VB-02-Kit Specification

Version V1.0

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Document development/revision/revocation resume

Vision	Data	Revised content	Edition	Approve
V1.0	2021.07.02	First developed	Shihai Mo	Hong Xu

CONTENT

1. Product overview

The VB-02-Kit development board shares the PCB of VB-01-Kit. Because VB-02-Kit uses the VB-02 module, it is called the VB-02-Kit development board.

The main chip of VB-02 is the voice brain VB590 launched by Huazhen Company. It is a chip that adopts offline voice recognition AI, software and hardware integrated solutions, with ultra-low cost, high reliability, and strong versatility. In the speech recognition technology, it has achieved high-reliable wake-up recognition rate, longer-distance wake-up, lower false wake-up rate, stronger anti-noise ability, faster response recognition time, and pure offline recognition without networking.

VB-02 uses a high-performance 32-bit processor, the chip has built-in DSP instruction enhancement units and MCA algorithm hardware accelerators required for speech recognition neural network calculations, and the AI algorithm is deeply integrated with the chip architecture. It is equipped with the company's fifth-generation AI algorithm (voice recognition algorithms, voice enhancement, noise reduction and other acoustic front-end processing algorithms), providing smart devices with excellent voice control and voice interaction capabilities in the far-field environment. The main chip has been fully and deeply optimized in AI computing power, storage performance, and integration, providing developers with a truly low-cost complete voice AI solution and enhancing differentiated competitiveness.

VB-02 has a wealth of peripheral interfaces, including UART/I2C/PWM, and simple and friendly secondary development tools, which are convenient for customers to implement single-module voice control application scenarios.

Figure 1 Chip architecture diagram

1.1. Characteristic

■ **Key technical indicators**

- Adjustable recognition distance: support 5 meters recognition distance 1
- Background noise suppression: steady state, dynamic noise, environmental noise suppression>20dB
- Local speech recognition (based on the latest TDNN deep neural network recognition algorithm), support pure offline recognition
- The comprehensive recognition rate can reach more than 98%
- Recognition time is less than 100 ms
- Very low misjudgment rate
- Up to 50 entries

■ **Kernel**

- Integrated TG head 32-bit Xuantie 804 processor frequency up to 240MHz
- Adopt 3-4 stage variable length pipeline, equipped with DSP calculation engine and MCA algorithm hardware accelerator supporting NN

- Support 32 interrupt nesting, each interrupt has corresponding priority
- Support JTAG debugging and hardware breakpoints

■ **Storage**

- Integrate 128KB SRAM
- 8KB ROM for Boot
- Built-in 2MB SPI FLASH

■ Audio

- Internally integrated audio AD/DA, can be connected to analog PA and MIC

■ Power

- Internal integrated LDO, 3.3V input, default output 1.2V
- Built-in watchdog monitor WDT

■ **Timing and control**

- 4 Timers, support a variety of clock source options, 2 of which can clock in standby mode and wake up with low power consumption
- 1 RTC, can be used for accurate timing and low-power wake-up

■ **Peripherals**

- 7 channel PWM
- UART*2, support high-speed flow control
- 10 general-purpose input and output interfaces, each pin can send an interrupt by rising/falling edge or level detection
- I2C, SPDIF and other audio interfaces

Description:

1. Test conditions for identifying distance: (1) The environmental noise is small; (2) The microphone sensitivity is 35bB. Excessive environmental noise or the use of low-sensitivity microphones may shorten the actual recognition distance.

2. Recognition rate description: 35dB microphone is used, the distance between the tester and the microphone is less than 1 meter, and the sound size for effective communication can reach more than 98%. The increase in the distance between the tester and the microphone or the decrease of the tester's speaking volume may affect the recognition rate.

2. Major parameters

Table 1 Main parameter description

Model	VB-02-Kit
Package	DIP-20
Size	42*36(±0.2)mm
Operating temperature	-40 ℃ ~ 85 ℃
Storage environment	-40 ℃ ~ 125 ℃ , < 90%RH
Power supply	Voltage 5V， current >500mA
Interface	UART/I2C/PWM/JTAG/GPIO
Serial port rate	Default 115200 bps
SPI Flash	2MB (built-in)

Table 2 Electrical parameter table

(V_{core}=1.20V，V_{IO}=3.3V，T=25°C，f=192/160MHz)

参　数	测试条件	最小值	典型值	最大值	单位
工作电压	正常工作	4.7	5	5.3	V
工作模式 VDD33 工作电流	端口 VDD33 电源电流		60	85	mA
监听模式 VDD33 工作电流	端口 VDD33 电源电流		20		mA
待机模式 VDD33 工作电流	端口 VDD33 电源电流	/	5		uA
上拉电阻				100	KΩ
晶振反馈电阻(内部)		/		/	MΩ
DAC Line Out（10KΩ负载）					
满幅输出电平	0dB gain	1.89	2.12	2.39	Vpp
采样率		8		96	kHz
信噪比（A-Weighted）	1kHz	90	95		dB
动态范围（A-Weighted）	1kHz，-60dBr	90	95		dB
总谐波失真	-1dBr		-80	-70	dB
可编程增益 step		-25		+6	dB
频率响应	Passband			0.42*Fs	Hz
	Passband Ripple			+/-0.1	dB
电源噪声抑制比	1kHz，100mVpp		90		dB
ADC MIC Input（差分输入）					
采样率		8		96	kHz
信噪比（A-Weighted）	输入：1kHz MIC_Boost=20dB	75	80		dB
动态范围（A-Weighted）	输入：1kHz，-60dBr MIC_Boost=20dB	75	80		dB
总谐波失真	输入：1kHz，-1dBr， 0dB Gain		-80	-70	dB
	输入：1kHz，-1dBr， 20dB Gain		-70	-60	dB
MIC Bias 电压			2.08		V
MIC Bias 电流				4	mA

VB-02-Kit development board is an electrostatic sensitive device, and special precautions must be taken when handling it.。

Figure 2

3. Dimensions

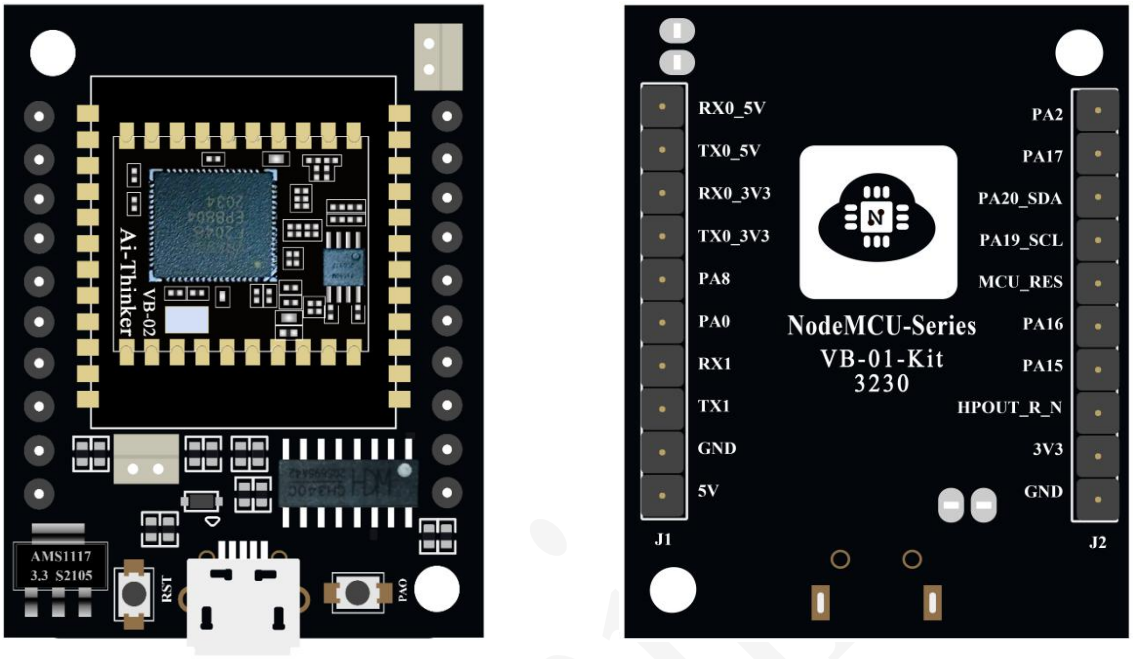


Figure 3 The appearance of the VB-02-Kit development board (the rendering is for reference only, the actual product shall prevail)

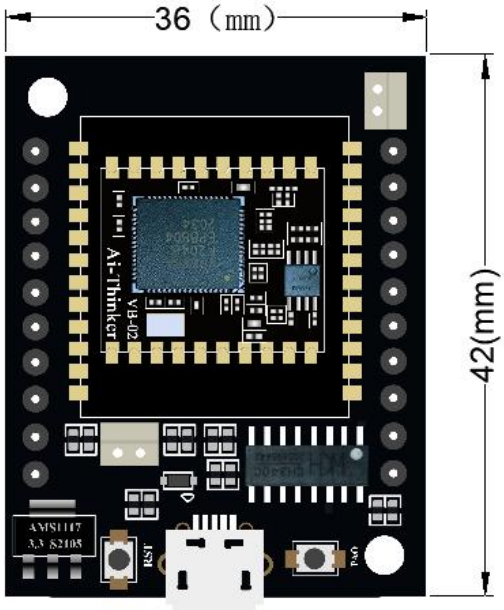


Figure 4 VB-02-Kit development board size chart

4. PIN definition

The VB-02-Kit development board has a total of 20 pins, as shown in the pin diagram, the functions of each pin are shown in list 3.

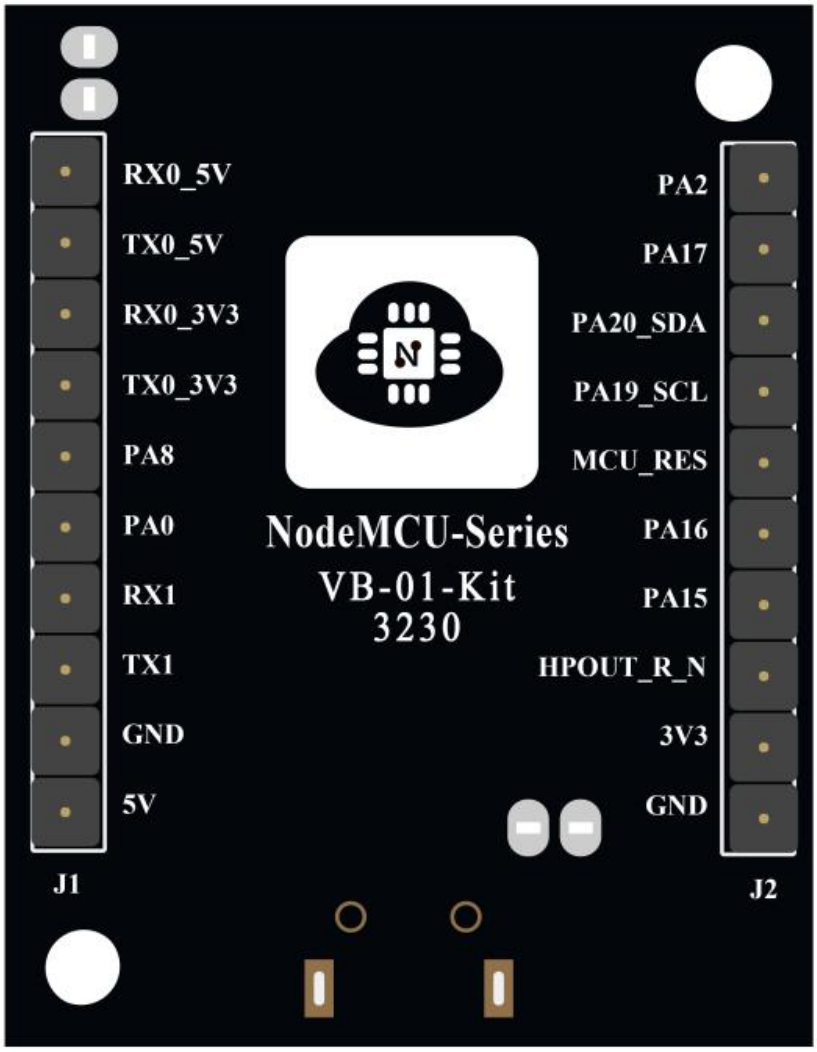


Figure 5 Pin diagram (reverse side)

Table 3 Pin function definition

No.	Name	Function Description
1	PA2	IO/3.3V level /PWM_CH2
2	PA17	IO/3.3V level /PWM_CH10
3	PA20_SDA	JTAG_TCK
4	PA19_SCL	JTAG_TMS
5	MCU_RES	RESET active low
6	PA16	IO/3.3V level /IICO_SDA
7	PA15	IO/3.3V level /IICO_SCL
8	HPOUT_R_N	Audio R channel output
9	3V3	3.3V power input
10	GND	Ground
11	5V	5V power input
12	GND	Ground
13	TX1	A28/TX1 UART1 TXD
14	RX1	A27/RX1 UART1 RXD
15	PA0	IO/3.3V level /PWM_CH0
16	PA8	IO/3.3V level /PWM_CH8
17	TX0_3V3	UART0 TXD peak voltage 3V3 default Log output
18	RX0_3V3	UART0 RXD peak voltage 3V3
19	TX0_5V	UART0 TXD peak voltage 5V default Log output
20	RX0_5V	UART0 RXD peak voltage5V

5. Schematic diagram

The VB-02-Kit development board shares the same schematic diagram with the VB-01-Kit development board.

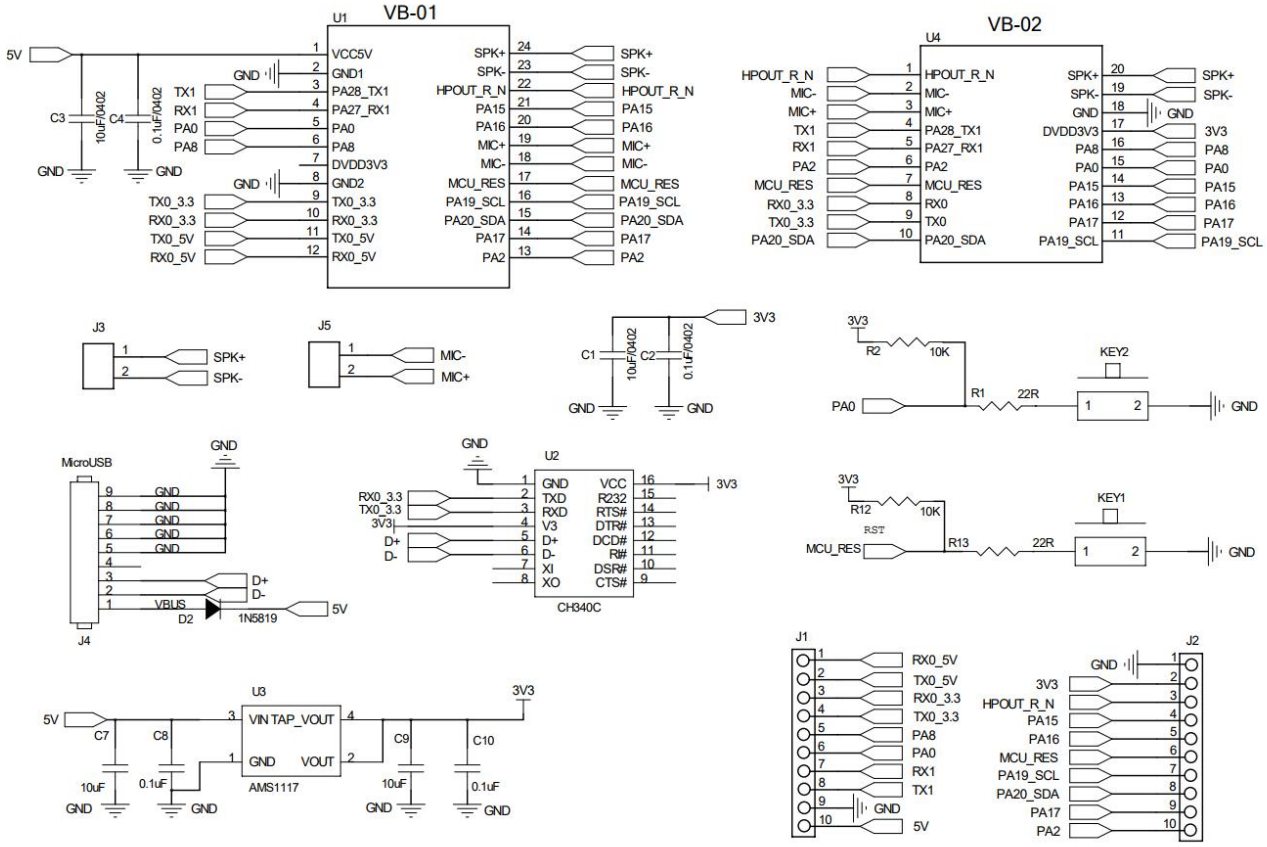


Figure 6 VB-02-Kit development board schematic diagram

6. Design guidance

- There are some GPIO ports on the periphery of the development board. If you need to use it, it is recommended to connect a 10-100 ohm resistor in series with the IO port. This can suppress overshoot and make the levels on both sides more stable. It is helpful for EMI and ESD.
- For the pull-up and pull-down of special IO ports, please refer to the instructions in the specification. This will affect the startup configuration of the module.
- The IO port of the module is 3.3V. If the main control and the IO level of the development board do not match, a level conversion circuit needs to be added.
- If the IO port is directly connected to a peripheral interface or terminal such as a header, it is recommended to reserve an ESD device near the terminal of the IO trace.

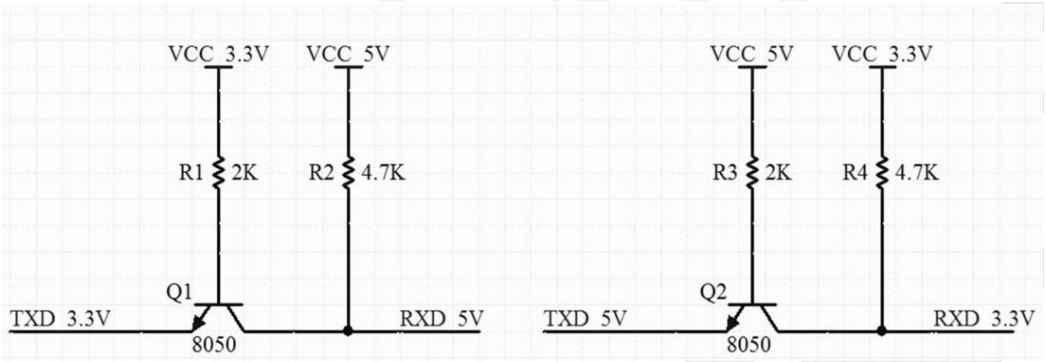


Figure 7 Level conversion circuit

7. Application example

- Example 1: The offline voice module recognizes the entry, and sends the entry identification serial code to the IOT-WIFI module via UART, and the module performs corresponding operations, such as turning on and off the light; at the same time, it reports the update status of the device to the cloud for synchronization. In the same way, after the cloud sends a control command, such as turning on and off the light, after executing the command, the entry identification sequence code is sent to the VB module through the UART, and the module plays the corresponding prompt tone.

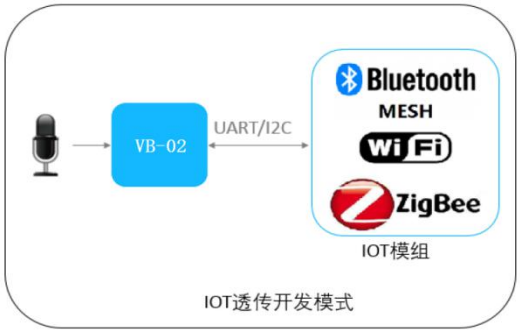


Figure 8 Application example

Example 2: The VB module has peripheral drive capabilities, such as GPIO and PWM lights, and the VB module can be used as the main control, so that the cost is greatly reduced, and the product has both voice recognition and peripheral control capabilities.

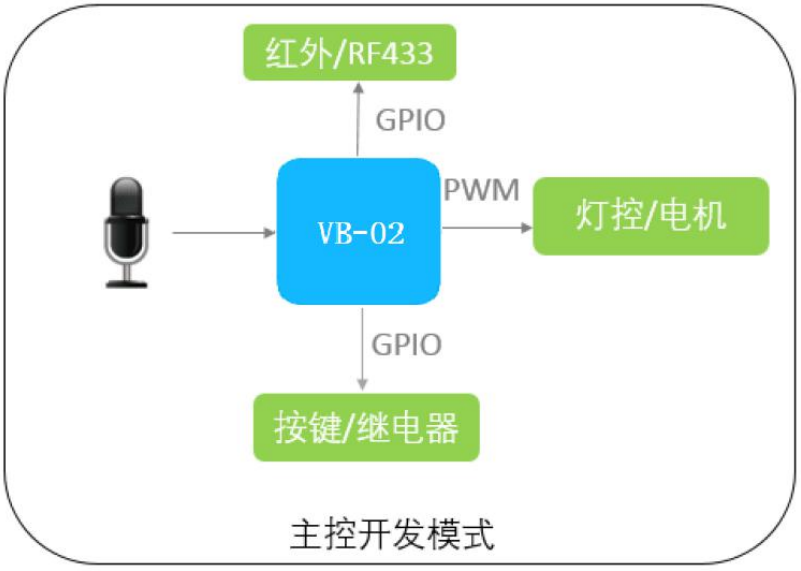


Figure 9 application example

- Example 3: Although the VB module has the ability to drive peripherals, there are often professional MCU hardware and integrated software in a specific industry, or the customer only performs voice upgrades based on the original equipment. This type of solution may not be suitable for the VB module as the main control. Connect with MCU through VB-UART to quickly upgrade products.

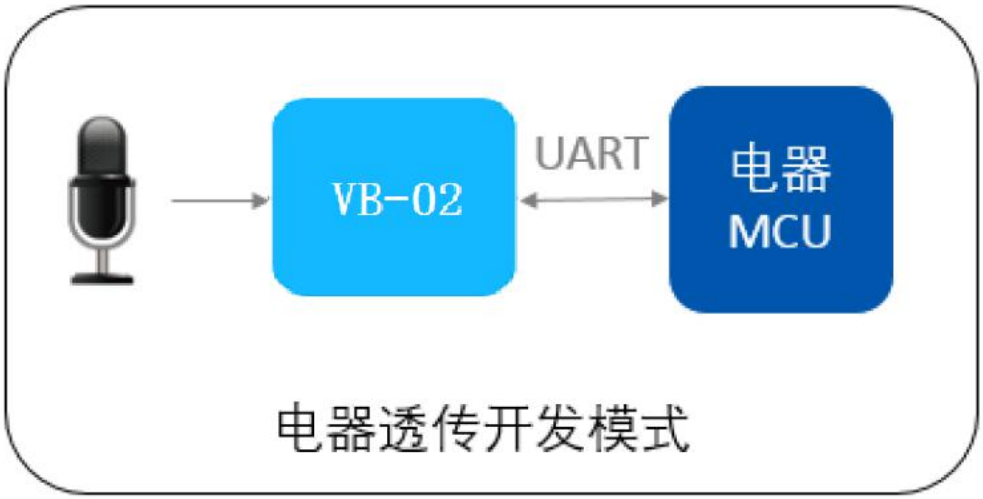
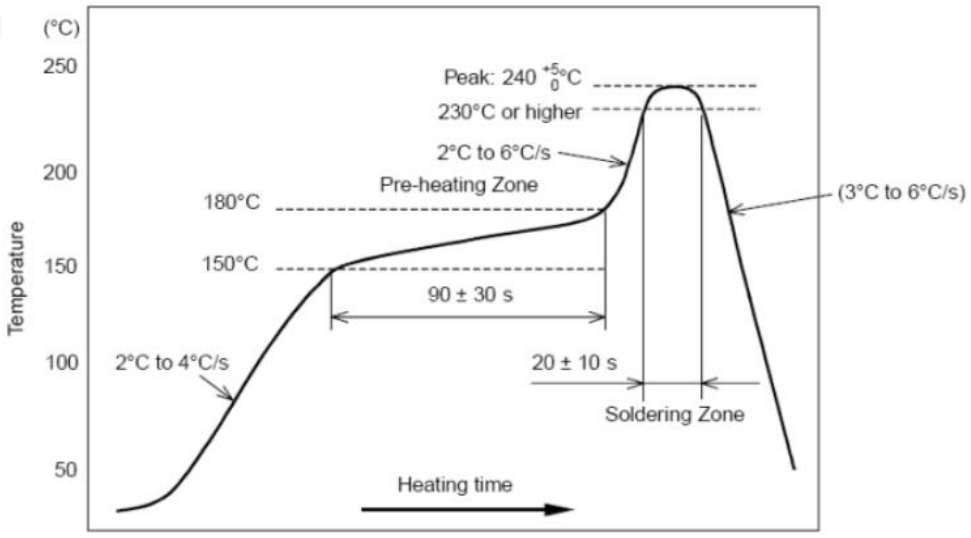


Figure 10 application example

8. Reflow soldering curve

- Heating method: conventional convection or IR convection;
- Allowable reflow times: 2 times, for the following reflow (conditions);
- Temperature curve: Reflow should conform to the temperature curve shown in the figure below;
- Max :245°C。



9. Related model

Table 4 related model

Model	Power supply	Package	Size	Interface
VB-01	5V，>500mA	SMD-24	25.5*24*3.25(±0.2)mm	UART
VB-02	3.3V，>400mA	SMD-20	18*17*1.7(±0.2)mm	UART
VB-01-Kit	5V，>500mA	DIP-20	42*36(±0.2)mm	UART
VB-02-Kit	5V，>500mA	DIP-20	42*36(±0.2)mm	UART

Figure 11 Reflow soldering curve

Product related information：https://docs.ai-thinker.com/vb

10. Packaging

The packaging of the VB-02-Kit is electrostatic bag packaging.

11. Contact us

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