 500mA
	Operating Temperature	-40°C to +85°C
	Storage temperature	-40°C to +105°C
	Humidity	10% ~ 90% Non-Condensing
Dimension		23mm(W) x 23mm(L) x 2.2mm(H) (without shielding cover) 23mm(W) x 23mm(L) x 3.0mm(H) (with shielding cover)

3 HARDWARE SPECIFICATION

3.1 Block Diagram and PIN Diagram

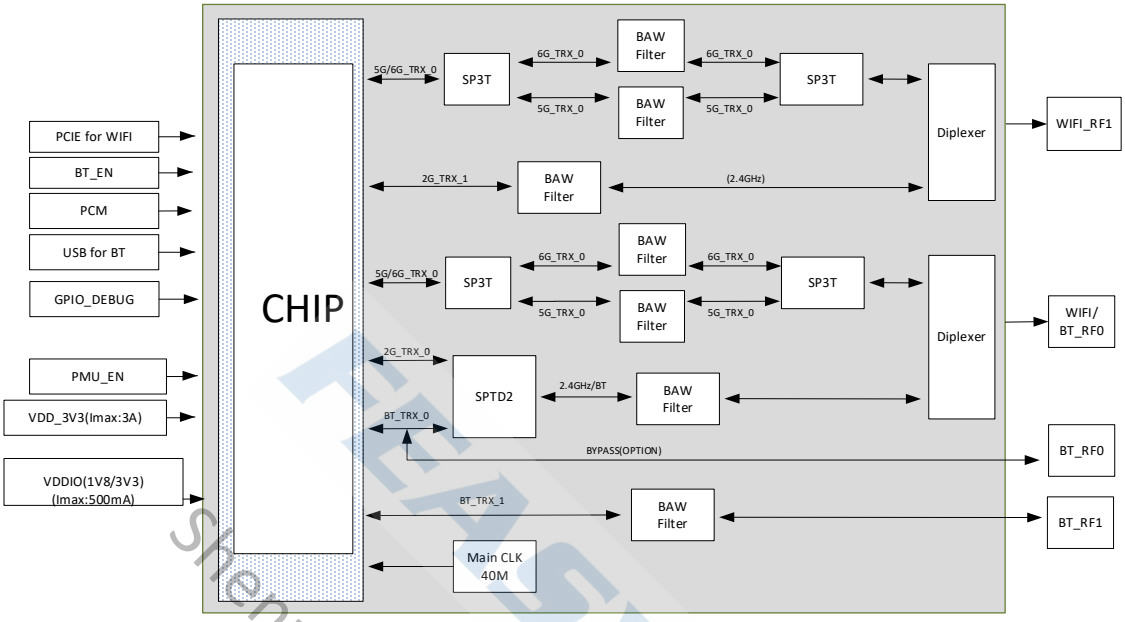


Figure 3-1-1: FSC-BW5028MV Block Diagram

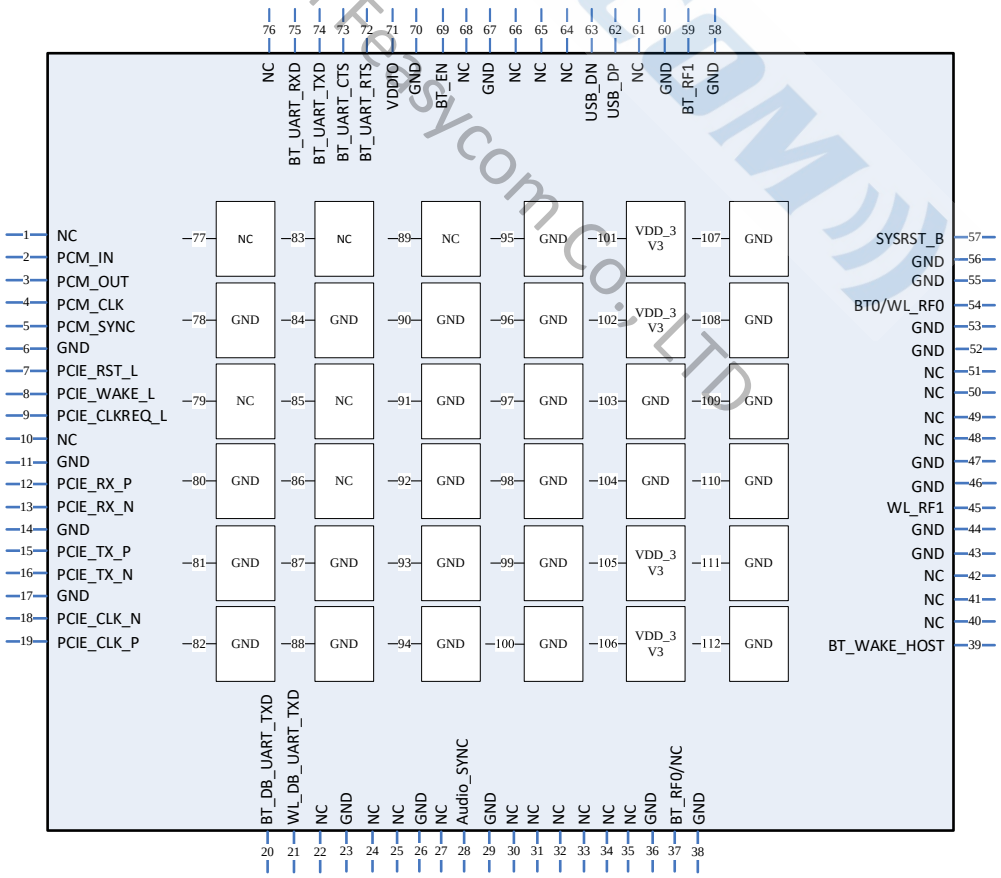


Figure 3-1-2: FSC-BW5028MV PIN Diagram (Top View)

3.2 PIN Definition Descriptions

LGA package, as shown in the figure below.

Figure 3-2-1: FSC-BW5028MV Package Module Appearance

3.3 PIN Definition Descriptions

Table 3-2： Pin definition

Pin	Pin Name	Type	Pin Descriptions	Notes
1	NC	NC	Not Connected	
2	PCM_IN	I	BT PCM/I2S Bus Data in	
3	PCM_OUT	O	BT PCM/I2S Bus Data out	
4	PCM_CLK	I	BT PCM/I2S Bus Clock in	
5	PCM_SYNC	I	BT PCM/I2S Bus Frame sync BT	
6	GND	GND	Ground	
7	PCIE_RST_L	I	PCI express reset with weak pull-down	
8	PCIE_WAKE_L	O	Request to service a function -initiated Wake Event	
9	PCIE_CLKREQ_L	O	Reference clock request	
10	NC	NC	Not Connected	
11	GND	GND	Ground	
12	PCIE_RX_P	I	PCI Express Receive Differential Pair	
13	PCIE_RX_N	I	PCI Express Receive Differential Pair	
14	GND	GND	Ground	
15	PCIE_TX_P	O	PCI Express Transmit Differential Pair	
16	PCIE_TX_N	O	PCI Express Transmit Differential Pair	
17	GND	GND	Ground	
18	PCIE_CLK_N	I	PCI Express Differential Reference CLK	
19	PCIE_CLK_P	I	PCI Express Differential Reference CLK	
20	BT_DB_UART_TXD	O	GPIO For DEBUG	
21	WL_DB_UART_ TXD	O	GPIO For DEBUG	
22	NC	NC	Not Connected	
23	GND	GND	Ground	
24	NC	NC	Not Connected	

25	NC	NC	Not Connected
26	GND	GND	Ground
27	NC	NC	Not Connected
28	Audio SYNC	I	Bluetooth communication time synchronization, reducing latency, If not use, please NC
29	GND	GND	Ground
30	NC	NC	Not Connected
31	NC	NC	Not Connected
32	NC	NC	Not Connected
33	NC	NC	Not Connected
34	NC	NC	Not Connected
35	NC	NC	Not Connected
36	GND	GND	Ground
37	BT_RF0/NC	RF/NC	BT RF input/output port0. (Optional inside the module)/NC
38	GND	GND	Ground
39	BT_WAKE_HOST	O	Bluetooth wake up the host
40	NC	NC	Not Connected
41	NC	NC	Not Connected
42	NC	NC	Not Connected
43	GND	GND	Ground
44	GND	GND	Ground
45	WL_RF1	RF	WIFI 2.4G/5G/6G RF input/output port 1
46	GND	GND	Ground
47	GND	GND	Ground
48	NC	NC	Not Connected
49	NC	NC	Not Connected
50	NC	NC	Not Connected
51	NC	NC	Not Connected
52	GND	GND	Ground
53	GND	GND	Ground
54	BT0/WL_RF0	I/O	BT 2.4G/WIFI 2.4/ 5G/6G RF input/output port 0
55	GND	GND	Ground
56	GND	GND	Ground
57	SYSRST_B	I	External system reset active low
58	GND	GND	Ground
59	BT_RF1	RF	BT RF input/output port0
60	GND	GND	Ground
61	NC	NC	Not Connected
62	USB_DP	I/O	USB D+ Signal
63	USB_DN	I/O	USB D- Signal

64	NC	NC	Not Connected
65	NC	NC	Not Connected
66	NC	NC	Not Connected
67	GND	GND	Ground
68	NC	NC	Not Connected
69	BT_EN	I	Bluetooth enable signal. Active high is low in reset
70	GND	GND	Ground
71	VDDIO	PI	1.8 V/3.3V supply for IO
72	BT_UART_RTS	I/O	UART request-to-send. Active- low request-to-send signal for the HCI UART Interface. If not use, please NC
73	BT_UART_CTS	I/O	UART clear-to-send Active-low request-to-send signal for the HCI UART interface. If not use, please NC
74	BT_UART_TXD	O	UART serial output. Serial data output for the HCI UART interface. If not use, please NC
75	BT_UART_RXD	I	UART serial input. Serial data input for the HCI UART interface. If not use, please NC
76	NC	NC	Not Connected
77	NC	NC	Not Connected
78	GND	GND	Ground
79	NC	NC	Not Connected
80	GND	GND	Ground
81	GND	GND	Ground
82	GND	GND	Ground
83	NC	NC	Not Connected
84	GND	GND	Ground
85	NC	NC	Not Connected
86	NC	NC	Not Connected
87	GND	GND	Ground
88	GND	GND	Ground
89	NC	NC	Not Connected
90	GND	GND	Ground
91	GND	GND	Ground
92	GND	GND	Ground
93	GND	GND	Ground
94	GND	GND	Ground
95	GND	GND	Ground
96	GND	GND	Ground
97	GND	GND	Ground
98	GND	GND	Ground
99	GND	GND	Ground
100	GND	GND	Ground

101	VDD_3V3	PI	3.3 V supply for Power
102	VDD_3V3	PI	3.3 V supply for Power
103	GND	GND	Ground
104	GND	GND	Ground
105	VDD_3V3	PI	3.3 V supply for Power
106	VDD_3V3	PI	3.3 V supply for Power
107	GND	GND	Ground
108	GND	GND	Ground
109	GND	GND	Ground
110	GND	GND	Ground
111	GND	GND	Ground
112	GND	GND	Ground

4 ELECTRICAL CHARACTERISTICS

4.1 Power Condition

Table 4-1：

Parameter	Min	Type	Max	Unit
VDD_3V3	2.97	3.3	3.63	V
VDDIO(1V8/3V3)	1.7 2.97	1.8 3.3	1.9 3.63	V
Operating temperature range	-40	-	+85	℃
Storage temperature range	-40	-	+105	℃

5 Module RF Performances

5.1 WLAN Performances

5.1.1 WLAN 2.4GHz Receiver Characteristics

Table 5-1-1：WLAN 2.4GHz Receiver Characteristics

Parameter	Mode	Data rate	Modulation	Std	Unit
Frequency Range				2.412～2.472	GHz
RX Sensitivity	802.11b	1Mbps	CCK	-93	dBm
		11Mbps	CCK	-86	dBm
	802.11g	6 Mbps	BPSK	-91	dBm
		54 Mbps	QAM64	-73	dBm
	802.11n HT20	MCS0	BPSK	-91	dBm
		MCS7	QAM64	-72	dBm
	802.11n HT40	MCS0	BPSK	-88	dBm
		MCS7	QAM64	-68	dBm
	802.11ax HE20	MCS0	BPSK	-91	dBm
		MCS11	QAM1024	-61	dBm
	802.11ax HE40	MCS0	BPSK	-88	dBm
		MCS11	QAM1024	-58	dBm
	802.11be EHT20	MCS0	BPSK	-90	dBm
		MCS13	QAM4096	-54	dBm
	802.11be EHT40	MCS0	BPSK	-88	dBm
		MCS13	QAM4096	-52	dBm

5.1.2 WLAN 2.4GHz Transmitter Power

Table 5-1-2：WLAN 2.4GHz Transmitter Power

Parameter	Mode	Data rate	Modulation	Std	Unit
Frequency Range				2.412～2.472	GHz
TX output Power	802.11b	1Mbps	CCK	18	dBm
		11Mbps	CCK	17	dBm
	802.11g	6 Mbps	BPSK	18	dBm
		54 Mbps	QAM64	15	dBm
	802.11n HT20	MCS0	BPSK	18	dBm
		MCS7	QAM64	14	dBm
	802.11n HT40	MCS0	BPSK	16	dBm
		MCS7	QAM64	14	dBm
	802.11ax HE20	MCS0	BPSK	18	dBm

		MCS7	QAM64	15	dBm
		MCS9	QAM256	14	dBm
		MCS11	QAM1024	13	dBm
	802.11ax HE40	MCS0	BPSK	16	dBm
		MCS7	QAM64	15	dBm
		MCS9	QAM256	14	dBm
		MCS11	QAM1024	13	dBm
	802.11be EHT20	MCS0	BPSK	18	dBm
		MCS7	QAM64	15	dBm
		MCS11	QAM1024	12	dBm
		MCS13	QAM4096	11	dBm
	802.11be EHT40	MCS0	BPSK	16	dBm
		MCS7	QAM64	15	dBm
		MCS11	QAM1024	12	dBm
		MCS13	QAM4096	11	dBm

5.2 WLAN 5 GHz Radio Characteristics

5.2.1 WLAN 5 GHz Rx RF Characteristics

Table 5-2-1： WLAN 5 GHz Rx RF Characteristics

Parameter	Mode	Data rate	Modulation	Std	Unit
Frequency Range				5.180～5.850	GHz
RX Sensitivity	802.11a	6 Mbps	BPSK	-88	dBm
		54 Mbps	QAM64	-72	dBm
	802.11n HT20	MCS0	BPSK	-88	dBm
		MCS7	QAM64	-70	dBm
	802.11n HT40	MCS0	BPSK	-86	dBm
		MCS7	QAM64	-68	dBm
	802.11ac VHT20	MCS0	BPSK	-88	dBm
		MCS8	QAM256	-66	dBm
	802.11ac VHT40	MCS0	BPSK	-86	dBm
		MCS9	QAM256	-62	dBm
	802.11ac VHT80	MCS0	BPSK	-84	dBm
		MCS9	QAM256	-59	dBm
	802.11ac VHT160	MCS0	BPSK	-80	dBm
		MCS9	QAM256	-55	dBm
	802.11ax HE20	MCS0	BPSK	-88	dBm
		MCS11	QAM1024	-59	dBm

	802.11ax HE40	MCS0	BPSK	-85	dBm
		MCS11	QAM1024	-56	dBm
	802.11ax HE80	MCS0	BPSK	-83	dBm
		MCS11	QAM1024	-52	dBm
	802.11ax HE160	MCS0	BPSK	-80	dBm
		MCS11	QAM1024	-49	dBm
	802.11be EHT20	MCS0	BPSK	-88	dBm
		MCS13	QAM4096	-52	dBm
	802.11be EHT40	MCS0	BPSK	-85	dBm
		MCS13	QAM4096	-49	dBm
	802.11be EHT80	MCS0	BPSK	-83	dBm
		MCS13	QAM4096	-48	dBm
	802.11be EHT160	MCS0	BPSK	-80	dBm
		MCS13	QAM4096	-43	dBm

5.2.2 WLAN 5 GHz Transmitter Power

Table 5-2-2： WLAN 5 GHz Transmitter Power

Parameter	Mode	Data rate	Modulation	Std	Unit
Frequency Range				5.180～5.850	GHz
TX output Power	802.11a	6 Mbps	BPSK	16	dBm
		54 Mbps	QAM64	12	dBm
	802.11n HT20	MCS0	BPSK	16	dBm
		MCS7	QAM64	13	dBm
	802.11n HT40	MCS0	BPSK	15	dBm
		MCS7	QAM64	12	dBm
	802.11ac VHT20	MCS0	BPSK	16	dBm
		MCS8	QAM256	12	dBm
	802.11ac VHT40	MCS0	BPSK	15	dBm
		MCS9	QAM256	11	dBm
	802.11ac VHT80	MCS0	BPSK	15	dBm
		MCS9	QAM256	11	dBm
	802.11ac VHT160	MCS0	BPSK	12	dBm
		MCS9	QAM256	9	dBm
	802.11ax HE20	MCS0	BPSK	16	dBm
		MCS11	QAM1024	11	dBm
	802.11ax HE40	MCS0	BPSK	15	dBm
		MCS11	QAM1024	11	dBm
	802.11ax HE80	MCS0	BPSK	15	dBm
		MCS11	QAM1024	9	dBm

	802.11ax HE160	MCS0	BPSK	12	dBm
		MCS11	QAM1024	8	dBm
	802.11be EHT20	MCS0	BPSK	16	dBm
		MCS13	QAM4096	9	dBm
	802.11be EHT40	MCS0	BPSK	15	dBm
		MCS13	QAM4096	9	dBm
	802.11be EHT80	MCS0	BPSK	15	dBm
		MCS13	QAM4096	8	dBm
	802.11be EHT160	MCS0	BPSK	12	dBm
		MCS13	QAM4096	6	dBm

5.3 WLAN 6 GHz Radio Characteristics

5.3.1 WLAN 6 GHz Rx RF Characteristics

Table 5-3-1： WLAN 6 GHz Rx RF Characteristics

Parameter	Mode	Data rate	Modulation	Std	Unit
Frequency Range				5.955～7.115	GHz
RX Sensitivity	802.11ax HE20	MCS0	BPSK	-88	dBm
		MCS11	QAM1024	-59	dBm
	802.11ax HE40	MCS0	BPSK	-85	dBm
		MCS11	QAM1024	-56	dBm
	802.11ax HE80	MCS0	BPSK	-83	dBm
		MCS11	QAM1024	-52	dBm
	802.11ax HE160	MCS0	BPSK	-80	dBm
		MCS11	QAM1024	-49	dBm
	802.11be EHT20	MCS0	BPSK	-88	dBm
		MCS13	QAM4096	-52	dBm
	802.11be EHT40	MCS0	BPSK	-85	dBm
		MCS13	QAM4096	-49	dBm
	802.11be EHT80	MCS0	BPSK	-83	dBm
		MCS13	QAM4096	-48	dBm
	802.11be EHT160	MCS0	BPSK	-80	dBm
		MCS13	QAM4096	-43	dBm

5.3.2 WLAN 6 GHz Transmitter Power

Table 5-3-2：WLAN 6 GHz Transmitter Power

Parameter	Mode	Data rate	Modulation	Std	Unit
Frequency Range				5.180～5.850	GHz
TX output Power	802.11ax HE20	MCS0	BPSK	14	dBm
		MCS11	QAM1024	9	dBm
	802.11ax HE40	MCS0	BPSK	13	dBm
		MCS11	QAM1024	9	dBm
	802.11ax HE80	MCS0	BPSK	12	dBm
		MCS11	QAM1024	8	dBm
	802.11ax HE160	MCS0	BPSK	10	dBm
		MCS11	QAM1024	6	dBm
	802.11be EHT20	MCS0	BPSK	14	dBm
		MCS13	QAM4096	7	dBm
	802.11be EHT40	MCS0	BPSK	13	dBm
		MCS13	QAM4096	6	dBm
	802.11be EHT80	MCS0	BPSK	12	dBm
		MCS13	QAM4096	6	dBm
	802.11be EHT160	MCS0	BPSK	10	dBm
		MCS13	QAM4096	3.5	dBm

5.4 BT Performance

5.4.1 BT Performance

Table 5-4-1：BT Performance

Parameter	Condition	Std	Unit
Test frequency range	2402 to 2480		MHz
Step size of Power Control	Channel 0	2～8	dB
	Channel 39		dB
	Channel 78		dB
ICFT (Initial Carrier Frequency Tolerance)	Channel 0	-75～75	KHz
	Channel 39		KHz
	Channel 78		KHz
Output Power	Channel 0	-6～12	dBm
	Channel 39		dBm
	Channel 78		dBm

Carrier Frequency Drift	Channel: 0	DH1	-25～25	KHz
		DH1 Drift rata/50us	-20～20	KHz
		DH3	-40～40	KHz
		DH3 Drift rata/50us	-20～20	KHz
		DH5	-40～40	KHz
		DH5 Drift rata/50us	-20～20	KHz
	Channel: 39	DH1	-25～25	KHz
		DH1 Drift rata/50us	-20～20	KHz
		DH3	-40～40	KHz
		DH3 Drift rata/50us	-20～20	KHz
		DH5	-40～40	KHz
		DH5 Drift rata/50us	-20～20	KHz
	Channel: 78	DH1	-25～25	KHz
		DH1 Drift rata/50us	-20～20	KHz
		DH3	-40～40	KHz
		DH3 Drift rata/50us	-20～20	KHz
		DH5	-40～40	KHz
		DH5 Drift rata/50us	-25～25	KHz
Modulation characteristic	Channel: 0	Df1avg	140～175	KHz
		Df2avg	≥115	KHz
		Df2avg/Df1avg	≥0.8	
	Channel: 39	Df1avg	140～175	KHz
		Df2avg	≥115	KHz
		Df2avg/Df1avg	≥0.8	
	Channel: 78	Df1avg	140～175	KHz
		Df2avg	≥115	KHz
		Df2avg/Df1avg	≥0.8	
Sensitivity (single/ multi slot packets) （Power=-70dBm)		Channel 0	BER ≤ 0.1%	
		Channel 39	BER ≤ 0.1%	
		Channel 78	BER ≤ 0.1%	
Maximum input Level （Power=-20dBm)		Channel 0	BER ≤ 0.1%	
		Channel 39	BER ≤ 0.1%	
		Channel 78	BER ≤ 0.1%	

5.4.2 BT EDR Performance

Table 5-4-2： BT EDR Performance

Parameter		Condition	Std	Unit
Test frequency range		2402 to 2480		MHz
EDR relative power	Channel: 0 Channel: 39 Channel: 78	PGFSK PDPSK PGFSK PDPSK PGFSK PDPSK	-4dB < PDPSK- PGFSK < + 1dB	dB dB dB dB dB dB
EDR carry frequency accuracy and modulation accuracy	Channel: 0 Channel: 39 Channel: 78	RMS DEVM(EDR2) RMS DEVM(EDR3) 99% DEVM(EDR2) 99% DEVM(EDR3) Peak DEVM(EDR2) Peak DEVM(EDR3)	< 0.2 < 0.13 < 0.3 < 0.2 < 0.35 < 0.25	
Sensitivity (Power=-70dBm)	Channel: 0 Channel: 39 Channel: 78	EDR2 EDR3	BER≤0.1% BER≤0.1%	
Maximum input Level (Power=-20dBm)	Channel: 0 Channel: 39 Channel: 78	EDR2 EDR3	BER≤0.1% BER≤0.1%	

5.4.3 BT BLE Performance

Table 5-4-3： BT BLE Performance

Parameter		Condition	Std	Unit
Test frequency range		2402 to 2480		MHz
ICFT (Initial Carrier Frequency Tolerance)		Channel: 0 Channel: 19 Channel: 39	-100～100	KHz KHz KHz
Output Power		Channel: 0 Channel: 19 Channel: 39	-6～12	dBm dBm dBm
Carrier Frequency Drift		Channel: 0 Channel: 19 Channel: 39	-25～25	KHz KHz KHz
Modulation characteristic	Channel: 0	Df1avg Df2avg Df2avg/Df1avg	225～275 ≥185 ≥0.8	KHz KHz
	Channel:19	Df1avg Df2avg Df2avg/Df1avg	225～275 ≥185 ≥0.8	KHz KHz

	Channel: 39	Df1avg Df2avg Df2avg/Df1avg	225～275 ≥185 ≥0.8	KHz KHz
Sensitivity (Power=-70dBm)	Channel: 0 Channel: 19 Channel: 39	Power=-70dBm Power=-70dBm Power=-70dBm	BER≤0.1% BER≤0.1% BER≤0.1%	
Maximum input Level (Power=-20dBm)	Channel: 0 Channel: 19 Channel: 39	Power=-70dBm Power=-70dBm Power=-70dBm	BER≤0.1% BER≤0.1% BER≤0.1%	

6 Reliability Test

6.1 Reliability Test Standard

Table 6-1-1： WLAN 2.4G Performance

Item	Condition	mode	rate	Unit	Std
Transmitter Power	@2412/2437/2462MHz	DSSS CCK	11Mbps 54Mbps	dBm dBm	12～20 8～20
EVM	@2412/2437/2462MHz	DSSS	1Mbps 54Mbps	dB dB	≤-10 ≤-25
Receiver sensitivity	At < 10% PER limit @2412/2437/2462MHz	11b mode: DSSS (PER<8%) 11g mode: OFDM (PER<10%)	11Mbps 54Mbps	dBm dBm	≤-82 ≤-65

Table 6-1-2： WLAN 5G Performance

Item	Condition	mode	rate	Unit	Std
Transmitter Power	@5210/5530/5745MHz	11be OFDMA	MCS13	dBm	4～18
EVM	@5210/5530/5745MHz	11be OFDMA	MCS13	dB	≤-38
Receiver sensitivity	@5210/5530/5745MHz	11be OFDMA	MCS13	dBm	≤-40

Table 6-1-3： WLAN 6G Performance

Item	Condition	mode	rate	Unit	Std
Transmitter Power	@5985/6465/6945MHz	11be OFDMA	MCS13	dBm	2～16
EVM	@5985/6465/6945MHz	11be OFDMA	MCS13	dB	≤-38
Receiver sensitivity	@5985/6465/6945MHz	11be OFDMA	MCS13	dBm	≤-40

Table 6-1-4： BT Performance

Parameter	Condition	Std	Unit
Test frequency	2402(Channel0) 2441(Channel39) 2480(Channel78)		MHz
BR Output Power		-6～12	dBm
single/ multi slot packets Sensitivity (Power=-70dBm)	Power-70dBm	BER≤ 0.1%	

7 PHYSICAL INTERFACE

7.1 USB INTERFACE

FSC-BW5028MV supports a USB device port that is fully compliant with the Universal Serial Bus Specification, Revision 2.0 (USB 2.0 specification). It supports high-speed and full-speed modes, suspend/resume signaling, as well as remote wake-up signaling.

7.2 Bluetooth PCM interface

The pulse-code modulation (PCM) interface connects the FSC-BW5028MV device to the phone's audio interface or to peripheral devices such as a codec. The PCM interface circuits use digital I/O pins that receive power from the VDD I/O supply. The FSC-BW5028MV PCM interface is designed to minimize audio latency.

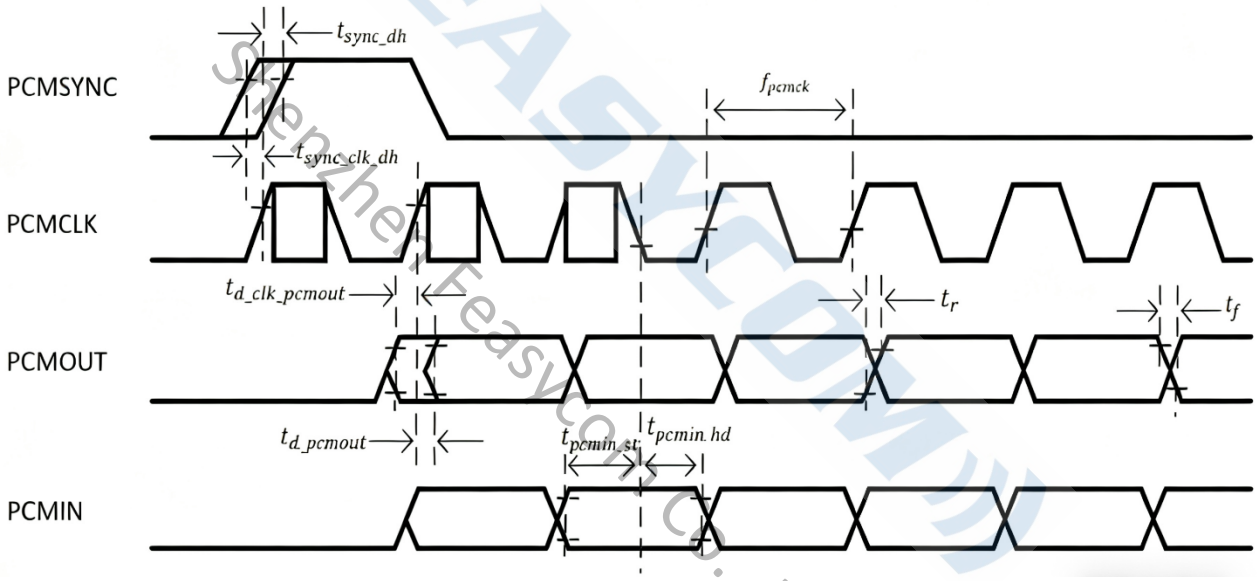


Figure 7-2-1: PCM interface timing diagram

Table 7-2-2： PCM interface timing

Symbol	Description	Mode	Min.	Typ.	Max.	Unit
fpcmck	PCM_CLK frequency	Master	128	-	2048	kHz
-	Frequency variation	Master	0	-	5	%
-	Clock duty cycle	Master	-	50	-	%
tsync_dh	Delay time from PCM_CLK high to PCM_SYNC high	Master/Slave	0	-	50	ns
tsync_clk_dh	Delay time from PCM_SYNC high to PCM_CLK high	Master/Slave	0	-	50	ns
td_pcmout	Delay time from PCM_CLK high to PCM_OUT change	Master/Slave	0	-	180	ns
td_clk_pcmout	Delay time from PCM_OUT change to PCM_CLK high	Master/Slave	0	-	50	ns

tf	PCM_OUT falling time from high to low	Master/Slave	-	-	20	ns
tr	PCM_OUT falling time from low to high	Master/Slave	-	-	20	ns
tpcmin_st	Setup time for PCM_IN valid to PCM_CLK low	Slave	50	-	-	ns
tpcmin_hd	Hold time for PCM_CLK low to PCM_IN invalid	Slave	180	-	-	ns

8 MSL & ESD

Table 8-1: MSL and ESD

Parameter	Value	Test method
MSL grade	MSL 3	
ESD grade	Electrostatic discharge	
ESD HBM(human body model) @RF pin		±2KV ±1KV
ESD CDM(charged device model) @RF pin		±500V ±250V

9 RECOMMENDED TEMPERATURE REFLOW PROFILE

Prior to reflow, it is crucial to ensure that the modules are properly packaged to prevent moisture absorption. The new packages are equipped with desiccants to absorb moisture, and a humidity indicator card is included to indicate the moisture level maintained during storage and shipment. If the card indicates the need to bake the units, please refer to the instructions specified by IPC/JEDEC J-STD-033 and follow them accordingly. It is important to adhere to these instructions to prevent any potential moisture-related issues during the reflow process.

Note: The shipping tray should not be exposed to temperatures exceeding 65°C. If baking is necessary at higher temperatures indicated below, it is essential to remove the modules from the shipping tray. This precaution is important to avoid any potential damage or deformation to the tray caused by excessive heat.

Any module that exceeds its floor life but has not yet been manufactured should be repackaged by using new desiccants and humidity indicator cards. For devices with a Moisture Sensitivity Level (MSL) of 3, the floor life is 168 hours in an environment with 30℃/60%RH.

Floor life refers to the maximum allowable time a moisture-sensitive device can be exposed to ambient conditions without risking moisture absorption and potential damage during soldering.

Notice (注意):

When using our modules, it is recommended to use a step steel mesh with a thickness of 0.16- 0.20mm. However, the thickness can be adjusted according to the adaptability of your own product.

使用我司模块，须使用阶梯钢网，建议阶梯钢网厚度0.16-0.20mm，可根据自己产品适应性，进行相应调整.

Table 9-1-1 Recommended baking times and temperatures

MSL	125°C Baking Temp.		90°C/≤ 5%RH Baking Temp.		40°C/ ≤ 5%RH Baking Temp.	
	Saturated @ 30°C/85%	Floor Life Limit + 72 hours @ 30°C/60%	Saturated @ 30°C/85%	Floor Life Limit + 72 hours @ 30°C/60%	Saturated @ 30°C/85%	Floor Life Limit + 72 hours @30°C/60%
3	9 hours	7 hours	33 hours	23 hours	13 days	9 days

Feasycom surface mount modules are designed to simplify manufacturing processes, such as reflow soldering on a PCB. However, Customers are responsible for selecting the appropriate solder paste and confirming that the oven temperatures during reflow meet with the specifications provided by the solder paste manufacturer. Notably, Feasycom surface mount modules adhere to the J-STD-020D1 standards for reflow temperatures.

The soldering profile may vary depending on different parameters, requiring a specific setup for each application. The data provided here is only intended as a general guideline for solder reflow and should be used as a reference.

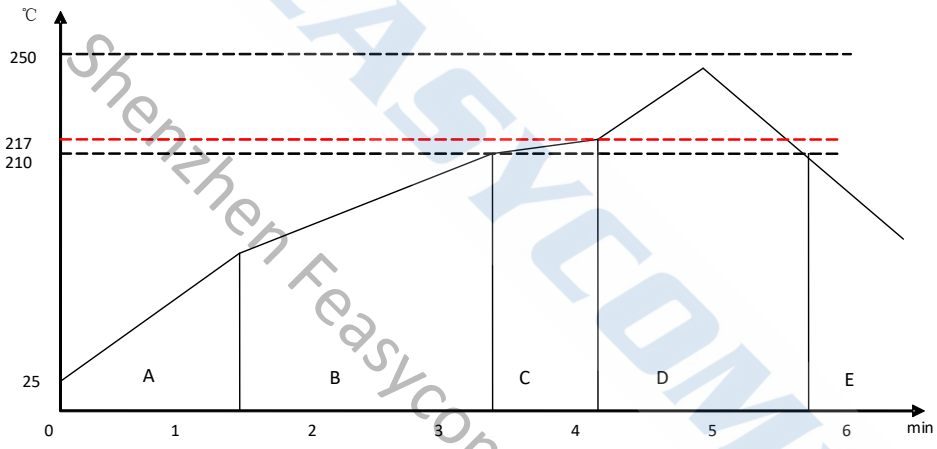


Figure 9-1-1： Typical Lead-free Re-flow

Pre-heat zone (A) — This zone gradually increases the temperature at a controlled rate, usually **ranging from 0.5 to 2 °C/s**. Its purpose is to preheat the PCB board and components to a temperature of 120-150 °C. This stage is necessary to ensure the even distribution of heat across the PCB board and to remove any remaining solvents completely, minimizing the risk of heat shock to the components.

Equilibrium Zone 1 (B) — In this stage, the flux undergoes softening and uniformly covers the solder particles, as well as spreading over the PCB board. This process helps prevent re-oxidation of the solder particles. Additionally, as the temperature rises and the flux liquefies, each activator and rosin component become activated. They work together to eliminate any oxide film formed on the surface of the solder particles and PCB board. **For this zone, it is recommended to maintain a temperature range of 150 to 210 °C for a duration of 60 to 120 seconds.**

Equilibrium Zone 2 (C) (optional) — To address the issue of upright components, it is recommended to maintain a temperature range of 210 to 217 °C for a duration of approximately 20 to 30 seconds. This will help ensure proper soldering and alignment of the components on the PCB board.

Reflow Zone (D) — The profile in the figure is designed for Sn/Ag3.0/Cu0.5. It can be a reference for other

lead-free solder. The peak temperature should be high enough to achieve good wetting but not so high as to cause component discoloration or damage. Excessive soldering time can lead to intermetallic growth which can result in a brittle joint. The recommended peak temperature (Tp) is 230 ~ 250 °C. The soldering time should be 30 to 90 second when the temperature is above 217 °C.

Cooling Zone (E) — The cooling ate should be fast, to keep the solder grains small which will give a longer-lasting joint. **Typical cooling rate should be 4 °C.**

10 MECHANICAL DETAILS

10.1 Mechanical Details

- Dimension: 23mm(W) x 23mm(L) x 2.2mm(H) Tolerance: ±0.2mm (without shielding cover)
  23mm(W) x 23mm(L) x 3.0mm(H) Tolerance: ±0.2mm (with shielding cover)
- Module size: 23mm X 23mm Tolerance: ±0.2mm
- Pad size: 1.1mm X 0.5mm,2.0mm X 2.0mm Tolerance: ±0.1mm
- Pad pitch: 1.0mm Tolerance: ±0.1mm

(分板后边角残留板边误差：≤ 0.5mm) (Residual plate edge error: ≤ 0.5mm)

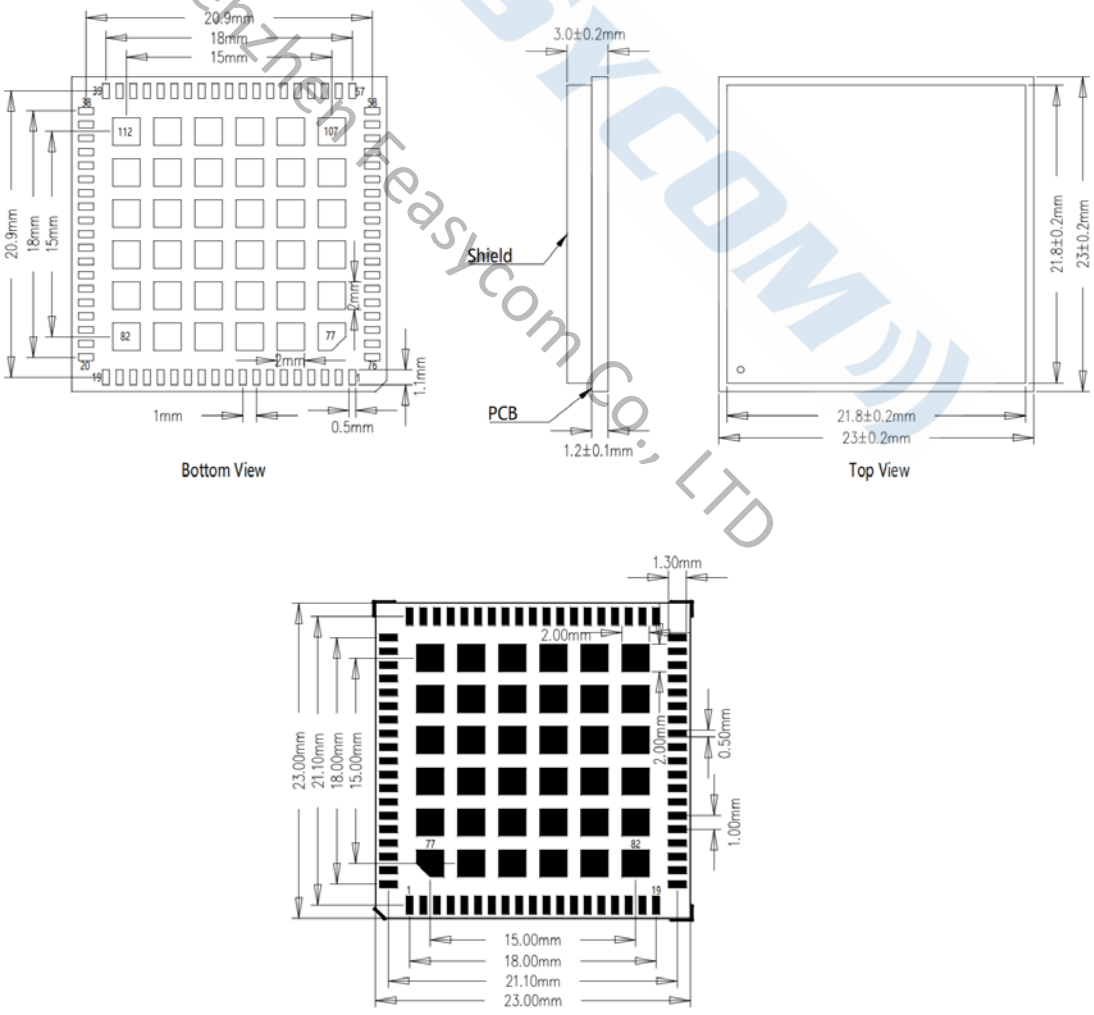


Figure 10-1-1：FSC-BW5028MV footprint Layout Guide (Top View)

11 HARDWARE INTEGRATION SUGGESTIONS

11.1 RF Circuit-RF pads

- Some RF components such as 0402-packaged RLC, connectors, or module pins are with large soldering pads, those pads have higher parasitic capacitance which can impact the characteristic impedance of RF traces.
- The GND under those pads shall be dug out, shown as below, for keeping good 50Ω matching.
- The dig-out layers and area should be calculated carefully, we recommend digging the area a little higher than the simulation results.

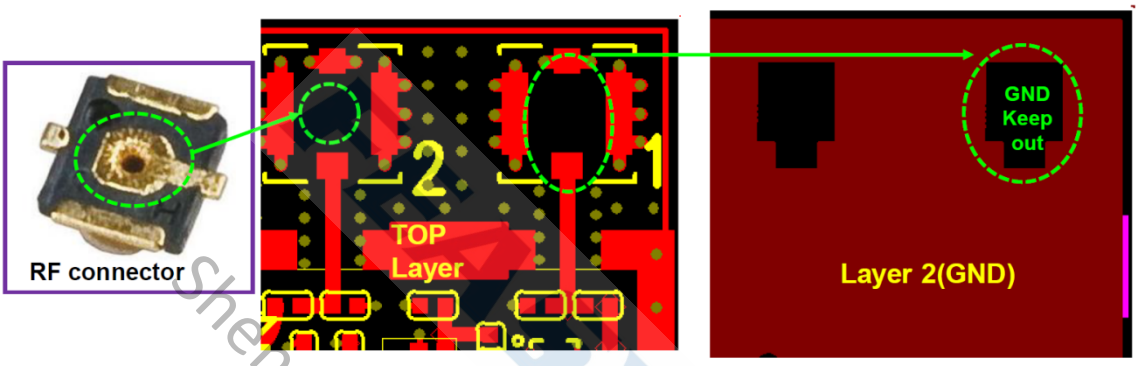


Figure 11-1-1: RF Circuit- RF pads

11.2 Recommendable antenna & IPEX by Feasycom

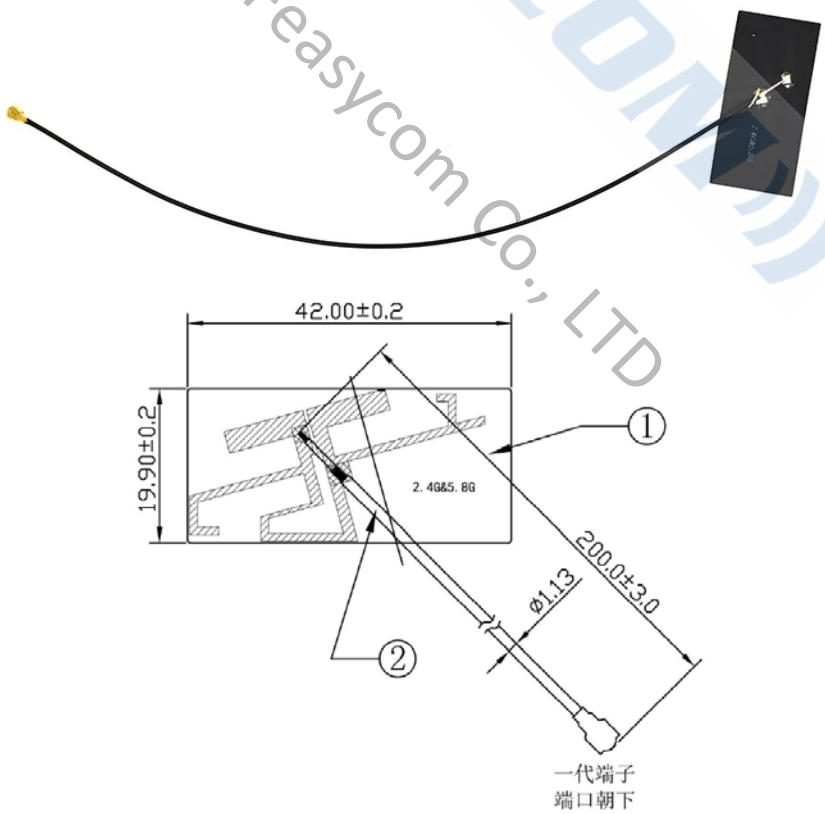


Figure 11-2-1: 2.4GHz & 5GHz Dual-band antenna, with IPEX first generation interface

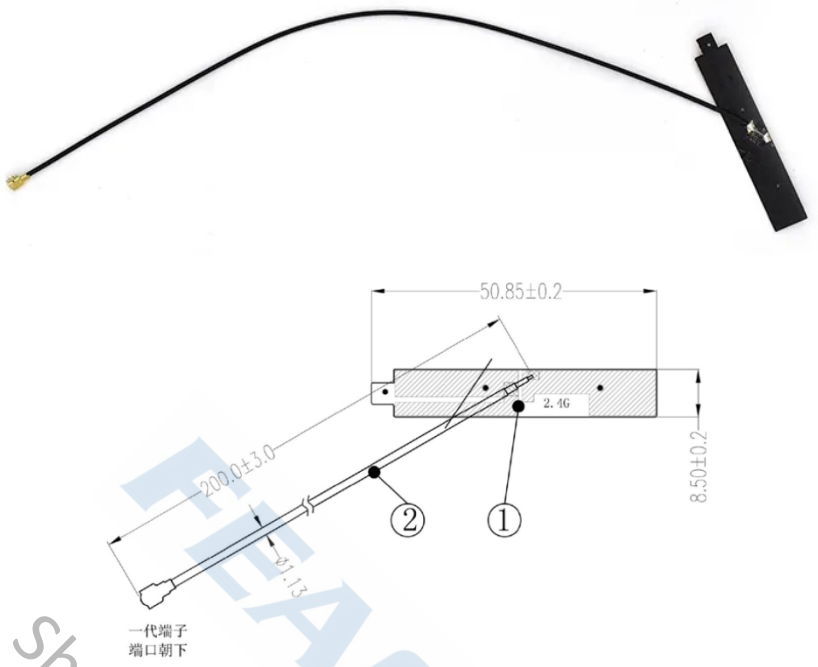
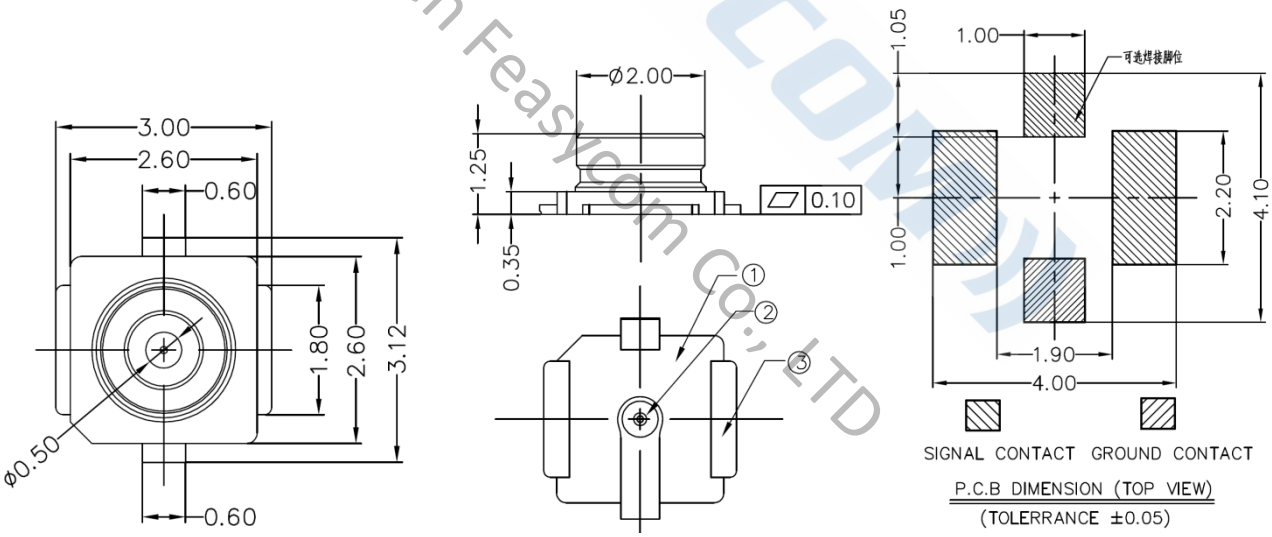


Figure 11-2-2: 2.4GHz antenna with IPEX first generation interface



3	GROUND CONTACT	1	JIS C5191-H	Au 1u" Min. over Ni 50~100u" Min.
2	CONTACT	1	JIS C2680-1/4H	Au 1u" Min. over Ni 50~100u" Min.
1	HOUSING	1	LCP E6808	UL94V-0,30% GF
ITEM	NAME	Q'TY	MATERIAL ⚠1	FINISH ⚠2

NOTES:
1. FREQUENCY RANGE:
   DC TO 6GHZ (VSWR: 1.3MAX AT 0.1~3GHZ, 1.4MAX AT 3~6GHZ)
2. CHARACTERISTIC IMPEDANCE: 50 (NOMINAL);
3. TEMPERATURE: -40°C TO +90°C;
4. RATED VOLTAGE : 60VAC;
5. CONTACT RESISTANCE :
   20m MAX.(SIGNAL CONTACT)
   20m MAX.(GROUND CONTACT)
6. WITHSTAND VOLTAGE : 200VAC FOR 1 MINUTE MIN;
7. INSULATION RESISTANCE : 500M MIN. AT 100VDC;
8. THIS COMPONENT IS HALOGEN FREE.

Figure 11-2-3: IPEX first generation interface

11.3 Soldering Recommendations

FSC-BW5028MV is compatible with the industrial standard reflow profile for Pb-free soldering. The specific reflow profile used depends on various factors, such as the thermal mass of the populated PCB, heat transfer efficiency of the oven and the type of solder paste used. It is advised to refer to the datasheet of the specific solder paste for profile configurations.

Feasycom provides the following recommendations for soldering the module to ensure reliable solder joints and proper module performance. However, since the optimal profile can vary based on the specific process and layout, these recommendations should be considered as a starting point guide and further evaluation based on the actual case is recommended.

11.4 Layout Guidelines (External Antenna)

The placement and PCB layout play a critical role in optimizing the performance of modules without on-board antenna designs. The trace connecting the antenna port of the module to an external antenna should have a characteristic impedance of 50Ω and should be kept as short as possible to prevent interference into the transceiver of the module. When positioning the external antenna and RF-IN port of the module, it is important to keep them away from any sources of noise and digital traces. To minimize return loss and achieve better impedance matching, a matching network may be required between the external antenna and RF-IN port.

To ensure proper RF performance, it is recommended to clearly separate the RF critical circuits of the module from any digital circuits on the system board. The RF circuits within the module are located near the antenna port. Therefore, the module should be placed in such a way that the module's digital part faces the digital section of the system PCB.

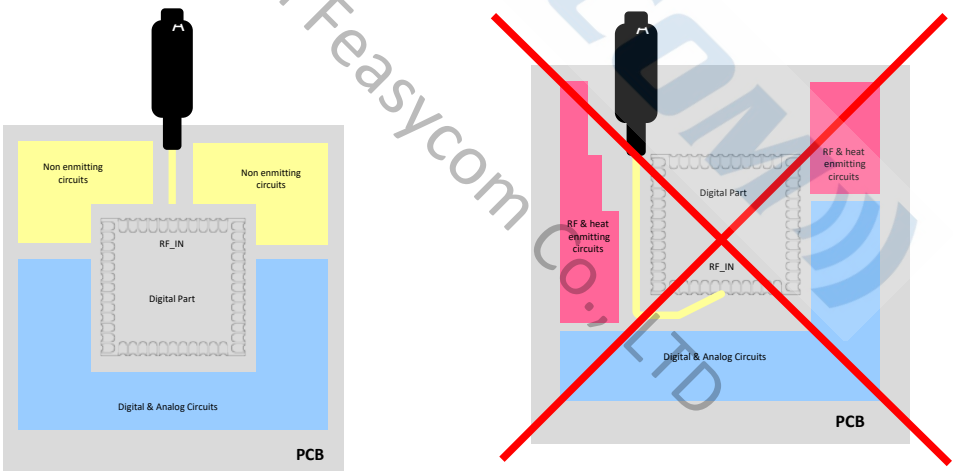


Figure 11-1-1: Placement the Module on a System Board

11.4.1 Antenna Connection and Grounding Plane Design

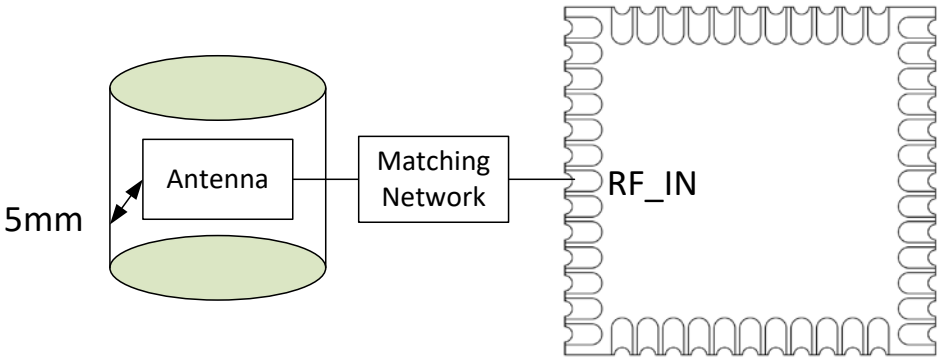


Figure 11-4-1-1: Leave 5mm Clearance Space from the Antenna

General design recommendations are:

- The length of the trace or connection line should be kept as short as possible.
- Distance between connection and ground area on the top layer should at least be as large as the dielectric thickness.
- Routing the RF close to digital sections of the system board should be avoided.
- To reduce signal reflections, sharp angles in the routing of the micro strip line should be avoided. Chamfers or fillets are preferred for rectangular routing; 45-degree routing is preferred over Manhattan style
- 90-degree routing.

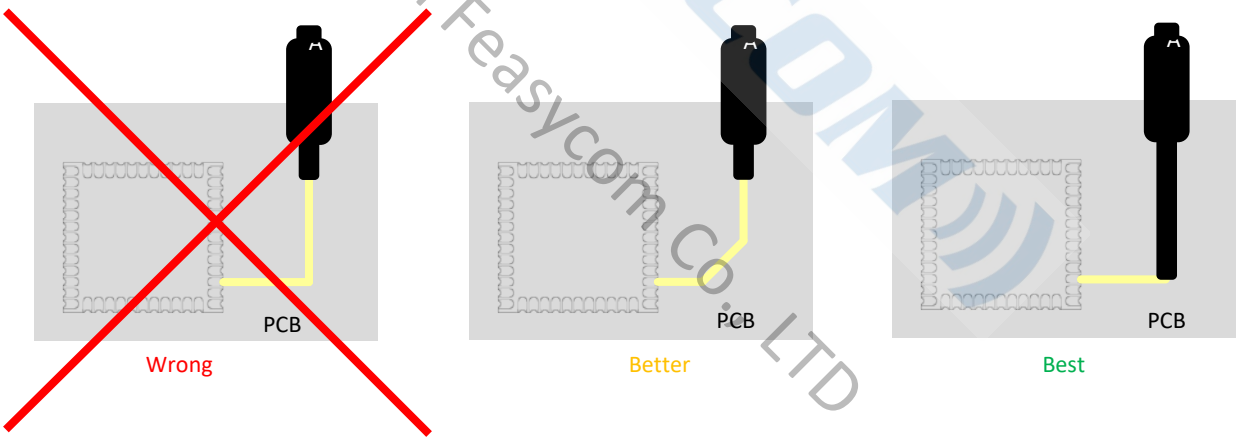


Figure 11-4-1-2: Recommended Trace Connects Antenna and the Module

- Routing of the RF-connection underneath the module should be avoided. The distance of the micro strip line to the ground plane on the bottom side of the receiver is very small and has huge tolerances. Therefore, the impedance of this part of the trace cannot be controlled.
- Use as many vias as possible to connect the ground planes.

11.5 Power Trace Lines Layout Guideline

VDD_3V3 Trace Width: 40mil

VDDIO Trace Width: 20mil

11.6 Ground Lines Layout Guideline

A Complete Ground in Ground Layer

Add Ground Through Holes to FSC-BW5028MV Module Ground Pads

Decoupling Capacitors close to FSC-BW5028MV Module Power and Ground Pads

12 PRODUCT PACKAGING INFORMATION

12.1 Default Packing

a, Tray vacuum

b, Tray Dimension: 310mm * 160mm

Figure 12-1-1: Vacuum Tray

12.2 Packing box (Optional)

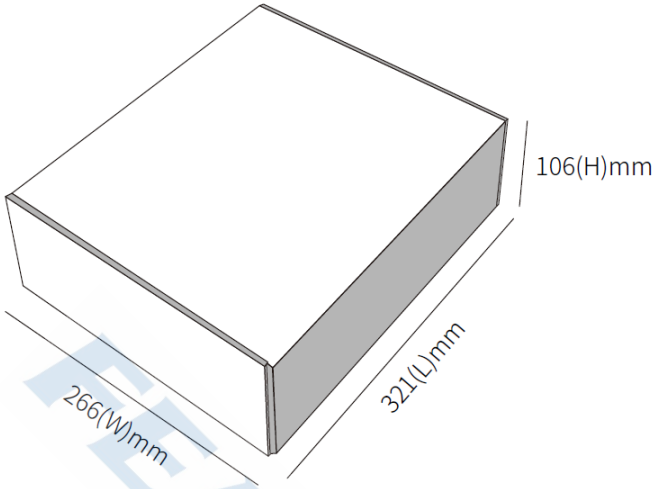


Figure 12-2-1: Packing box (Optional)

** If any packaging other than the package mentioned above is required, please confirm the packaging size again.*

** Packing: 1000pcs per carton (Minimum packing quantity).*

** The outer packing size provided above is for reference purposes only. For the actual dimensions of the product's packaging, please refer to the packaging of the actual goods.*

13 APPLICATION SCHEMATIC

The IO level of this module is 1V8/3V3

Select the supply voltage of VDDIO based on the level of SOC.