

ARMxy Embedded Computer



BL450 User Manual

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Date: 2025-6-27

Shenzhen Beilai Technology Co.,Ltd

Website: <https://www.bliiot.com>

Preface

Thanks for choosing BLIIOT ARM based Embedded Computer. These operating instructions contain all the information you need for operation of BL450.

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Disclaimer

This document is designed for assisting user to better understand the device. As the described device is under continuous improvement, this manual may be updated or revised from time to time without prior notice. Please follow the instructions in the manual. Any damages caused by wrong operation will be beyond warranty.

This product can only be used with the system version provided by our company. We shall not be held liable for any issues such as software installation failures, usage problems, incompatibility, property loss, or personal injury caused by the use of other systems.

Revision History

Revision Date	Version	Description	Owner
2025/6/27	V1.0	Initial Release	PH

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1 Introduction

1.1 Overview

BL450 series is developed based on an embedded Linux system, offering exceptional stability. The mainboard adopts the Rockchip RK series RK3588 processor, featuring a multi-core architecture with a quad-core ARM Cortex-A76, a quad-core ARM Cortex-A55, and a triple-core ARM Cortex-M0, with clock speeds up to 2.0G/2.4GHz. All key components on the core board—including the CPU, ROM, RAM, power supply, and crystal oscillator—are designed to industrial-grade standards. The core board has also undergone PCB layout optimization as well as high- and low-temperature testing, ensuring stable and reliable performance suitable for various industrial application environments.

BL450 offers abundant interface resources, including three Ethernet ports, two USB ports, multiple RS485 communication interfaces, an optional Wi-Fi module, and an optional 4G module. It also provides one power input interface and one HDMI video output interface. The device supports both Linux and Ubuntu operating systems, is compatible with Node-RED, Qt, Python, and C++ applications, and supports databases such as MySQL, InfluxDB, and SQLite. With its rich hardware interfaces and strong software compatibility, the BL450 series is ideal for a wide range of application scenarios.

1.2 Appearance



Standard Model



C Model



A Model



B Model



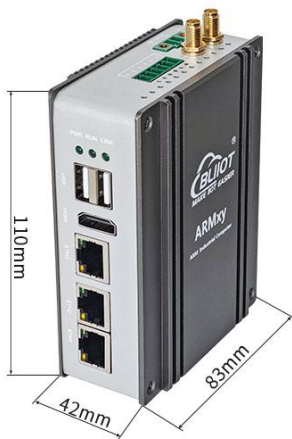
Standard Model



A Model



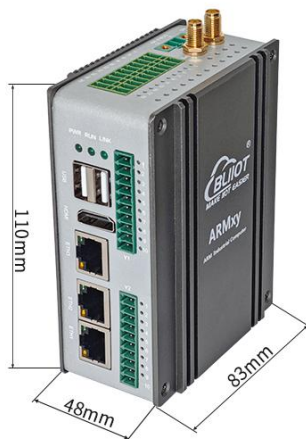
B Model



Standard Model



A Model



B Model

1.3 Technical Specifications

	Parameter	Description
System	CPU	Rockchip RK3588J/RK3588, 64-bit, 8nm
	Clock Speed	4x ARM Cortex-A76 RK3588J Clock Speed: Normal Mode 1.6GHz, Overdrive Mode 2.0GHz

		RK3588 Clock Speed: 2.4GHz 4x ARM Cortex-A55 RK3588J Clock Speed: Normal Mode 1.3GHz, Overdrive Mode 1.7GHz RK3588 Clock Speed: 1.8GHz
		3x ARM Cortex-M0 (PMU_M0, NPU_M0, DDR_M0) PMU_M0 Clock Speed: 200MHz Note: NPU_M0 and DDR_M0 are not officially released yet; the exact release date is TBD.
	RAM	4/8/16GByte LPDDR4X
	eMMC	32/64/128GByte eMMC
	NPU	6 TOPS Supports INT4/INT8/INT16/BF16/TF32 Compatible with deep learning frameworks including TensorFlow, PyTorch, Caffe, and MXNet
	GPU	GPU: Mali-G610 MP4, supports OpenGL ES 1.1/2.0/3.2, OpenCL 2.2, and Vulkan 1.2
		Decoder: Supports 8K@60fps H.265, 8K@30fps H.264 Encoder: Supports 8K@30fps H.265/H.264
		ISP: 2x ISPs (ISP0/ISP1), supporting HDR and 3DNR, with the following input capabilities: 48M: 8064x6048 @ 15fps (dual ISP) 32M: 6528x4898 @ 30fps (dual ISP) 16M: 4672x3504 @ 30fps (single ISP)
Power	Input Voltage	DC 12~24V
	Consumption	Normal: 312mA@12V(with 4G module), 252mA@12V (without 4G module) Maximum: 700mA@12V
	Reverse Polarity	Reverse Polarity Protection
Ethernet	Specification	RJ-45 ports, 1 to 3 available: 2 ports support 10/100/1000Mbps 1 port supports 10/100Mbps adaptive speed
	Protection	ESD ±6kV (contact), ±8kV (air);
SIM Card	Slot Quantity	1
	Type	Drawer interface
USB	Quantity	1*micro USB, 2*USB 3.0 HOST
SD Card	Quantity	1
	Type	Support SD, SDHC and SDXC(UHS-I) card
HDMI	Quantity	1

Antenna	Interface	1*WIFI/4G, 1*GPS antenna
	Type	SMA
Serial Port (optional)	Channels	2/4/8 channels x RS232/RS485
	Baud Rate	300bps–115200bps
	Data Bits	7, 8
	Parity	None, Even, Odd
	Stop Bits	1, 1.5, 2
X board digital input (optional)	Channels	2/4/8/16 channels
	Input Type	Supports dry contact or wet contact
	Dry Contact	Close = short circuit Open = open circuit
	Wet Contact	Logic 0 = 0–3V DC Logic 1 = 10–30V DC
	Isolation protection	2KVrms
X board digital output (optional)	Channels	2/4/8/16 channels
	Output Type	SINK
	Capacity	100mA per channel
4G Module(Optional)	L-E	GSM/EDGE:900,1800MHz WCDMA:B1,B5,B8 FDD-LTE:B1,B3,B5,B7,B8,B20 TDD-LTE:B38,B40,B41
	L-CE	GSM/EDGE:900,1800MHz WCDMA:B1,B8 TD-SCDMA:B34,B39 FDD-LTE:B1,B3,B8 TDD-LTE:B38,B39,B40,B41
	L-A	WCDMA:B2,B4,B5 FDD-LTE:B2,B4,B12
	L-AU	GSM/EDGE:850,900,1800MHz WCDMA:B1,B2,B5,B8 FDD-LTE:B1,B3,B4,B5,B7,B8,B28 TDD-LTE:B40
	L-AF	WCDMA:B2,B4,B5 FDD-LTE:B2,B4,B5,B12,B13,B14,B66,B71
	CAT-1	GSM:900,1800 FDD-LTE:B1,B3,B5,B8 TDD-LTE:B34,B38,B39,B40,B41
WiFi (Optional)	Interface	PCIE
	Protocol	IEEE 802.11b/g/n

	Mode	STA, AP
	Frequency	2.4GHz
	Channel QTY	Ch1 ~ Ch13
	Security	Open, WPA, WPA2
	Encryption	AES, TKIP, TKIPAES
	Number of connections	8 (Max)
	Speed	150Mbps (Max)
	SSID broadcast switch	Support
LED	Quantity	LED*3(with two programmable LEDs)
Environment	Working	-40~85°C/0~70°C, 5~95% RH
	Storage	-40 to 85°C, 5 to 95% RH
Others	Housing	Aluminium housing + stainless steel
	Dimensions	110*83*42mm or 110*83*48mm
	Protection Level	IP30
	Installation	DIN35 rail mounted, wall mounting
	System	Buildroot 2021.11 (Linux 5.10.209, Linux RT 5.10.209) Ubuntu 20.04 (Linux 5.10.209, Linux RT 5.10.209)

1.4 Model Selection

1.4.1 Host Model Selection

Model	ETH	USB	HDMI	X I/O Board	Y I/O Board	Dimension
BL450	1x10/100/1000M	2	×	1×6PIN	×	42×83×110mm
BL450A	1x10/100/1000M	2	×	1×20PIN	×	42×83×110mm
BL450B	1x10/100/1000M	2	×	1×20PIN	2	48×83×110mm
BL450C	1x10/100/1000M	2	×	1×10PIN	×	42×83×110mm
BL451	2x10/100/1000M	2	×	1×6PIN	×	42×83×110mm
BL451A	2x10/100/1000M	2	×	1×20PIN	×	42×83×110mm
BL451B	2x10/100/1000M	2	×	1×20PIN	2	48×83×110mm
BL452	2x10/100/1000M, 1x10/100M	2	1	1×6PIN	×	42×83×110mm

BL452A	2x10/100/1000M, 1x10/100M	2	1	1×20PIN	x	42×83×110mm
BL452B	2x10/100/1000M, 1x10/100M	2	1	1×20PIN	2	48×83×110mm

1.4.2 SOM Selection

Model	MCU	Clock Speed	Kernel	NPU	eMMC	LPDDR4X	Temperature
SOM450	RK3588J	2.0GHz	4 x A76 + 4 x A55 + 3 x M0	6TOPS	32GByte	4GByte	-40~85°C
SOM451	RK3588J	2.0GHz	4 x A76 + 4 x A55 + 3 x M0	6TOPS	64GByte	8GByte	-40~85°C
SOM452	RK3588J	2.0GHz	4 x A76 + 4 x A55 + 3 x M0	6TOPS	128GByte	16GByte	-40~85°C
SOM453	RK3588	2.4GHz	4 x A76 + 4 x A55 + 3 x M0	6TOPS	64GByte	4GByte	0~80°C
SOM454	RK3588	2.4GHz	4 x A76 + 4 x A55 + 3 x M0	6TOPS	64GByte	8GByte	0~80°C

1.4.3 X Series I/O Board Selection

You can choose the X-series I/O board based on your needs. The number of pins on the X-series I/O board must match the housing. X-series IO boards with CAN ports, such as the X11, are currently not compatible with the BL450 series.

Note: The default port for this device is RS485. If you need RS232, please specify this to the sales team.

Model	RS232/RS485	CAN	DI	DO	GPIO	PIN	
X10	2	x	x	x	x	6PIN	
X11	x	2	x	x	x	6PIN	Not support
X12	1	1	x	x	x	6PIN	Not support
X13	x	x	2	2	x	6PIN	
X14	x	x	4	x	x	6PIN	
X15	x	x	x	4	x	6PIN	
X16	x	x	x	x	4	6PIN	
X20	4	x	x	x	x	10PIN	
X21	3	1	x	x	x	10PIN	Not support
X22	2	2	x	x	x	10PIN	Not support
X23	4	x	4	4	x	20PIN	
X24	3	1	4	4	x	20PIN	Not support
X25	2	2	4	4	x	20PIN	Not support
X26	2	x	8	4	x	20PIN	
X27	1	1	8	4	x	20PIN	Not support
X28	2	x	12	x	x	20PIN	
X29	1	1	12	x	x	20PIN	Not support
X30	x	x	x	x	16	20PIN	

1.4.4 Y Series I/O Board Selection

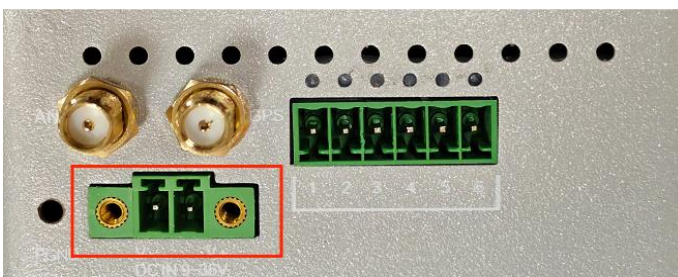
You can select the Y-series I/O board based on your needs. Y-series I/O modules are compatible with all Y slots. When the Y63 is selected, you can not choose second Y-series IO board.

Model	Description	Model	Description
Y01	4DI+4DO, NPN	Y41	4AO, 0/4~20mA
Y02	4DI+4DO, PNP	Y43	4AO, 0~5/10V
Y11	8DI, NPN	Y46	4AO, ±5V/±10V

Y12	8DI, PNP		Y51	2RTD, 3-Wire PT100
Y13	8DI, Dry Contact		Y52	2RTD, 3-Wire PT1000
Y21	8DO, PNP		Y53	2RTD, 4-Wire PT100
Y22	8DO, NPN		Y54	2RTD, 4-Wire PT1000
Y24	4DO, Relay		Y56	Resistance measurement
Y31	4AI, single-ended, 0/4~20mA		Y57	Voltage measurement
Y33	4AI, single-ended, 0~5/10V		Y58	4TC
Y34	4AI, differential, 0~5/10V		Y63	4 RS485 or RS232
Y36	4AI, differential, $\pm 5V/\pm 10V$		Y95	4 PWM Output + 4 Pulse Counter (1 High-Speed, 3 Low-Speed), NPN
Y37	4 IEPE Measurement		Y96	4 PWM Output + 4 Pulse Counter (1 High-Speed, 3 Low-Speed), PNP

2 Hardware

2.1 Power Interface



Supports 1CH DC12~24V input, with reverse polarity protection.

2.2 I/O Module Port Description

Different X/Y boards offer various serial port options. The currently available board types are as follows. Note: POWER serves as the common negative terminal for DO, COM is used for DI wet contact, and GND is used for DI dry contact.

2.2.1 X Series I/O Board Port Description

X10(2 RS485 or RS232 serial ports)						
Port Number	1	2	3	4	5	6
Name	ttyS4-A	ttyS4-B	GND	ttyS5-A	ttyS5-B	GND

X13 (2 DO, 2 DI, COM used for DI wet contact and GND used for DI dry contact)						
Port Number	1	2	3	4	5	6
Name	DO1	DO2	GND	DI1	DI2	COM

X14 (4 DI, COM used for DI wet contact and the GND used for DI dry contact.)						
Port Number	1	2	3	4	5	6
Name	DI1	DI2	GND	DI3	DI4	COM

X15 (4 DO)						
Port Number	1	2	3	4	5	6
Name	DO1	DO2	GND	DO3	DO4	GND

X16 (4 GPIO)						
Port Number	1	2	3	4	5	6
Name	GPIO4	GPIO3	GND	GPIO2	GPIO1	GND

X20 (4 RS485 or RS232 serial ports)					
Port Number	1	3	5	7	9
Name	GND	ttyS7-A	ttyS6-A	ttyS5-A	ttyS4-A
Port Number	2	4	6	8	10
Name	GND	ttyS7-B	ttyS6-B	ttyS5-B	ttyS4-B

X22 (2 RS485 or RS232 serial ports, 2 CAN interfaces)					
Port Number	1	3	5	7	9
Name	GND	ttyS7-A	ttyS6-A	CAN1-H	CAN0-H
Port Number	2	4	6	8	10
Name	GND	ttyS7-B	ttyS6-B	CAN1-L	CAN0-L

X23 (4 RS485 or RS232 serial ports, 4 DO, and 4 DI)										
Port	1	3	5	7	9	11	13	15	17	19

Number										
Name	DI4	DI3	DI2	DI1	COM	GND	ttyS9-A	ttyS8-A	ttyS5-A	ttyS3-A
Port Number	2	4	6	8	10	12	14	16	18	20
Name	DO4	DO3	DO2	DO1	POWER	GND	ttyS9-B	ttyS8-B	ttyS5-B	ttyS3-B

X26 (2 RS485 or RS232 serial ports, 4 DO, and 8 DI)										
Port Number	1	3	5	7	9	11	13	15	17	19
Name	DI6	DI5	DI4	DI3	COM	GND	DI2	DI1	ttyS5-A	ttyS3-A
Port Number	2	4	6	8	10	12	14	16	18	20
Name	DO4	DO3	DO2	DO1	POWER	GND	DI8	DI7	ttyS5-B	ttyS3-B

X28 (2 RS485 or RS232 serial ports, 12 DI)										
Port Number	1	3	5	7	9	11	13	15	17	19
Name	DI6	DI5	DI4	DI3	COM	GND	DI2	DI1	ttyS5-A	ttyS3-A
Port Number	2	4	6	8	10	12	14	16	18	20
Name	DI12	DI11	DI10	DI9	POWER	GND	DI8	DI7	ttyS5-B	ttyS3-B

X30 (16 GPIO)										
Port Number	1	3	5	7	9	11	13	15	17	19
Name	GPIO8	GPIO7	GPIO6	GPIO5	POWER	GND	GPIO4	GPIO3	GPIO2	GPIO1
Port Number	2	4	6	8	10	12	14	16	18	20
Name	GPIO6	GPIO15	GPIO4	GPIO3	POWER	GND	GPIO12	GPIO1	GPIO0	GPIO9

Note: The POWER port on the X30 module is 3.3V. All port inputs and outputs are user-defined. For details, please refer to Chapter 10: Pin Definition Appendix.

2.2.2 Y Series I/O Board Port Description

Y01 (4-channel DI(Dry contact or NPN type) and 4-channel NPN type DO module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	DO1	DO2	DO3	DO4	GND_IOS	DI_COM	DI1	DI2	DI3	DI4

Note: GND_IOS is the common terminal for DO wet contact, and DI_COM is the common terminal for

dry contact.

Y02 (4-channel DI(Dry contact or PNP type) and 4-channel PNP type DO module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	DO1	DO2	DO3	DO4	GND_IOS	DI_COM	DI1	DI2	DI3	DI4

Note: GND_IOS is the common terminal for DO wet contact, and DI_COM is the common terminal for dry contact.

Y11 (8-channel NPN Type Digital Input Module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	DI1	DI2	DI3	DI4	DI_COM	DI_COM	DI5	DI6	DI7	DI8

Note: DI_COM is the common terminal for dry contacts.

Y12 (8-channel PNP Type Digital Input Module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	DI1	DI2	DI3	DI4	DI_COM	DI_COM	DI5	DI6	DI7	DI8

Note: DI_COM is the common terminal for dry contacts.

Y21 (8-channel PNP Type Digital Output Module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	DO1	DO2	DO3	DO4	GND_IOS	GND_IOS	DO5	DO6	DO7	DO8

Note: GND_IOS is the common terminal for wet contacts of the DO ports.

Y22 (8-channel NPN Type Digital Output Module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	DO1	DO2	DO3	DO4	GND_IOS	GND_IOS	DO5	DO6	DO7	DO8

Note: GND_IOS is the common terminal for wet contacts of the DO ports.

Y24 (4-channel Relay Module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	AO1+	AO1-	AO2+	AO2-	/	/	AO3+	AO3-	AO4+	AO4-

Y31 (4-channel 4~20mA / 0~20mA Analog Single-ended Input Module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	AI1+	AI1-	AI2+	AI2-	GND	GND	AI3+	AI3-	AI4+	AI4-

Y33 (4-channel 0~5V / 0~10V Analog Single-ended Input Module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	AI1+	AI1-	AI2+	AI2-	/	/	AI3+	AI3-	AI4+	AI4-

Y34 (4-channel 0~5V / 0~10V Analog Differential Input Module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	AI1+	AI1-	AI2+	AI2-	/	/	AI3+	AI3-	AI4+	AI4-

Y36 (4-channel -5~5V / -10~10V Analog Differential Input Module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	AI1+	AI1-	AI2+	AI2-	/	/	AI3+	AI3-	AI4+	AI4-

Y41 (4-channel 4~20mA / 0~20mA Analog Single-ended Output Module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	AO1+	AO1-	AO2+	AO2-	/	/	AO3+	AO3-	AO4+	AO4-

Y43 (4-channel 0~5V / 0~10V Analog Single-ended Output Module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	AO1+	AO1-	AO2+	AO2-	/	/	AO3+	AO3-	AO4+	AO4-

Y46 (4-channel -5~5V / -10~10V Analog Single-ended Output Module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	AO1+	AO1-	AO2+	AO2-	/	/	AO3+	AO3-	AO4+	AO4-

Y51 (2-channel RTD Module, Three-wire PT100)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	/	PT1+	PT1-	PT1-	/	/	/	PT2+	PT2-	PT2-

Y52 (2-channel RTD Module, Three-wire PT1000)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	/	PT1+	PT1-	PT1-	/	/	/	PT2+	PT2-	PT2-

Y53 (2-channel RTD Module, Four-wire PT100)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	PT1+	PT1+	PT1-	PT1-	/	/	PT2+	PT2+	PT2-	PT2-

Y54 (2-channel RTD Module, Four-wire PT1000)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	PT1+	PT1+	PT1-	PT1-	/	/	PT2+	PT2+	PT2-	PT2-

Y58 (4-channel Thermocouple Temperature Measurement Module)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	T1+	T1-	T2+	T2-	/	/	T3+	T3-	T4+	T4-

Y63(4-channels RS485 or RS232)										
Port Number	1	2	3	4	5	6	7	8	9	10
Name	ttyWCH 0-A	ttyWCH 0-B	ttyWCH 1-A	ttyWCH 1-B	GN D	GN D	ttyWCH 2-A	ttyWCH 2-B	ttyWCH 3-A	ttyWCH 3-B

2.2.3 RS485 Usage

In the BL450, “ttySX-A” and “ttySX-B” represent a pair of RS485 serial port lines. When using the RS485 serial port, connect the RS485 lines to these terminals. For example, in the X10 module, there are two terminals: ttyS4-A and ttyS4-B, corresponding to the device file /dev/ttyS4. Set the baud rate to 115200, data bits to 8, no parity, and 1 stop bit (8N1).

```
stty -F /dev/ttyS4 ispeed 115200 ospeed 115200 cs8
echo 12345 > /dev/ttyS4           //Send Data via RS485-1 Port
cat /dev/ttyS4                   //Wait to check the received data
```

Press "Ctrl+C" to stop.

2.2.4 RS232 Usage

In the BL450, “ttySX-RX” and “ttySX-TX” represent a pair of RS232 serial port lines. When using the RS232 serial port, connect the RS232 lines to these terminals. For example, in the X10 module, there

are two terminals: ttyS4-RX and ttyS4-TX, corresponding to the device file /dev/ttyS4. Set the baud rate to 115200, data bits to 8, no parity, and 1 stop bit (8N1).

```
stty -F /dev/ttyS4 ispeed 115200 ospeed 115200 cs8
echo 12345 > /dev/ttyS4           //Send Data via RS232-1 Port
cat /dev/ttyS4                    //Wait to check the received data.
```

Press "Ctrl+C" to stop.

2.2.5 GPIO Usage

Enter the /sys/class/beilai/ directory and type ls to view the controllable GPIO ports:

```
root@bliiot:/sys/class/beilai# ls
GPIO1 GPIO2 GPIO3 GPIO4
root@bliiot:/sys/class/beilai/GPIO1# ls
cfg data device drv power pull subsystem uevent
```

Among them, writing 1 to cfg sets the GPIO as output, and writing 0 sets it as input.

After setting it as output:

Writing 1 to data outputs a low level

Writing 0 to data outputs a high level

If set as input, reading from data will give the input value

For example, using GPIO1 (dry contact) on the X16 module, set GPIO1 as output and output a high level:

```
root@bliiot:/sys/class/beilai/GPIO1# echo 1 > cfg
root@bliiot:/sys/class/beilai/GPIO1# echo 0 > data
```

For example, using GPIO1 (dry contact) on the X16 module, set GPIO1 as input and read the current level:

```
root@bliiot:/sys/class/beilai/GPIO1# echo 0 > cfg
root@bliiot:/sys/class/beilai/GPIO1# cat data
```

2.2.6 Y board Serial Port Usage

Note: This usage method does not apply to the Y63 module. For the Y63 module, please refer to section 2.2.8.

(1) Software Installation

The corresponding files are located in the /usr/demo/ioy/ folder. Please refer to the actual file names. Execute the command chmod +x on BEILAI_IOy_RK3588_*.bin. Then proceed with the software installation.

```
root@bliiot:/# cd /usr/demo/ioy/
```

```

root@bliiot:/# chmod +x BEILAI_IOy_RK3588.bin
root@bliiot:/# ./BEILAI_IOy_RK3588.bin
Md5 verify pass!
tar: ./iolib: time stamp 2024-05-29 09:16:25 is 1716973791.042311023 s in the future
tar: ./ioy: time stamp 2024-06-25 03:05:22 is 1719284328.036465231 s in the future
tar: ./S90iolib: time stamp 2024-05-27 07:47:16 is 1716795642.036139981 s in the future
Install complete!
Restarting iolib:
Stopping iolib: stopped iolib (pid 1568)
OK
Starting iolib: OK

```

(2) Usage of Y Board Ports

Use ioy show to view IO board information. Use ioy help to see command help.

```
root@bliiot:/# ioy help
```

Usage: ioy <command> [<arguments>]

Commands:

```

show
get      <address>|<slot>.<channel>
set      <address>|<slot>.<channel> <value>
config  <address>|<slot>.<channel> mode <mode>,
        <address>|<slot>.<channel> min <min-value> max <max-value>

```

config mode:

```

ai|ao    4t20(4~20mA),0t20(0~20mA),0t5(0~5V),0t10(0~10V),
         -5t5(-5~5V),-10t10(-10~10V)
rtd      pt100-3(pt100 3wire),pt100-4(pt100 4wire),
         pt1000-3(pt1000 3wire),pt1000-4(pt1000 4wire)
tc       k,i,e,t,s,r,b,n

```

For example, with the DI module, short-circuit DI2, then enter ioy show to view the information.

slot	name	channel	address	mode	value	min	max
2	Y12	1	2000	*	0	0.0000	0.0000
2	Y12	2	2001	*	1	0.0000	0.0000
2	Y12	3	2002	*	0	0.0000	0.0000
2	Y12	4	2003	*	0	0.0000	0.0000
2	Y12	5	2004	*	0	0.0000	0.0000
2	Y12	6	2005	*	0	0.0000	0.0000
2	Y12	7	2006	*	0	0.0000	0.0000
2	Y12	8	2007	*	0	0.0000	0.0000

You can also obtain the channel value using the get command:

```
root@bliiot:/# ioy get 2004 //View via address
```

```
address 2004 value 1
```

```
root@bliiot:/# ioy get 2.5 //View by <slot>.<channel>
```

```
slot 2 channel 5 value 1
```

For example, with the AO module, enter ioy show to view the information.

slot	name	channel	address	mode	value	min	max
2	Y41	1	4000	4t20	4.0000	4.0000	20.0000
2	Y41	2	4002	4t20	4.0000	4.0000	20.0000
2	Y41	3	4004	4t20	4.0000	4.0000	20.0000
2	Y41	4	4006	4t20	4.0000	4.0000	20.0000
2	Y41	5	4008	4t20	4.0000	4.0000	20.0000
2	Y41	6	4010	4t20	4.0000	4.0000	20.0000
2	Y41	7	4012	4t20	4.0000	4.0000	20.0000
2	Y41	8	4014	4t20	4.0000	4.0000	20.0000

In the "mode" column, if it shows "4t20," it corresponds to the 4~20mA current output as described in ioy help under config mode. Use the set command to set the channel value.

```
root@bliiot:~# ioy set 4000 10 //Set the output to 10mA via address
root@bliiot:~# ioy set 2.1 10 //Set the output via <slot>.<channel>
root@bliiot:~# ioy get 4000
address 4000 value 10.000000
```

(3) Port Configuration

By using the ioy help command, you can see the command format for config.

Usage: ioy <command> [<arguments>]

```
Commands:
  show
  get      <address>|<slot>.<channel>
  set      <address>|<slot>.<channel> <value>
  config  <address>|<slot>.<channel> mode <mode>,
          <address>|<slot>.<channel> min <min-value> max <max-value>

config mode:
  ai|ao    4t20(4~20mA),0t20(0~20mA),0t5(0~5V),0t10(0~10V),
           -5t5(-5~5V),-10t10(-10~10V)
  rtd      pt100-3(pt100 3wire),pt100-4(pt100 4wire),
           pt1000-3(pt1000 3wire),pt1000-4(pt1000 4wire)
  tc       k,i,e,t,s,r,b,n
```

To change the range from 4-20mA to 0-20mA, either of the following two commands can be used:

```
root@bliiot:~# ioy config 4000 mode 0t20
root@bliiot:~# ioy config 2.1 mode 0t20 //Change the range to 0-20mA
```

Modify the range by setting the corresponding minimum and maximum values:

```
root@bliiot:~# ioy config 4000 min 0 max 20 //Set the minimum and maximum values to 0 and 20.
```

2.2.7 Y63 Board Usage

In the BL450, "ttyWCHX-A" and "ttyWCHX-B" represent a pair of RS485 serial port lines. When using the RS485 serial port, connect the RS485 lines to these terminals. For example, in the Y63 module, there are two terminals: ttyWCH0-A and ttyWCH0-B, corresponding to the device file /dev/ttyWCH0. Set the baud rate to 115200, data bits to 8, no parity, and 1 stop bit (8N1).

```
stty -F /dev/ttyWCH0 ispeed 115200 ospeed 115200 cs8
echo 12345 > /dev/ttyWCH0 //Send data via RS485-1 port.
cat /dev/ttyWCH0 //Wait to check the received data.
```

Press "Ctrl+C" to stop.

2.3 LED



LED	Description
PWR	Power LED: It remains constantly on when the power is connected. This LED light cannot be programmed by the user.
RUN	Default Settings: The LED blinks when the CPU usage is below 90% and remains on continuously when the CPU usage exceeds 90% This LED light can be programmed by the user.
LINK	Default Settings: The LED remains on when there is an internet connection and turns off when there is no internet connection. This LED light can be programmed by the user.

The LED indicators are as follow

LED2 (POWER): Stays on when the power is normal after startup.

LED1 (RUN): Blinks when the system is running normally.

LED0 (LINK): Remains on when connected to the internet via a wired network; blinks when using 4G or WiFi.

The configuration file for these settings is `/etc/beilai_led.sh`

To view the trigger conditions: `cat /sys/class/leds/user-led0/trigger`

```
root@bliiot:~# cat /sys/class/leds/user-led0/trigger
[none] rc-feedback mmc0 mmc1 mmc2 timer oneshot heartbeat backlight gpio cpu0 cpu1 cpu2 cpu3
default-on transient
```

Where [none] means the current trigger condition of led0 is none. Write the above string to trigger to modify the trigger condition.

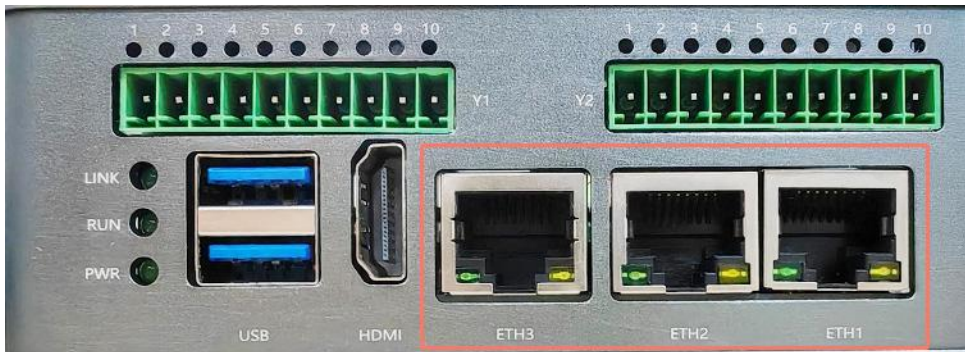
When the led trigger condition is set to none, the user can control the led light on or off by commands

To control LED0 to be on: `echo 1 >/sys/class/leds/user-led0/brightness`

```
root@bliiot:~# echo none >/sys/class/leds/user-led0/brightness
root@bliiot:~# echo 1 >/sys/class/leds/user-led0/brightness
```

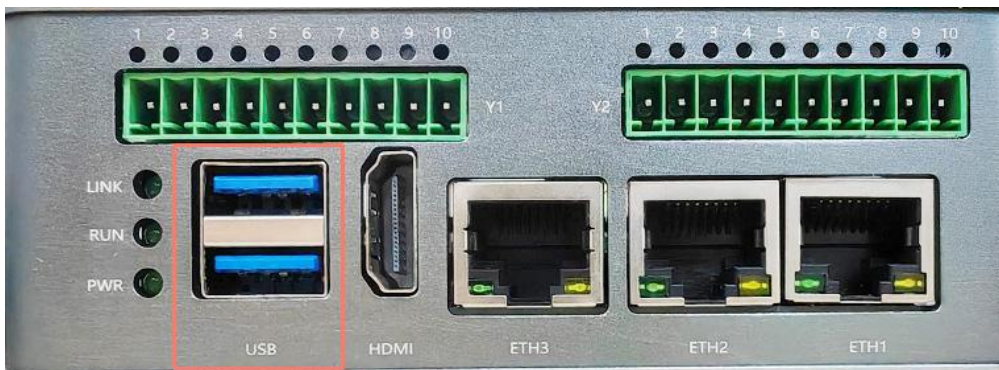
To control LED1 to be off: `echo 0 >/sys/class/leds/user-led1/brightness`

2.4 Ethernet Port



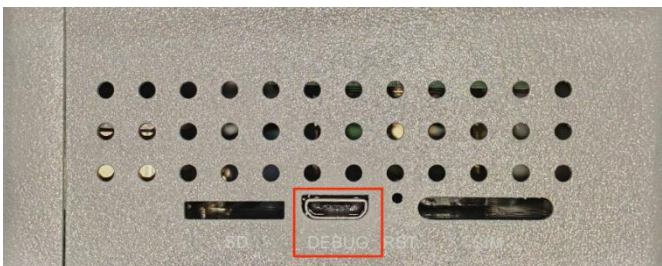
The device comes with a maximum of 3 network ports.

2.5 USB Port



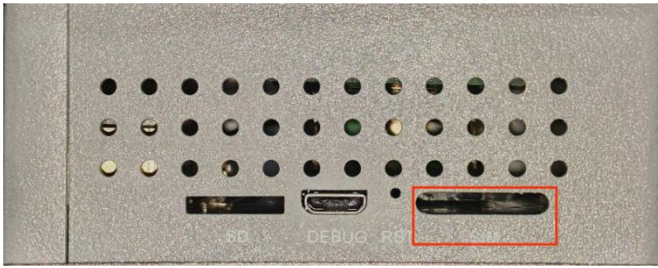
The device has 2 USB 3.0 HOST interfaces, supporting FAT32 formatted USB drives. When reading or writing data to the USB drive, use the sync command to ensure data is properly saved and prevent data loss.

2.6 Debugging Serial Port



The debugging interface is as shown in the image. You can access the device's system through this port.

2.7 SIM Card Slot

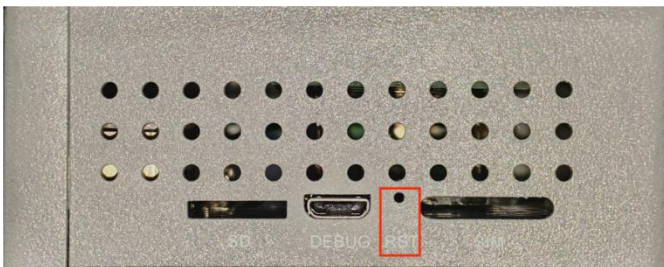


2.8 SD Card Slot



The SD card slot, as shown in the image, supports FAT32 formatted SD cards. After reading or writing data using this slot, use the sync command to ensure data is properly saved and prevent data loss.

2.9 Reset Button



Press the restart button and release it to reboot the device.

2.10 PCIE

The PCIe interface supports both 4G and WiFi.

2.10.1 4G Module

Using the Quectel EC20 module as an example, place the SIM card into the module and connect the

antenna. The test program can be found in the /usr/demo/4G directory.

(1) Network Function

Disable other network connections and keep only the 4G module network active.

```
ifconfig eth1 down  
ifconfig eth2 down  
ifconfig eth3 down  
udhcpc -i usb0  
ifconfig
```

At this point, a network node usb0 should be generated. If this node is not present, the module may not have network functionality enabled by default. Try configuring the 4G module with the following commands:

```
microcom /dev/ttyUSB2  
AT+QCFG="USBNET",1
```

If using the EC200 module, an additional command may be required to establish a network connection.

```
AT+QNETDEVCTL=3,1,1
```

After executing the command, if the device returns "OK", it indicates that the configuration is successful and this setup needs to be done only once. After rebooting the device, the usb0 node should be created. Then, you can re-run the network disable and enable commands.

Once the usb0 node is generated, use the following commands to test the network.

```
ping www.baidu.com -I usb0
```

(2) SMS Function

To test the SMS functionality, execute the test command in the program directory.

```
./send_sms <device> <phonenumber> <text>
```

Command Description:

<device>: The 4G module device node.

<phonenumber>: The target phone number for sending the SMS.

<text>: The content of the SMS. There should be no spaces between characters in the SMS content; otherwise, an error will be prompted.

For example: `./send_sms /dev/ttyUSB2 152***** test`

At this time, the corresponding number should receive a text message with the content of "test".

(3) Call Function

To test the dialing function, execute the test command in the program directory:

```
./phone_call <device> <phonenumber>
```

Command Description: <device> is the 4G module device node. <phonenumber> is the dialling target mobile phone number.

For example: `./phone_call /dev/ttyUSB2 152*****`

At this point the corresponding number should receive an incoming call from the device.

(4) GPS Function

The GPS function can be tested by executing the test command in the test program directory:

```
./get_location <device> <timeout>
```

Command Description:

<device>: The device node, determined by the result of the command `ls /dev/ttyUSB*`. This may change after rebooting the device.

<timeout>: The time to wait for the return of latitude and longitude information (in seconds).

For example: `./get_location /dev/ttyUSB2 1`

Obtaining latitude and longitude information may take a few minutes. If the retrieval fails or times out, check if the antenna is properly connected and ensure you are testing in an open area.

(5) 4G Module Usage

In certain countries, using the 4G module requires APN, username, and password configuration. This can be done through the quectel-CM application located in the `/usr/demo/4G` directory.

If APN settings are not required, simply run the program to connect to the internet.

If APN settings are required, execute the command in the following format:

```
quectel-CM -s "your_apn" -m "your_apn_username" -v "your_apn_password"
```

Note:

your_apn = Carrier name

your_apn_username = Username provided by the carrier

your_apn_password = Password provided by the carrier

Quotation marks are part of the parameters and must be English double quotes.

For more available parameters, run:

```
quecteb-CM -h
```

Before use, ensure that the wwan0 network interface is enabled. To enable it, run:

```
ifconfig wwan0 up
```

When executing the quectel-CM application, make sure it runs in the background. If the application exits, the network connection will be lost. To run it in the background, use:

```
quecteb-CM -s "your_apn" -m "your_apn_username" -v "your_apn_password" &
```

Note: There must be an & symbol at the end of the command.

2.10.2 WiFi Module

The WiFi module used here is the BL-R8188EU2 (2.4G frequency band). The test program and drivers are located in the /usr/demo/wifi directory. Make sure to connect the antenna properly.

(1) STA Function

Enter the test program directory, disable other networks, keep only the WiFi network, and load the WiFi driver.

```
ifconfig eth1 down
ifconfig eth2 down
ifconfig eth3 down
insmod -f 8188eu.ko           //Load WiFi driver
ifconfig wlan0 up           //Based on the name of the network card shown in ifconfig
```

Execute the following command to connect the device to the specified WiFi network. Use -i followed by the WiFi name and -p followed by the WiFi password.

```
./wifi_setup.sh -i bliot -p bebetter
```

You can check the obtained IP address using ifconfig. Then, execute the following command to test if the network functionality is working correctly.

```
ping www.baidu.com
```

(2) AP Function

After restarting the system, enter the directory where the test program is located, disable other networks, keep only the WiFi network, and load the WiFi driver.

```
ifconfig eth1 down
ifconfig eth2 down
```

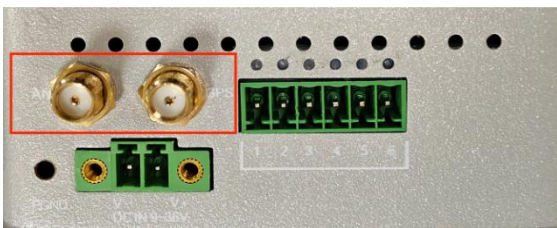
```
ifconfig eth3 down
insmod -f 8188eu.ko
Ifconfig wlan0 up
```

Execute the following command to set the WiFi module to AP mode:

```
./ap_setup.sh
```

The default WiFi name is rtl8188eu and the password is 88888888. You can modify these settings in the rtl_hostapd_2G.conf configuration file.

2.11 Antenna Interface



The antenna interfaces include one WiFi/cellular antenna interface and one GPS antenna interface.

Note: The GPS port is exclusively for connecting the GPS antenna; if there is no GPS, do not connect anything. The ANT interface is used to connect either the 4G signal antenna or the WiFi signal antenna.

2.12 Hardware Watchdog

The hardware watchdog timeout is 30 ms. If you need to disable the hardware watchdog, you must unload the bl450_watchdog.ko module.

```
root@bliiot: rmmmod -f bl450_watchdog.ko
```

If you need to re-enable the hardware watchdog, reload the bl450_watchdog.ko module from the /usr/demo/watchdog/ directory.

```
root@bliiot:cd /usr/demo/watchdog/
```

```
root@bliiot: insmod -f bl450_watchdog.ko
```

2.13 Encryption Chip

The encryption chip model RJGT102 is based on the SHA-256 encryption and authentication algorithm. It also provides a configurable watchdog timer and external reset functionality. The chip communicates with the MCU through an I²C-5 serial interface and supports a low-power mode.

The device uses the encryption chip's demo by writing `/proc/sys/kernel/random/uuid` to the encryption chip and saving the UUID to `/usr/rjgt_unique.json`. When used, the data from the encryption chip is compared with the external data. If the external data matches the internal data on the encryption chip, the encryption validation is successful.

Please modify the cross-compiler path in the Makefile and then run `make` to compile. Alternatively, refer to the "RJGT102 Data Manual" for more details.

Run the sample programme `rigt102` and if the uuid is correct, the following reply will appear.

```
root@bliiot: ./rigt102
open unique file failed, create unique file!
random uuid would write rjgt102 : b6275e22-4928-4828-88fb-54a6fd8!
Contrast success
root@bliiot:./rigt102
Contrast success
```

2.14 SD Card, Solid-State Drive and USB Drive Usage

If the USB drive, Solid-State Drive or SD card is not formatted as FAT32, you need to format the USB drive, Solid-State Drive or SD card (formatting will erase all data, so please back up in advance).

To check the disk mounting status:

```
fdisk -l
```

Find the USB drive, Solid-State Drive or SD card that is not mounted.

```
Disk /dev/mmcblk1: 29.74 GiB, 31914983424 bytes, 62333952 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: dos
Disk identifier: 0xb507e9d5

Device      Boot  Start      End  Sectors  Size Id Type
/dev/mmcblk1p1  434176 62331903 61897728 29.5G  7 HPFS/NTFS/exFAT
root@bliiot: #
```

Format the USB drive, Solid-State Drive or SD card. Here, as an example, format the SD card partition `mmcblk1p1` with the following command:

```
mkfs.ext4 /dev/mmcblk1p1
```

When prompted to confirm formatting, enter `y` to start the format process.

```
root@bliiot:~# mkfs.ext4 /dev/mmcblk1p1
mke2fs 1.43.3 (07-Jan-2020)
/dev/mmcblk1p1 contains a vfat file system labelled 'Volumn'
Proceed anyway? (y,N) y
Creating filesystem with 4304 4k blocks and 4320 inodes
Allocating group tables: done
Writing inode tables: done
Creating journal (1024 blocks): done
Writing superblocks and filesystem accounting information: done
root@bliiot:~#
```

After formatting is complete, you can mount the USB drive, Solid-State Drive or SD card normally. Use the following command to mount it

```
mkdir /mnt/data
mount /dev/mmcbk1p1 /mnt/data
```

After successful mounting, the USB drive, Solid-State Drive or SD card can be used normally. When finished using the USB drive or SD card, you need to unmount it. Use the following command to unmount:

```
umount /mnt/data
```

If you need to mount permanently, please follow these steps:

1. Determine the device: Insert the device, use the following commands to check: `sudo fdisk -l` or `lsblk -f` Record the device's UUID and file system type (such as ext4, ntfs, vfat, etc.).
2. Create a mount point: For example, if we want to mount to `/mnt/usb`, then: `sudo mkdir -p /mnt/usb`
3. Get the UUID: Use the `blkid` command or check the output of `lsblk -f` to find the corresponding device UUID.

```
root@BL450-bliiot:~# blkid
/dev/mmcbk0p6: UUID="ee0a6096-5a64-467e-8c16-0f36a8624141" TYPE="ext4" PARTLABEL="rc
D="614e0000-0000-4b53-8000-1d28000054a9"
/dev/mmcbk0p7: LABEL="oem" UUID="1b4ba83f-0190-4e3c-8d91-8e80284bb604" TYPE="ext4" P
" PARTUUID="2bfee623-d83c-426a-ab80-21732c9bb7d3"
/dev/mmcbk0p8: LABEL="userdata" UUID="8e7993c3-e670-4275-84f2-4e7badc85788" TYPE="ex
="userdata" PARTUUID="b2af085d-a675-48c6-c437-f6d557ff4744"
/dev/mmcbk0p1: PARTLABEL="uboot" PARTUUID="b750e44e-833f-4a30-c38c-b117241d84d4"
/dev/mmcbk0p2: PARTLABEL="misc" PARTUUID="a1c81622-7741-47ad-b846-c6972488d396"
/dev/mmcbk0p3: PARTLABEL="boot" PARTUUID="7a3f0000-0000-446a-8000-702f00006273"
/dev/mmcbk0p4: PARTLABEL="recovery" PARTUUID="000b305f-484a-4582-9090-4ad0099d47bd"
/dev/mmcbk0p5: PARTLABEL="backup" PARTUUID="24eeb640-277f-4c11-ffe8-d9f20027a83b"
/dev/sda1: UUID="CAB6239DB6238951" TYPE="ntfs" PARTUUID="b134eb10-01"
root@BL450-bliiot:~#
root@BL450-bliiot:~#
```

4. Edit `/etc/fstab`: `sudo nano /etc/fstab` Add a line at the end of the file in the following format: `UUID=<device UUID> <mount point> <file system type> <mount options> <dump backup setting> <file system check order>` For example, for a USB drive with NTFS format, you can write: `UUID=1234-5678 /mnt/usb ntfs-3g defaults,uid=1000,gid=1000,umask=022 0 0` For the commonly used Linux ext4 file system: `UUID=abcd1234 /mnt/ssd ext4 defaults 0 2` For FAT32 format (vfat): `UUID=1234-5678 /mnt/sd vfat defaults,uid=1000,gid=1000,umask=000 0 0` Note: uid and gid set the user and group, umask sets the permission mask (for example, 000 means readable and writable by all users).

```
/swapfile none swap sw 0 0
UUID=1234-5678 /mnt/usb ntfs-3g defaults,uid=1000,gid=1000,umask=022 0 0
~
~
~
~
~
~
~
```

5. If you do not want to specify a user, you can omit options such as uid, gid, umask, and just use defaults.
6. For NTFS, you need to install ntfs-3g (usually already installed), and use ntfs-3g as the file system type, or simply write ntfs (some systems may have a symbolic link to ntfs-3g).
7. For exFAT, you need to install exfat-fuse and exfat-utils, and then use exfat as the file system

type.

8. Test: After saving `/etc/fstab`, run the following command to check for errors: `sudo mount -a` If there is no error message, the mount is successful, and you can see the files at the mount point.
9. Permission settings: If the permissions do not meet the requirements after mounting, you can adjust them in the mount options or use the `chown` and `chmod` commands after mounting. Important: If `/etc/fstab` is configured incorrectly, it may cause the system to fail to boot. Therefore, be sure to test using `sudo mount -a` before rebooting. If the test mount fails, correct `/etc/fstab` based on the error message. Additionally, for removable devices (such as USB drives or SD cards), if you want them to mount only when inserted and allow users to safely unmount them, you can consider using `udisks2` and `udev` rules for automatic mounting (but this is not permanent; it is plug-and-play). The `/etc/fstab` method mounts every time the system starts, suitable for permanently connected devices (such as built-in SSDs). Therefore, for USB drives and SD cards that are not always connected to the system, using `/etc/fstab` for permanent mounting may not be appropriate. If the device is missing at startup, the system may report an error and enter emergency mode. To avoid this, you can add the `nofail` option in the mount options, so that even if the device is missing, the system will continue to boot. For example: `UUID=1234-5678 /mnt/usb ntfs-3g defaults,nofail 0 0` This way, even if the device is not connected at startup, it will not affect system boot.

2.15 External RTC

This device includes an external RTC clock.

To view the external RTC device node:

```
root@bliiot:~# ls /dev/rtc*
/dev/rtc  /dev/rtc0
root@bliiot:~# dmesg | grep rtc0
[ 4.319167] rtc-isl1208 5-006f: rtc core: registered rtc-isl1208 as rtc0
```

To view the system clock:

```
root@bliiot:~# date
Tue Jul 05 01:22:15 UTC 2024
```

To set the system time:

```
root@bliiot:~# date -s "2024-7-05 09:24:00" && hwclock -w -f /dev/rtc0
root@bliiot:~# hwclock -f /dev/rtc0
```

To synchronize the system clock to the RTC:

```
root@bliiot:~# hwclock --systohc -u
```

```
root@bliiot:~# hwclock -u
```

To synchronize both the system clock and the RTC

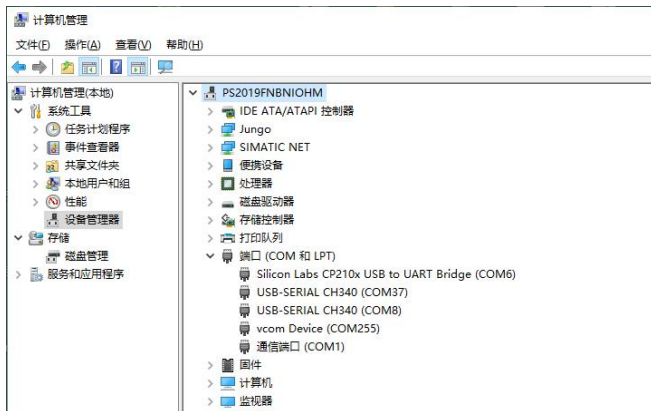
```
root@bliiot:~# hwclock --hctosys -u
```

After executing the command, the system will synchronize the RTC clock to be the system clock.

3 Device Login

3.1 USB Login

To access this on a computer, navigate to "This PC" → "Manage" → "Device Manager". Open the Ports section, then insert the USB cable. The refreshed port indicates the connected device port.



Here's an example using SecureCRT:

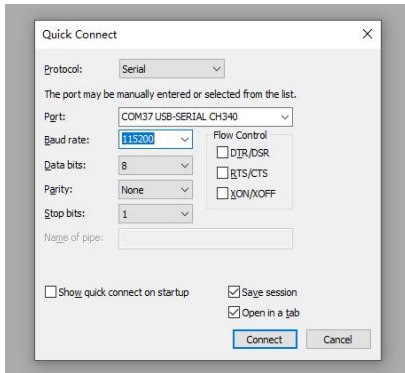
1. Open SecureCRT and create a new connection.
2. Choose "Serial" for the connection type.
3. Select the corresponding port.
4. Set the following parameters:
 1. Baud rate: 115200
 2. Data bits: 8
 3. Parity: None
 4. Stop bits: 1
5. Click "Connect" to access the device.

Linux systems do not have a default login password set.

For Ubuntu systems:

Default Login Account: root

Password: root



3.2 SSH2 Login

Before logging in via the network port, you need to set the IP address for the corresponding port. For example, ETH2 is connected to the router, and the obtained IP address is 192.168.2.107. The computer IP is on network segment 2.

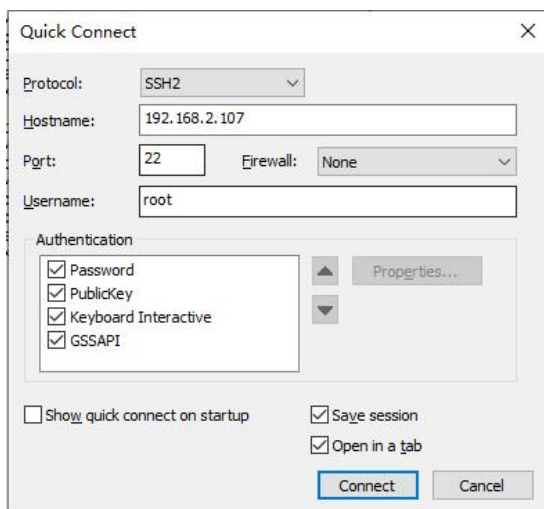
```

docker0  Link encap:Ethernet  HWaddr 02:42:3d:E2:6F:88
          inet addr:172.17.0.1  Bcast:172.17.255.255  Mask:255.255.0.0
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

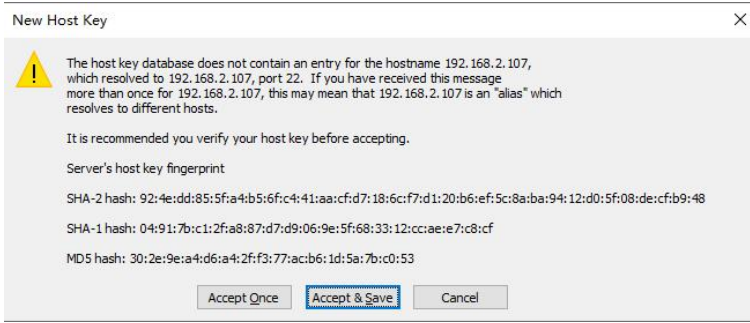
eth2     Link encap:Ethernet  HWaddr 00:E0:99:CD:55:B9
          inet addr:192.168.2.107  Bcast:192.168.2.255  Mask:255.255.255.0
          inet6 addr: fd5f:4184:3ad4:4:66ee:75b9:2b9:476d/64  scope:Global
          inet6 addr: fe80::5d2c:48eb:826c:7f6/64  scope:Link
          inet6 addr: fd5f:4184:3ad4:::74e/128  scope:Global
          inet6 addr: fd2f:fd7:7cda::74e/128  scope:Global
          inet6 addr: fd2f:fd7:7cda:0:15d3:ffef:f05a:3ebf/64  scope:Global
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:240 errors:0 dropped:18 overruns:0 frame:0
          TX packets:80 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:24541 (23.9 KiB)  TX bytes:8407 (8.2 KiB)

lo       Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128  scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:146 errors:0 dropped:0 overruns:0 frame:0
          TX packets:146 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:10796 (10.5 KiB)  TX bytes:10796 (10.5 KiB)
    
```

Click Create Connection, select the protocol as SSH2, enter the hostname as the device IP: 192.168.2.107, set the port to 22, and use the username root. Then, click Connect to establish the connection.



Select Accept for a successful connection.



4 System Programming

4.1 Micro SD Card Boot

4.1.1 Boot Card Creation

Open the “SDDiskTool_v1.69” folder. Switch the language to English before running the software. Open the config.ini file. The setting Selected=2 means the language switched to English.

Language	2024/09/20 15:06	文件夹	
Log	2024/11/13 15:57	文件夹	
config.ini	2024/11/13 15:57	配置设置	2 KB
revision.txt	2021/04/21 18:01	文本文档	1 KB
sd_boot_config.config	2014/09/03 9:52	CONFIG 文件	1 KB
SD_Firmware_Tool.exe	2021/04/21 17:57	应用程序	698 KB
SDBoot.bin	2015/09/29 17:13	BIN 文件	149 KB

```

config.ini - 记事本
文件(F) 编辑(E) 格式(O) 查看(V) 帮助(H)
#选择工具语言:Selected=1(中文);Selected=2(英文)
[Language]
Kinds=2
Selected=2
LangPath=Language\

Lang1File=Chinese.ini
Lang1FontName=宋体
Lang1FontSize=9

Lang2File=English.ini
Lang2FontName=Arial
Lang2FontSize=9

[System]
#升级后,默认拷贝的Demo路径

```

Since the BL450 image typically requires more than 4GB of memory, the memory card needs to be formatted as NTFS when creating the boot card.

Open the “config.ini” file, then locate the “System” section and add the line `USER_DISK_FS=NTFS`; otherwise, the flashing process may fail.

```

[System]
#升级后,默认拷贝的Demo路径
DEFAULT_DEMO_PATH=
#格式化用户盘时使用的卷标
USER_DISK_VOLUME=
#格式化用户盘时文件系统[FAT32,NTFS,EXFAT]
USER_DISK_FS=NTFS
#固件升级模式
UPGRADE_FW_MODE=TRUE
#PCBA测试模式
PCBA_MODE=
#SD启动模式
SDBOOT_MODE=
#TRANSFER_SIZE:扇区为单位
TRANSFER_SIZE=
#IDBLOCK_POS:默认是64,单位为扇区
IDBLOCK_POS=

```

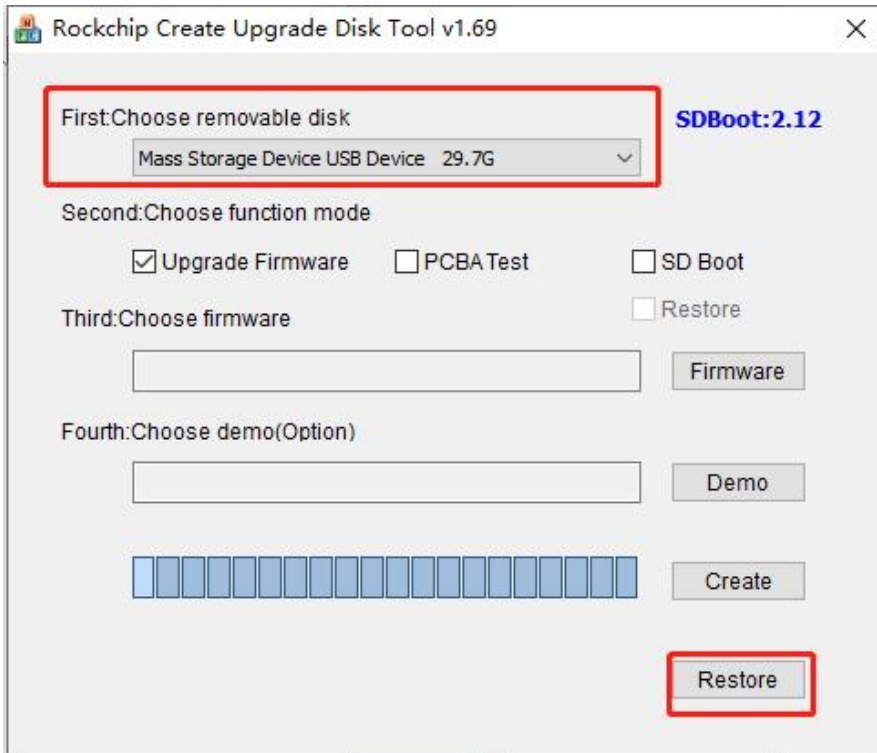
Connect the blank Micro SD card to your computer, right-click on "SD_Firmware_Tool.exe," and select "Run as administrator (A)."

名称	修改日期	类型	大小
Language	2024/09/20 15:06	文件夹	
Log	2024/09/20 15:06	文件夹	
config.ini	2020/03/18 17:27	配置设置	2 KB
revision.txt	2021/04/21 18:01	文本文档	1 KB
sd_boot_config.config	2014/09/03 9:52	CONFIG 文件	1 KB
SD_Firmware_Tool.exe	2021/04/21 17:57	应用程序	698 KB
SDBoot.bin	2015/09/29 17:13	BIN 文件	149 KB

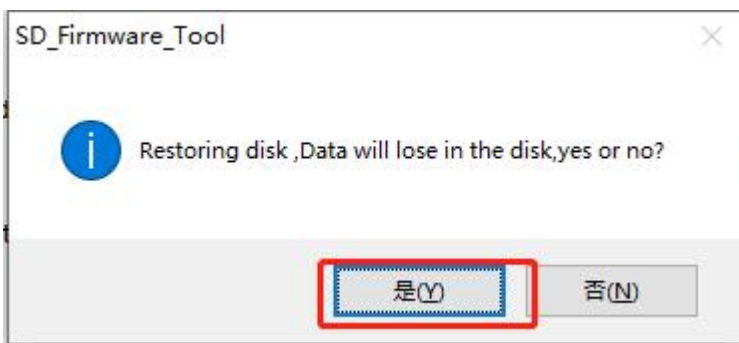
In "First: Choose Removable Disk," choose the removable disk device, then click "Restore" to format

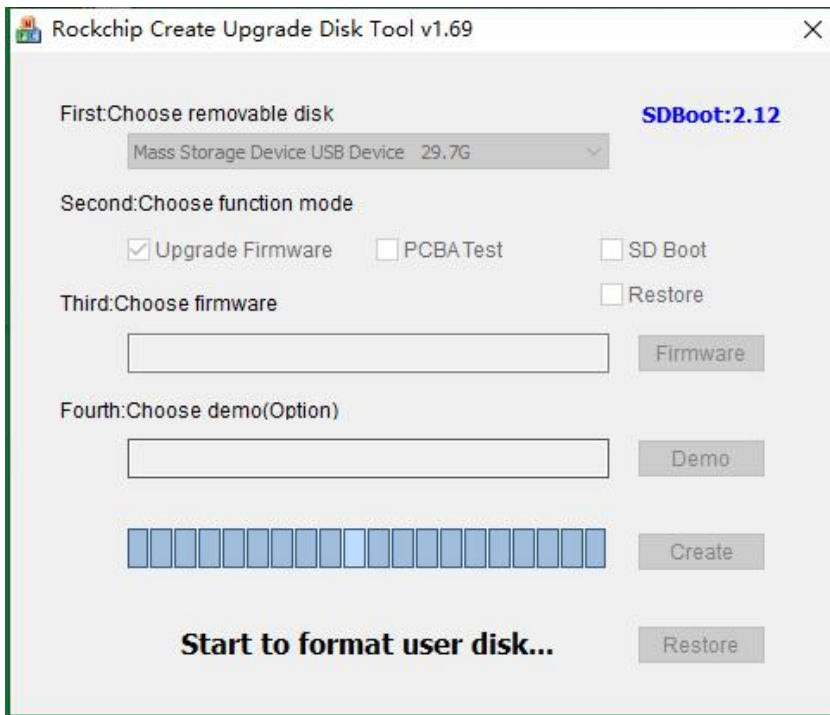
it, as shown in the image below.

Note: The selected SD card will be formatted, so it is recommended to back up any files on the SD card beforehand. Frequent flashing of the system on an SD card can cause damage, so it is advised not to change the system on the SD card frequently after flashing.

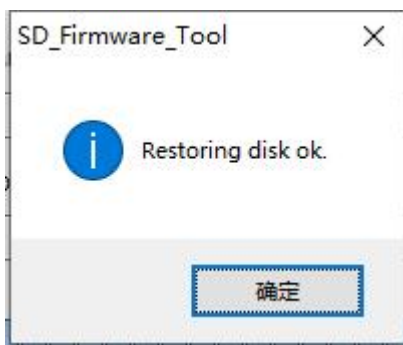


Please confirm that the selected removable disk device is correct, then click “Yes” in the pop-up window to proceed with formatting.

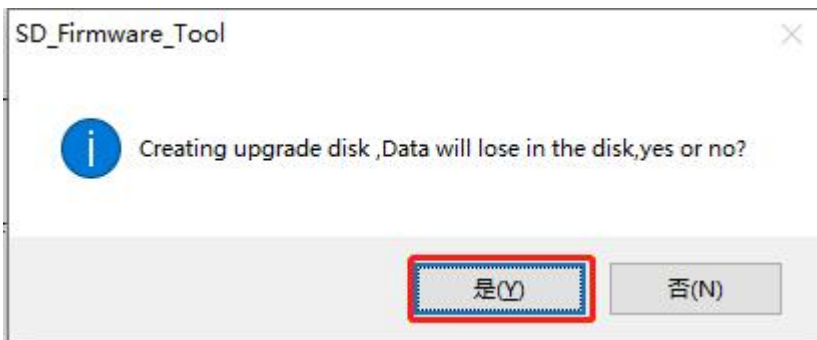
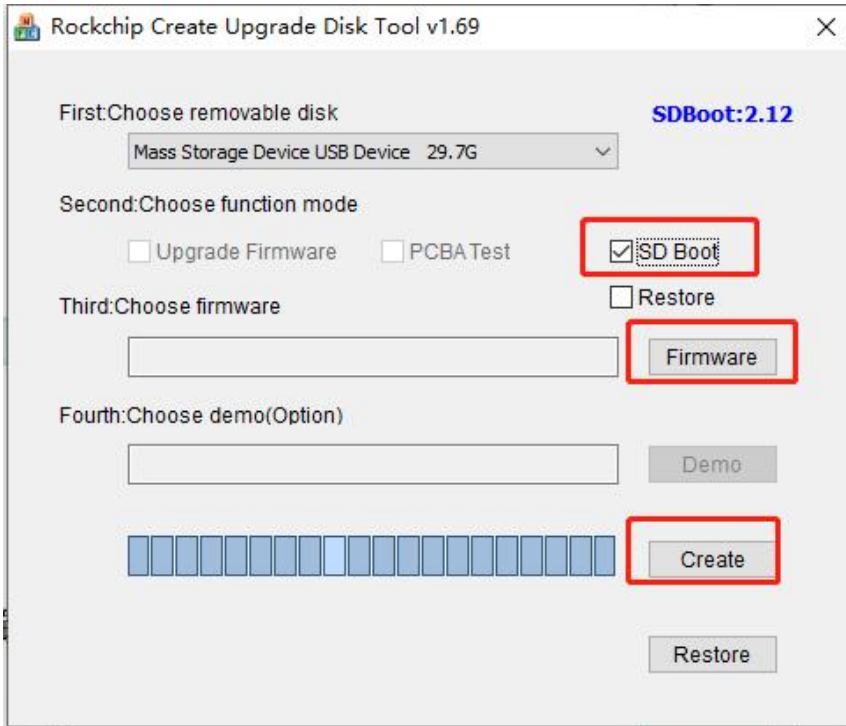


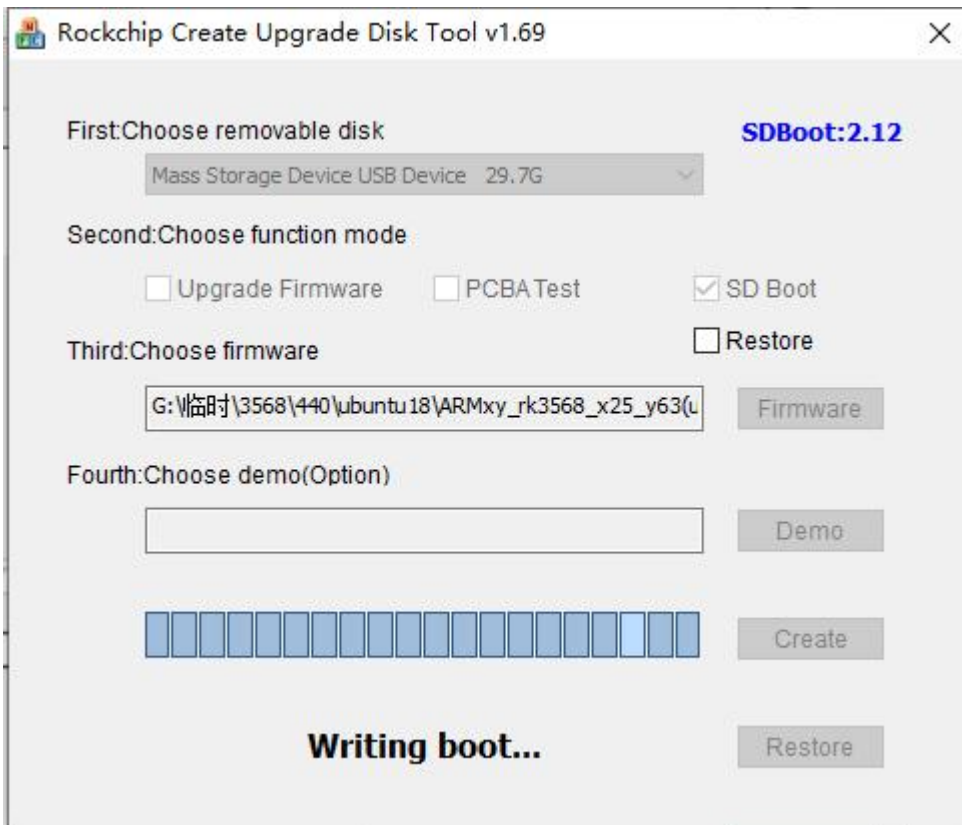


After the formatting is complete, click "OK" in the pop-up window.



Check the "SD Boot" option, click "Choose Firmware" to choose the target system image file, then click "Start Create." In the pop-up window, click "Yes" to create the SD boot card.





When the message “Creating upgrade disk is ok” appears, it indicates that the system flashing is complete. If any other message appears, you need to restart the process from step 1.

In the pop-up window, click "OK." The SD boot card create is now complete.



4.1.2 Boot from the Boot Card

After inserting the boot card into the device's Micro SD card slot and powering on the device, the system will automatically boot from the boot card and log in as the root user. The serial debug terminal will print similar startup information.

"Bootdev(atags): mmc 1" indicates booting in Micro SD mode, while "Bootdev(atags): mmc 0" indicates booting in eMMC mode.

```

U-Boot 2017.09 (Apr 09 2025 - 17:16:23 +0800)

Model: Rockchip RK3588 Evaluation Board
MPIDR: 0x0
PreSerial: 2, raw, 0xfeb50000
DRAM: 4 GiB
System: init
Relocation Offset: eda14000
Relocation fdt: eb7f9b60 - eb7fecd8
CR: M/C/I
optee api revision: 2.0
no mmc device at slot 1
mmc@afe2c0000: 1 (SD), mmc@afe2e0000: 0
Bootdev(ataqs): mmc 1
MMC1: Legacy, 52Mhz
PartType: EFI
TEEC: Warning: Could not find security partition
DM: v2
boot mode: None
    
```

4.2 EMMC Boot

4.2.1 Programming Card Creation

Open the “SDDiskTool_v1.69” folder. Switch the language to English before running the software. Open the config.ini file. The setting Selected=2 means the language switched to English.

Language	2024/09/20 15:06	文件夹	
Log	2024/11/13 15:57	文件夹	
config.ini	2024/11/13 15:57	配置设置	2 KB
revision.txt	2021/04/21 18:01	文本文档	1 KB
sd_boot_config.config	2014/09/03 9:52	CONFIG 文件	1 KB
SD_Firmware_Tool.exe	2021/04/21 17:57	应用程序	698 KB
SDBoot.bin	2015/09/29 17:13	BIN 文件	149 KB

```

config.ini - 记事本
文件(F) 编辑(E) 格式(O) 查看(V) 帮助(H)
#选择工具语言:Selected=1(中文);Selected=2(英文)
[Language]
Kinds=2
Selected=2
LangPath=Language\

Lang1File=Chinese.ini
Lang1FontName=宋体
Lang1FontSize=9

Lang2File=English.ini
Lang2FontName=Arial
Lang2FontSize=9

[System]
#升级后,默认拷贝的Demo路径
DEFAULT_DEMO_PATH=
#格式化用户盘时使用的卷标
USER_DISK_VOLUME=
#格式化用户盘时文件系统[FAT32,NTFS,EXFAT]
USER_DISK_FS=NTFS
#固件升级模式
UPGRADE_FW_MODE=TRUE
#PCBA测试模式
PCBA_MODE=
#SD启动模式
SDBOOT_MODE=
#TRANSFER_SIZE:扇区为单位
TRANSFER_SIZE=
#IDBLOCK_POS:默认是64,单位为扇区
IDBLOCK_POS=
    
```

Since the BL450 image typically requires more than 4GB of memory, the memory card needs to be formatted as NTFS when creating the boot card.

Open the “config.ini” file, then locate the “System” section and add the line `USER_DISK_FS=NTFS`; otherwise, the flashing process may fail.

```

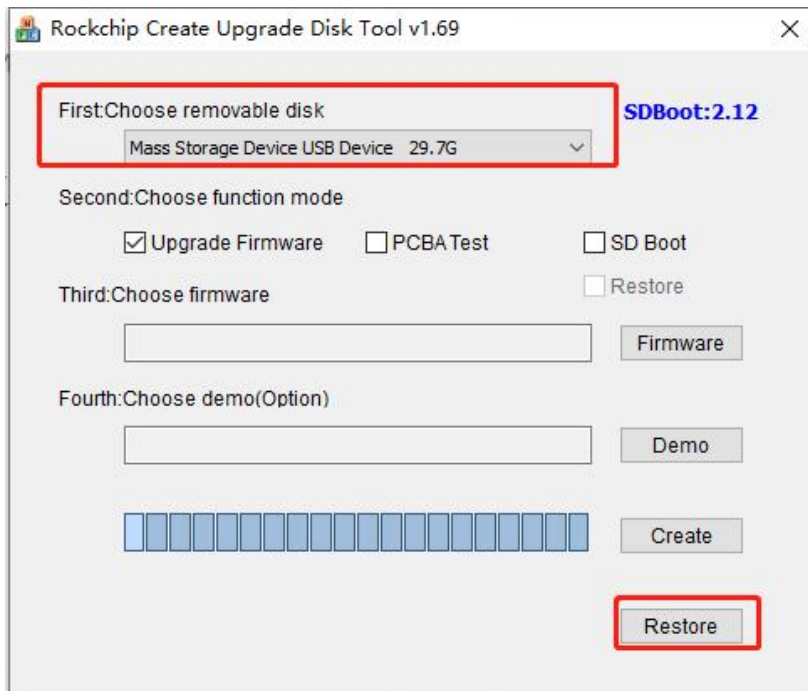
[System]
#升级后,默认拷贝的Demo路径
DEFAULT_DEMO_PATH=
#格式化用户盘时使用的卷标
USER_DISK_VOLUME=
#格式化用户盘时文件系统[FAT32,NTFS,EXFAT]
USER_DISK_FS=NTFS
#固件升级模式
UPGRADE_FW_MODE=TRUE
#PCBA测试模式
PCBA_MODE=
#SD启动模式
SDBOOT_MODE=
#TRANSFER_SIZE:扇区为单位
TRANSFER_SIZE=
#IDBLOCK_POS:默认是64,单位为扇区
IDBLOCK_POS=
    
```

Connect the blank Micro SD card to your computer, right-click on "SD_Firmware_Tool.exe," and select "Run as Administrator (A)."

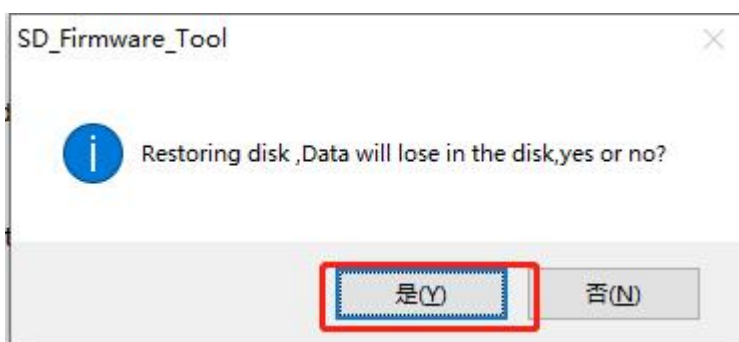
名称	修改日期	类型	大小
Language	2024/09/20 15:06	文件夹	
Log	2024/09/20 15:06	文件夹	
config.ini	2020/03/18 17:27	配置设置	2 KB
revision.txt	2021/04/21 18:01	文本文档	1 KB
sd_boot_config.config	2014/09/03 9:52	CONFIG 文件	1 KB
SD_Firmware_Tool.exe	2021/04/21 17:57	应用程序	698 KB
SDBoot.bin	2015/09/29 17:13	BIN 文件	149 KB

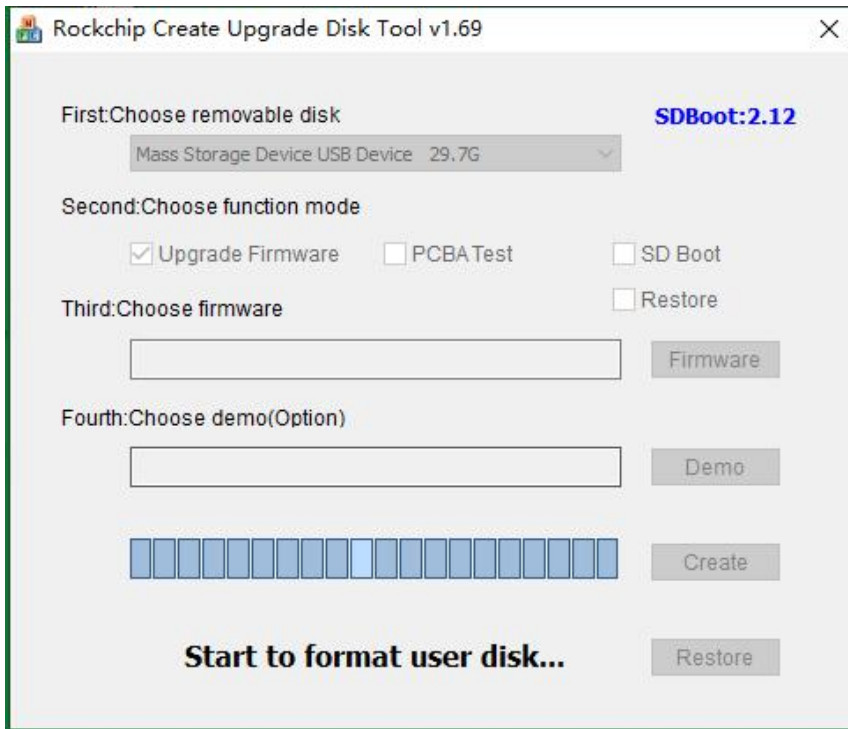
In "First: Choose Removable Disk," choose the removable disk device, then click "Restore" to format it, as shown in the image below.

Note: The selected SD card will be formatted, so it is recommended to back up any files on the SD card beforehand. Frequent flashing of the system on an SD card can cause damage, so it is advised not to change the system on the SD card frequently after flashing.



Please confirm that the selected removable disk device is correct, then click "Yes" in the pop-up window to proceed with formatting.

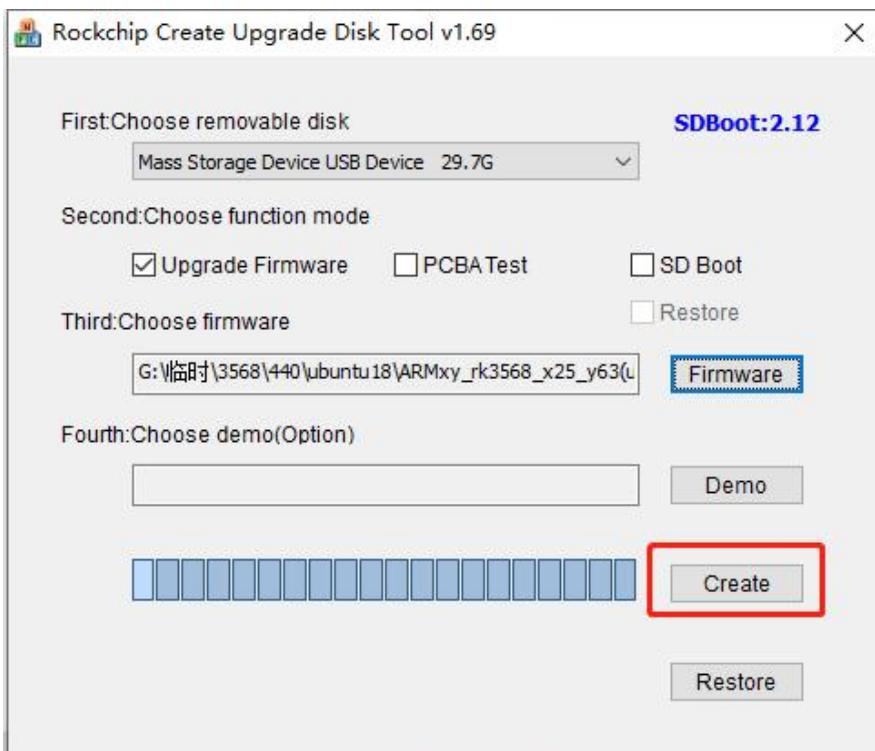
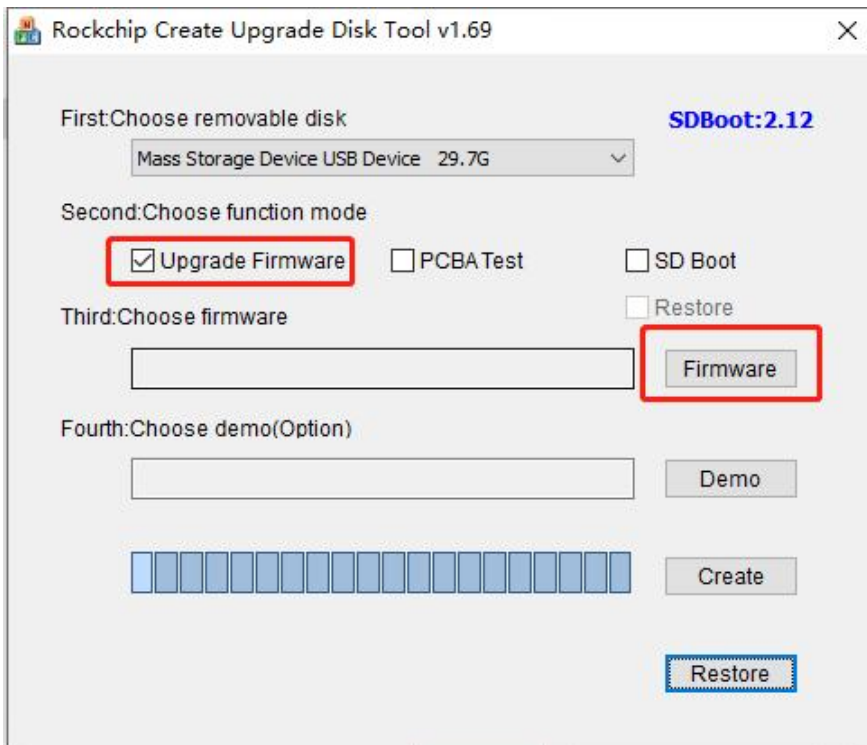




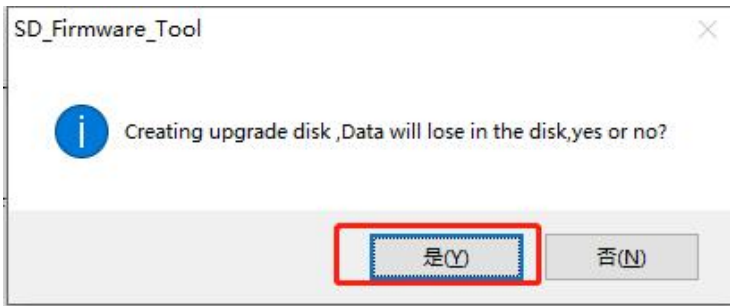
Wait for the formatting to complete, then click "OK" in the pop-up window.



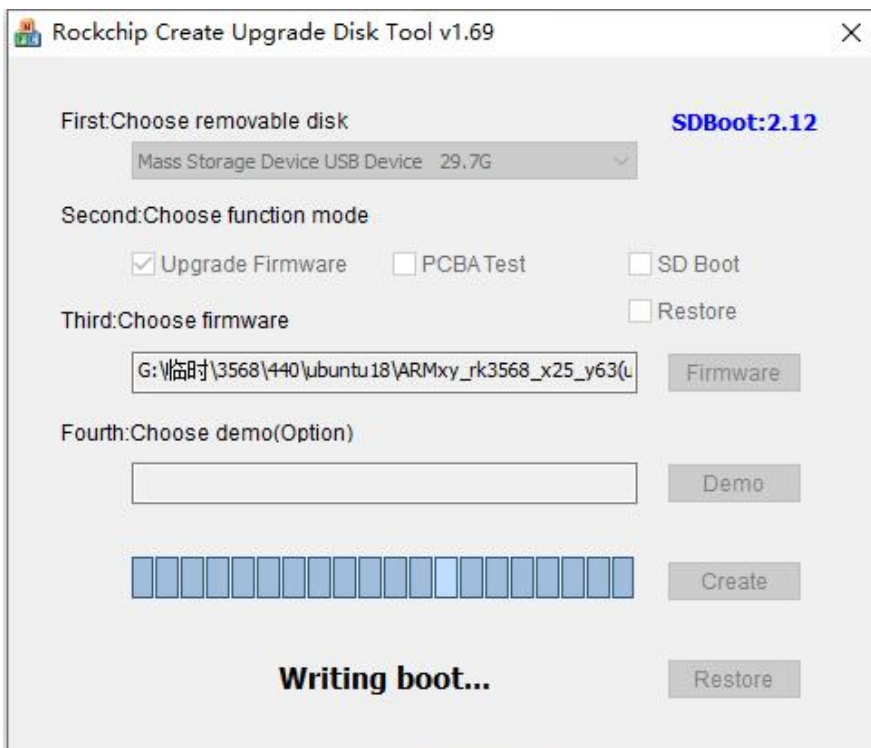
Check the "Upgrade Firmware" option, click "Choose Firmware" to choose the target system image file, then click "Start Create." In the pop-up window, click "Yes" to create the SD boot card.



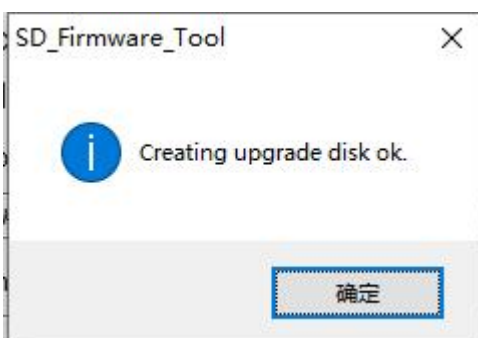
Click "OK"



Start flashing the system.



A prompt will appear indicating that the creation was successful.



4.2.2 System Programming

Insert the prepared SD card into the device's Micro SD card slot. After powering on, the device will boot from the SD card. If you see “boot mode: recovery (misc)”, it indicates that the firmware is starting.

```

U-Boot 2017.09 (Apr 09 2025 - 17:16:23 +0800)

Model: Rockchip RK3588 Evaluation Board
MPIDR: 0x0
PreSerial: 2, raw, 0xfeb50000
DRAM: 4 GiB
Systemem: init
Relocation Offset: eda14000
Relocation fdt: eb7f9b60 - eb7fecd8
CR: M/C/I
optee api revision: 2.0
no mmc device at slot 1
mmc@fe2c0000: 1 (SD), mmc@fe2e0000: 0
Bootdev(atags): mmc 1
MMC1: Legacy, 52Mhz
PartType: EFI
TEEC: Warning: Could not find security partition
DM: v2
boot mode: recovery (misc)
RESC: 'recovery', blk@0x00041fdd
resource: sha256+
FIT: no signed, no conf required
DTB: rk-kernel.dtb
HASH(c): OK
usb dr mode not found

```

When the message “Please remove SD CARD!!!, wait for reboot.” appears, it means the firmware flashing is complete. Remove the SD card, and the device will automatically reboot.

```

[ 6.611572] rk-pcie_establish_link: 231 callbacks suppressed
[ 6.611604] rk-pcie fe180000.pcie: PCIe Linking... LTSSM is 0x3
[ 6.638193] rk-pcie fe180000.pcie: PCIe Linking... LTSSM is 0x3
[ 6.664856] rk-pcie fe180000.pcie: PCIe Linking... LTSSM is 0x3
[ 6.691522] rk-pcie fe180000.pcie: PCIe Linking... LTSSM is 0x3
[ 6.718190] rk-pcie fe180000.pcie: PCIe Linking... LTSSM is 0x3
[ 6.744856] rk-pcie fe180000.pcie: PCIe Linking... LTSSM is 0x3
[ 6.771525] rk-pcie fe180000.pcie: PCIe Linking... LTSSM is 0x3
[ 6.798197] rk-pcie fe180000.pcie: PCIe Linking... LTSSM is 0x3
[ 6.824857] rk-pcie fe180000.pcie: PCIe Linking... LTSSM is 0x3
[ 6.851523] rk-pcie fe180000.pcie: PCIe Linking... LTSSM is 0x3
[ 8.184864] rk-pcie fe180000.pcie: PCIe Link Fail, LTSSM is 0x3, hw_retries=1
[ 9.204901] rk-pcie fe180000.pcie: failed to initialize host
[ 9.791525] rk-pcie fe190000.pcie: PCIe Link Fail, LTSSM is 0x3, hw_retries=1
[ 10.804876] rk-pcie fe190000.pcie: failed to initialize host
[ 33.844839] vcc3v3_pcie30: disabling
[ 33.844862] vcc_mipidcphy0: disabling
[ 33.844866] vcc_3v3_sd_s0: disabling
[ 259.455169] Alternate GPT is invalid, using primary GPT.
[ 259.455192] mmcblk0: p1 p2 p3 p4 p5 p6 p7 p8
LOG_INFO:
Please remove SD CARD!!!, wait for reboot.

```

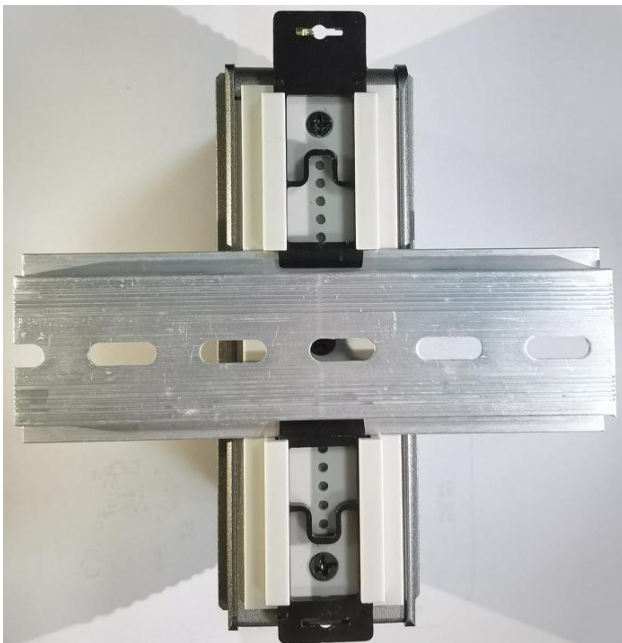
5 Software

- BLIoTLink
- Node-red
- Docker
- QT
- Codesys
- IgnitionSCADA
- Ubuntu 20.04

6 DIN Rail Mounting

The provided DIN rail clips are divided into two parts, upper and lower. The upper part, which is longer, is installed first, while the shorter lower part is mounted on the rail. This arrangement makes it easier to install screws.

Press the clip downward, and it can be mounted onto the DIN rail. The following is a rear view of the DIN rail installation:



7 Electromagnetic Compatibility Testing

Test	Item	Standard	Level	Condition	Result	Remarks
Electromagnetic Emission	Conducted Emission	GB/T 9254 Class A/ CISPR 32 Class A	Class A	150 kHz - 30 MHz	PASS	Complies with limits for general industrial environments
	Radiated Emission	GB/T 9254 Class A/ CISPR 32 Class A	Class A	30 MHz - 1 GHz	PASS	Complies with limits for general industrial environments
Immunity Testing	ESD	GB/T 17626.2/IEC 61000-4-2	Level III	Contact discharge: ± 4 kV; Air discharge: ± 8 kV	PASS	—
	Radiated RF Immunity	GB/T 17626.3/IEC 61000-4-3	Level III	Field strength: 10 V/m, 80 MHz – 1 GHz	PASS	—
	EFT	GB/T 17626.4/IEC 61000-4-4	Level III	Power lines: 2 kV; Signal lines: 1 kV	PASS	—
	Surge	GB/T 17626.5/IEC 61000-4-5	Level III	Differential mode: 2 kV; Common mode: 4 kV	PASS	—
	Voltage Dips and Interruptions	GB/T 17626.11/IEC 61000-4-11	Level III	Voltage dip: 70% for 500 ms; Complete interruption: 10 ms	PASS	—
	Power Frequency Magnetic Field Immunity	GB/T 17626.8/IEC 61000-4-8	Level III	Test intensity: 30 A/m, 50 Hz	PASS	—

Note: If the Electrical Fast Transient (EFT) standard needs to reach Level 3, filter module must be purchased separately.

8 Appendix

X30 Port Numbering	Actual Pin Numbers
GPIO1	GPIO4_PA5
GPIO2	GPIO3_PC4
GPIO3	GPIO4_PB0
GPIO4	GPIO3_PD5
GPIO5	GPIO4_PB2
GPIO6	GPIO3_PC7
GPIO7	GPIO4_PA3
GPIO8	GPIO3_PC1
GPIO9	GPIO4_PA6
GPIO10	GPIO3_PC5
GPIO11	GPIO4_PB1
GPIO12	GPIO3_PD3
GPIO13	GPIO1_PA7
GPIO14	GPIO3_PD0
GPIO15	GPIO4_PA4
GPIO16	GPIO3_PC0

9 Warranty Terms

- 1) This equipment will be repaired free of charge for any material or quality problems within one year from the date of purchase.
- 2) This one-year warranty does not cover any product failure caused by man-made damage, improper operation, etc

10 Technical Support

Shenzhen Beilai Technology Co., Ltd
Website: <https://www.bliiot.com>