User Manual
E103-W20 WIFI Module

Based on MediaTek MT7688AN/ MT7628AN



Chengdu Ebyte Electronic Technology Co.,Ltd.

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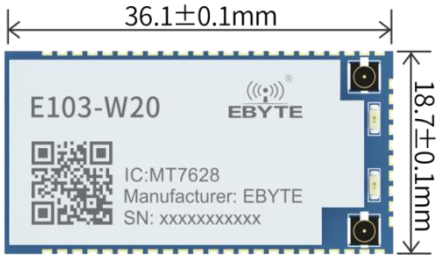
1 Overview

1.1 Product introduction

The E103-W20(7688) and E103-W20(7628) modules are low-cost and low-power IoT modules based on MediaTek MT7688AN and MT7628AN. This module brings out all the interfaces of MT7688AN/MT7628AN, supports OpenWrt operating systems and custom development, has rich interfaces and powerful processors, can be widely used in smart devices or cloud service applications, etc., and can freely perform two secondary development.



E103-W20(7688)



E103-W20(7628)

1.2 Features

- Super data processing capability, MCU main frequency up to 580MHz
- Support for the global license-free ISM 2.4 GHz frequency band
- 150M wireless speed
- Support 802.11b/g/n mode
- 20/40 channel bandwidth
- 802.11v support
- Support AP,STA and AP,STA mixed mode
- 5 10/100M adaptive network ports
- 1 USB2.0 host interface
- Multiple interfacesSPI/SD-XC/eMMC
- Rich peripheral interfaces, SPI, I2C, I2S, UART, JTAG, GPIO
- Widely used in the Internet of Things
- Built-in powerful PMU
- Supports 16 Multiple BSSIDs
- Support multiple encryption methods WEP64/128, TKIP, AES, WPA, WPA2, WAPI
- Support QoS, WMM, WMM-PS
- Support OpenWrt 14.07 version for secondary development.

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1.3 Application scenarios

- wifi video transmission
- wifi audio transmission
- router
- wifi repeater
- Serial port forwarding and other smart home universal modules
- Cloud service application
- IoT Gateway

2 Specifications

2.1 Radio Frequency parameters

RF parameters	unit	Model		Remark
		E103-W20(7688)	E103-W20(7628)	
transmit power	dBm	20～24		
WiFi protocol	-	IEEE 802.11b/g/n		
Ideal Range	Meter	200		Antenna gain 5dBi , in a line of sight
main frequency	MB	580		
frequency channel	GHz	2.4		Global license-free ISM 2.4 GHz band

2.2 Electrical parameters

Electrical parameters		unit	model		Remark
			E103-W20(7688)	E103-W20(7628)	
working voltage		V	3.3±0.2V		Voltage over 3.5 V will permanently burn the module
communication level		V	3.3		Voltage over 3.5 V will permanently burn the module
No-load running current		mA	180±50		Average power consumption
Supply Current Requirements		mA	≥1000		
temperature	Operating temperature	°C	-20 to +5 5 _		
	Storage temperature		-40 to +8 5		
humidity	use	%RH	10 to 95(non-condensing)		
	storage		5～ 95(non-condensing)		

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2.3 Hardware parameters

Hardware parameters		model		Remark
		E103-W20(7688)	E103-W20(7628)	
chip		MT7688AN	MT7628AN	
Flash		32MB		Customizable 16MB/8MB
Memory		DDR2 128MB		Customizable DDR2 256M/64M/32MB
kernel		MIPS24KEc		
Packaging method		patch		
Antenna interface		IPEX×1 (1T2R 2.4 GHz with 150Mbps PHY data rate)	IPEX×2 (2T2R 2.4 GHz with 300Mbps PHY data rate)	Characteristic impedance about 50 ohms
interface	Ethernet interface	5 10M/100M adaptive		Interfaces supported by factory default firmware 1 WAN, 4 LAN .
	UART	3 way		
	SDIO	1 way		Firmware interface not supported
	SPI	1 way		Firmware interface not supported
	I2C	1 way		Firmware interface not supported
	I2S	1 way		Firmware interface not supported
	PWM	1 way		Firmware interface not supported
	GPIO	8 or more		Firmware Supported Interfaces Defined Functions
size		34.1*18.7*2.7mm	36.1*18.7*2.7mm	The error size is ±0.1mm
weight		3. 4g	3. 5g	The error is ± 0.1g

Note: 1. The default firmware of the module is the firmware developed by our company based on OPENWRT;

2. The OPENWRT program or the original MTK Linux program can be programmed according to the actual usage.

3. The default baud rate of the serial port is 57600 bps.

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3 Mechanical Dimensions and Pin Definition

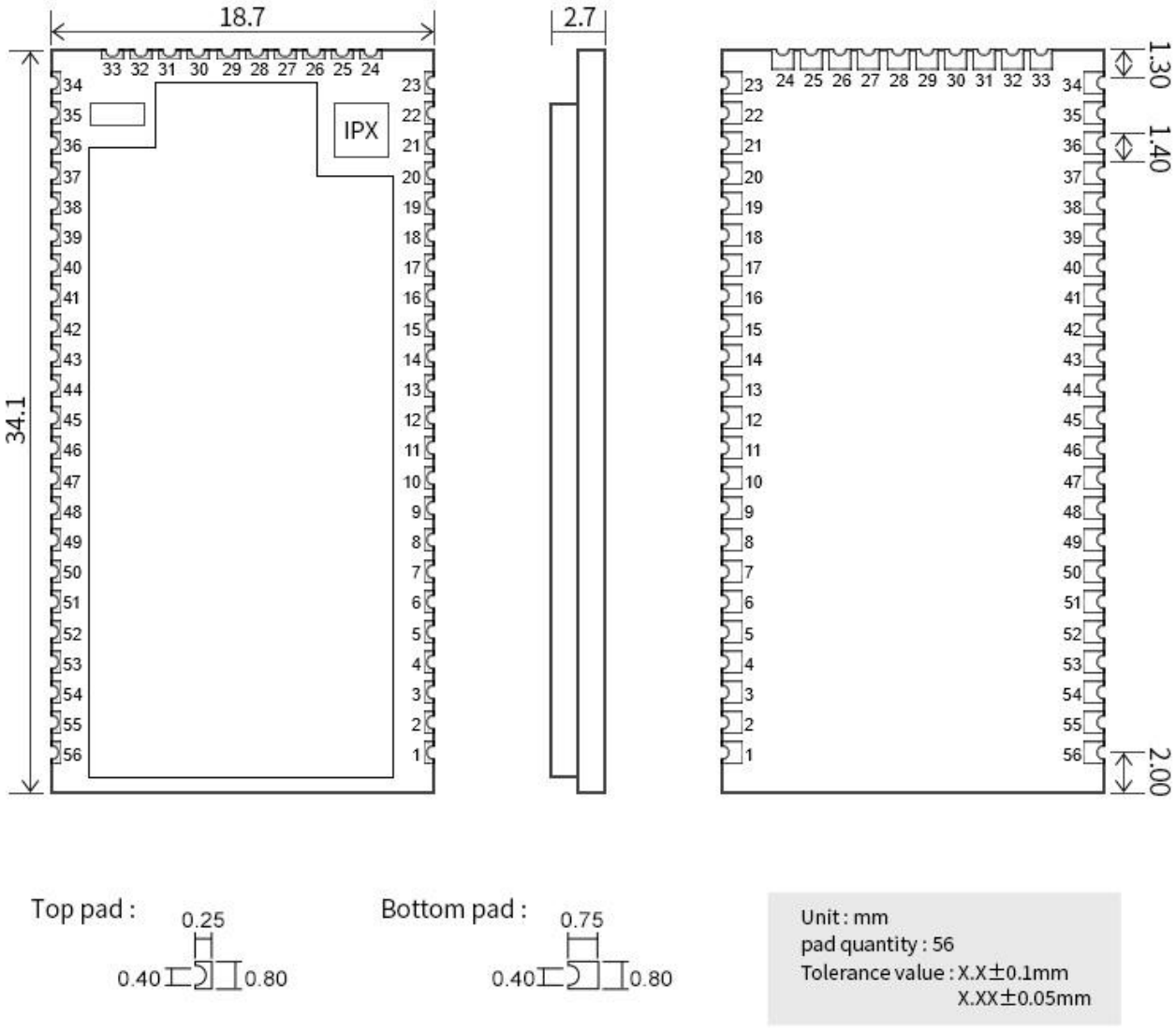


Figure 1 : Dimensions of E103-W20(7688)

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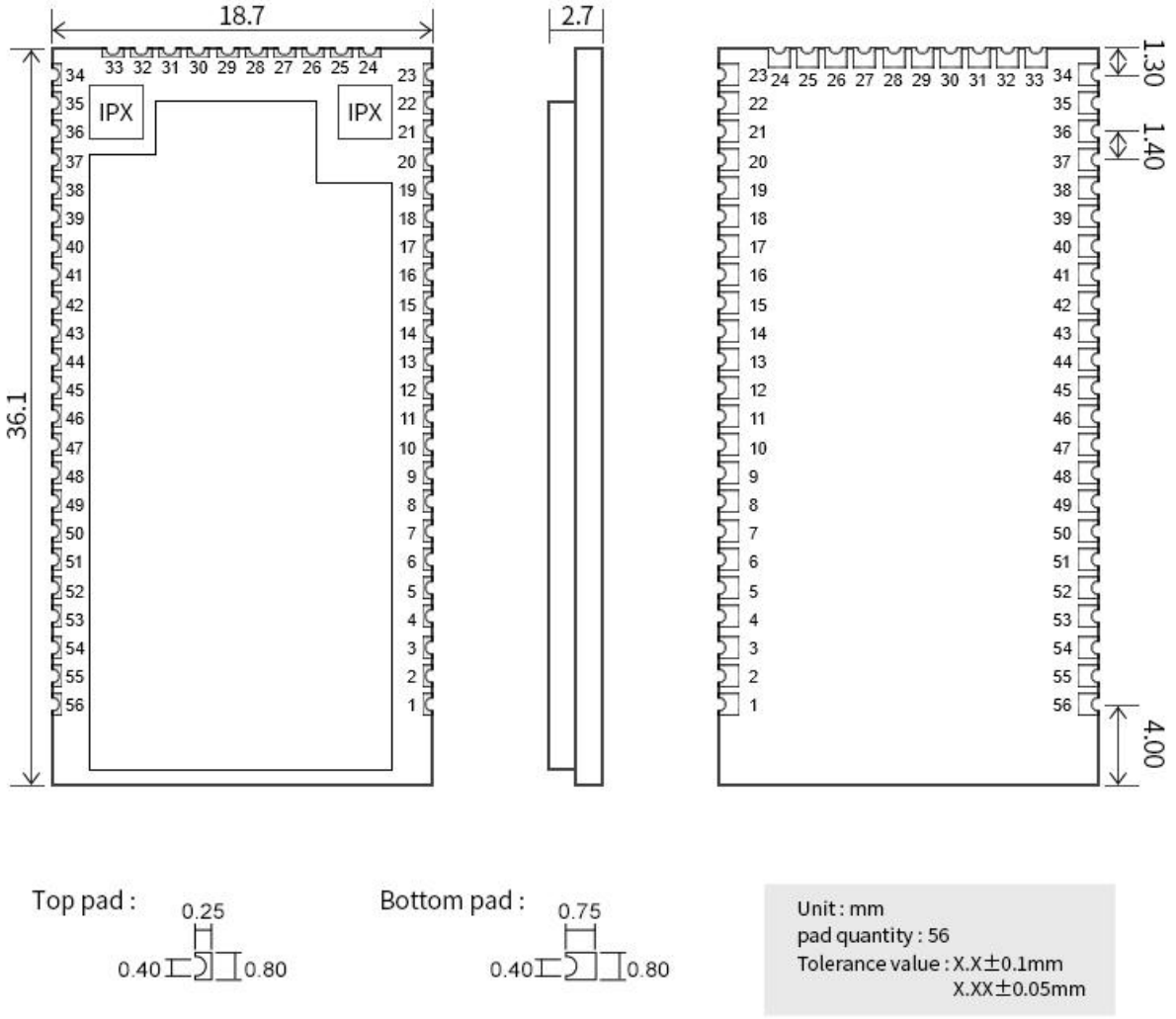


Figure 2 : Dimensions of E103-W20(7628)

No	pin name	pin type	Pin function description	function by default
1	GND	P	land	System power supply(it is recommended to increase the capacitor at the power supply end)
2	3.3VD	P	3.3V input, recommended supply current >=1000mA	
3	3.3VD	P		
4	GND	P	land	
5	SPI_CS0	I/O	SPI bus chip select signal 0	undefined, please leave blank
6	REF_CLKO	I/O	Reference clock output	undefined, please leave blank
7	PERST_N	I/O	PCIe device reset output	Undefined, please leave it in the air, cannot be pulled down
8	WDT_RST_	I/O	watchdog timeout reset	

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	N			
9	EPHY_LED 4	I/O	PORT4 LED active low	LAN4 network port light
10	EPHY_LED 3	I/O	PORT3 LED active low	LAN3 network port light
11	EPHY_LED 2	I/O	PORT2 LED active low	LAN2 network port light
12	EPHY_LED 1	I/O	PORT1 LED active low	LAN1 network port light
13	EPHY_LED 0	I/O	PORT0 LED active low	WAN port light
14	PORT_N	I/O	CPU reset, active low	Reset input, please leave it open
15	UART_TXD 1	O	Serial port 1 data transmission	Serial port 1 output, please leave it in the air if it is not used, and cannot be pulled down
16	UART_RXD 1	I	Serial port 1 data reception	Serial port 1 input, please leave it in the air
17	I2S_SDI	I/O	I2S data input	undefined, please leave blank
18	I2S_SDO	I/O	I2S data output	Undefined, please leave it in the air, cannot be pulled up
19	I2S_WS	I/O	I2S channel selection, 0: left, 1: right	undefined, please leave blank
20	I2S_CLK	I/O	I2S data bit clock	undefined, please leave blank
21	GND	P	land	ground
22	ANT	P	Antenna RF interface, not connected by default	If you need to connect this pin, you need to remove the antenna base and replace it with a 0 ohm resistor
23	GND	P	land	ground
24	I2C_SCLK	I/O	I2C bus clock	undefined, please leave blank
25	I2C_SD	I/O	I2C bus data	undefined, please leave blank
26	SPI_CS1	I/O	SPI chip select signal 1	undefined, please leave blank
27	SPI_CLK	I/O	SPI clock signal	Undefined, please leave it in the air, cannot be pulled up
28	SPI_MISO	I/O	SPI bus data master input slave output	Undefined, please leave it in the air, cannot be pulled down
29	SPI_MOSI	I/O	SPI bus data master out slave in	Undefined, please leave it in the air, cannot be pulled up
30	GPIO0	I/O	General purpose input and output interface	undefined, please leave blank
31	UART_TXD 0	O	Serial port 0 data output	Serial port 0 output, please leave it in the air, do not pull up
32	UART_RXD 0	I	Serial 0 data input	Serial port 0 input, please leave it in the air
33	WLED_N	I/O	WIFI LED, active low	When there is a WIFI signal, the WIFI LED flashes and can be left floating

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34	MDI_RP_P0	I/O	PORT0 network signal receiving positive	WAN port, please leave it empty
35	MDI_RN_P0	I/O	PORT0 network signal receive negative	
36	MDI_TP_P0	I/O	PORT0 network signal sending is positive	
37	MDI_TN_P0	I/O	PORT0 network signal sending negative	
38	MDI_TP_P1	I/O	PORT0 network signal sending is positive	LAN1 port, please leave it empty
39	MDI_TN_P1	I/O	PORT1 network signal sending negative	
40	MDI_RP_P1	I/O	PORT1 network signal receiving positive	
41	MDI_RN_P1	I/O	PORT1 network signal receive negative	
42	MDI_RP_P2	I/O	PORT2 network signal reception is positive	LAN2 port, please leave it empty
43	MDI_RN_P2	I/O	PORT2 network signal receive negative	
44	MDI_TP_P2	I/O	PORT2 network signal sending is positive	
45	MDI_TN_P2	I/O	PORT2 network signal send negative	
46	MDI_TP_P3	I/O	PORT3 network signal sending is positive	LAN3 port, please leave it empty
47	MDI_TN_P3	I/O	PORT3 network signal send negative	
48	MDI_RP_P3	I/O	PORT3 network signal reception is positive	
49	MDI_RN_P3	I/O	PORT3 network signal receive negative	
50	MDI_RP_P4	I/O	PORT4 network signal reception is positive	LAN4 port, please leave it empty
51	MDI_RN_P4	I/O	PORT4 network signal receive negative	
52	MDI_TP_P4	I/O	PORT4 network signal sending is positive	
53	MDI_TN_P4	I/O	PORT4 network signal send negative	
54	USB_DP	I/O	USB data positive	undefined, please leave blank
55	USB_DM	I/O	USB data negative	undefined, please leave blank
56	GND	P	land	ground

Note: 1.I-input; O-output; I/O-digital I/O; P-power. IO port drive current 8mA.

2. The LED light on the module is the status indicator light, which should be developed by the user to determine the LED

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indicator status.

4 WiFi Protocol Features

4.1 802.11b 11M

802.11b Transmit(Conductive)					
Item	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
Frequency Range		Channel 1		Channel 13	
Tx Power Level	DQPSK	18	20	twenty two	dBm
Frequency Tolerance		-15	0	15	ppm
Spectral Mask	11MHz→22MHz		40		dBr
	>22MHz		53		dBr
Modulation Accuracy	All Data Rate		15		%
802.11b Receiver(Conductive)					
Item	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
Frequency Range		Channel 1		Channel 13	
Min. Input	11Mbps PER<8%	-91.5	-89.5	-87.5	dBm

4.2 802.11g 54M

802.11g Transmit(Conductive)					
Item	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
Frequency Range		Channel 1		Channel 13	
Tx Power Level	OFDM	15	17	19	dBm
Frequency Tolerance		-15	0	15	ppm
Modulation Accuracy	All Data Rate		-31	-28	%
802.11g Receiver(Conductive)					

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Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range		Channel 1		Channel 13	
Min. Input	54Mbps PER<10%	-78.0	-76.0	-74.0	dBm

4.3 802.11n MCS7(HT20)

802.11n_HT20 Transmit(Conductive)					
Item	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
Frequency Range		Channel 1		Channel 13	
Tx Power Level	OFDM	15	17	19	dBm
Frequency Tolerance		-15	0	15	ppm
Modulation Accuracy	All Data Rate		-31	-28	dB
802.11n_HT20 Receiver(Conductive)					
Item	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
Frequency Range		Channel 1		Channel 13	
Min. Input	MCS7 PER<10%	-76.5	-74.5	-72.5	dBm

4.4 802.11n_MCS7(HT40)

802.11n_HT40 Transmit(Conductive)					
project	**condition**	**minimum**	**Typical**	**maximum**	**unit**
Frequency Range		Channel 1		Channel 13	
Tx Power Level	OFDM	15.0	17.0	19.0	dBm
Frequency Tolerance		-15	0	15	ppm
Modulation Accuracy	All Data Rate		-31	-28	dB
802.11n_HT40 Receiver(Conductive)					
Item	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
Frequency Range		Channel 1		Channel 13	

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Min. Input	MCS7 PER<10%	-76.5	-74.5	-72.5	dBm

5 E103-W20 for secondary development

5.1 Acquisition and compilation of secondary development SDK

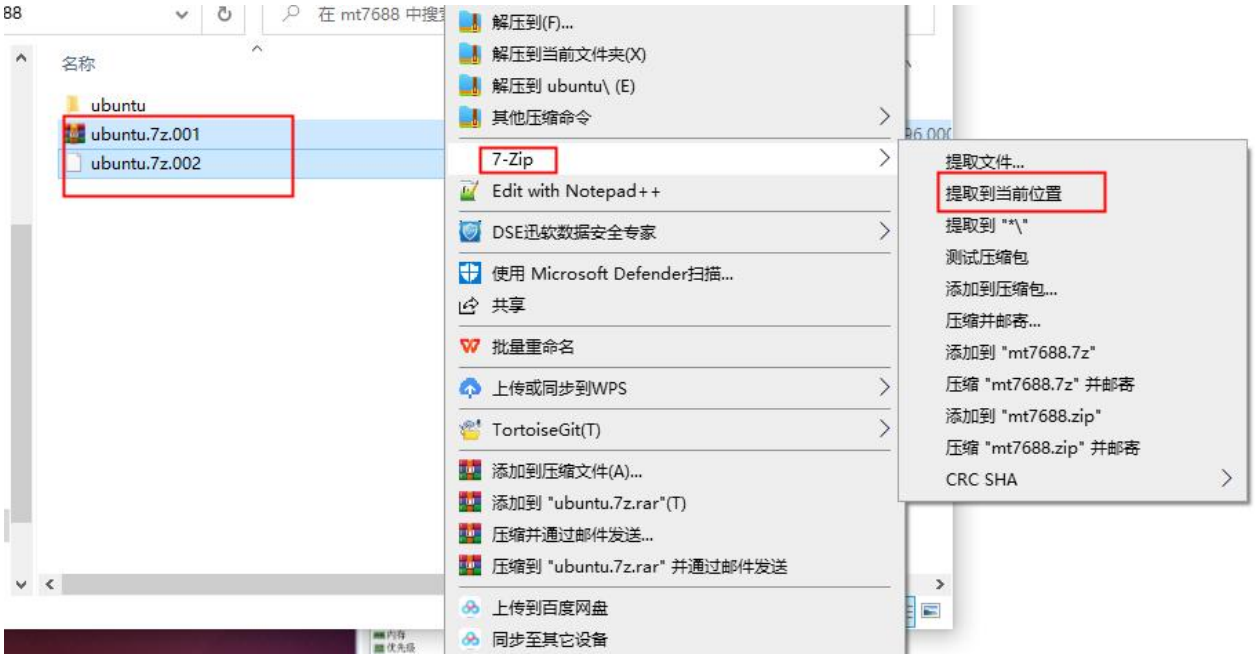
The module is factory-burned with the basic firmware of openwrt version 14.07. We provide this version of the openwrt SDK for developers to use. Since compiling the source code needs to download some foreign packages, it is easy to make mistakes during the compiling process, and there may be some environmental problems, so we provide the configured source code in the form of a virtual machine image, and the compilation can be successful directly.

（1）Compile the virtual machine on Baidu network disk(using vmware virtual machine)

Link: https://pan.baidu.com/s/1V-HEIY1E2oa41sJcs6Gbgw?pwd=ct04

Extraction code: ct04

（2）After downloading, there are two compressed files in 7zip format. After selecting these two files, use 7zip to extract them to the current location.



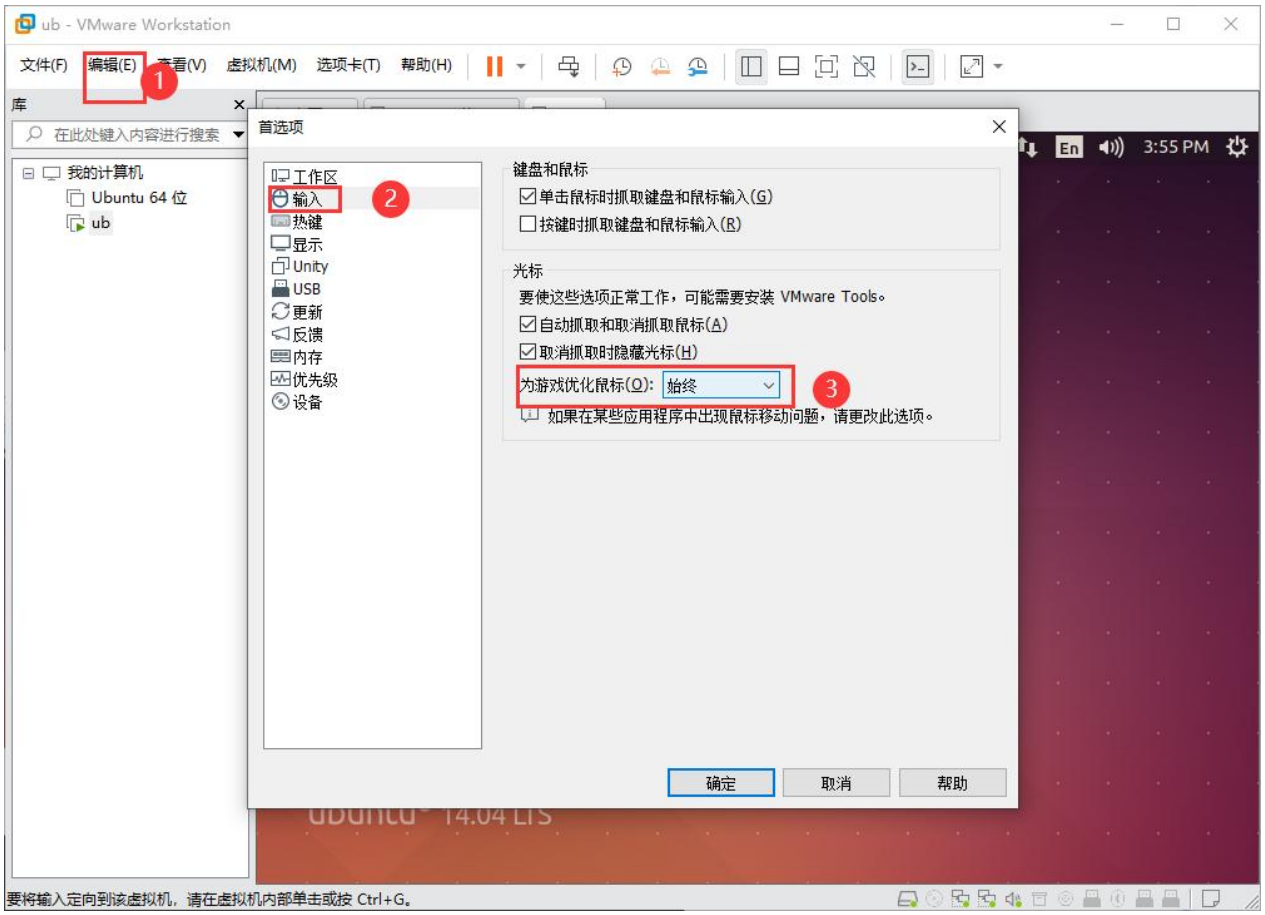
(3) Use vmware to open ubuntu

Virtual machine username: luke password: luke

Virtual machine version 14.1.1

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(4) When opening the virtual machine, the mouse may not be available. You can set it in vmware's Edit->Preferences->Input->Mouse Optimized for Games to always



(5) The source code of Mtk Openwrt comes with the virtual machine, /home/luke/MtkOpenwrt, which already has the default configuration and can be compiled directly

luke@ub:~$ cd MtkOpenwrt
luke@ub:~$ make V=s

(6) Openwrt configuration compilation

There is already a default configuration in the SDK, which meets the basic functions of routing. Customers can also customize the configuration according to their own needs.

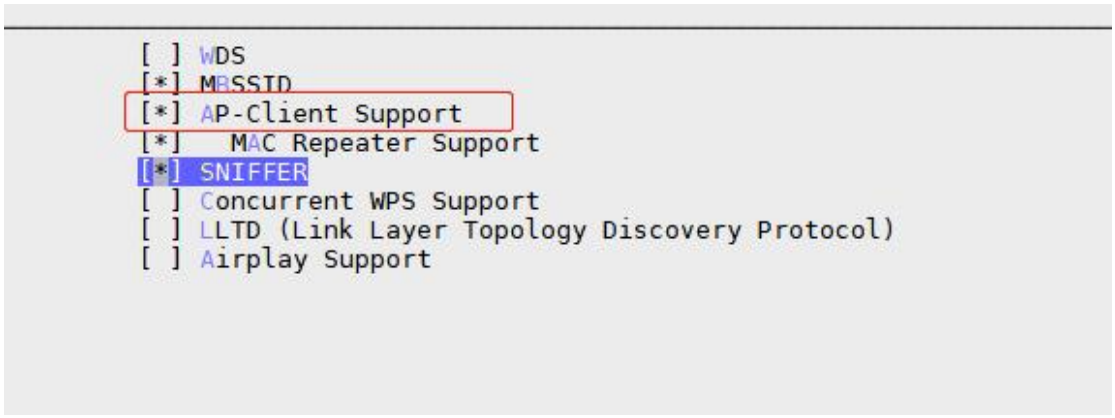
Command: make menuconfig

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The WIFI driver is configured under MTK Properties-> Drivers --->kmod-mt7628

If you need STA function, you can choose: AP-Client Support



Notice:

Kmod-mt7628sta cannot be used, please do not select it, if you need sta function, please select ap-client support under kmod-mt7628 driver



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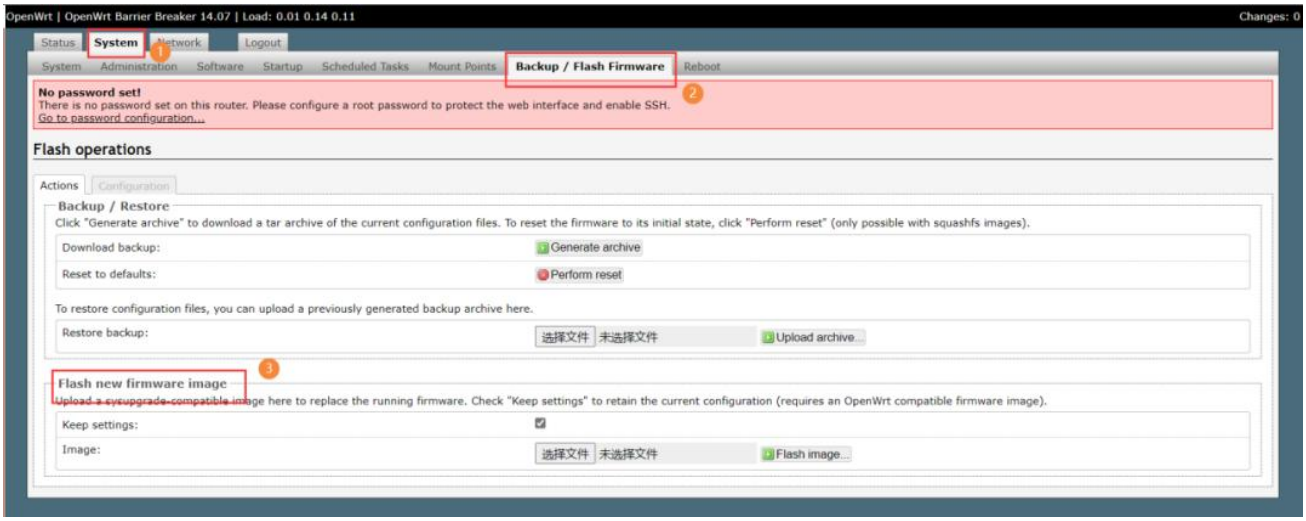
5.2 Firmware burning

(1) Burn through the openwrt web page

①After the module is powered on, connect to the module's wifi, and then enter 192.168.10.1 in the browser to enter the openwrt web configuration interface



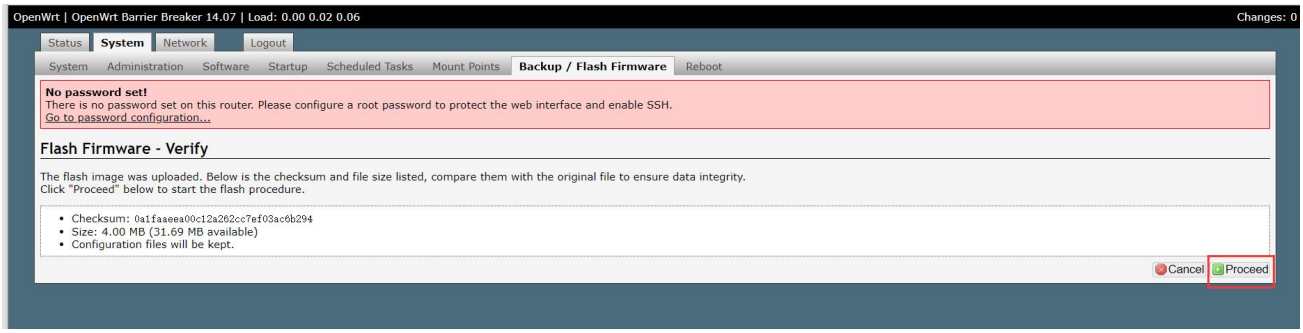
②Enter the password root to log in, then enter the System-->Backup/Flash Firmware option, and select the file to be updated at the Flash new firmware image.



③ After selecting, click Flash image



④ Enter the verification, click proceed to start burning



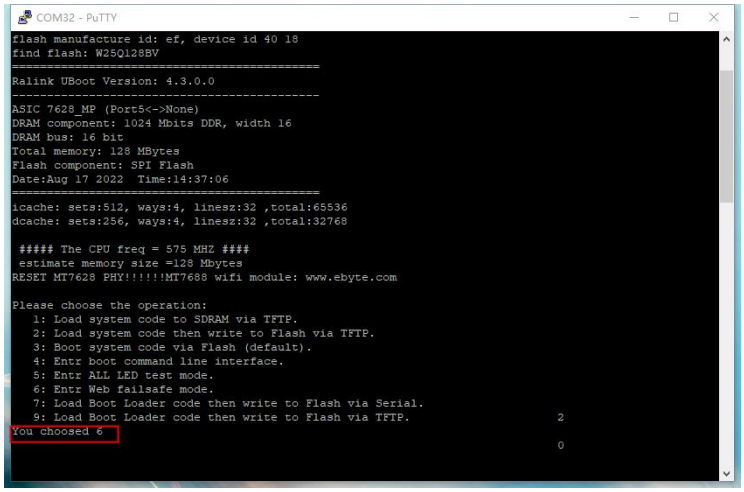
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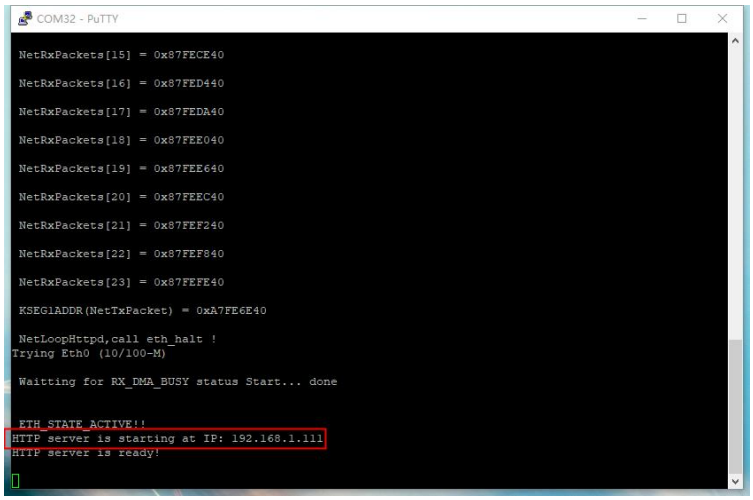
⑤Wait about a minute or so, the module indicator lights up and the programming is complete

(2) Use uboot to burn

Using uboot to burn requires the module to be connected to the network cable, and the module and the computer are in the same network segment

①When the development board is powered on, enter "6" to enter the web page to burn



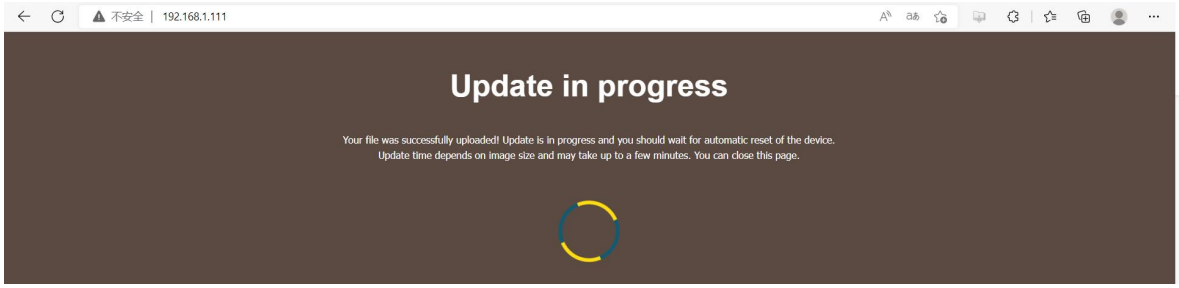


② Enter the IP address in the above picture in the browser, you can jump to the burning interface; here you can choose to burn uboot, openwrt firmware, factory parameters

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③ Here is an example of upgrading openwrt, first select the bin file we need to burn, then click update firmware to start the upgrade , and close the webpage after the upgrade.



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6 Frequently Asked Questions

6.1 The transmission distance is not ideal

- When there is a straight-line communication obstacle, the communication distance will be correspondingly attenuated;
- Temperature, humidity, and co-channel interference will increase the communication packet loss rate;
- The ground absorbs and reflects radio waves, and the test effect close to the ground is poor;
- Seawater has a strong ability to absorb radio waves, so the seaside test effect is poor;
- If there is a metal object near the antenna, or placed in a metal shell, the signal attenuation will be very serious;
- The power register is set incorrectly, and the air rate is set too high(the higher the air rate, the closer the distance);
- The low voltage of the power supply at room temperature is lower than the recommended value, and the lower the voltage, the lower the output power;
- Poor matching of the antenna and the module or the quality of the antenna itself.

6.2 Modules are easily damaged

- Please check the power supply to ensure that it is between the recommended supply voltages, if exceeding the maximum value will cause permanent damage to the module;
- Please check the stability of the power supply, the voltage should not fluctuate greatly and frequently;
- Please ensure anti-static operation during installation and use, and high-frequency components are electrostatically sensitive;
- Please ensure that the humidity during installation and use should not be too high, and some components are humidity-sensitive devices;
- If there is no special requirement, it is not recommended to use it at too high or too low temperature.

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7 Welding Operation Instructions

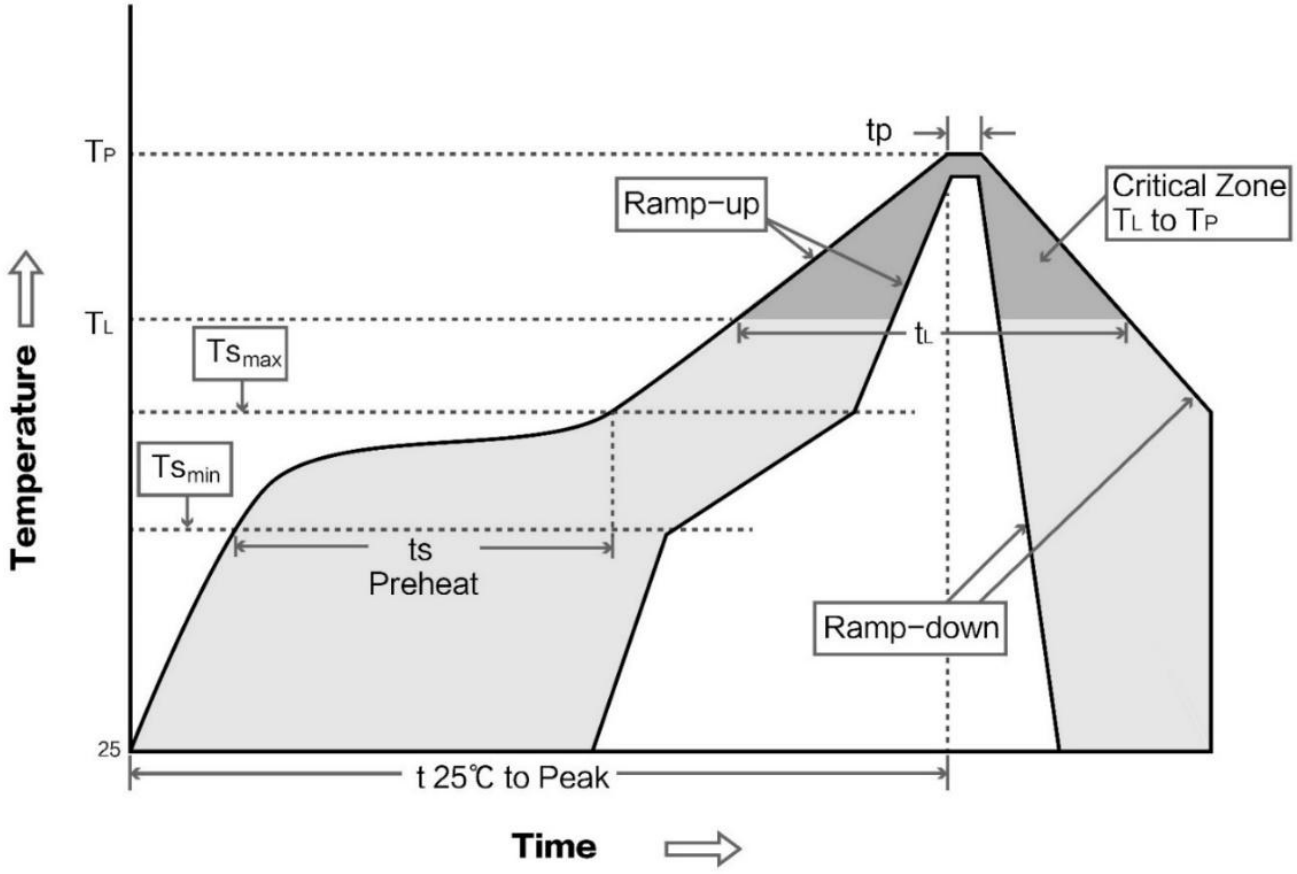
7.1 Reflow soldering temperature

Profile Feature	Curve feature	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	solder paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min(Tsmin)	Minimum preheat temperature	100℃	150℃
Preheat temperature max(Tsmax)	maximum preheat temperature	150℃	200℃
Preheat Time(Tsmin to Tsmax)(ts)	Preheat time	60-120sec	60-120sec
Average ramp-up rate(Tsmax to Tp)	average rate of ascent	3℃/second max	3℃/second max
Liquidous Temperature(TL)	liquidus temperature	183℃	217℃
Time(tL)Maintained Above(TL)	time above liquidus	60-90sec	30-90 sec
Peak temperature(Tp)	peak temperature	220-235℃	230-250℃
Aveage ramp-down rate(Tp to Tsmax)	average rate of descent	6℃/second max	6℃/second max
Time 25℃to peak temperature	Time from 25℃ to peak temperature	6 minutes max	8 minutes max

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7.2 Reflow soldering profile

Reflow soldering profile



8 Antenna Options

Antennas play an important role in the communication process, and often inferior antennas will have a great impact on the communication system. Therefore, our company recommends some antennas as antennas with excellent performance and reasonable price for our wireless modules.

Product number	type	frequency band	gain	size	feeder	interface	Features
		Hz	dBi	mm	cm		
TX2400-JKD-20	Rubber,foldable	2.4G	5.0	1 3 x 175x25	-	SMA-J	Fixed bent, omnidirectional antenna
TX2400-JK-11	Rubber,foldable	2.4G	2.5	8x90x10	-	SMA-J	Fixed bent, omnidirectional antenna
TX2400-JZLW-15	Rubber	2.4G	5.0	165	-	IPEX-1 generation	Straight, omnidirectional antenna

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9 Packing details

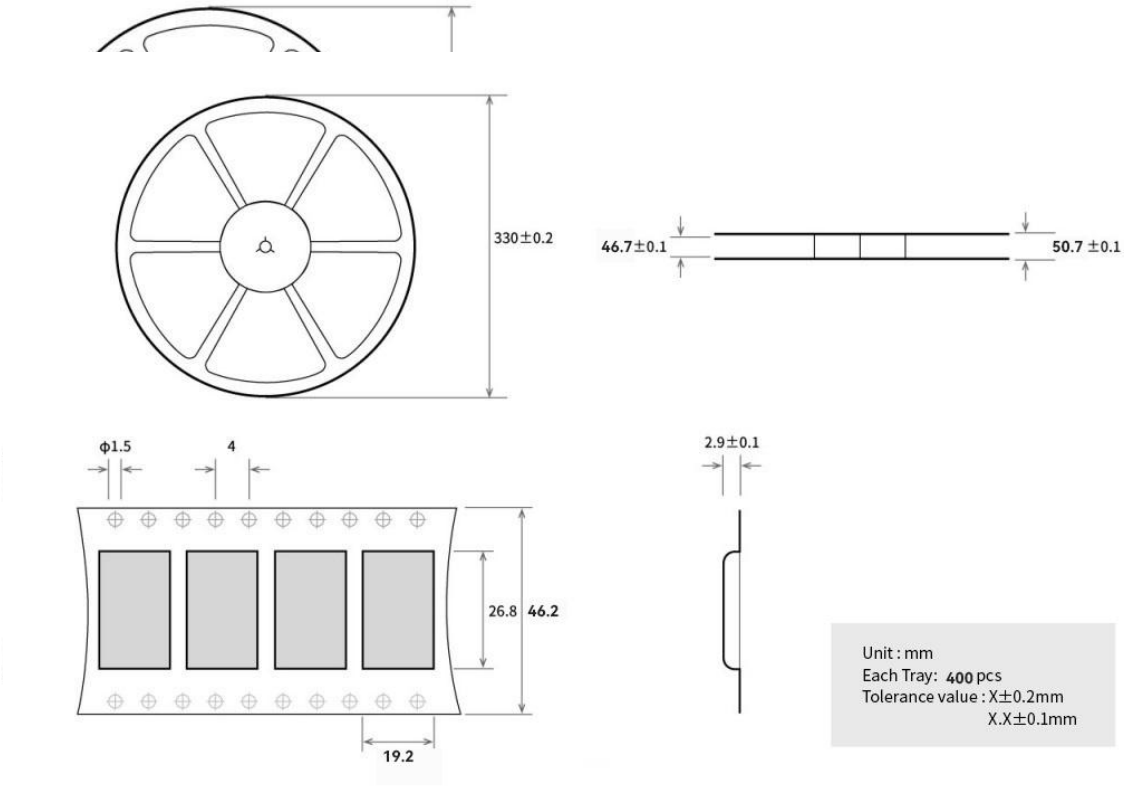


Figure 1: E103-W20(7688)

Figure 2: E103-W20(7628)

Revision History

Version	revision date	Revision Notes	Maintenance man
1.0	2022-9-26	initial version	Hao
1.1	2023-4-23	Update the pin diagram	Hao
1.2	2023-7-11	Update the pin diagram	Hao
1.3	2023-7-18	Content correction	Hao
1.4	2023-11-13	Content correction	Hao
1.5	2024-6-18	Content correction	Hao

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1.6	2024-7-5	Content correction	Hao
1.7	2024-9-26	Temperature description change	Hao

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