BL-61C User manual

Version V1.2

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This device is intended only for OEM integrators under the following conditions:

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and

2) This device and its antenna(s) must not be co‑located with any other transmitters except in accordance with FCC multi‑transmitter product procedures. Referring to the multi‑transmitter policy, multiple‑transmitter(s) and module(s) can be operated simultaneously without C2P.

3) For all products market in US, OEM has to limit the operation channels in CH1 to CH11 for 2.4G band by supplied firmware programming tool. OEM shall not supply any tool or info to the end‑user regarding to Regulatory Domain change.

USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied.

The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual:

This device complies with Part 15 of 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.

LABEL OF THE END PRODUCT:

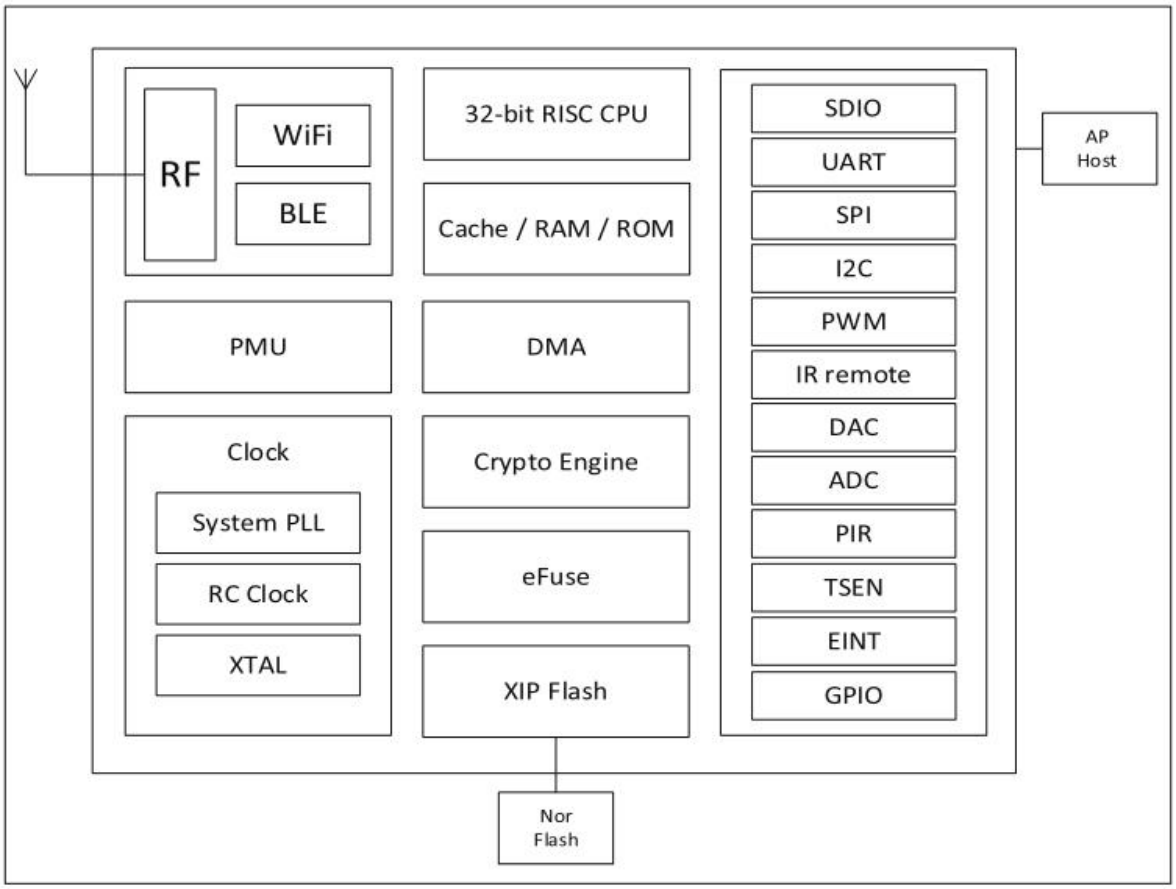
The final end product must be labeled in a visible area with the following " Contains FCC ID: 2AVTT-BL61C ". If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label:

This device complies with Part 15 of 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.

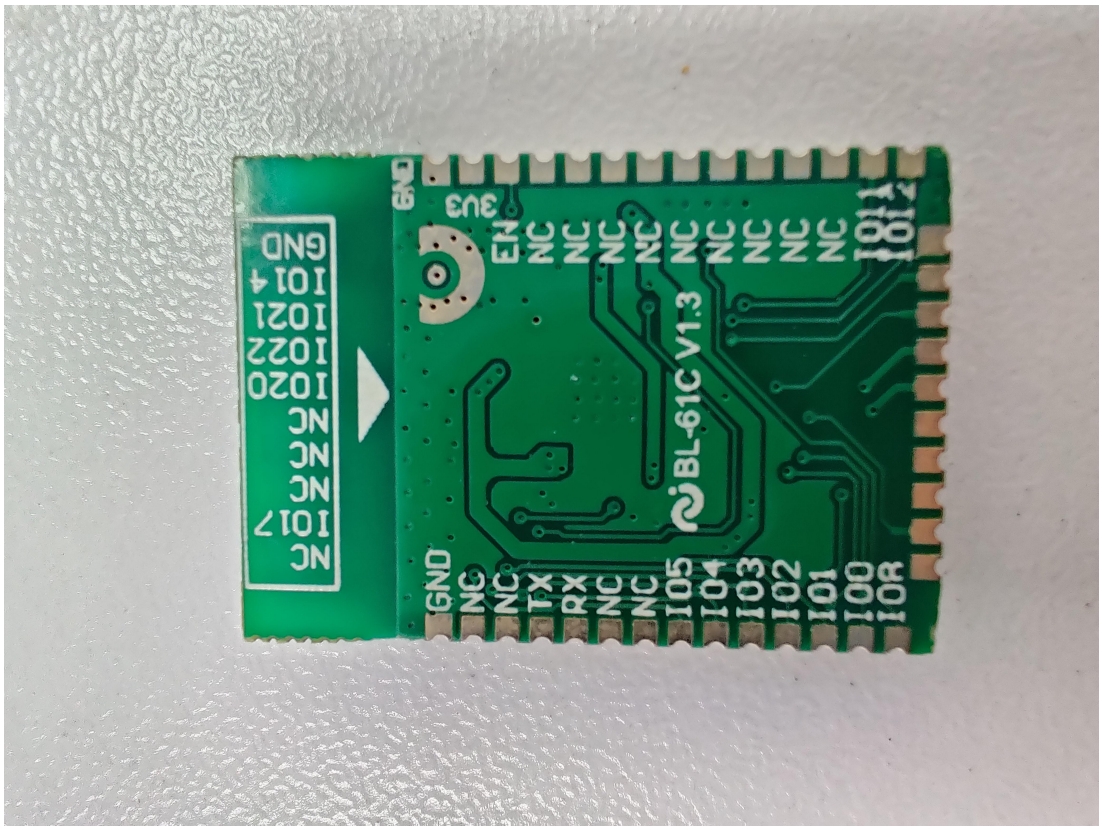
1. Product Overview

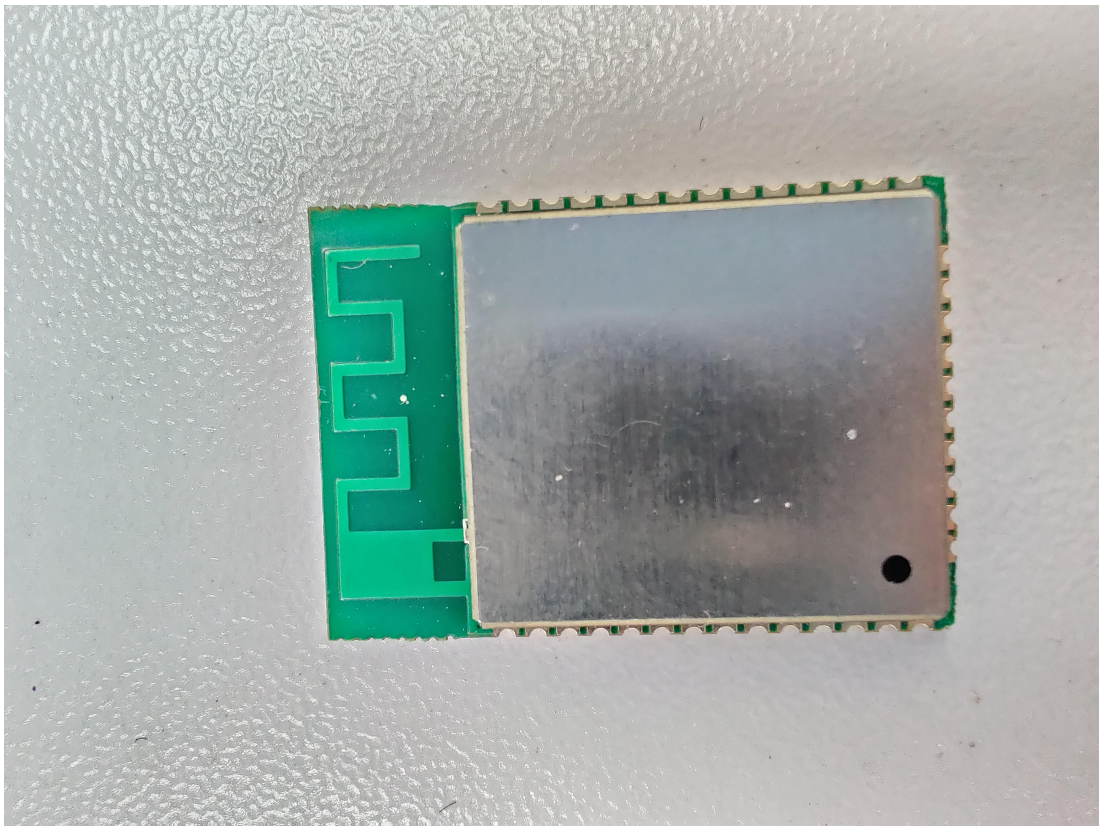
BL-61C is a wireless module based on WiFi+BLE single-chip SoC as the main control. It meets low-power, high-performance, low-cost IOT application scenarios. The module's core processor BL602C integrates 2.4G Wi-Fi (802.11 b/g/n) and BLE 5.0 wireless subsystem. Its microcontroller subsystem includes a high-performance and low-power 32-bit RISC-V CPU, high-speed cache and FLASH memory. It has an advanced power management unit and supports a variety of low-power Consumption mode. The module peripheral interface supports UART, GPIO, ADC, PWM, I2C, etc., onboard a switch and an RGB LED light.

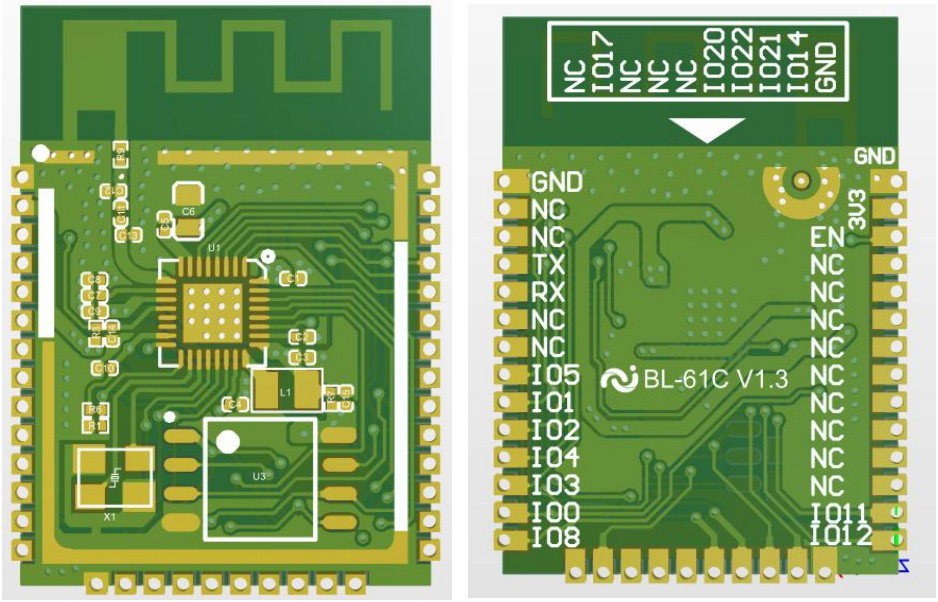
BL602C functional block diagram:

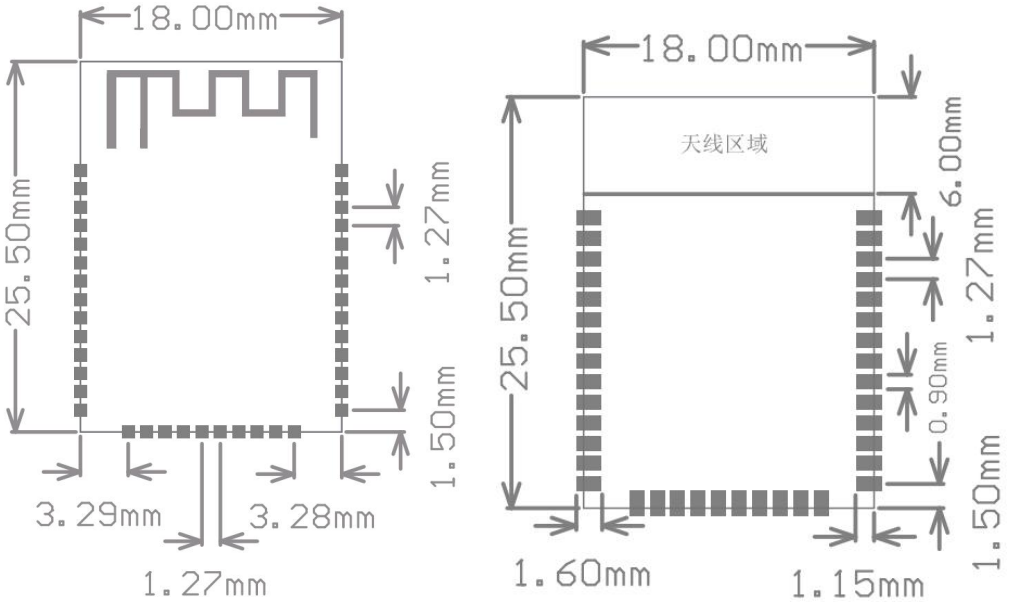


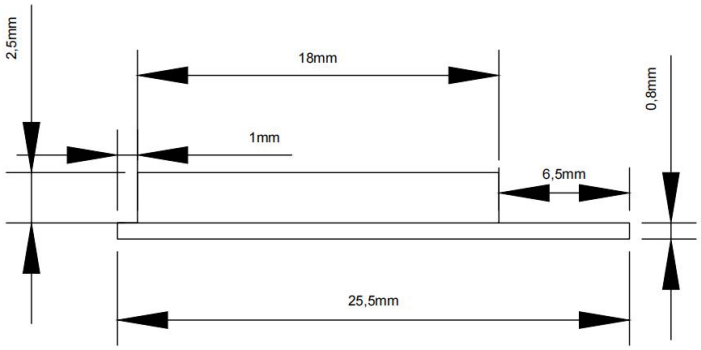
1.1 Appearance and Dimensions











1.2 Features

1.2.1 Wireless

- IEEE 802.11b/g/n, 1x1 SISO 2.4GHz
- Bluetooth® BLE 5.0
- Wi-Fi 20MHz bandwidth
- Wi-Fi security WPS/WEP/WPA/WPA2 Personal/ WPA2 Enterprise/WPA3
- STA，SoftAP and Sniffer mode
- Wi-Fi and BLE coexist, BLE assists in realizing Wi-Fi fast connection
- Integrated balun，PA/LNA
- Support serial port local upgrade and remote firmware upgrade (FOTA)
- General AT commands can be used quickly
- Support secondary development, integrated Windows and Linux development environment

1.2.2 MCU Subsystem

- 32-bit RISC-V CPU with FPU (floating point unit)
- One RTC timer (cycle one year)
- Two 32-bit general-purpose timers
- Four DMA channels
- DFS (Dynamic Frequency Scaling) from 1MHz to 192MHz

- JTAG development support
- XIP QSPI Flash has hardware encryption support

1.2.3 Memory

- 276KB RAM
- 128KB ROM
- 1Kb eFuse
- Embedded 2M Byte flash

1.2.4 Security Mechanism

- QSPI Flash Instant AES Decryption (OTFAD)-AES-128, CTR mode
- Support AES 128/192/256 bit encryption engine
- Support SHA-1/224/256
- Real random number generator (TRNG)

Public Key Accelerator (PKA)

1.3 Key parameter

Table 1.1 Description of the main parameters

Module model	BL-61C
Mounting	SMD-38
Size	25.5*18*3.5(±0.2)mm
Cert.	FCC、CE
Flash	Chip built-in 2MB
Interface	UART/GPIO/ADC /PWM/ I2C
IO 口	16
Number of GPIO	9600/19200/38400/115200/921600 bps , Up to 5Mbps
Freq.	2400 ~2483.5MHz
Antenna	Onboard PCB antenna
Security	WPS/WEP/WPA/WPA2 Personal/WPA2 Enterprise/WPA3
Power Supply	DC 3.0V ~ 3.6V，Imax >300mA
Temperature	-30 ℃ ~ 85 ℃
Storage Condition	-45℃ ~ 135℃ ,< 90%RH

2. Pin definition

BL-61C module has 38 pins in total, as shown in Figure 2.1. Peripherals include 13 GPIOs, 2 UARTs, 1 I2C master/slave, 4 PWM channels, and 1 12-bit general-purpose ADC. Each GPIO can be used

as a general-purpose input and output function. Table 2.2 is the interface definition.

2.1 Figure 2.1 BL-61C Pin diagram

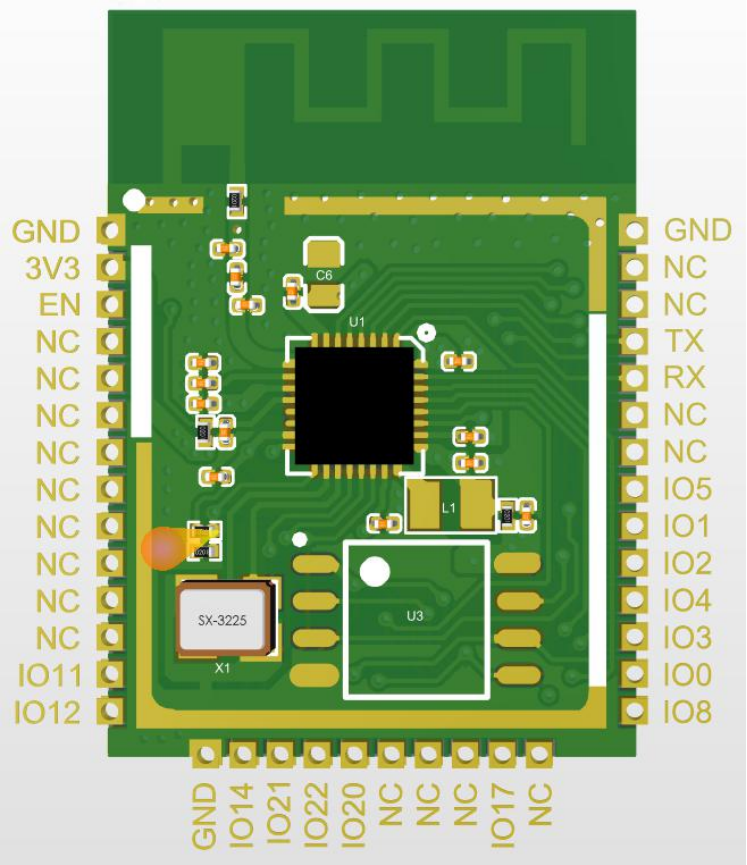


Table 2.2 Pin description

Number	Pin Name	Function description
1	GND	ground
2	3V3	Power supply 3.3V
3	EN	Reset
4	NC	reserved pin
5	NC	reserved pin

6	NC	reserved pin
7	NC	reserved pin
8	NC	reserved pin
9	NC	reserved pin
10	NC	reserved pin
11	NC	reserved pin
12	NC	reserved pin
13	IO11	GPIO11；SPI_SCLK；I2C_SDA；UART；PWM_CH1；IROUT/ADC_CH10；JTAG_TDO
14	IO12	GPIO12；SPI_MISO；I2C_SCL；UART1；PWM_CH2；ADC_VREF/ADC_CH0；JTAG_TMS
15	GND	ground
16	IO14	GPIO14；SPI_SS；I2C_SCL；UART；PWM_CH4；ADC_CH2；DAC_OUTB；JTAG_TCK
17	IO21	GPIO17;FLASH_CS;SPI_MOSI;I2C_SDA;UART;PWM_CH1;JTAG_TDI
18	IO22	GPIO17;FLASH_D3;SPI_SS;I2C_SCL;UART;PWM_CH2;JTAG_TCK
19	IO20	GPIO20;FLASH_D0;SPI_MOSI;I2C_SCL;UART;PWM_CH0;JTAG_TMS

20	NC	reserved pin
21	NC	reserved pin
22	NC	reserved pin
23	IO17	GPIO17;FLASH_D3;SPI_MOSI;I2C_SDA;UART;PWM_CH2; DC_TP_OUT; JTAG_TDI
24	NC	reserved pin
25	IO8	GPIO8; I2C_SCL; PWM_CH3; IO8 should be pulled high when downloading, and low when running (IO8 inside the module has been pulled low)
26	IO0	GPIO0;SDIO_CLK;FLASH_D1;SPI_MISO;I2C_SCL;UART; PWM_CH0; JTAG_TMS
27	IO3	GPIO3; I2C_SDA; UART1_RX; PWM_CH3
28	IO4	GPIO4; I2C_SCL; UART1_TX; PWM_CH4; ADC_CH1
29	IO2	GPIO2; SDIO_DAT0; FLASH_D2; SPI_SS; I2C_SCL; UART; PWM_CH2; JTAG_TCK
30	IO1	GPIO1;SDIO_CMD;FLASH_D2;SPI_MOSI;I2C_SDA; UART; PWM_CH1; JTAG_TDI
31	IO5	GPIO5;SDIO_DAT3;SPI_MOSI;I2C_SDA;UART;PWM_CH0; ADC_CH4;JTAG_TDI
32	NC	reserved pin

33	NC	reserved pin
34	RX	GPIO7; UART0_RX; I2C_SDA; PWM_CH2;(Only this UART0 can be used to burn firmware)
35	TX	GPIO16; I2C_SCL; UART0_TX; PWM_CH1; (Only this UART0 can be used to burn firmware)
36	NC	reserved pin
37	NC	reserved pin
38	GND	ground

3. Electrical parameters

3.1 Electrical characteristics

parameter		test condition	min	Typ.	max	unit
Storage Temp.		-	-45	normal	135	℃
Work temp.		-	-30	20	85	℃
Max welding temp.		IPC/JEDEC J-STD-020	-	-	260	℃
Static Protection (HBM)					2000	V
Supply volt.		VCC	3.0	3.3	3.6	V
I/O	V_{IL}	VCC_IO=3.3V	-0.3	-	1.32	V

	V_{IH}	VCC_IO=3.3V	2.06	-	3.6	V
	V_{OL}	VCC_IO=3.3V, |IOL|=7.5~50 mA	-0.3	-	0.4	V
	V_{OH}	VCC_IO=3.3V, |IOL|=7.5~50 mA	2.9	-	3.4	V
	I_{MAX}	-	-	-	12	mA

3.2 Wi-Fi RF characteristic

Description	**Min**	**Typ.**	**Max**	**Unit**
Frequency	2400	-	2483.5	MHz
S11		<-10		dB
Transmit Power				
CCK, 1 Mbps	-	18.6	-	dBm
CCK, 11 Mbps	-	18.5	-	dBm
6 Mbps OFDM	-	15.5	-	dBm
54Mbps OFDM	-	15.2	-	dBm
HT20, MCS0	-	14.5	-	dBm
HT20, MCS7	-	14.3	-	dBm
EVM				

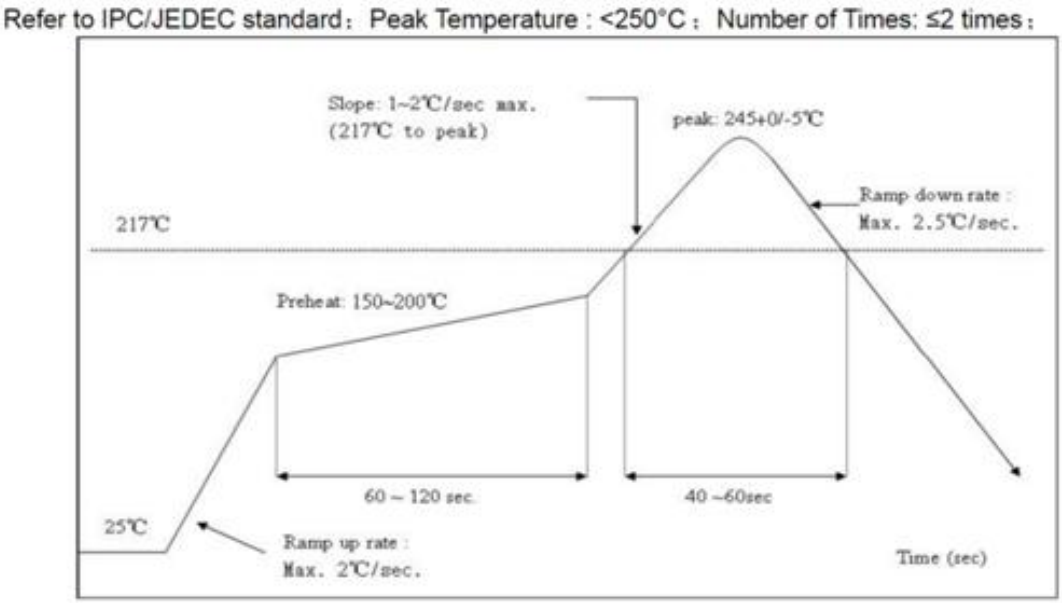
CCK, 11 Mbps	-	-24.6	-	dB
54Mbps OFDM	-	-32.4	-	dB
HT20, MCS7	-	-33.1	-	dB
Receiver Sensitivity				
CCK, 11 Mbps	-	-88	-	dBm
54 Mbps OFDM	-	-76	-	dBm
HT20, MCS7	-	-72	-	dBm

3.3 Power dissipation

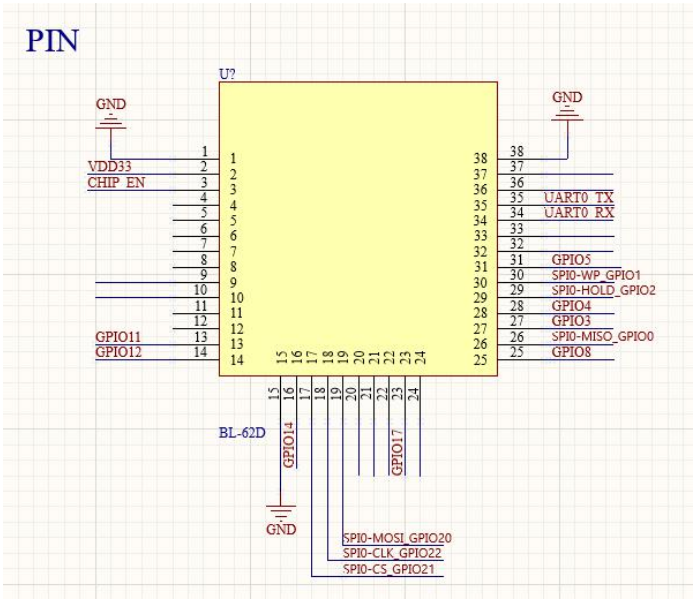
BL602, 25℃, VCC=3.3V

Work mode	Test condition	Min.	Typ.	Max.	unit
RX	11b	-	35	-	mA
	11g	-	39	-	
	11n	-	39	-	
TX	11b - 11Mbps @21dBm	Duty 50%	190	-	
		Duty 99%	310	-	
	11g - 54Mbps @18dBm	Duty 50%	145	-	
		Duty 99%	230		
	11n - MCS7 @17dBm	Duty 50%	130	-	
		Duty 99%	215	-	
MCU	Run	Freq@ 192MHz	22	-	
	Standby	Freq@<10MHz	2	-	
Sleep	PDS7	Fast recover	12	-	uA
Hibernate	HBN	RTC or GPIO wakeup	0.5	-	
Shut-down	-	-	0.1	-	

4. Reflow welding temperature curve



5. Application circuit



6. Contact Us

Address: A903 Room,Complex Building,Suojia Science Park,Xixiang,Baoan District,Shenzhen

Telephone: 0755-23220940

Website: www.aimachip.com

7. FCC module warning user manual

Federal Communication Commission Statement (FCC, U.S.)

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 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.

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.

FCC Caution:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

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.

IMPORTANT NOTES

Co-location warning:

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

OEM integration instructions:

This device is intended only for OEM integrators under the following conditions:

The transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the external antenna(s) that has been originally tested and certified with this module.

As long as the conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End product labeling:

The final end product must be labeled in a visible area with the following: “Contains Transmitter Module FCC ID: 2AVTT-BL61C”.

Information that must be placed in the end user manual:

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

Integration instructions for host product manufactures according to KDB 996369 D03 OEM Manual v01

7.2 List of applicable FCC rules

FCC Part 15 Subpart C 15.247 & 15.207 & 15.209

7.3 Specific operational use conditions

The module is a Bluetooth module with WiFi & BLE 2.4G function.

WiFi Specification：

Operation Frequency:

2412~2462MHz Number of

Channel: 11

Modulation: DSSS,

OFDM Type: PCB

Antenna
Gain: 2 dBi

BLE Specification：

Operation Frequency:

2402~2480MHz Number of

Channel: 40

Modulation:

GFSK Type:

PCB Antenna

Gain: 2 dBi

The module can be used for mobile or applications with a maximum 2dBi antenna. The host manufacturer installing this module into their product must ensure that the final composit product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operaition. The host manufacturer has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

7.4 Limited module procedures

Not applicable.

7.5 Trace antenna designs

Not applicable. The module has its own antenna, and doesn ′ t need a host ′ s printed board microstrip trace antenna etc.

7.6 RF exposure considerations

The module must be installed in the host equipment such that at least 20cm is maintained between the antenna and users ′ body; and if RF exposure statement or module layout is changed, then the host product manufacturer required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization

7.7 Antennas

Antenna Specification are as follows:

Type: PCB

Antenna Gain: 2

dBi

This device is intended only for host manufacturers under the following conditions: The transmitter module may not be co-located with any other transmitter or antenna; The module shall be only used with the internal antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employ a ‘unique ′ antenna coupler.
As long as the conditions above are met, further transmitter test will not be required. However, the host manufacturer is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.)

7.8 Label and compliance information

Host product manufacturers need to provide a physical or e-label stating “Contains Transmitter

Module FCC ID: 2AVTT-BL61C” with their finished product.

7.9 Information on test modes and additional

testingrequirements BLE

Operation Frequency:

2402~2480MHz Number of

Channel: 40
Modulation: GFSK

WIFI

Operation Frequency:

2412~2462MHz Number of

Channel: 11
Modulation: DSSS, OFDM

Host manufacturer must perfom test of radiated & conducted emission and spurious emission, etc according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product. Only when all the test results of test modes comply with FCC requirements, then the end product can be sold legally.

7.10 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 & 15.207 & 15.209 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 circuity), 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.