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TCU Series Intelligent Gateway User Manual

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Industrial Ethernet Communication Solution Expert **3onedata Co., Ltd.**

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Preface

The User Manual has introduced:

- Difference between two TCU series intelligent gateway systems
- How to log in to the TCU series intelligent gateway device
- How to upload files to TCU series intelligent gateway
- How to quickly test the TCU series intelligent gateway

Audience

This manual applies to the following audience:

- Network administrators responsible for network configuration and maintenance
- On-site technical support and maintenance personnel
- Software engineer

Port Convention

Due to the fact that this manual covers multiple products of the TCU series intelligent gateway, the port number in this manual is only an example, and does not represent the actual port with this number on the device. In actual use, the port number existing on the device shall prevail.

Text Format Convention

Format	Description
" "	Words with “” represent the interface words. Such as: “Port No.”.
>	Multi-level path is separated by ">". Such as opening the local connection path description: Open "Control Panel> Network Connection> Local Area Connection".

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Format	Description
Light Blue Font	It represents the words clicked to achieve hyperlink. The font color is as follows: 'Light Blue'.
About this chapter	The section 'About This Chapter' provides links to various sections of this chapter, as well as links to the Principles/Operations Section of this chapter.

Icon Convention

Format	Description
 Notice	Remind the announcements in the operation, improper operation may result in data loss or equipment damage.
 Warning	Pay attention to the notes on the mark, improper operation may cause personal injury.
 Note	Make a necessary supplementary instruction for operation description.
 Key	Configuration, operation, or tips for device usage.
 Tips	Pay attention to the operation or information to ensure success device configuration or normal working.

Revision Record

Version No.	Revision Date	Revision Note
01	2024-04-26	First release

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1 Introduction

At present, the TCU series intelligent gateway developed and produced by 3onedata Co., Ltd. is mainly based on the Linux kernel operating system: Ubuntu, according to product positioning

1.1 Ubuntu System

The current version is Ubuntu 20.04 LTS. The Ubuntu system is suitable for common scenarios, adopts the standard cross-compilation tool chain, supports the apt tool to install software online, and is suitable for users to modify the system more freely.

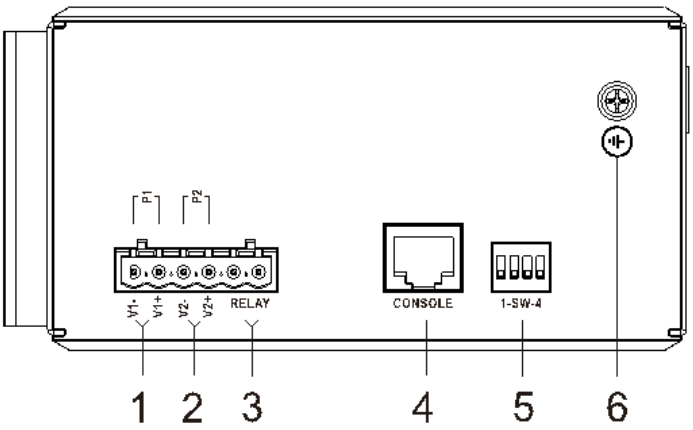

Key

More documents can be accessed at the address https://ubuntu.com/server/docs.

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2 Device Connection Preparation

2.1 Power Connection



Users need to prepare a DC voltage source with an output voltage between 12V and 48V. "V+" is the positive pole of the power supply, "V -" is the negative pole of the power supply, and FG is the ground wire; Before powering on, the device needs to be reliably grounded.

2.2 Login Password

User Type	System Contact	Normal Users
User name	root	tcu
Password	admin	tcu

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2.3 Terminal Software

Using MobaXterm (recommend,: https://mobaxterm.mobatek.net/ ）in the Windows operating system or putty to connect to the device, and both terminal software can support both SSH and serial connection methods simultaneously.

In the Ubuntu operating system, openssh-client is used for SSH connection and minicom is used for serial communication, both of which can be installed using apt install.

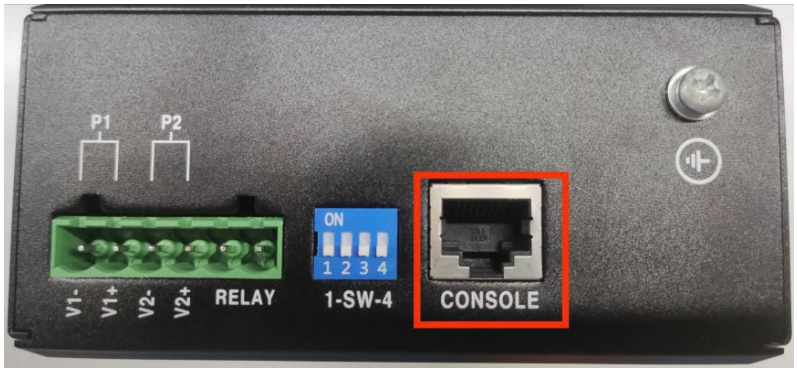
sudo apt install openssh-client minicom

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3 System Login

3.1 Serial Terminal Login

3.1.1 Hardware Connection



3.1.1.1 Device Connection Port

Device console port (as shown in the figure above)

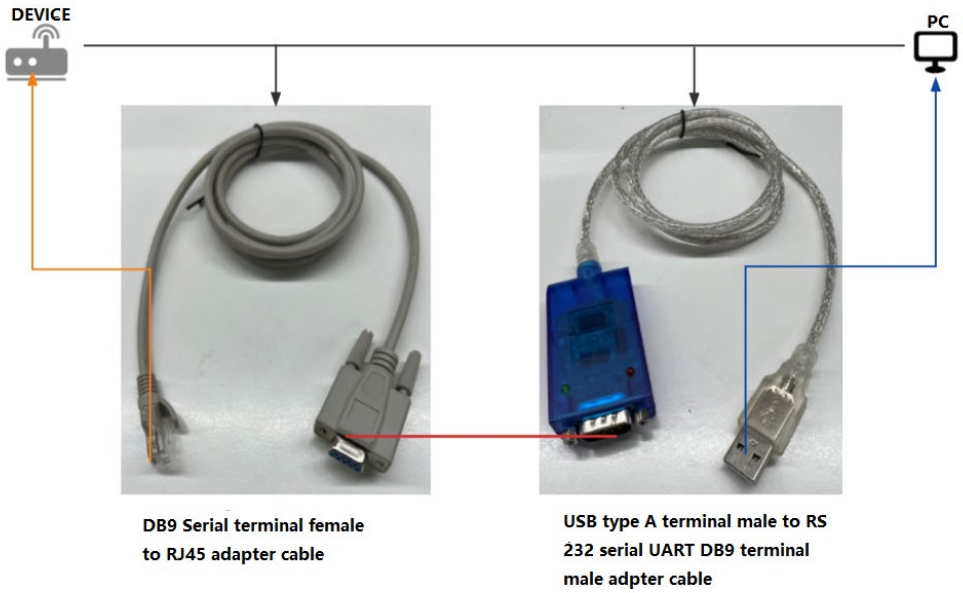
3.1.1.2 Connection Cable

Step 1 UART DB9 serial port female to RJ45 adapter cable (included with the package); Connect the DB9 female to the DB9 male of the PC, and connect the RJ45 terminal to the device console port. If there is no DB9 male connector on the PC, you still need to: USB type A male connector to RS232 serial port UART DB9 male connector patch cord.

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Step 2 First, assemble the Cable a and b as shown in the diagram above, then connect the USB male to the USB interface of the PC as shown in the diagram below, and connect the RJ45 end to the console port of the device.



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3.1.2 Login via Windows Host

3.1.2.1 Verify the Port

By following these steps, view the port number currently assigned by the operating system to the serial port in Windows Device Manager:

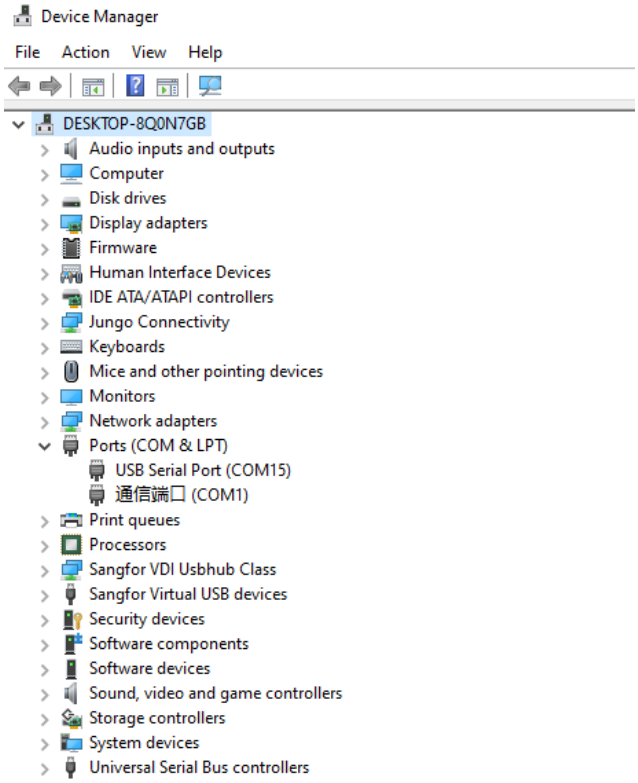
Right-click Windows Start Menu > Select Device Manager > Click Ports (COM and LPT)

Key

If there are multiple serial devices installed in the system, the port number corresponding to the USB serial port connected to the device can be determined by hot plugging the USB port.

Tips

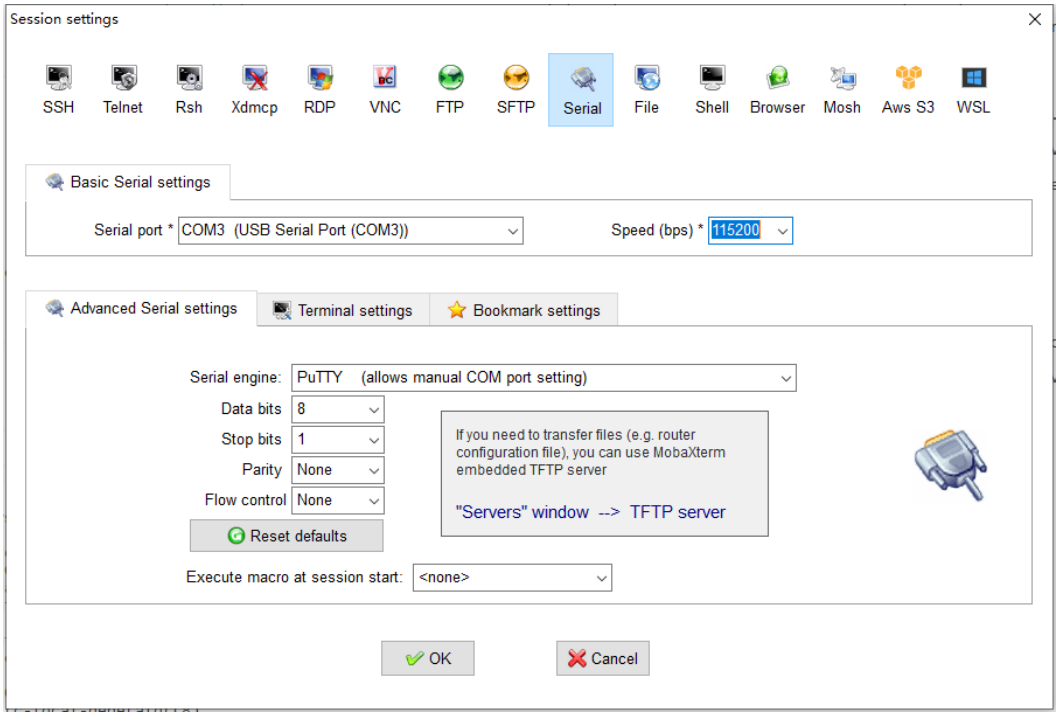
The port number of the USB serial port in the following figure is COM3.



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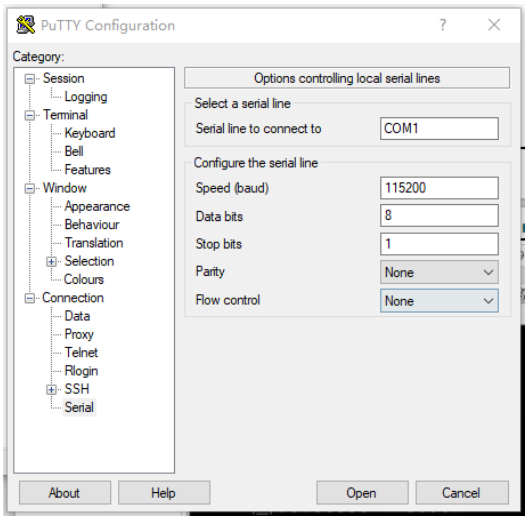
3.1.2.2 Create A Serial Session

On the premise that the device console interface is well connected to the PC, open the MobaXterm software and create a new serial terminal session in the following order. Click on the Session in the upper left corner>Click on the Serial tab in the new window>Open the Serial tab>Select the serial port number corresponding to the device in the Serial port bar>Set the baud rate to "115200" in the Speed bar>Click on the Advanced Serial settings tab>Select PuTTY in the Serial engine bar>Select 8 in the Data bits bar>Select 1 in the Stop bits bar>Select None in the Parity bar>Select None in the Flow control bar. After configuration is completed, click OK to confirm and save to enter the console.

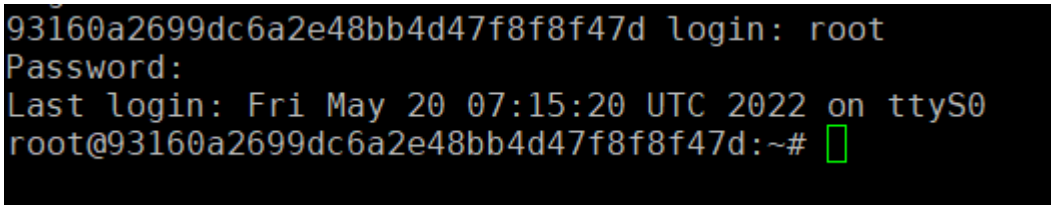


If using putty, select the corresponding COM port, and change the baud rate to 115200, 8Bit data bits, 1 stop bit, no parity and no flow control.

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Click OPEN to open the serial login console. After the device is started, you can press Enter on the serial port login console to view the message "*login:", prompting you to enter the user name and password to login to the terminal. After the successful login, you can perform CLI operations on the device.



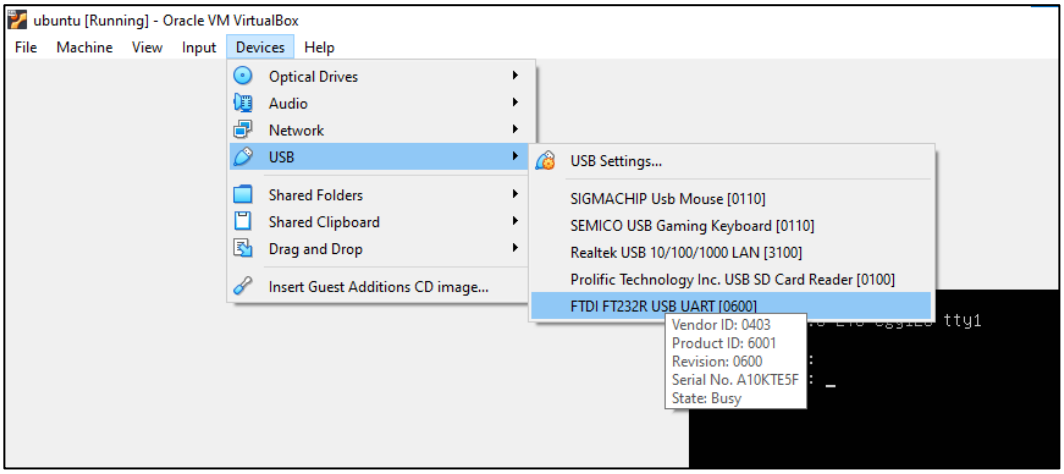
Tips

If there is no response from the console after Enter, it indicates that there is a problem with the hardware connection between the device and the PC, and the adapter cable needs to be replaced or the plug needs to be checked for firmness.

3.1.3 Login via Ubuntu Host

3.1.3.1 Mapping Serial Device

This step is optional when using a virtual machine, skip this step for non-virtual machines. Take the VirtualBox virtual machine as an example, start the Ubuntu virtual machine, and then in the top menu of VirtualBox, complete the mapping of the USB serial port on the virtual machine in the following order (as shown in the figure): Click [Device] > [USB] > Select serial device [FTDI FT232R USB UART...]



After selecting the USB serial port, VirtualBox will mark a "√" symbol in front of the selected device, and then map the USB serial port to the Ubuntu virtual machine. At this time, by entering ls/dev/ttyUSB * in the command line of the virtual machine, you can see an additional device file, whose device file name is named as: /dev/ttyUSB0

Tips

If there is no newly added device file in the above command result, such as/dev/ttyUSB0, you can use the command "dmesg | tail" to check if the kernel contains USB serial port drivers.

3.1.3.2 Use Minicom to Log in to the Device

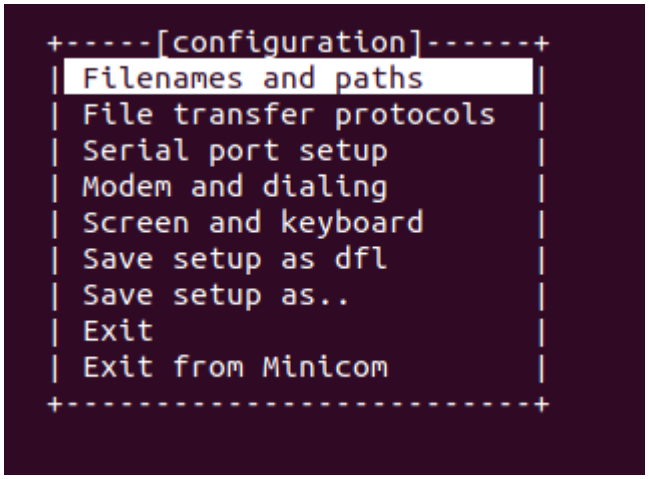
It is recommended to use Minicom to log in to the device on Ubuntu. Under the command line serial port, enter the command:

sudo apt update

sudo apt install minicom

Wait for the installation to complete. After the installation is complete, enter the command sudo mini com - s and the following interface will pop up

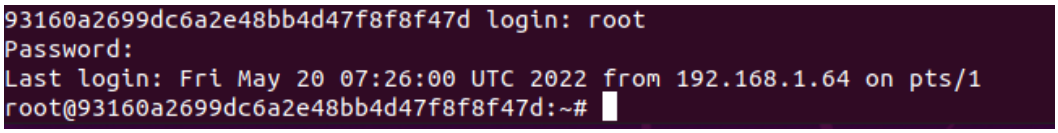
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Move the cursor to select Serial port setup



Press A, then enter/dev/ttyUSB0, press F to turn off hardware flow control. For other parameters, refer to the screenshot settings. The setting is finished, press Enter to confirm, then select Exit to go back to the minicom main menu, minicom will open the serial port and open the serial terminal interface as below:



Enter your account and password in this interface to log in to the device.

3.2 SSH Terminal Login

SSH terminal login using the network interface to connect to the device, first use the network cable to connect the PC to the device's Ethernet interface, and then configure the IP address of the network card to the 192.168.1.x network segment (where x takes

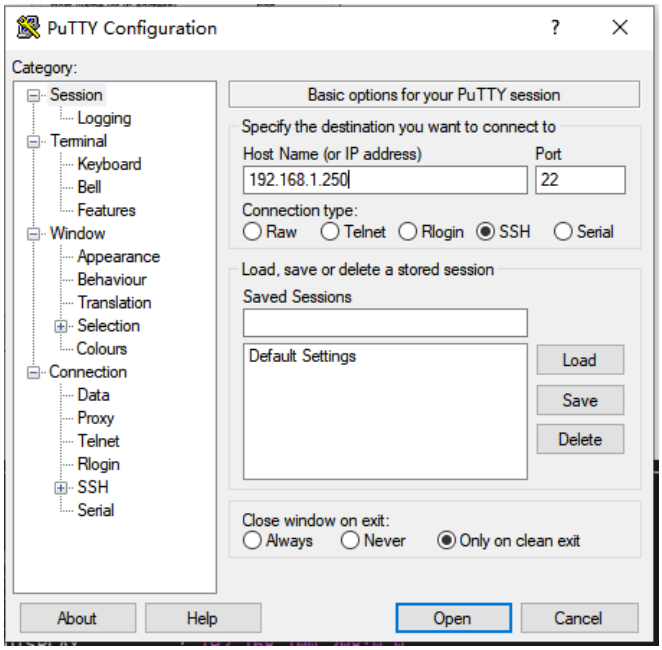
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the value of 2 to 254), the device factory default IP address of the LAN port is 192.168.1.250.



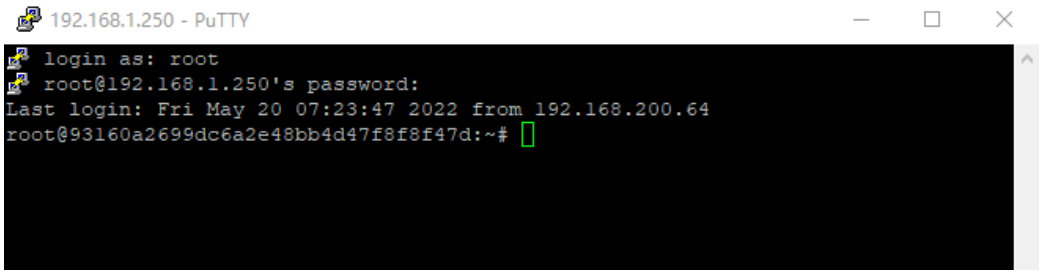
3.2.1 Login via Windows

Connect device and PC to the same LAN, and configure putty as follows:



Click Open to open the session, and enter the user name and password in the SSH terminal window to complete the login.

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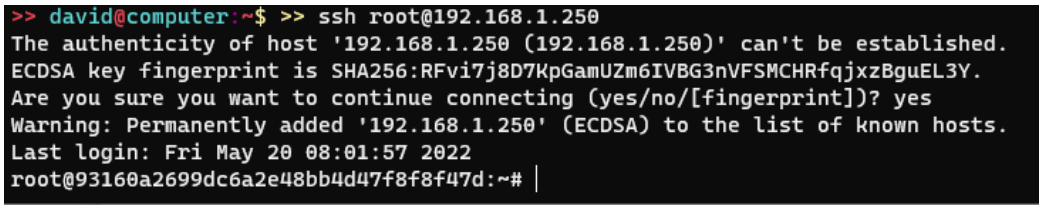


3.2.2 Logging in to the Device via Ubuntu

After connecting the device through the network cable, set the ubuntu network address on the PC to the 192.168.1.x network segment, and then enter the command:

ssh root@192.168.1.250

Then enter the password according to the prompts, and the login interface is shown in the screenshot below.



3.3 HDMI Login

Notice

By default, TCU series devices only support text mode login, the following operations are limited to tcu series devices that support graphical interface, the operating system needs to be upgraded to a version that supports graphical interface

3.3.1 Graphical Login Interface

Connect an external monitor through HDMI, with TCU as the default user. The login interface is shown in the following figure.

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3.3.2 Enable On-Screen Keyboard

The login interface can also open the on-screen keyboard, and the specific operations are:

Step 1 Click the People Icon in the upper left corner of the interface

Step 2 Select "Onscreen keyboard"

As shown in the picture below:



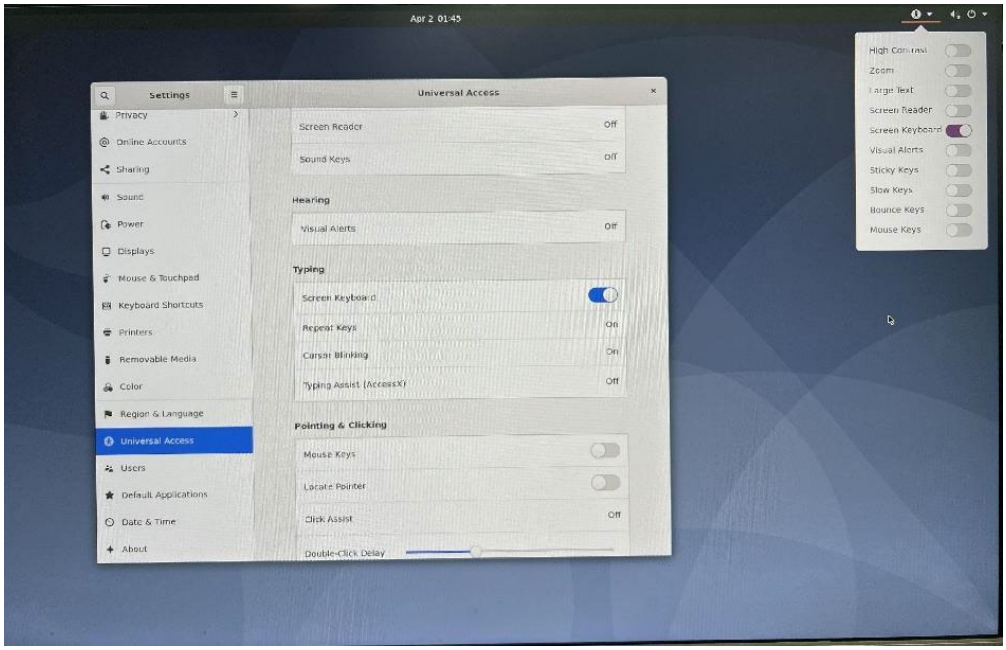
Steps for logging into the desktop to turn on the on-screen keyboard:

Step 1 Right click on the mouse to select and turn on "setting".

Step 2 Select "Universal Access" → "Typing" → "Screen Keyboard" and set it to "on".

As shown in the picture below:

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3.4 Ubuntu Username and Password Modification

Tips

If you want to change the password and username, please change the password first, reboot, then change the username and reboot. If you change the user name and then the password, you may fail to log in to Ubuntu.

3.4.1 Change Password

Enter the following command in the shell terminal:

sudo passwd old_user

old_user is the username of the user whose password was changed.

Enter the new password and confirm it. After successfully changing the password, log out of the current logged in user, and then enter the username and new password to log in to Ubuntu.

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3.4.2 User Name Modification

3.4.2.1 By Adding New Users (Recommended)

Switch to the root user in the shell.

Enter the following command to add a new user:

adduser newname

```
root@emu1000-a31:~# adduser ttt
Adding user `ttt' ...
Adding new group `ttt' (1003) ...
Adding new user `ttt' (1003) with group `ttt' ...
Creating home directory `/home/ttt' ...
Copying files from `/etc/skel' ...
New password:
Retype new password:
```

After entering the command, the system will require setting a password.

User directory migration involves setting directory permissions for files in the original user directory under the home directory to the new user, and then migrating these files to the new user directory:

chown -R newuser:newuser /home/olduser

mv /home/olduser/* /home/newuser/

Enter the following command to delete the original user.

userdel olduser

3.4.2.2 By Modifying Configuration Files

Notice

Improper operation of this method may cause the system to fail to log in and is not recommended.

Switch to the root user at a shell command prompt, and then enter them in order at the command line:

vim /etc/passwd

Find the original username and change it to your own username (change the entire line).

```
sshd:x:107:65534::/run/sshd:/usr/sbin/nologin
systemd-coredump:x:999:999:systemd Core Dumper:/:/usr/sbin/nologin
dlsoft:x:1000:1000:,,,:/home/dlsoft:/bin/bash
```


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vim /etc/shadow

You also need to find the original username (all names need to be changed) and change it to your new username.

vim /etc/group

Find the original username in the group and modify them all!

Change the name of the user's home directory, change the user directory under the home directory to your own user name: for example, the original directory name AAA, now you want to change it to user BBB, use the command mv AAA BBB to do it.

Verify login with the newly set username and password.

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4 Upload Files to Device

The following describes how to upload files from the PC to the device.

4.1 Windows System

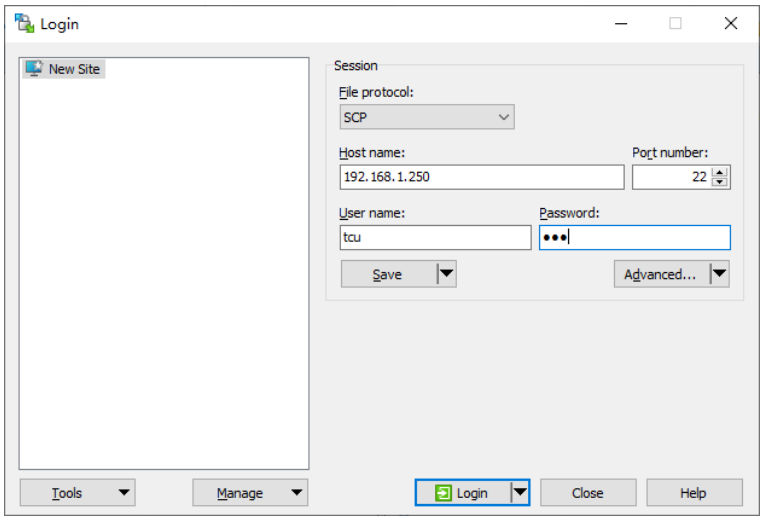
Take the WinSCP software as an example.

4.1.1 Download and Install WinSCP

https://winscp.net/eng/index.php。

4.1.2 Login Device

Open WinSCP and click on the Menu Session > New Session, and configure it as follows:



4.1.3 File Upload

Click on login in the previous step, and after successfully connecting to the device, find the file you want to upload on the left side and drag it to the right to upload.

4.2 Linux System

Taking scp as an example, let's assume that the file to be uploaded is bingo.sh.

scp bingo.sh root@192.168.1.250:~

The above command can upload the bingo.sh file to the home directory of the root user of the device.

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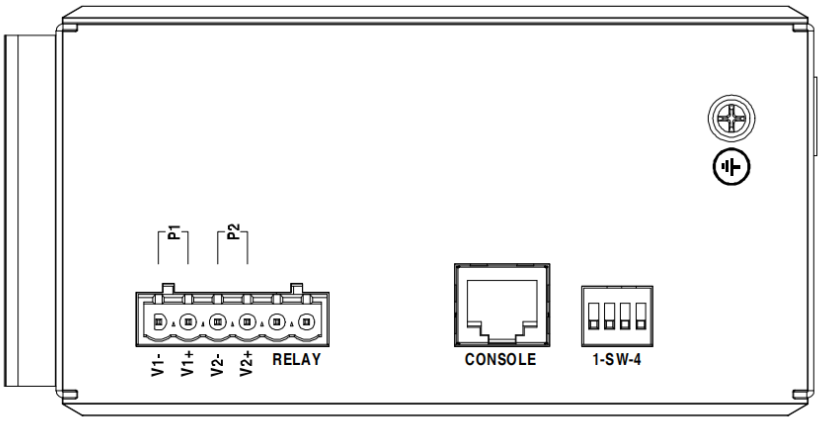
5 Quick Functional Test

Notice

The software required for the following test can be selected from the test-suites directory based on the system type tested and uploaded to the device.

5.1 Console Port

Connect the PC to the CONSOLE port of the device by using the RJ45 Console cable as described in Section 3.1.1. Start the serial port terminal software on the PC, configure the terminal as described in Section 3.1.2, and then power on the device. If the log of the device power-on process is displayed on the terminal window, it indicates that the console port works properly.



5.2 RELAY Terminal

As shown in the figure above, the RELAY terminal is located on the right of the two power terminals. The relay is normally closed and the device node is "/dev/relay". Input "cat/dev/relay" in the terminal to print out the state of relay, the default is "1", at this time, use the multimeter to measure the two terminals of relay, it is the on state; After that, you can input "echo 0 > /dev/relay" in the terminal to change its state to "0", and then use a multimeter to measure the on/off state, which is the off state.

5.3 DIP Switch

The device node of the DIP switch is "/dev/dial". Enter the command "/usr/bin/factory/test_dial" in the terminal to print the status of the DIP switch. The Switch 1-4 of the DIP switch correspond to the four digits of the binary number from low to high respectively. The pull-up state of the switch is low level “0”, and the pull-down state is high level “1”. For example, when the Switch 1, 2, and 3 is pulled up, and the Switch 4 is pulled down, the printing status is "8" (hexadecimal), which is the binary number "1000".

5.4 LED Indicator

Enter the following command in the terminal command line to light up all software-controlled LED:

```
find /sys/devices/platform/leds/leds -
name brightness | while read b; do echo 1 > $b; done
```

Then observe the LED indicator status on the panel, where the PWR indicator, DO indicator, RS232 indicator and RS485 indicator are steady on, otherwise the corresponding LED indicator is faulty. After testing, enter the command:

```
find /sys/devices/platform/leds/leds -
name brightness | while read b; do echo 0 > $b; done
```

Switch all LED indicators to the normally off state. At this point, observe the LED controlled by the software again, and it should all be turned off.

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5.5 DI and DO Interface

- DI Interface

  Digital Input is used to detect whether there is a voltage difference on DI-DI+. The allowable measurement range for voltage difference is 5V~24V. When there is a voltage difference, the corresponding file outputs 1, and when there is no voltage difference, outputs 0.

- DO Interface

  Digital Output, whose output is a switch signal, controls the on/off between DO- and DO+ by writing 1 and 0 to the corresponding file. It is a passive signal output, so users need to provide a power supply voltage with a voltage difference of 5V~24V, which is then connected to the DO port of the device.

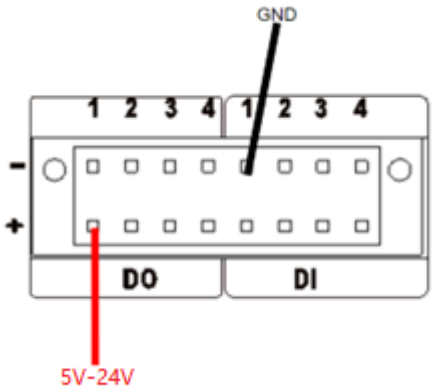
Tips

According to the characteristics of DI and DO, if this model has both DI and DO interfaces, the output of the DO port can be directly connected to the DI port. As the DO port is a passive signal output method, a power supply voltage with a voltage difference between 5V and 24V needs to be connected outside the DO port, and then the voltage difference signal is transmitted to the DI port through a switch signal to achieve DI and DO loop measurement.

5.5.1 DI and DO Loopback Test Connection Method

The + port of the DO is connected to the positive power supply (5-24V DC power supply).

The DI - port is connected to a negative power supply.



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5.5.2 Port Device Path

Due to the fact that the drivers for DI and DO use the Linux IIO driver framework, and there may be multiple devices using the IIO driver framework in the system, the following methods need to be used to confirm the device paths for the DI and DO interfaces before testing.

Input: "ls - l/sys/devices/platform/| grep di" (use grep do when searching for DO), find the iio directory (the directory name in the following text is iio di or iio do);

Input: "cd /sys/devices/platform/iio-di" into the corresponding iio directory, and find the corresponding "iio:device" folder in that directory. The "in_voltage0_raw"/"out_voltage0_raw" in this folder are the device file nodes to be operated in the following text. The value (0/1) represents the on/off status of the DI and DO ports, where 0 represents disconnected and 1 represents connected.

Tips

Specifically, the new version of the software has simplified the above process by generating a character device node with the same name for the device corresponding to the DI/DO interface in the/dev directory. The standard read/write method can be used to configure the port status.

5.5.3 Test through Multimeter

After completing the wiring according to the above steps, use the on/off switch of a multimeter to measure the on/off status of the DO interface. After the red and black probes of the multimeter maintain good contact with the positive and negative terminals of the DO interface, the multimeter shows that the channel status is off, indicating that the DO switch is in the "off" state; Assuming the DO device port path DEV-PATH obtained in the previous section is /sys/devices/platform/iio-do/iio:device2, enter the command in the serial console:

echo 1 > /sys/devices/platform/iio-do/iio:device2/out_voltage0_raw

At this point, the multimeter buzzes, it indicates that the first channel of the DO switch is connected. Maintain the connection between the measuring probe of the multimeter and the DO interface, and then issue commands on the serial console:

echo 0 > /sys/devices/platform/iio-do/iio:device2/out_voltage0_raw

The multimeter immediately stops buzzing, indicating that the first channel of the DO switch has been disconnected. If the buzzing status of the multimeter matches the

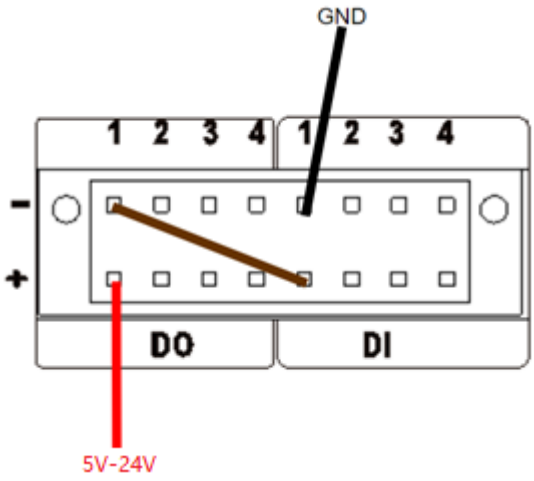
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input command, it indicates that the DO port is functioning properly; If the actual result does not meet the above description, the DO port function is abnormal.

Tips

For the second channel, first switch the multimeter probe to contact the second channel terminal, and then simply change the previous command node out_voltage0_raw to out_voltage1raw when executing the command. The testing method for other DO channels is the same.

5.5.4 Test through Command and LED Status



After connecting the wires according to the diagram, connect the negative terminal of the DO port to the positive terminal of the DI port. After the wiring is completed, it can be observed that the LED indicators of the DO and DI interfaces are both in off state. Then enter the command in the console command line:

echo 1 > /sys/devices/platform/iio-do/iio:device2/out_voltage0_raw

cat /sys/devices/platform/iio-di/iio:device1/in_voltage0_raw

If the LED indicators corresponding to the DO interface is on at this time, it means the function of the DO interface is intact; otherwise, the DO function is abnormal;

If the LED indicators corresponding to the DO and DI interfaces are both on, and the console outputs 1 after inputting command (b), it proves that the DI interface function is also intact;

If the LED indicators corresponding to the DO interfaces are on and the LED indicators corresponding to the DI interfaces are off, and the console outputs 0 after inputting command (b), it proves that the DI interface function is abnormal

The DI function is normal as shown in the following figure:

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```
root@tcu100:~# echo 1 > /sys/devices/platform/iio-do/iio:device2/out_voltage0_raw
root@tcu100:~# cat /sys/devices/platform/iio-di/iio:device1/in_voltage0_raw
1
root@tcu100:~#
```

The DI function is abnormal as shown in the following figure.

```
root@tcu100:~# echo 1 > /sys/devices/platform/iio-do/iio:device2/out_voltage0_raw
root@tcu100:~# cat /sys/devices/platform/iio-di/iio:device1/in_voltage0_raw
0
root@tcu100:~#
```

5.6 RS232 Port

5.6.1 Port Device File Path

Enter the command in the console:

ls -l /dev | grep 232

You can obtain the name corresponding to the RS232 port of the device. The naming format for this name is rs232s0p+interface number, for example, rs232s0p2 corresponds to the No.2 RS232 port of the device.

Notice

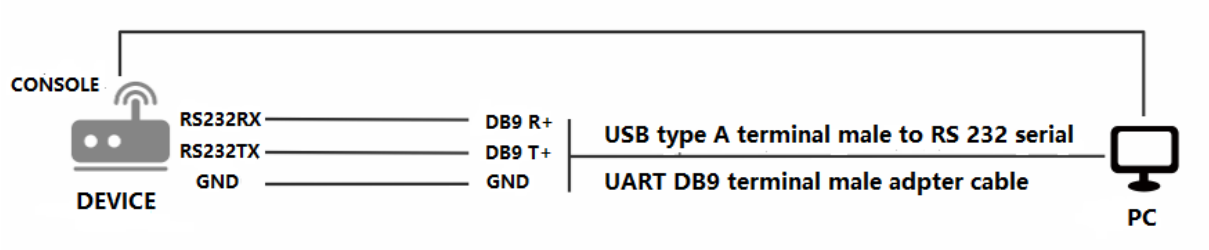
Some devices have multiplexed RS232/RS485 ports, which means a set of UART serial ports can achieve two functions: RS232 and RS485, corresponding to RS232 and RS485 interfaces with the same serial number outside the device. In response to this multiplex situation, check its name in the dev directory under the console, in the format of rs485-232s0p+interface number. For example, rs485-232s0p5 indicates that the 5th RS485 interface and the 5th RS232 interface on the device are multiplexed using the same UART serial port. When using the device, these two interfaces cannot be used at the same time, and only one can be selected for use at the same time.

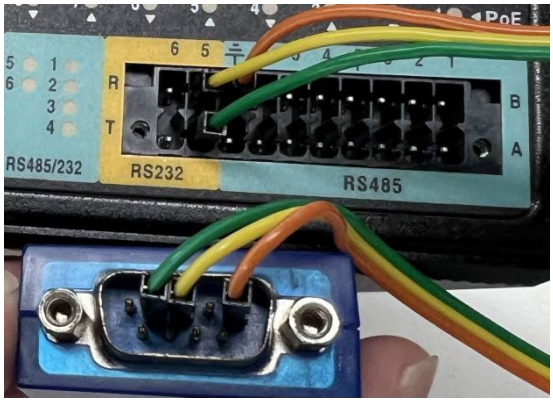
5.6.2 Single Device Test

5.6.2.1 Wiring Method

The RS232 port is connected to the PC through the “lead-DB9-USB-RS232 converter”. The RX port of the device is connected to the R+ port of DB9, the TX port is connected to the T+ port of DB9, and the GND port of the device is connected to the GND port of DB9.

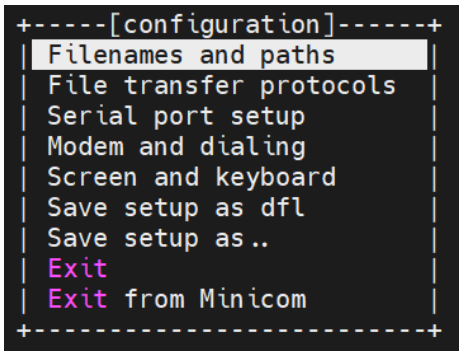
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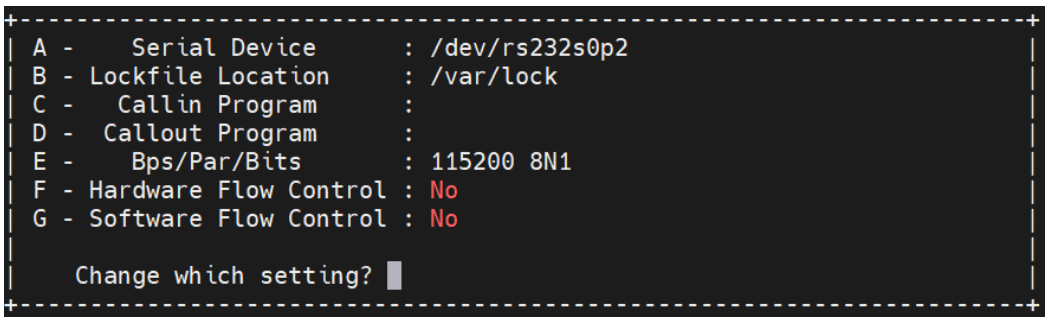


5.6.2.2 Test Procedure

Step 1 Under the command line serial port, enter the command "**minicom -s**" and the following interface will pop up:



Step 2 Select Serial port setup

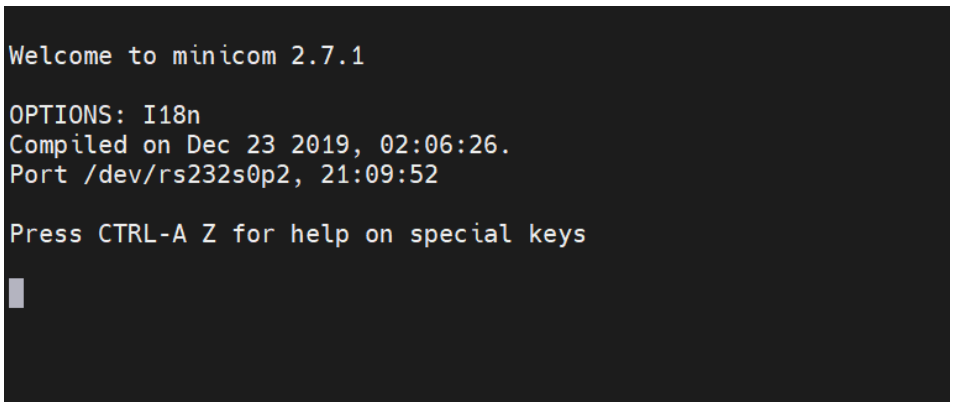


Step 3 Select the device name, press **A**, and then enter the device name, for example: "**/dev/rs232s0p2**";

Step 4 To set the baud rate, press **E**, then press **A** or **B** to select the baud rate, then press **Enter** to confirm. The default 115200N1 will be used here;

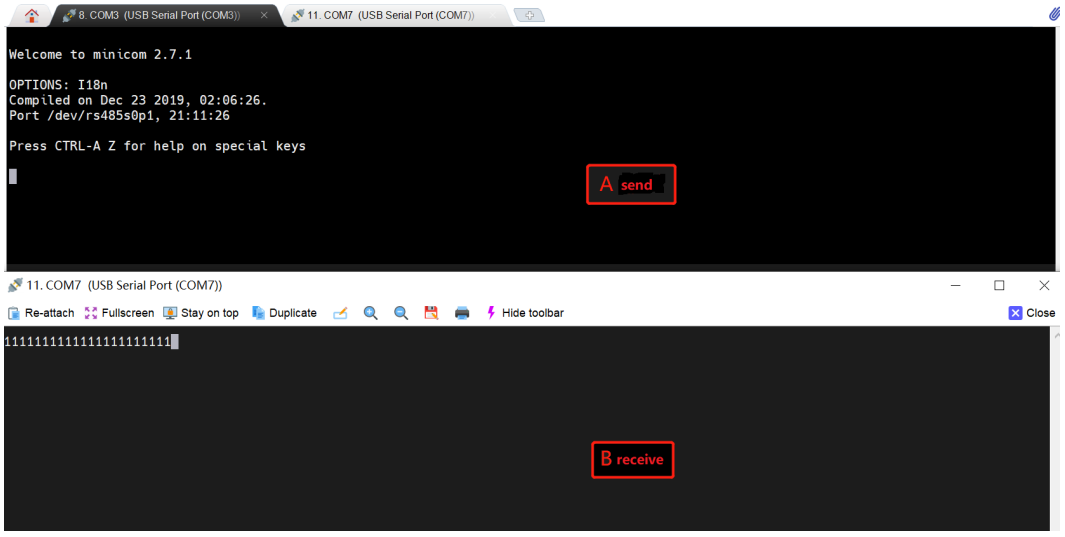
Step 5 Turn off hardware flow control, press **F**, and modify the configuration value of "**Hardware Flow Control**" to "**No**"

Step 6 For other parameters, use the default values. After setting up, press **Enter** to confirm and return to the main menu, then select **Exit** to enter the **minicom** interface. As shown in the following figure:



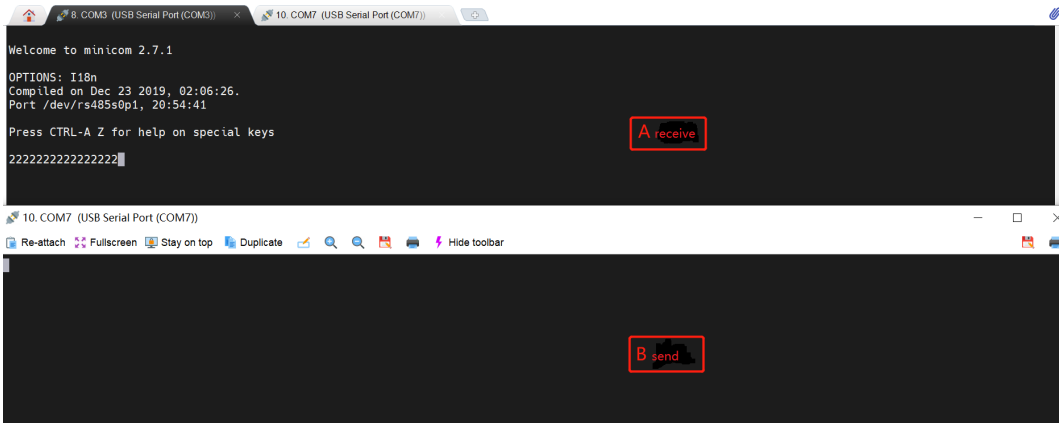
Step 7 Later, open the console terminal corresponding to **RS232** on the PC through the serial port function of **MobaXterm** software and select the same baud rate, for example: 115200 8N1.

Step 8 If data is input into the **minicom** interface corresponding to the **console** port, it will be displayed on the terminal corresponding to RS232, as shown in the following figure:



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If data is input at the RS232 terminal, the data will be displayed on the corresponding minicom interface of the console port. As shown in the following figure.



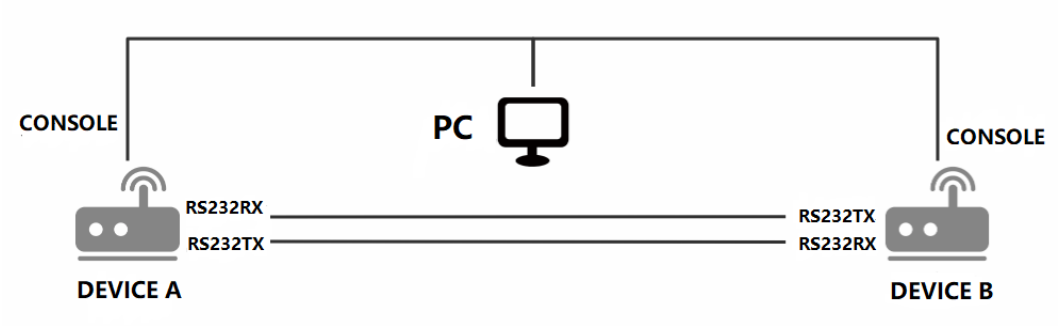
Step 9 If the actual test results comply with step 8, the RS232 port function of the device is normal. Otherwise, the function is abnormal. In case of abnormality, it is necessary to first check whether the 232 cable is connected according to the above requirements? Or is the interface loose? If the test fails after repeated attempts, contact the relevant technical personnel for assistance.

Tips

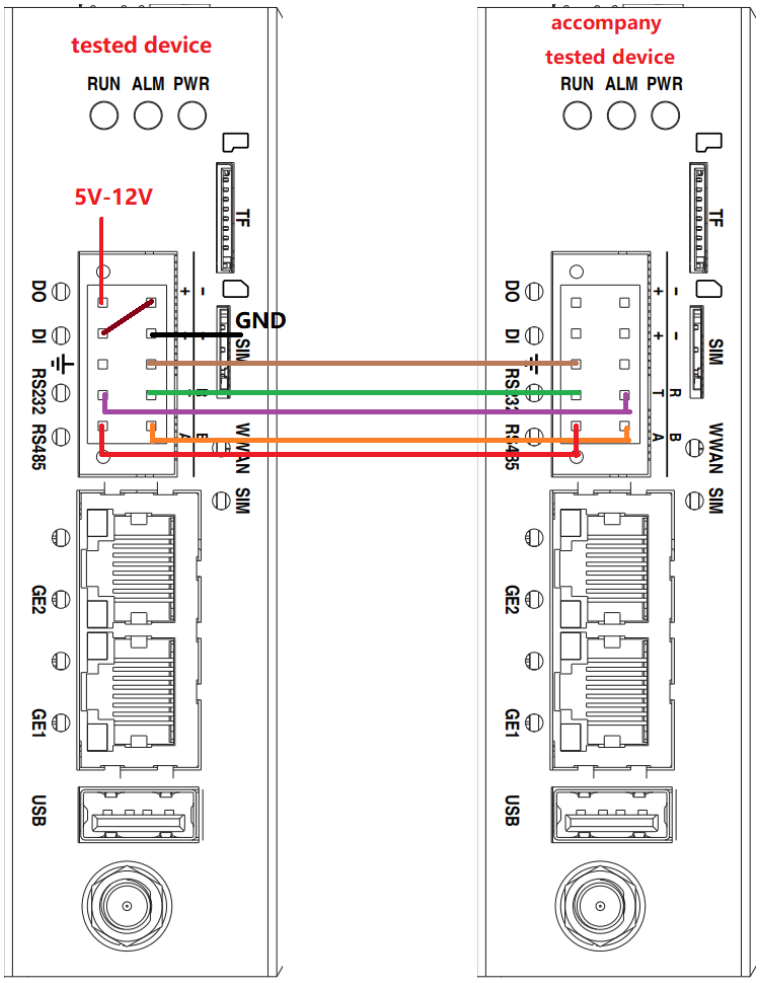
To exit minicom, press Ctrl+A to enter the setting state, press Z to enter the setting menu, and then press X to exit minicom, you will be prompted to confirm your exit.

5.6.3 Online Test of Two Devices

5.6.3.1 Wiring Method



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The RX port of the tested device is connected to the TX port of the accompanying device, and the TX port of the tested device is connected to the RX port of the accompanying device. Power on the accompanying testing device and connect it to the PC through the console interface.

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5.6.3.2 Test Procedure

Step 1 First, configure the tested device A, enter the command "minicom -s under the command line serial port, and the interface will pop up as follows:

```
+-----[configuration]------+
| Filenames and paths      |
| File transfer protocols  |
| Serial port setup        |
| Modem and dialing        |
| Screen and keyboard      |
| Save setup as dfl        |
| Save setup as..          |
| Exit                     |
| Exit from Minicom        |
+--------------------------+
```

Step 2 Select **Serial port setup**

```
+-----------------------------------------------------------------------+
| A -    Serial Device      : /dev/rs232s0p2                            |
| B - Lockfile Location     : /var/lock                                 |
| C -   Callin Program      :                                           |
| D -  Callout Program      :                                           |
| E -    Bps/Par/Bits       : 115200 8N1                                |
| F - Hardware Flow Control : No                                        |
| G - Software Flow Control : No                                        |
|                                                                       |
|    Change which setting?                                              |
+-----------------------------------------------------------------------+
```

Step 3 Select the device name, press A, and then enter the device name, for example: "/dev/rs232s0p2";

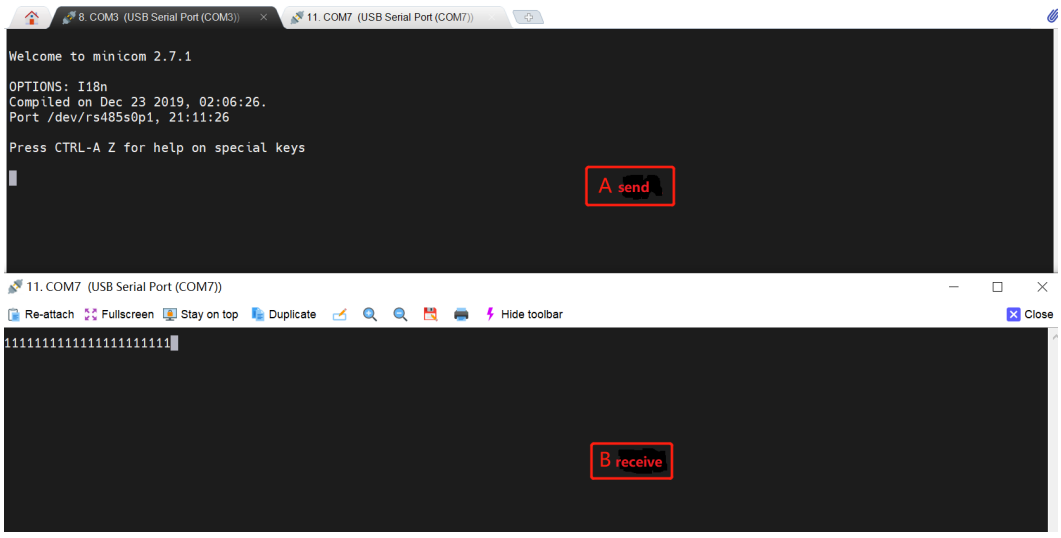
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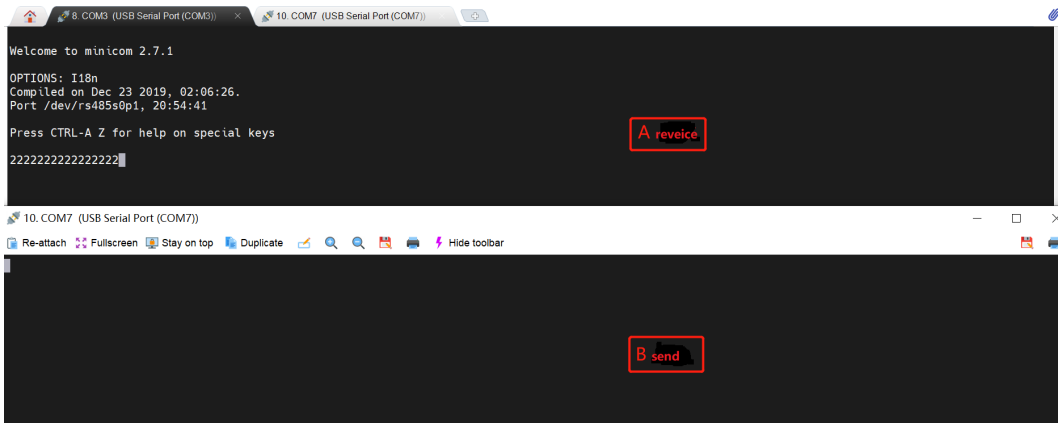
Step 4 To set the baud rate, press E, press N and B to select the baud rate, and press enter to confirm. The default value is 115200;

Step 5 Turn off flow control, press F, and change the Hardware setting to "No".

Refer to screenshot settings (default) for other parameters. After setting up, press enter to confirm, then return to the main menu and select Exit. The minicom window is displayed. As shown in the figure below, the configuration steps of accompanying device B are consistent with the steps of device A mentioned above.

Step 6 After the configuration and connection are completed, the consoles of both devices enter the minicom operation interface. At this time, if we input information on the interface of Device A, the information will be transmitted to device B and printed out on the interface of Device B. Otherwise, information entered on Device B will be displayed on the console interface of Device A.





Step 7 If the actual results meet the above requirements, then the RS232 interface function is normal;

If there is no response from the consoles of both parties when typing information, or if

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only the console of this machine displays after typing, it indicates that the RS232 interface is malfunctioning.

5.7 RS485 Port

5.7.1 Port Device File Path

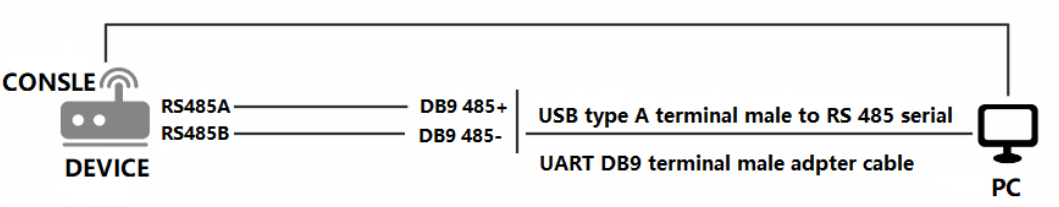
Enter the command in the console:

ls -l /dev | grep 485

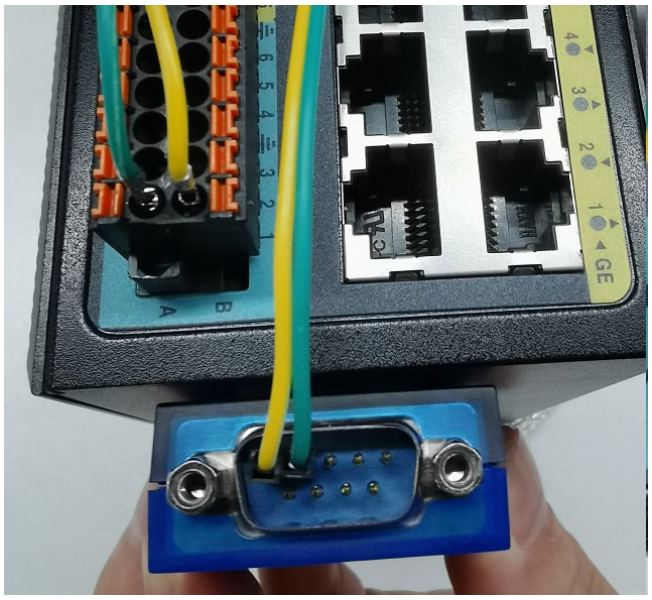
You can obtain the name corresponding to the RS485 port of the device. The naming format for this name is rs485s0p+interface number, for example, rs485s0p1 corresponds to the No.1 RS485 port of the device.

5.7.2 Single Device Test

The RS485 port is connected to the PC through the “lead-DB9-USB-RS485 converter”. When wiring, the A port of the device is connected to the 485+ pole of DB9, and the B port of the device is connected to the 485- pole of DB9.



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Notice

The 485+ and 485- pole wiring sequences of DB9-USB-RS485 converters from different manufacturers may differ, and it needs to be checked clearly. The wiring sequence in the above figure is for reference only.

Still tested by the minicom tool, in the interface of Serial port setup:

```
+-----------------------------------------------------------------------+
| A -    Serial Device      : /dev/rs485s0p1                            |
| B - Lockfile Location     : /var/lock                                 |
| C -   Callin Program      :                                           |
| D -  Callout Program      :                                           |
| E -    Bps/Par/Bits       : 115200 8N1                                |
| F - Hardware Flow Control : No                                        |
| G - Software Flow Control : No                                        |
|                                                                       |
|    Change which setting?                                              |
+-----------------------------------------------------------------------+
```

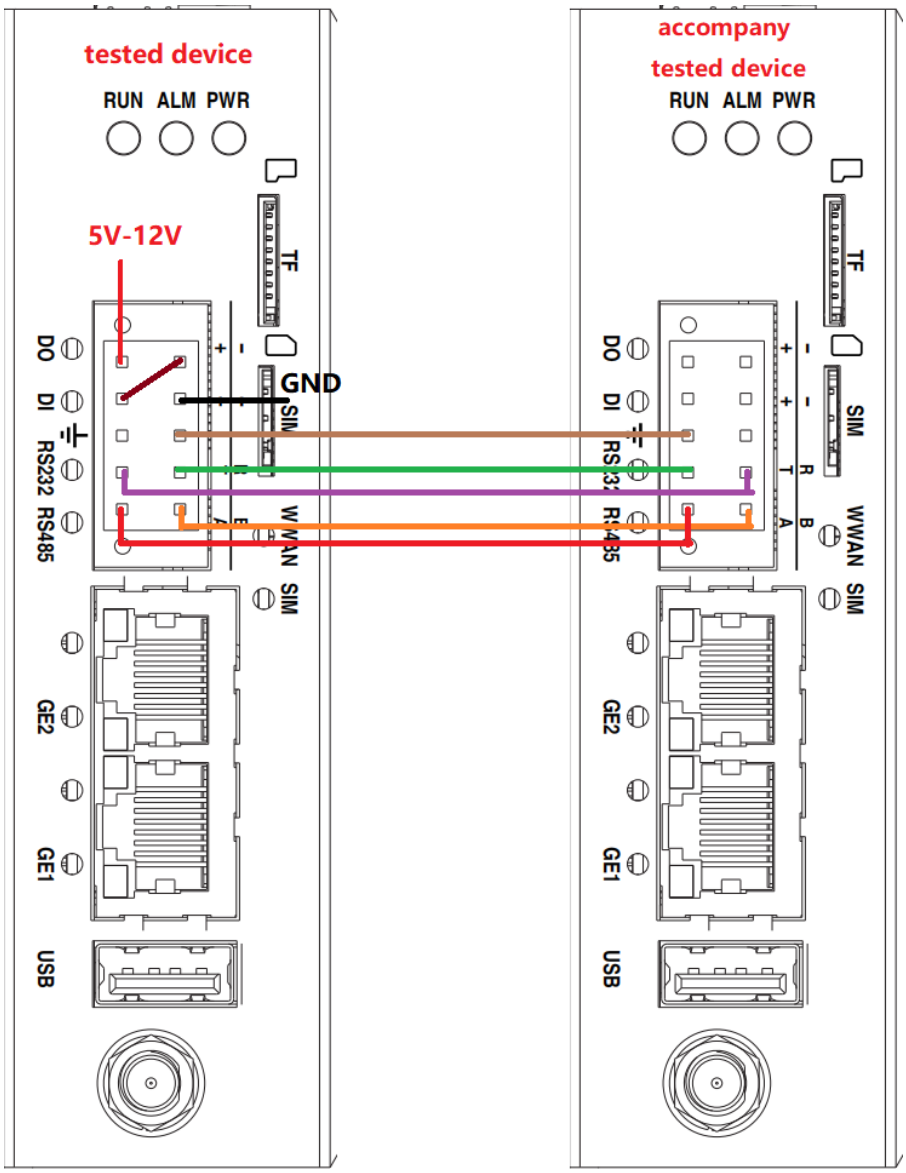
Select the device name, press A, and then enter the device name, for example: "/dev/rs485s0p1"; other parameters are set according to the above figure. After setting up, press enter to confirm, then return to the main menu and select Exit.

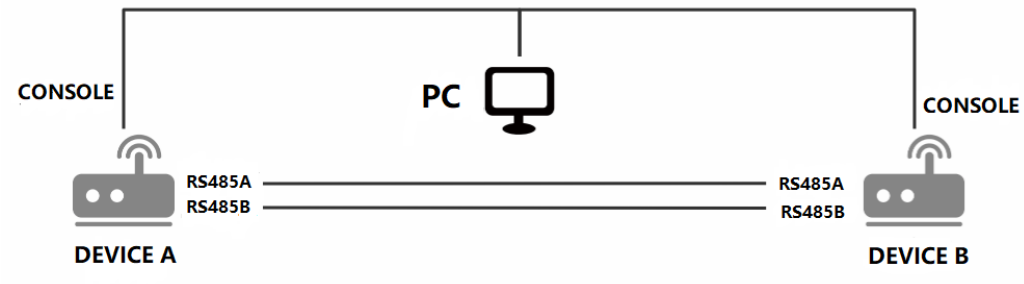
The remaining operations are completely consistent with the testing of the RS232 interface. Ultimately, if both consoles can display each other's input information, it proves that the RS485 interface functions normally; Otherwise, the RS485 interface function is abnormal.

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5.7.3 Online Test of Two Devices

5.7.3.1 Wiring Method





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As shown in the diagram, Port A and Port B of one device are connected to the other's Port A and Port B respectively. Power on the accompanying testing device and connect it to the PC through the console interface.

5.7.3.2 Test Procedure

Still tested by the minicom tool, in the interface of Serial port setup:

```
+-----------------------------------------------------------------------+
| A -    Serial Device      : /dev/rs485s0p1                            |
| B - Lockfile Location     : /var/lock                                 |
| C -   Callin Program      :                                           |
| D -  Callout Program      :                                           |
| E -    Bps/Par/Bits       : 115200 8N1                                |
| F - Hardware Flow Control : No                                        |
| G - Software Flow Control : No                                        |
|                                                                       |
|    Change which setting?                                              |
+-----------------------------------------------------------------------+
```

press A, and enter "/dev/rs485s0p1, other parameters are set according to the above figure. After setting up, press enter to confirm, then return to the main menu and select Exit.

The remaining operations are completely consistent with the testing of the RS232 interface. Ultimately, if both consoles can display each other's input information, it proves that the RS485 interface functions normally; Otherwise, the RS485 interface function is abnormal.

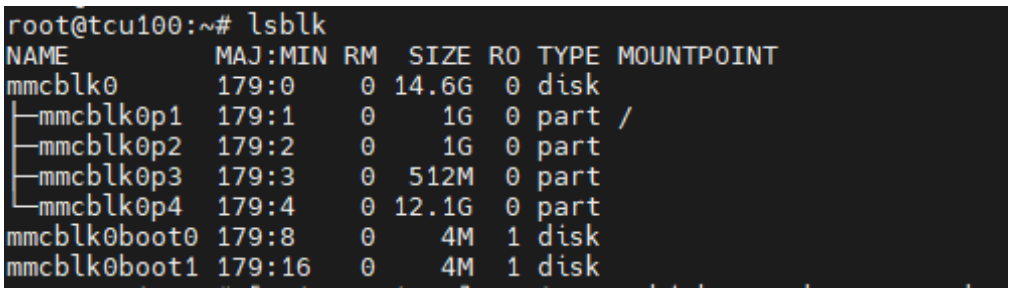
5.8 TF Card Slot and USB Port

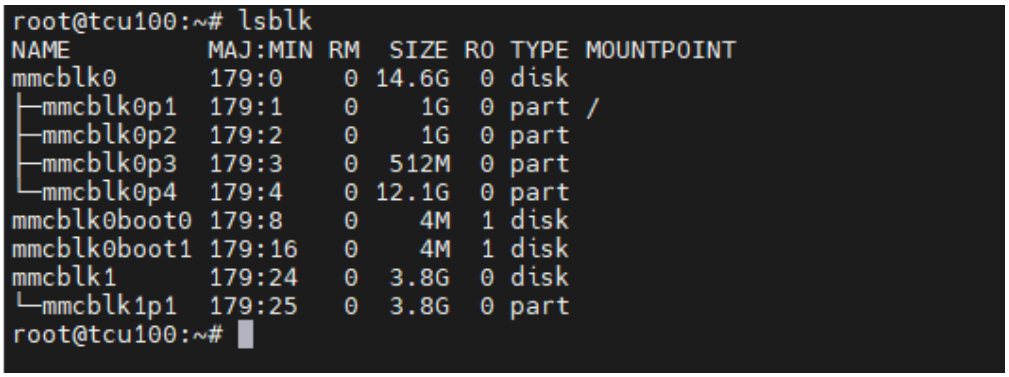


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5.8.1 USB/TF Card Mounting

Step 1 First, when the TF card is not inserted or the U disk is inserted through the USB interface, input lsblk, and then insert the TF card or U disk, and input lsblk again. Through two comparisons, it can be seen from the figure that the new device is mmcblk1.





Step 2 Create a new directory and enter the command "mkdir - p~/disk".

Step 3 Mount the directory and enter the command "sudo mount/dev/mmcblk1~/disk".

Step 4 Create a new file in the~/disk directory and enter the command "echo 8888>~/disk/filename".

Step 5 Copy the file and enter the command "sudo cp~/disk/filename~/".

Step 6 View the file and enter the command "cat~/filename". If only 8888 is displayed, it indicates that the USB/TF card is working properly. Otherwise, it is abnormal.

Key

The command dmesg | tail can be used to view the driver loading status of a newly inserted device into the system.

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5.8.2 Use TF Card to Burn System Firmware

Step 1 Insert the TF card for burning into the TF card slot;

Step 2 After powering on, it will automatically enter the flashing state after about 15 seconds (the RUN light will remain on and the ARM light will flash once every 1 second);

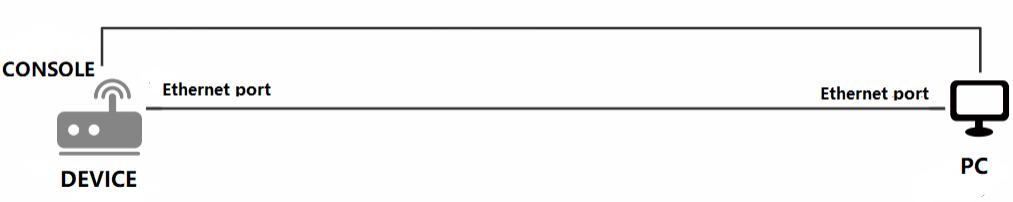
Step 3 "Waiting for flashing status" lasts for about 8 minutes, during which the power should not be cut off, otherwise the burning will fail and a new burning will be required;

Step 4 When the ALM light and RUN light flash rapidly at the same time (flashing 5 times in 1 second), the burning is completed. Power off first, then remove the TF card to power on the device again.

5.9 Ethernet

5.9.1 Port Connection

5.9.1.1 Copper Port Connection

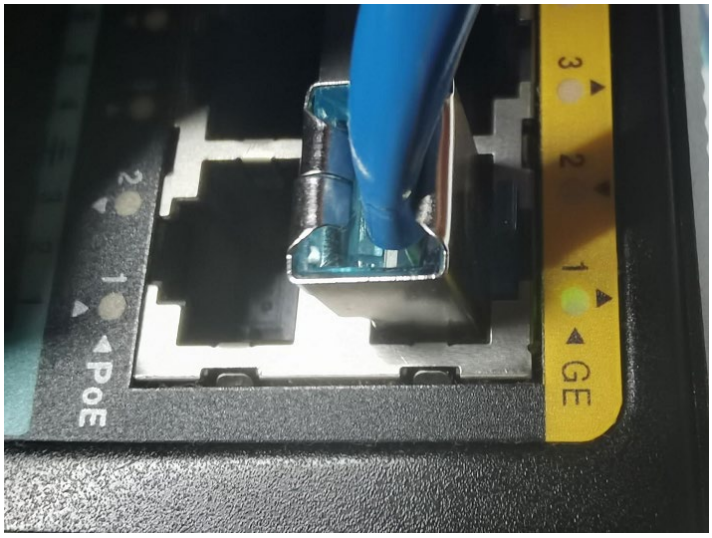


Connect according to the network topology shown in the figure above, and insert the network cable into the corresponding RJ45 network port as shown in the figure below:



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After inserting the network cable into the RJ45 port, the device will automatically negotiate speed, duplex, and other connection capabilities with the opposite network port. After the connection is successfully established, the LED light of the corresponding port will light up. If there is data transmission and reception at this time, the LED will flash. The figure below shows that the LED of the corresponding port will light up when the network port ge1 is successfully connected.



Notice

The Console port of the device is also an RJ45 interface, which should be different from the RJ45 interface of Ethernet and should not be connected incorrectly.

5.9.1.2 Fiber Port Connection



Connect the device to another accompanying optical communication device using fiber optic and SFP optical module as shown in the above figure. The interface of the SFP optical module slot is shown in the following figure:

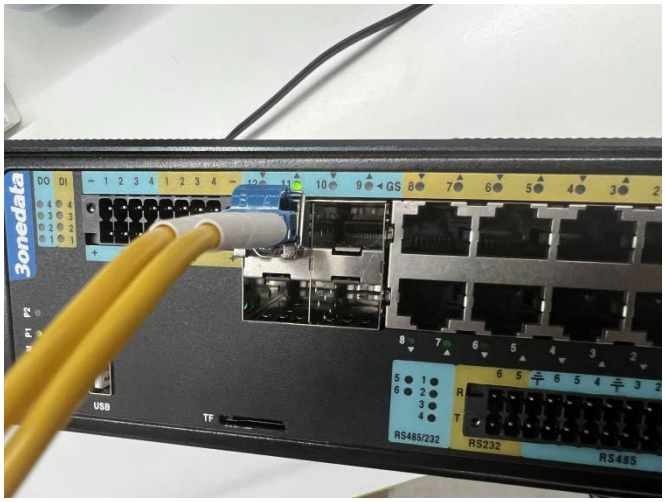
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After inserting the optical port into the device, the console displays corresponding printing information, as shown in the following figure: indicating that the optical module has been correctly recognized by the device.

```
root@tcu1300:~# [  206.009571][  T166]@1 sfp sfp@0: module ALLRAY INC.      ATR-S0202T       rev 1.1  sn 3091021476087
3   dc 191016
[  206.019959][  T166]@1 mv88e6085 stmmac-0:00 gs9: switched to inband/1000base-x link mode
```

Insert the fiber optic cable into the optical module, and after the optical port is connected, the corresponding channel's LED lights up:



As shown in the above figure, the interface LED of gs11 lights up, indicating that the interface gs11 is connected.

After successfully establishing the connection, the Console displays information related to network connection such as rate, duplex, flow control, etc. If there is no connection to the network port, there is no IP configuration option. As the picture below.

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```
tcu100 login: root
Password:
Welcome to Ubuntu 20.04.5 LTS (GNU/Linux 5.4.128 armv7l)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage
Last login: Thu Apr 21 20:55:02 CST 2022 on ttyS0

root@tcu100:~#
root@tcu100:~# [   79.254465] mv88e6085 stmmac-0:00 ge1: Link is Up - 1Gbps/Full - flow control rx/tx
[   79.262148] IPv6: ADDRCONF(NETDEV_CHANGE): ge1: link becomes ready
[   79.268512] lan: port 1(ge1) entered blocking state
[   79.273397] lan: port 1(ge1) entered forwarding state
```

5.9.2 View Interface Status

To view all interface status information, the ifconfig command is typically used as follows:

ifconfig -a

If you want to view a specific network interface, such as checking the interface status of ge1, enter the following command:

ifconfig ge1

Obtain the return result as shown in the following figure:

```
ge1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.2.1  netmask 255.255.255.0  broadcast 192.168.2.255
        inet6 fe80::84d7:7eff:fec3:7003  prefixlen 64  scopeid 0x20<link>
        ether 86:d7:7e:c3:70:03  txqueuelen 1000  (Ethernet)
        RX packets 193  bytes 14184 (14.1 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 37  bytes 5416 (5.4 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

In addition to the ifconfig command, the ip command is also another widely used tool for viewing interface status by entering commands in the terminal:

ip address show

View the status information of all interfaces, as shown in the following figure:

```
15: ge1.10@ge1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
    link/ether 4a:60:48:84:74:fe brd ff:ff:ff:ff:ff:ff
    inet 192.168.2.56/24 brd 192.168.2.255 scope global ge1.10
       valid_lft forever preferred_lft forever
    inet6 fe80::4860:48ff:fe84:74fe/64 scope link
       valid_lft forever preferred_lft forever
16: ge1.20@ge1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
    link/ether 4a:60:48:84:74:fe brd ff:ff:ff:ff:ff:ff
    inet 192.168.3.22/24 brd 192.168.3.255 scope global ge1.20
       valid_lft forever preferred_lft forever
    inet6 fe80::4860:48ff:fe84:74fe/64 scope link
       valid_lft forever preferred_lft forever
root@tcu100:/etc/systemd/network#
```

Command to view routing status information:

ip route show

Command to view DNS server address configuration:

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cat /etc/resolv.conf

Note

The status UP indicates the interface processing enable status, while the status LOWER_UP indicates that the physical layer signal of the interface has been connected normally; On the contrary, the state NO-CARRIER indicates that the physical layer signal of the interface is in a disconnected state.

5.9.3 Interface Configuration

The TCU series intelligent gateway adopts the system networked suite to manage Ethernet interfaces, and all its configuration files are located in the /etc/systemd/network directory. By checking the configuration files in this directory, it can be found that each physical interface has a corresponding interface configuration file, as shown in the following figure:

```
40-ge1.network
41-ge2.network
```

5.9.3.1 DHCP Dynamically Obtains IP

Taking the Ethernet interface ge1 as an example: Use the vim editor to edit the configuration file "40-ge1. network" of the ge1 interface, configure the DHCP field to "DHCP=yes" to enable the DHCP client, or configure the field to "DHCP=ipv6" to explicitly enable the DHCP IPv6 client. After modification, it is shown in the following figure:

```
[Match]
Name=ge1

[Network]
DHCP=yes
~
~
~
~
```

If you need to configure DHCP to only use the IPv4 protocol to obtain an IP address, you can modify the DHCP configuration to "DHCP=ipv4" as shown in the following figure:

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```
[Match]
Name=ge1

[Network]
DHCP=ipv4
```

After editing is completed, save the configuration file and exit the editor. Use the method mentioned above to check the interface status to ensure that the ge1 interface has successfully connected to the Ethernet network with DHCP service enabled. When the interface status is LOWER_UP, enter the command to restart the network service:

sudo systemctl restart systemd-networkd

Wait for the DHCP server to assign an IP address to the interface, during which you can use the ip command to continuously check the status of the interface and check if the IP address has been successfully obtained.

```
10: ge1@swap: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
    link/ether 26:ca:45:b6:01:5c brd ff:ff:ff:ff:ff:ff
    inet6 fe80::24ca:45ff:feb6:15c/64 scope link
       valid_lft forever preferred_lft forever
```

Note

The "DHCP=yes" setting option will enable both IPv4 and IPv6 clients, and when IPv6 is available, priority will be given to obtaining IPv6 addresses.

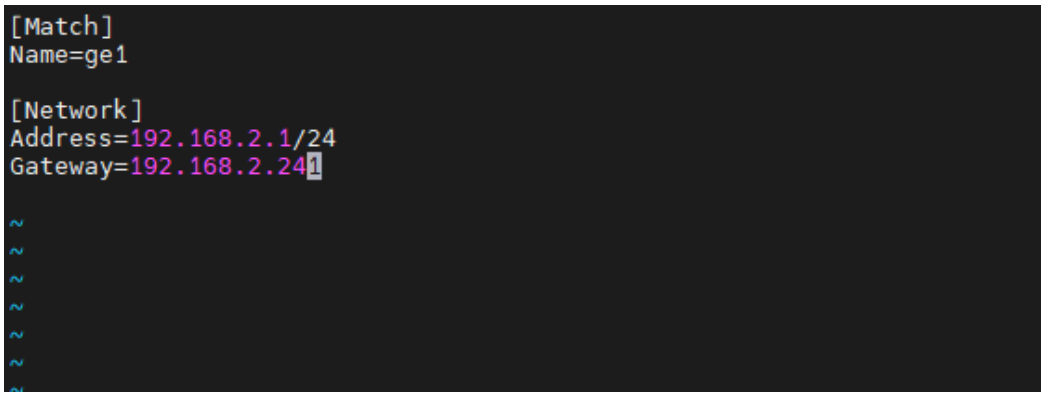
Tips

Regarding the usage of vim, please refer to the link https://www.vim.org/docs.php.

5.9.3.2 Static Single IP Address

To set a static IP address, simply fill in the required IP address and gateway information in the configuration file according to the syntax, as shown in the following figure:

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After completing the modifications, save and exit. Use the following command to restart the network service:

sudo systemctl restart systemd-networkd

Notice

When the configured network interface status is "NO-CARRIER", that is, when the physical signal of the interface is disconnected, the system-networkd service will not trigger the relevant IP address configuration action. At this time, when the IP address of the interface is viewed, the IP address will not be immediately configured. Only when the interface status switches to LOWER_UP, that is, when the physical signal of the interface has established a connection, will the systemd-networked service trigger the IP address configuration operation process.

Tips

For more syntax and usage instructions on systemd-networked services, please refer to https://systemd.network/systemd.network.html.

5.9.3.3 Static Multiple IP Addresses

If multiple IP addresses need to be configured in a single network interface, simply add the list of IP addresses that you want to configure to the corresponding configuration file. For example, in the following figure, three different network segments are configured with IP addresses: 192.168.1.23/24192.168.2.23/24192.168.3.23/24. At the same time, a gateway and two different DNS servers are also configured.

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```
[Match]
Name=ge1

[Network]
Address=192.168.1.23/24
Address=192.168.2.23/24
Address=192.168.3.23/24
Gateway=192.168.1.8
DNS=114.114.114.114
DNS=202.96.134.133
```

After completing the modifications, save and exit. Use the following command to restart the network service:

sudo systemctl restart systemd-networkd

After the service restarts, you can use the ip address show command to view the configuration status of the IP address:

```
ge1@swap: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
link/ether a6:79:80:42:60:f0 brd ff:ff:ff:ff:ff:ff
inet 192.168.1.23/24 brd 192.168.1.255 scope global ge1
   valid_lft forever preferred_lft forever
inet 192.168.2.23/24 brd 192.168.2.255 scope global ge1
   valid_lft forever preferred_lft forever
inet 192.168.3.23/24 brd 192.168.3.255 scope global ge1
   valid_lft forever preferred_lft forever
inet6 fe80::a479:80ff:fe42:60f0/64 scope link
   valid_lft forever preferred_lft forever
```

You can also use the ip route show command to view the routing status, and use the cat/etc/resolve. conf command to view the configuration results of the DNS server:

```
root@tcu2000-v5:~# ip route show
default via 192.168.1.8 dev ge1 proto static
192.168.1.0/24 dev ge1 proto kernel scope link src 192.168.1.23
192.168.2.0/24 dev ge1 proto kernel scope link src 192.168.2.23
192.168.3.0/24 dev ge1 proto kernel scope link src 192.168.3.23
root@tcu2000-v5:~# cat /etc/resolv.conf
# This file is managed by man:systemd-resolved(8). Do not edit.
#
# This is a dynamic resolv.conf file for connecting local clients directly to
# all known uplink DNS servers. This file lists all configured search domains.
#
# Third party programs must not access this file directly, but only through the
# symlink at /etc/resolv.conf. To manage man:resolv.conf(5) in a different way,
# replace this symlink by a static file or a different symlink.
#
# See man:systemd-resolved.service(8) for details about the supported modes of
# operation for /etc/resolv.conf.

nameserver 223.5.5.5
nameserver 114.114.114.114
nameserver 202.96.134.133
```

Notice

If the configured network interface has added a bridge before configuration, but no bridge has been added in the new configuration, a manual command needs to be issued to remove the

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configured network interface from the original bridge, such as: brctl delif wan ge1. Or restart the device to apply the latest network configuration.

5.9.4 Manually Modify Configuration

If the user wants the device to temporarily use another IP address, the following command can be used:

ifconfig [InterfaceName] [IP]

For example:

ifconfig ge1 192.168.1.2

The IP address of the device ge1 interface will be temporarily changed to 192.168.1.2

Notice

The manually modified IP address will only take effect temporarily during the current startup and will be restored to the system configuration after system or service restart.

5.9.5 Manually Modify the DNS Server

5.9.5.1 Dynamic Change

If the user wants to use a different DNS address (such as 8.8.8.8), the command is as follows:

vim /etc/resolv.conf

Change nameserver 114.114.114.114 to nameserver 8.8.8.8

Notice

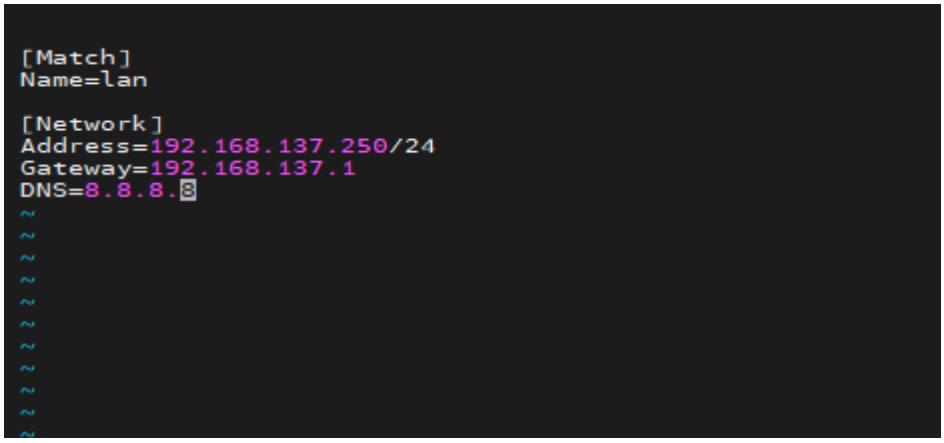
The DNS server address manually modified by this method only takes effect temporarily during the current startup and will be restored to the system configuration after system or service restart.

5.9.5.1 Static Change

Find the configuration file for the final exit interface that needs to be configured in the /etc/systemd/network directory (for example, if the exit IP is in the bridge, add it to the configuration file of the bridge)

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Configure static addresses and their corresponding gateways. Then add a configuration node value such as "DNS=8.8.8.8" under the [Network] field, as shown in the following figure:



After saving the modifications, execute the systemctl restart systemd-networkd command to restart the service.

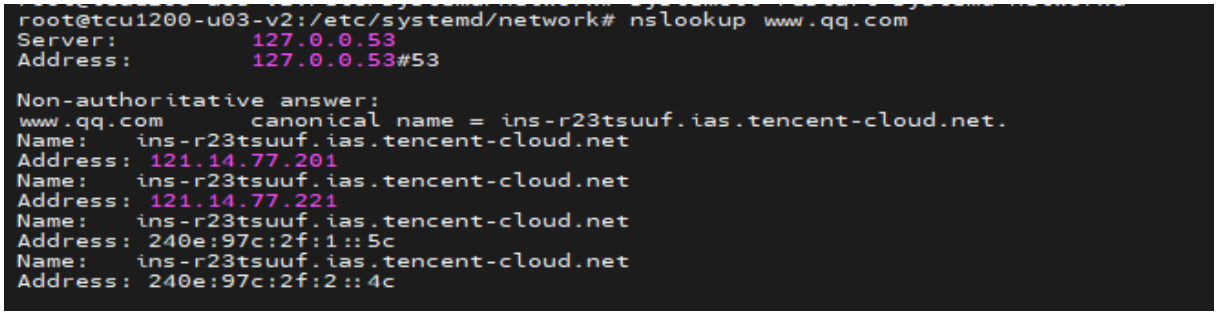
Run the following command to view the contents of the configuration file:

cat /run/systemd/resolve/resolv.conf

It can be seen that the configured DNS server address has taken effect. To verify the DNS resolution, enter command

nslookup www.qq.com

to check whether the DNS resolution is normal



5.9.6 Bridge Configuration

Create a virtual bridge interface device file named “10-bridge-br1.netdev” in the /etc/systemd/network directory.

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```
[NetDev]
Name=br1
Kind=bridge
~
~
~
~
~
~
~
~
```

Then edit the bridge interface device file, add the IP address and gateway information of the bridge interface.

```
[Match]
Name=br1
[Network]
Address=192.168.5.211/24
Gateway=192.168.5.1
~
~
~
~
~
~
~
~
```

Then configure the slave device interfaces that need to be added to the bridge one by one.

```
[Match]
Name=ge1

[Network]
Bridge=br1
~
~
~
```

After all the Bridges and slave device interfaces are configured, run the following command to restart the systemd-networkd service.

systemctl restart systemd-networkd

Use the following command to view the device dependency relationships of all bridges in the system:

brctl show

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```
root@tcu100:/etc/systemd/network# brctl show
bridge name     bridge id               STP enabled     interfaces
br1             8000.86d77ec37003       no              ge1
lan             8000.000000000000       no
wan             8000.000000000000       no
```

The above figure shows that there are three network bridges in the system: br1, lan, and wan. Among them, br1 has a slave interface ge1, and the other two network bridges have not yet added slave interfaces.

5.9.7 VLAN Configuration

5.7.7.1 Configure Multiple VLANs on the Same Network Port

5.7.7.1.1 Create VLAN Interfaces

Use the command "modinfo 8021q" to check if the 8021q function is enabled in the system (kernel builtin or module can be added):

```
name:           8021q
filename:       (builtin)
version:        1.8
license:        GPL
alias:          rtnl-link-vlan
```

Create virtual interface device files named "20-vlan ge1.10. netdev" and "50-vlan ge1.20. netdev" in the /etc/systemd/network directory (vlan is the type name, ge1 is the interface name, and 10 is the VLAN ID), configure the type as VLAN and set its VLAN IDs to 10 and 20 respectively, as shown in the following figure:

```
[NetDev]
Name=ge1.10
Kind=vlan

[VLAN]
Id=10
~
~
~
~
```


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```
[NetDev]
Name=ge1.20
Kind=vlan

[VLAN]
Id=20
~
~
```

Note

Multiple VLANs can be set on the same interface, and this time two VLANs will be set.

5.7.7.1.2 VLAN Interface Address Configuration

Creating a VLAN device interface Enter “vim 21-vlan-ge1.10.network” to create the “21-vlan-ge1.10.network” file. Enter "vim 51-vlan-ge1.10.network" to create a "51-vlan-ge1.20.network" file, and set the address and gateway. (The file name can be customized) is shown in the following figure:

```
[Match]
Name=ge1.10

[Network]
Address=192.168.2.56/24
~
~
~
~
~
~
```

```
[Match]
Name=ge1.20

[Network]
Address=192.168.3.22/24
~
~
~
~
~
```

Add a physical interface Enter “vim 40-ge1.network” to modify the “40-ge1.network” interface file. As the picture below.

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```
[Match]
Name=ge1

[Network]
VLAN=ge1.10
VLAN=ge1.20
~
~
~
~
```

Enter "systemctl restart systemd-networked" to update the network configuration, and enter "networkctl list" to list all device interfaces of the system.

```
root@tcu100:/etc/systemd/network# networkctl list
IDX LINK     TYPE      OPERATIONAL SETUP
  1 lo       loopback  carrier     unmanaged
  2 tunl0    tunnel    off         unmanaged
  3 gre0     ipgre     off         unmanaged
  4 gretap0  ether     off         unmanaged
  5 erspan0  ether     off         unmanaged
  6 sit0     sit       off         unmanaged
  7 ip6tnl0  tunnel6   off         unmanaged
  8 ip6gre0  ip6gre    off         unmanaged
  9 swap     ether     degraded    unmanaged
 10 ge1      dsa       carrier     configuring
 11 ge2      dsa       no-carrier  configuring
 12 wan      bridge    degraded    configuring
 13 lan      bridge    routable    configured
 14 br1      bridge    routable    configured
 15 ge1.10   vlan      routable    configured
 16 ge1.20   vlan      routable    configured

16 links listed.
root@tcu100:/etc/systemd/network#
```

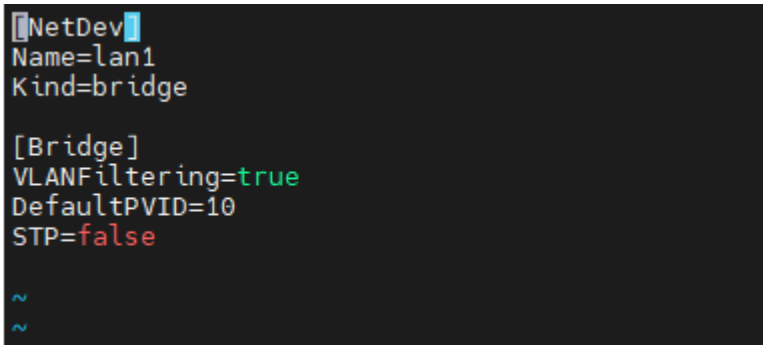
The presence of device interfaces ge1.10 and ge1.20 indicates successful addition of VLAN; The device interface status of "routable" and "configured" indicates successful configuration.

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5.9.7.1 Configure the Same VLAN for Different Network Ports

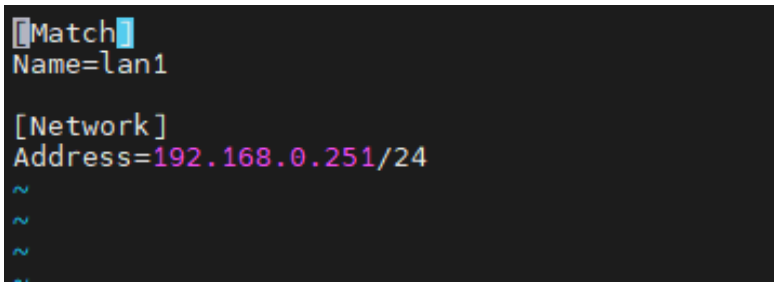
5.7.7.2.1 Create a Bridge Interface with VLAN Forwarding Function

Create a virtual interface device file named "20-lan1. netdev" in the /etc/systemd/network directory. configure the type to bridge and set its VLANFiltering and Default PVID to 10, as shown in the following figure:

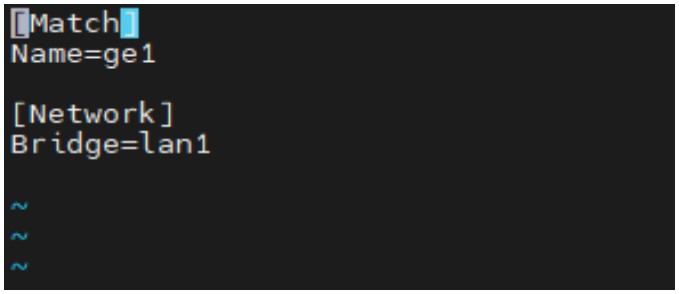


5.7.7.2.2 Bridge Interface Address Configuration with VLAN Function

Create a configuration file for the new bridge device interface by entering "vim 31-lan1. network". Match device and set address. As the picture below.



Add a physical interface Enter “vim 40-ge1.network” to modify the “40-ge1.network” interface file. As the picture below.



Multiple interfaces can be added to the bridge.

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5.9.8 Packet-Capture Statistics

5.9.8.1 Network Port Packet Capture

Use tcpdump to capture packets on the specified interface on the device, and enter "tcpdump - i [interface number]" in the command console to monitor the packets flowing through the specified network card. (Directly input "tcpdump" to monitor the packets flowing through the first network card by default) as shown in the following figure:

```
root@tcu100:~# tcpdump
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on swap, link-type EN10MB (Ethernet), capture size 262144 bytes
22:08:47.673560 MEDSA 0.3:1: IP 192.168.2.1.netbios-dgm > 192.168.2.255.netbios-
dgm: UDP, length 201
22:08:50.641424 MEDSA 0.3:1: IP 192.168.2.1.netbios-dgm > 192.168.2.255.netbios-
dgm: UDP, length 201
22:08:52.076829 MEDSA 0.3:1: IP 192.168.2.1.netbios-dgm > 192.168.2.255.netbios-
dgm: UDP, length 201
```

5.9.8.2 Packet Statistics

Enter “cat /proc/net/dev” to view the data receiving and sending packet statistics of each network card. As the picture below.

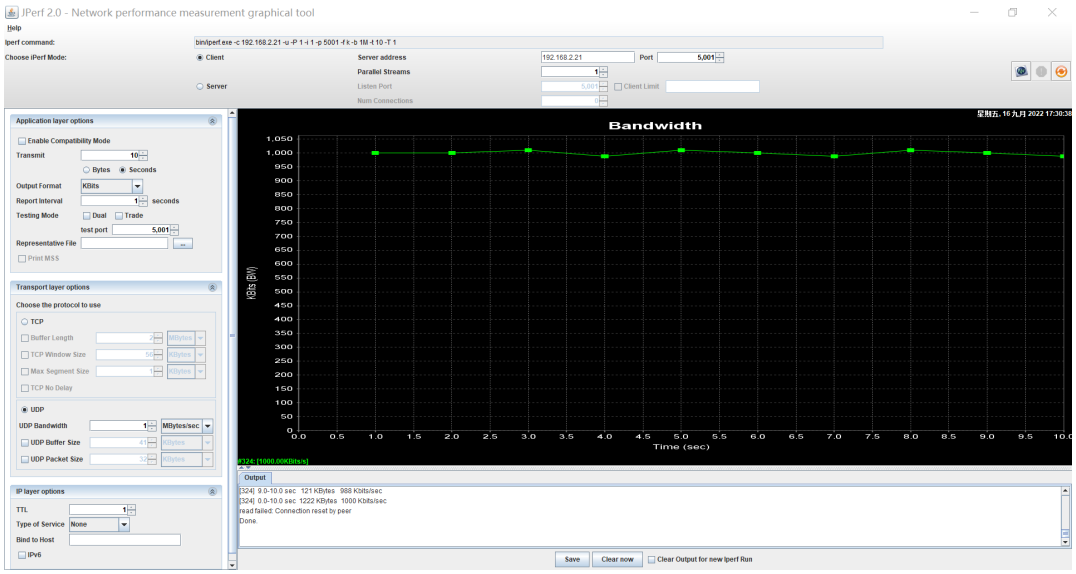
```
root@tcu100:~# cat /proc/net/dev
Inter-|   Receive                                                |  Transmit
 face |bytes    packets errs drop fifo frame compressed multicast|bytes    packets errs drop fifo colls carrier compressed
    lo: 1155080   15608    0    0    0     0          0         0  1155080   15608    0    0    0     0       0          0
   br1:  108606     797    0    0    0     0          0       564     9306     111    0    0    0     0       0          0
  sit0:       0       0    0    0    0     0          0         0        0       0    0    0    0     0       0          0
ip6tnl0:       0       0    0    0    0     0          0         0        0       0    0    0    0     0       0          0
  gre0:       0       0    0    0    0     0          0         0        0       0    0    0    0     0       0          0
 tunl0:       0       0    0    0    0     0          0         0        0       0    0    0    0     0       0          0
   wan:       0       0    0    0    0     0          0         0    53973     240    0    0    0     0       0          0
erspan0:       0       0    0    0    0     0          0         0        0       0    0    0    0     0       0          0
   ge2:    6002      54    0    0    0     0          0         0      656       8    0    0    0     0       0          0
  swap:  154529    1062    0    0    0     0          0         0    20564     144    0    0    0     0       0          0
ip6gre0:       0       0    0    0    0     0          0         0        0       0    0    0    0     0       0          0
   lan:       0       0    0    0    0     0          0         0     8626     103    0    0    0     0       0          0
gretap0:       0       0    0    0    0     0          0         0        0       0    0    0    0     0       0          0
   ge1:  125163    1008    0    0    0     0          0         0    17668     120    0    0    0     0       0          0
```

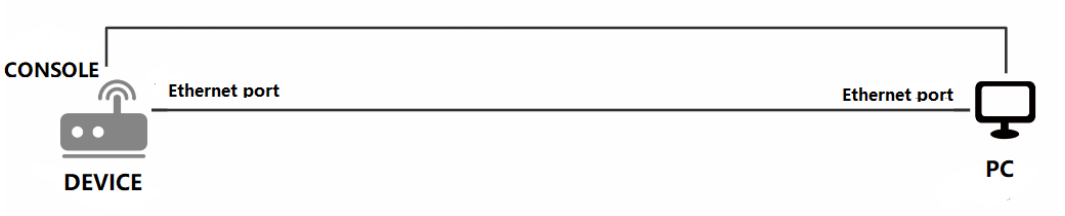
The packet statistics of the switch interface can be viewed to view the mib counter of the hardware. Taking the ge1 interface as an example, its command is:

5.9.9 Throughput Test

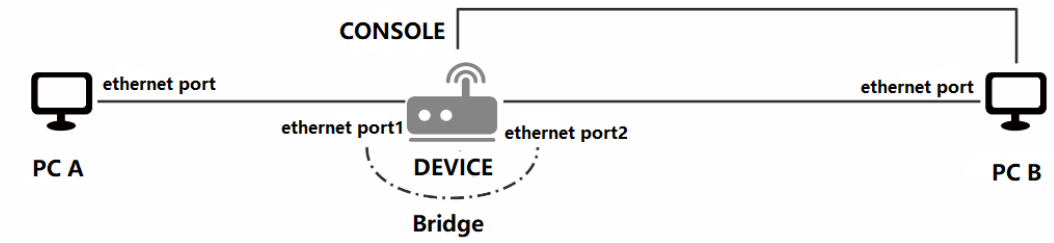
Open the jperf-2.0 software on the PC, select "Client", set PC A as the host, enter the slave device interface address in "Server address", select "UDP" mode, and the rest are default options. As the picture below.

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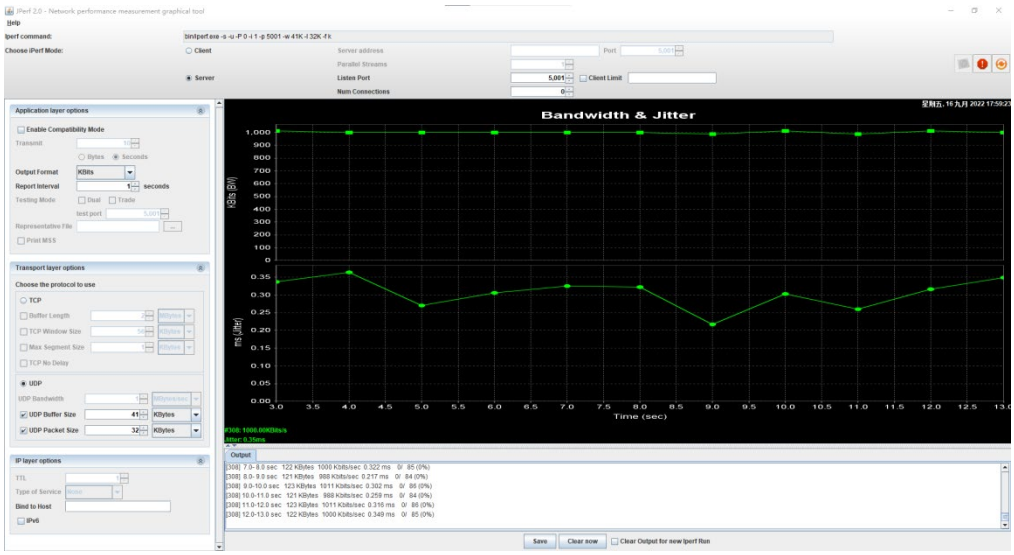




Test the forwarding speed, bridge the two network ports of the device, connect the two PCs to the network ports, and set the IP addresses of the PCs to the same network segment, such as PC1: "192.168.2.1" and PC2: "192.168.2.2" (disable firewall). Set them in the jperf software as described above. The test results are shown in the following figure:

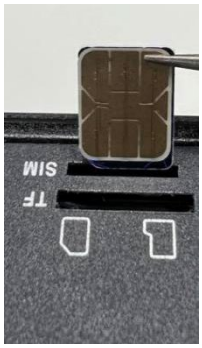


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5.10 4G/5G Network

5.10.1 SIM Card Dial-Up Internet Access

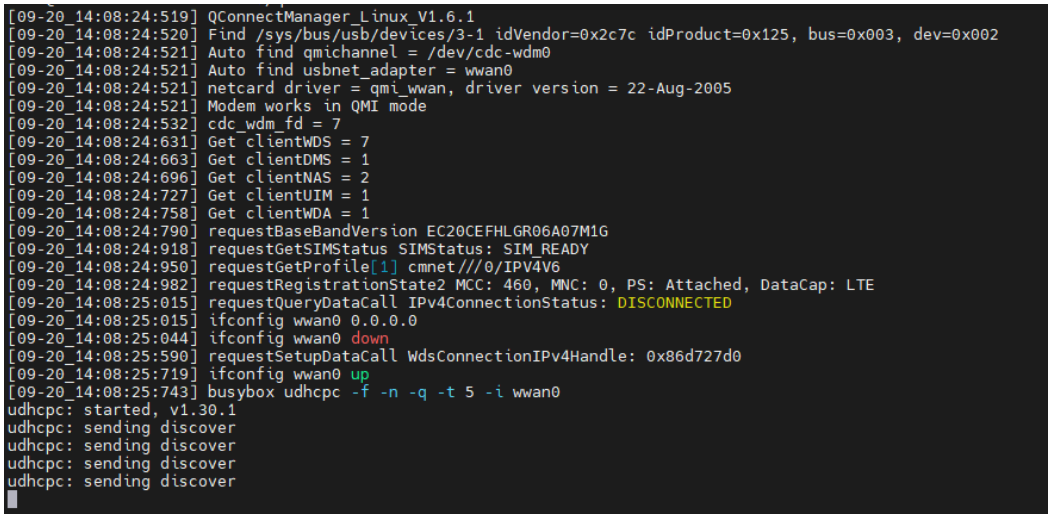


Turn off the power first, as shown in the above picture, insert the SIM card, and check if the 4G/5G antenna is installed properly and in the normal signal area (check the phone signal strength). After powering on and logging into the system, enter "lsusb" to check for 4G/5G Internet module functionality (print the message "Quectel Wireless Solutions..." to indicate 4G/5G Internet module functionality), as shown in the following figure:

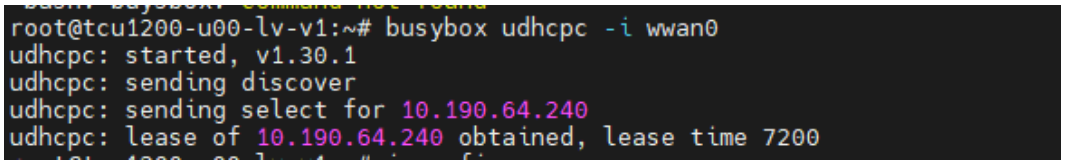
```
root@tcu1200-u00-lv-v1:~# lsusb
Bus 006 Device 001: ID 1d6b:0001 Linux Foundation 1.1 root hub
Bus 003 Device 002: ID 2c7c:0125 Quectel Wireless Solutions Co., Ltd. EC25 LTE modem
Bus 003 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 005 Device 001: ID 1d6b:0001 Linux Foundation 1.1 root hub
Bus 002 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 004 Device 001: ID 1d6b:0001 Linux Foundation 1.1 root hub
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 007 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
root@tcu1200-u00-lv-v1:~#
```


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Enter "quectel-CM&" (print message "requestGetSIMStatus SIMStatus: SIM_READY" indicates that the SIM card has been detected. "requestQueryDataCall IPv4 ConnectionStatus: DISCONNECTED" indicates that the SIM card IP address has not been assigned). The running results are shown in the following figure:



Normally, the quectel-CM process will automatically call the dhcp client program to obtain the IP address for the wwan0 interface, or it can manually run "busybox udhcpc -i wwan0" to obtain the IP address after ending the udhcpc or dhclient process. (The network interface "wwan0" corresponds to the print message "wwan0" in the above figure, which may vary depending on the device)



After disconnecting the wired network or WiFi connection, try to test whether it is connected to the network. Enter "ping -c 10 114.114.114.114" and the output result is shown in the following figure:

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```
PING 114.114.114.114 (114.114.114.114) 56(84) bytes of data.
64 bytes from 114.114.114.114: icmp_seq=1 ttl=86 time=29.6 ms
64 bytes from 114.114.114.114: icmp_seq=2 ttl=77 time=29.4 ms
64 bytes from 114.114.114.114: icmp_seq=3 ttl=79 time=30.4 ms
64 bytes from 114.114.114.114: icmp_seq=4 ttl=72 time=29.5 ms
64 bytes from 114.114.114.114: icmp_seq=5 ttl=89 time=30.7 ms
64 bytes from 114.114.114.114: icmp_seq=6 ttl=64 time=29.9 ms
64 bytes from 114.114.114.114: icmp_seq=7 ttl=68 time=61.8 ms
64 bytes from 114.114.114.114: icmp_seq=8 ttl=91 time=68.4 ms
64 bytes from 114.114.114.114: icmp_seq=9 ttl=76 time=31.0 ms
64 bytes from 114.114.114.114: icmp_seq=10 ttl=93 time=37.6 ms

--- 114.114.114.114 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9115ms
rtt min/avg/max/mdev = 29.428/37.824/68.369/13.900 ms
```

indicating that the SIM card dial-up Internet access was successful.

5.10.2 Dual SIM Card Switching Function

Power off first, insert the two SIM cards into the card slot, and check whether the signal is normal. Enter "cat/dev/xt-xim-sel" at the command line to check the current SIM card usage status. There may be a printing sequence issue. If there is no printing, enter the command again, as shown in the following figure. (Default SIM card 1, selection status is 1)

```
root@tcu1200-u03-v2:/# cat /dev/xt-sim-sel
[ 2115.602546] priv→card_sel 1
root@tcu1200-u03-v2:/#
```

Enter "echo 0 > /dev/xt-sim-sel" on the command line to set the SIM selection status to 0. (If the original state is 0, enter "echo 1 > /dev/xt-sim-sel")

Then enter "echo 2 > /dev/wwan-rst" on the command line to restart the SIM card, wait for all the contents shown in the following figure to appear, and complete the dual SIM card switching operation. Repeat the dial-up Internet access steps in 5.10.1.

```
[ 2185.962628] priv→card_sel 0
[ 2405.348426] misc wwan-rst: try to active
[ 2405.355230] misc wwan-rst: now delay for 500000 usec
[ 2405.477662] usb 3-1: USB disconnect, device number 3
[ 2405.483685] qmi_wwan_q 3-1:1.4 wwan0: unregister 'qmi_wwan_q' usb-1c1c000.usb-1, WWAN/QMI device
[ 2405.868101] misc wwan-rst: try to deactive
[ 2405.872211] misc wwan-rst: now delay for 30000 usec
root@tcu1200-u03-v2:/# [ 2415.828098] usb 3-1: new high-speed USB device number 4 using ehci-platform
[ 2416.041857] qmi_wwan_q 3-1:1.4: cdc-wdm0: USB WDM device
[ 2416.048361] qmi_wwan_q 3-1:1.4: Quectel Android work on RawIP mode
[ 2416.054729] qmi_wwan_q 3-1:1.4: rx_urb_size = 1520
[ 2416.060372] qmi_wwan_q 3-1:1.4 wwan0: register 'qmi_wwan_q' at usb-1c1c000.usb-1, WWAN/QMI device, 96:6a:da:87:1a:a8
```


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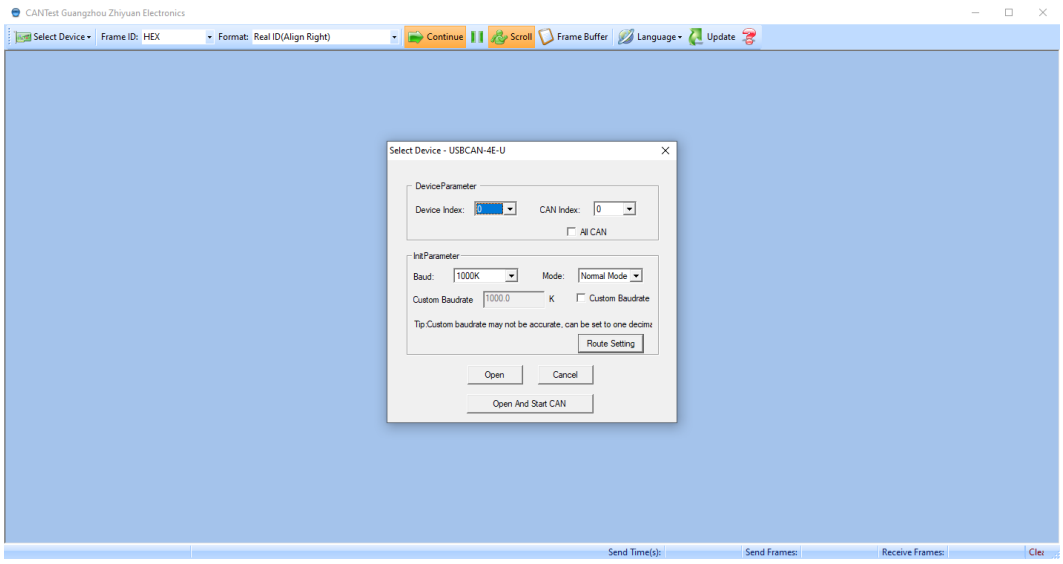
5.11 CAN Interface

5.11.1 CAN Interface Physical Connection

Connect the CAN port of the device to the USB-CAN converter on the PC end.

5.11.2 PC Test Software Preparation

The USB-CAN converter on the PC side needs to first install the driver program, then open the CANTest test tool after the CAN is connected, select the CAN converter model connected to the device, set the CAN interface, set the baud rate to 75K, then "confirm and start CAN", and wait for CAN data.



5.11.3 Device Test Software Preparation

The CAN function test on the device side requires the use of the can-utils package, opening Terminal, logging in to the device, and using the command line:

sudo apt update

Update the software package database, then

sudo apt-get install can-utils

Wait for the download to complete and complete the installation. Afterwards, use the “ifconfig -a” command to view the CAN interface. Assuming that the CAN interface is can0, the command given is:

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ip link set can0 type can bitrate 75000

Set the baud rate to 75000. Next, open the corresponding CAN interface through “ifconfig can0 up”.

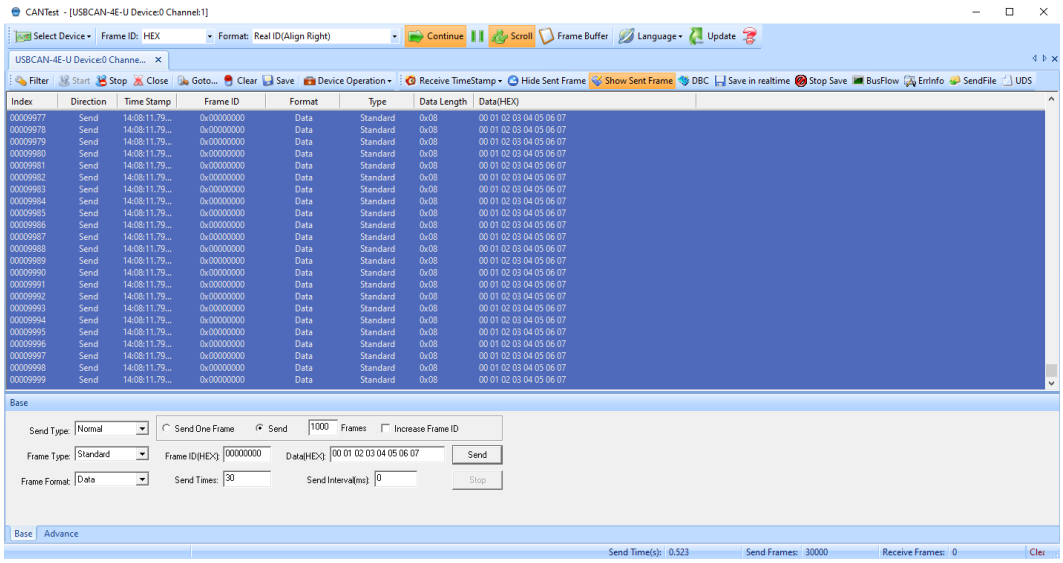
5.11.4 CAN Transceiver Test

As shown in the figure below, CAN data is sent using cangen or cansend on the device.

```
root@tcu1200-u02-lv-v2:~# ifconfig can0 down
root@tcu1200-u02-lv-v2:~# ip link set can0 type can bitrate 75000
root@tcu1200-u02-lv-v2:~# ifconfig can0 up
```

```
root@tcu1200-u02-lv-v2:~# cangen can0 -g 5 -I 42A -L 1 -D i -x -n 10
root@tcu1200-u02-lv-v2:~#
```

At this point, the CANTest software on the PC receives CAN data sent by the device.



Next, use the candump command to wait for the CAN data to be received, and send the data on cantest. The received data is as follows.

```
root@tcu1200-u02-lv-v2:~# candump can0 -T 10000
  can0  000   [8]  00 01 02 03 04 05 06 07
  can0  000   [8]  00 01 02 03 04 05 06 07
  can0  000   [8]  00 01 02 03 04 05 06 07
  can0  000   [8]  00 01 02 03 04 05 06 07
  can0  000   [8]  00 01 02 03 04 05 06 07
  can0  000   [8]  00 01 02 03 04 05 06 07
  can0  000   [8]  00 01 02 03 04 05 06 07
  can0  000   [8]  00 01 02 03 04 05 06 07
  can0  000   [8]  00 01 02 03 04 05 06 07
  can0  000   [8]  00 01 02 03 04 05 06 07
```

5.12 WiFi

5.12.1 WiFi Connection Configuration Component

The TCU series intelligent gateway uses hostapd and wpa_supplicant suite to manage WiFi interfaces and corresponding functions. Therefore, it is necessary to configure the device to be able to access the external network according to the configuration method of Ethernet in the previous section. Afterwards, connect the normal network cable to one of the Ethernet ports on the device (such as ge8), and run the following command to install the required components:

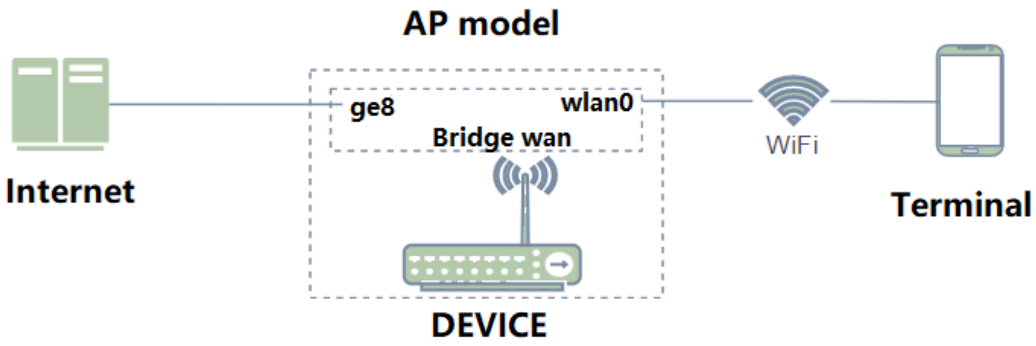
sudo apt install hostapd wireless-tools wpasupplicant

5.12.2 WiFi AP Mode

5.12.2.1 AP Mode Network Topology

Firstly, we plan the following network topology connection:

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5.12.2.2 Configure hostapd

After installing the WiFi related components, edit the configuration file of hostapd:

vim /etc/hostapd/hostapd.conf

Modify the content of fields such as interface, ssid, bridge, hw_mode, channel, wpa_psk, etc. according to actual needs, as shown in the following figure

```
##### hostapd configuration file ##############################################
# Empty lines and lines starting with # are ignored

# AP netdevice name (without 'ap' postfix, i.e., wlan0 uses wlan0ap for
# management frames with the Host AP driver); wlan0 with many nl80211 drivers
# Note: This attribute can be overridden by the values supplied with the '-i'
# command line parameter.
interface=wlan0

# In case of atheros and nl80211 driver interfaces, an additional
# configuration parameter, bridge, may be used to notify hostapd if the
# interface is included in a bridge. This parameter is not used with Host AP
# driver. If the bridge parameter is not set, the drivers will automatically
# figure out the bridge interface (assuming sysfs is enabled and mounted to
# /sys) and this parameter may not be needed.
#
# For nl80211, this parameter can be used to request the AP interface to be
# added to the bridge automatically (brctl may refuse to do this before hostapd
# has been started to change the interface mode). If needed, the bridge
# interface is also created.
bridge=wan

# Driver interface type (hostap/wired/none/nl80211/bsd);
                                                              1,10          Top
```

Tips

For details about how to configure hostapd, see https://w1.fi/hostapd/.

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```
# g = IEEE 802.11g (2.4 GHz), ad = IEEE 802.11ad (60 GHz); a/g options are used
# with IEEE 802.11n (HT), too, to specify band). For IEEE 802.11ac (VHT), this
# needs to be set to hw_mode=a. When using ACS (see channel parameter), a
# special value "any" can be used to indicate that any support band can be used.
# This special case is currently supported only with drivers with which
# offloaded ACS is used.
# Default: IEEE 802.11b
hw_mode=g

# Channel number (IEEE 802.11)
# (default: 0, i.e., not set)
# Please note that some drivers do not use this value from hostapd and the
# channel will need to be configured separately with iwconfig.
#
# If CONFIG_ACS build option is enabled, the channel can be selected
# automatically at run time by setting channel=acs_survey or channel=0, both of
# which will enable the ACS survey based algorithm.
channel=1

# ACS tuning - Automatic Channel Selection
# See: http://wireless.kernel.org/en/users/Documentation/acs
#
# You can customize the ACS survey algorithm with following variables:
                                                              155,1         5%
```

Note

The wpa_psk field is stored in an encrypted string. The encrypted string is generated by the wpa_passphrase tool after the plaintext ssid and password are encrypted.

```
# wpa_key_mgmt=SAE for WPA3-Personal instead of wpa_key_mgmt=WPA-PSK).
wpa=2

# WPA pre-shared keys for WPA-PSK. This can be either entered as a 256-bit
# secret in hex format (64 hex digits), wpa_psk, or as an ASCII passphrase
# (8..63 characters) that will be converted to PSK. This conversion uses SSID
# so the PSK changes when ASCII passphrase is used and the SSID is changed.
# wpa_psk (dot11RSNAConfigPSKValue)
# wpa_passphrase (dot11RSNAConfigPSKPassPhrase)
#wpa_psk=0123456789abcdef0123456789abcdef0123456789abcdef0123456789abcdef
wpa_psk=2d1de60c63bf85e936ca7d564ec539fdc76cb51eebcfeafc9b51326f1b4afeac
#wpa_passphrase="00000000"

# Optionally, WPA PSKs can be read from a separate text file (containing list
# of (PSK,MAC address) pairs. This allows more than one PSK to be configured.
# Use absolute path name to make sure that the files can be read on SIGHUP
# configuration reloads.
#wpa_psk_file=/etc/hostapd.wpa_psk

# Optionally, WPA passphrase can be received from RADIUS authentication server
# This requires macaddr_acl to be set to 2 (RADIUS)
# 0 = disabled (default)
# 1 = optional; use default passphrase/psk if RADIUS server does not include
                                                             1477,1        54%
```

Tips

If“hostapd.conf' file is not found”, please go to the/usr/share/doc/hostapd/examples path and copy the hostapd.conf file from the example file to the /etc/hostapd/directory.

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5.12.2.3 Configure hostapd Startup Parameters

Use the following command to edit the startup parameters of hostpad:

vim /etc/defult/hostapd

Set field DAEMON_CONF based on the actual configuration file path and add additional startup parameters required by hostapd to DAEMON_OPTS field as required.

```
# Defaults for hostapd initscript
#
# WARNING: The DAEMON_CONF setting has been deprecated and will be removed
#          in future package releases.
#
# See /usr/share/doc/hostapd/README.Debian for information about alternative
# methods of managing hostapd.
#
# Uncomment and set DAEMON_CONF to the absolute path of a hostapd configuration
# file and hostapd will be started during system boot. An example configuration
# file can be found at /usr/share/doc/hostapd/examples/hostapd.conf.gz
#
DAEMON_CONF="/etc/hostapd/hostapd.conf"

# Additional daemon options to be appended to hostapd command:-
#       -d   show more debug messages (-dd for even more)
#       -K   include key data in debug messages
#       -t   include timestamps in some debug messages
#
# Note that -B (daemon mode) and -P (pidfile) options are automatically
# configured by the init.d script and must not be added to DAEMON_OPTS.
#
DAEMON_OPTS=""
"/etc/default/hostapd" 23L, 909C                              23,1          All
```

After editing, save and exit vim, then use the following command to start the hostapd service.

systemctl unmask hostapd

systemctl restart hostapd

```
root@tcu5000:~# systemctl unmask hostapd
Removed /etc/systemd/system/hostapd.service.
root@tcu5000:~# systemctl restart hostapd
[ 6537.432136][ T1029]@2 wan: port 2(wlan0) entered blocking state
[ 6537.438097][ T1029]@2 wan: port 2(wlan0) entered disabled state
[ 6537.444255][ T1029]@2 device wlan0 entered promiscuous mode
[ 6537.549958][ T1030]@2 IPv6: ADDRCONF(NETDEV_CHANGE): wlan0: link becomes ready
[ 6537.557310][ T1030]@2 wan: port 2(wlan0) entered blocking state
[ 6537.563255][ T1030]@2 wan: port 2(wlan0) entered forwarding state
root@tcu5000:~#
```

After the hostapd service starts normally, the SSID specified in the hostapd.conf file can be discovered through the WiFi terminal:

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Then use the set password to establish an association with the device and test whether the WiFi client is communicating properly.

Enter the command in the command line window:

dpkg -L hostapd

The results are shown in the following figure (ensure that the hostapd tool is installed):

```
:~# dpkg -L hostapd
/.
/etc
/etc/default
/etc/default/hostapd
/etc/hostapd
/etc/hostapd/ifupdown.sh
/etc/init.d
/etc/init.d/hostapd
/etc/network
/etc/network/if-post-down.d
/etc/network/if-pre-up.d
/lib
/lib/systemd
/lib/systemd/system
/lib/systemd/system/hostapd.service
/lib/systemd/system/hostapd@.service
/usr
/usr/sbin
/usr/sbin/hostapd
/usr/sbin/hostapd_cli
/usr/share
/usr/share/doc
/usr/share/doc/hostapd
/usr/share/doc/hostapd/NEWS.Debian.gz
/usr/share/doc/hostapd/README-MULTI-AP.gz
/usr/share/doc/hostapd/README-WPS.gz
/usr/share/doc/hostapd/README.Debian
/usr/share/doc/hostapd/README.gz
/usr/share/doc/hostapd/changelog.Debian.gz
/usr/share/doc/hostapd/copyright
/usr/share/doc/hostapd/examples
/usr/share/doc/hostapd/examples/hostapd.accept
/usr/share/doc/hostapd/examples/hostapd.conf
/usr/share/doc/hostapd/examples/hostapd.deny
/usr/share/doc/hostapd/examples/hostapd.eap_user
/usr/share/doc/hostapd/examples/hostapd.radius_clients
/usr/share/doc/hostapd/examples/hostapd.wpa_psk
/usr/share/lintian
/usr/share/lintian/overrides
/usr/share/lintian/overrides/hostapd
/usr/share/man
/usr/share/man/man1
/usr/share/man/man1/hostapd_cli.1.gz
/usr/share/man/man8
/usr/share/man/man8/hostapd.8.gz
/etc/network/if-post-down.d/hostapd
/etc/network/if-pre-up.d/hostapd
```

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Find the location of the hostapd.conf file and enter the following command to copy it to the /dev/hostapd directory

(The hostapd.conf file path may not be the same for different devices and systems, please modify the path according to the actual situation).

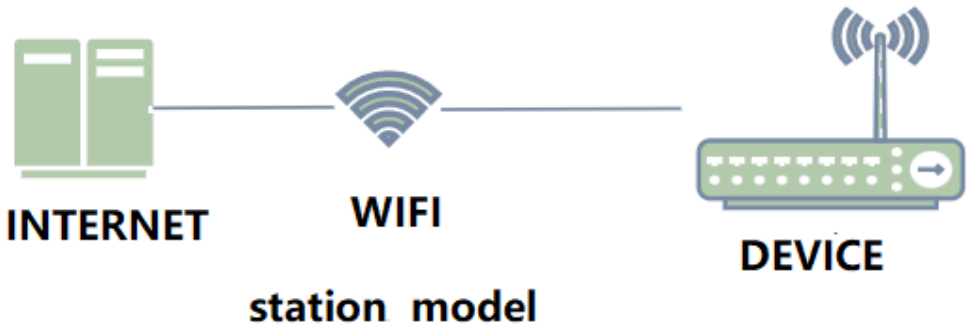
cp /usr/share/doc/hostapd/examples/hostapd.conf /etc/hostapd/

After completion, continue with 5.10.2.2 operation configuration.

5.12.3 WiFi STA Mode

5.12.3.1 STA Mode Network Topology

Firstly, we plan the following network topology connection:



5.12.3.2 Turn off Excess WiFi Services

To avoid multiple WiFi services controlling the WiFi interface simultaneously and avoid conflicts, first shut down the system services that may cause conflicts (commonly known as hostapd and NetworkManager).

sudo systemctl stop hostapd

sudo systemctl disable hostapd

sudo systemctl stop NetworkManager

5.12.3.3 Configure wpa_supplicant

Run the following command to generate the configuration file wpa_supplicant.conf:

wpa_passphrase "WiFitest_5G-1" 11111111 | tee wpa_supplicant.conf

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Among them, "WiFItest_5G-1" is the SSID of the WiFi to be connected, and 11111111 is the password.

```
root@tcu5000:~# wpa_passphrase "WiFitest_5G-1" 11111111 |  tee wpa_supplicant.conf
network={
        ssid="WiFitest_5G-1"
        #psk="11111111"
        psk=2f124529b3622da67974803ac8662e3e894e45341aaac244cc8081f450ee6fd7
}
```

Move the configuration file to the /etc/ directory, and then use the vim command to modify the configuration file:

mv wpa_supplicant.conf /etc/

vim /etc/wpa_supplicant.conf

Add to wpa_supplicant.conf:

ctrl_interface=/var/run/wpa_supplicant

eapol_version=1

ap_scan=1

fast_reauth=1

Finally, the modified effect is shown in the following figure:

```
ctrl_interface=/var/run/wpa_supplicant
eapol_version=1
ap_scan=1
fast_reauth=1


network={
        ssid="WiFitest_5G-1"
        #psk="11111111"
        psk=2f124529b3622da67974803ac8662e3e894e45341aaac244cc8081f450ee6fd7
        scan_ssid=1
}
~
~
~
~
~
~
~
~
~
~
~
"/etc/wpa_supplicant.conf" 13L, 223C                          1,1           All
```

5.12.3.4 Configure wpa_supplicant Startup Parameters

Edit the wpa_supplicant service script, modify the command line parameters of the ExecStart field, and specify the configuration file for wpa_supplicant:

vim /lib/systemd/system/wpa_supplicant.service

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After modification, it is shown in the following figure:

```
[Unit]
Description=WPA supplicant
Before=network.target
After=dbus.service
Wants=network.target
IgnoreOnIsolate=true

[Service]
Type=dbus
BusName=fi.w1.wpa_supplicant1
#ExecStart=/sbin/wpa_supplicant -u -s -O /run/wpa_supplicant
ExecStart=/sbin/wpa_supplicant -u -s -O /run/wpa_supplicant -i wlan0 -c /etc/wpa
_supplicant.conf
[Install]
WantedBy=multi-user.target
Alias=dbus-fi.w1.wpa_supplicant1.service
~
~
~
~
~
~
~
<b/systemd/system/wpa_supplicant.service" 15L, 404C          12,79         All
```

5.12.3.5 Restart wpa_supplicant Service

After enabling the wireless network card, restart the wpa_supplicant service:

ifconfig wlan0 up

systemctl restart wpa_supplicant

Then continuously use the wpa_cli command to query the association status of the current WiFi interface. If it is successfully associated with the AP, the wlan0 interface will switch to the link ready state, as shown in the following figure:

```
[   11.949442][  T363]@3 wlan0: authenticate with 00:03:7f:12:c4:47
[   12.077535][  T363]@3 wlan0: send auth to 00:03:7f:12:c4:47 (try 1/3)
[   12.187278][  T351]@0 wlan0: send auth to 00:03:7f:12:c4:47 (try 2/3)
[   12.196838][  T351]@0 wlan0: authenticated
[   12.203882][  T351]@0 wlan0: associate with 00:03:7f:12:c4:47 (try 1/3)
[   12.218262][  T351]@0 wlan0: RX AssocResp from 00:03:7f:12:c4:47 (capab=0x511 status=0 aid=6)
[   12.240861][  T351]@0 wlan0: associated
[   12.264252][  T363]@3 IPv6: ADDRCONF(NETDEV_CHANGE): wlan0: link becomes ready
[   12.307749][  T351]@1 wlan0: Limiting TX power to 33 (33 - 0) dBm as advertised by 00:03:7f:12:c4:47
```

Finally, configure a static IP address for the wlan0 interface, or use the following command to automatically obtain the IP address:

dhclient wlan0

If the connection is successful, you can refer to the Ethernet chapter for further network connection test of the WiFi interface wlan0.

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5.13 Audio

5.13.1 Hardware Interface Connection

Insert the audio device's 3.5mm standard audio source plug or CTIA standard 3.5mm headphones into the Audio interface.



5.13.2 Installing Audio Components

The TCU series intelligent gateway adopts a universal ALSA architecture to drive audio devices. To achieve this, it is necessary to install ALSA related audio kits. Firstly, configure the device to the networked state according to the Ethernet related chapters, and then install mplayer and alsa-utils components online:

sudo apt install mplayer alsa-utils

Among them, mplayer is used to play audio files, while alsa-utils is used for adjusting volume and channel configurations.

5.13.3 Play Audio

Run the command in the console to play MP3 files:

mplayer filename.mp3

After initializing the audio interface, mplayer delivers the bitstream to the decoder, and finally pushes the headphones or speakers to produce sound.

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5.13.4 Audio Property Adjustment

5.13.4.1 View Audio Component Properties

Enter the following command to view how many interfaces are provided in the driver for operation:

amixer controls

The return result is shown in the following figure:

```
root@tcu:~# amixer controls
numid=22,iface=MIXER,name='Headphone Source Playback Route'
numid=3,iface=MIXER,name='Headphone Playback Switch'
numid=2,iface=MIXER,name='Headphone Playback Volume'
numid=19,iface=MIXER,name='Line In Capture Switch'
numid=14,iface=MIXER,name='Line In Playback Switch'
numid=4,iface=MIXER,name='Line In Playback Volume'
numid=6,iface=MIXER,name='Line Out Playback Switch'
numid=5,iface=MIXER,name='Line Out Playback Volume'
numid=23,iface=MIXER,name='Line Out Source Playback Route'
numid=10,iface=MIXER,name='Mic1 Boost Volume'
numid=20,iface=MIXER,name='Mic1 Capture Switch'
numid=15,iface=MIXER,name='Mic1 Playback Switch'
numid=9,iface=MIXER,name='Mic1 Playback Volume'
numid=8,iface=MIXER,name='Mic2 Boost Volume'
numid=21,iface=MIXER,name='Mic2 Capture Switch'
numid=16,iface=MIXER,name='Mic2 Playback Switch'
numid=7,iface=MIXER,name='Mic2 Playback Volume'
numid=11,iface=MIXER,name='ADC Gain Capture Volume'
numid=12,iface=MIXER,name='DAC Playback Switch'
numid=1,iface=MIXER,name='DAC Playback Volume'
numid=13,iface=MIXER,name='DAC Reversed Playback Switch'
numid=17,iface=MIXER,name='Mixer Capture Switch'
numid=18,iface=MIXER,name='Mixer Reversed Capture Switch'
```

You can also view the current configured values of each interface through the command "amixer contents", as shown in the following figure:

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```
root@tcu:~# amixer contents
numid=22,iface=MIXER,name='Headphone Source Playback Route'
  ; type=ENUMERATED,access=rw------,values=2,items=2
  ; Item #0 'DAC'
  ; Item #1 'Mixer'
  : values=0,0
numid=3,iface=MIXER,name='Headphone Playback Switch'
  ; type=BOOLEAN,access=rw------,values=2
  : values=on,on
numid=2,iface=MIXER,name='Headphone Playback Volume'
  ; type=INTEGER,access=rw---R--,values=1,min=0,max=63,step=0
  : values=43
  | dBscale-min=-63.00dB,step=1.00dB,mute=1
numid=19,iface=MIXER,name='Line In Capture Switch'
  ; type=BOOLEAN,access=rw------,values=2
  : values=off,off
numid=14,iface=MIXER,name='Line In Playback Switch'
  ; type=BOOLEAN,access=rw------,values=2
  : values=off,off
```

The value of "Headphone Playback Volume" is the volume value we need to adjust. View the attribute information of the corresponding configuration through the “amixer get” command:

sudo amixer get ‘Headphone Playback Volume’

```
root@tcu:~# amixer get Headphone Playback Volume
Simple mixer control 'Headphone',0
  Capabilities: pvolume pvolume-joined pswitch
  Playback channels: Front Left - Front Right
  Limits: Playback 0 - 63
  Mono:
  Front Left: Playback 50 [79%] [-13.00dB] [on]
  Front Right: Playback 50 [79%] [-13.00dB] [on]
```

The content added after "amixer get" is the "name" item in the corresponding configuration viewed by the "amixer controls" command.

Tips

In the above example, you can see that the maximum volume is 63 and the current volume is 50.

In addition to the "amixer get" command, the corresponding configuration information can also be viewed through the "amixer cget" command:

sudo amixer cget numid=2,iface=MIXER,name=’Headphone Playback Volume’

The specific operation is shown in the following figure

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```
root@tcu:~# amixer cget numid=2,iface=MIXER,name='Headphone Playback Volume'
numid=2,iface=MIXER,name='Headphone Playback Volume'
  ; type=INTEGER,access=rw---R--,values=1,min=0,max=63,step=0
  : values=43
  | dBscale-min=-63.00dB,step=1.00dB,mute=1
```

The content added after "amixer cget" is the corresponding configuration name ("numid", "iface", and "name") viewed by the "amixer controls" command.

Tips

In the above example, you can see that the maximum volume is 63 and the current volume is 43.

5.13.4.2 Volume Adjustment

Before adjusting the volume, end the application process using audio interfaces such as the player. Afterwards, you can use the "amixer set" command to set the volume in the form of a percentage parameter. The specific operation is shown in the following figure:

sudo amixer set 'Headphone Playback Volume' 50%

```
root@tcu:~# amixer set Headphone Playback Volume 50%
Simple mixer control 'Headphone',0
  Capabilities: pvolume pvolume-joined pswitch
  Playback channels: Front Left - Front Right
  Limits: Playback 0 - 63
  Mono:
  Front Left: Playback 32 [51%] [-31.00dB] [on]
  Front Right: Playback 32 [51%] [-31.00dB] [on]
```

The format is "amixer set"+"name"+"volume percentage", and it can be seen that the volume in the above image has been set to 51%. (Precision causes slight differences between the set value and the actual value). You can also set the volume value directly using numerical value, as shown in the following figure:

sudo amixer set 'Headphone Playback Volume' 30

```
root@tcu:~# amixer set Headphone Playback Volume 30
Simple mixer control 'Headphone',0
  Capabilities: pvolume pvolume-joined pswitch
  Playback channels: Front Left - Front Right
  Limits: Playback 0 - 63
  Mono:
  Front Left: Playback 30 [48%] [-33.00dB] [on]
  Front Right: Playback 30 [48%] [-33.00dB] [on]
```

The format is "amixer set"+"name"+"volume value".

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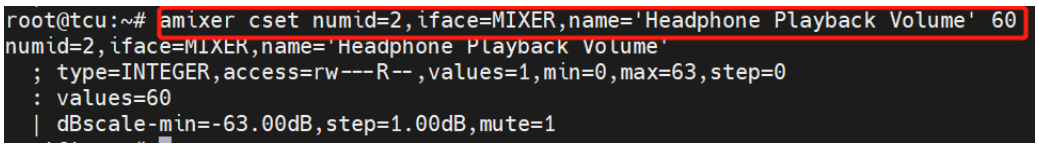
Tips

The volume cannot exceed the range between the minimum and maximum values. In the example above, it can be seen that the volume has been set to 30.

In addition to the "amixer set" command, the volume can also be set using the "amixer cset" command:

sudo amixer cset numid=2,iface=MIXER,name='Headphone Playback Volue' 60

The specific operation is shown in the following figure:



The format is "amixer cset"+"configuration"+"volume size", and it can be seen that the volume in the above image has been set to 60.

5.14 HDMI

The HDMI interface of the intelligent gateway is shown by the red arrow in the following figure:

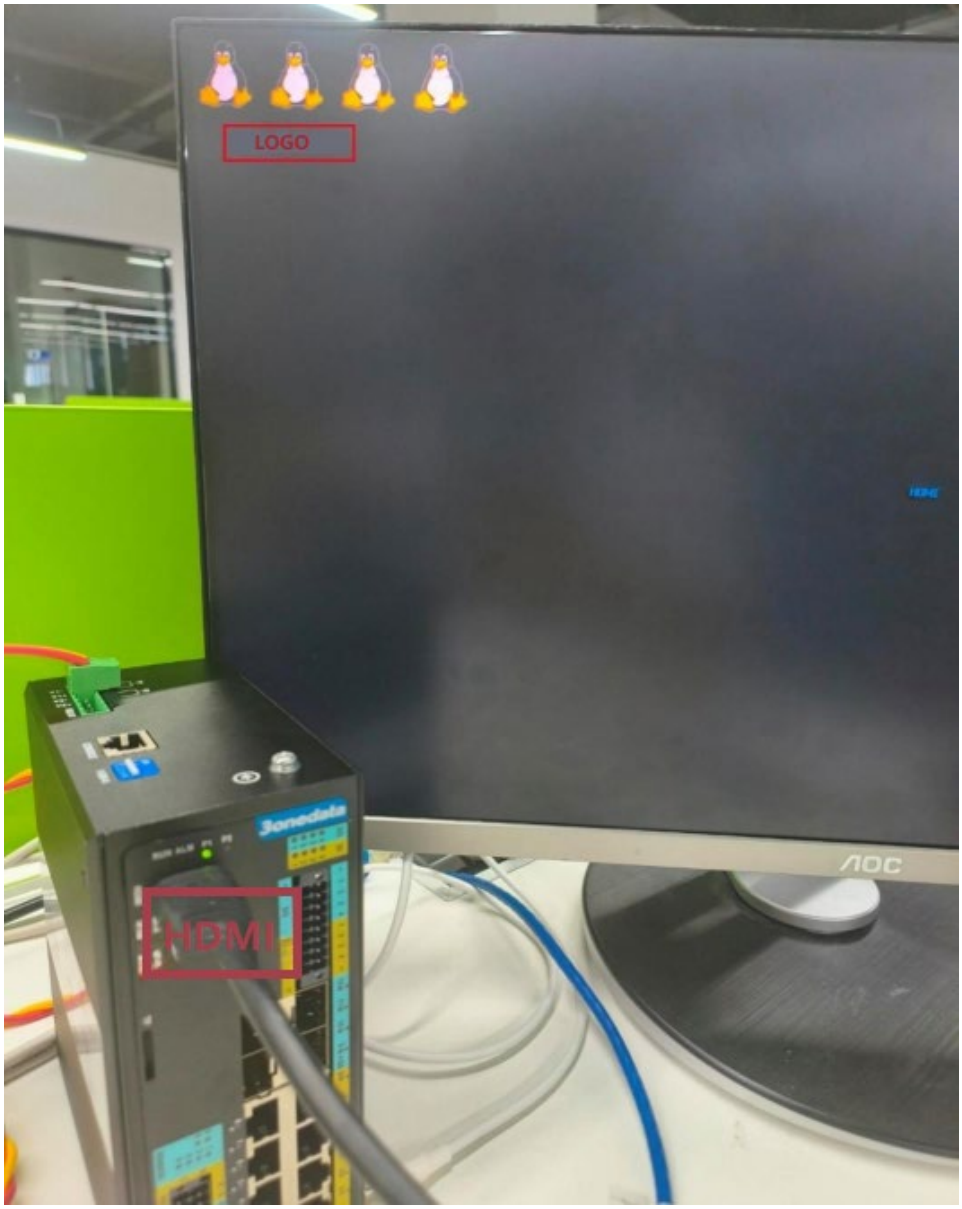
Copyright © 3onedata Co., Ltd.



The red arrow indicates the HDMI interface.

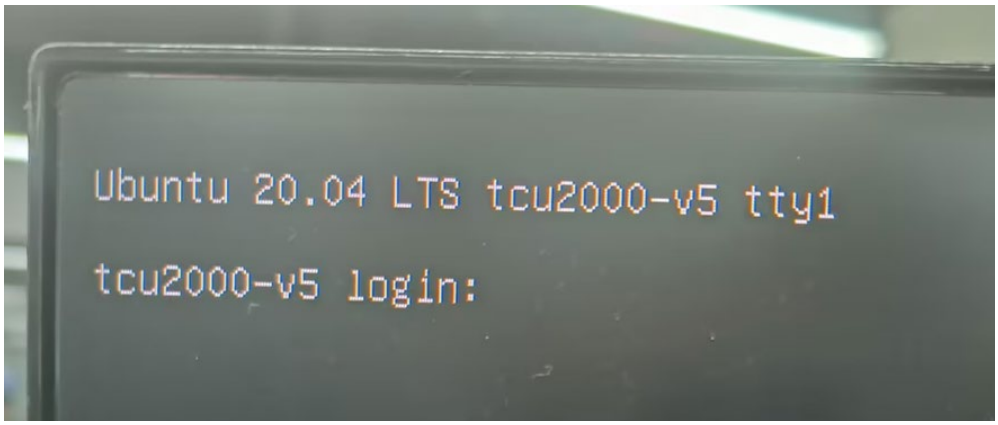
Connect one end of the HDMI cable to the HDMI port of the intelligent gateway, and the other end to a display with an HDMI interface. When the intelligent gateway is powered on and started, the HDMI display will display the interface shown in the following figure:

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During the process of HDMI port wiring and gateway startup, the display displays the interface. When the intelligent gateway is powered on and started, the HDMI display interface is shown in the following figure, indicating that the HDMI of the intelligent gateway is normal.

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After the gateway is started, the display displays login: The text interface indicates that the HDMI is normal.

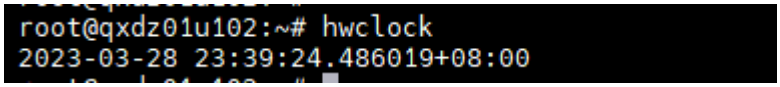


The graphical version displays the login screen.

5.15 RTC Clock

5.15.1 Query RTC Clock Information

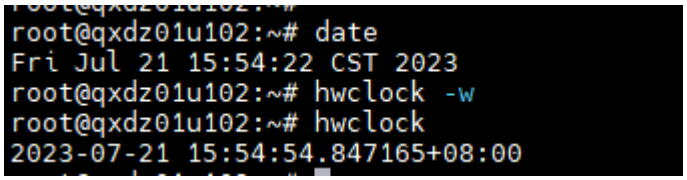
Enter "hwclock" on the command line to print RTC clock information on the screen. The specific operation is shown in the following figure:



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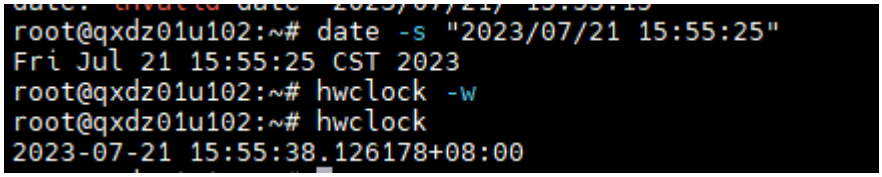
5.15.2 Synchronize System Time

Enter "hwclock -w" on the command line to synchronize the date information, and then enter "hwclock" to view the RTC clock information. The specific operation is shown in the following figure:



5.15.3 Change Clock Information

The command line input format is "date -s “year/month/day hour:minute:second ", and then enter “hwclock -w” to synchronize the date information. The specific operation is shown in the following figure:



5.15.4 Synchronize Clock Server

By default, the TCU system intelligent gateway uses the systemd-timesyncd service to manage and maintain synchronization between system time and network time. If the service is not installed in the current system, the installation can be completed using the following command:

sudo apt install systemd-timesyncd ntp

5.15.4.1 Configure Server

Open the configuration file for the systemd-timesyncd service using the vim editor:

vim /etc/systemd/timesyncd.conf

Then enter the timing server address (e.g. ntp.ubuntu.com) under the [Time] field, as shown in the following figure

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```
#  (at your option) any later version.
#
# Entries in this file show the compile time default
# You can change settings by editing this file.
# Defaults can be restored by simply deleting this f
#
# See timesyncd.conf(5) for details.

[Time]
NTP=ntp.ubuntu.com
#FallbackNTP=ntp.ubuntu.com
#RootDistanceMaxSec=5
#PollIntervalMinSec=32
#PollIntervalMaxSec=2048
```

5.15.4.2 Start Service and Query Synchronization Status

Command to start the time synchronization service:

sudo systemctl start systemd-timesyncd

If you need to set the service to start automatically, use the command:

sudo systemctl enable systemd-timesyncd

The "timdatectl" command provides a query function for clock synchronization status

```
Thu Oct 12 18:35:49 CST 2023
root@tcu2000-v5:~# timedatectl
                Local time: Thu 2023-10-12 18:45:43 CST
            Universal time: Thu 2023-10-12 10:45:43 UTC
                  RTC time: Thu 2023-10-12 10:45:44
                 Time zone: Asia/Shanghai (CST, +0800)
System clock synchronized: no
              NTP service: active
          RTC in local TZ: no
root@tcu2000-v5:~#
```

5.15.4.3 Install ntp and ntpdate Packages

Run the following command in the terminal using the APT tool to update all software package databases to the latest version online:

sudo apt update

Then enter the following command to complete the installation:

sudo apt install ntp ntpdate

Notice

Choose either the systemd-timesyncd service or the NTP client service.

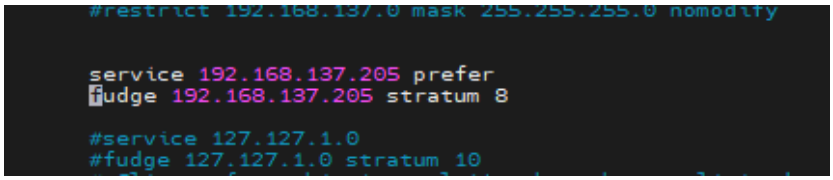
5.15.4.4 Modify NTP Service Configuration

Enter the command vim/etc/ntp.conf to open the configuration file and configure the client to obtain the server address for the clock (assuming server IP: 192.168.137.205).

service 192.168.137.205 prefer

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fudge 192.168.137.205 stratum 8

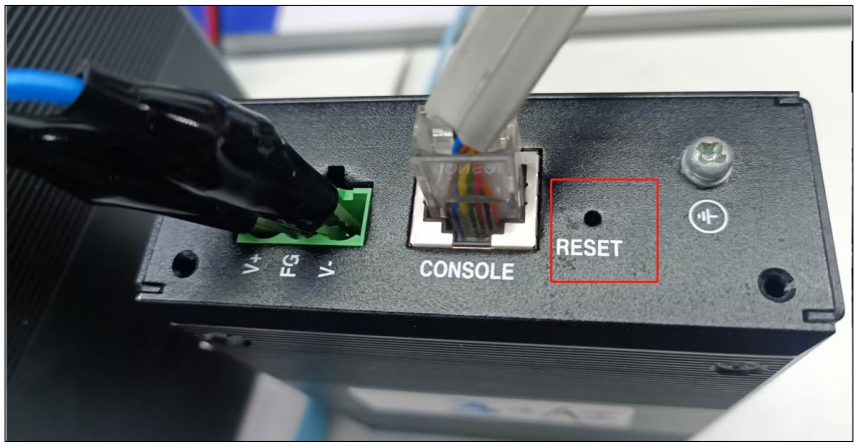


5.15.4.5 Restart NTP Service

Enter the "service ntp restart" command to start the NTP service

5.16 Reset

Some TCU series intelligent gateways have the Reset function, allowing users to quickly restore the device to its factory defaults by long pressing the RESET button in the event of an abnormality in the current system.



Notice

Only some models of devices support the Reset function, please refer to the actual model for details.

5.16.1 Backup Data

After the first software burning, the device will automatically run the recovery service upon entering the system, synchronizing the latest version to the backup area. At this

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point, the current backup status can be queried through the /run/recoverystate file in the serial terminal:

If the backup status of the system shows "recovery.service is running for rootdisk mmcblk0", it indicates that the current backup work of the system is copying data and the system backup has not been completed yet. Only when "redundant part/dev/mmcblk0p1 is ready" is displayed, it indicates that copying the default system image to the mmcblk0p1 partition has been completed and the system backup is complete.

To complete the test comparison, we first create a hello.c file in the/root directory using the following command before restoring the factory settings.

```
root@tcu1200-u00-g0-lv-v1:~# ls
root@tcu1200-u00-g0-lv-v1:~# echo //filename:hello.c > hello.c
root@tcu1200-u00-g0-lv-v1:~# ls
hello.c
root@tcu1200-u00-g0-lv-v1:~# cat hello.c
//filename:hello.c
```

5.16.2 Restore Data

When data recovery is required, first turn off the device, then press and hold the reset button, and then power on the device again until the console port prints "Recovery key event!!" (press and hold for 10 seconds after power-on), then release it. After startup, the system returns to its factory settings.

```
U-Boot 2019.07 (Sep 06 2023 - 16:59:10 +0800) Allwinner Technology, Build: jenkins-tcu2000-
77

CPU:   Allwinner R40 (SUN8I 1701)
Model: 3Onedata TCU1200-U00-G0-LV-V1
I2C:   ready
DRAM:  2 GiB
MMC:   mmc@1c0f000: 0, mmc@1c11000: 1
Loading Environment from MMC... OK
In:    serial@1c28000
Out:   serial@1c28000
Err:   serial@1c28000
Recovery key event!!
Saving Environment to MMC... Writing to MMC(1)... OK
```

After entering the system, check the status of "/run/recoverystate". If the reset status shows "redundant part 1 is up to date", it indicates that data replication has been completed and the system partition has been restored.

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```
root@tcu1200-u00-g0-lv-v1:~#
root@tcu1200-u00-g0-lv-v1:~# cat /run/recoverystate
redundant part 1 is up to date
```

After restoring the factory settings, check the files in the “/root” directory and it can also be observed that they have been restored to their factory settings.

```
root@tcu1200-u00-g0-lv-v1:~# ls
root@tcu1200-u00-g0-lv-v1:~#
```

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