

Aurora Software Guide

This software provide some shell commands to demo how to drive devices on the Aurora Device.

Specification

For Aurora 100

Item	Values
Memory	512MB DDR3 RAM(测速)
Storage	4GB 8-bit eMMC on-board flash(测速) SD slot
Peripheral Interface	1 x USB Host 1 x 100M Ethernet interface 1 x Record interface 1 x Play interface 2 x Relay output interface(MAX 30V/2A) 2 x GPIO input interface 1 x Extern 12V interface(MAX 2A) 1 x USB OTG 1 x SD card interface 1 x TTL UART
On-board LED	1 x Power LED 1 x user-defined LED
Power	1 x DC interface (24V/2.5A)
Button	1 x reset button
Knob	1 x sound volume knob
Operating temperature(C)	0 ~ 90 (refer to am3358)

For Aurora 200

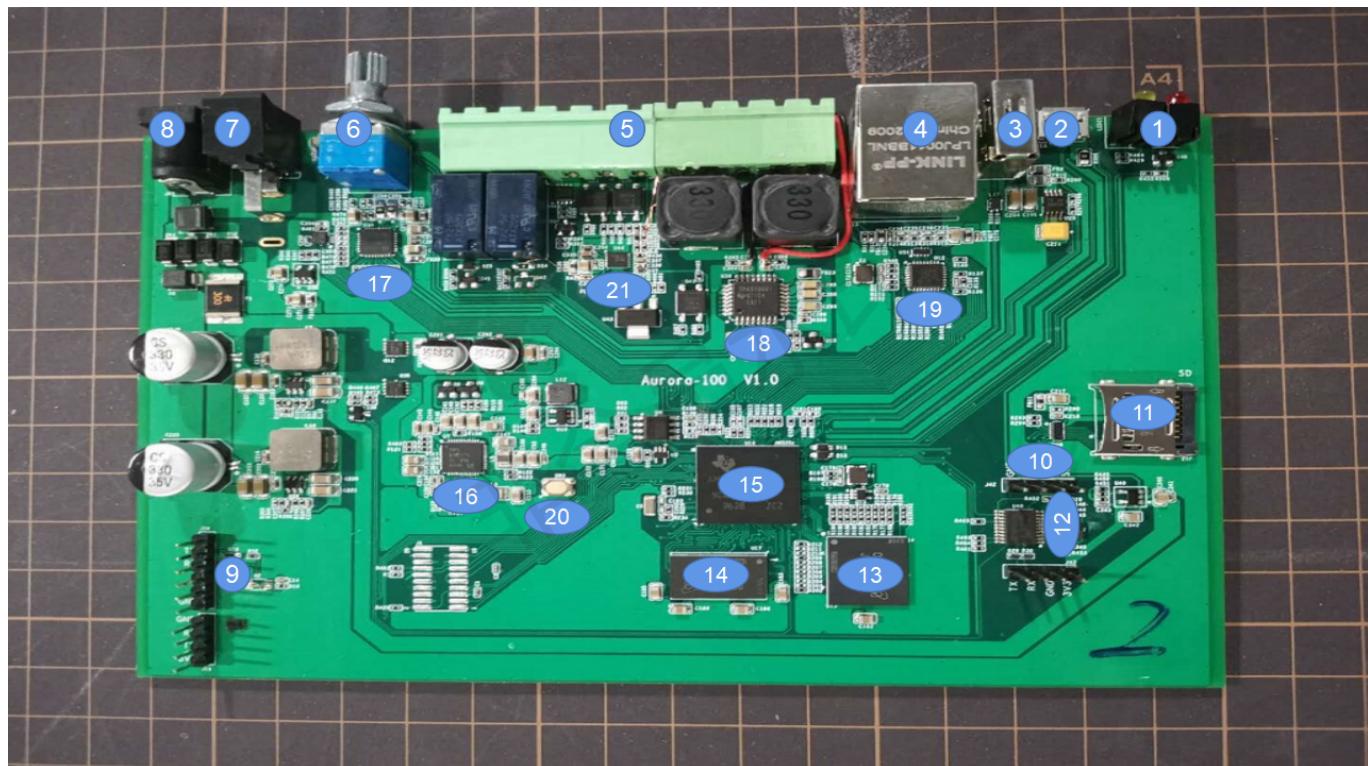
Item	Values
Memory	512MB DDR3 RAM(测速)
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Peripheral Interface	1 x USB Host 4 x 100M Ethernet interface 1 x Record interface 2 x Play interface 3 x Relay output interface(MAX 30V/2A) 3 x GPIO input interface 1 x Extern 12V interface(MAX 2A) 1 x USB OTG 1 x SD card interface 1 x TTL UART
On-board LED	1 x Power LED 1 x User-defined LED 1 x Network status LED
Power	1 x DC interface(24V/2.5A)
Button	1 x Reset button
Knob	1 x Sound volume knob
Operating temperature(C)	0 ~ 90 (refer to am3358)

Hardware Overview

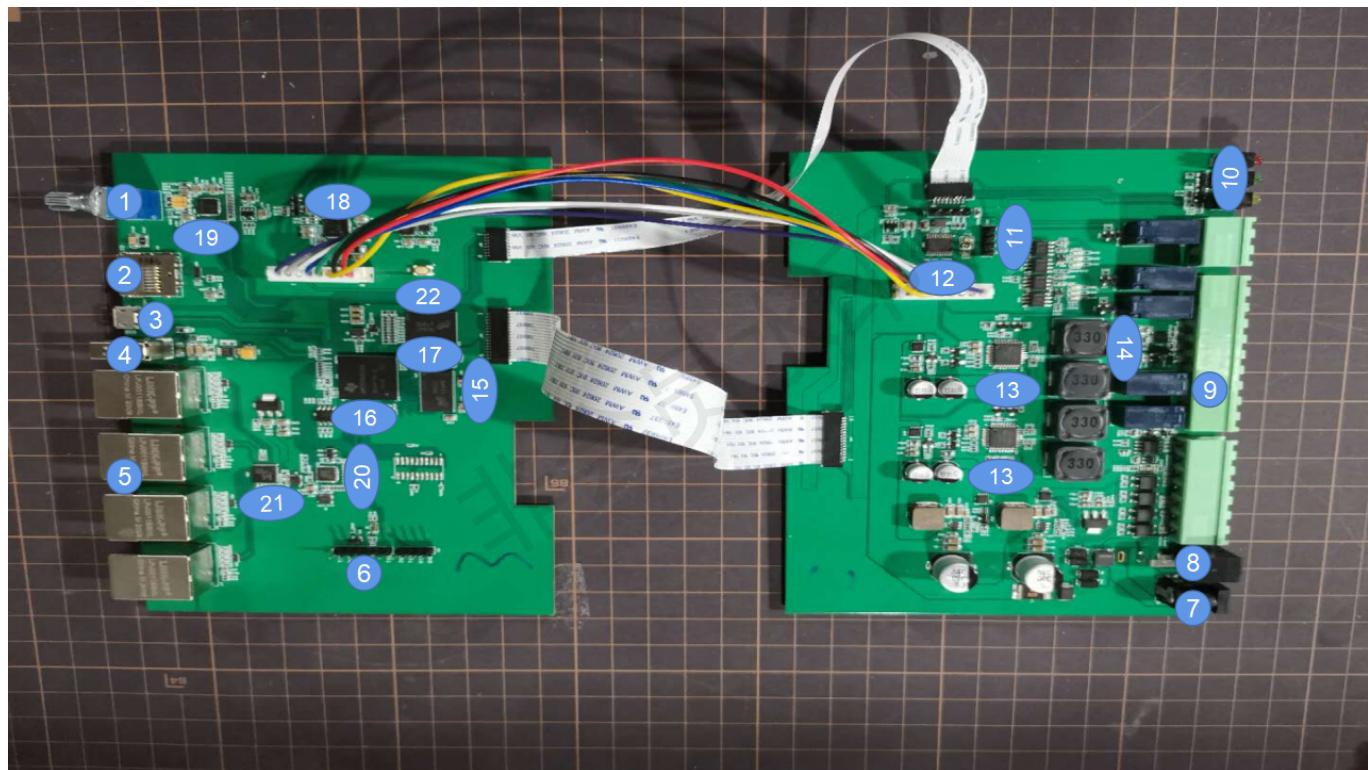
It is convenient to use this hardware overview for finding the location of the hardware.

For Aurora 100



- **1. LED:** Include power LED and user-defined LED.

- **2. USB OTG:** This USB Port is used to connect to your computer via serial mode of putty.
- **3. USB Host:** You can plug USB device, such as USB mouse,USB keyboard and USB flash disk into Aurora via those two USB hosts.
- **4. Ethernet interface:** Access to the Internet.
- **5. Extern Interface:** Include 1 x Record interface , 1 x Play interface , 2 x Relay output interface , 2 x GPIO input interface , 1 x Extern 12V interface.
- **6. Knob:** Adjust the speaker volume.
- **7. Power switch:** Power on or power off the Aurora.
- **8. DC jack:** Input 24V/2.5A power.
- **9. TTL UART:** You also can connect the Aurora with your computer via this UART port.
- **10. SWIM jack:** You can use this jack to update the mpu(stm8) firmware.
- **11. SD Card Slot:** To plug in micro-SD card to update the Aurora firmware.
- **12. STM8:** Software power switch chip for Aurora.
- **13. MTFC4GACAJCN:** 4GB EMMC Storage.
- **14. MT41K256M16TW:** 512M DDR3 RAM.
- **15. AM3358:** Main controller.
- **16. TPS65217CRSLR:** Power Management Chip.
- **17. TLV320AIC3104:** Audio codec chip.
- **18. TPA3106D1:** Amplifier for speaker.
- **19. LAN8710A:** 100M Network cable drive network card.
- **20. Power button:** power on or power off the AM3358.
- **21. MAX9814ETD:** Amplifier for Mic.



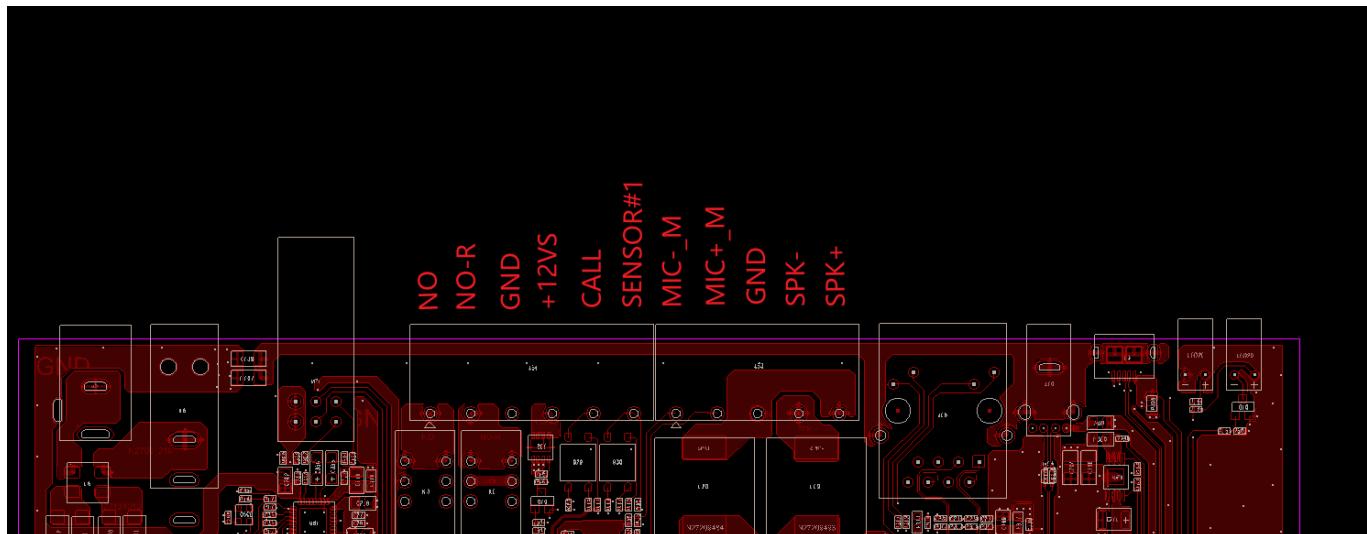
- **1. Knob:** Adjust the speaker volume.
- **2. SD Card Slot:** To plug in micro-SD card to update the Aurora firmware.
- **3. USB OTG:** This USB Port is used to connect to your computer via serial mode of putty.
- **4. USB Host:** You can plug USB device, such as USB mouse,USB keyboard and USB flash disk into Aurora via those two USB hosts.
- **5. Ethernet interface:** 4 x Ethernet Interface be controlled by the switch chip.
- **6. TTL UART:** You also can connect the Aurora with your computer via this UART port.
- **7. DC jack:** Input 24V/2.5A power.
- **8. Power switch:** Power on or power off the Aurora.
- **9. Extern Interface:** Include 1 x Record interface , 2 x Play interface , 3 x Relay output interface , 3 x GPIO input interface , 1 x Extern 12V interface.
- **10. LED:** Include power LED and user-defined LED , network status LED.
- **11. SWIM jack:** You can use this jack to update the mpu(stm8) firmware.
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- **20. LAN8710A:** 100M Network cable drive network card.
- **21. RTL8305NB:** Ethernet switch controller.
- **22. Power button:** power on or power off the AM3358.

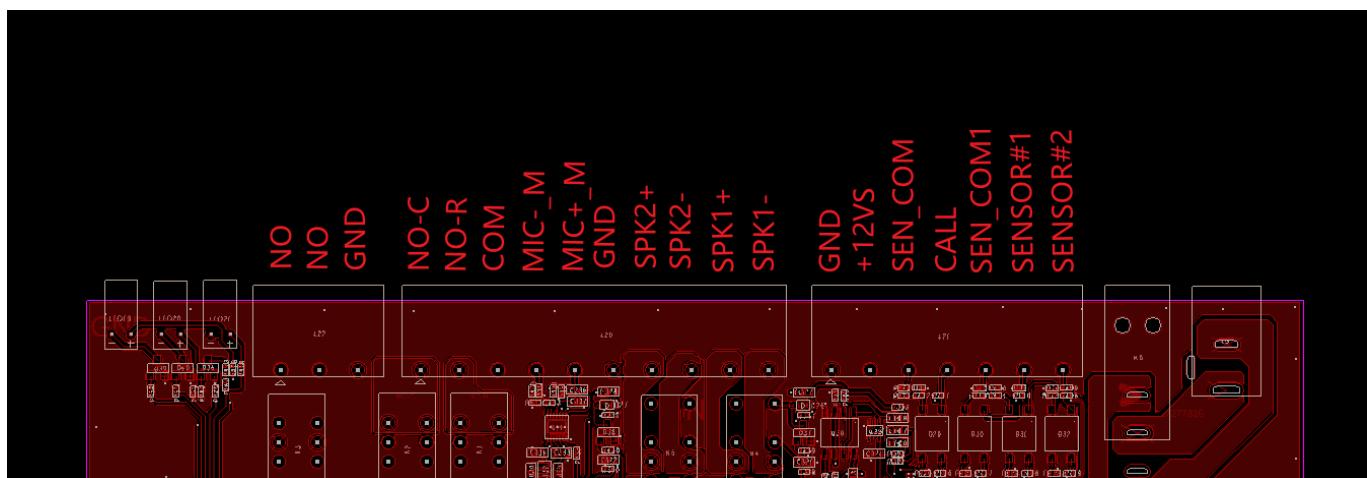
Extern Interface pinout

It is very useful when we test there pin.

For Aurora 100



For Aurora 200



Introduction To Software

Preparatory Work

Materials Required

- Aurora100 or Aurora200
- Internet network
- Internet cable
- 4GB (or more memory) SD card and SD card reader
- PC or Mac
- [USB To Uart Adapter](#) (optional)
- 24V/2A DC interface adapter
- Especial Speaker x 1 (Aurora100) or Especial Speaker x 2 (Aurora200)
- Especial Mic

Update firmware

- **Step 1.** Select the [firmware](#) to download:

BeagleBoard.org Latest Firmware Images

Download the latest firmware for your BeagleBoard, BeagleBoard-xM, BeagleBoard-X15, BeagleBone, BeagleBone Black, BeagleBone Black Wireless, BeagleBone AI, BeagleBone Blue, SeeedStudio BeagleBone Green, SeeedStudio BeagleBone Green Wireless, SanCloud BeagleBone Enhanced, element14 BeagleBone Black Industrial, Arrow BeagleBone Black Industrial, Mentrelo BeagleBone uSomIQ, Neuromeka BeagleBone Air, or PocketBeagle



See the [Getting Started](#) guide and the [community wiki page](#) for hints on loading these images. See our [Debian page](#) on how the latest images are built.

Recommended Debian Images

Buster IoT TIDL (without graphical desktop and with machine learning acceleration tools) for [BeagleBoard-X15](#) and [BeagleBone AI](#) via microSD card

- ▶ [AM5729 Debian 10.3 2020-04-06 8GB SD IoT TIDL](#)

image for [BeagleBoard-X15](#), and [BeagleBone AI](#) - more info - sha256sum: b9ac77af8be8156144b6192ed5d94404e381f19c0611042b26aadff18f49530e

Buster IoT (without graphical desktop) for [BeagleBone](#) and [PocketBeagle](#) via microSD card

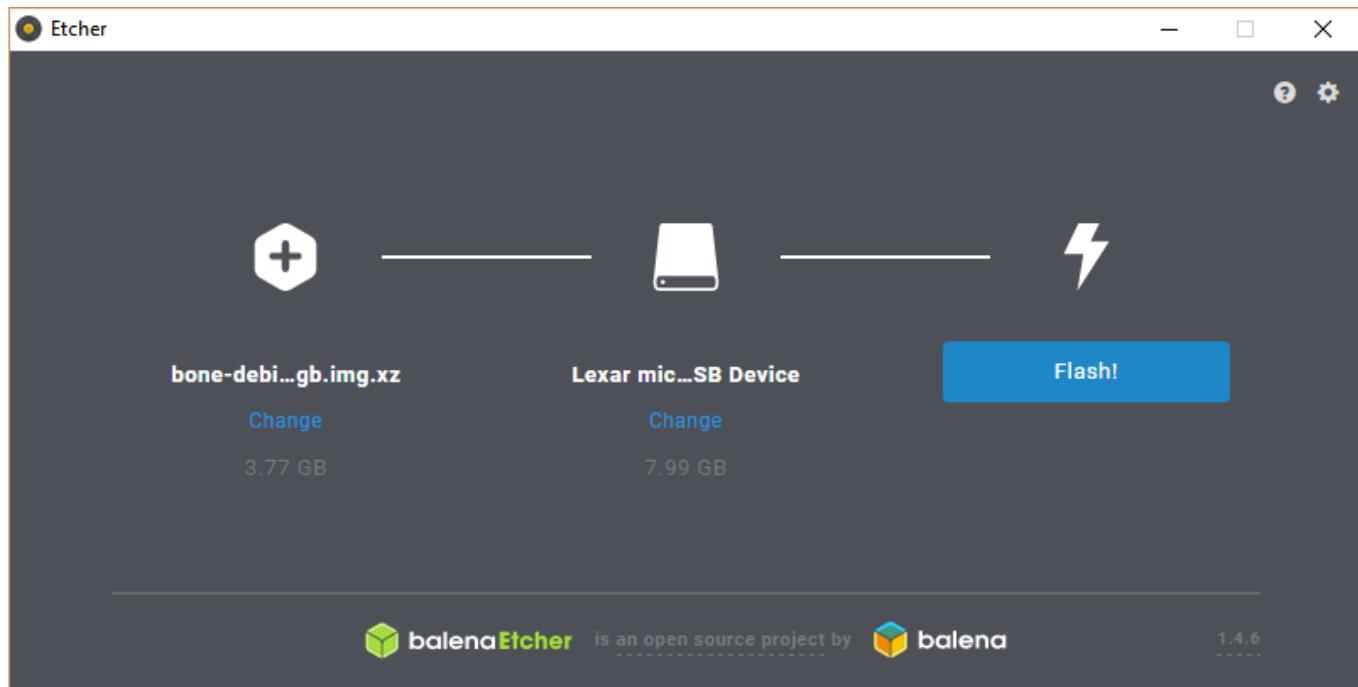
- ▶ [AM3358 Debian 10.3 2020-04-06 4GB SD IoT](#)

image for [PocketBeagle](#), [BeagleBone](#), [BeagleBone Black](#), [BeagleBone Black Wireless](#), [BeagleBone Black Industrial](#), [BeagleBone Blue](#), [SeeedStudio BeagleBone Green](#), [SeeedStudio BeagleBone Green Wireless](#), [SanCloud BeagleBone Enhanced](#), [Arrow BeagleBone Black Industrial](#) and [Mentrelo BeagleBone uSomIQ](#) - more info - sha256sum: 22448ba28d0d58e25e875aac3b4e91eaef82e2d11c9d2c43d948ed607087434

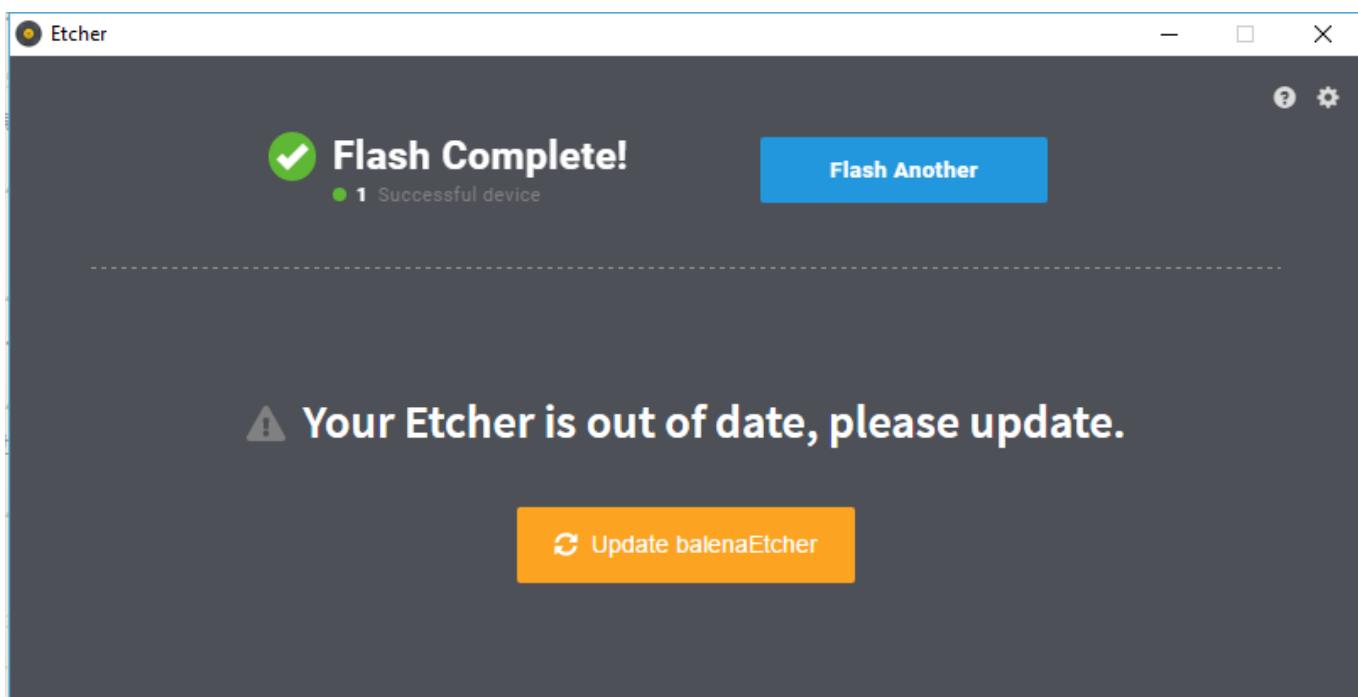
Stretch for [BeagleBoard](#) via microSD card

- ▶ [OMAP3/DM3730 Debian 9.5 2018-10-07 4GB SD LXQT](#) image for [BeagleBoard](#), [BeagleBoard-xM](#) - more info - sha256sum: 2a29626ab7c20890109a0eea4ea6e88e4e31d01d8a447b38eaac5953d8eb9ece

- **Step 2.** Connect an SD card to a PC or MAC with an SD card reader, an SD card with more than 4G memory is required.
- **Step 3.** Click here to download [Etcher](#), then use the Etcher to write the [*.img.xz](#) file directly to the SD card. Or extract the [*.img.xz](#) file into a [*.img](#) file, and then burn it to an SD card using another mirror write tool.

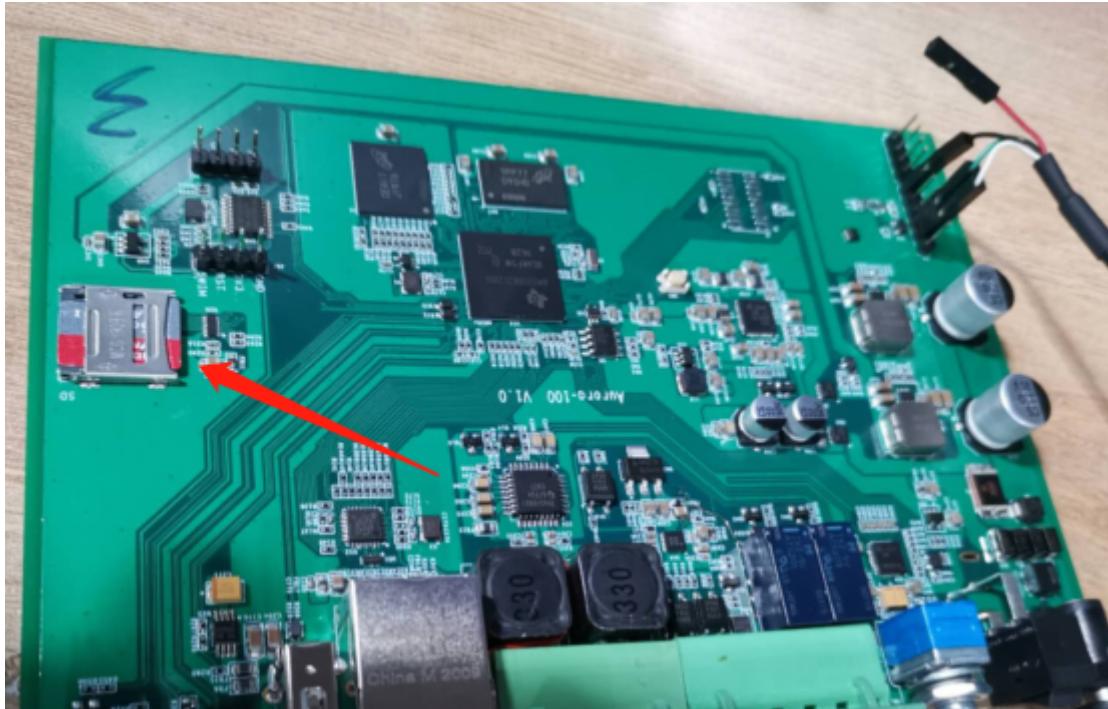


we can get below the picture when the etcher burns successful.

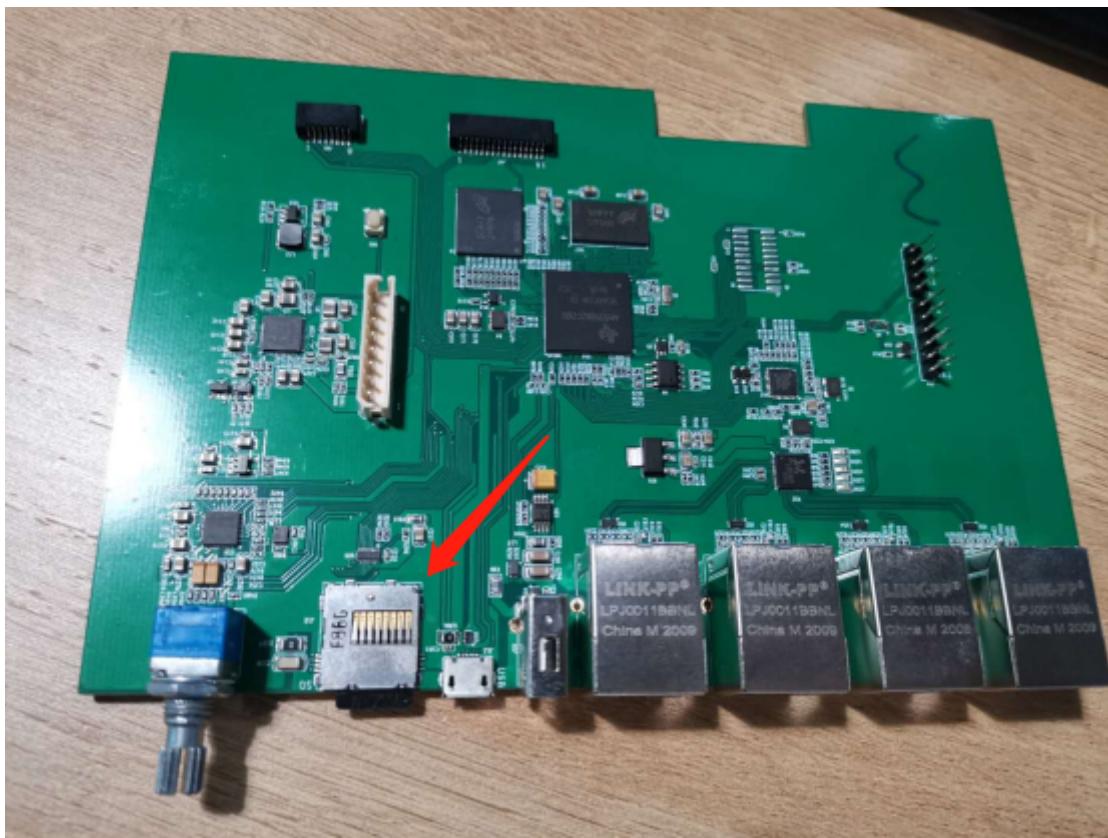


- **Step 4.** After writing the image to the SD card, insert the SD card into Aurora.

For Aurora 100



For Aurora 200



- **Step 5.** Connect Aurora to a computer by using USB To Uart Adapter.the hardware connection as below.

Aurora USB To Uart Adapter

TX	RX
RX	TX

Aurora USB To Uart Adapter

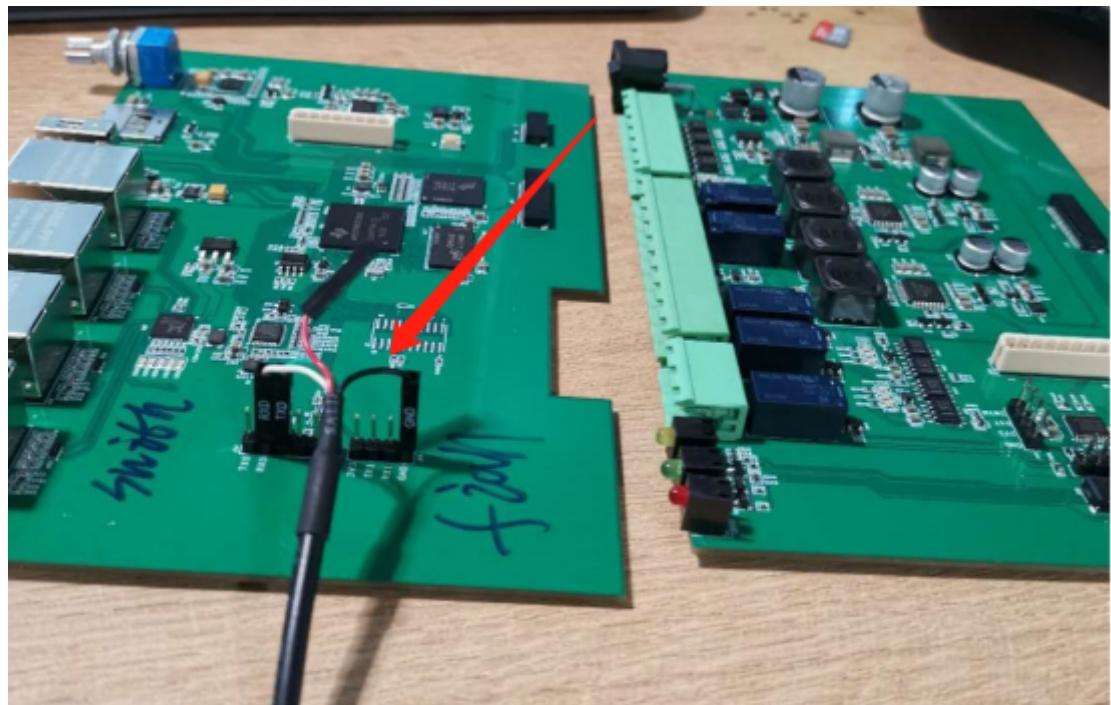
GND

GND

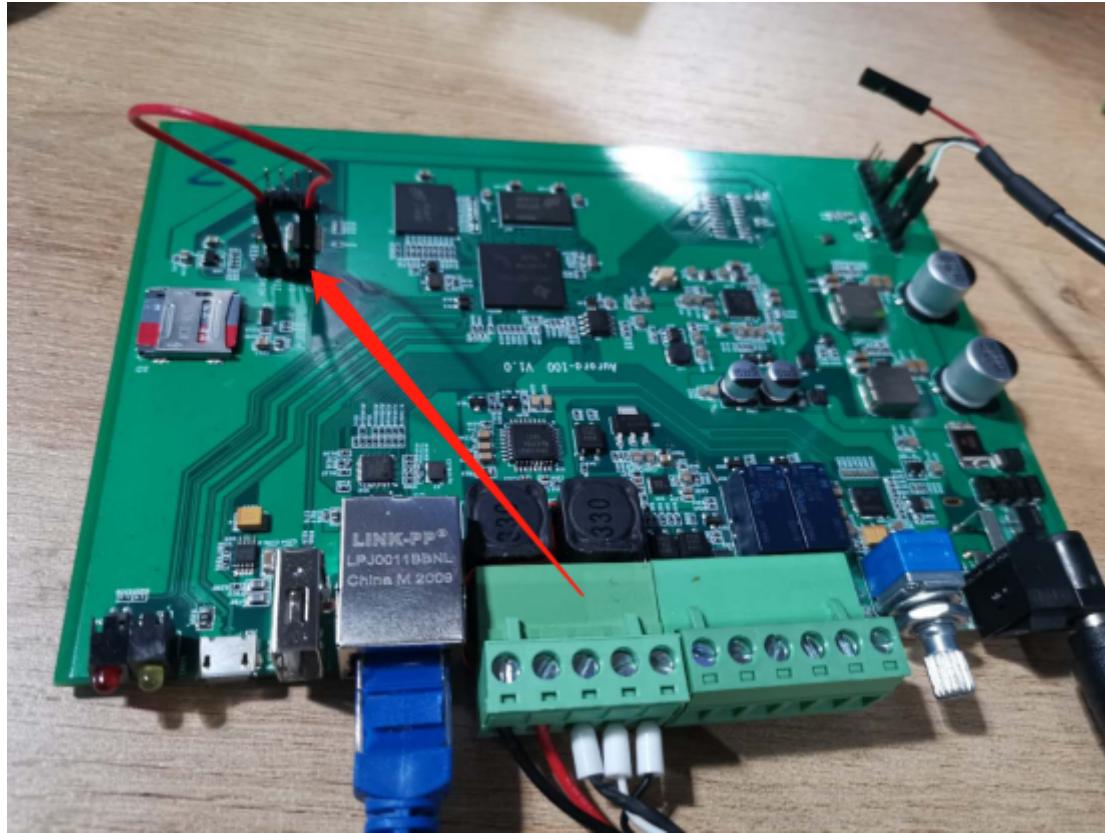
For Aurora 100



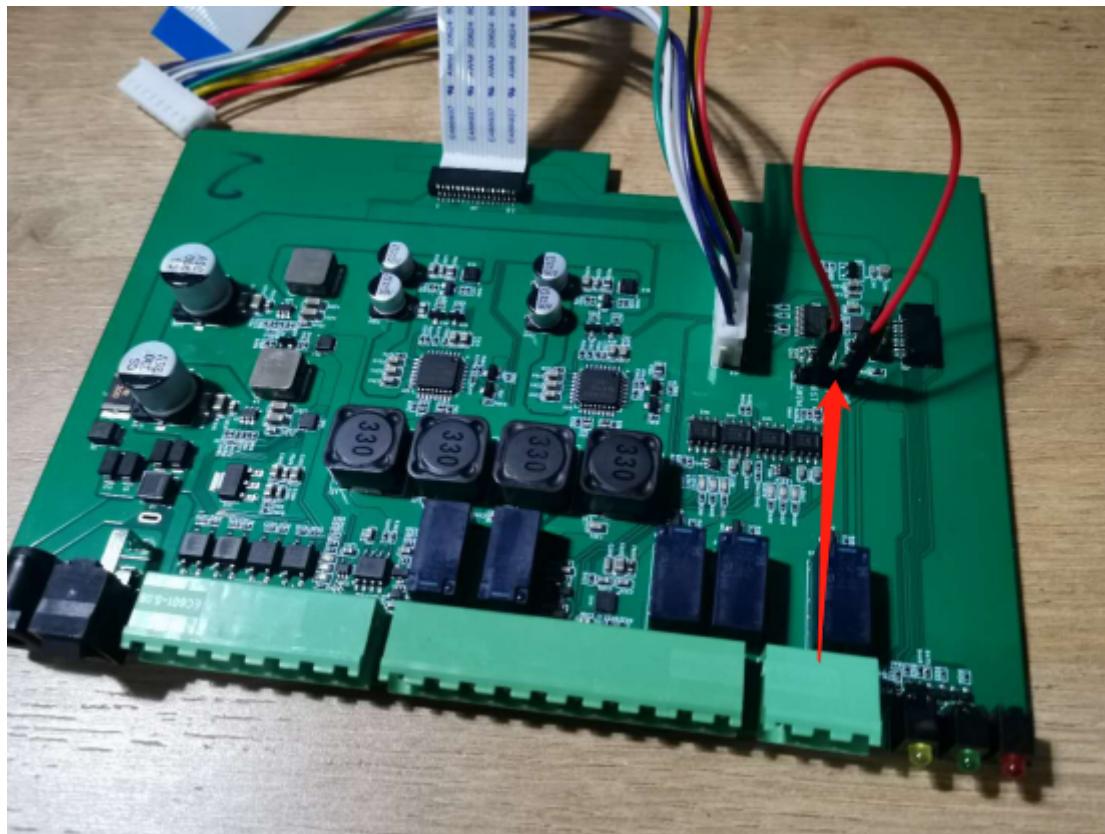
For Aurora 200



- **Step 6.** Connect RST to GND at stm8 to stop stm8 power-manager code. For Aurora 100

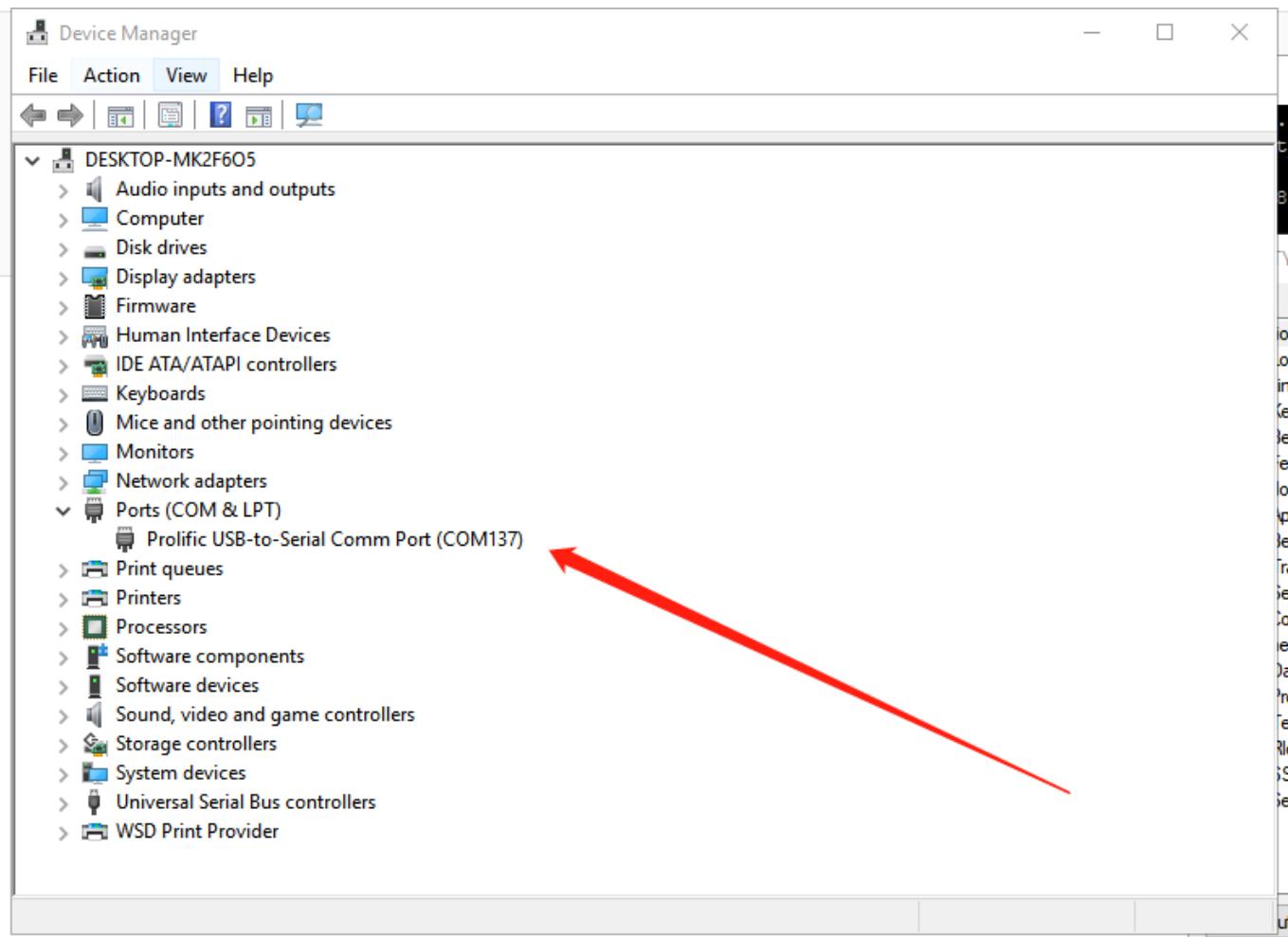


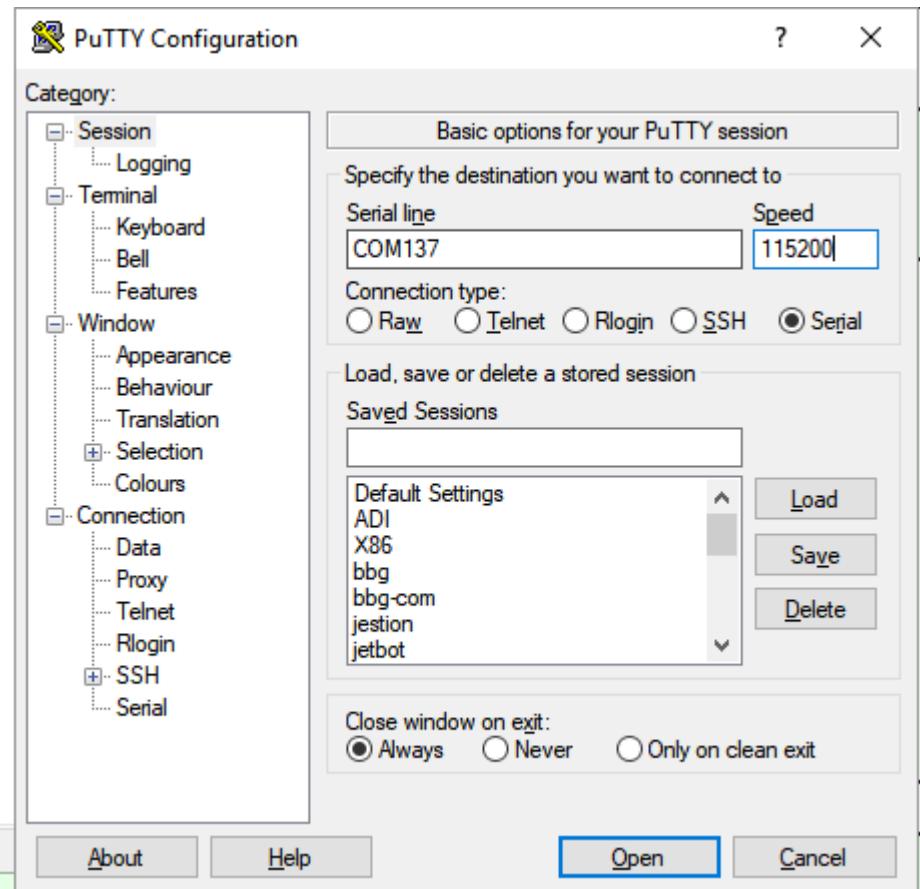
For Aurora 200



the system will reboot repeatedly if our firmware have not `power-manager.service`.and there does not exist `power-manager.service` at default firmware. So we have to connect RST to GND at stm8 to stop `power-manager.service` . we will install the `power-manager.service` at subsequent steps.

- **Step 7.** Use a 24V Power adapter to power the Aurora board. and you can see the LED power on. Do not take out the SD card during writing.
- **Step 8.** Use [PUTTY](#), select [Serial](#) protocol, fill in the correct COM port of Aurora, 115200 baud, 8Bits, Parity None, Stop Bits 1, Flow Control None.





- **Step 9.** The login user name is `debian`, and password is `temppwd`.

The screenshot shows a PuTTY terminal window titled "COM137 - PuTTY". The window displays a terminal log of a BeagleBoard boot process. The log includes kernel boot messages, such as "Booting using the fdt blob at 0x88000000", and a root password prompt: "default username:password is [debian:temppwd]". The password field is redacted with a green bar.

```

cb1klpl ro rootfstype=ext4 rootwait coherent_pool=1M net.ifnames=0 lpj=1990656 r
ng_core.default_quality=100 quiet] ...
debug: [bootz 0x82000000 0x88080000:648cf9 88000000] ...
## Flattened Device Tree blob at 88000000
  Booting using the fdt blob at 0x88000000
  Loading Ramdisk to 8f9b7000, end 8ffffcf9 ... OK
  Loading Device Tree to 8f92b000, end 8f9b6fff ... OK

Starting kernel ...

[    0.002149] timer_probe: no matching timers found
[    0.195726] 14_wkup_cm:clk:0010:0: failed to disable
[    1.476388] omap_voltage_late_init: Voltage driver support not added

Debian GNU/Linux 10 beaglebone ttyS0

BeagleBoard.org Debian Buster IoT Image 2020-04-06

Support: http://elinux.org/Beagleboard:BeagleBoneBlack_Debian

default username:password is [debian:temppwd]

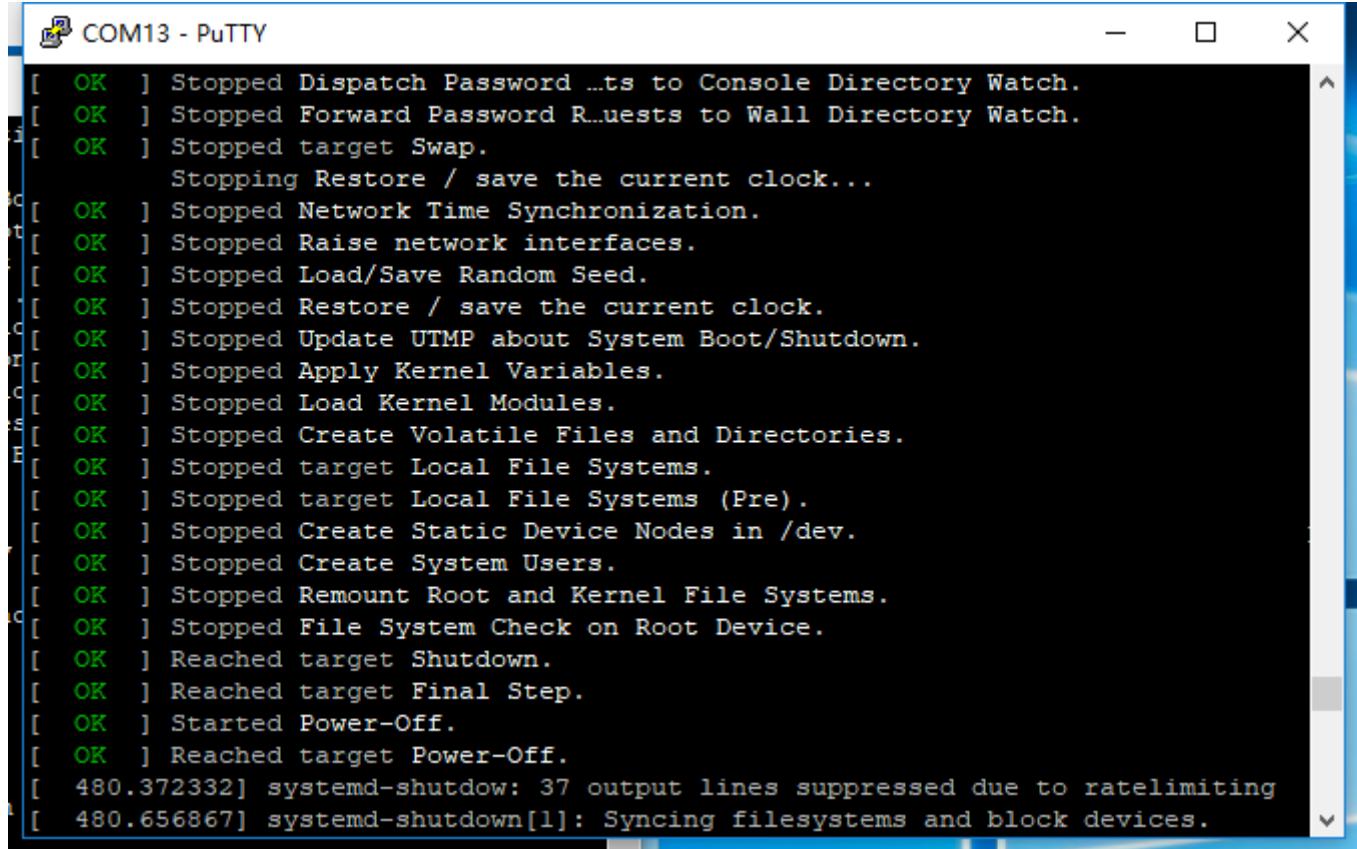
beaglebone login: debian
Password: 

```

- **Step 10.** Edit `/boot/uEnv.txt` to start eMMC boot then reboot at Aurora.

```
sudo sh -c "echo cmdline=init=/opt/scripts/tools/eMMC/init-eMMC-flasher-v3.sh >> /boot/uEnv.txt"
sudo reboot
```

if the update firmware finish, the terminal will show power-off cmd.



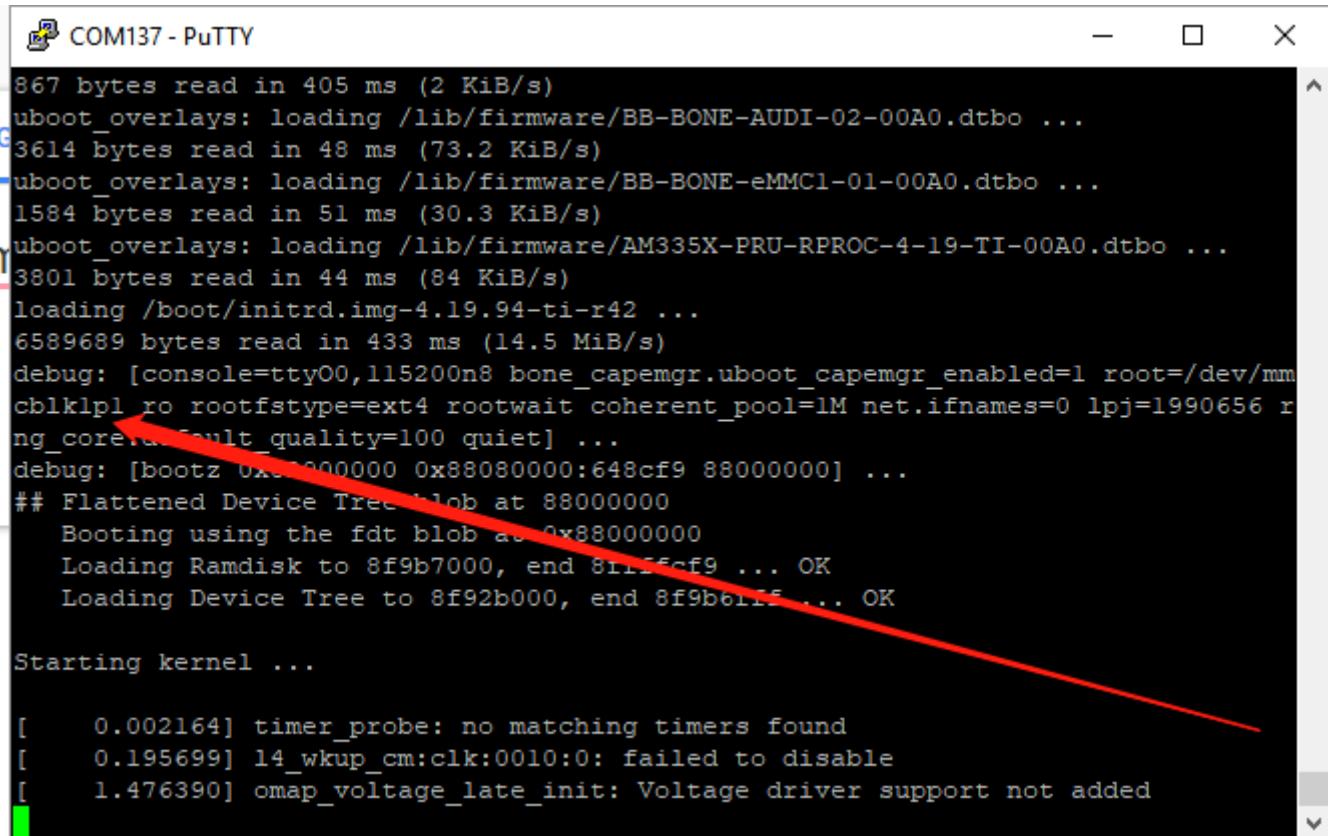
The screenshot shows a PuTTY terminal window titled "COM13 - PuTTY". The window displays a log of system shutdown operations. The log entries are as follows:

```
[ OK ] Stopped Dispatch Password ...ts to Console Directory Watch.
[ OK ] Stopped Forward Password R...uests to Wall Directory Watch.
[ OK ] Stopped target Swap.
      Stopping Restore / save the current clock...
[ OK ] Stopped Network Time Synchronization.
[ OK ] Stopped Raise network interfaces.
[ OK ] Stopped Load/Save Random Seed.
[ OK ] Stopped Restore / save the current clock.
[ OK ] Stopped Update UTMP about System Boot/Shutdown.
[ OK ] Stopped Apply Kernel Variables.
[ OK ] Stopped Load Kernel Modules.
[ OK ] Stopped Create Volatile Files and Directories.
[ OK ] Stopped target Local File Systems.
[ OK ] Stopped target Local File Systems (Pre).
[ OK ] Stopped Create Static Device Nodes in /dev.
[ OK ] Stopped Create System Users.
[ OK ] Stopped Remount Root and Kernel File Systems.
[ OK ] Stopped File System Check on Root Device.
[ OK ] Reached target Shutdown.
[ OK ] Reached target Final Step.
[ OK ] Started Power-Off.
[ OK ] Reached target Power-Off.
[ 480.372332] systemd-shutdown: 37 output lines suppressed due to ratelimiting
[ 480.656867] systemd-shutdown[1]: Syncing filesystems and block devices.
```

You have to power off the board and unplug sd card If you terminal show this message.

- **Step 11.** Unplug **sd card** then power on.

If you boot at emmc , the terminal will print `/dev/mmcblk1p1`.



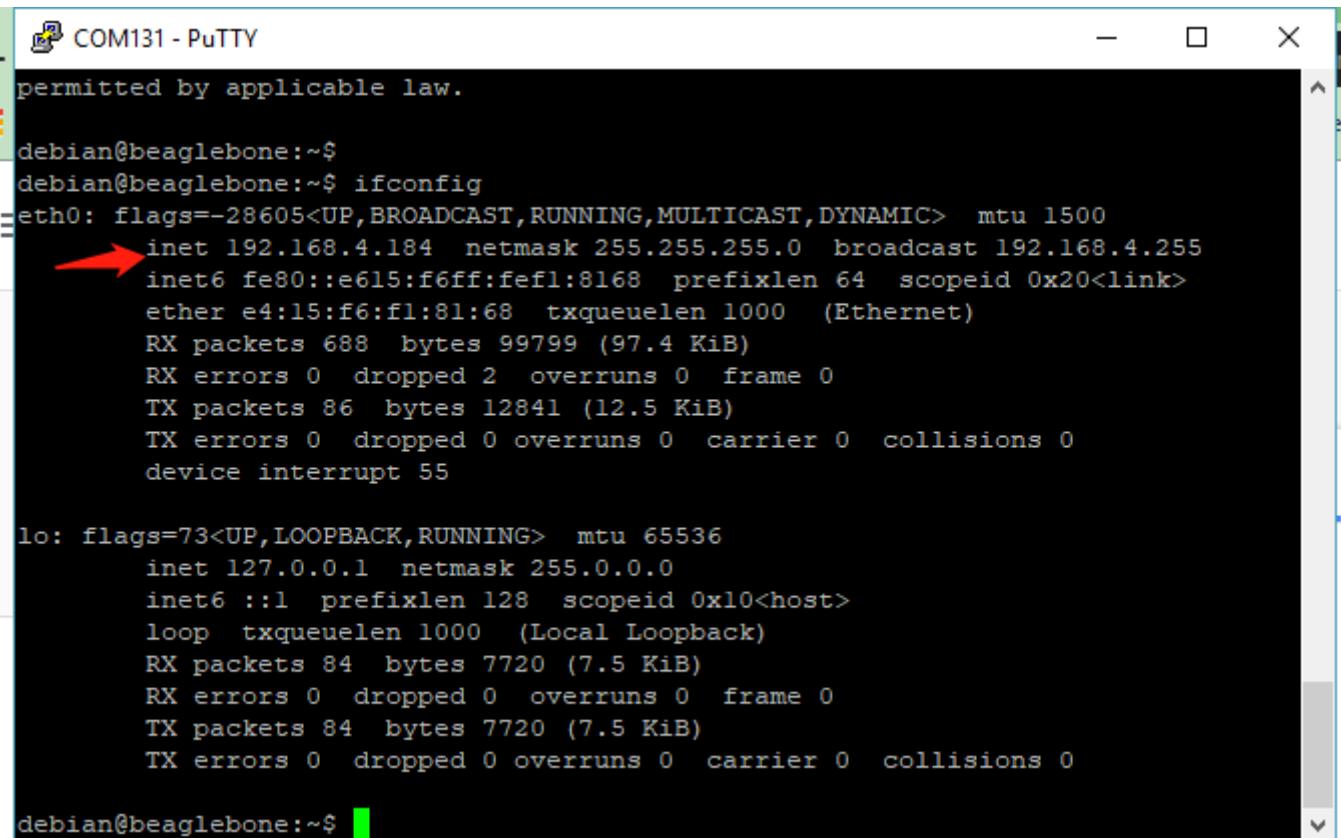
```
867 bytes read in 405 ms (2 KiB/s)
uboot_overlays: loading /lib/firmware/BB-BONE-AUDI-02-00A0.dtbo ...
3614 bytes read in 48 ms (73.2 KiB/s)
uboot_overlays: loading /lib/firmware/BB-BONE-eMMC1-01-00A0.dtbo ...
1584 bytes read in 51 ms (30.3 KiB/s)
uboot_overlays: loading /lib/firmware/AM335X-PRU-RPROC-4-19-TI-00A0.dtbo ...
3801 bytes read in 44 ms (84 KiB/s)
loading /boot/initrd.img-4.19.94-ti-r42 ...
6589689 bytes read in 433 ms (14.5 MiB/s)
debug: [console=ttyO0,115200n8 bone_capemgr.uboot_capemgr_enabled=1 root=/dev/mmcblk0p1 ro rootfstype=ext4 rootwait coherent_pool=1M net.ifnames=0 lpj=1990656 ring_core.default_quality=100 quiet] ...
debug: [bootz 0x8000000 0x88080000:648cf9 88000000] ...
## Flattened Device Tree blob at 88000000
  Booting using the fdt blob at 0x88000000
  Loading Ramdisk to 8f9b7000, end 8f95fcf9 ... OK
  Loading Device Tree to 8f92b000, end 8f9b611f ... OK

Starting kernel ...

[    0.002164] timer_probe: no matching timers found
[    0.195699] l4_wkup_cm:clk:0010:0: failed to disable
[    1.476390] omap_voltage_late_init: Voltage driver support not added
```

- **Step 12.** Connect Internet cable to Ethernet interface if the Green LED to blink and the Yellow LED to light that indicates the network work well.we can get as below information about the eth0 at Aurora if we type **ifconfig** cmd.

```
ifconfig
```



```
COM131 - PuTTY
permitted by applicable law.

debian@beaglebone:~$ ifconfig
eth0: flags=-28605<UP,BROADCAST,RUNNING,MULTICAST,DYNAMIC> mtu 1500
    inet 192.168.4.184 netmask 255.255.255.0 broadcast 192.168.4.255
        ether e4:15:f6:f1:81:68 txqueuelen 1000 (Ethernet)
        RX packets 688 bytes 99799 (97.4 KiB)
        RX errors 0 dropped 2 overruns 0 frame 0
        TX packets 86 bytes 12841 (12.5 KiB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
        device interrupt 55

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
        loop txqueuelen 1000 (Local Loopback)
        RX packets 84 bytes 7720 (7.5 KiB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 84 bytes 7720 (7.5 KiB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

debian@beaglebone:~$
```

the ip addr maybe different for this picture depending on your router.

- **Step 13.** Internet test

```
ping -c 5 www.china.com
```

```
ether e4:15:f6:f1:82:30 txqueuelen 1000 (Ethernet)
RX packets 0 bytes 0 (0.0 B)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 0 bytes 0 (0.0 B)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

usbl: flags=4099<UP,BROADCAST,MULTICAST> mtu 1500
inet 192.168.6.2 netmask 255.255.255.0 broadcast 192.168.6.255
ether e4:15:f6:f1:82:34 txqueuelen 1000 (Ethernet)
RX packets 0 bytes 0 (0.0 B)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 0 bytes 0 (0.0 B)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

debian@beaglebone:~/aurora_test/eth0$ ping -c 5 www.china.com
PING www.china.com.wscdns.com (183.6.248.88) 56(84) bytes of data.
64 bytes from 183.6.248.88 (183.6.248.88): icmp_seq=1 ttl=55 time=6.44 ms
64 bytes from 183.6.248.88 (183.6.248.88): icmp_seq=3 ttl=55 time=420 ms
64 bytes from 183.6.248.88 (183.6.248.88): icmp_seq=4 ttl=55 time=295 ms
64 bytes from 183.6.248.88 (183.6.248.88): icmp_seq=5 ttl=55 time=6.27 ms

--- www.china.com.wscdns.com ping statistics ---
5 packets transmitted, 4 received, 20% packet loss, time 26ms
rtt min/avg/max/mdev = 6.268/182.020/420.249/181.151 ms
debian@beaglebone:~/aurora_test/eth0$
```

if the terminal print like this indicates the network has been connecting to the Internet. if we can not get the Internet maybe need to check your network environment.

Devices Usage

Env install

- **Step 1.** git clone the test code.

```
cd ~
git clone https://github.com/Hansen0314/aurora_test.git
```

- **Step 2.** Install the gpio to control the gpio of Aurora.

```
sudo cp ~/aurora_test/gpio /bin/
```

- **Step 3.** Install the phytool to config the LAN of Aurora.

```
git clone https://github.com/wkz/phytool
cd ~/phytool
make
sudo make install
sudo cp /usr/local/bin/phytool /home/debian/aurora_test/eth0/
```

- **Step 4.** Install the power-service that communicate with stm8 to enable `power-manager.service`.

```
cd ~/aurora_test/power-service  
sudo ./install.sh
```

you can disconnect GND to RST at stm8 for now.

- **Step 5.** Install voice card to enable speaker and mic then reboot.

```
sudo sh -c \  
"echo uboot_overlay_addr0=/lib/firmware/BB-BONE-AUDI-02-00A0.dtbo >>  
/boot/uEnv.txt"  
cd ~/aurora_test/voice_card  
sudo cp asound.state /var/lib/alsa/  
sudo cp asound.conf /etc/  
sudo reboot
```

If the terminal prints no error go to next step.

12+V

we can use this cmd to make 12v power on.

```
gpio set 11
```

You can get 12v at J54(aurora 100)-pin4 or J21(aurora 200)-pin1 by using a multimeter.and the pin's location you can view the [Extern-Interface-pinout](#).

we can use this cmd to make 12v power off.

```
gpio clear 11
```

Input

If you want to test input of aurora 100.

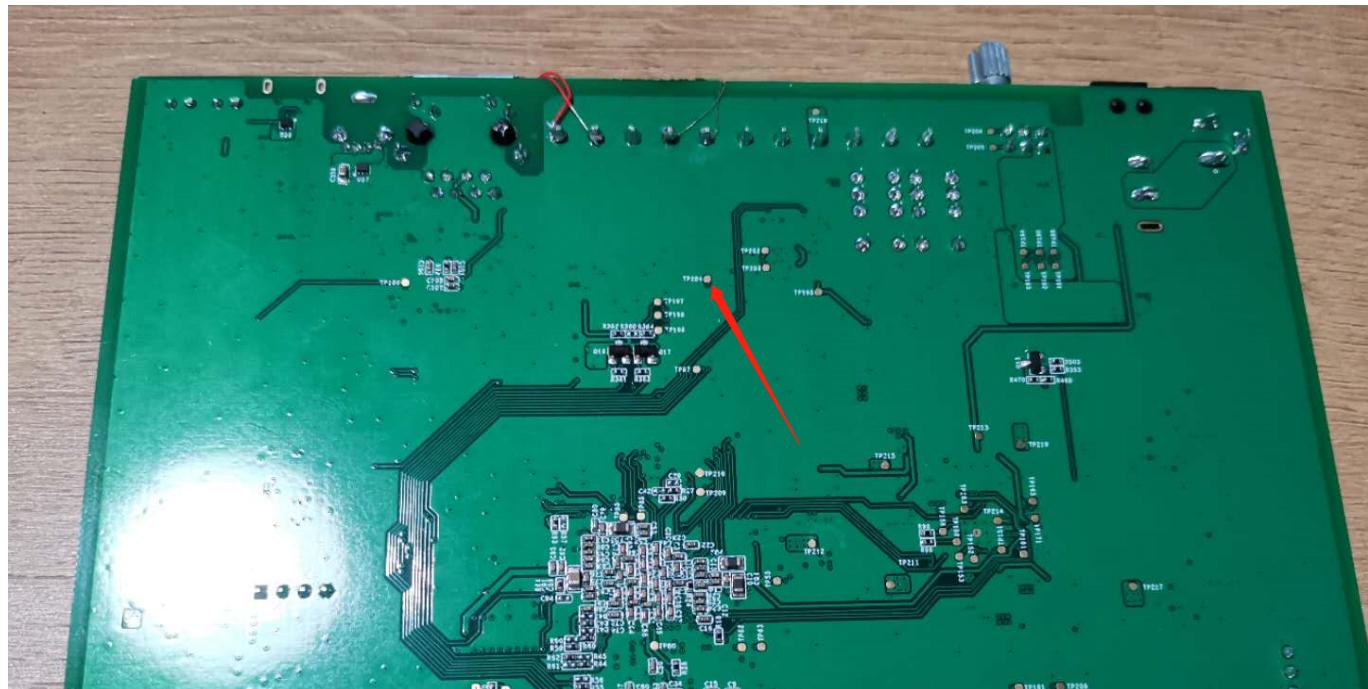
```
cd ~/aurora_test/input  
../input.sh 100
```

If you want to test input of aurora 200.

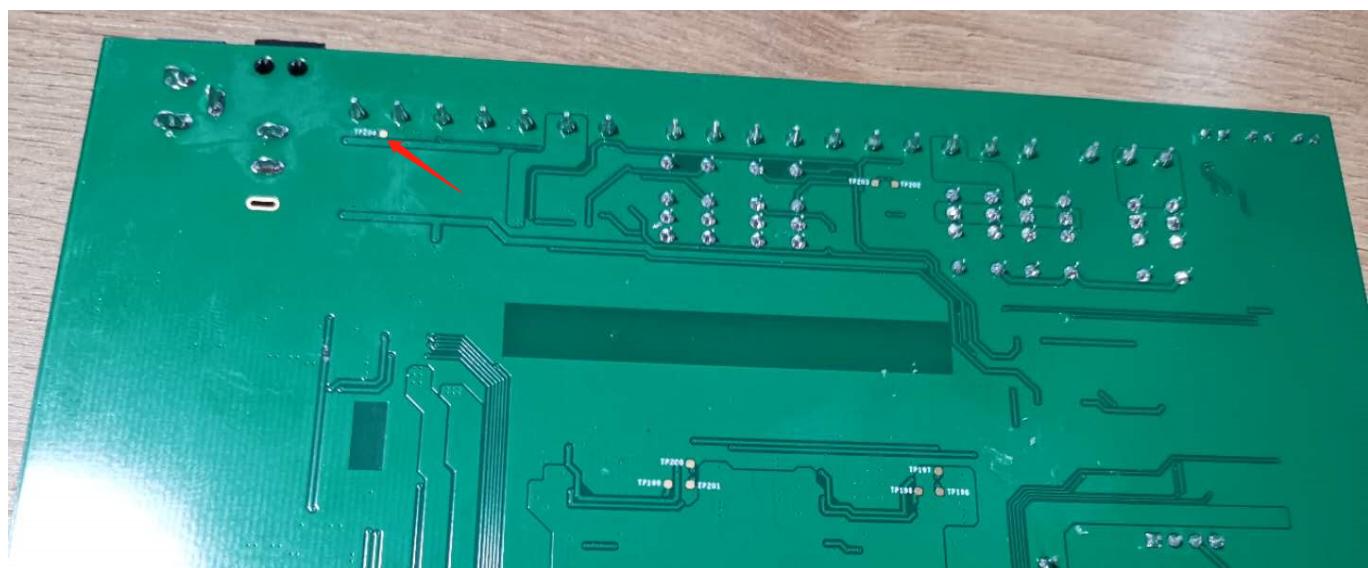
```
cd ~/aurora_test/input  
.input.sh 200
```

Connect input pin to GND that will print the name of the pin at the terminal. and the pin's location you can view the [Extern-Interface-pinout](#). this is Trigger sequence: `CALL_IN -> SEN1_IN -> EXT_SEN -> SEN2_IN(aurora 200)`

the EXT_SEN's location for Aurora100



the EXT_SEN's location for Aurora200



LED state

we can use this cmd to blink the user-define LED.

```
cd ~/aurora_test/LED_state  
./LED_test.sh
```

Relay

If you want to test relay of aurora 100 You can use this cmd.

```
gpio set 71 #make NO connect to GND  
gpio clear 71 #make NO disconnect to GND  
gpio set 47 #make NO-R connect to GND  
gpio clear 47 #make NO-R disconnect to GND
```

If you want to test relay of aurora 200 You can use this cmd.

```
gpio set 71 #make NO connect to GND  
gpio clear 71 #make NO disconnect to GND  
gpio set 47 #make NO-R connect to GND  
gpio clear 47 #make NO-R disconnect to GND  
gpio set 27 #make NO-C connect to GND  
gpio clear 27 #make NO-C disconnect to GND
```

and the pin's location you can view [Extern-Interface-pinout](#).

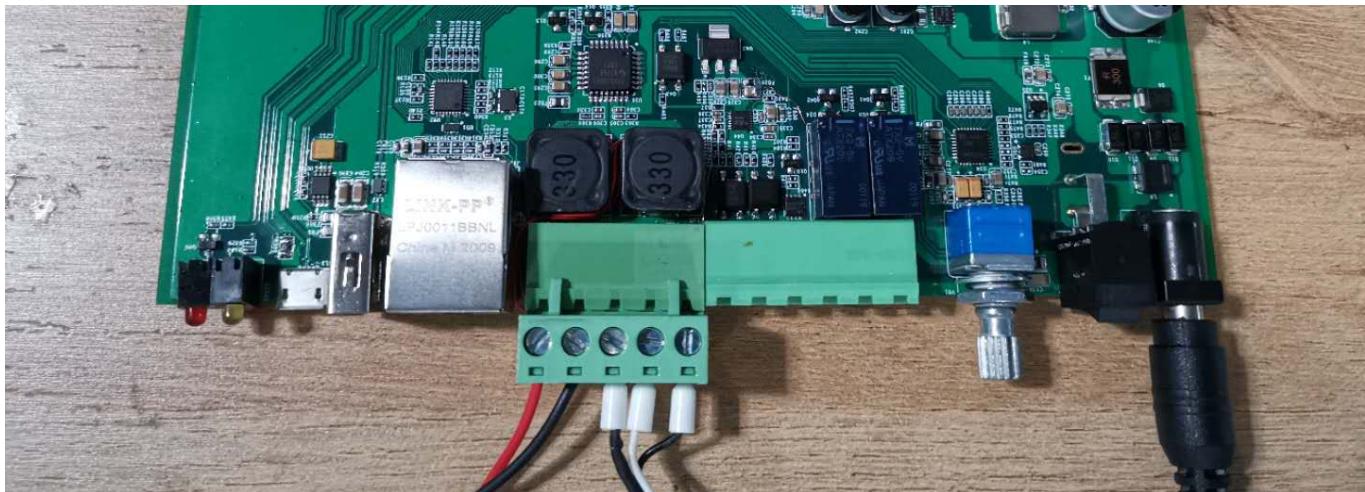
Voice card

the voice card needs some time to setup after power on. So we need to check voice card setup successful before run [./power_on_voice.sh](#).we can use aplay -l to check whether set up successful. we can get this message if set up successful.

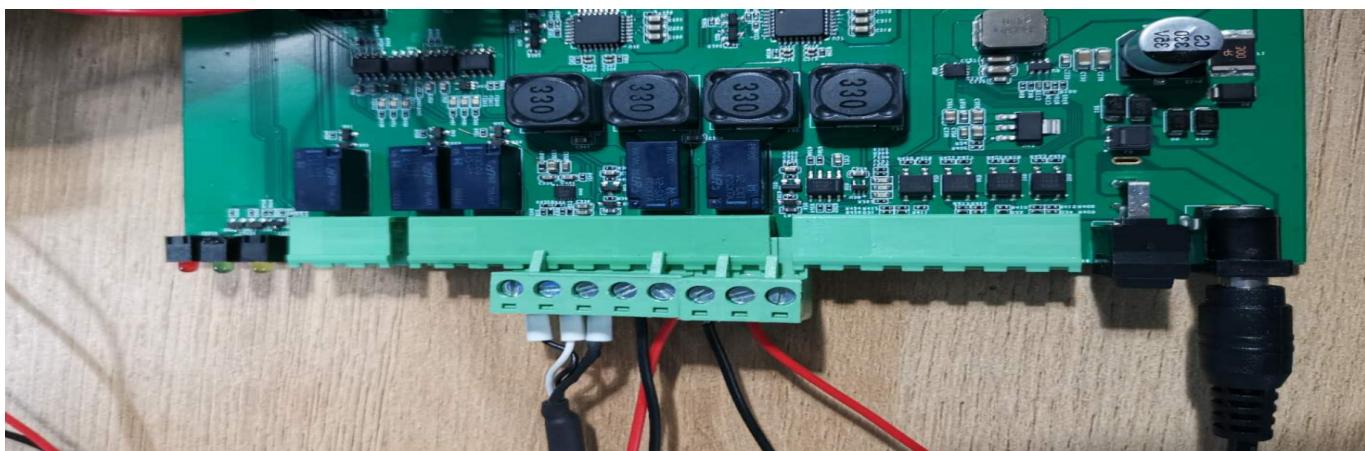
```
debian@beaglebone:~/aurora_test/voice_card$ aplay -l  
**** List of PLAYBACK Hardware Devices ****  
card 0: B [AudioCape Rev B], device 0: davinci-mcasp.0-tlv320aic3x-hifi tlv320ai  
c3x-hifi-0 [davinci-mcasp.0-tlv320aic3x-hifi tlv320aic3x-hifi-0]  
Subdevices: 1/1  
Subdevice #0: subdevice #0
```

It is very important to check the connection of the Speaker and the Mic.and the pin's location you can view [Extern-Interface-pinout](#).

For Aurora100



For Aurora200



if you use aurora 100 we can use this cmd to test it.

```
cd ~/aurora_test/voice_card  
./power_on_voice.sh 1
```

if you use aurora 200 we can use this cmd to test it.

```
cd ~/aurora_test/voice_card  
./power_on_voice.sh 1 #the one speaker  
./power_on_voice.sh 2 #the other speaker
```

you can hear your speech from the Speaker if you speak to the mic.and you can adjust the knob to modify the sound volume for hardware side.the software also supports adjust the sound volume by using [alsamixer](#).

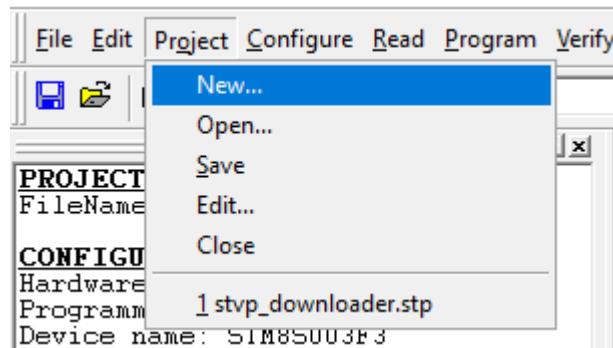
```
sudo alsamixer
```

The asound.conf and asound.state that you can found by accessing [github](#).

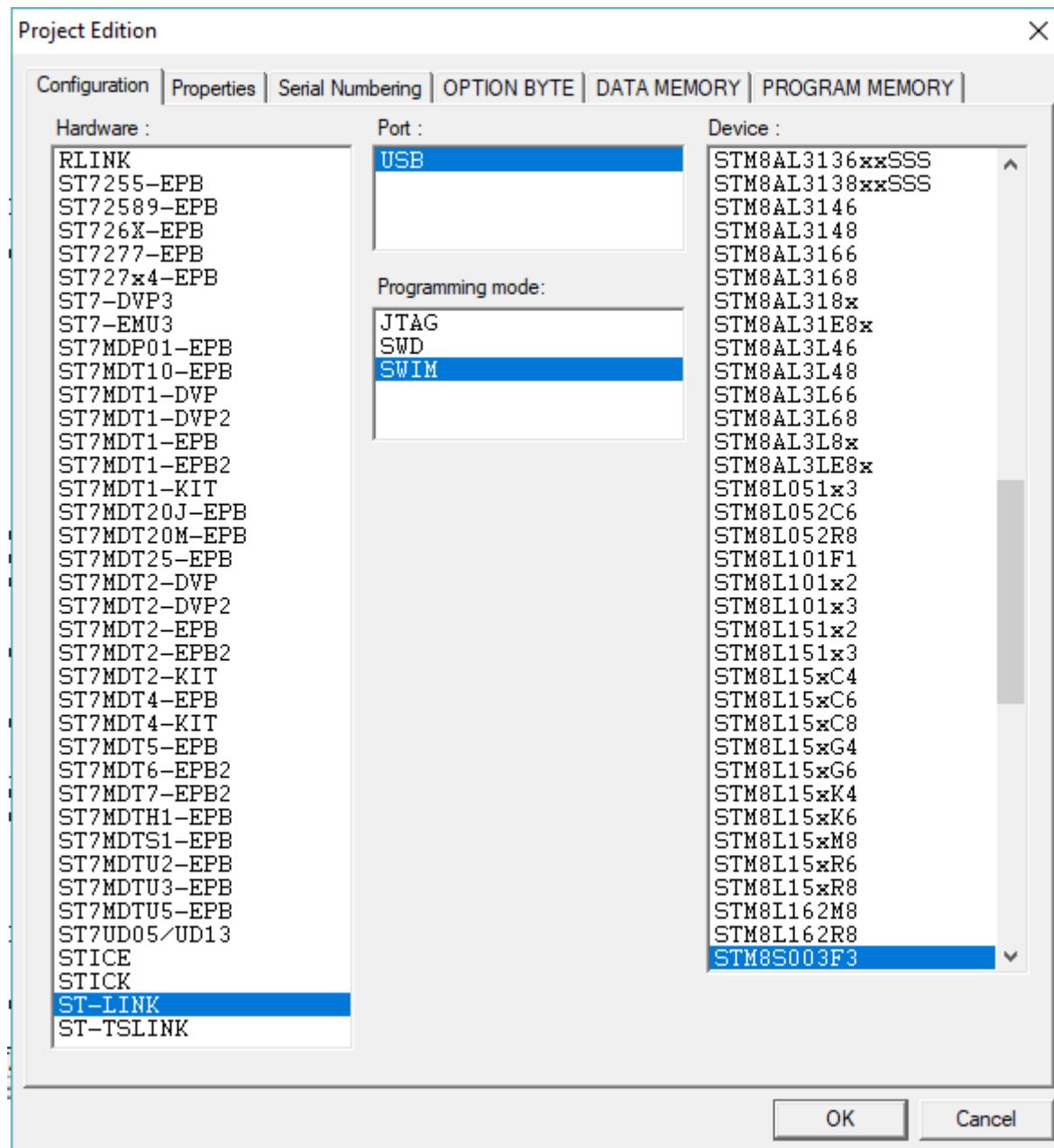
Update STM8 firmware

- **Step 1.** Download [stvp](#) that is a download tool for stm8.
 - **Step 2.** Open the stvp and config it.

Click Project -> New



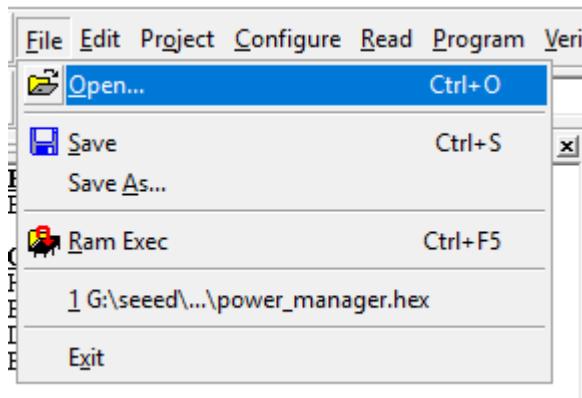
Select ST-Link ->SWIM->STM8S00F3



- **Step 3.** download [firmware](#)
- **Step 4.** Connect STM8 to the computer by ST-link



- **Step 5.** Open the firmware then burn it to stm8



burn the firmware

```

project [stvp_downloader.stp] - STVP

File Edit Project Configure Read Program Verify Erase Blank-Check View Help
STM8S003F3

PROJECT:
FileName: stvp_downloader.stp

CONFIGURATION:
Hardware: ST-LINK
Programming mode: SWIM
Device name: STM8S003F3
Port: USB

PROGRAM MEMORY status:
[0x008000 - 0x009FFF]
File: power_manager.hex Checksum: 0x
Programmed
Memory checksum: 0x72A41

DATA MEMORY status:
[0x004000 - 0x00407F]
No File
Programmed
Memory checksum: 0x0

OPTION BYTE status:
No File
Not programmed
Option byte 0: 00
Option byte 1: 00
Option byte 2: 00
Option byte 3: 00
Option byte 4: 00
Option byte 5: 00
Memory checksum: 0x0

00008010 82 00 94 63 82 00 94 64 80 00 94 65 82 00 94 66
00008020 82 00 94 67 82 00 94 68 82 00 94 52 82 00 94 52
00008030 82 00 94 69 82 00 94 68 82 00 94 68 82 00 94 6C
00008040 82 00 94 6D 82 00 94 52 82 00 94 52 82 00 94 6E
00008050 82 00 94 6F 82 00 94 70 82 00 94 52 82 00 94 52
00008060 82 00 94 71 82 00 93 8B 82 00 94 72 82 00 94 52
00008070 82 00 94 52 82 00 94 52 82 00 94 52 82 00 94 52
00008080 CD 87 E1 CD 87 E6 88 3B 00 04 53 00 05 3B 00 06
00008090 3B 00 07 52 04 CD 88 88 5F 1F 00 5F 01 F3 5F BF
000080A0 0E BF 0C BE 08 A3 00 09 26 05 BE 0A A3 89 69 25
000080B0 0E AE 00 61 BF 02 5F BF 00 AE 8E 3 CD 94 5E 0D
000080C0 09 27 14 7B 09 A1 10 27 0E AE 00 63 BE 02 5F BF
000080D0 00 AE 8E 63 CD 94 5E 0D 08 27 20 73 08 A1 10 27
000080E0 1A 7B 08 A1 20 27 14 7B 08 A1 30 27 0E AE 00 63
000080F0 BF 02 5F BF 00 AE 8E 63 CD 94 5E 0D 07 27 1A 7B
00008100 07 A1 04 27 14 7B 07 A1 06 27 0E AE 00 64 BF 02
00008110 5F BF 00 AE 8E 63 CD 94 5E 7B 05 A1 08 27 3E 7B
00008120 05 A1 40 27 38 7B 05 A1 04 27 32 7B 05 A1 80 27
00008130 2C 7B 05 A1 0C 27 26 7B 05 A1 0C 27 20 7B 05 A1
00008140 44 27 1A 7B 05 A1 C0 27 14 7B 05 A1 88 20 0E AE
00008150 00 65 BF 02 5F BF 00 AE 8E 63 CD 94 5E 0E 06 A4
00008160 88 A1 88 27 18 7B 06 A4 44 A1 44 27 10 7B 06 A4
00008170 22 A1 22 27 07 08 7B 06 A4 1A 11 26 0E AE 00 66
00008180 BF 02 5F BF 00 AE 8E 63 CD 94 5E 72 19 52 30 7B
00008190 09 CA 52 34 C7 52 34 C6 52 36 A4 C7 C7 52 36 7B
000081A0 08 CA 52 36 C7 52 36 C6 52 34 A4 F9 C7 52 34 7B
000081B0 07 CA 52 34 C7 52 34 C6 52 32 6B 01 72 5F 52 32
000081C0 C6 52 33 A4 0F C7 52 33 C6 52 33 A4 F0 C7 52 33
000081D0 CD 89 47 A6 04 CD 85 6F CD 88 95 CD 80 C1 CD 88
000081E0 7B CD 85 02 CD 90 AF 01 CD 88 47 A6 04 CD 85 6F
000081F0 CD 88 88 CD 8C C1 CD 84 70 00 00 64 CD 88 6E
00008200 CD 85 02 CD 88 95 CD 90 87 01 CD 84 70 00 00 00
00008210 64 CD 88 61 CD 88 54 CD 84 55 A6 04 CD 85 6F CD
00008220 84 FF 00 00 00 64 B6 03 C4 00 AF CA 52 33 C7 52 33
00008230 1E 03 CD 91 A1 9F A4 F0 CA 52 33 C7 52 33 1E 03
00008240 9F CA 52 32 C7 52 32 C6 52 35 A4 F3 C7 52 35 C6
00008250 52 36 A4 F8 C7 52 36 7B 06 A4 07 CA 52 36 C7 52
00008260 36 7B 05 A4 04 A1 00 27 06 72 16 52 35 20 04 72
00008270 17 52 35 7B 05 A4 08 A1 00 27 06 72 14 52 35 20
00008280 04 72 15 52 35 7B 06 A4 80 A1 00 27 06 72 17 52
00008290 36 20 04 7B 06 A4 08 CA 52 36 C7 52 36 5B 09 CC
000082A0 88 3C CD 87 E1 CD 87 E6 B7 0E 45 00 08 45 01 09
000082B0 45 02 DE 45 03 0D 45 04 0E 45 05 0A 45 06 0B 3D
000082C0 0F 27 14 B6 0F A1 01 27 0E AE 00 5B BF 02 5F BF
000082D0 00 AE 8F 03 CD 94 5E 3D 08 27 4A B6 08 A1 01 27
000082E0 44 B6 08 A1 02 27 3E B6 08 A1 03 27 38 B6 08 A1

```

成功的现象

Appendix