BW21-CBV Specification

Version V1.0.0

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Document Resume

Version	Date	Develop/revise content	Edition	Approve
V1.0.0	2024.12.19	First Edition	Dong Pengfei	Guang Ning

Content

1. Product Overview

BW 21-CBV is a dual-frequency Wi-Fi + BLE camera SoC module developed by Shenzhen Ai-Thinker Technology Co., Ltd. based on RTL8735B series chips, which supports dual-frequency (2.4 GHz or 5 GHz)802.11a/b/g/n WLAN protocol and BLE 5.1 protocol. BW 21-CBV integrates ARM v8M MCU (500 MHz and 2.23 DMIP S/MHz), WLAN MAC, WLAN baseband with 1T1R support, Bluetooth MAC, RF, audio codec, ISP, and H264 / H265 encoder.

The BW 21-CBV module has rich peripheral interfaces, including UART / GPIO / ADC / PWM / IIC / IIS / SPI / SDIO /SWD / EPHY / Audio / MI C/M IPI / USB et al. It can be widely used in the Internet of Things (IoT), intelligent audio and video devices, smart home and other fields.

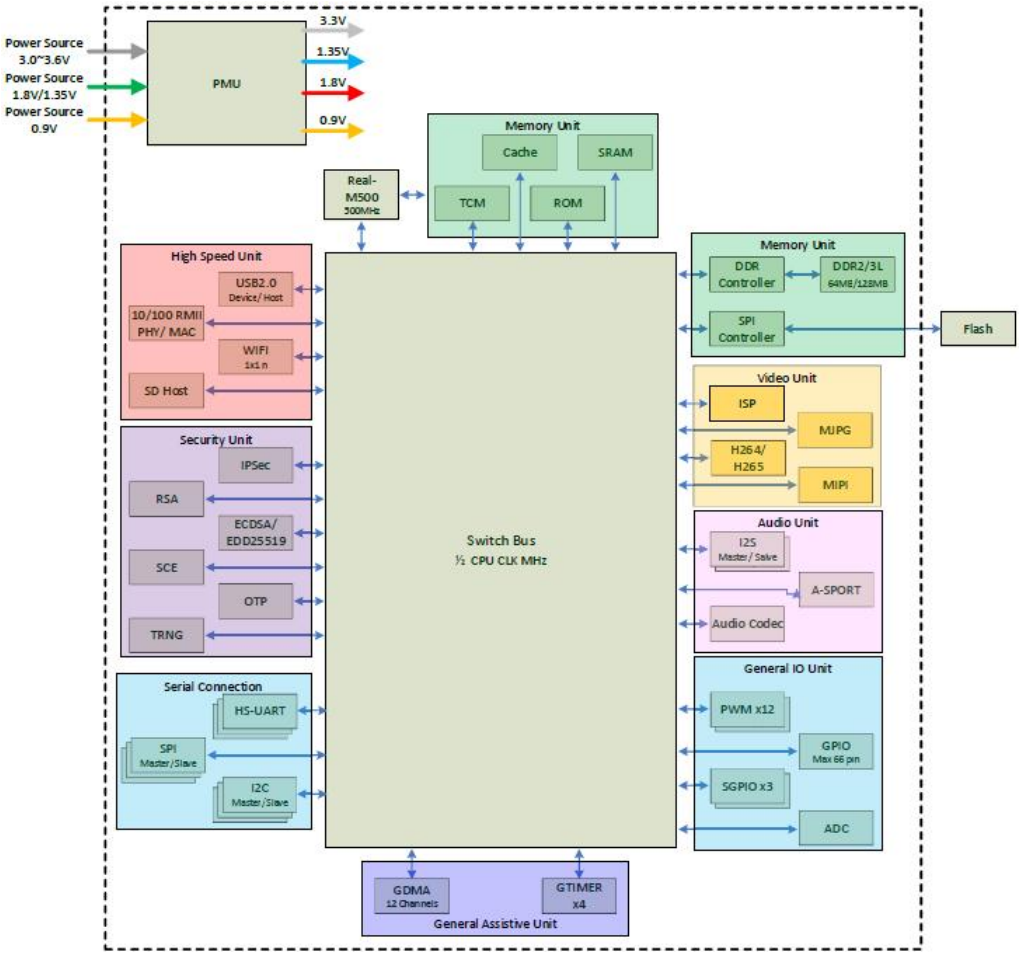


Figure 1 Main chip block diagram

1.1. Characteristic

- Support 802.11a/b/g/n protocol
- Support for 802.11e QoS enhancement (WMM)
- Support for dual-frequency 2.4GHz or 5GHz
- Supports the HT 20 / HT 40 mode
- Support for the BLE 5.1 protocol
- Support for a LE secure connection
- Support for the LE scattering net
- Support LE 1 master / 1 slave
- LE data length extension
- Support for link layer privacy
- Support for a hardware encryption engine
- Real-M500 (TM9) clock frequency up to 500 MHz
- Abundant interfaces, with 58 flexible and compatible IO ports
- YUY 2 input and 12-bit Bayer mode input for 8-bit CMOS sensor
- Support for MIPI CSI-2 four data channels
- Support for MCM embedded 64MB / 128MB DDR2 memory
- Support for short distance low power Tx / Rx applications
- Wi-Fi and Bluetooth share the same antenna
- Support for Arduino development

2. Main Parameters

Table 1 Description of the main parameters

Model	BW21-CBV
Package	SMD-90
Size	27.5*20*3.2(±0.2)MM
Antenna	I-PEX （1 generation）
Frequency	2400~2483.5MHz or 5180~5825MHz
Operating temperature	-40 ℃~85 ℃
Storage temperature	-40 ℃~125 ℃, <90%RH
Power supply	Power supply voltage is 3.135V~3.465V, the typical value is 3.3V, and the power supply current is> 700 mA
Interface	UART/GPIO/ADC/PWM/IIC/IIS/SPI/SDIO/SWD/EPHY/ Audio/MIC/MIPI/USB
IO	Default 58
UART rate	Default 115200bps
Bluetooth	BLE 5.1
SPI Flash	Default 16MByte

2.1. Static electricity requirement

BW 21-CBV module is electrostatic sensitive device, which requires special ESD precautions, and usually ESD protective devices should be added in use. Proper ESD handling and packaging must be used during the transportation, operation, and use of the BW21-CBV module. Do not touch the module by hand or use non-antistatic iron to damage the module.

Figure 2 ESD Antic-static diagram

2.2. Electrical Characteristics

Table 2 Electrical characteristics table

Parameters		Condition	Min.	Typical value	Max.	Unit
Voltage Supply		VDD_DDR（DDR2）	1.71	1.8	1.89	V
		VDD3	3.135	3.3	3.465	V
		5VDD	4.75	5	5.25	V
I/O	VIL	-	-	-	0.8	V
	VIH	-	2.0	-	-	V
	VOL	-	2.4	-	-	V
	VOH	-	-	-	0.4	V

2.3. Wi-Fi RF Performance

Table 3 Wi-Fi RF performance table

Description	Typical value			Unit
Frequency range	2400~2483.5 和 5180~5825			MHz
Output Power				
Mode	**Min.**	**Typical**	**Max.**	**Unit**
11a mode，PA output power	-	17	-	dBm
11b mode，PA output power	-	19	-	dBm
11g mode，PA output power	-	18	-	dBm
11n mode，PA output power	-	17	-	dBm
Receive Sensitivity				
Mode	**Min.**	**Typical**	**Max.**	**Unit**
11b，1Mbps	-	-98	-	dBm
11b，11Mbps	-	-91	-	dBm
11a/g，6Mbps	-	-97	-	dBm
11a/g，54Mbps	-	-78	-	dBm
HT20（MCS0）	-	-96	-	dBm
HT20（MCS7）	-	-76	-	dBm

HT40（MCS0）	-	-93	-	dBm
HT40（MCS7）	-	-73	-	dBm

2.4. BLE RF Performance

Table 4 BLE RF performance table

Description	Typical value			Unit
Frequency range	2400~2483.5			MHz
Output Power				
Rate Mode	**Min.**	**Typical**	**Max.**	**Unit**
1Mbps	-	8	-	dBm
2Mbps	-	8	-	dBm
Receive Sensitivity				
Rate Mode	**Min.**	**Typical**	**Max.**	**Unit**
1Mbps @30.8%PER	-	-98	-	dBm
2Mbps @30.8%PER	-	-96	-	dBm

2.5. Power

The following power consumption data are based on the 3.3V power supply and the ambient temperature of 25°C.

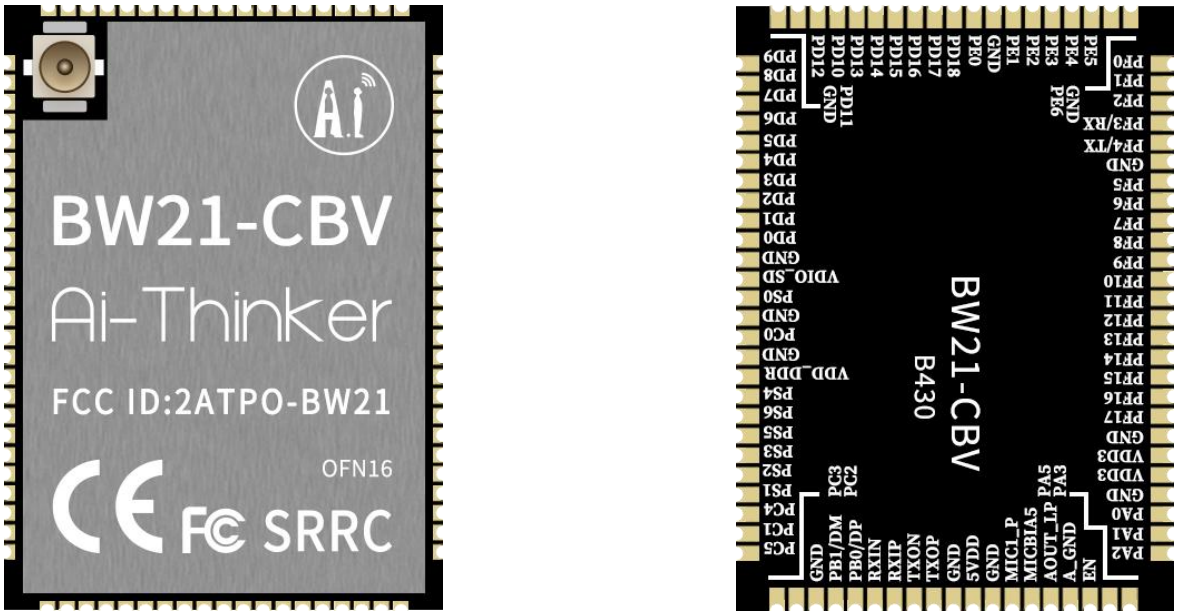
The POUT power for all transmission modes is measured at the antenna interface.

All transmission data are measured in continuous transmission mode.

Table 5 Power consumption

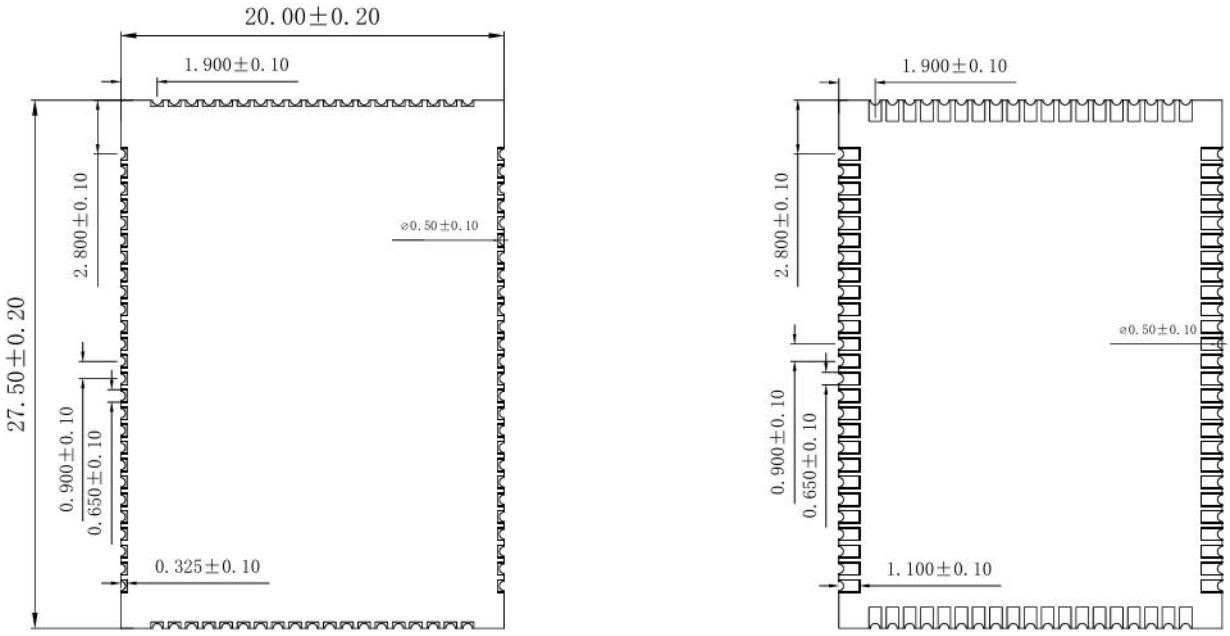
Mode	Min.	AVG	Max.	Unit
Tx 802.11b，11Mbps，POUT=+21dBm	-	615	-	mA
Tx 802.11g， 54Mbps， POUT =+19dBm	-	398	-	mA
Txc 802.11n， MCS7， POUT =+18dBm	-	369	-	mA
Rx 802.11b	-	50	-	mA
Rx 802.11g	-	50	-	mA
Rx 802.11n	-	50	-	mA

3. Appearance Dimensions



Front Back

Figure 3 Appearance diagram (rendering diagram is for reference only, subject to physical objects)



Front Back

Figure 4 Dimensions diagram

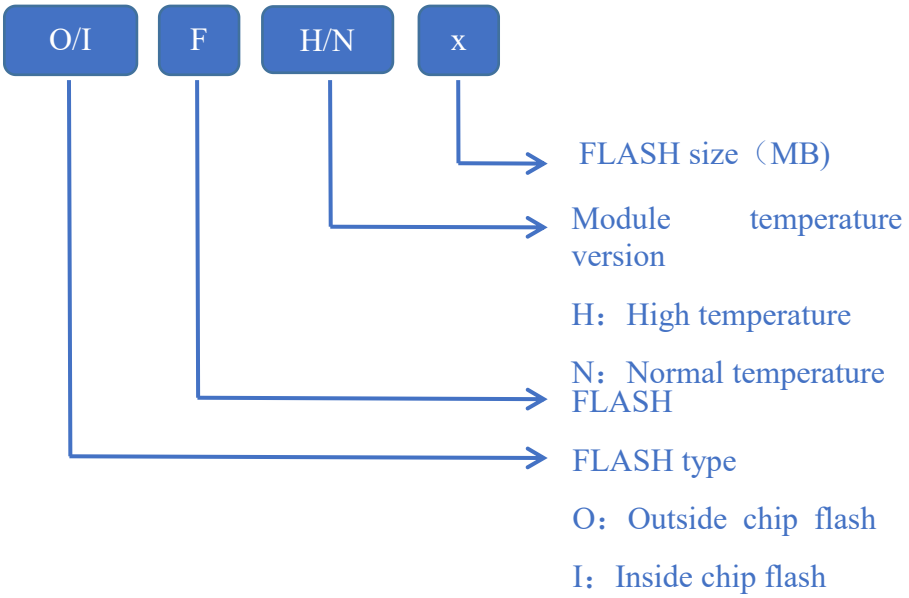


Figure 5 Shell cover information

4. Pin Definition

The BW21-CBV module has a total of 90 pins, as shown in the pin diagram. The pin function definitions are shown in the table below.

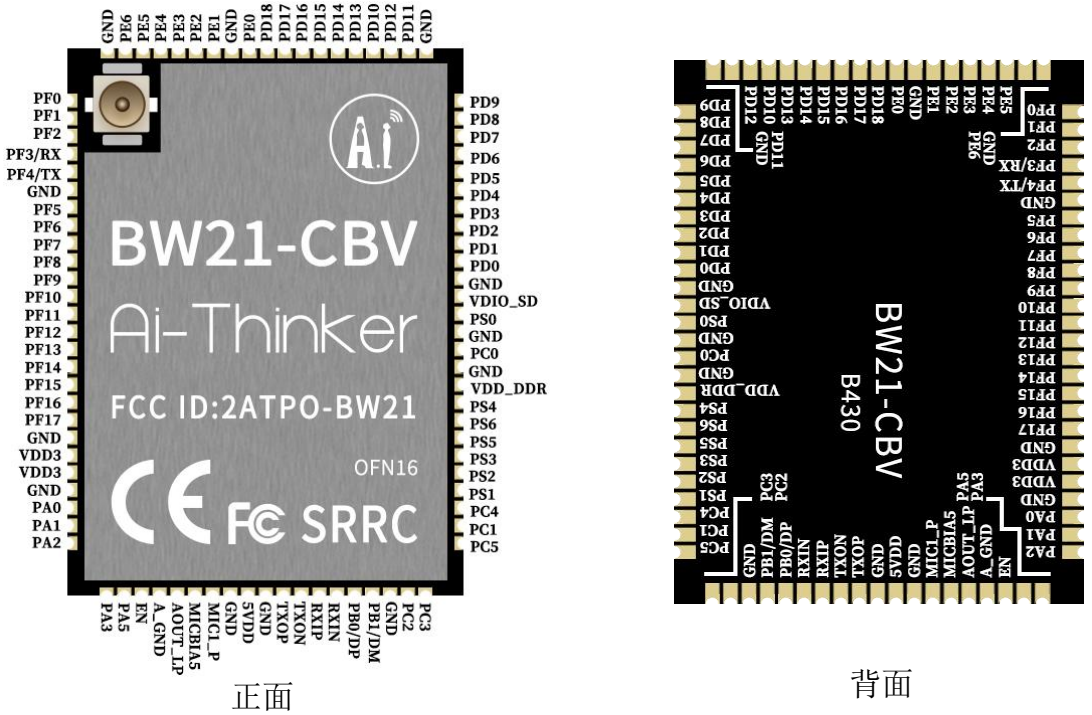


Figure 6 Schematic Diagram of Pin

Table 6 Definitions of pin function

No	Name	Function Declaration
90	PC5	Default NC；GPIOC_5/FLASH_CS#
1	PC1	Default NC；GPIOC_1/FLASH_D3
2	PC4	Default NC；GPIOC_4/FLASH_D1
3	PS1	GPIOS_1/IO9/SD_D1/PWM8
4	PS2	GPIOS_2/IO80/SD_D0
5	PS3	GPIOS_3/IO81/SD_CMD
6	PS5	GPIOS_5/IO82/SD_D3/PWM10
7	PS6	GPIOS_6/IO12/SD_D2/PWM11
8	PS4	GPIOS_4/IO11/SD_CD/PWM9
9	VDD_DDR	DDR 2 power supply terminal, 1.8V input, external power supply output current is recommended to be above 500 mA

10	GND	Ground
11	PC0	Default NC；GPIOC_0/FLASH_CLK
12	GND	Ground
13	PS0	GPIOS_0/IO79/SD_CLK
14	VDIO_SD	The power supply terminal of GPIOS power domain is powered by the chip inside. When the SD card is used, it can be used as the resistance power supply for the SD card. in other cases
15	GND	Ground
16	PD0	GPIOD_0/IO83/MIPI_DATA0_P
17	PD1	GPIOD_1/IO13/MIPI_DATA0_N
18	PD2	GPIOD_2/IO84/MIPI_DATA1_P
19	PD3	GPIOD_3/IO14/MIPI_DATA1_N
20	PD4	GPIOD_4/IO85/MIPI_CKI_P
21	PD5	GPIOD_5/IO15/MIPI_CKI_N
22	PD6	GPIOD_6/IO86/MIPI_DATA2_P
23	PD7	GPIOD_7/IO16/MIPI_DATA2_N
24	PD8	GPIOD_8/IO17/MIPI_DATA3_P
25	PD9	GPIOD_9/IO17/MIPI_DATA3_N
26	GND	Ground
27	PD11	GPIOD_11/IO19/SSOR_PDN
28	PD12	GPIOD_12/IO21/I2C3_SCL
29	PD10	GPIOD_10/IO20/I2C3_SDA
30	PD13	GPIOD_13/IO88/SSOR_SYSCLK
31	PD14	GPIOD_14/IO89/DMIC_CLK/WIFI_LED/I2S1_CLK/BT_PRI
32	PD15	GPIOD_15/IO23/I2S1_SD_TX0/UART2_OUT/BT_STA
33	PD16	GPIOD_16/IO90/DMIC_CLK/I2S1_MCK/UART2_IN/BT_CK
34	PD17	GPIOD_17/IO24/RFE_CTRL_4/I2S1_WS/UART2_CTS/WL_ACT
35	PD18	GPIOD_18/IO91/DMIC_DATA/RFE_CTRL_5/I2S1_SD_RX/UART2_RTS/BTCMD_IRQ
36	PE0	GPIOE_0/IO92/SSOR_RST/WIFI_LED/RFE_CTRL_3/UART2_OUT
37	GND	Ground

38	PE1	GPIOE_1/IO93/SPI_0_SCL/SPI_2_SCL/UART3_OUT
39	PE2	GPIOE_2/IO94/SPI_0_MISO/SPI_2_MSIO/UART3_IN
40	PE3	GPIOE_3/IO28/I2C2_SCL/RFE_CTRL4/SPI_0_MOSI/SPI_2_MOSI/UART3_RTS
41	PE4	GPIOE_4/IO95/I2C_SDA/RFE_CTRL5/SPI_0_CS0/SPI_2_CS/UART3_CTS
42	PE5	GPIOE_5/IO29/I2C2_SCL/SPI_0_CS1
43	PE6	GPIOE_6/IO96/I2C2_SDA/SPI_0_CS2
44	GND	Ground
45	PF0	GPIOF_0/IO43/ADC0
46	PF1	GPIOF_1/IO106/ADC1/I2C1_SCL/RFE_CTRL_0/UART1_CTS
47	PF2	GPIOF_2/IO44/ADC2/I2C1_SDA/RFE_CTRL_1/UART1_RTS
48	PF3/RX	GPIOF_3/IO107/ADC3/RFE_CTRL_2/UART1_IN
49	PF4/TX	GPIOF_4/IO108/UART1_OUT
50	GND	Ground
51	PF5	GPIOF_5/IO46/SPI_1_MISO/SPI_3_MISO
52	PF6	GPIOF_6/IO109/PWM0/SPI_1_SCL/SPI_3_SCL
53	PF7	GPIOF_7/IO47/PWM1/SPI_1_MOSI/SPI_3_MOSI
54	PF8	GPIOF_8/IO110/PWM2/SPI_1_CS0/SPI_3_CS
55	PF9	GPIOF_9/IO111/SGPIO_RX/PWM3/SPI_1_CS1
56	PF10	GPIOF_10/IO49/PWM4/SPI_1_CS2

57	PF11	GPIOF_11/IO112/PWM5/I2S0_MCK
58	PF12	GPIOF_12/IO50/PWM6/I2S0_SD_RX/UART1_IN
59	PF13	GPIOF_13/IO113/PWM7/I2S0_CLK/UART1_OUT
60	PF14	GPIOF_14/IO114/SGPIO_RX/PWM8/I2S0_SD_TX0
61	PF15	GPIOF_15/IO52/SGPIO_TX/PWM9/I2S_WS
62	PF16	GPIOF_16/IO53/PWM10/SPI_1_CS3
63	PF17	GPIOF_17/IO54/VDD_DDR_EN/PWM11，DDR power enable pin
64	GND	Ground
65	VDD3	3.3V power supply pin, the output current of the external power supply is recommended to be above 700 mA
66	VDD3	3.3V power supply pin, the output current of the external power supply is recommended to be above 700 mA
67	GND	Ground
68	PA0	GPIOA_0/IO117/ADC4/XTAL_XO_32/I2C0_SCL,32K crystal vibration output pin
69	PA1	GPIOA_1/IO59/ADC5/XTAL_XI_32/I2C0_SDA，32Kcrystal vibration output pin
70	PA2	GPIOA_2/IO118/ADC6/UART0_OUT
71	PA3	GPIOA_3/IO60/ADC7/UART0_IN
72	PA5	GPIOA_5/IO120/SSOR_PWR_CTRL, Camera Sensor power control pin, pull up effective, module default pull down 100K resistance
73	EN	CHIP_EN，the chip enable pin， pull up Enable; pull down shutdown.10K resistance inside the module
74	A_GND	AUDIO_GND，Audio simulation
75	AOUT_LP	AOUT_LP，The speaker output a positive signal

76	MICBIAS	MICBIAS，MIC offset output
77	MIC1_P	MIC1_P，MIC enter a positive signal
78	GND	Ground
79	5VDD	5V power supply pin, the output current of the external power supply is recommended to be above 500 mA
80	GND	Ground
81	TXOP	EPHY_TXOP；Ethernet TX+
82	TXON	EPHY_TXON；Ethernet TX-
83	RXIP	EPHY_RXIP；Ethernet RX+
84	RXIN	EPHY_RXIN；Ethernet RX+
85	PB0/DP	GPIOB_0/IO70/I2C0_SCL/HSDP，High-speed USB D + signal
86	PB1/DM	GPIOB_1/IO71/I2C0_SDA/HSDM，High-speed USB D + signal
87	GND	Ground
88	PC2	Default NC；GPIOC_2/FLASH_D0#
89	PC3	Default NC；GPIOC_3/FLASH_D2#

Note: 1. When the power moment of PA5 is high level, the module enters the burning mode; when the power moment is low level, the module starts normally, and the internal pull-down by default.

2. PC0, PC1, PC2, PC3, PC4 and PC5 are internal FLASH pins in the module, which are not available by default and are suspended.

5. Schematic Diagram

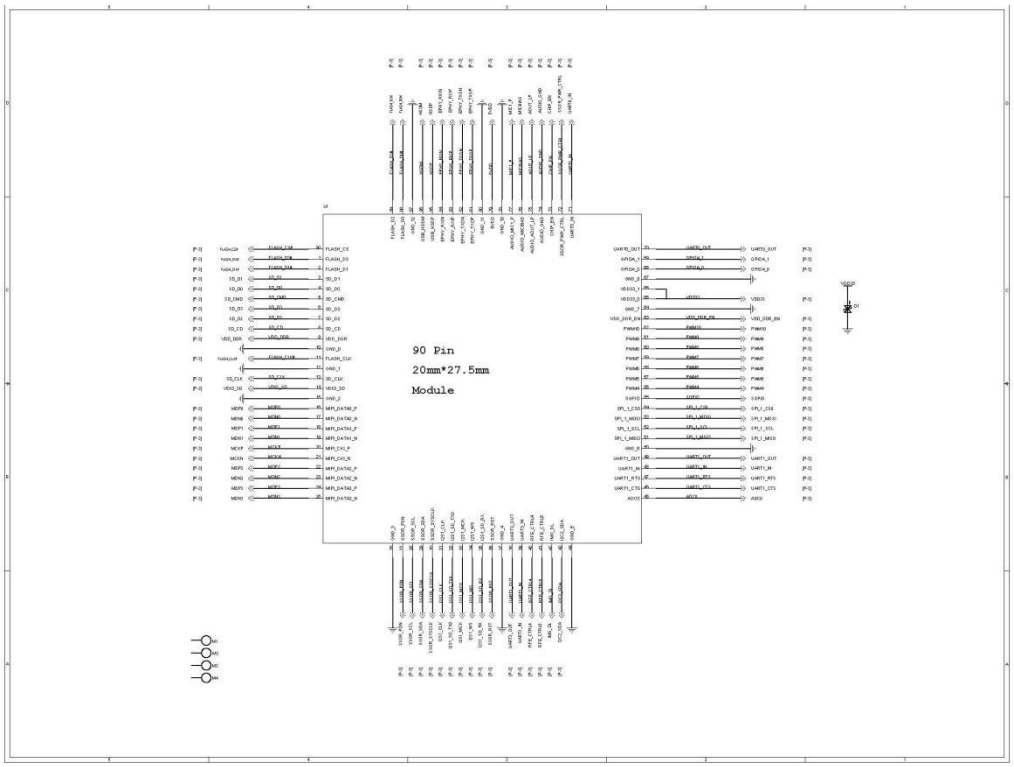


Figure 7: Schematic diagram 1

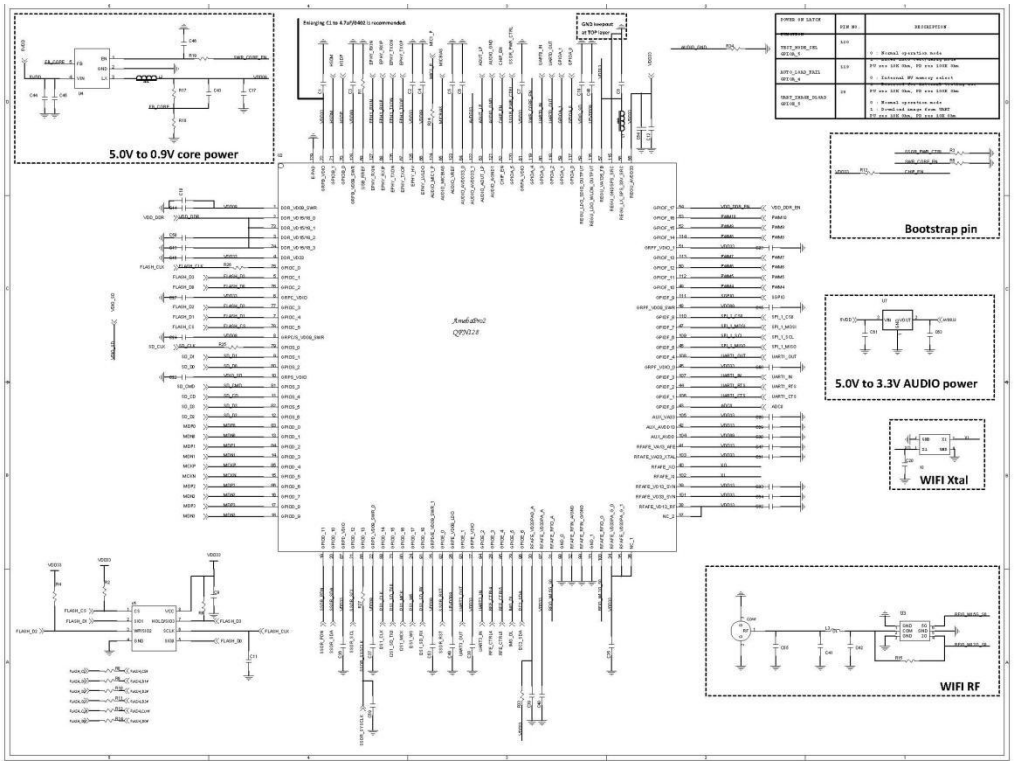


Figure 8: Schematic diagram 2

6. Design Guidance

6.1. Application circuit guidance

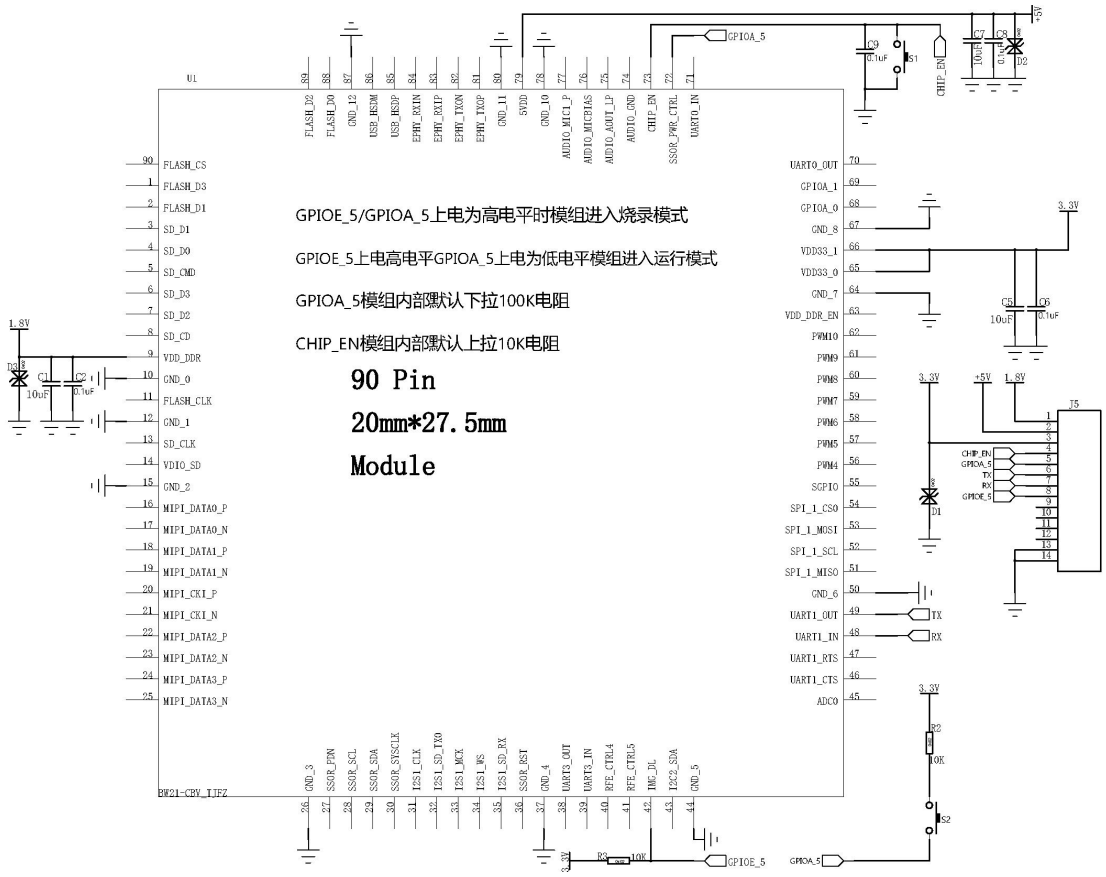


Figure Application circuit guidance

Note：

- GPIOA _ 5 is the starting control foot, in normal operating mode at low level and burning firmware mode at high level. The default pull-down resistance is 100K.
- The module pin 9 VDD _ DDR is built DDR 2 power pin, which must be connected to 1.8V power supply; module 79 pin 5 VDD must be connected to 5V power supply; module 65 and 66 pins VDD 3, please use 3.3V current greater than 700 mA power supply. The four power pins must supply power normally, otherwise the module cannot start normally.

6.2. Recommend for PCB package size

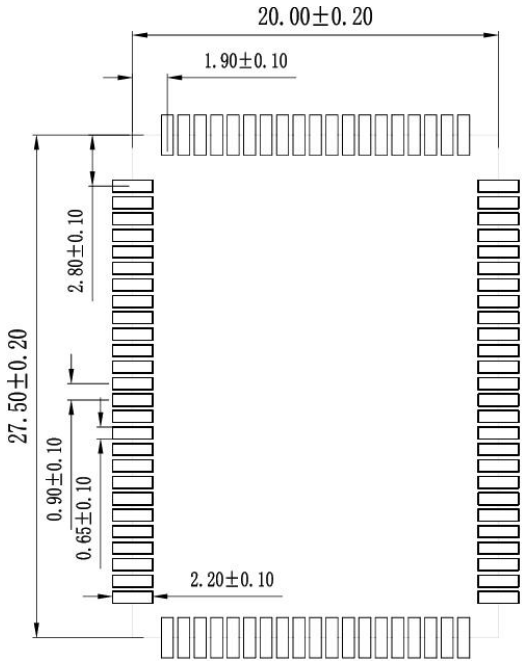


Figure 10 Recommend PCB package size (TOP view)

6.3. Antenna layout requirements

- The module requires use an external antenna.
- In order to satisfy the performance of the antenna, metal parts are prohibited around the antenna away from high frequency devices.

6.4. Power supply

- Recommended 3.3V voltage, peak current above 700 mA.
- It is recommended to use LDO power supply; if use DC-DC, suggest ripple wave within 100 mV.
- The DC-DC power supply circuit suggests to reserve the position of the dynamic response capacitor, which can optimize the output ripple when the load change is large.
- In the 3.3V power interface, it is recommended to add ESD devices.
- If the power supply is boosted from 1.5V to 3.0V for more than 15 ms, increase the voltage reset IC.
- During the repeated power on-off process, if the voltage cannot be guaranteed to be less than 0.3V, the voltage reset IC must be increased.

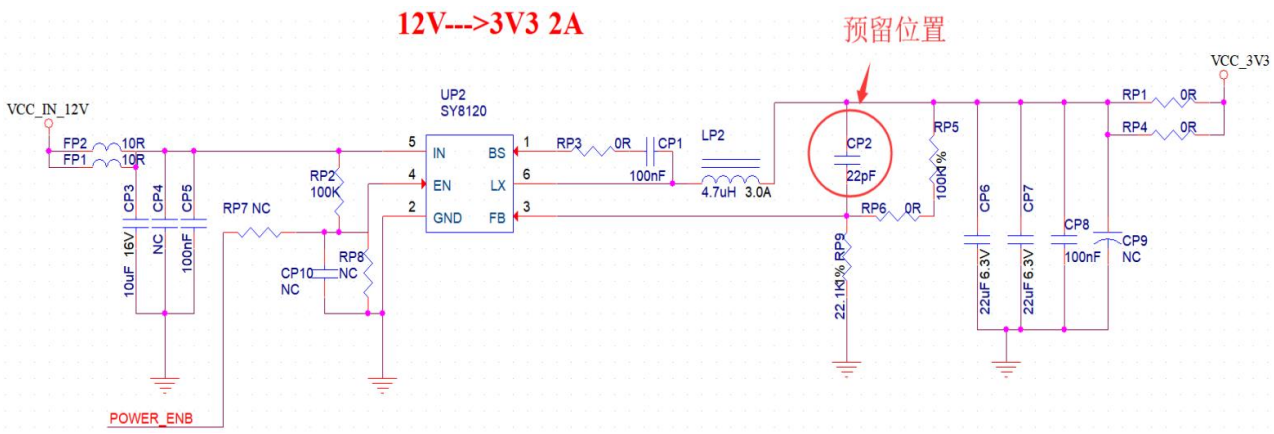


Figure 11 The DC-DC step-down circuit diagram

6.5. GPIO

- The periphery of the module pin outs some IO ports, If you need to use them, it is recommended to connect a 10-100 ohm resistor in series to the IO ports. This can suppress the overshoot and make the level on both sides more stable, it helps both for EMI and ESD
- Pull up and down of the special IO port, refer to the instructions of the specification, which will affect the startup configuration of the module.
- The IO port of the module is 3.3V. If the main control does not match the IO port level of the module, the level conversion circuit should be added.
- If the IO port is directly connected to the peripheral interface or terminals, it is recommended to reserve ESD devices at the IO port line near the terminal.

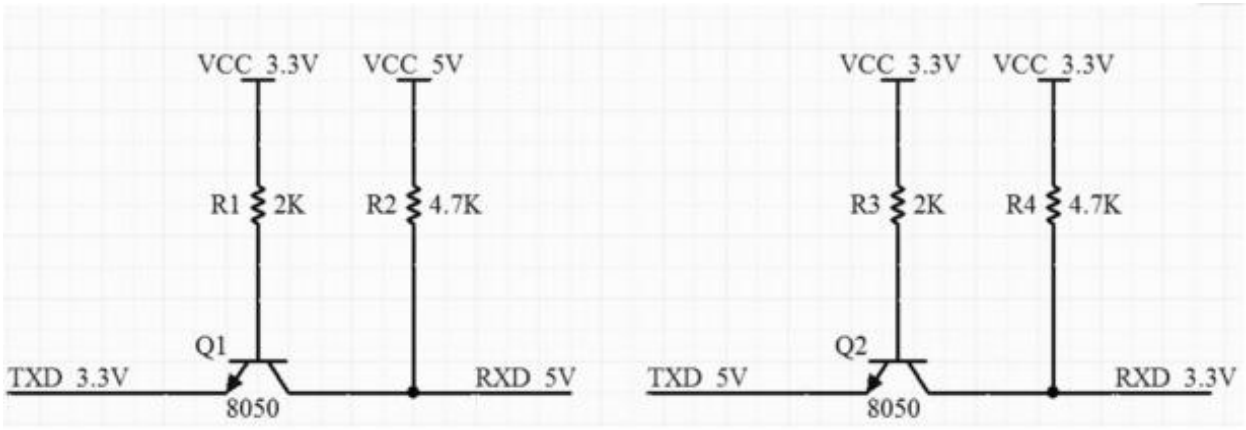


Figure 12 Level conversion circuit

7. Storage Condition

Products sealed in a moisture-proof bag shall be stored in a non-condensing atmosphere of <40℃ / 90% RH.

The moisture sensitivity grade MSL of the module is level 3.

After the vacuum bag is unsealed, it must be used within 168 hours at 25 ± 5℃ / 60% RH, otherwise it needs to be baked before the production.

8. Reflow Welding Curve Diagram

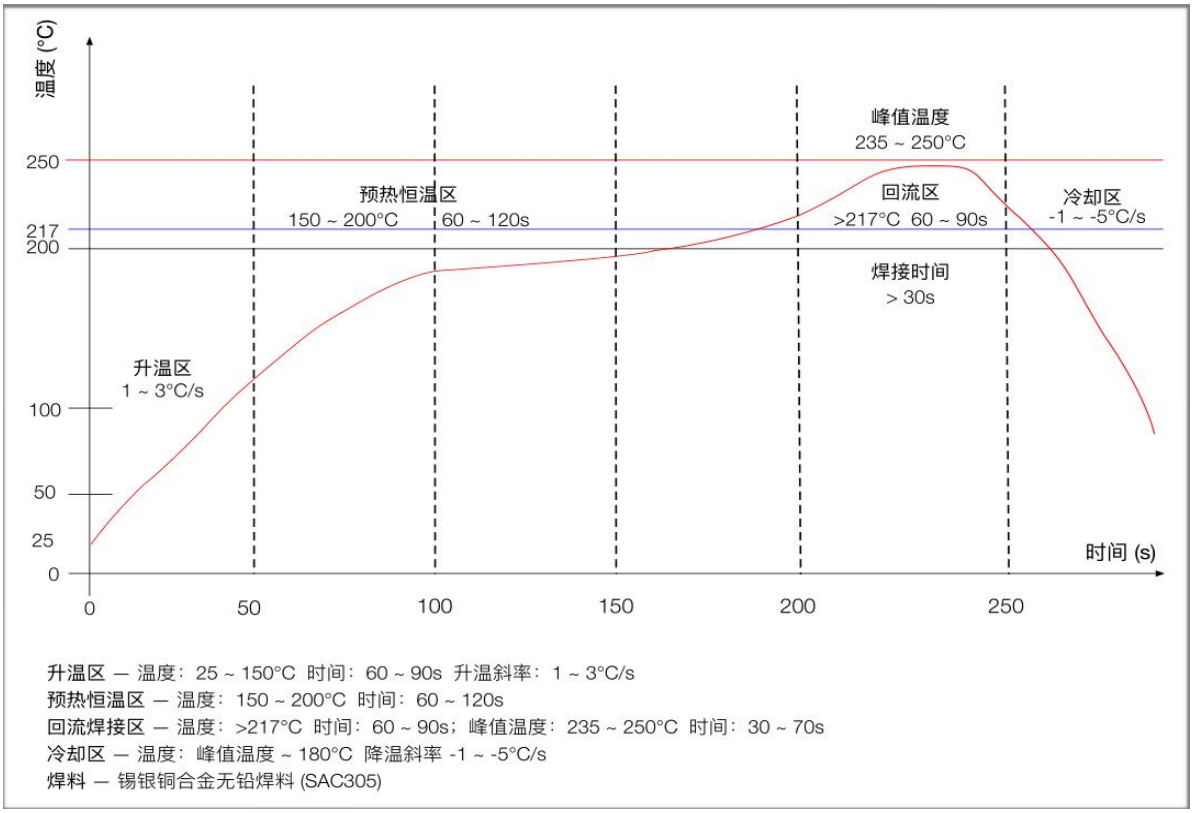


Figure 13 Reflow welding curve diagram

9. Product Packaging Information

BW21-CBV module is packaged at 700 pcs /tape. As shown in the figure below:

Figure 14 Tape packaging diagram

10.Contact Us

Ai-Thinker official website　Office forum　Develop DOCS

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WeChat mini program

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