DEBIX User Manual

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Editor: Polyhex Technology Company Limited (http://www.polyhex.net/)

In recent years, with the ever-increasing product demand in fields of application such as smart home, smart security, video surveillance and industrial automation, AI chips capable of resolving problems in these fields have also emerged. Polyhex Technology has responded to this demand with the launch of DEBIX, a development board based on NXP NPU processor i.MX 8M Plus. It focuses on machine learning, vision processing, and industrial IoTs, meeting the application needs of commercial and industrial fields such as education, security monitoring, industrial automation, smart homes and smart cities.

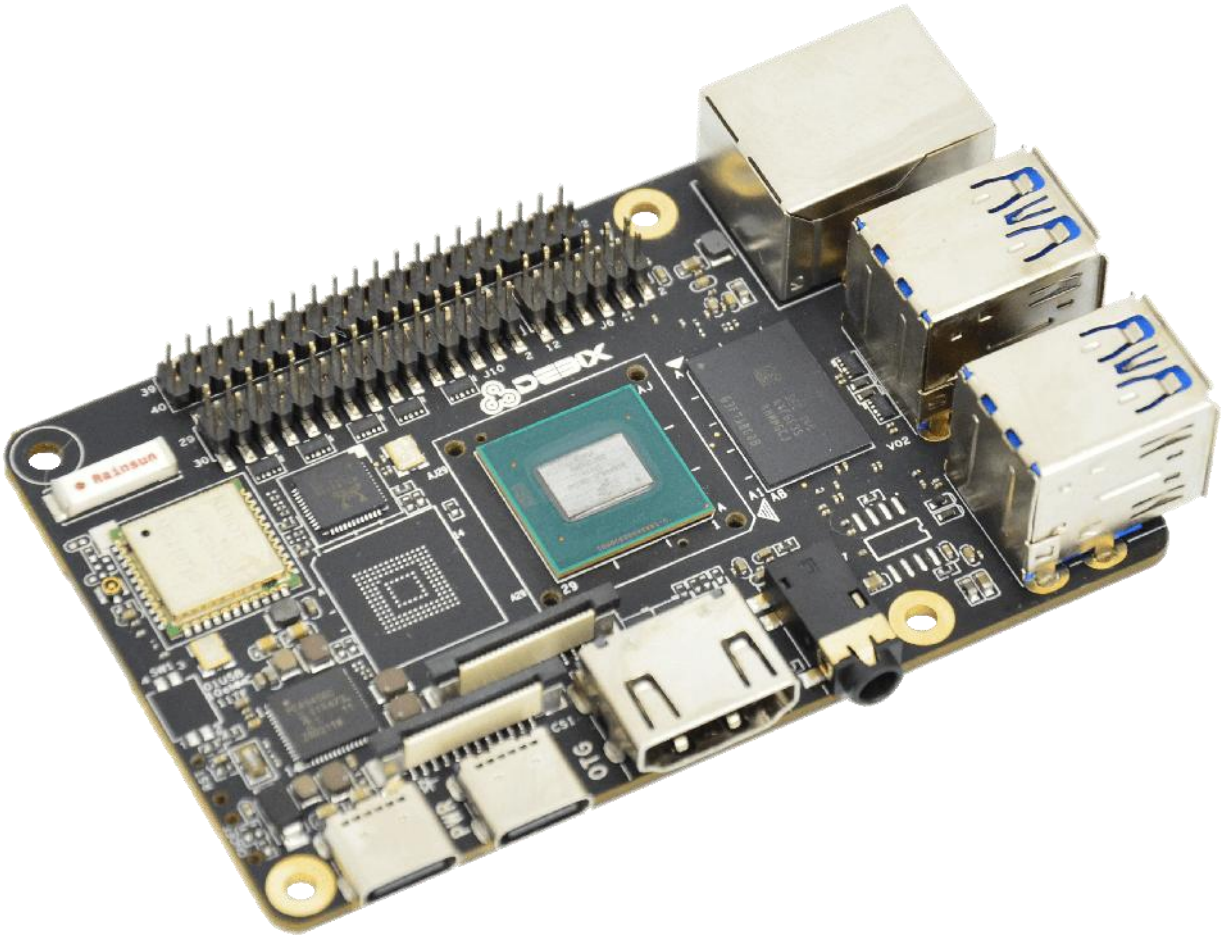

Figure 1

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Chapter 1 About DEBIX

DEBIX is essentially a versatile single board computer, which can be widely used in artificial intelligence, machine learning, industry 4.0, edge computation, gateway, IoT, security monitoring etc..

The following are some of the powerful features of DEBIX:

- Powerful Quad Core Arm ® Cortex ® -A53 CPU with a Neural Processing Unit (NPU) operating at up to 2.3 TOPS.
- The multimedia capabilities include video encode (including h.265) and decode, 3D/2D graphic acceleration, and multiple audio and voice functionalities.
- Real-time control with Cortex-M7. Robust control networks supported by dual CAN FD and dual Gigabit Ethernet with Time Sensitive Networking (TSN).
- High industrial reliability with DRAM inline ECC.
- Designed for severe environmental conditions and industrial grade temperature requirements. The wide CPU temperature range of -40°C to 105°C makes it suitable for extreme operation environments like public transportation and industrial control etc.
- The size of the board is nearly the same with a credit card, it has multiple extended ports. This allows DEBIX to give full processor performance while being free from application restrictions in physical space.
- Support mainstream operating systems including Android, Ubuntu and Yocto.

DEBIX has a clear edge in the area of facial and object recognition applications which combine machine learning and visual processing. Take facial recognition as an example: DEBIX can simultaneously detect and identify the body frames and facial features of multiple people. It can also be used in traffic control to identify vehicle types and information of drivers. Using NPU to perform recognition operations not only increases the recognition speed, but also sees a noticeable reduction to the burden on the CPU.

DEBIX's TSN technology makes it essential for Industrial 4.0 applications, as it meets the needs of industrial enterprises with precision oriented production time control, thus increasing the interconnection speed of the IoT.

DEBIX Structure Overview

DEBIX's interface features a compact arrangement, the interface components are visible at a glance. Let's learn more about DEBIX's interface through the following Figure 2.

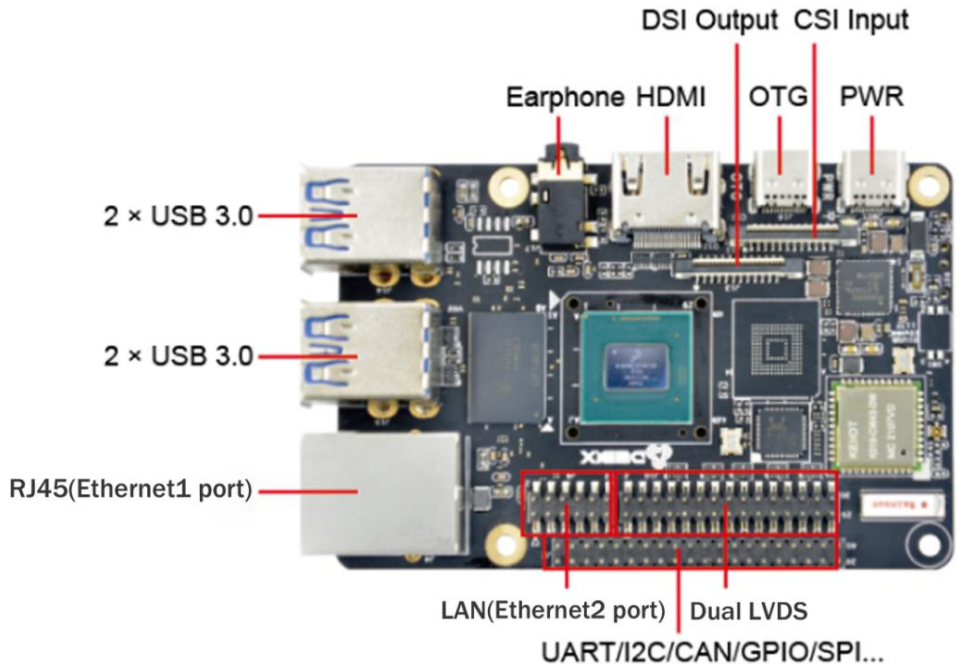


Figure 2

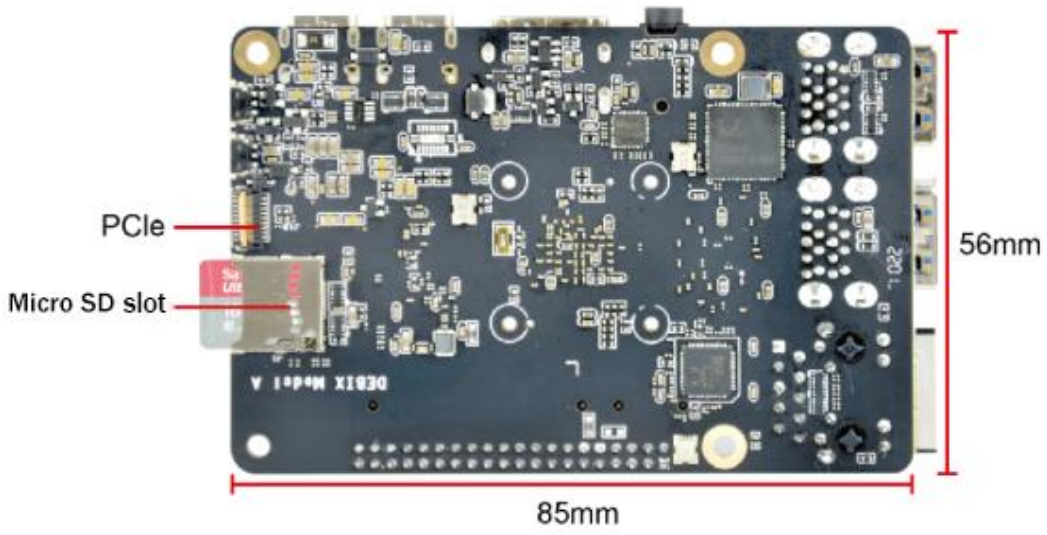


Figure 3

DEBIX uses NXP i.MX 8M Plus based SoC, it has 2GB/4GB/6GB/8GB memory, supports Gigabit Ethernet, dual-band wireless network and Bluetooth 5.0. The data specifications are as below:

System	
CPU	NXP i.MX 8M Plus (default), 4 x Cortex-A53, comes with an integrated neural processing unit (NPU) that delivers up to 2.3 TOPS. Industrial grade CPU runs at 1.6GHz, and commercial grade CPU runs at up to 1.8GHz. (i.MX 8M Plus series CPU optional) with C520L 3D GPU andGC7000UltraLite 3D GPU
Memory	2GB LPDDR4 (4GB/6GB optional)
Storage	Default: Micro SD card(The Micro SD card should be prepared by the users themselves, the capacity can be 8GB/16GB/32GB/64GB/128GB) (Onboard 8GB/16GB/32GB/64GB/128GB eMMC optional)
Operating System	Android 11、Ubuntu 20.04 、Yocto-L5.10.72_2.2.0
I/O Interfaces	
Gigabit Network	10/100/1000M 2 Ethernet interfaces • 1 x RJ45 with POE power supply (need POE power supply module) • 1 x pin header (without network transformer)
WIFI & BT	2.4G & 5G dual-frequency WIFI, BT5.0
USB	4 x USB 3.0 Host Type-A, 1 x USB 2.0 OTG Type-C
Audio	1 x 3.5mm headphone and composite microphone port
HDMI	1 x HDMI OUT
Expansion	
40-Pin Double-Row Headers	(1) 3 x UART, 2 x SPI, 2 x I2C, 2 x CAN, 1 x PWM, 2 x GPIO, dedicated interfaces can be reused as GPIO ports (2) 1 x SPDIF digital audio input/output (3) 5V power supply, system reset, ON/OFF
LVDS	1 x LVDS, single & dual channel 8bit, double-row pin headers
MIPI CSI	1 x MIPI CSI, support 4-lane, 24Pin 0.5mm Pitch FPC socket
MIPI DSI	1 x MIPI DSI, support 4-lane, 24Pin 0.5mm Pitch FPC socket
PCIe	1 x PCIe, support PCIe x1, 19Pin 0.3mm Pitch FPC socket
Power Supply	

Power Supply	DC 5V/3A Type-C
Mechanical & Environmental	
Size	85.0mm x 56.0mm
CPU Temperature	-40 ˚ C to 105 ˚ C

DEBIX Tech Specs

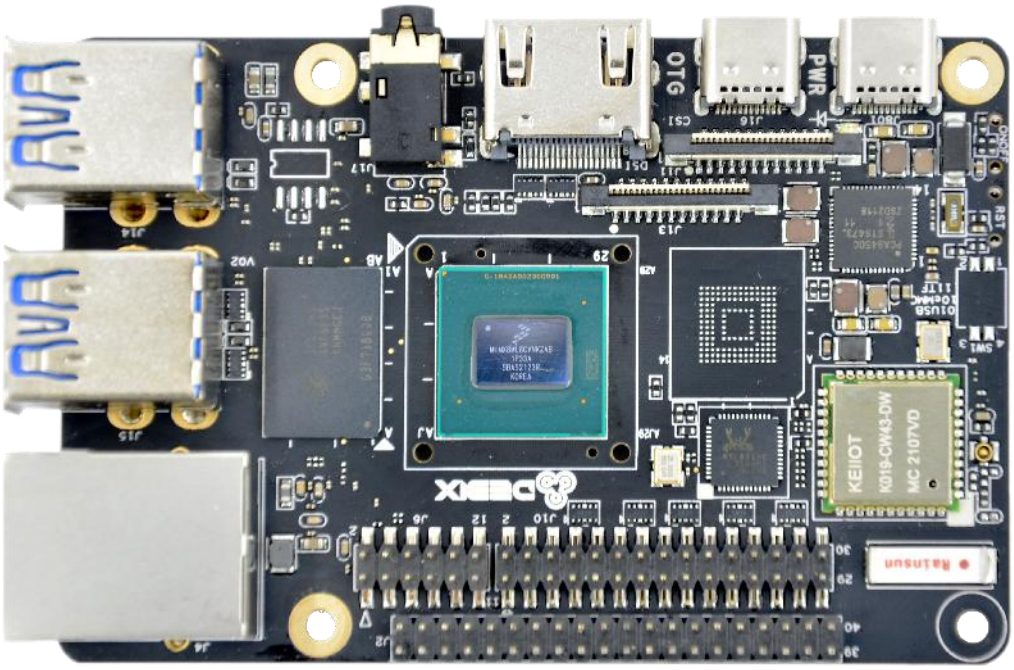


Figure 4

Like any standard computer, DEBIX consists of a range of different computer components. The most important component is the "brain" of the computer, the system-on-chip/SoC in the center at the front of the motherboard.

The SoC contains most of the components of the computer, often containing both the central processing unit (CPU) and the graphics processing unit (GPU). Next to the SoC you will find another larger chip, the random access memory (RAM).

Figure 5 CPU&GPU

Figure 6 RAM

There is a component with a metal cover in the upper left corner of the motherboard, it contains the wireless communication module which contains the wireless network card and Bluetooth components.

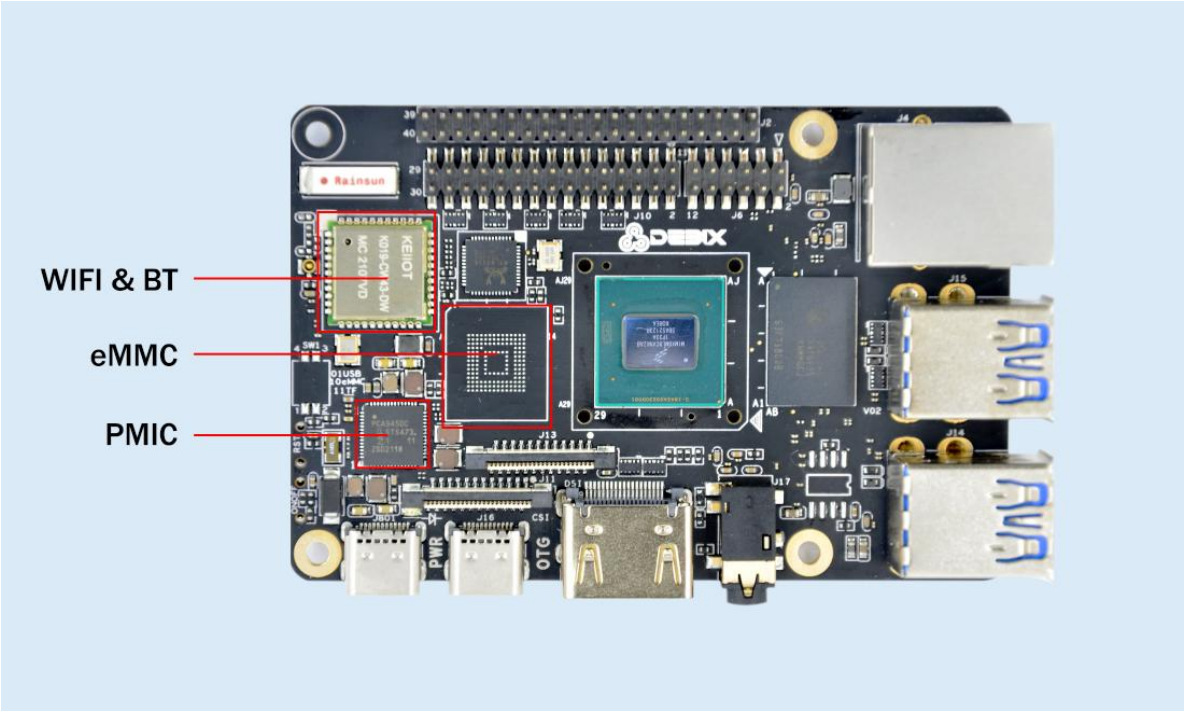


Figure 7

The eMMC is in the right down direction of WIFI & BT, it integrates a controller in its enclosure, provides standard interfaces and manage the flash. The PMIC(PCA9450c) is in the right down corner of the motherboard, it manages the power devices of the host machine.

DEBIX I/O Interfaces

DEBIX has 4 USB3.0 Host A ports, they are all USB3.0 interfaces. The Ethernet port is on the right side of the USB 3.0, it connects DEBIX to the network through a cable with an RJ45 connector. There are two status indicators below the Ethernet port to show the signal upstream or downstream status, one is Link, the other is Active:

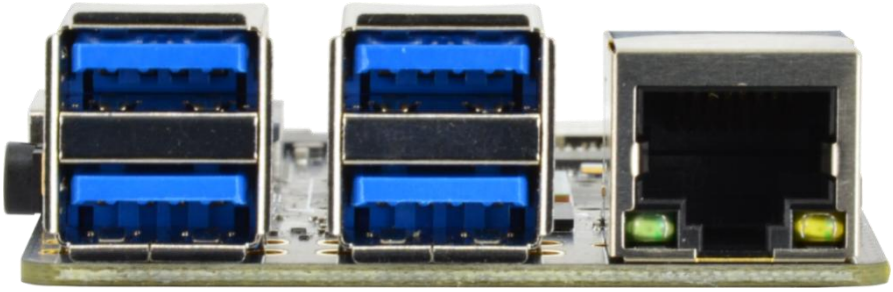


Figure 8

There is a 3.5mm headphone interface with audio input/output function on the edge of the board. Next to the headphone interface, there is a Type A HDMI connector for connecting a display device, TV or projector. On the left side, there is a multifunctional OTG port for programming, system updating, or USB drive & hard disk connecting etc. Next to the OTG interface is the USB Type-C power port for DEBIX power supply. We recommend using a 5V/3A power adapter to ensure sufficient power supply.

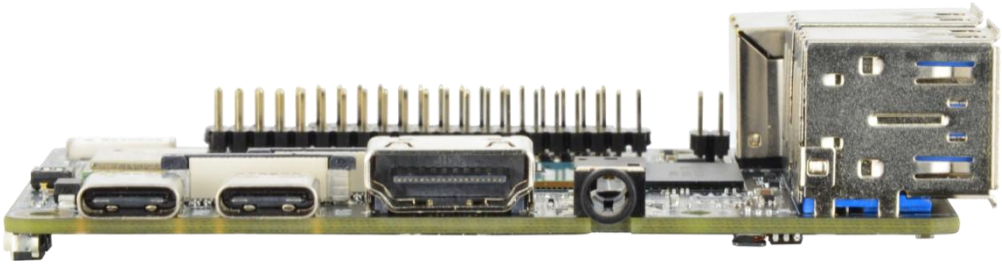


Figure 9

Next to the OTG port is the CSI connector for camera module connection. There is also a DSI connector for MIPI touch screen connection.

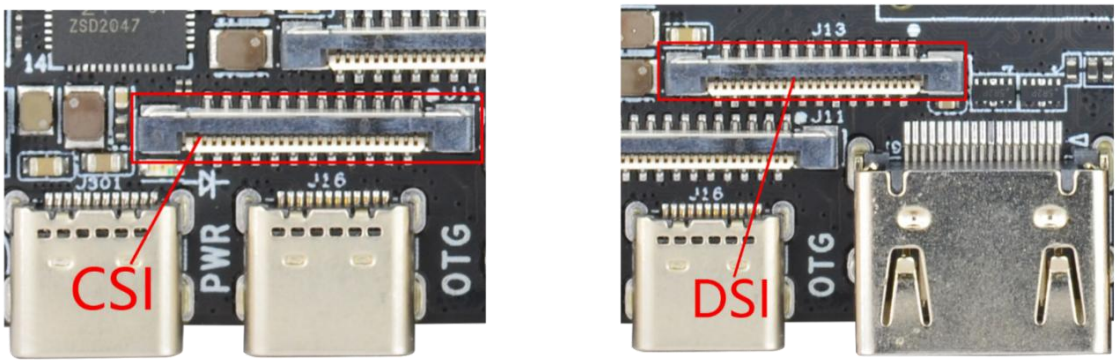


Figure 10

The 40-pin GPIO connectors on one side of DEBIX are for external hardware connections such as LEDs, buttons, sensors, and functional modules, among the 40 pins, the 4 pins on the right side of the 40 pins are called POE (Power Over Ethernet) connectors.

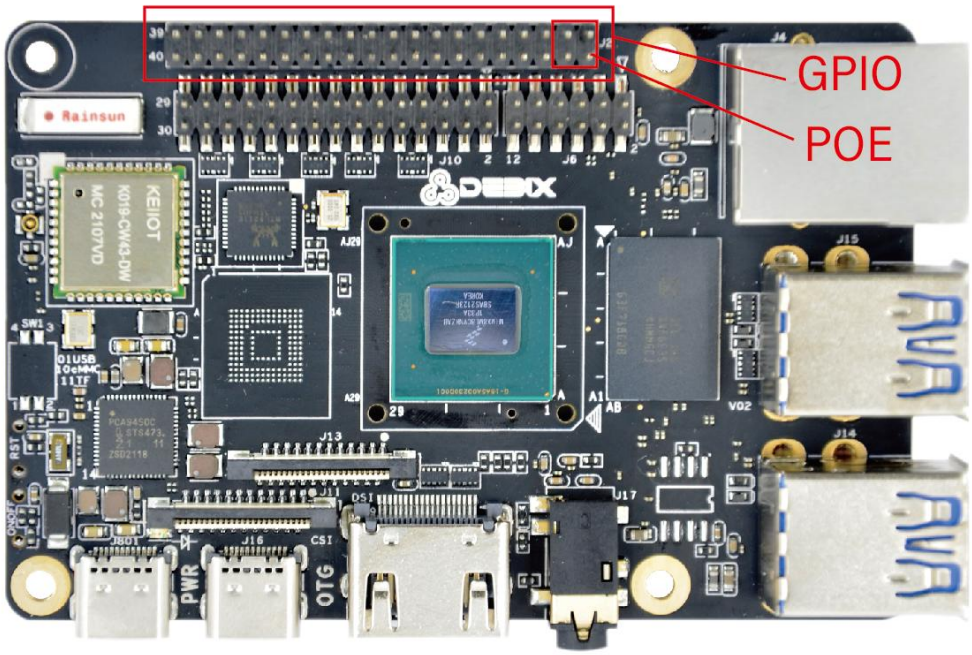


Figure 11

U77410n0der the GPIO pins, there are two connectors, the right side connector J6 is 2x6Pin LAN pins for connecting to the local network, the left side connector J10 is 2x15Pin LVDS pins, it is a LVDS display output interface, it support single channel and dual channel LVDS display.

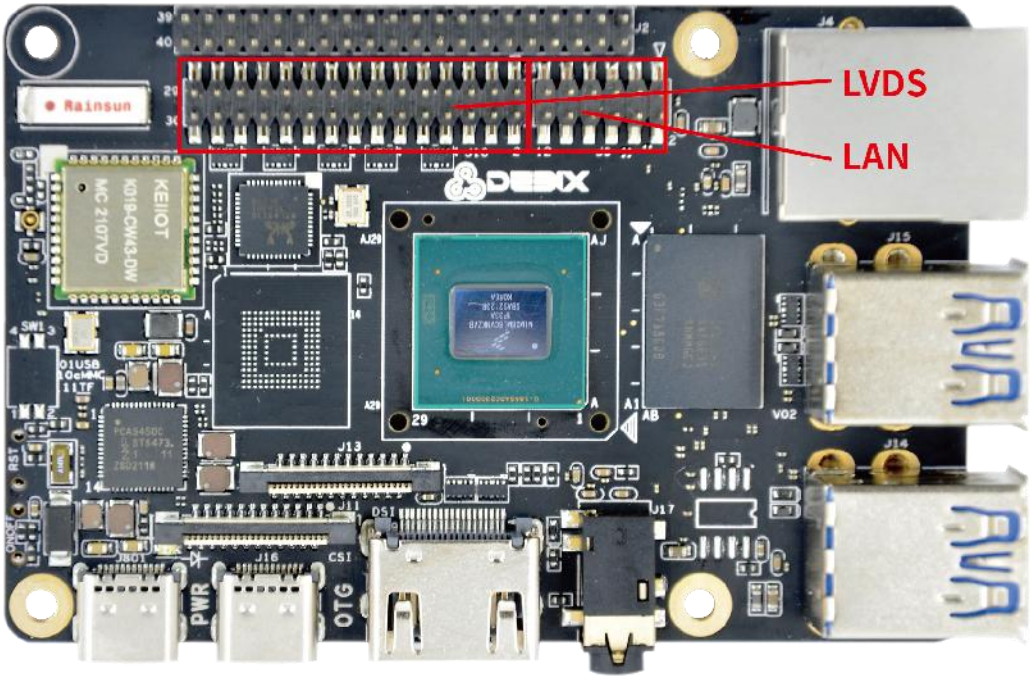


Figure 12

The Micro SD card slot is on the back of the motherboard. Insert the Micro SD card with the installed system in the slot, and then power it up to boot.

There is a connector beside the Micro SD card slot. The J18 connector is a 19Pin PCIe pin, which can be used to connect some independent accessories, such as PCIe to USB.

PCIe connector is FH26W-19S-0.3SHW(97). please refer to FH26W-19S-0.3SHW(97) on website https://www.debix.io/. The corresponding wire material shall meet the above connector interface requirements.

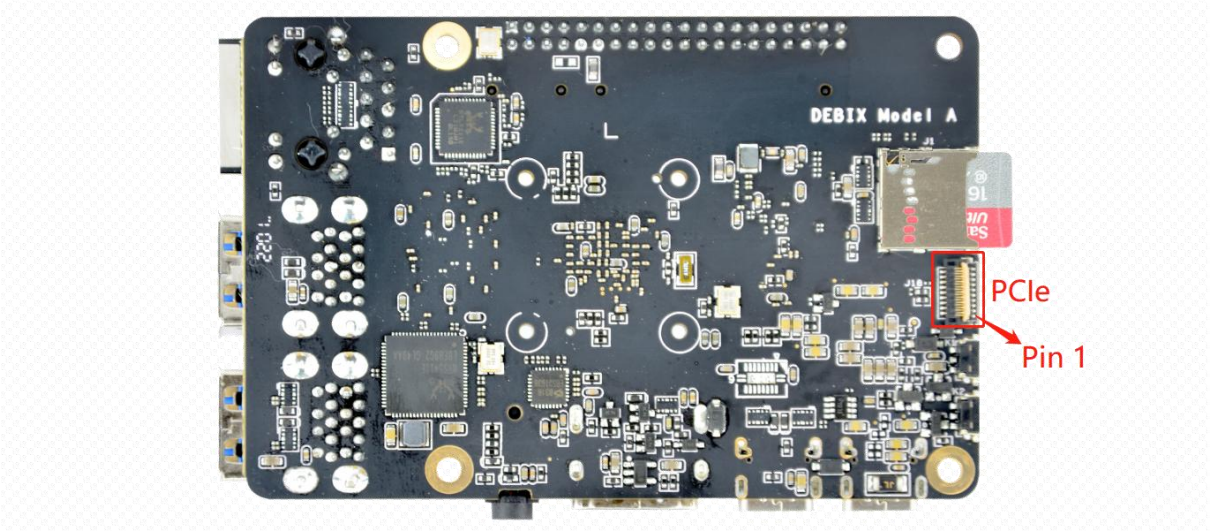


Figure 13

PCIe interface pins are defined as follows:

Pins	Definition	CPU PAD/Pin
1	VDD_3V3	-
2	VDD_5V	-
3	VDD_1V8	-
4	GND	-
5	GND	-
6	GND	-
7	SAI2_MCLK	AJ15
8	SAI2_RXFS	AH17
9	SAI2_RXC	AJ16
10	GND	-
11	PCIE_CLKN	E16
12	PCIE_CLKP	D16
13	GND	-
14	PCIE_TXN	B15
15	PCIE_TXP	A15
16	GND	-
17	PCIE_RXN	B14
18	PCIE_RXP	A14
19	GND	-

Display Interface

i.MX 8M Plus supports the following displays:

- One LCDIF driver for MIPI DSI, Up to UWHD and WUXGA
- One LCDIF driver for LVDS Tx, Up to 1920x1080p60
- One LCDIF driver HDMI Tx, 4kp30

When less than or equal to 2 LCD interfaces are used at the same time, each LCD interface supports 1920x1200p60 display. When 3 LCD interfaces are used at the same time, it supports 2 1080p60 + HDMI 4kp30.

HDMI Interface

DEBIX Model A has an HDMI connector (J9) at the lower right. The connector is a type A HDMI mother base, which is used to connect the display, TV or projector.

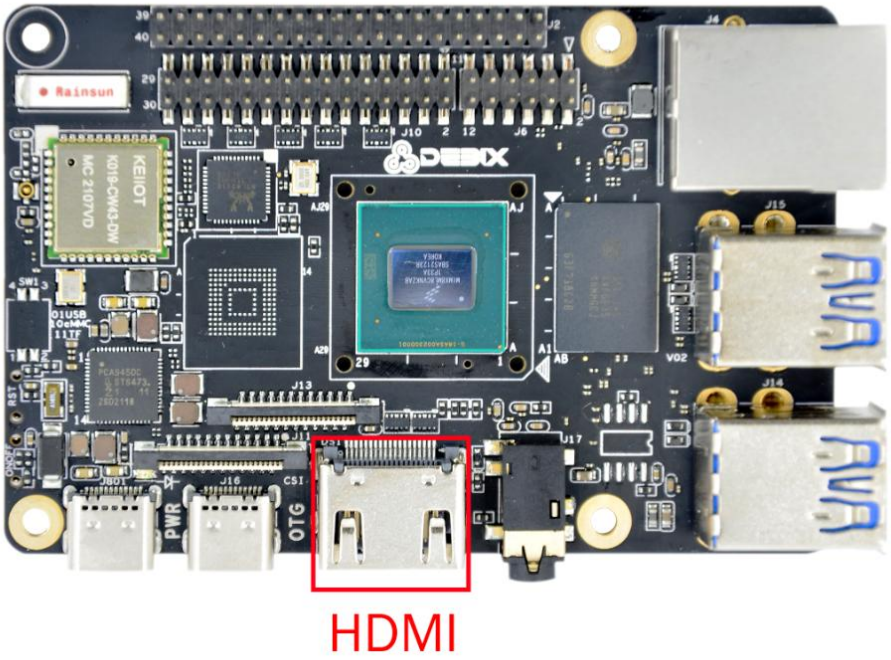


Figure 14

The supported HDMI resolutions are as follows:

- 740x480p60, 720x480p60, 1280x720p60, 1920x1080p60, 1920x1080p120, 3840x2160p30.

The pin sequence is as shown in the figure:

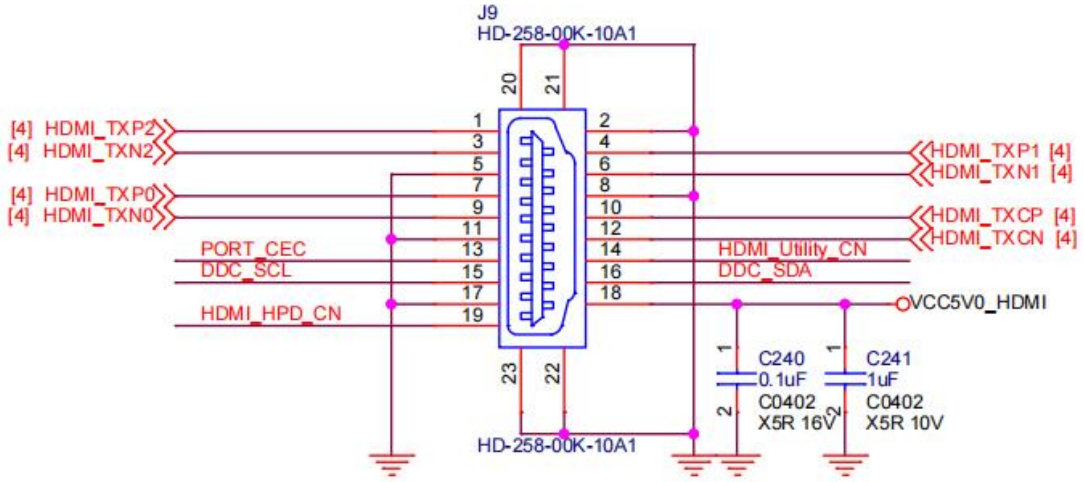


Figure 15

The HDMI interface is defined as follows:

Pins	Definition	Pins	Definition
1	HDMI-TXP2	2	GND
3	HDMI-TXN2	4	HDMI-TXP1
5	GND	6	HDMI-TXN1
7	HDMI-TXP0	8	GND
9	HDMI-TXN0	10	HDMI-TXCP
11	GND	12	HDMI-TXCN
13	PORT_CEC	14	HDMI_Utility_CN
15	DDC_SCL	16	DDC_SDA
17	GND	18	VDD5V
19	HDMI_HPD_CN	20	GND
21	GND	22	GND
23	GND		

LVDS Interface

The LVDS display bridge (LDB) connects the LCDIF inside the CPU with the external LVDS display device. The purpose of the LVDS display bridge (LDB) is to transmit synchronous RGB data to an external display device through the LVDS interface.

The LVDS interface is used for the following:

1.Single channel (4 lanes) 80MHz pixel clock and LVDS clock output. It supports resolutions up to 1366x768p60.

2.Asynchronous dual channel (8 data, 2 clocks). This is for a screen with two interfaces, which are transmitted through two channels (odd pixel/even pixel). It supports pixels higher than 1366x768p60 and up to 1080p60.

The left tag J10 connector of GPIO connector of DEBIX Model A is 2x15Pin, which is an LVDS display output interface and supports single or dual LVDS display.

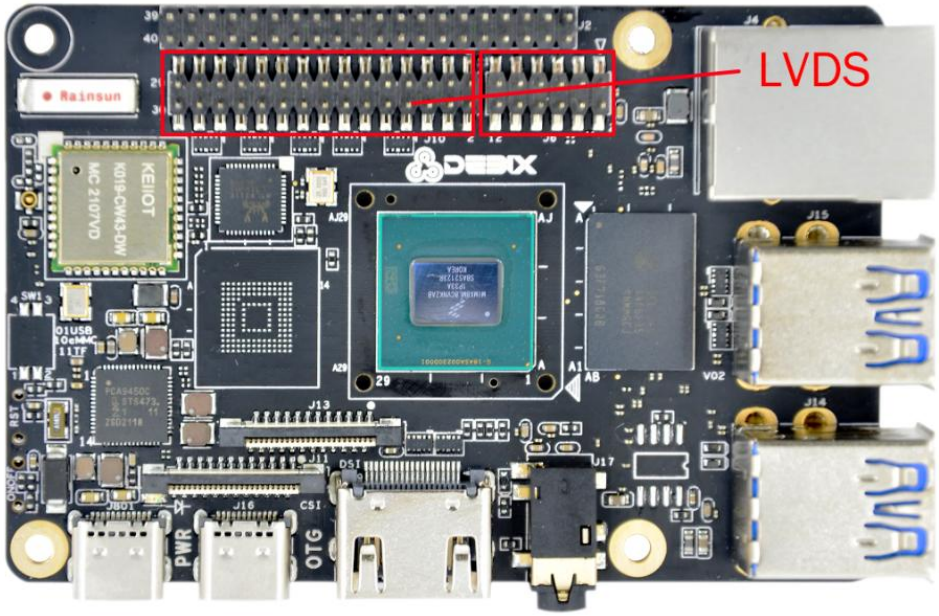


Figure 16

The pin sequence is shown in the figure:

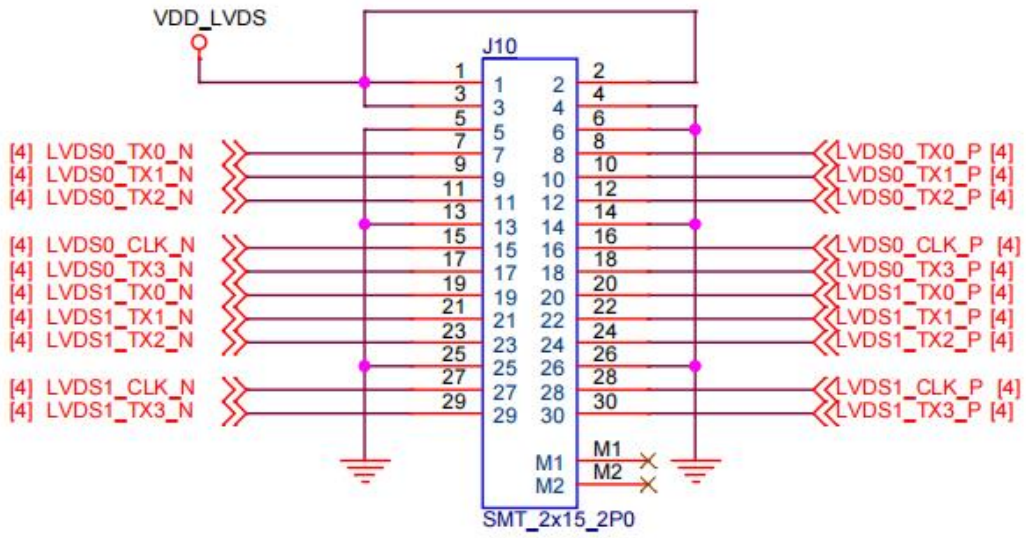


Figure 17

The interface is defined as follows:

Pins	Definition	Description
1	VDD_LVDS	Default 5V（3.3V,5V,12-36V optional）
2	VDD_LVDS	Default 5V（3.3V,5V,12-36V optional）
3	VDD_LVDS	Default 5V（3.3V,5V,12-36V optional）
4	GND	To Ground
5	GND	To Ground
6	GND	To Ground
7	LVDS0_TX0_N	LVDS0 Differential data channel 0（-）
8	LVDS0_TX0_P	LVDS0 Differential data channel 0（+）
9	LVDS0_TX1_N	LVDS0 Differential data channel 1（-）
10	LVDS0_TX1_P	LVDS0 Differential data channel 1（+）
11	LVDS0_TX2_N	LVDS0 Differential data channel 2（-）
12	LVDS0_TX2_P	LVDS0 Differential data channel 2（+）
13	GND	To Ground
14	GND	To Ground
15	LVDS0_CLK_N	LVDS0 Clock differential signal path（-）
16	LVDS0_CLK_P	LVDS0 Clock differential signal path（+）
17	LVDS0_TX3_N	LVDS0 Differential data channel 3（-）
18	LVDS0_TX3_P	LVDS0 Differential data channel 3（+）
19	LVDS1_TX0_N	LVDS1 Differential data channel 0（-）
20	LVDS1_TX0_P	LVDS1 Differential data channel 0（+）
21	LVDS1_TX1_N	LVDS1 Differential data channel 1（-）
22	LVDS1_TX1_P	LVDS1 Differential data channel 1（+）
23	LVDS1_TX2_N	LVDS1 Differential data channel 2（-）
24	LVDS1_TX2_P	LVDS1 Differential data channel 2（+）
25	GND	To Ground
26	GND	To Ground
27	LVDS1_CLK_N	LVDS1 Clock differential signal path（-）
28	LVDS1_CLK_P	LVDS1 Clock differential signal path（+）
29	LVDS1_TX3_N	LVDS1 Differential data channel 3（-）

30	LVDS1_TX3_P	LVDS1 Differential data channel 3（+）

DSI Interface

Key features of MIPI DSI include：

The commonly used MIPI DSI resolutions are supported as follows:

- 1080 p60, WUXGA (1920x1200) at 60 Hz, 1920x1440 at 60 Hz, UWHD (2560x1080) at 60 Hz
- Maximum resolution up to WQHD(2560x1440), it depends on bandwidth between input clock (video clock) and output clock (D-PHY HS clock)

The MIPI-DSI interface (J13) of DEBIX Model A can be used to connect the MIPI display touch screen, as follows: the connector is 2 * 10Pin/1.25mm pin base.

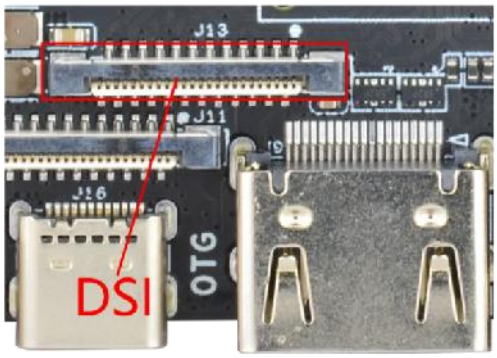


Figure 18

The pin sequence is as shown in the figure:

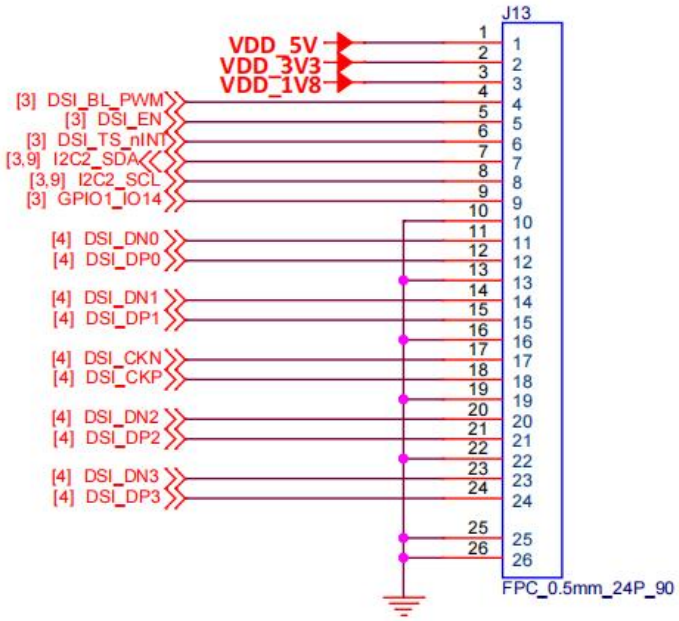


Figure 19

The interface is defined as follows:

Pins	Definition	Description
1	VDD_5V	5V input
2	VDD_3V3	3.3V input
3	VDD_1V8	1.8V input
4	DSI_BL_PWM	Backlight control signal
5	DSI_EN	LCD enable signal
6	DSI_TP_nINT	touch interrupt pin
7	DSI_I2C_SDA	Touch the clock terminal of I2C (controlled by I2C2)
8	DSI_I2C_SCL	Touch the clock terminal of I2C (controlled by I2C2)
9	GPIO1_IO14	IO control pin
10	GND	Ground terminal
11	DSI_DN0	DSI Differential data channel 0（-）
12	DSI_DP0	DSI Differential data channel 0（+）
13	GND	Ground terminal
14	DSI_DN1	DSI Differential data channel 1（-）
15	DSI_DP1	DSI Differential data channel 1（+）
16	GND	Ground terminal
17	DSI_CKN	DSI Differential Clock Channels（-）
18	DSI_CKP	DSI Differential Clock Channels（+）
19	GND	Ground terminal
20	DSI_DN2	DSI Differential data channel 2（-）
21	DSI_DP2	DSI Differential data channel 2（+）
22	GND	Ground terminal
23	DSI_DN3	DSI Differential data channel 3（-）
24	DSI_DP3	DSI Differential data channel 3（+）
25	GND	Ground terminal
26	GND	Ground terminal

Chapter 2 DEBIX Installation Guide

DEBIX is designed to maximize the ease of use and convenience for users, as much as possible, while making sure it still works normally like a standard computer.

You will need to prepare the following peripherals to make it work:

Power adapter - DC5V power adapter, at least 3A rated current, equipped with USB Type-C Output.

Figure 20

Micro SD card - DEBIX operating system is installed on it, the minimum capacity requirement is 8GB, 16GB or larger capacity (32GB/64GB/128GB) is recommended.
Note: If you need to change the Micro SD card of system, please power off the system beforehand.

Figure 21

USB keyboard and mouse - Any standard USB computer keyboard and mouse will do. They should work normally after being inserted into the USB interfaces.

Figure 22

HDMI Cable - Being used to connect to a TV, projector, or display device that supports HDMI input. If your display device only supports VGA or DVI input, you will also need an adapter. Users can choose to replace HDMI with the LVDS interface or MIPI DSI interface when connecting to a LVDS screen or a MIPI display.

Figure 23

Note: We recommend installing a chassis/case for DEBIX before assembling the hardware, which can effectively avoid the short circuit of the motherboard components caused by accidental touch.

Hardware Installation

Before we start to install the hardware, please make sure that previous contents about DEBIX interface have been fully understood.

Insert Micro SD card

Prepare the Micro SD card with the operating system installed, and insert it into the card slot on the back of DEBIX. If you need to remove it, just pull out the card gently after the power is off.

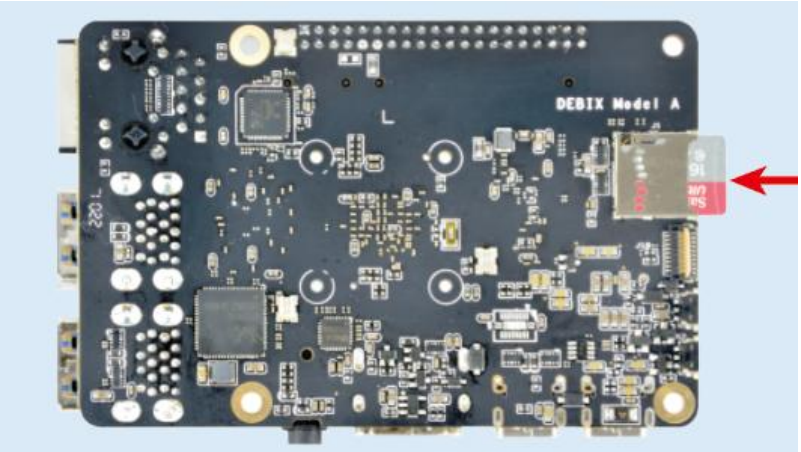


Figure 24

Connect the display device

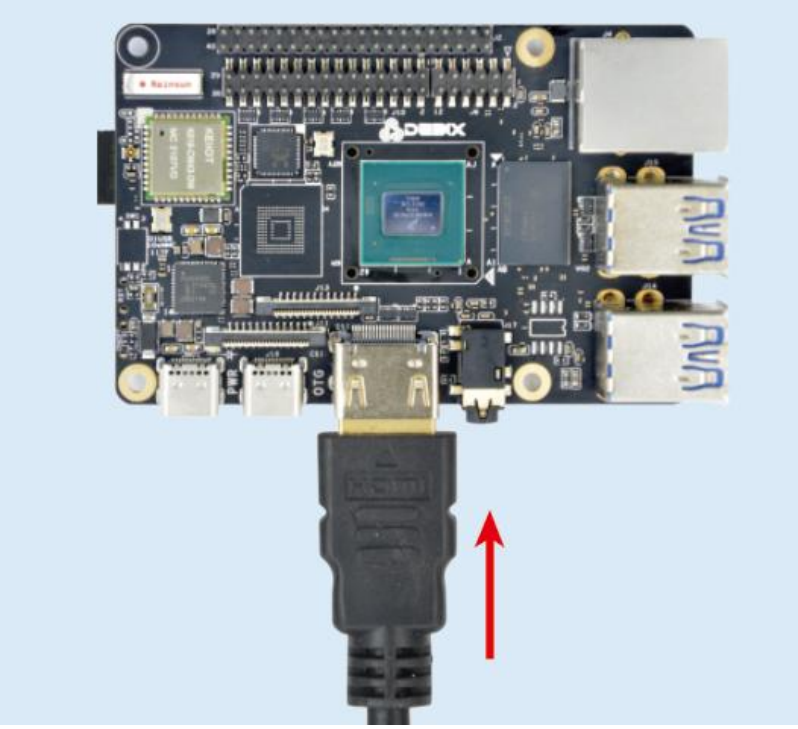


Figure 25

Connect the keyboard and mouse

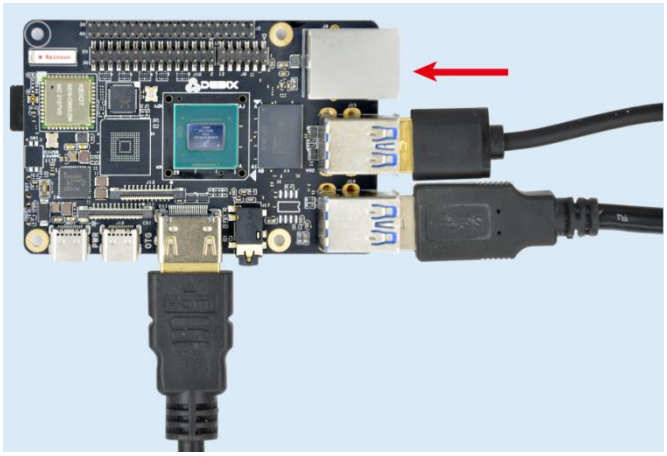


Figure 26

Connect the network cable

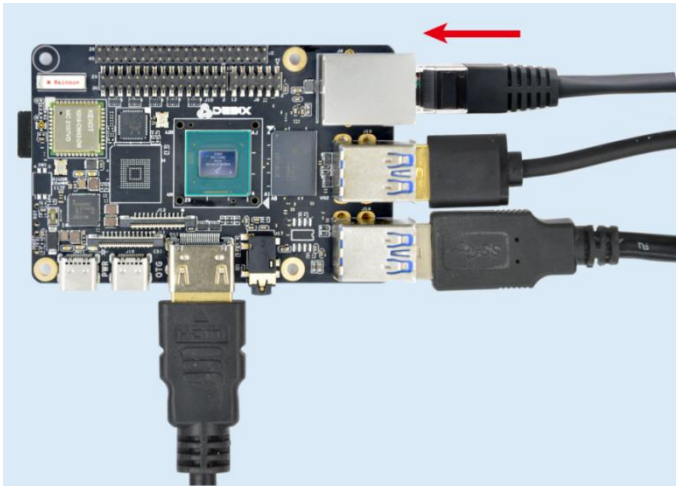


Figure 27

Connect the power adapter

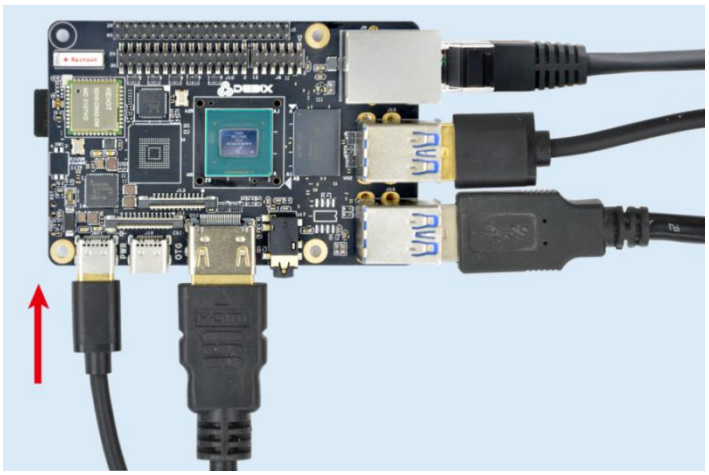


Figure 28

Plug in the power to boot up, when DEBIX begins to boot, the indicator light(red) on the

board will light up(if boot failed, the indicator light will not light up).

Congratulations! You have completed the installation of DEBIX hardware.

Software Installation

Boot from the Micro SD card

After downloading the latest system image file we provided to DEBIX, you can use the tool called Etcher to write the system image to the Micro SD card. Etcher supports Windows system, you also can find the corresponding version for Linux system and macOS. We have simplified the DEBIX software installation process with only the following three steps:

1. Download link：https://www.balena.io/etcher/

2. After installation, start Etcher, insert the Micro SD card, select the img file to be installed and the disk partition corresponding to the Micro SD card.

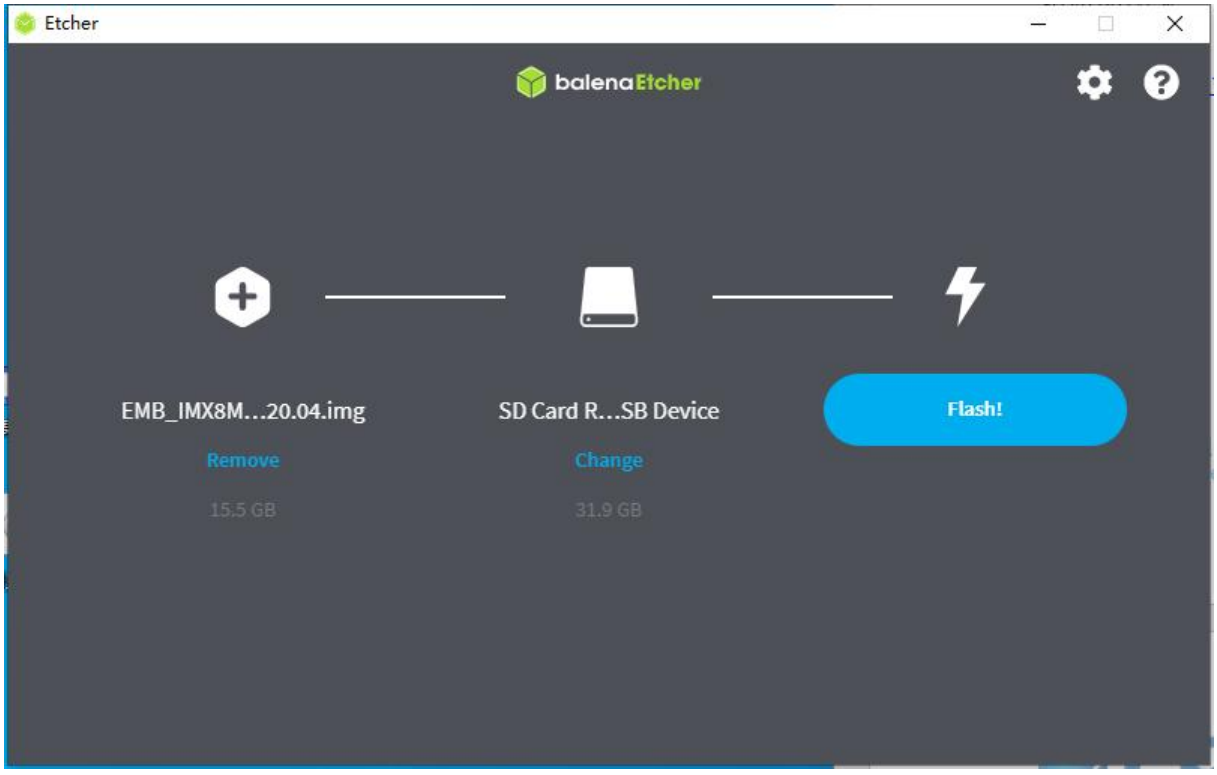


Figure 29

3. Click “Flash!“ Wait patiently, the program will write the system to your Micro SD card. When "Flash Complete" appears, it means that the system has been successfully programmed into the Micro SD card.

Note: The system may prompt you that the disk is unavailable and needs to be formatted, please ignore it, it is not an error!

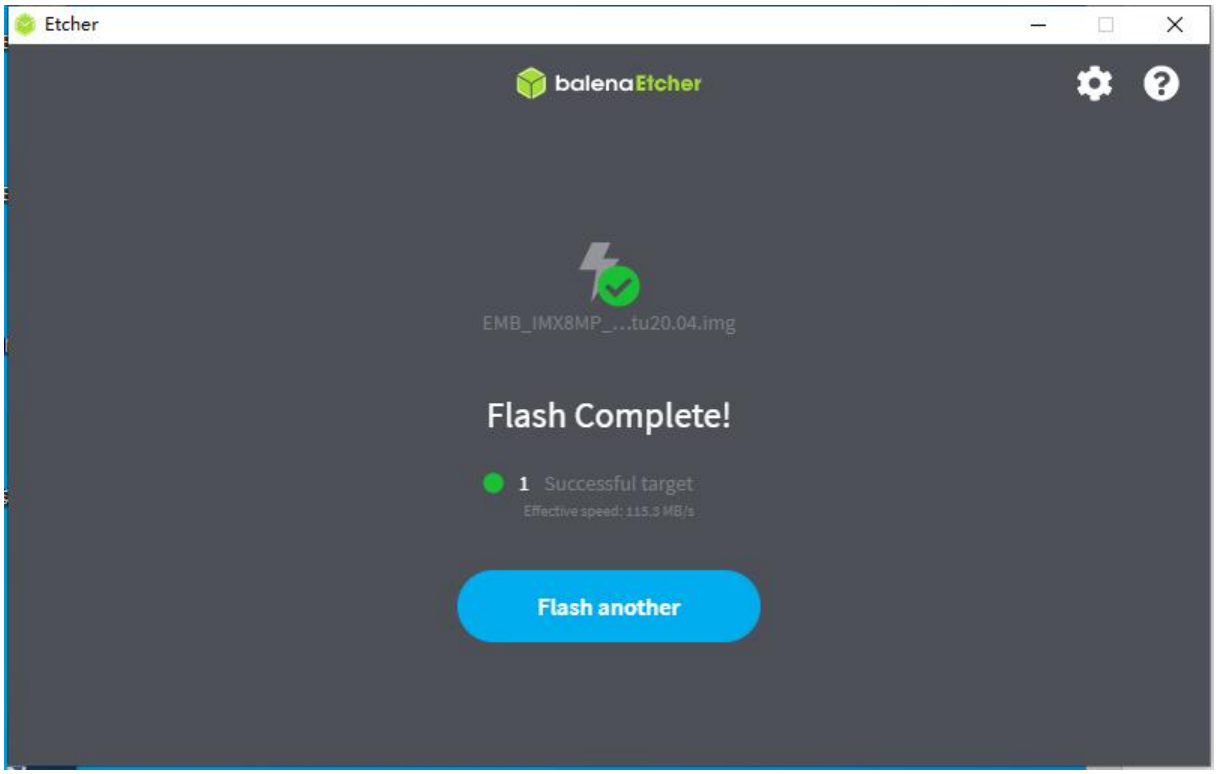


Figure 30

Insert the Micro SD card into DEBIX, connect the display device and power on, then you can see the boot screen.

Boot from eMMC

Prepare a Micro SD card above 16GB, enter the official website of DEBIX https://debix.io/Software/download.html, find the image corresponding to the memory configuration version. The 4GB DDR Version as an example, as shown in the figure below, choose to download the image: Debix-ModelAB-4GBDDR-Installation-Disk-V2.3-2023011.img

Figure 31

Write the downloaded system image to the Micro SD card according to the three steps operation above. Then burn the system to eMMC with the following steps:

4. Insert the Micro SD card, and turn the onboard DIP switch to "11", the system will boot from the Micro SD card, and then turn on the power.

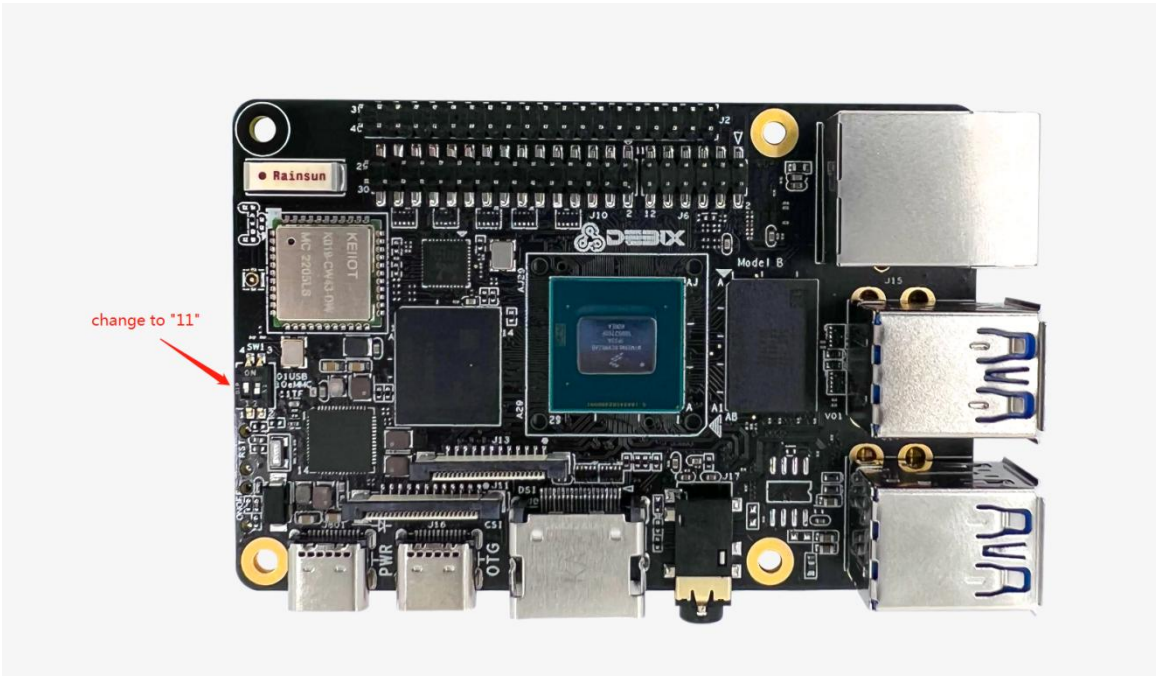


Figure 32

5. After booting, the system will automatically write to the eMMC through the Micro SD card. This burn process will not be displayed on screen. When burning, the red indicator light on the

main board will flash quickly. Please wait. When the red indicator light changes from fast flashing to slow flashing, the programming is complete.

Note: If the system with the same version as the Micro SD card has been burned to eMMC, the system will not be burned again, and the indicator light will not flash quickly.

6. Then turn off the power and turn the DIP switch to "10", the system will boot from eMMC, connect to HDMI and power on.

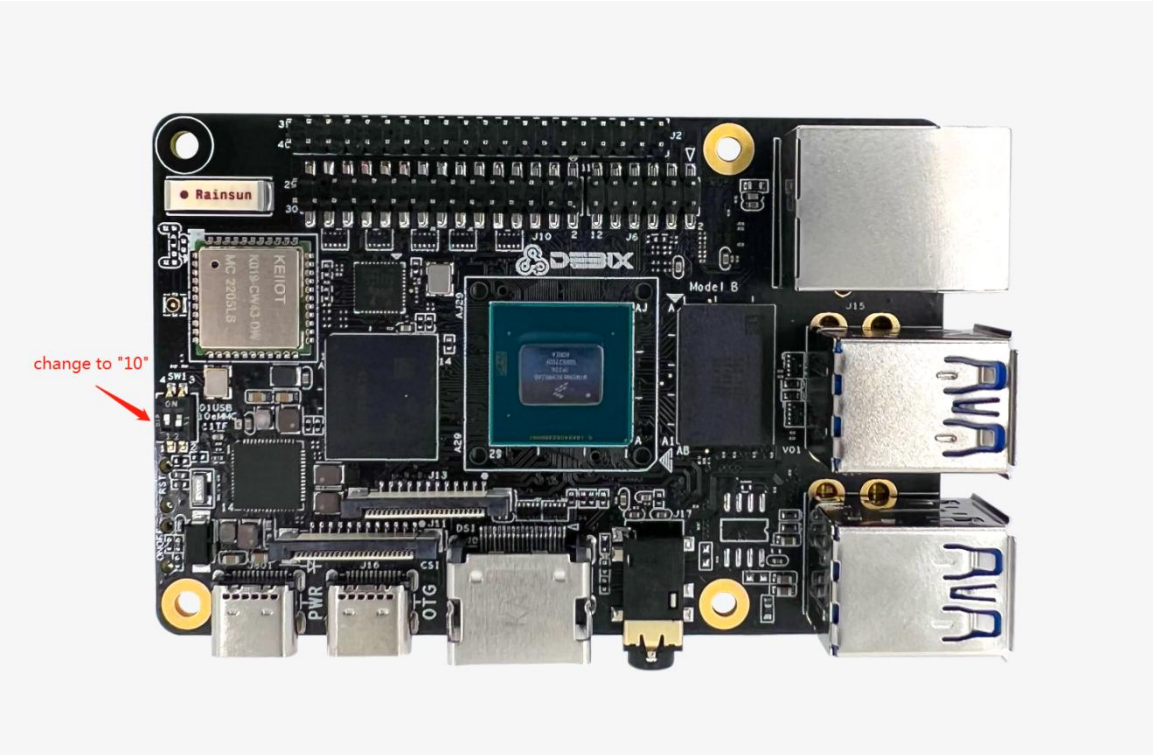


Figure 33

If you need to flash the eMMC system again, you need to format the eMMC first. Proceed as follows:

1) Connect the motherboard to the keyboard, mouse and HDMI display, turn the DIP switch to "11" to start the system from the Micro SD card, enter the default username “debix” and password "debix" to enter the command line, and run the following commands in sequence:

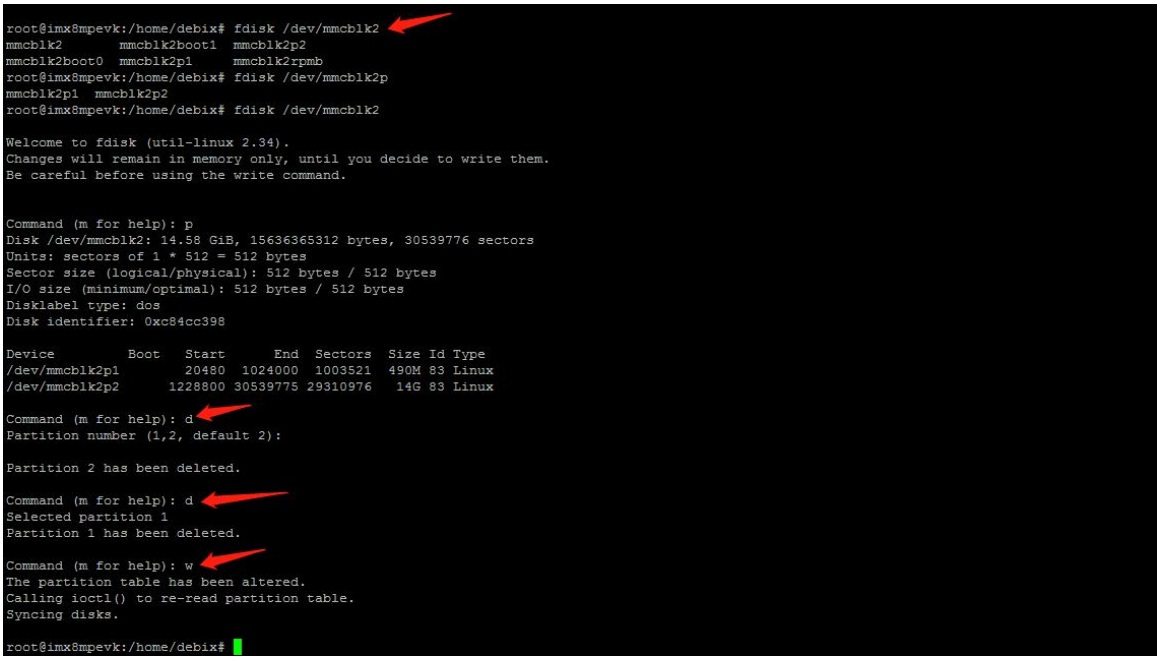
#sudo su (password: debix)

#fdisk /dev/mmcblk2

d

d

w



2) Repeat step 5 to reprogram the eMMC.

Chapter 3 Using DEBIX

During the first boot, you will first enter the login interface. At this time, enter the default username “debix” and password "debix" to enter the desktop.

Desktop Introduction

The default DEBIX system we provide is with Desktop. Here is a brief exhibition.

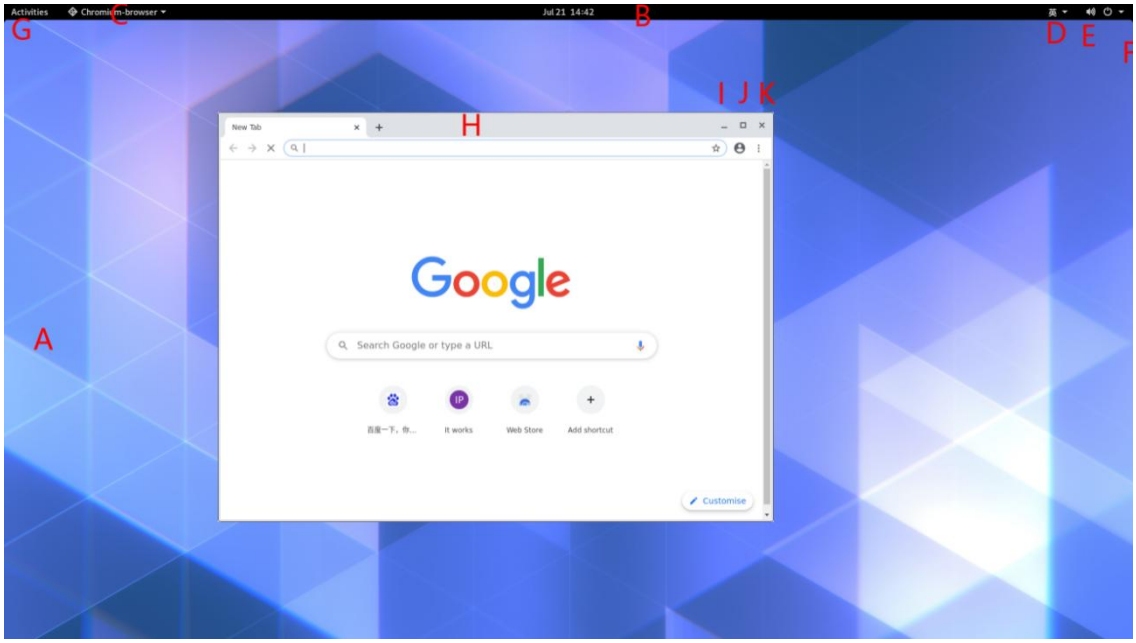


Figure 34

[A]Wallpaper	[B]Taskbar	[C]Task
[D]Language Switch Button	[E]Sound Volume Icon	[F]Power Button
[G]Activity Button	[H]Window Title Bar	[I]Minimize Button
[J]Maximum Button	[K]Close Button	

System Browser

DEBIX's desktop system pre-installed the Chromium browser. If you have used Google Chrome, you will be familiar with it.

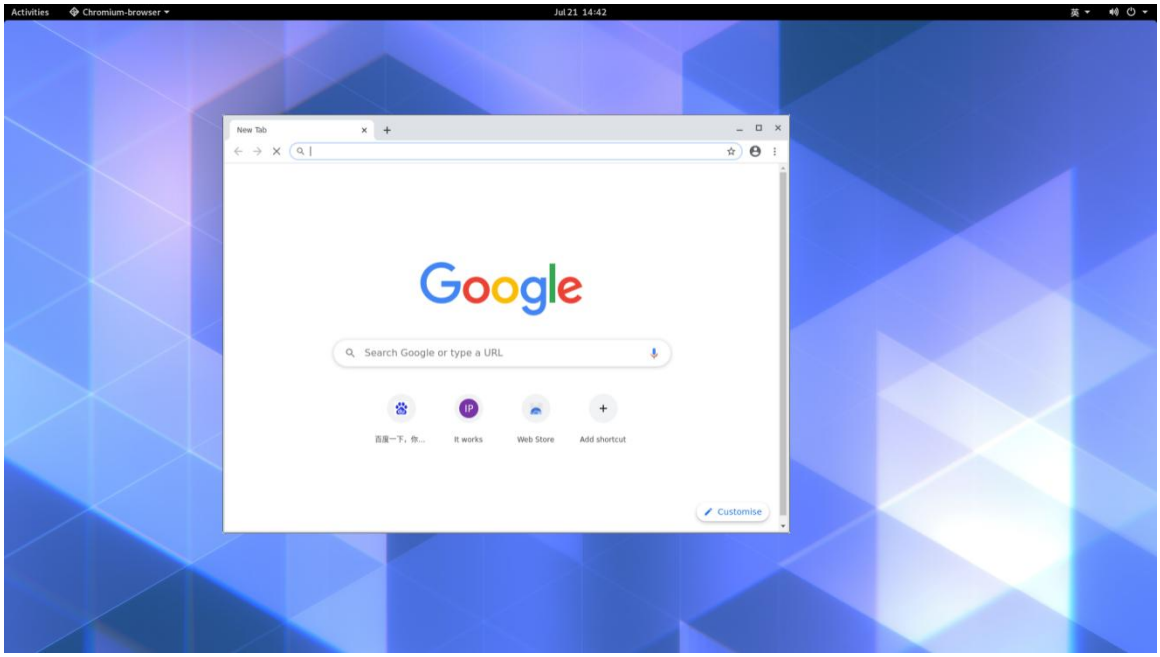


Figure 35

File Management

Like other systems, DEBIX uses file manager as the desktop file management tool.

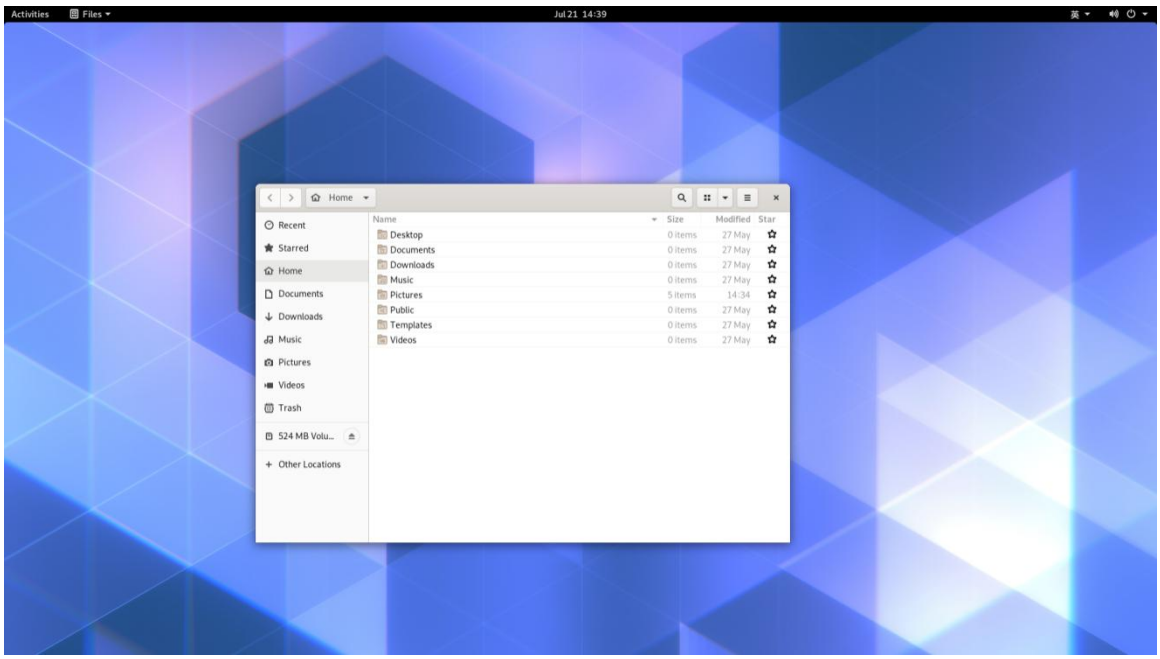


Figure 36

The files downloaded through browser are stored in the Downloads directory under the user's

Home directory. The desktop files are stored in the Desktop directory. For removable disks, the disk name will be displayed in the file manager when inserted, users can click to view them.

First Time Use

Click “Activities” in the upper left corner to open application interface. There are some pre-installed applications.

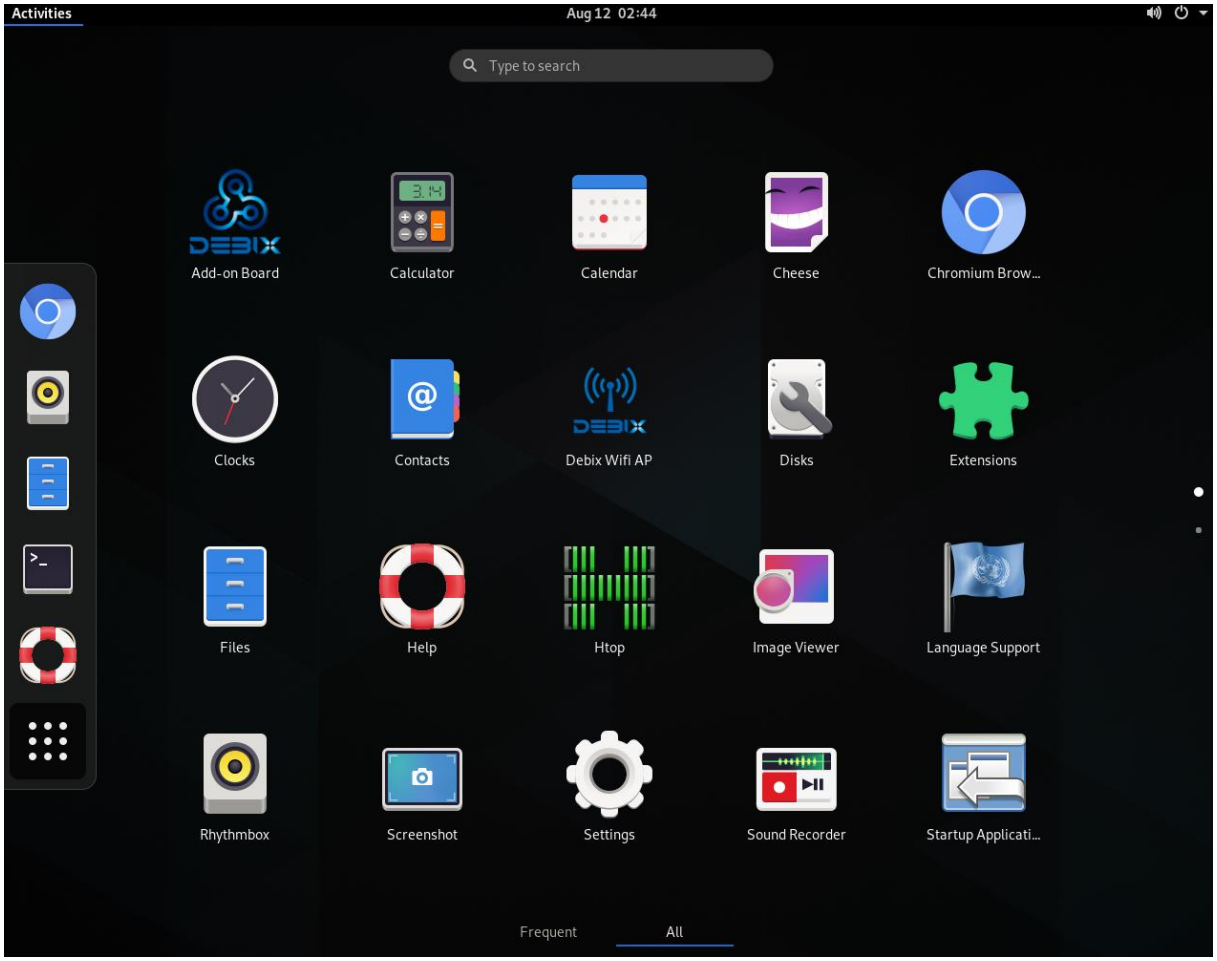


Figure 37

Open Setting, you will see some personal settings about the system, you can set up Wi-Fi, Bluetooth and other settings here:

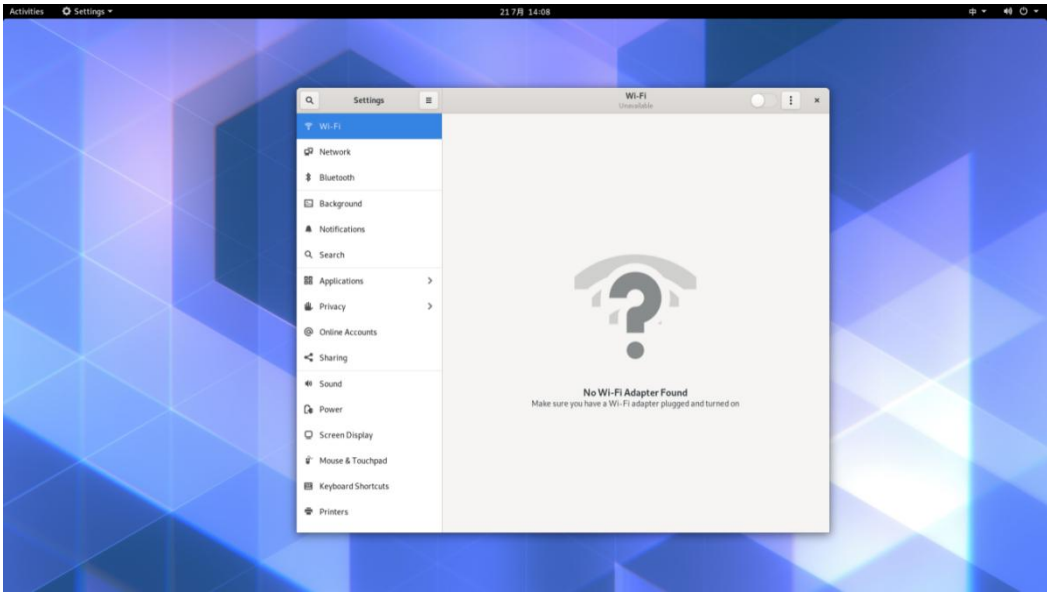


Figure 38

Change User Password

First open the Users tab, where your username and password are displayed, click “Unlock” in the upper right corner to enter the default user password, and then click “password” to set a new user id and password:

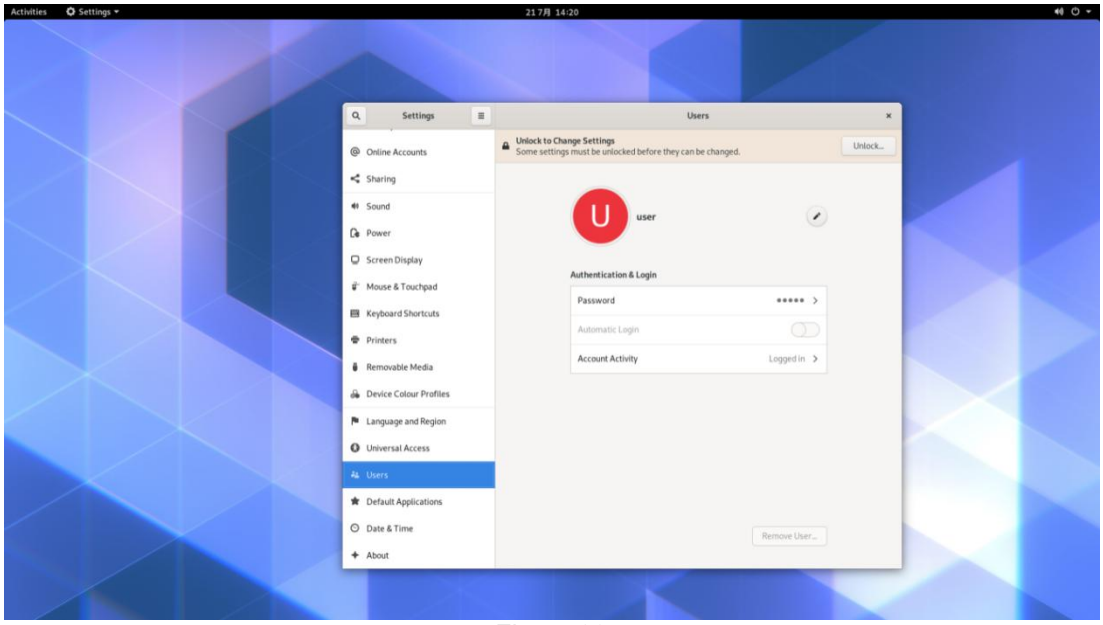


Figure 39

Wi-Fi Connection

Click the Wi-Fi tab, open the switch in the upper right corner of the window, then select your Wi-Fi and enter the password to connect to the network.

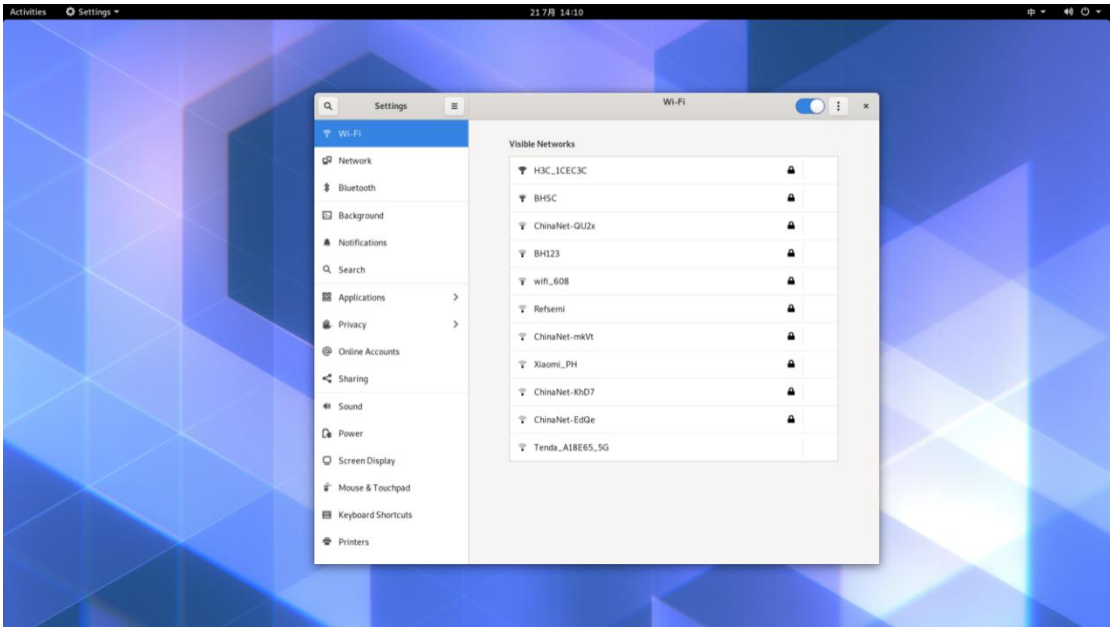


Figure 40

Change Language

If you want to change the language, select “Language and Region”, then open “Manage Installed Languages”:

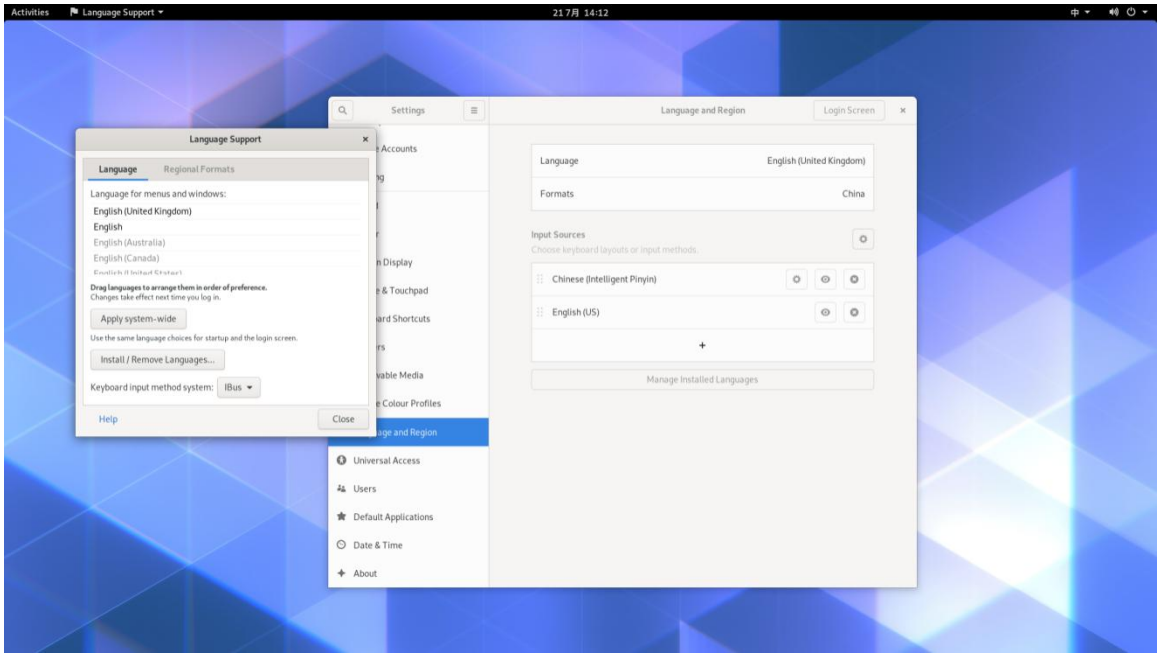


Figure 41

Then click ”Install/Remove Languages“ in the newly appeared window:

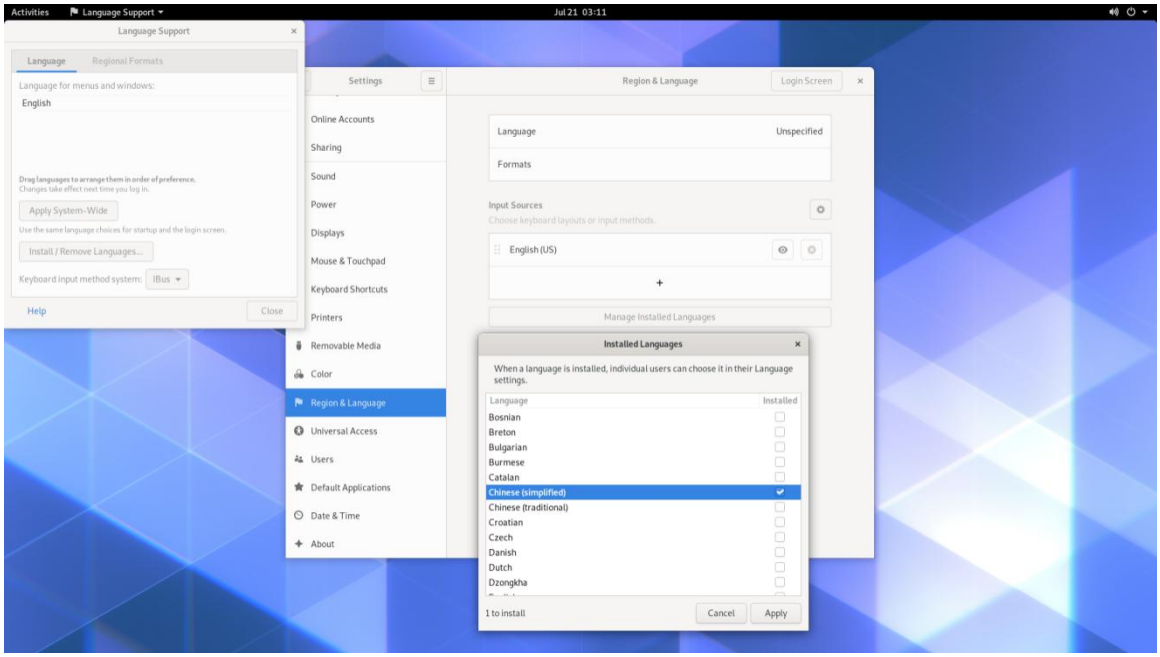


Figure 42

Open Installed Languages, check the language you want, click “Apply”, the system will automatically download the language pack, you may need to enter the user password before download:

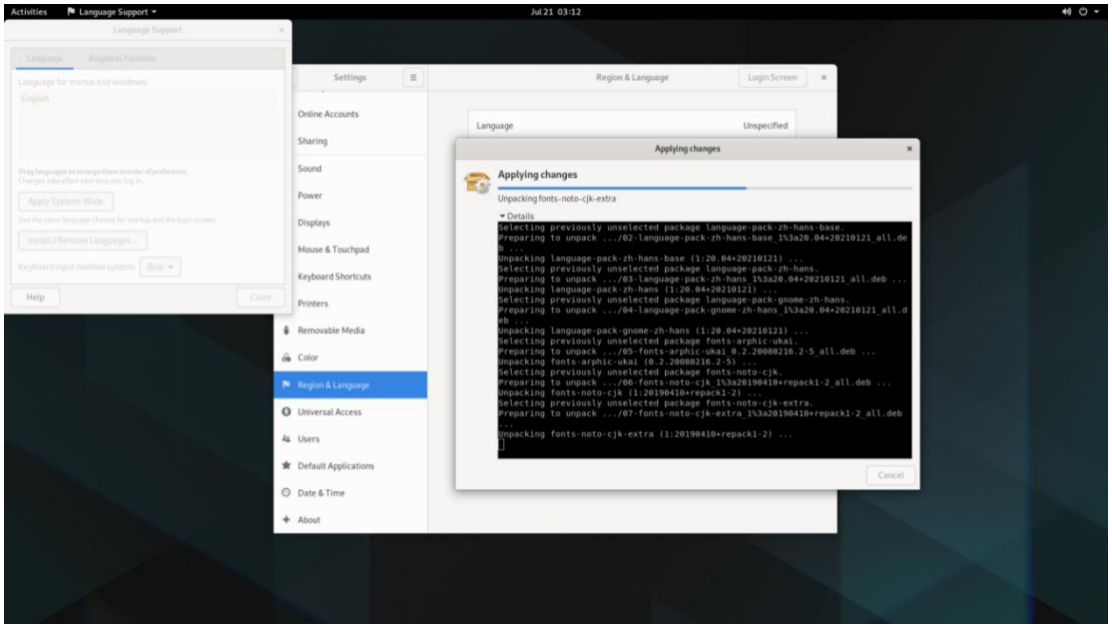


Figure 43

After the installation, click “Apply System-Wide”, then go back to the Language and Region tab, click “Language” at the top, select the language you want, and then click “restart”:

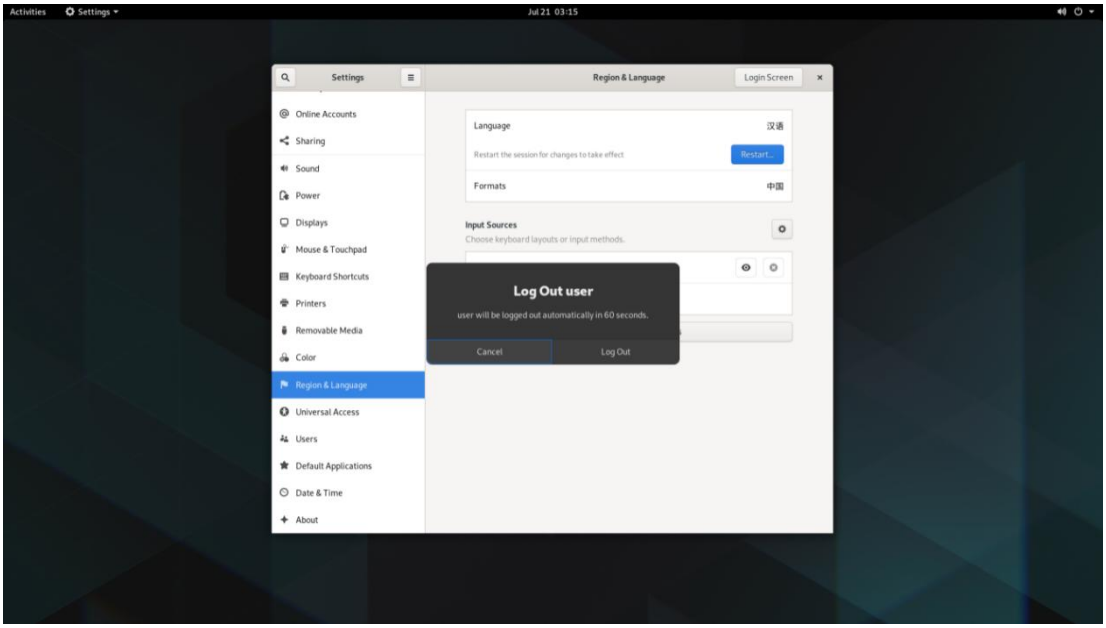


Figure 44

Setting up Access Point

Click the application “Debix Wifi AP” application on the desktop of DEBIX, input sudo password, Access Point name, Access Point password, choose the port number(ens33 or ens34) and finally click “Create AP”, the Access Point can be created.

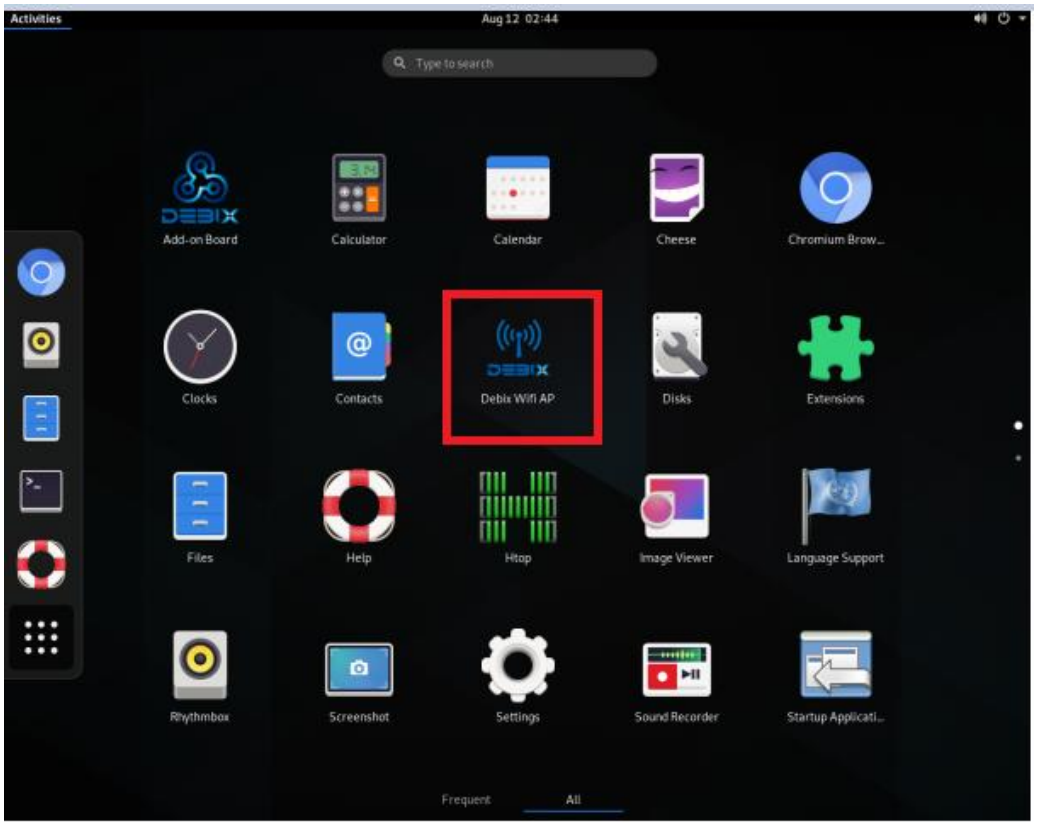


Figure 45

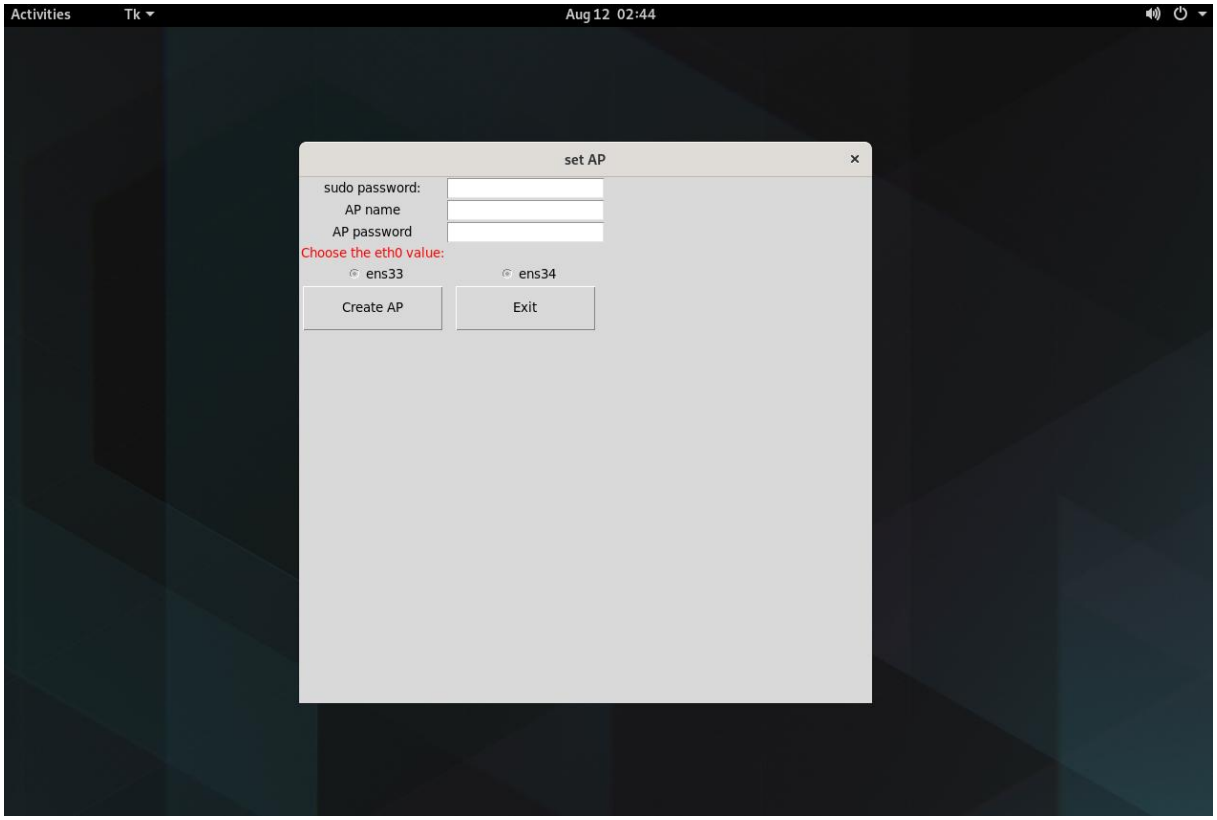


Figure 46

Alternatively, you can set up the Access Point from the command line with command debix_wifi_ap, input the required value according to the tips, the Access Point can be created.

Shut Down

The power tab will show up when users click the Power Button in the upper right corner of the system. You can choose to log off, restart or Power Off to shut down. Wait until the display turns black and the status indicator (red) on the motherboard is completely off, then disconnect the power supply.

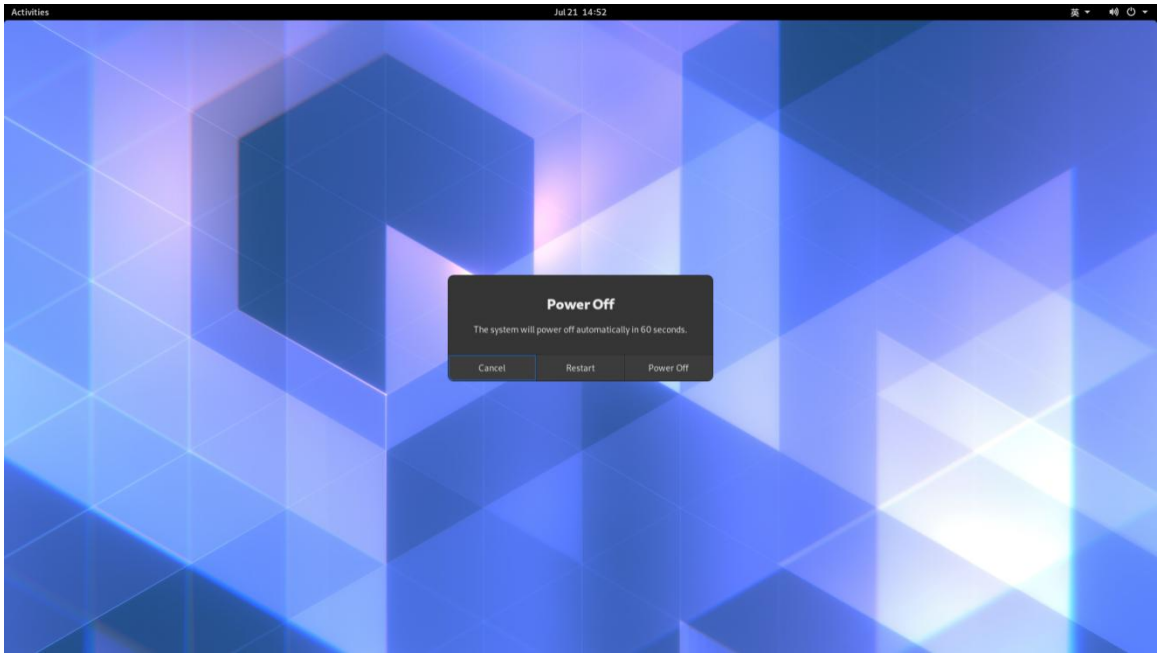


Figure 47

The three screens supported by DEBIX

screen	specification
HC080IY28026-D60V.C(800x1280) 8 inches MIPI screen	https://debix.io/Uploads/Temp/file/20220921/HC080IY28026-D60V.C(800x1280)_Product+Spec.pdf
HC050IG40029-D58V.C(LVDS) 800x480 5 inches LVDS screen	https://debix.io/Uploads/Temp/file/20220921/HC050IG40029-D58V.C(LVDS)%20800x480_Product%20Spec_220915.pdf
HC101IK25050-D59V.C(LVDS) 1024x600 10.1 inches LVDS screen	https://debix.io/Uploads/Temp/file/20220921/HC101IK25050-D59V.C(LVDS)%201024x600_Product%20Spec_220915.pdf

HC080IY28026-D60V.C(800x1280) 8 inches MIPI screen connection method:

- Prepare DEBIX, FPC flat cable and the MIPI screen

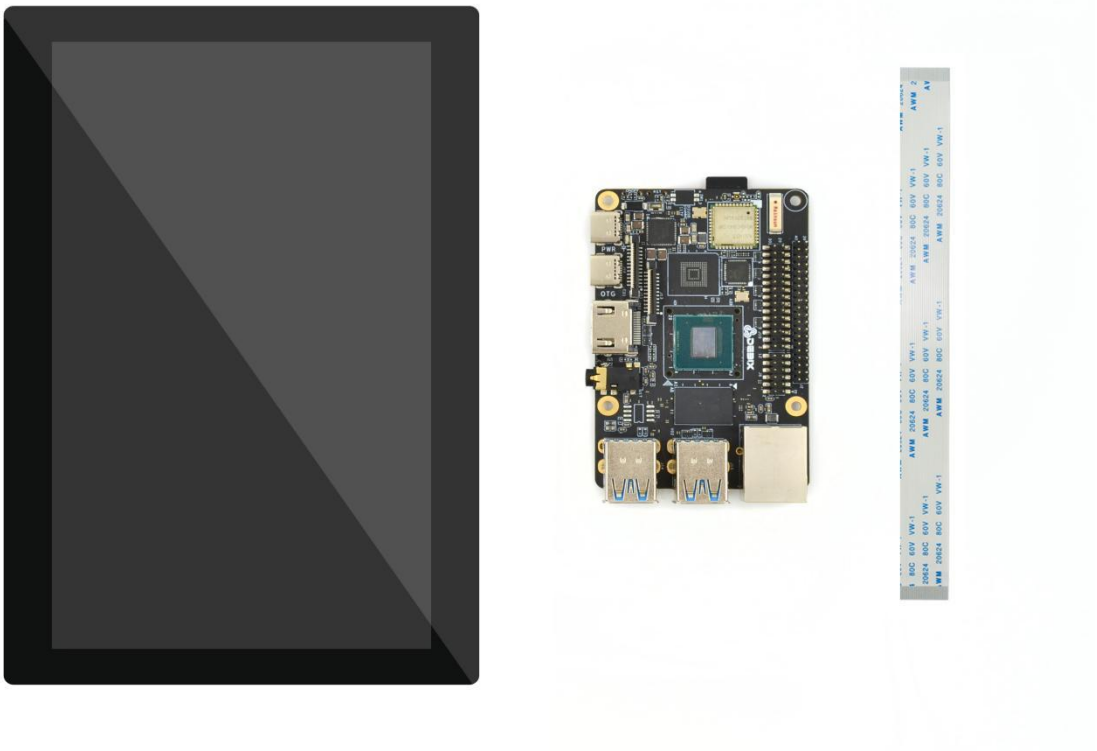


Figure 48

- Use same-direction 24Pin FPC flat cable to connect to J13 of DEBIX, just like the figure below:

Figure 49

Figure 50

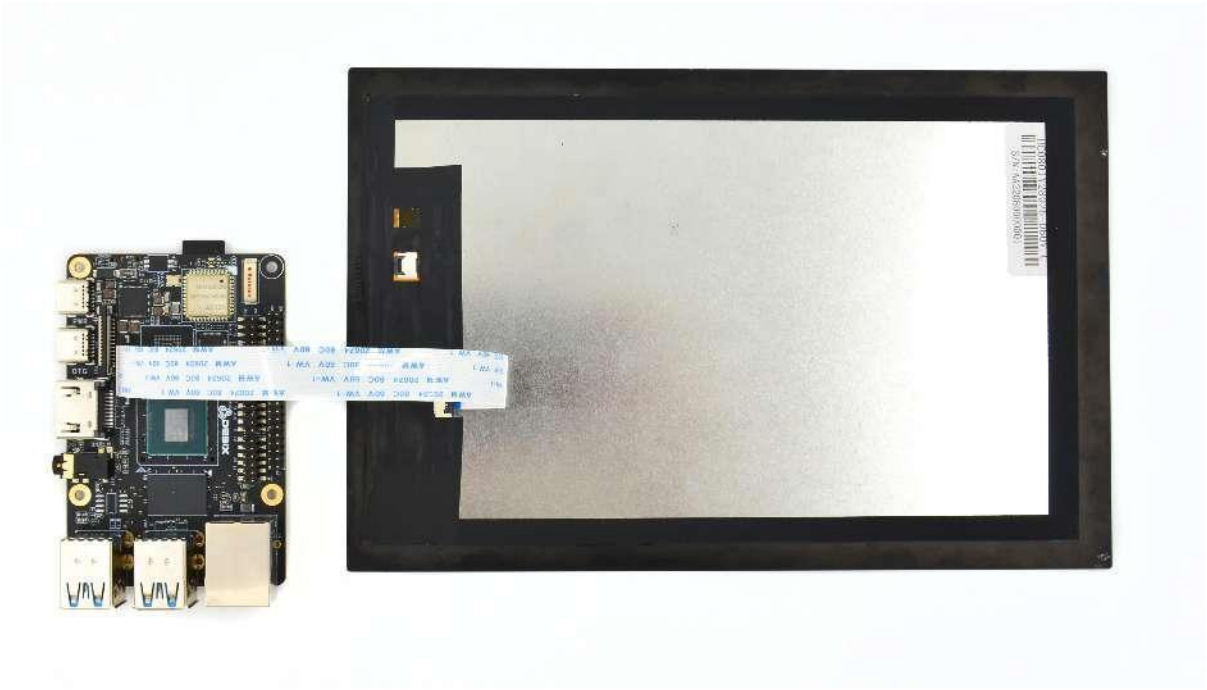


Figure 51

Figure 52

HC050IG40029-D58V.C(LVDS) 800x480 5 inches LVDS screen connection:

- Prepare DEBIX, LVDS screen cable, LVDS screen

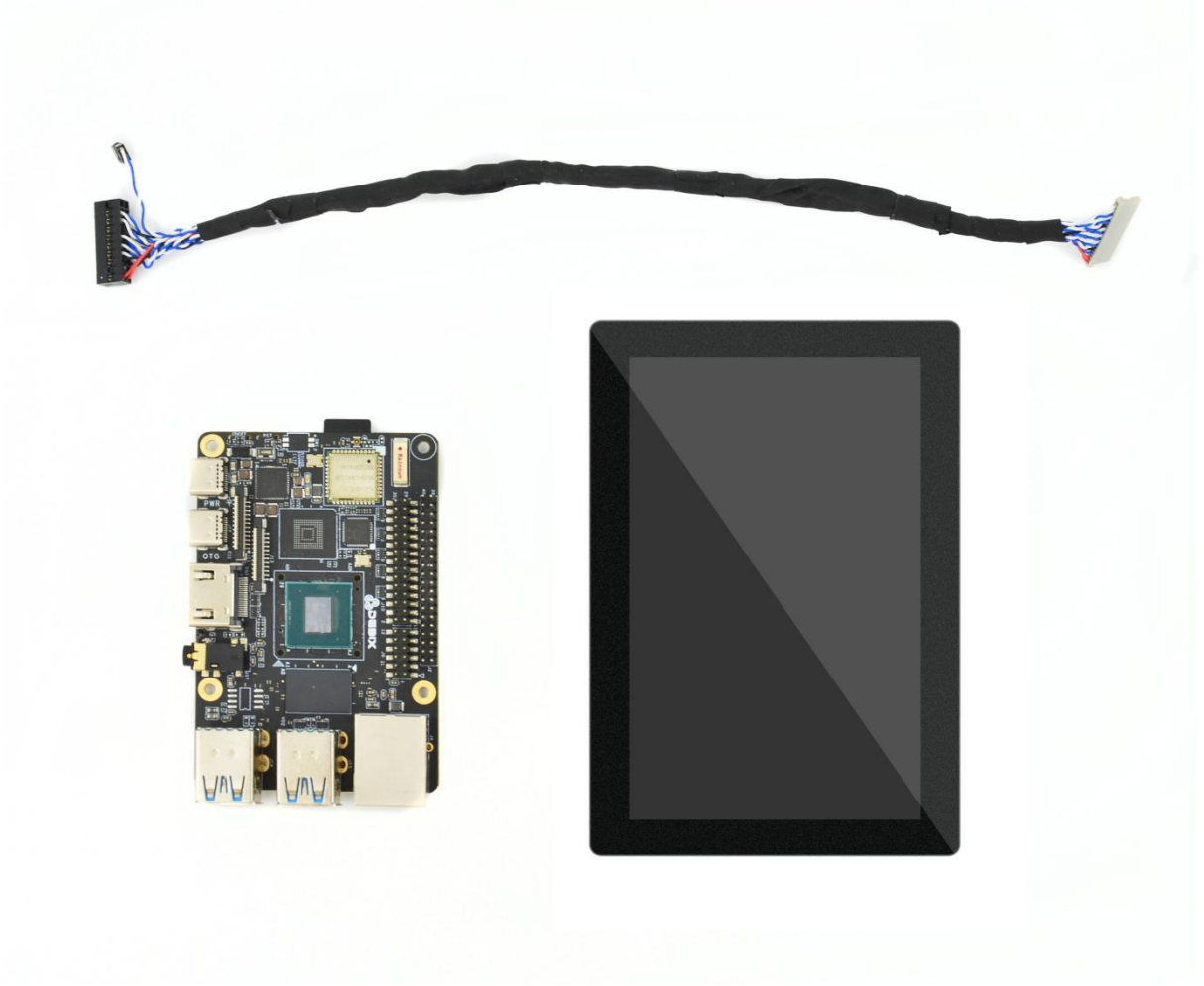


Figure 53

- Plug the double-row female header connector to J10, the red line should be connected to Pin1/2, as for the sole 2Pin blue and white line, The blue line is LVDS VCC Power EN (Active High) connected to J2 Pin36; The white line is Backlight Power EN (Active High) and PWM connected to J2 Pin38

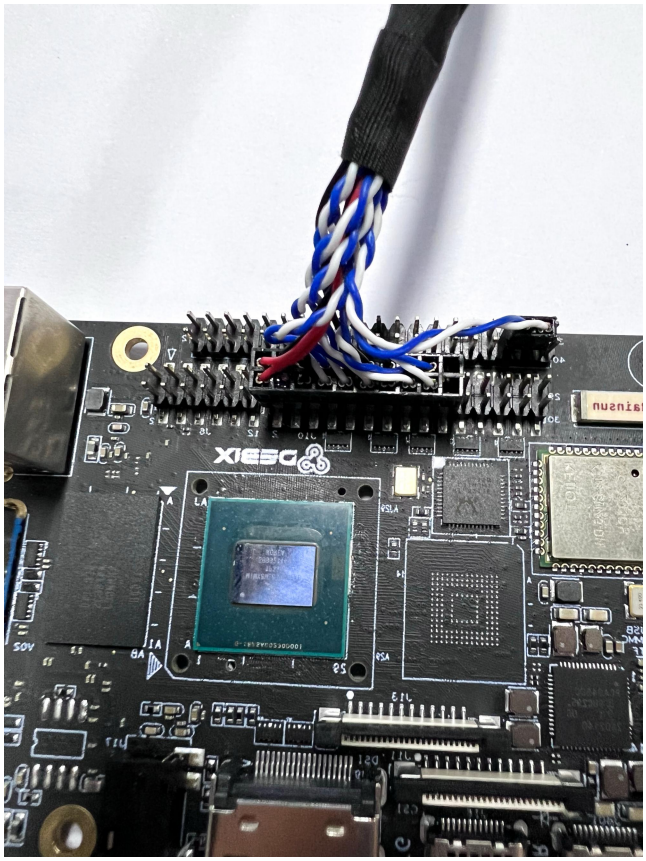


Figure 54

Figure 55

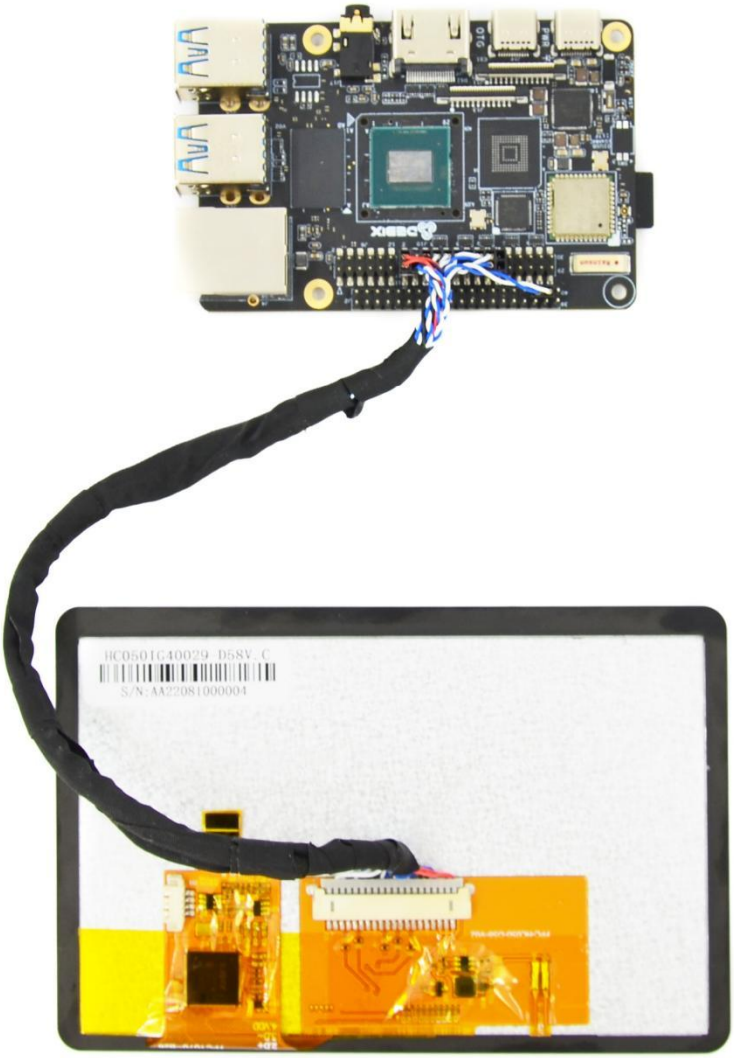


Figure 56

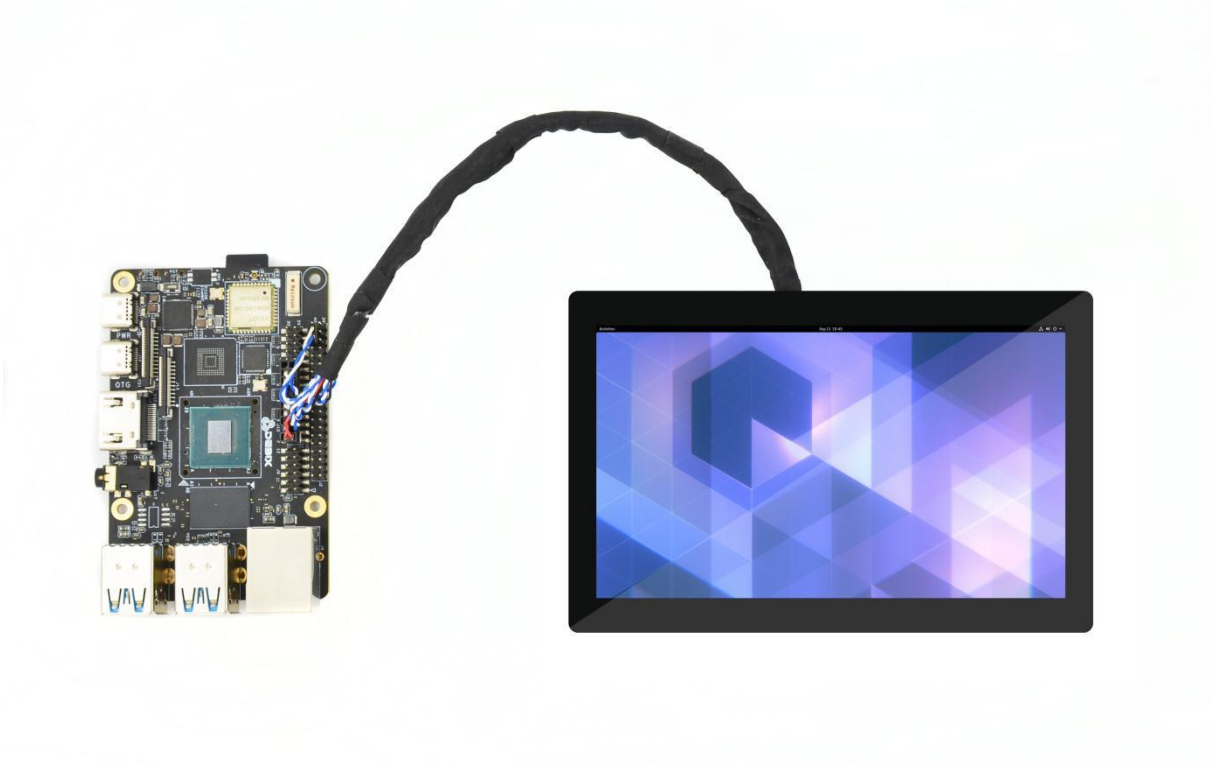


Figure 57

HC101IK25050-D59V.C(LVDS) 1024x600 10.1 inches LVDS screen connection:

- Prepare DEBIX, LVDS screen cable, LVDS screen

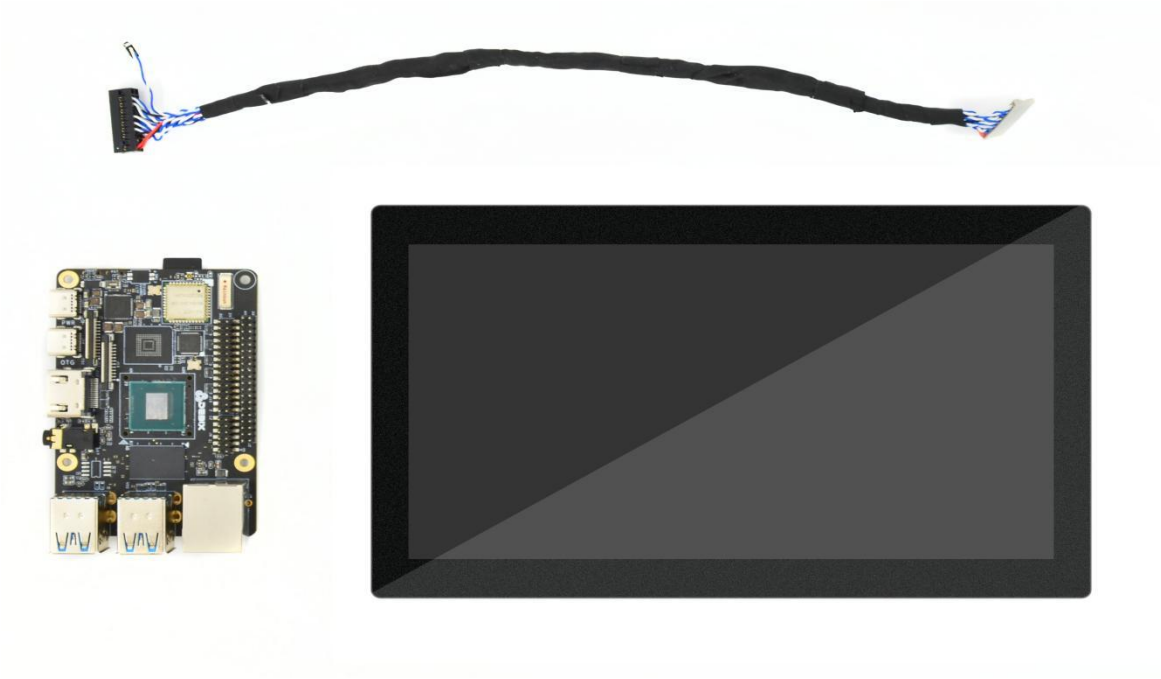


Figure 58

- Connect the double-row female header connector to J10 of DEBIX, connect the red line to Pin1/2, as for the sole 2Pin blue and white line, connect the blue line to Pin36 of J2, connect the white line to Pin38 of J2.

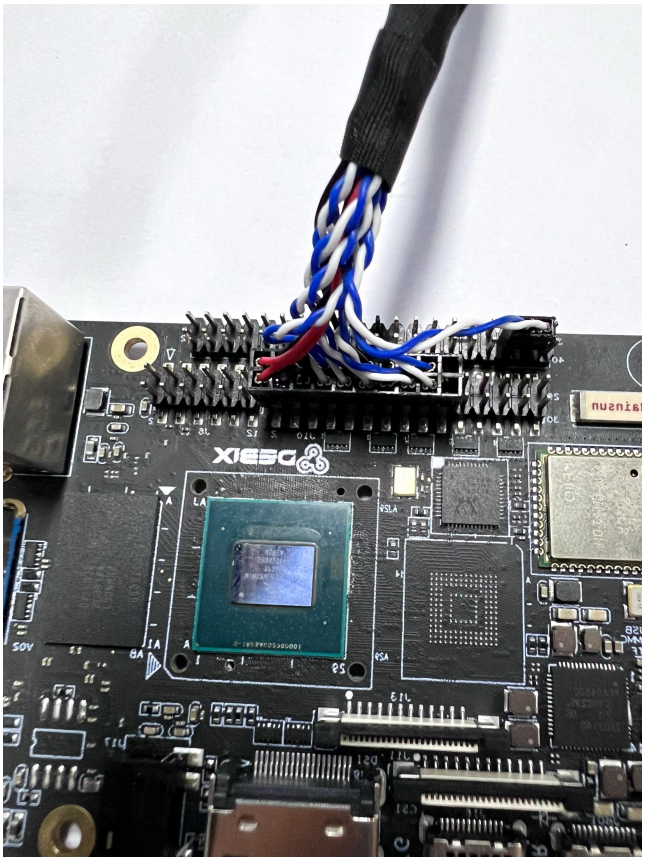


Figure 59

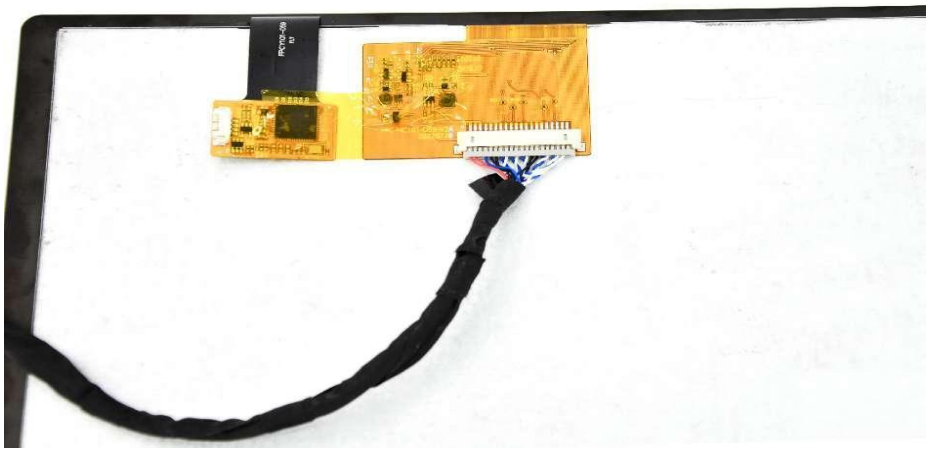


Figure 60

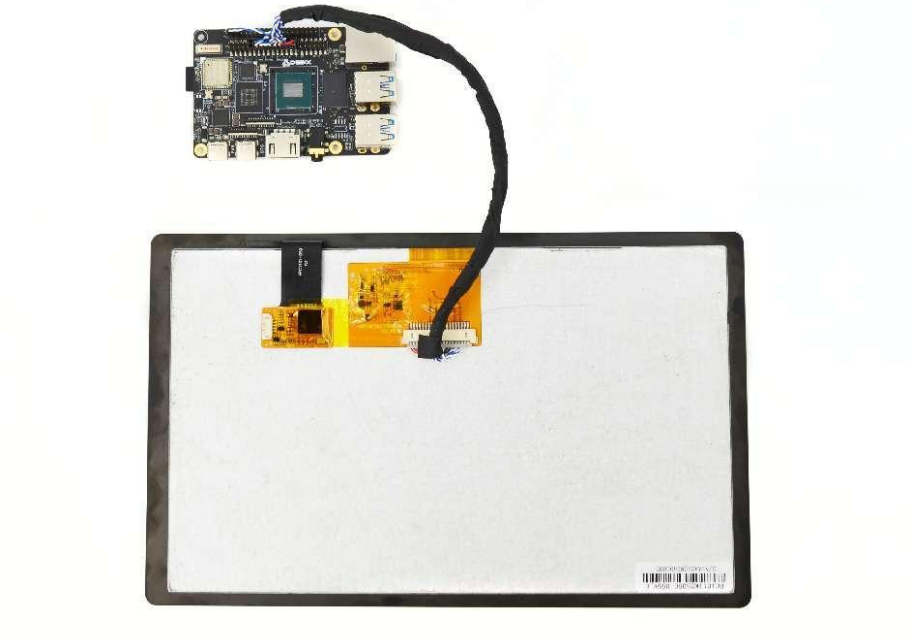


Figure 61

Figure 62

Use lidar module on DEBIX

Prepare the lidar module, control board of the lidar module, standard micro USB data cable and DEBIX

Figure 63

- For the specification of the lidar module, refer to : https://debix.io/Uploads/Temp/file/20220921/LDrobot_LD06_Datasheet.pdf
- For the specification of the cable kit, refer to: https://debix.io/Uploads/Temp/file/20220923/LD06-PI%20Lidar%20Cable%20Kit.pdf

Figure 64

Figure 65

Use a micro USB data cable to connect the lidar module with DEBIX:

Figure 66

Figure 67

Figure 68

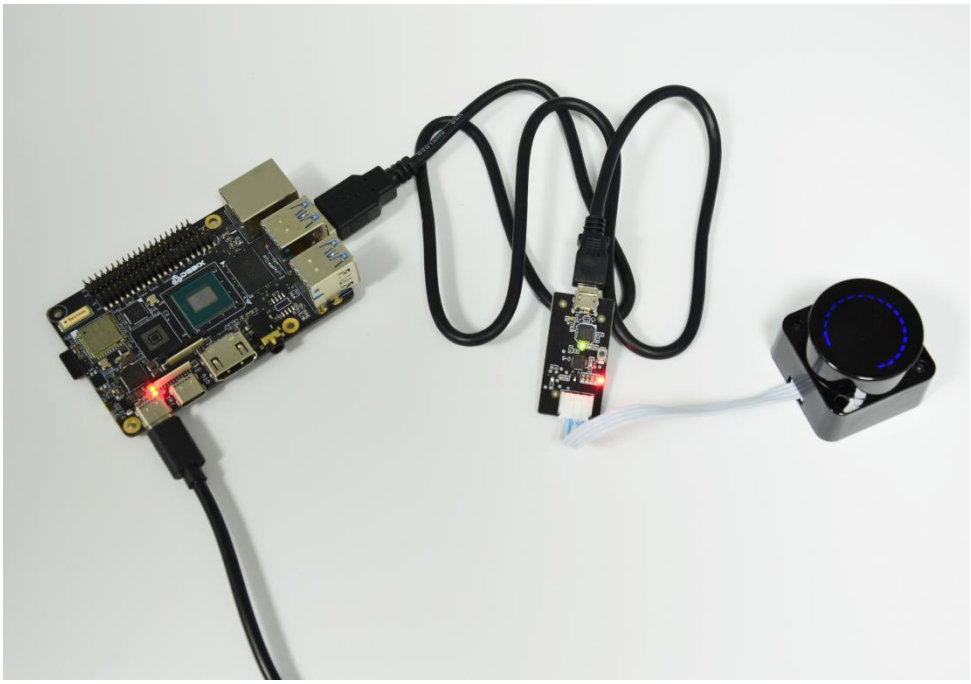


Figure 69

Once finished connecting the lidar module with DEBIX, connect DEBIX with the peripherals

(keyboard, mouse, display), insert the Micro SD card that has DEBIX system. Power on DEBIX, open the terminal, run the following command:

```
ldlidar_stl  /dev/ttyUSB0
```

When the lidar module begins to work, the above command will output data continuously, if you cover the lidar module, some data will change to 0

```
[ldrobot] angle: 315.51 distance(mm): 0 intensity: 232
[ldrobot] angle: 316.3 distance(mm): 0 intensity: 232
[ldrobot] angle: 317.09 distance(mm): 0 intensity: 231
[ldrobot] angle: 317.88 distance(mm): 0 intensity: 233
[ldrobot] angle: 318.67 distance(mm): 0 intensity: 232
[ldrobot] angle: 319.46 distance(mm): 0 intensity: 233
[ldrobot] angle: 320.25 distance(mm): 0 intensity: 235
[ldrobot] angle: 321.04 distance(mm): 0 intensity: 233
[ldrobot] angle: 321.83 distance(mm): 0 intensity: 232
[ldrobot] angle: 322.62 distance(mm): 0 intensity: 235
[ldrobot] angle: 323.41 distance(mm): 0 intensity: 234
[ldrobot] angle: 324.2 distance(mm): 0 intensity: 233
[ldrobot] angle: 324.99 distance(mm): 0 intensity: 235
[ldrobot] angle: 325.78 distance(mm): 0 intensity: 234
[ldrobot] angle: 326.57 distance(mm): 0 intensity: 235
[ldrobot] angle: 327.36 distance(mm): 0 intensity: 234
[ldrobot] angle: 328.15 distance(mm): 0 intensity: 232
[ldrobot] angle: 328.94 distance(mm): 0 intensity: 232
[ldrobot] angle: 329.73 distance(mm): 0 intensity: 236
[ldrobot] angle: 330.52 distance(mm): 0 intensity: 234
[ldrobot] angle: 331.31 distance(mm): 4 intensity: 234
[ldrobot] angle: 332.1 distance(mm): 0 intensity: 235
[ldrobot] angle: 332.89 distance(mm): 4 intensity: 234
[ldrobot] angle: 333.76 distance(mm): 0 intensity: 235
[ldrobot] angle: 335.69 distance(mm): 0 intensity: 238
[ldrobot] angle: 336.47 distance(mm): 0 intensity: 237
[ldrobot] angle: 337.25 distance(mm): 0 intensity: 238
[ldrobot] angle: 338.03 distance(mm): 0 intensity: 240
[ldrobot] angle: 338.81 distance(mm): 0 intensity: 242
[ldrobot] angle: 339.59 distance(mm): 3 intensity: 241
[ldrobot] angle: 340.37 distance(mm): 0 intensity: 243
[ldrobot] angle: 341.12 distance(mm): 3 intensity: 244
[ldrobot] angle: 341.91 distance(mm): 3 intensity: 247
[ldrobot] angle: 342.7 distance(mm): 3 intensity: 246
[ldrobot] angle: 343.49 distance(mm): 3 intensity: 248
[ldrobot] angle: 344.28 distance(mm): 3 intensity: 249
[ldrobot] angle: 345.07 distance(mm): 3 intensity: 248
[ldrobot] angle: 345.86 distance(mm): 3 intensity: 249
[ldrobot] angle: 346.65 distance(mm): 3 intensity: 247
[ldrobot] angle: 347.44 distance(mm): 3 intensity: 245
[ldrobot] angle: 348.23 distance(mm): 3 intensity: 243
[ldrobot] angle: 349.02 distance(mm): 3 intensity: 239
[ldrobot] angle: 349.81 distance(mm): 3 intensity: 240
[ldrobot] angle: 350.6 distance(mm): 0 intensity: 237
[ldrobot] angle: 351.37 distance(mm): 0 intensity: 237
[ldrobot] angle: 352.14 distance(mm): 0 intensity: 238
[ldrobot] angle: 352.91 distance(mm): 3 intensity: 236
[ldrobot] angle: 353.68 distance(mm): 0 intensity: 236
[ldrobot] angle: 354.45 distance(mm): 0 intensity: 235
[ldrobot] angle: 355.22 distance(mm): 0 intensity: 237
[ldrobot] angle: 355.99 distance(mm): 0 intensity: 234
[ldrobot] angle: 356.76 distance(mm): 0 intensity: 237
[ldrobot] angle: 357.53 distance(mm): 0 intensity: 237
[ldrobot] angle: 358.3 distance(mm): 3 intensity: 236
[ldrobot] angle: 359.07 distance(mm): 0 intensity: 238
[ldrobot] angle: 359.87 distance(mm): 0 intensity: 239
[ldrobot] speed(Hz): 10.0222
```

Chapter 4 Introduction of Hardware Programming

When it comes to programming, software usually appears first to the mind, while In fact, programming can be applied far beyond the scope of software. The field of hardware programming that has tangible effects in the real world is called physical computing.
Physical computing methods are widely adopted in the facilities all around you. You can find traces of hardware programming when you set the timers for washing machines, set traffic lights for intersections, and configure a constant room temperature level with your air conditioner, these are all examples of hardware programming around us.

DEBIX is designed with a set of general-purpose input/output interfaces (GPIO), which makes it an unparalleled tool for you to discover and learn about physical computing!

GPIO Introduction

The GPIO connector is on the top edge of the DEBIX presented in the form of 2x20Pin with 2.0mm pitch. The GPIO connectors can be used to make the LED to turn on/off or blink. The GPIO pins have different applications including physical computing, power supply.
The following image shows the detailed function definition of DEBIX GPIO pins:

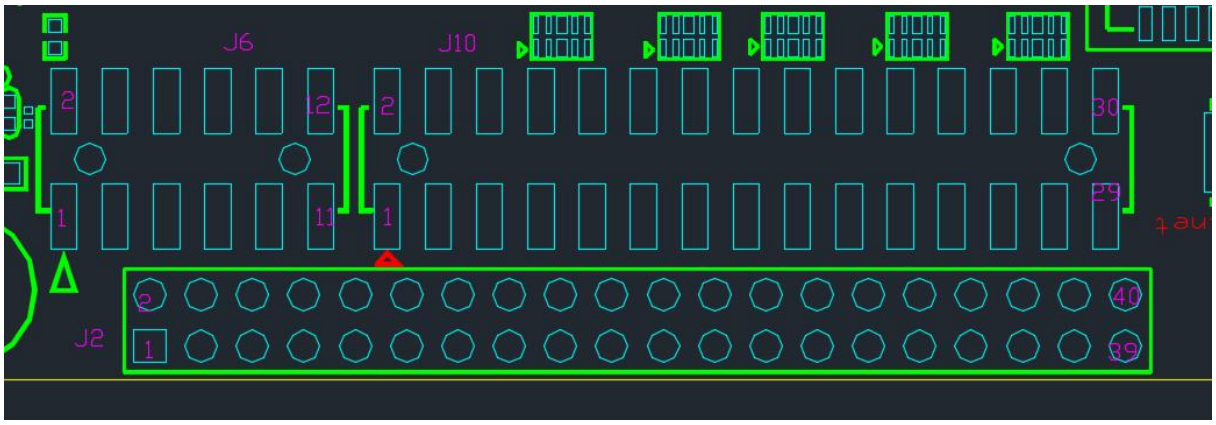


Figure 70

40 Pin double-row pin headers (J2)

The voltage of the pins of I2C, UART, CAN, SPI, GPIO is 3.3V

Pins	Definition	Pins	Definition
1	POE_VA1	2	POE_VA2
3	POE_VB1	4	POE_VB2
5	GND	6	VDD_5V
7	GND	8	VDD_5V
9	UART2_RXD	10	ONOFF
11	UART2_TXD	12	SYS_nRST
13	UART3_RXD	14	ECSPI1_SS0
15	UART3_TXD	16	ECSPI1_MOSI
17	UART4_RXD	18	ECSPI1_MISO
19	UART4_TXD	20	ECSPI1_SCLK
21	I2C4_SCL	22	ECSPI2_SS0
23	I2C4_SDA	24	ECSPI2_MOSI
25	I2C6_SCL	26	ECSPI2_MISO
27	I2C6_SDA	28	ECSPI2_SCLK
29	GPIO1_IO11	30	GPIO1_IO12
31	CAN1_TXD	32	GPIO1_IO13
33	CAN1_RXD	34	GPIO5_IO03
35	CAN2_TXD	36	GPIO5_IO04
37	CAN2_RXD	38	GPIO3_IO21
39	GND	40	GND

As for the mapped functional definition of the 40 pins of J2, please refer to *DEBIX Model A Reduced GPIO Function List* on website https://www.debix.io/.

Chapter 5 DEBIX I/O Board

Brief Introduction of DEBIX I/O Board

DEBIX I/O board is compatible with Raspberry Pi's camera and display, e.g. DSI display(The DSI interface can be used for Raspberry Pi's official 7'' display)and CSI camera. Additionally, it expands I/O interfaces of DEBIX, for example, RJ45 gigabyte LAN,RS232,RS485,CAN etc., making it more convenient communicating with industrial devices.

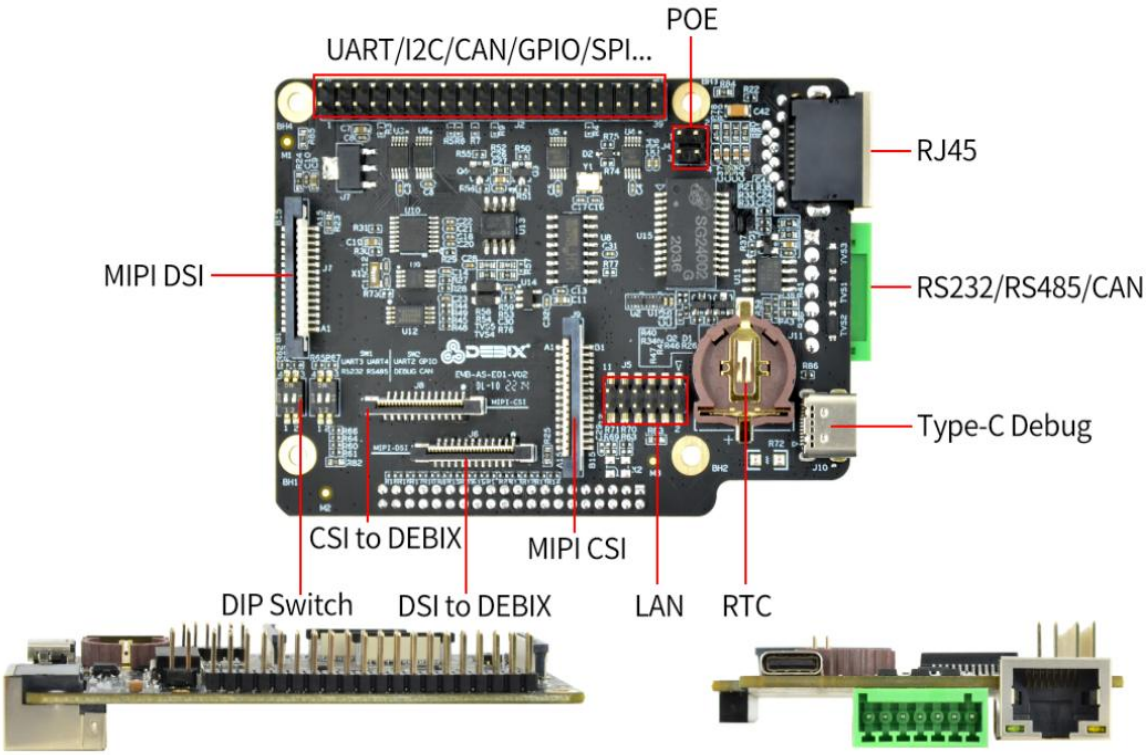


Figure 71

Interface Definition

- Type-C Debug
- RS232/RS485/CAN
- Ethernet
- LAN (used for connecting with DEBIX LAN interface)
- MIPI DSI
- MIPI CSI
- UART/I2C/CAN/GPIO/SPI...
- POE
- CSI to DEBIX
- DSI to DEBIX

The data specifications are as below:

I/O Interfaces	
Network	1 x RJ45 Gigabit Network POE Supported (Compatible with POE power device module)
USB	1 x USB Type-C Debug (USB to Serial)
RTC	1 x RTC
Serial Ports	1 x RS232 1 x RS485
CAN	1 x CAN Transceiver
DIP Switch	2 x 2bit DIP Switch (used for selecting USB-Debug, RS232, RS485 and CAN)
Expansion	
40-Pin Double-Row Headers	3xUART, 2xI2C, 2xSPI, 2xCAN, 6xGPIO by default, refer to *DEBIX Model A Reduced GPIO Function List* on website https://www.debix.io, they can be configure to I2S, PWM, SPDIF, GPIO etc. through software
MIPI CSI	1 x MIPI CSI
MIPI DSI	1 x MIPI DSI
EEPROM	1 x 2Kbit EEPROM
Accessories	
Cables	2 x Flexible flat cable for DSI & CSI
	1 x Female to female jumper wires for Ethernet

J2 40 Pin Definitions of DEBIX I/O add-on board:

Pins	Definition	Pins	Definition
1	VDD_3V3	2	VDD_5V
3	I2C4_SDA	4	VDD_5V
5	I2C4_SCL	6	GND
7	GPIO1_IO12	8	UART3-TXD
9	GND	10	UART3-RXD
11	CAN1-TXD	12	I2C6_SDA
13	CAN1-RXD	14	GND
15	ECSPI2_SS0	16	ECSPI2_MOSI

17	VDD_3V3	18	ECSPI2_MISO
19	ECSPI1_MOSI	20	GND
21	ECSPI1_MISO	22	ECSPI2_SCLK
23	ECSPI1_SCLK	24	ECSPI1_SS0
25	GND	26	GPIO1_IO11
27	UART4-TXD	28	UART4-RXD
29	CAN2_RXD	30	GND
31	GPIO5_IO04	32	GPIO1_IO13
33	GPIO5_IO03	34	GND
35	I2C6_SCL	36	UART2-RXD
37	UART2-TXD	38	GPIO3_IO21
39	GND	40	CAN2_TXD

As for the mapped functional definition of J2 40 pins on DEBIX I/O board, please refer to *DEBIX Model A Reduced GPIO Function List* on website https://www.debix.io/.

Connection with DEBIX Model A

There is a group of I/O on the reverse side of I/O board, they are circled out with red line as below:

Figure 72

There is a group of pins on the edge of DEBIX, they are circled out with red line as below:

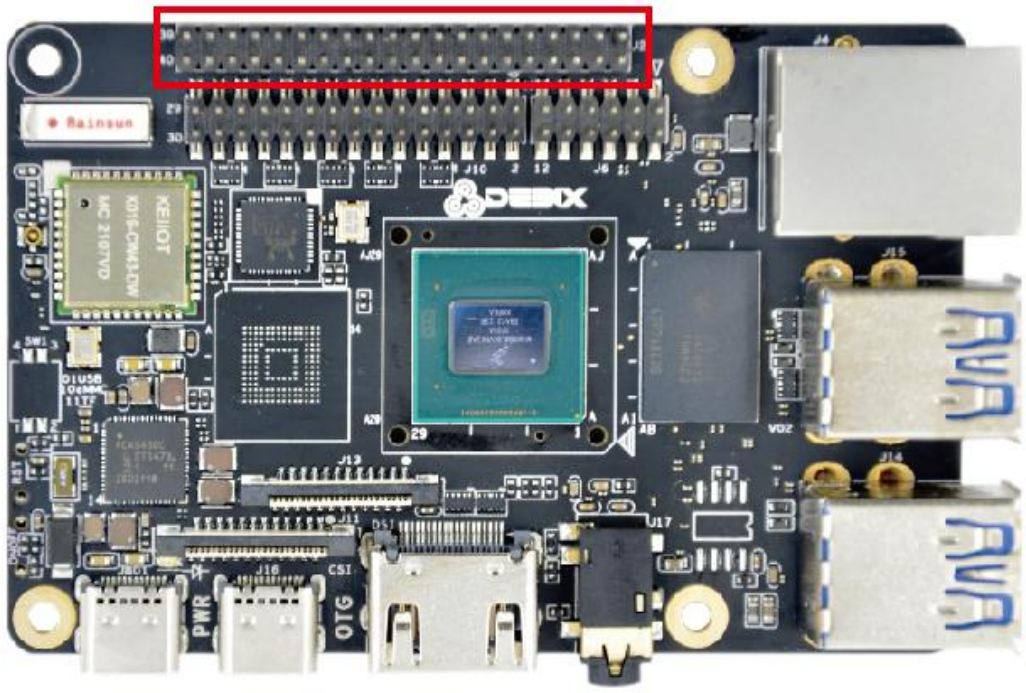


Figure 73

Align highlighted I/O of the I/O board with DEBIX pins and press them, using the approach of hole-to-pin. After this step, the boards should be look like this:

Figure 74

Prepare the blue and white double headed dupont cross line and the FPC line with English words printed on. The CSI FPC line is 2cm longer than DSI FPC line.

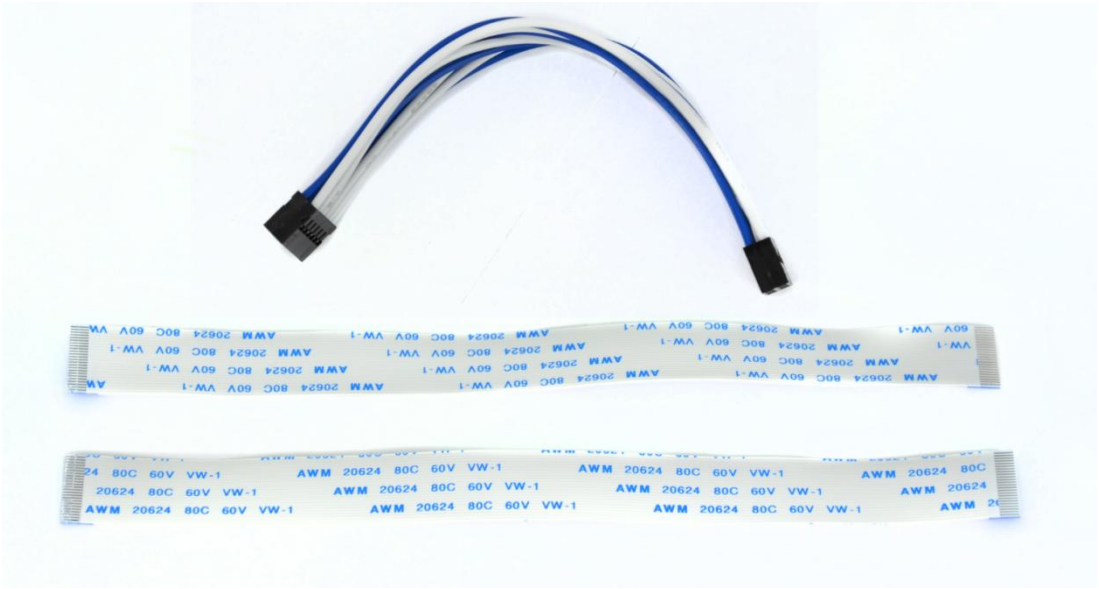


Figure 75

The two boards are connected to each other as described in the following figure, 1 and 2 stands for LAN interface on each board separately, connect 1 and 2 with a colorful dupont line, there is no color sequence, just make sure that the line is inserted into the right pin.

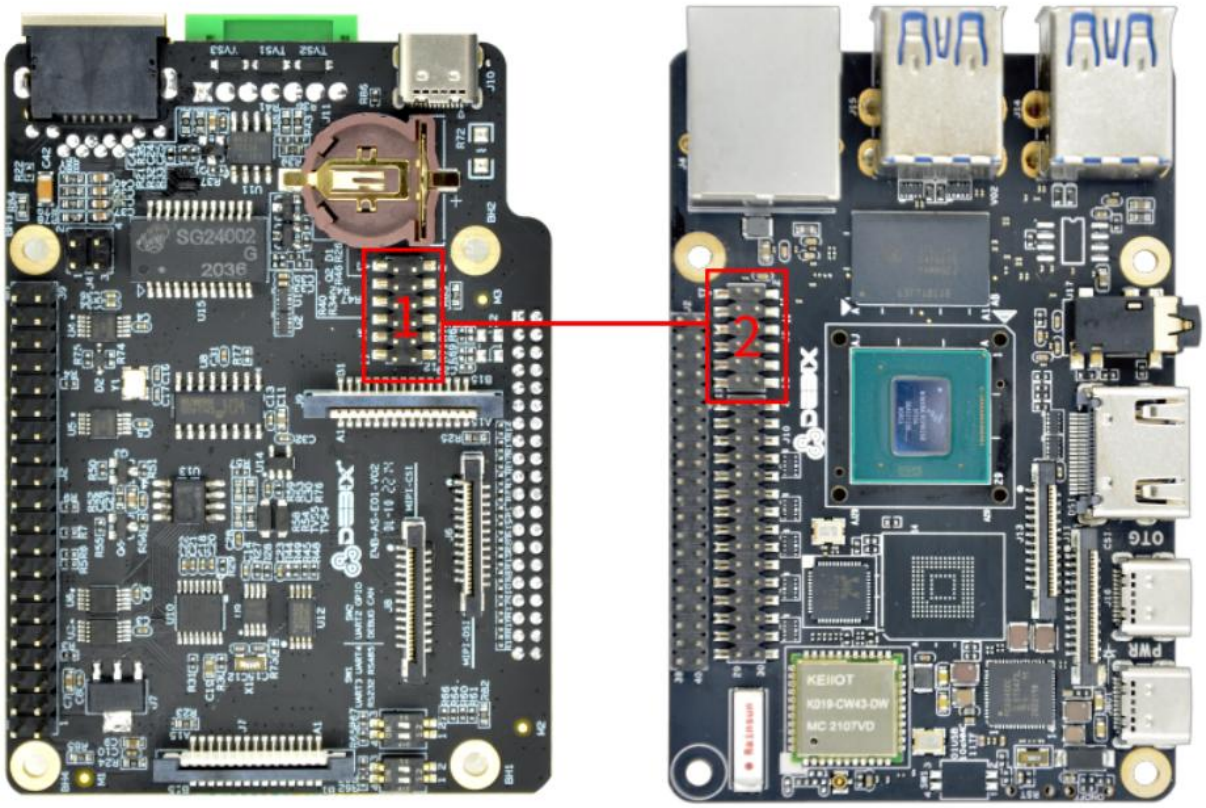


Figure 76

After connection, the boards should look like this

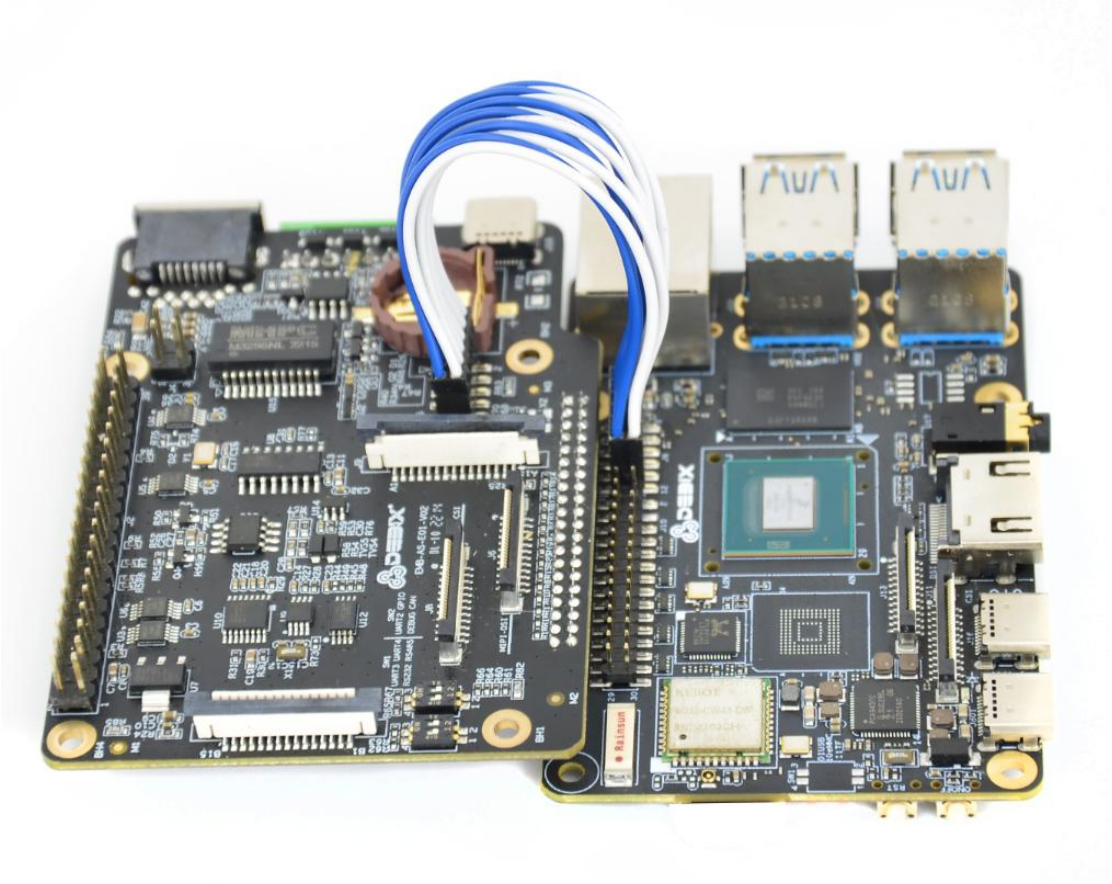


Figure 77

DSI connection locations are as below

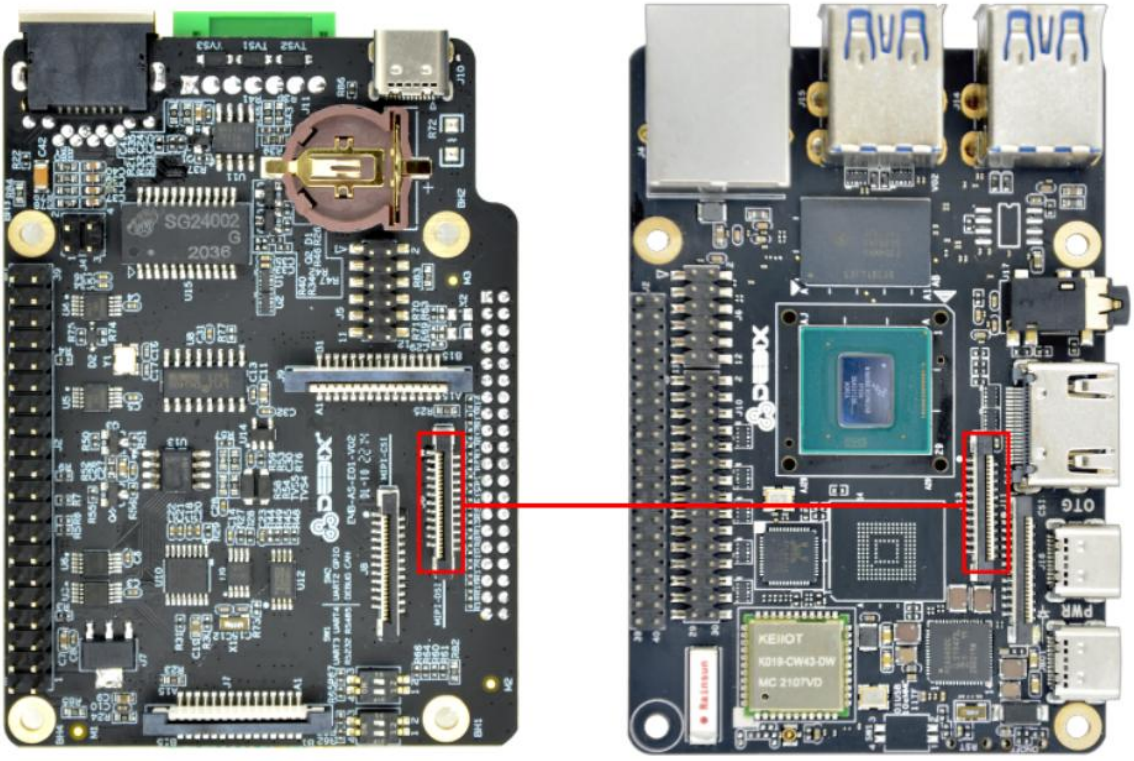


Figure 78

CSI connection locations are as below

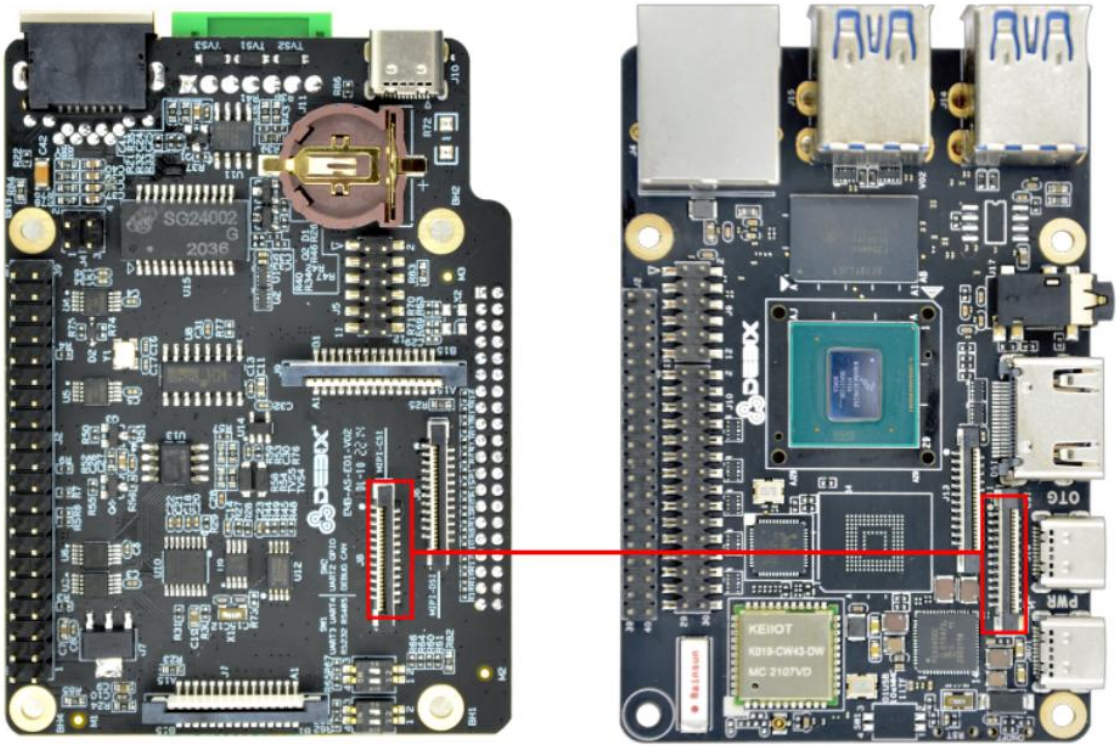


Figure 79

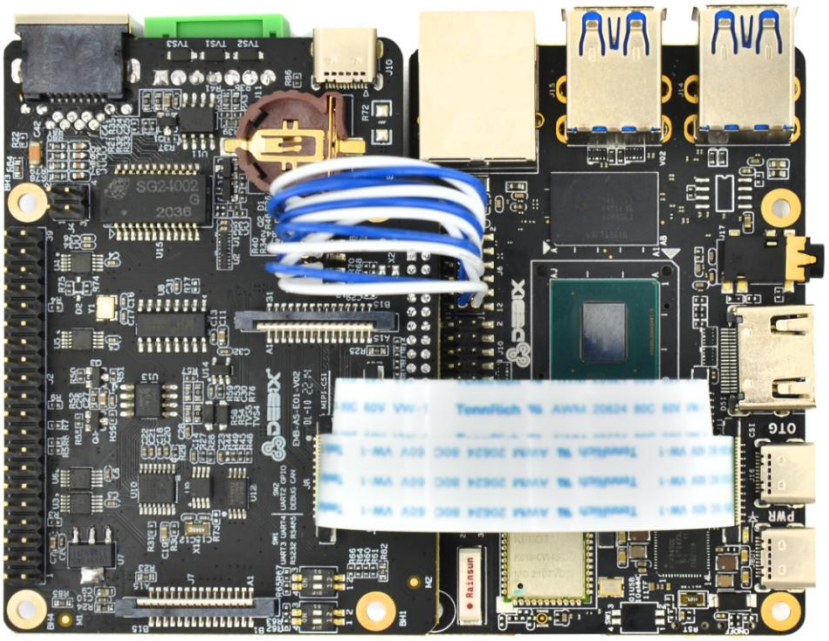


Figure 80

After connection, the boards should look like the above figure. Connect DEBIX with peripheral devices according to Chapter 2, then the boards can work.

Note: When connecting DSI and CSI interfaces, you should take care of the plugging

in/out manner. Before plugging in/out the interface line, remember pulling up the black rubber button, on finishing plugging in/out the interface line, just push down the black rubber button. The stations of the black rubber button are highlighted in the following figures.

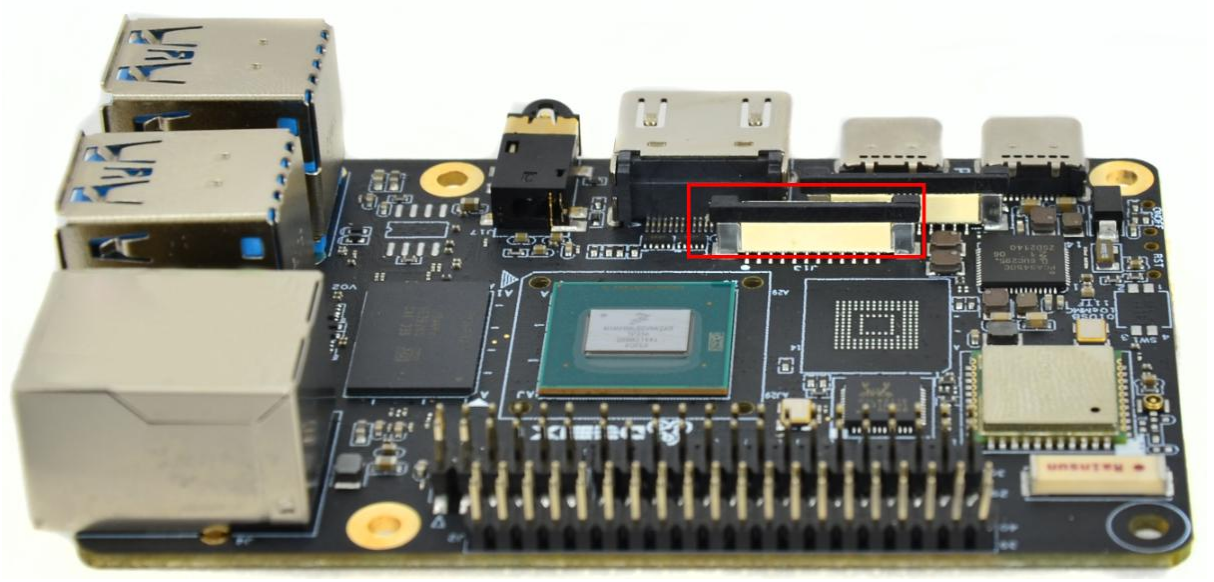


Figure 81 Rubber Button being pushed down

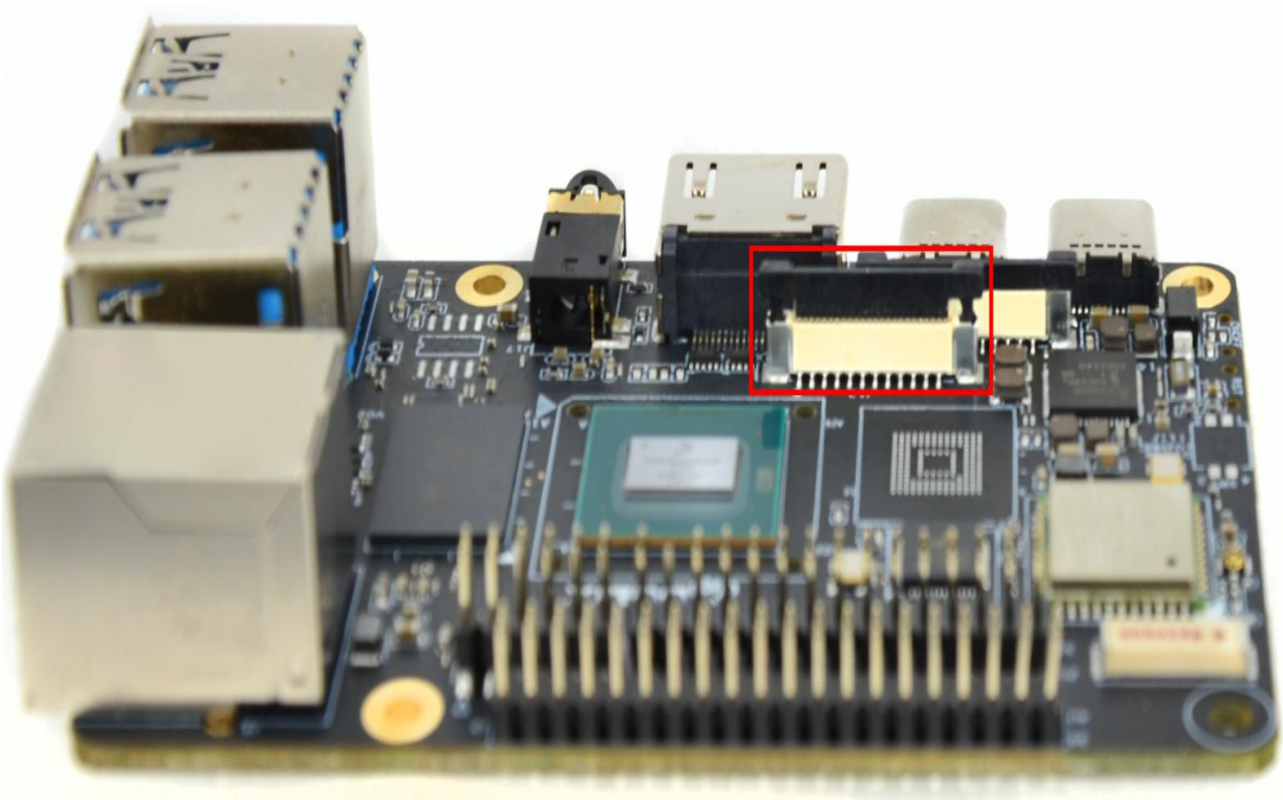


Figure 82 Rubber Button being pulled up

DIP Switch Introduction

The DIP switch location is circled with red line in the following figure:

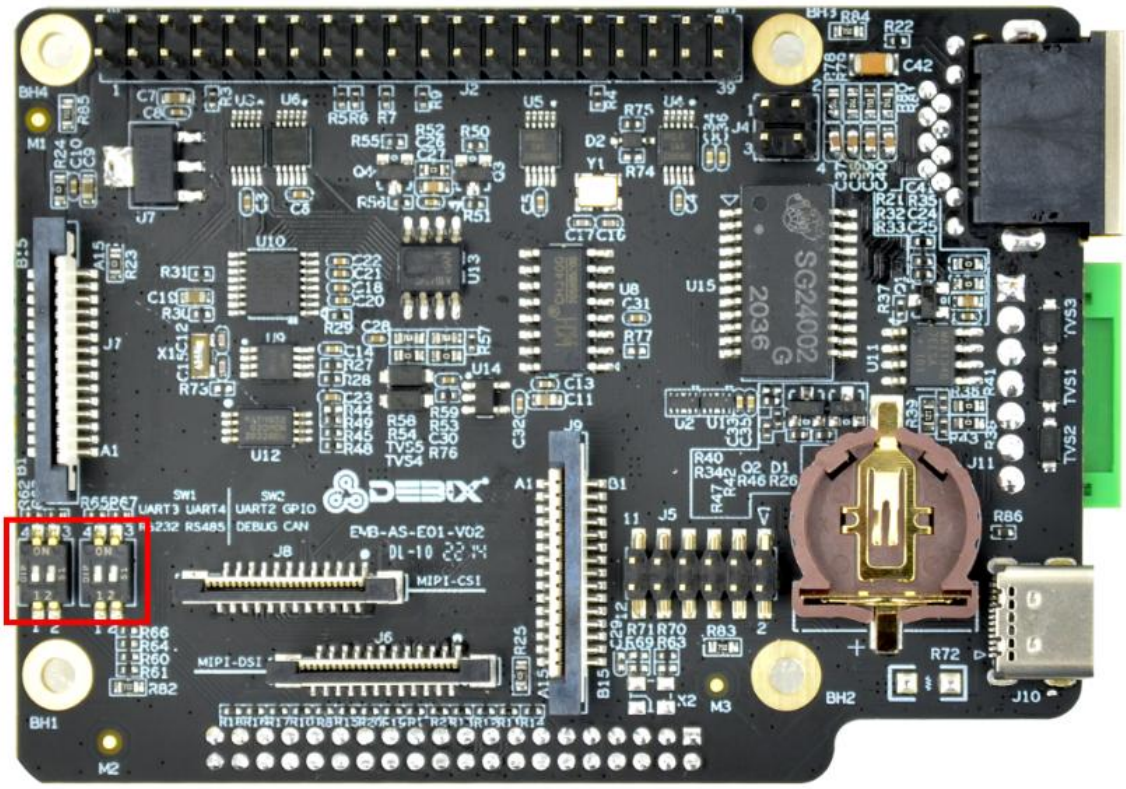


Figure 83

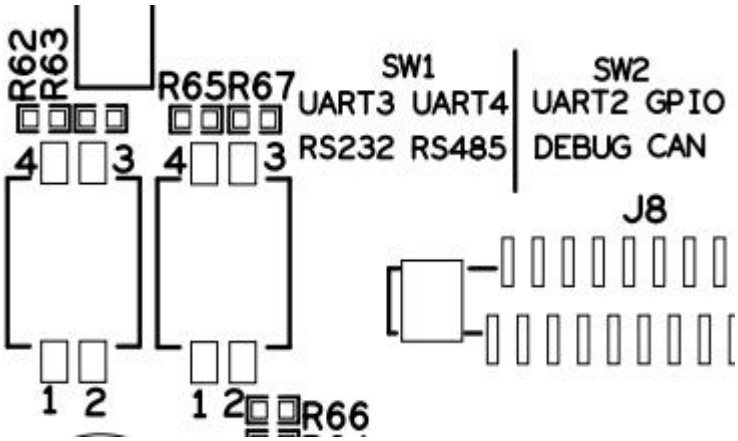


Figure 84

***WARNINGS*:**

To protect the DIP switch, the following instructions should be taken care of:

1. The yellow gummed paper should be taken off

2. Do not use sharp materials to toggle DIP switch

As shown in Figure 83, there are four switches, each switch has two types of station(ON/OFF), i.e There are 8 types of station, which is corresponding with the 8 interfaces shown in the upper right corner of Figure 84. DIP switches make it realizable that Debix is able to be compatible with Raspberry 40 pins. If you are going to use RS232,RS485,DEBUG,CAN, just turn off the corresponding switch (by default, the switches are located on the upper side, i.e., they are in the station of ON).

The relationship between switch locations and interfaces are described in the following table:

Switch station	SW1-1	SW1-2	SW2-1	SW2-2
ON	UART3	UART4	UART2	GPIO
OFF	RS232	RS485	DEBUG	CAN
Note: switch up stands for ON, switch down stands for OFF;SW1-1 is the left switch of SW1, SW1-2 is the right switch of SW1 and SW2-1 the left switch of SW2, SW2-2 the right switch of SW2				

CAN interfaces communication sample in the J2 2x20Pin of DEBIX I/O board

Take the connection of CAN1 and CAN2 as an example. Two CAN receivers as shown in the following picture is used in the sample:

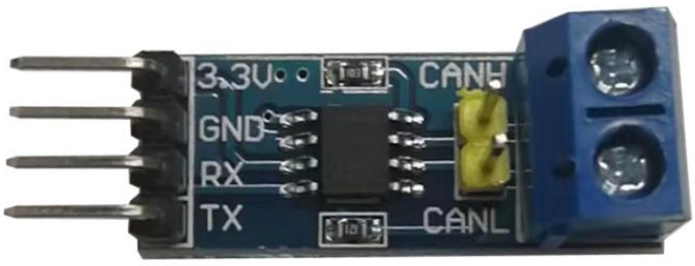


Figure 85

1. Turn DIP SW2-2 ON, at this time, CAN1 signals are at Pin11 and Pin13 of J2. Refer to the J2 2x20 Pin definition in the part of Interface Definition of this chapter, the connection of CAN1 receiver and DEBIX I/O board is described in the following table(the connection line is dupont line):

CAN1 receiver pins	I/O add-on board pins
3.3V	Pin1/Pin17(VDD_3V3)
GND	Pin6/Pin9/Pin14/Pin20/Pin25/Pin30/Pin39(GND)
RX	Pin13(CAN1-RXD)
TX	Pin11(CAN1-TXD)

According to the J2 2x20 Pin definition, the connection of CAN2 receiver and I/O add-on board is described in the following table(the connection line is dupont line):

CAN2 receiver pins	I/O add-on board pins
3.3V	Pin1/Pin17(VDD_3V3)
GND	Pin6/Pin9/Pin14/Pin20/Pin25/Pin30/Pin39(GND)
RX	Pin29(CAN2-RXD)
TX	Pin40(CAN2-TXD)

The connection between the CAN1 receiver and CAN2 receiver is described as below(the connection line is dupont line):

CAN1 receiver pins	CAN2 receiver pins
CANH	CANH
CANL	CANL

Once connected with the corresponding peripherals, the image should look like this:

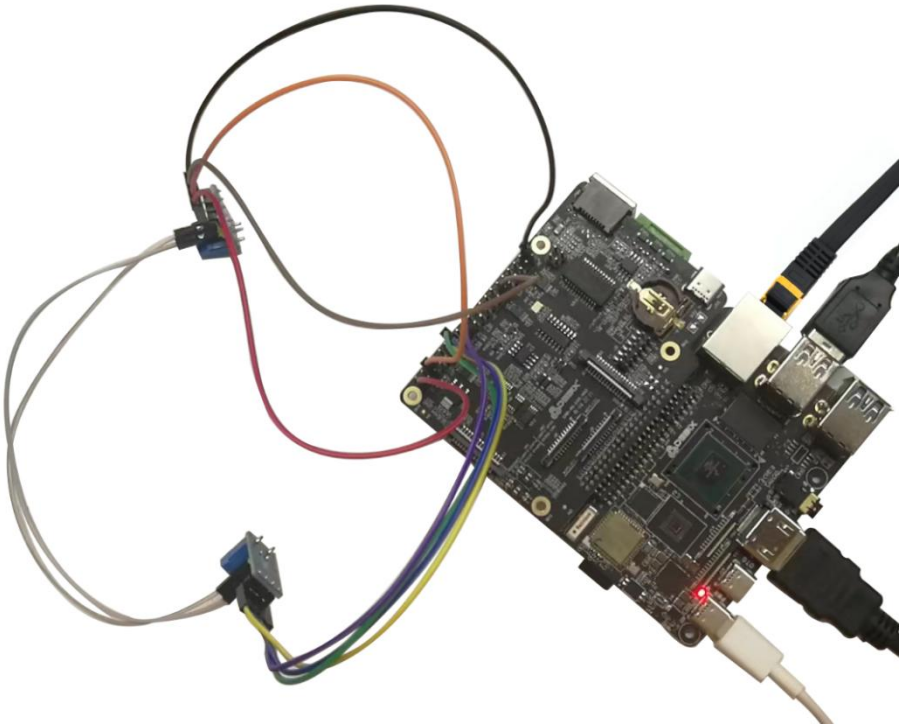


Figure 86

2. Verify the communication between CAN1 and CAN2:

- Run the following command to configure CAN1 and CAN2:

  sudo su

  ifconfig can0 down

  ip link set can0 type can bitrate 500000

  ifconfig can0 up

  ifconfig can1 down

  ip link set can1 type can bitrate 500000

  ifconfig can1 up

- Run the following commands to verify the communication between CAN1 and CAN2

  Receive: candump can1

  Send: cansend can0 123#1122334455667788

  Or

  Receive: candump can0

  Send: cansend can1 123#1122334455667788

CAN/RS485/RS232

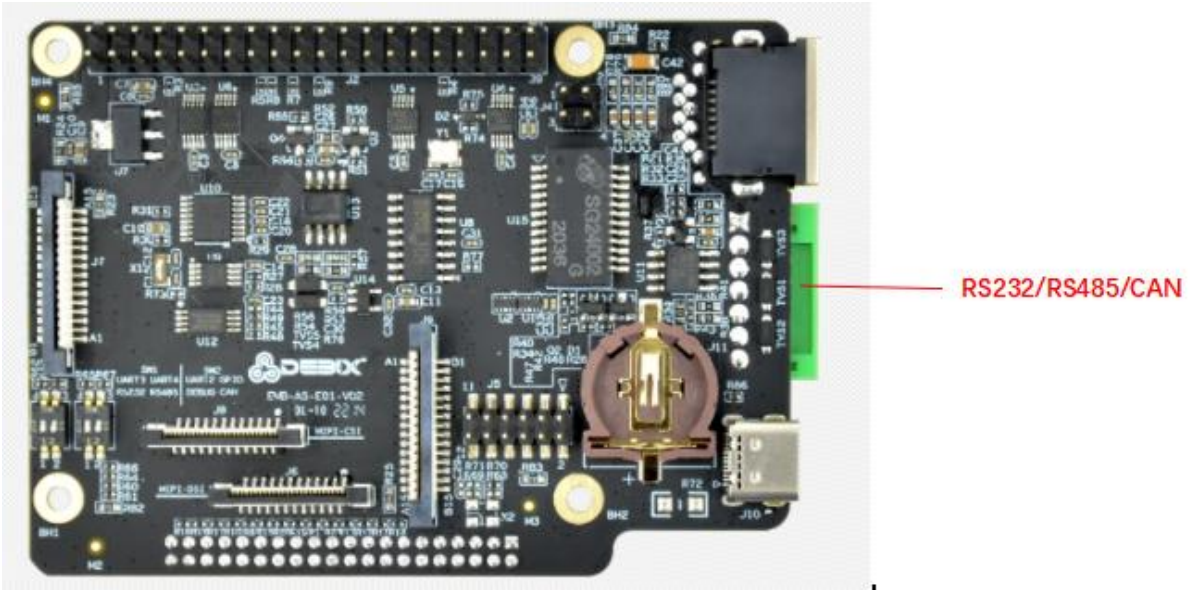


Figure 87

Function name	IO name	Device node	Description
CAN	CAN1_H	can0	HIGH-level CAN bus line
	CAN1_L		LOW-level CAN bus line
R485	RS485_A	/dev/ttymxc3	Noninverting Receiver input and Noninverting Driver Output
	RS485_B		Inverting Receiver Input and Inverting Driver Output
R232	UART3-RXD	/dev/ttymxc2	Debix serial port receive
	UART3-TXD		Debix serial port send

The green connector in Figure 88 is standard industrial communication connector, its model is KF2EDGR-2P5_7P. As for its specification, please refer to *DEBIX_I/O_board_RS232/RS485/CAN_connector_specification* on website https://debix.io, users can prepare the matched connectors by themselves.

Detail description and usage samples are shown in the following part.

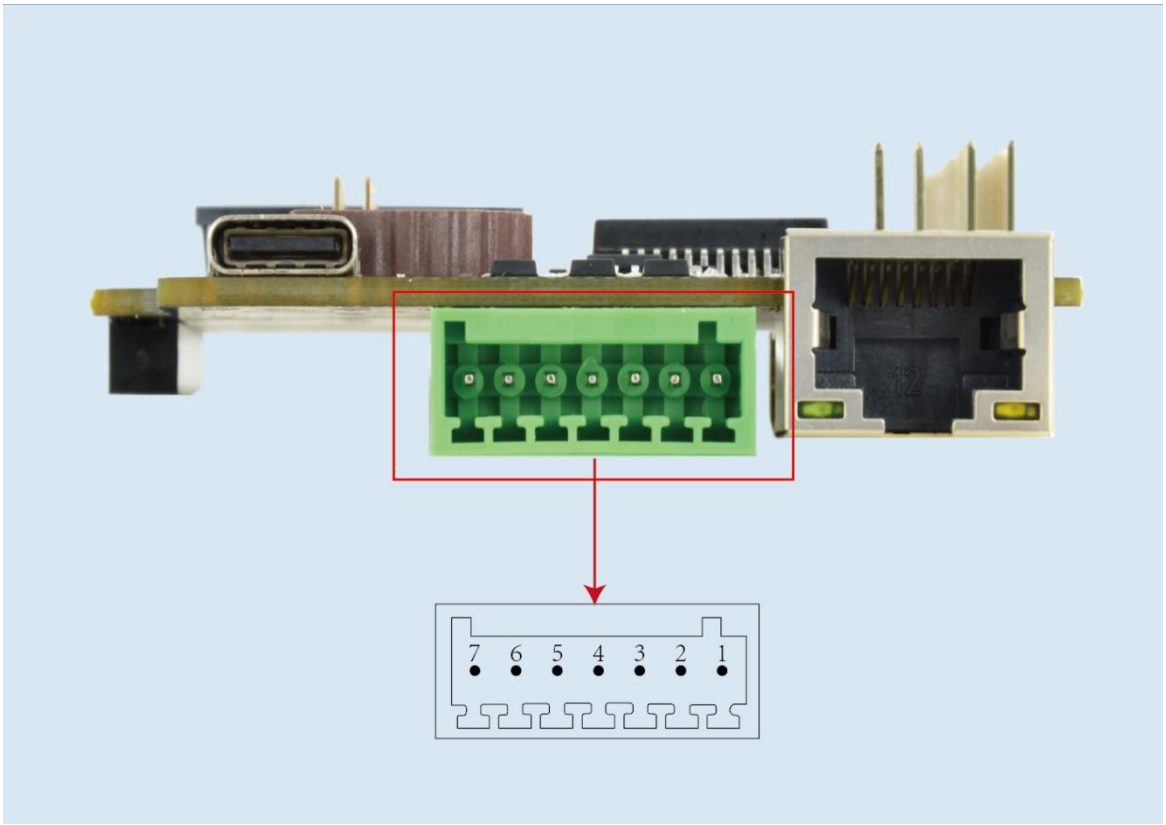


Figure 88

Pin definitions:

Pins	Definition
1	CAN1_H
2	CAN1_L
3	RS485_A
4	RS485_B
5	RS232_RXD3
6	RS232_TXD3
7	GND

CAN sample:

1. Prepare two pieces of DEBIX + DEBIX I/O board, turn the DIP SW2-2 OFF. Note, When SW2-2 is OFF, CAN1 signals are at Pin1 and Pin2 of the green connector J12;when SW2-2 is ON(default state), CAN1 signals are at Pin11 and Pin13 of 2x20Pin J2, at this time, Pin11 and Pin13 can also be configured as other functions.

2. Connection(the connection line is dupont line):

DEBIX I/O board 1	DEBIX I/O board 2
CAN1_H	CAN1_H
CAN1_L	CAN1_L

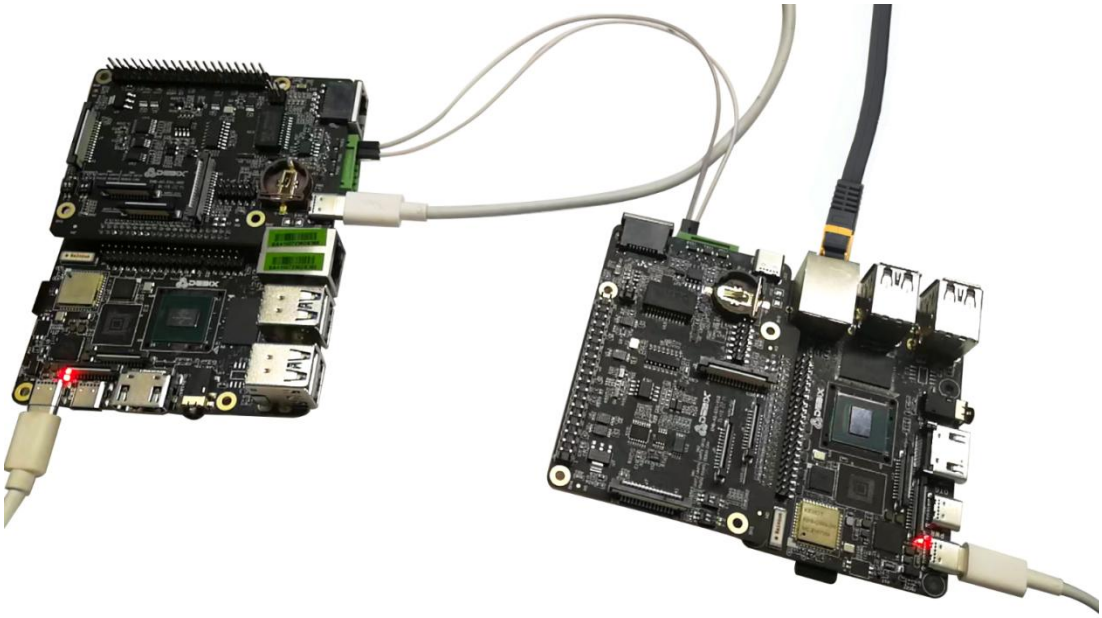


Figure 89

3. Communication between two CAN1 ports of the two DEBIX

- Run the following commands to configure the CAN1 ports of the two DEBIX

  sudo su

  ifconfig can0 down

  ip link set can0 type can bitrate 500000

  ifconfig can0 up

- Run the following commands to verify the communication between the CAN1 ports of the two DEBIX

  Receive: candump can0

  Send: cansend can0 123#1122334455667788

RS485 communication sample

1. Prepare two DEBIX + DEBIX I/O board, turn the DIP SW1-2 of the two DEBIX I/O board OFF.

2. Connection between the two I/O boards(the connection line is dupont line):

I/O board1	I/O board2
RS485_A	RS485_A
RS485_B	RS485_B

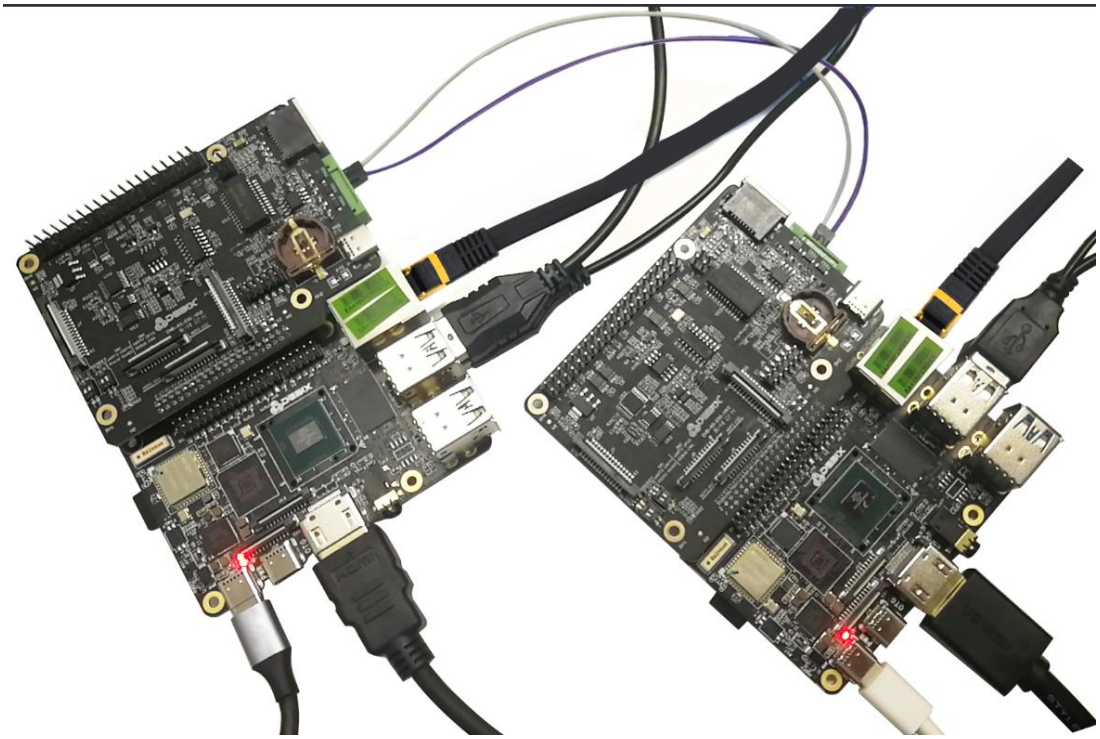


Figure 90

3. Communication between RS485 ports of the two DEBIX

Finish the following steps on the two DEBIX:

- Run command sudo apt install cutecom
- Run command sudo apt install qtwayland5
- Run command cutecom to open the serial interface tool, select /dev/ttymxc3, click open, try sending and receiving data between the two platforms

RS232 Sample

1. Prepare two DEBIX + DEBIX I/O board, turn the DIP SW1-1 of the two DEBIX I/O board OFF.

2. Connection between the two I/O boards are as below(the connection line is dupont line):

I/O board1	I/O board 2
RS232_RXD3	RS232_TXD3
RS232_TXD3	RS232_RXD3

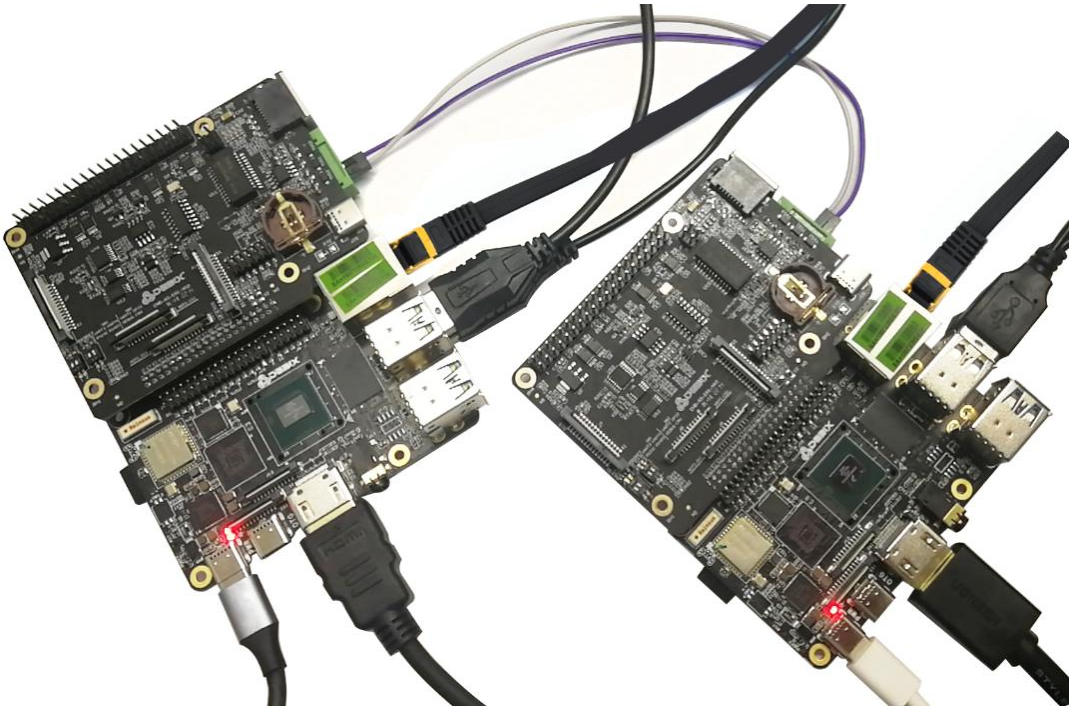


Figure 91

3. Communication between the two RS232 ports on the two DEBIX:

Finish the following steps on the two DEBIX:

- Run command sudo apt install cutecom
- Run command sudo apt install qtwayland5
- Run command cutecom to open the serial port communication tool, select /dev/ttymxc2, click open, send and receive data between the two platforms.

Usage of Type-C Debug

Connect DEBIX I/O board with DEBIX, connect DEBIX I/O board Debug interface and Windows computer with a type-C cable, power up DEBIX through inserting the type-C power cable. After connection, the boards should look like this

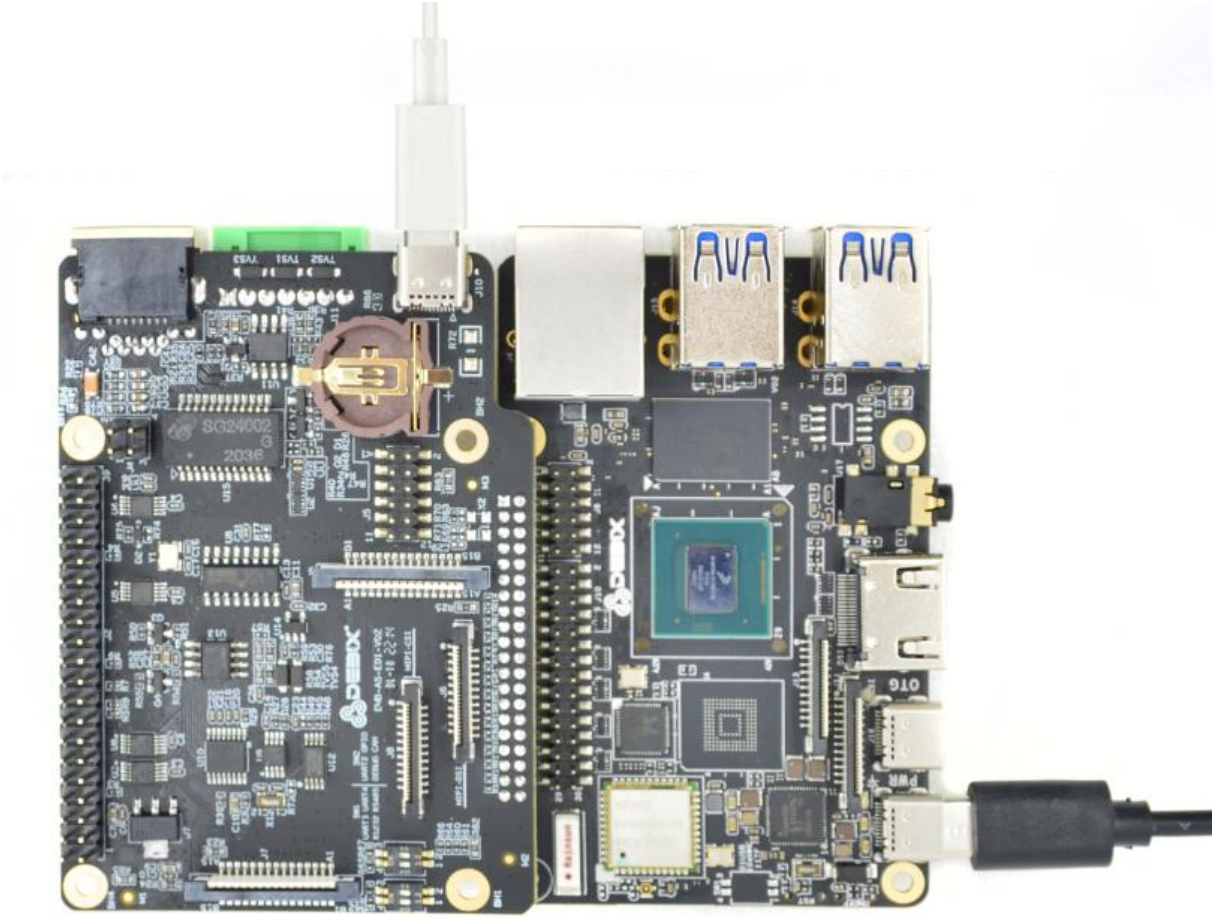


Figure 92

- On windows, download the USB-to-serial driver on following website http://www.wch.cn/downloads/CH341SER_EXE.html ,open this website and click download.
- Once the download finished, you can find following file.

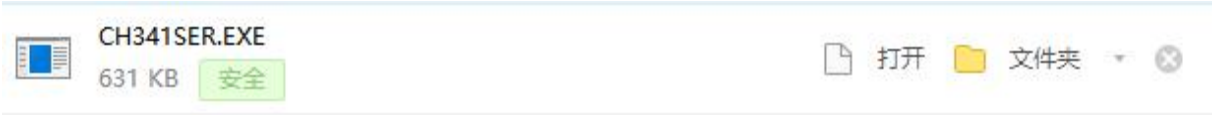


Figure 93

- Click **open** and then **run** then **install**,once installation is finished there will be a prompt to notify you that the driver is installed successfully.
- Right click **my computer**, select **management**, select **device manager**, unfold **port (COM and LPT)**,you will see USB-SERIAL CH340, just like the figure below

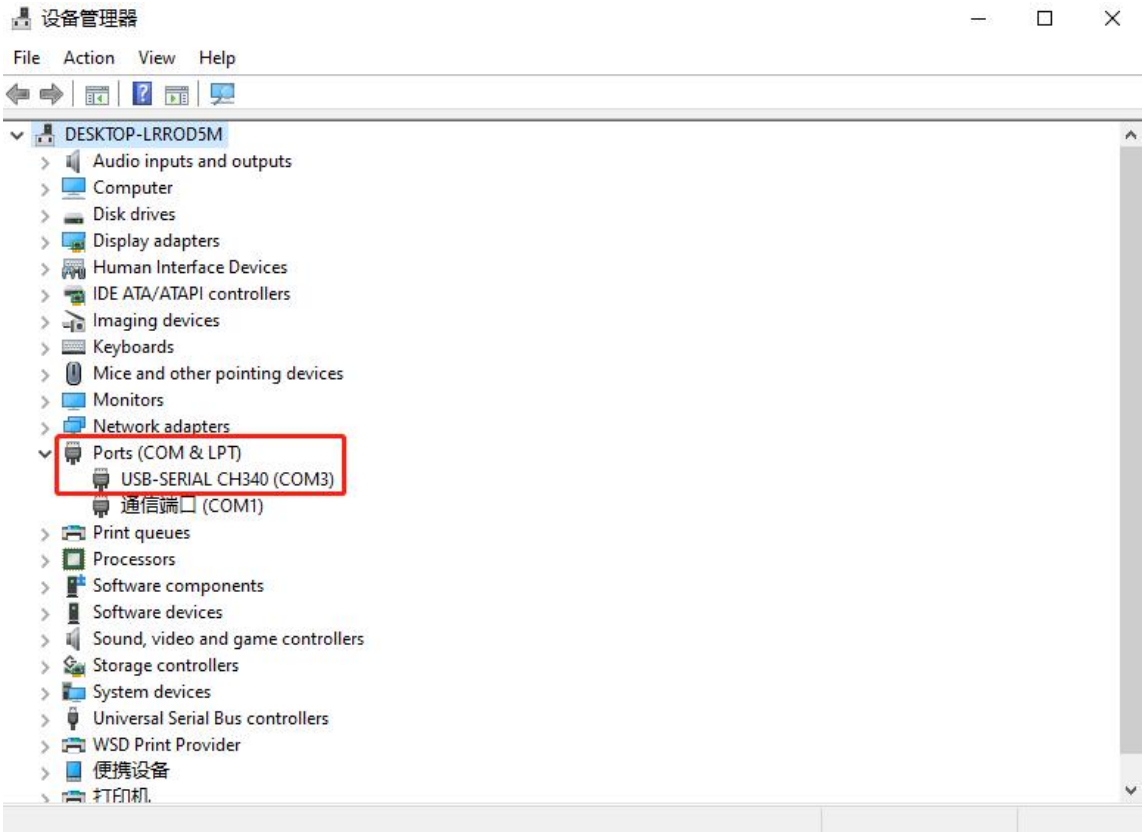


Figure 94

- Download putty from the internet(e.g. https://www.onlinedown.net/soft/2186.htm), install it following the installation wizard.
- Open putty, select **Session**, select **serial**, input speed with value 115200, set the **serial line** to the serial line that shown in step 3 Figure 95, finally, click **open**.

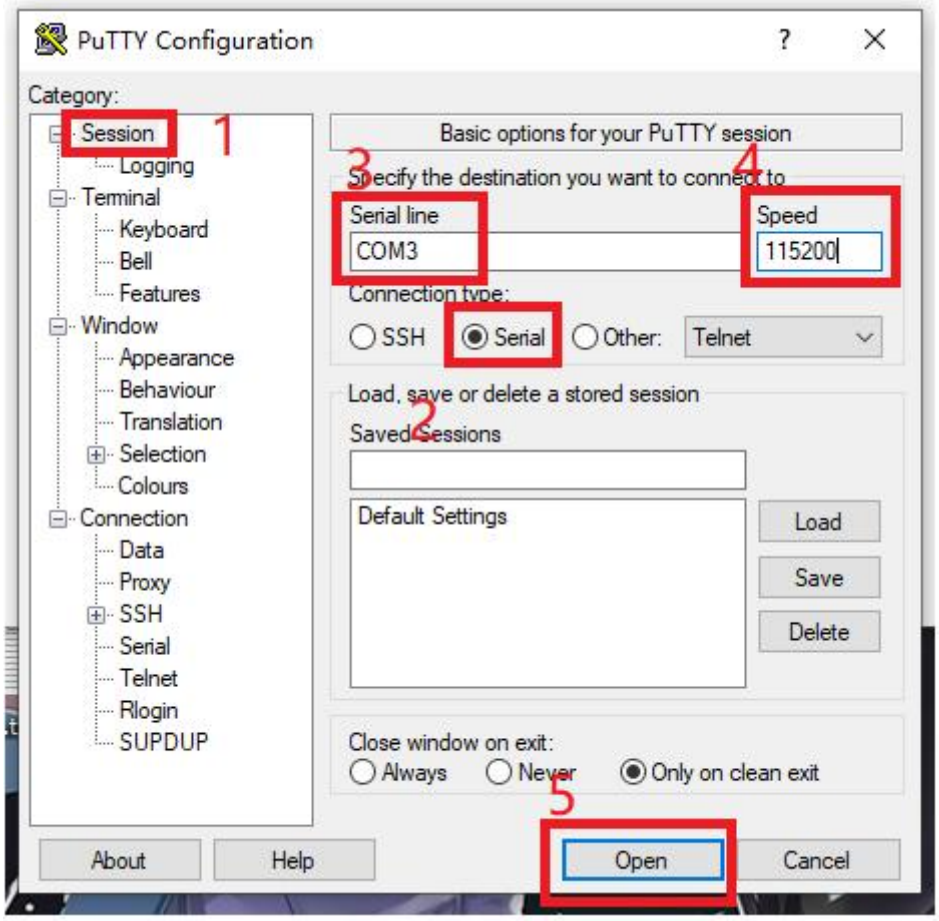


Figure 95

Once the serial port is open, you can see the following image, you can check kernel log, alternatively, you can type linux commands.

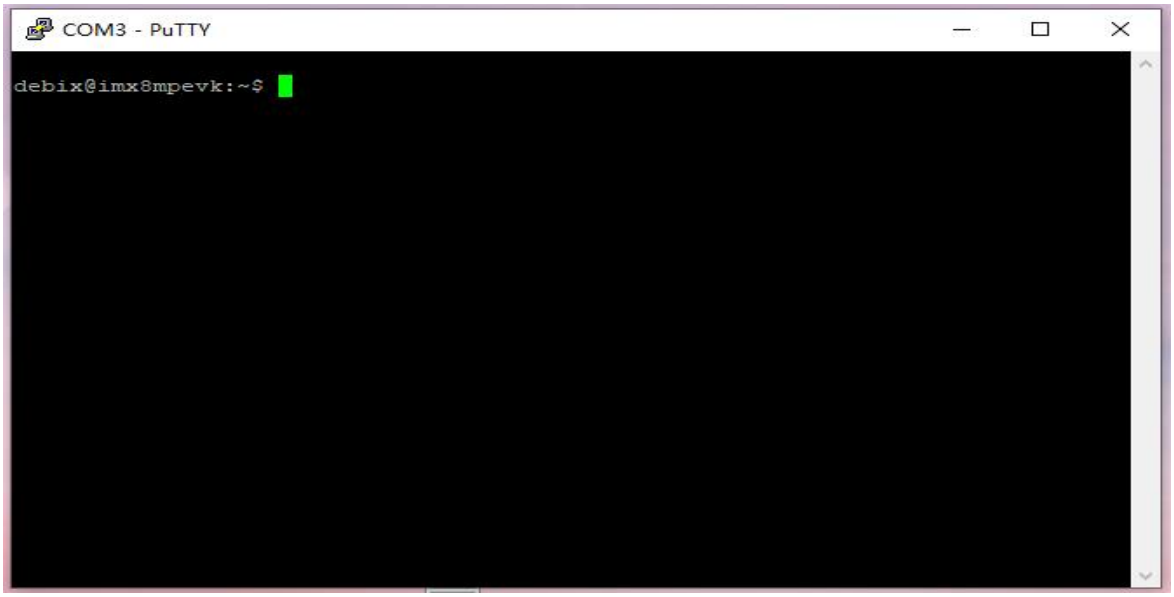


Figure 96

Usage of CSI Camera

Prepare a camera just like the figure below

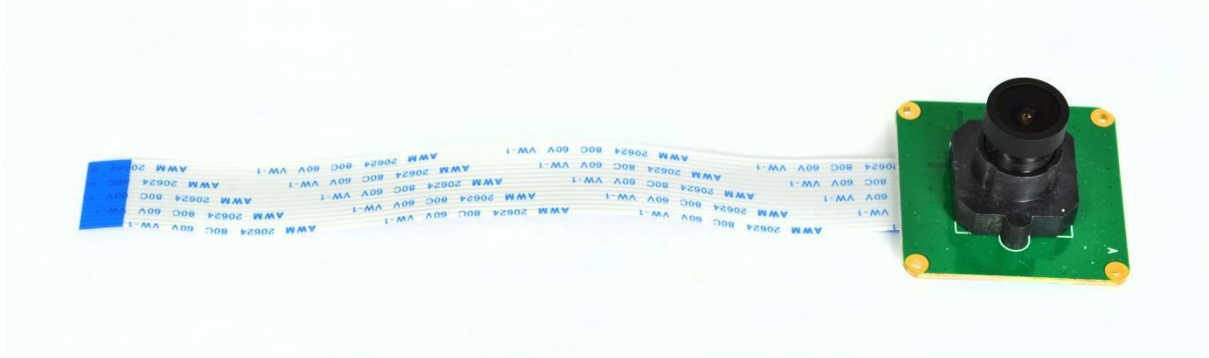


Figure 97

The CSI interface on DEBIX I/O board is as below

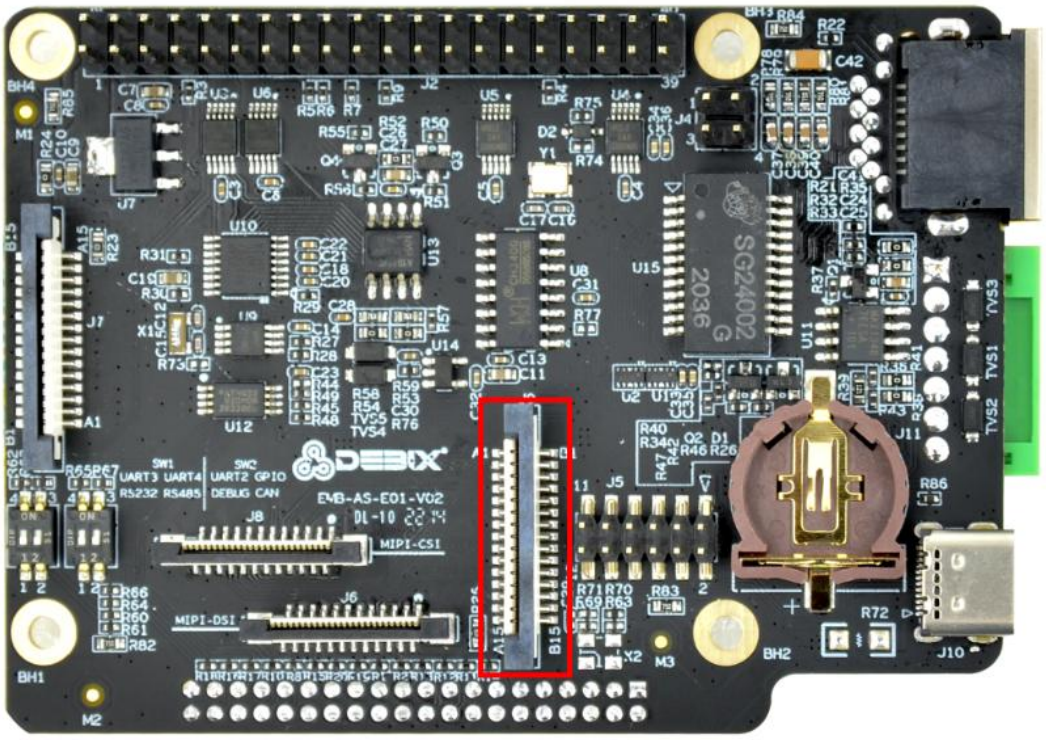


Figure 98

Connect the camera to the DEBIX I/O board, once connected, the board is as below

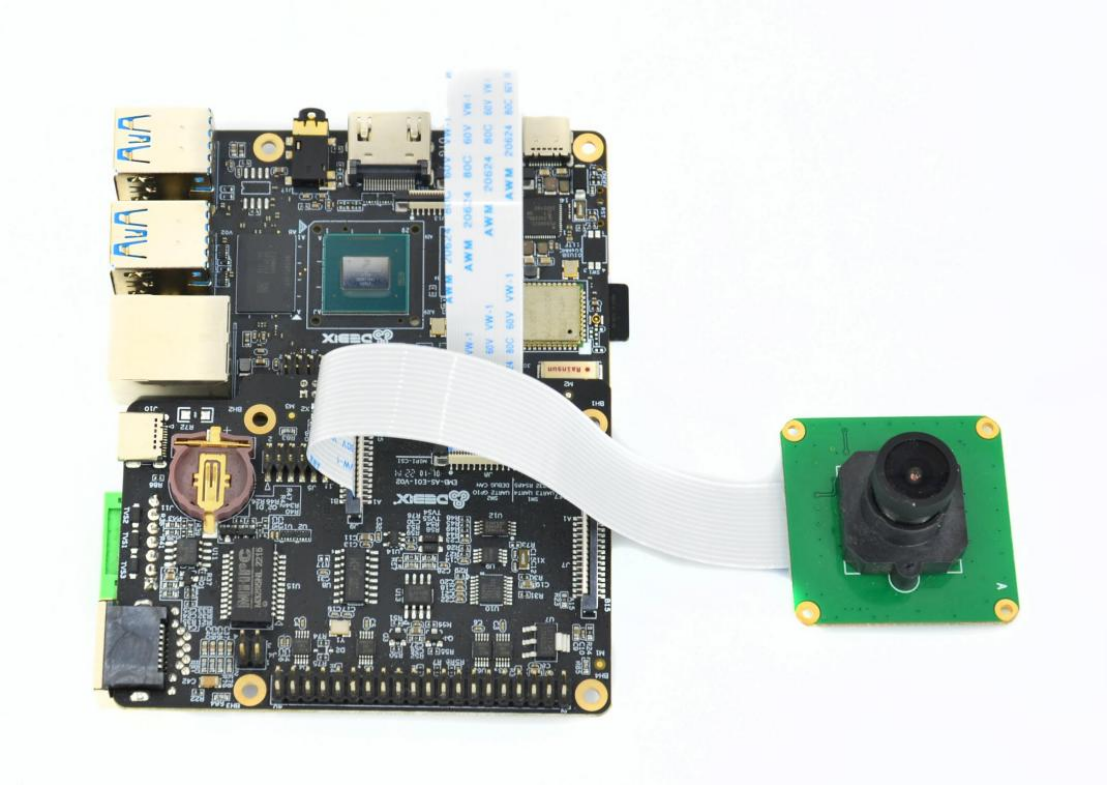


Figure 99

Insert Micro SD card to DEBIX and connect DEBIX with peripheral devices (keyboard, mouse, display device..) referring to Chapter 2. Finally, the board is as below

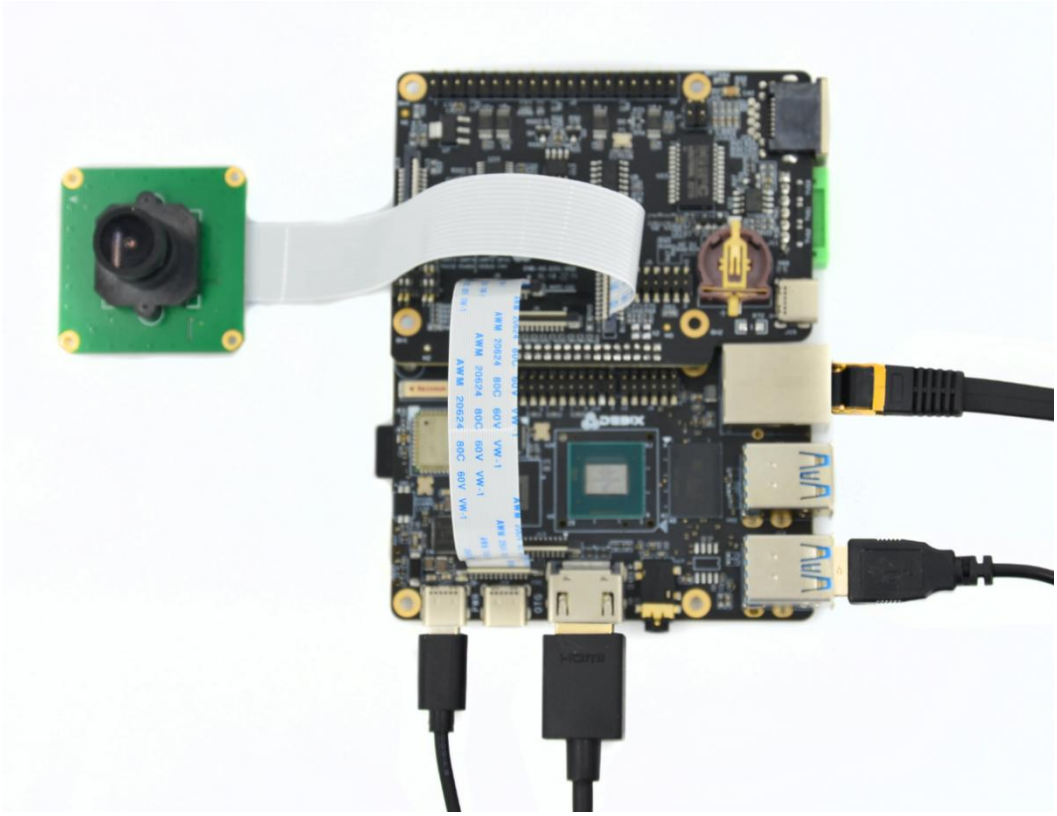


Figure 100

Camera Interface Verification

Connect DEBIX I/O board, camera, DEBIX using the steps described above, power up DEBIX, the camera should work normally.

Related hardware

Function name	IO name	Description
Power control	CSI1_PWDN	
Reset control	CSI1_nRST	
I2C	I2C2_SDA	/dev/i2c-1
	I2C2_SCL	
CSI	CSI1_DN0/CSI1_DP0~ CSI1_DN3/CSI1_DP3	Device tree node mipi_csi_0

Verify that the driver has been loaded normally

Open terminal, run command lsmod | grep imx219, you should get an output like this

```
imx219                 28672  1
```

Open terminal, run command dmesg | grep imx219, you should get an output like this

```
[    8.789571] imx219: loading out-of-tree module taints kernel.
[    8.790442] enter imx219_probe
[    8.790502] enter imx219_power_on
[    8.846817] imx219_probe camera mipi imx219, is found
[    9.114965] mx8-img-md: Registered sensor subdevice: imx219 1-
0010 (1)
[    9.114981] mx8-img-md: created link [imx219 1-0010] => [mxc-
mipi-csi2.0]
[   15.574934] mx8-img-md: Registered sensor subdevice: imx219 1-
0010 (1)
[   15.574949] mx8-img-md: created link [imx219 1-0010] => [mxc-
mipi-csi2.0]
```

V4L2 node：/dev/video2(when there are two cameras connected to DEBIX, it's needed to check which video node is correct.)

Usage of DSI Display

The DSI display interface on DEBIX I/O board is as below

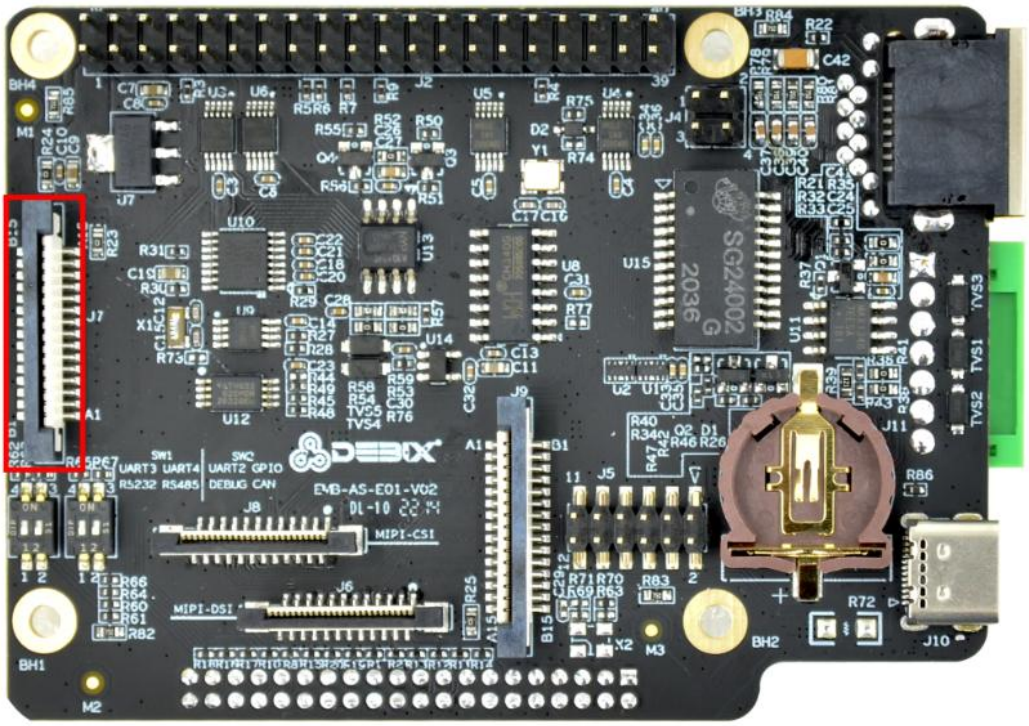


Figure 101

Prepare mother-to-mother dupont thread and assistant display DSI line

Figure 102 Mother-to-mother Dupont Thread

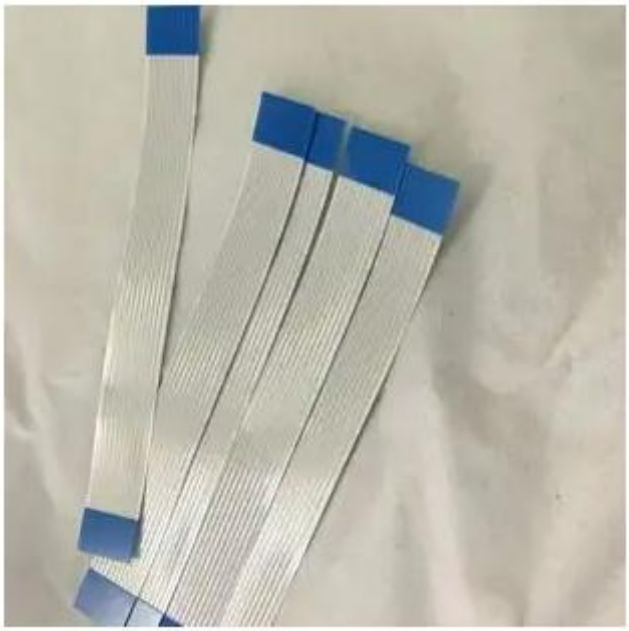


Figure 103 Assistant Display DSI Line

Connect the display with the I/O board using mother-to-mother dupont thread (pin2 of I/O board to 5V power pin of the display), and also, connect the assistant display DSI line. Once these two lines are connected, the display can work.

Figure 104

Figure 105

Usage of RTC

Connect DEBIX I/O board and DEBIX as the steps described above, power up DEBIX, the boards should look like this

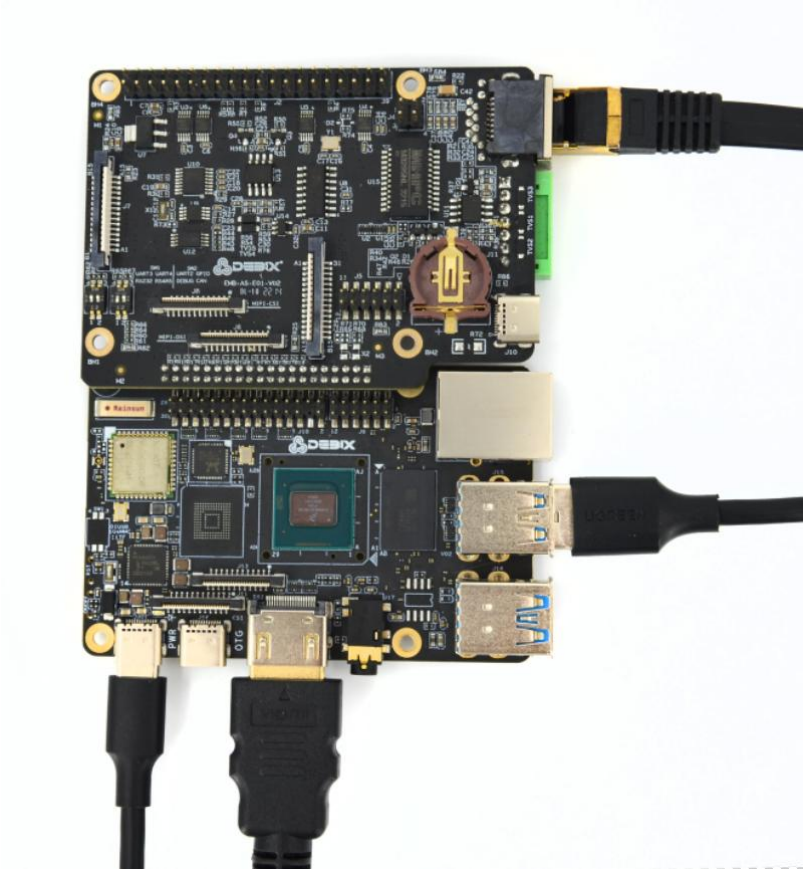


Figure 106

Chip model: HYM8563S I2C address:0x51

- Related hardware

Function	IO name	Device node	description
I2C	I2C4-SCL	/dev/i2c-3	I2C4 clock
	I2C4-SDA		I2C4 data pin

- Make sure that driver HYM8563S is loaded

Open terminal, Run command dmesg | grep rtc-hym8563, the output should look like this

```
[    2.329714] rtc-hym8563 3-0051: registered as rtc1
```

- Set and read RTC time

Open terminal, Run command sudo hwclock --systohc ,and then run command sudo hwclock --show,the output should look like this

```
2022-04-01 15:17:18.348167+00:00
```

Usage of LAN2

Connect DEBIX I/O board and DEBIX as the steps described above, power up DEBIX, the boards should look like this (make sure that the LAN interface of I/O board is inserted with network cable)

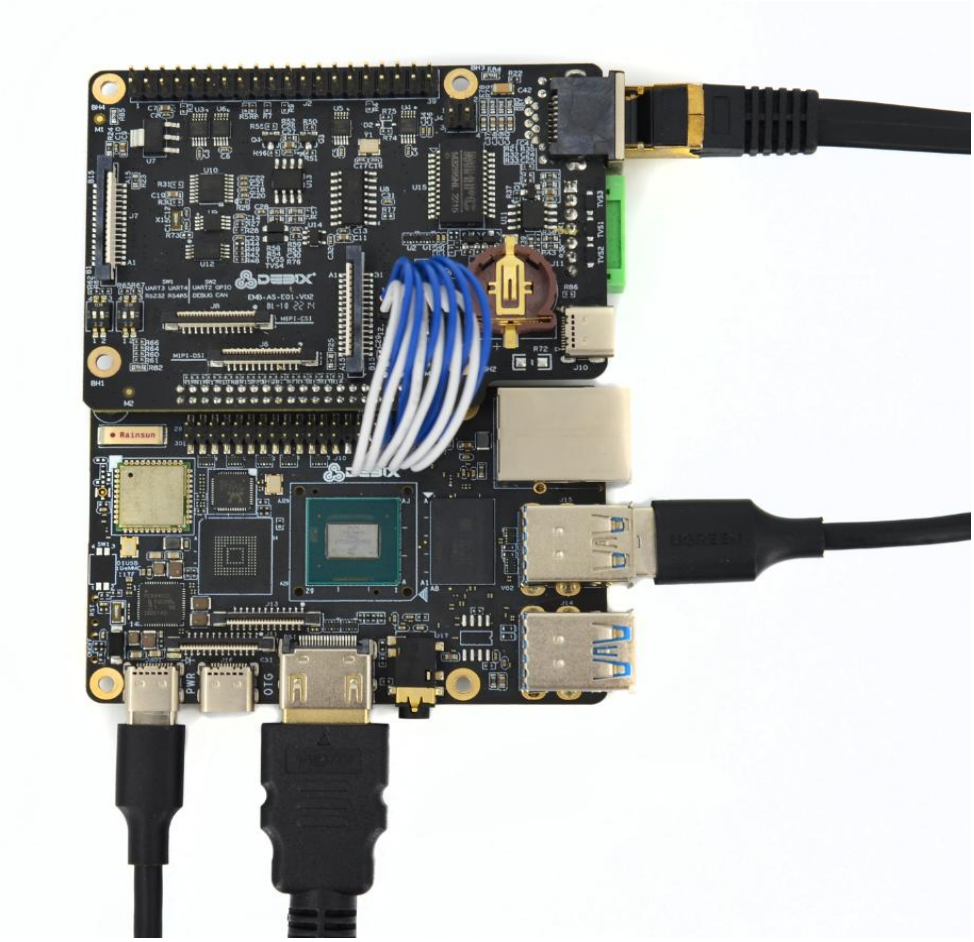


Figure 107

Port number:ens34

Open terminal, Run command ifconfig, the output should look like this

```
debix@imx8mpevk:~$ ifconfig
ens33: flags=-28669<UP,BROADCAST,MULTICAST,DYNAMIC>  mtu 1500
        ether 10:07:23:60:59:ca  txqueuelen 1000  (Ethernet)
        RX packets 1666  bytes 136218 (136.2 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 776  bytes 86821 (86.8 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
        device interrupt 56

ens34: flags=-28605<UP,BROADCAST,RUNNING,MULTICAST,DYNAMIC>  mtu 1500
        inet 192.168.2.14  netmask 255.255.255.0  broadcast 192.168.2.255
        inet6 fe80::a5f0:ec78:636c:6700  prefixlen 64  scopeid 0x20<link>
        ether 10:07:23:60:59:cb  txqueuelen 1000  (Ethernet)
        RX packets 62  bytes 6282 (6.2 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 55  bytes 8204 (8.2 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

Usage of Raspberry Pi POE HAT

Components preparation:

- DEBIX Model A, DEBIX I/O add-on board
- Raspberry Pi POE HAT
- Switch(supporting POE) or router(supporting POE)
- Micro SD card(already flashed DEBIX OS), common network cable

Component connection:

1. Connect DEBIX Model A and DEBIX I/O board according to Figure 72, Figure 73 of Chapter5.

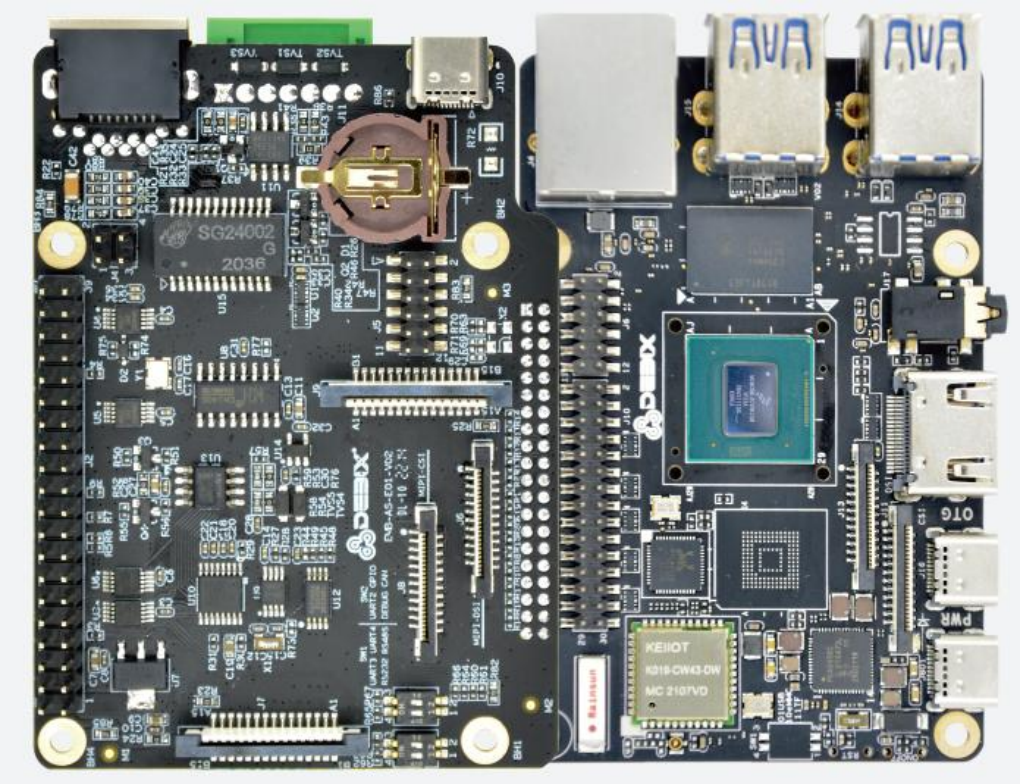


Figure 108

2. Connect Raspberry Pi POE HAT and DEBIX I/O add-on board. It can be seen from the following figures that Raspberry Pi has 40-pin and 4-pin slots, connect the 40-pin slot and 4-pin slot with the corresponding parts of DEBIX I/O board.

Note: When connecting Raspberry Pi POE HAT and DEBIX I/O add-on board, except the 40-pin and 4-pin connection parts, the other components of the two boards should be kept away from each other in case that short circuit occurs.

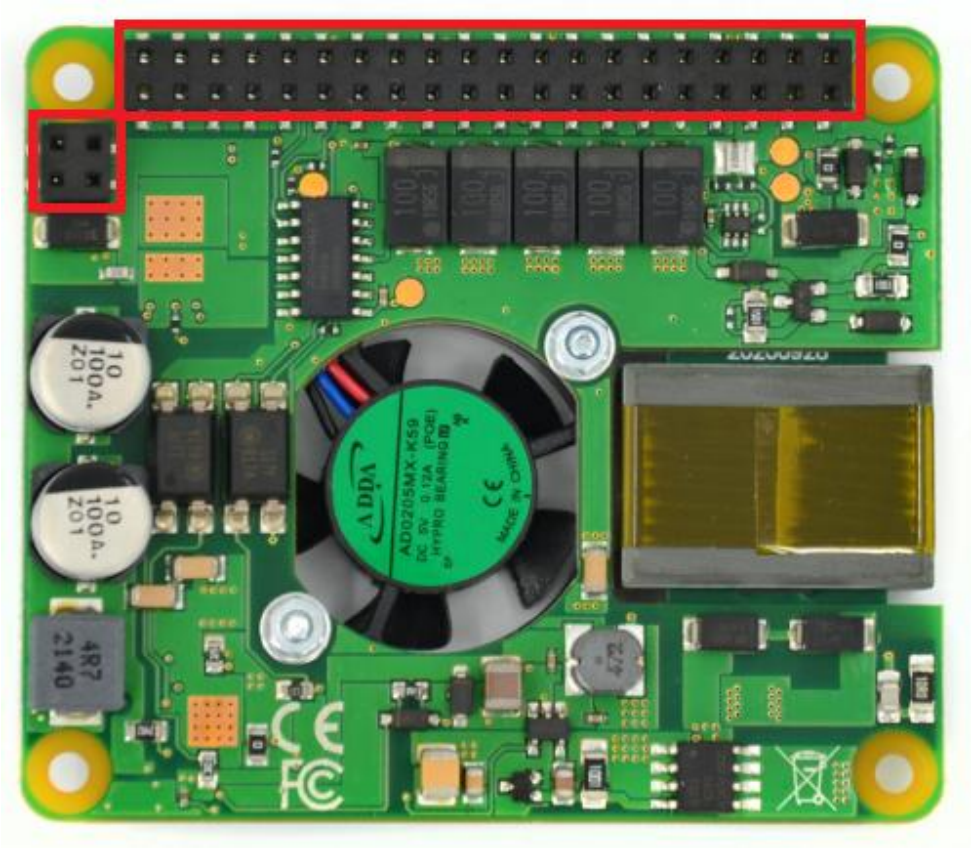


Figure 109

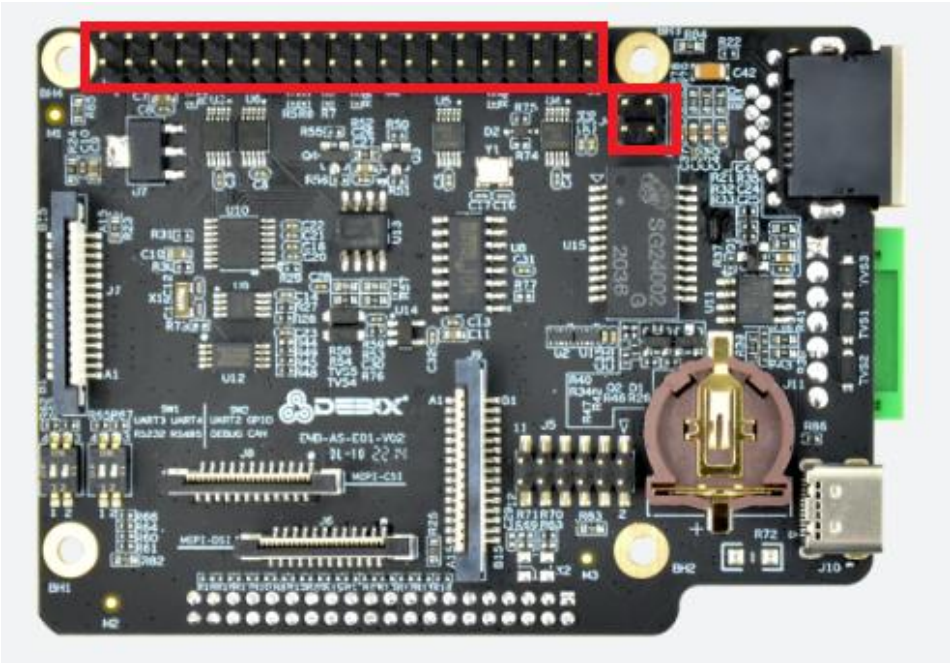


Figure 110

3. Connect the switch(supporting POE) with DEBIX Model A

Figure 111

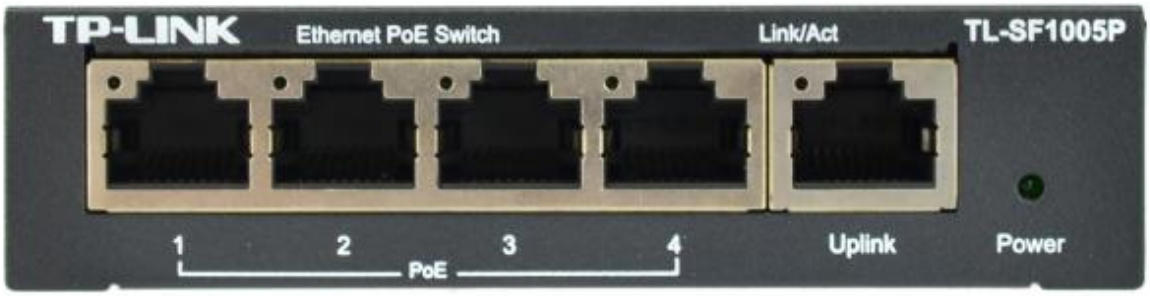


Figure 112

Insert the Micro SD card into the SD card slot of DEBIX Model A, power up the switch, the red indicator of DEBIX Model A will light, which indicates that POE function is normal. It is without error that the POE HAT fan does not work, since it is not used.

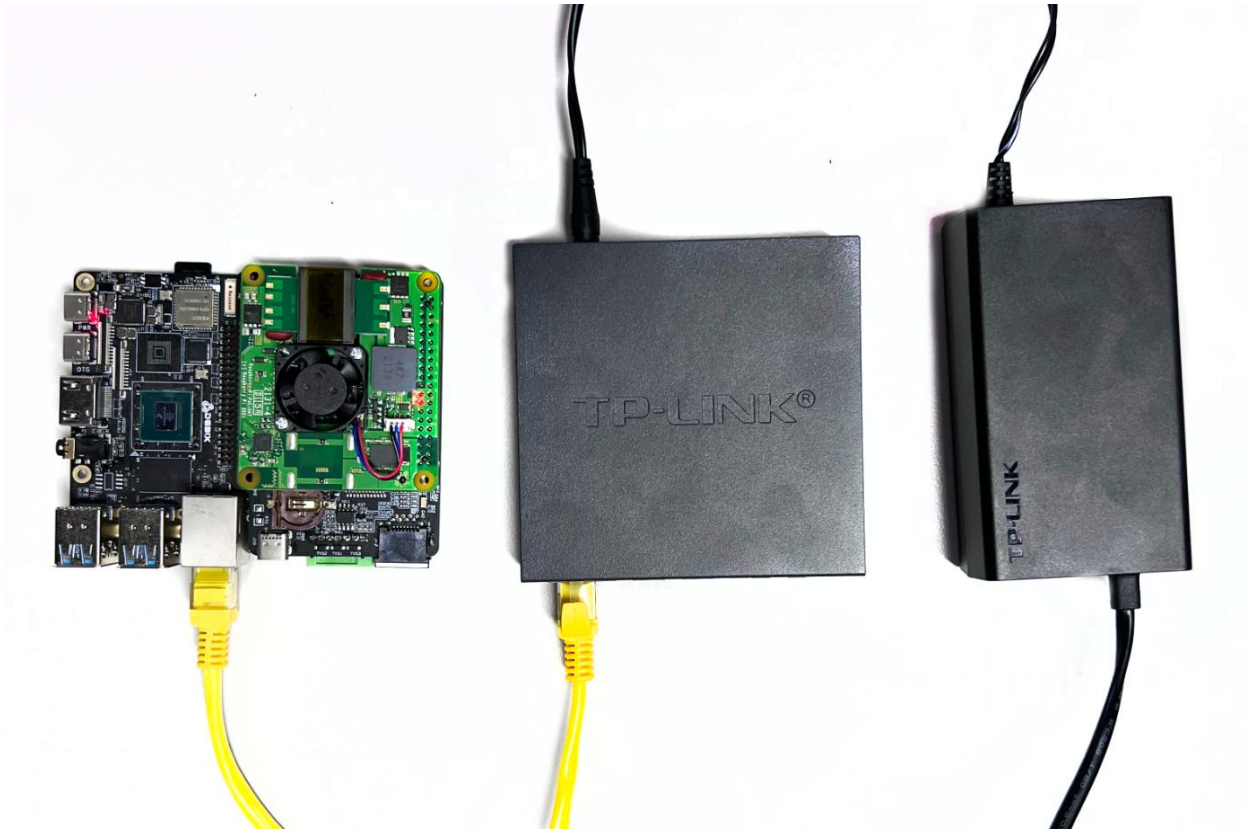


Figure 113

Finally, you can connect DEBIX Model A with peripherals (keyboard, mouse, display), refer to chapter 2 of this document for connection steps.

Chapter 6 DEBIX LoRa Board

Brief Introduction of DEBIX LoRa Board

DEBIX Model A LoRa Board is compatible with DEBIX Model A and provides a Mini PCIe interface for LoRa Module. LoRa enables long-range transmissions with low power consumption.

LoRa board has a LoRa antenna connecor, a Wi-Fi antenna connector and a Bluetooth paring button.

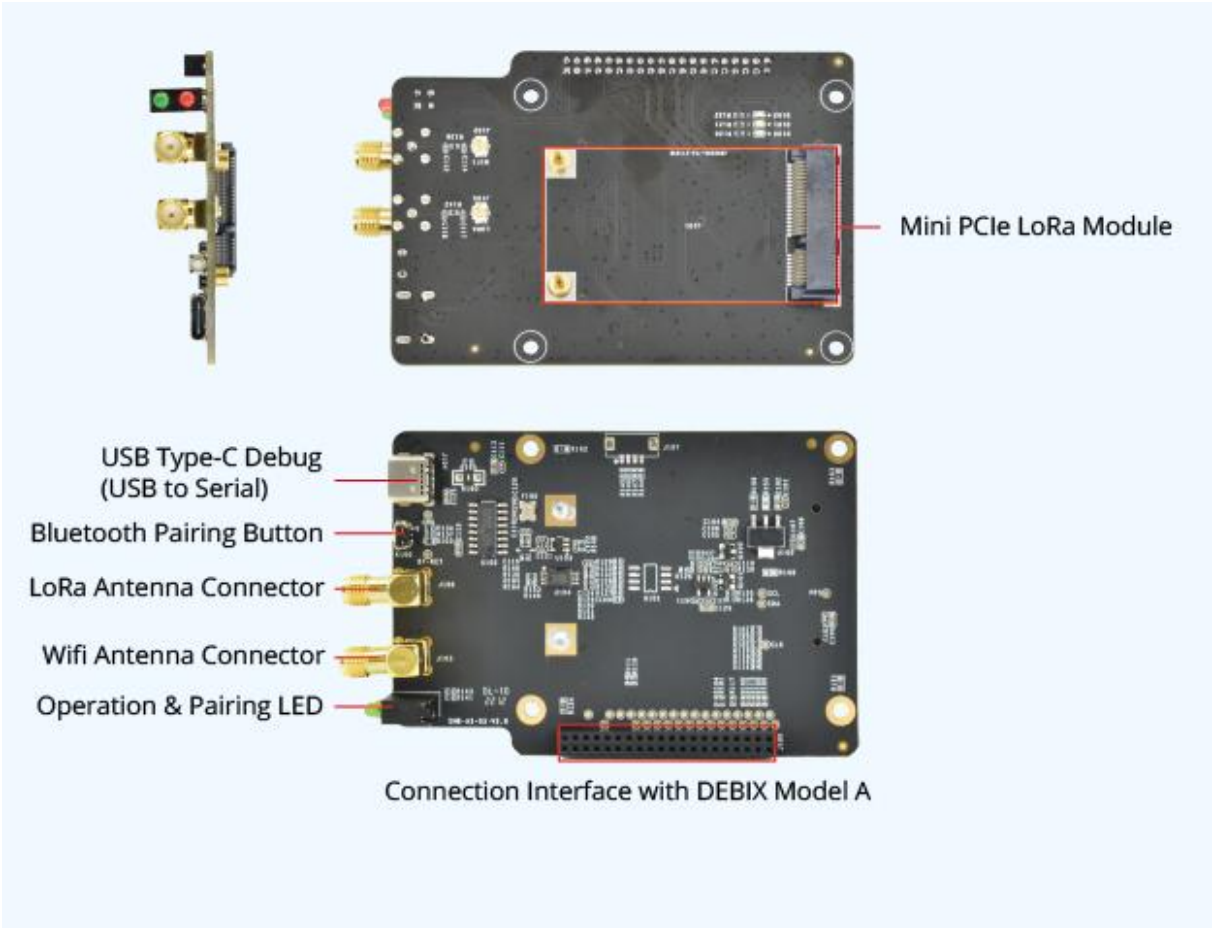


Figure 114

Interface Definition

- Debug Serial Port
- USB Type-C Debug(USB to Serial)
- LoRa Antenna
- Wifi Antenna

The data specifications are as below:

I/O Interfaces	
USB	1 x USB Type-C Debug (USB to Serial)
Mini PCIe	1 x Mini PCIe (LoRa Module)
Buttons	1 x Bluetooth Pairing Button
LED	1 x Operation Indicator, 1 x Pairing Indicator
External Antenna	1 x LoRa Antenna Connector, 1 x Wifi Antenna Connector
EEPROM	1 x 2Kbit EEPROM
Clipper Chip	1 x Secure Element, e.g.ATECC608

Connection with DEBIX Model A

Insert LoRa module to DEBIX LoRa board, once installed, the board is as below

Figure 115

Prepare two antennas

Figure 116

The corresponding antenna interfaces are circled out with red line as below

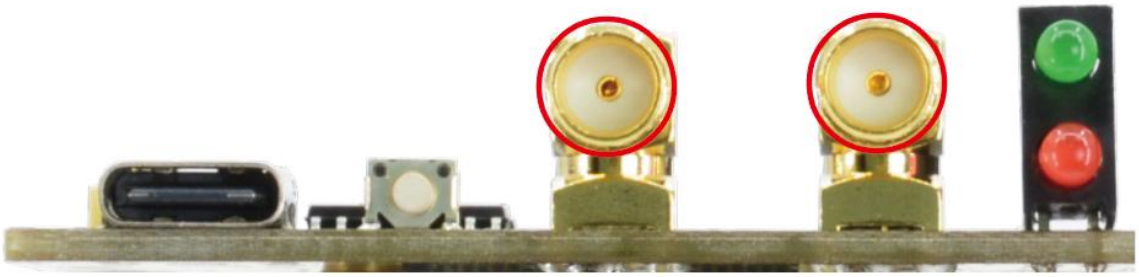


Figure 117

Install the antennas to LoRa board, once installed, the board is as below

Figure 118

Connect LoRa board with DEBIX, there is a group of I/O on LoRa board, there is a group of pins on DEBIX, insert the pins to corresponding I/O, press them to fix the two boards together.

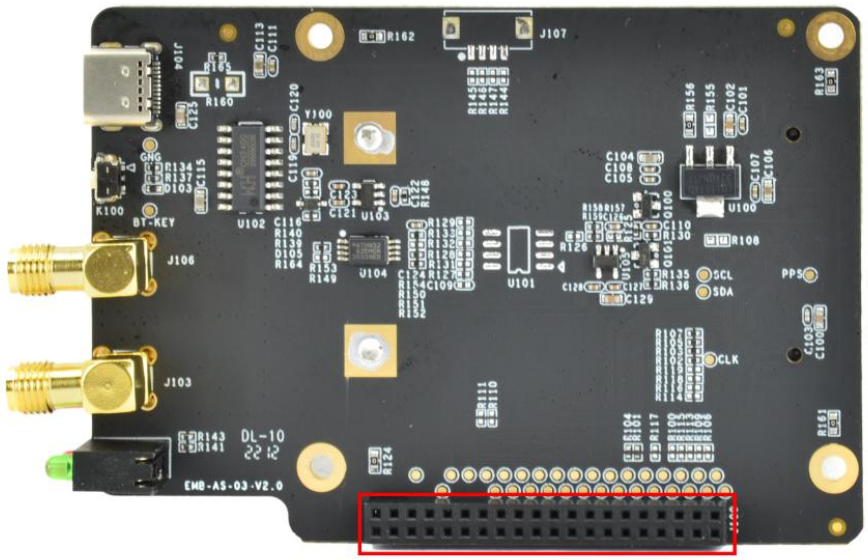


Figure 119

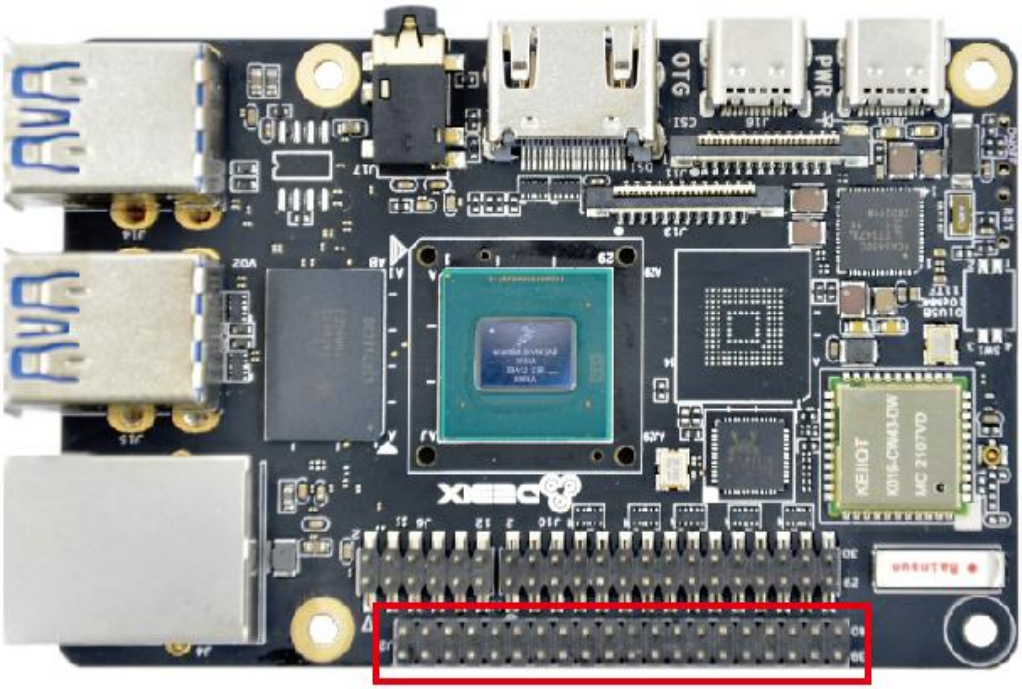


Figure 120

Figure 121

Verify Functions of LoRa Board

DEBIX offers compatibility with LoRa boards by default. Connect DEBIX with LoRa board following the previously described steps. and connect DEBIX with peripherals (keyboard, display, mouse, power supply) which has been described in chapter 2 .

Verify LoRa module function

- The hardware used by LoRa module

Function name	IO name	Device node	Description
SPI	ECSPI1-SS0	/dev/spidev0.0	SPI chip select
	ECSPI1-MOSI		Debix SPI data output
	ECSPI1-MISO		Debix SPI data input
	ECSPI1-SCLK		SPI clock
LORA_RST	GPIO1-IO11	/dev/lora_reset	Lora module reset
LORA-PWR-EN	CAN1-TXD	/dev/lora_en	Lora module enable power

- Check whether LoRa is supported in the system

  Open terminal, run ls /dev/lora*, you should see output like this

```
/dev/lora_en  /dev/lora_reset
```

The existence of lora_en and lora_reset proves that the kernel supports LoRa.

- Check whether LoRa module works

  Open terminal, run command cd /opt/packet_forwarder/,then run command sudo ./lora_pkt_fwd, and you should see output like this.

```
*** Packet Forwarder ***
Version: 1.0.5
*** SX1302 HAL library version info ***
Version: 1.0.5;
***
INFO: Little endian host
INFO: found configuration file global_conf.json, parsing it
INFO: global_conf.json does contain a JSON object named
SX130x_conf, parsing SX1302 parameters
INFO: spidev_path /dev/spidev0.0, lorawan_public 1, clksrc 0,
full_duplex 0
lgw_board_setconf:236: Note: board configuration: spidev_path:
/dev/spidev0.0, lorawan_public:1, clksrc:0, full_duplex:0
INFO: antenna_gain 0 dBi
...
Note: success connecting the concentrator
Loading AGC fw for sx1250
Loading ARB fw
INFO: [main] concentrator started, packet can now be received
INFO: concentrator EUI: 0x0016c001ff1a8f79
```

As shown in the image above, there is a notification “success connecting the concentrator” which indicates that the LoRa module has been successfully connected.

Chapter 7 DEBIX 4G Expansion Board

Brief Introduction of DEBIX 4G Expansion Board

DEBIX Model A 4G Board is an adapter board specially designed for DEBIX Model A, and the 4G Board can supplement DEBIX Model A with 4G network functions. It has a compact appearance, measuring only 57mm x 51.3mm, with a Mini PCIe 4G module slot and a Micro SIM card slot.

Interface definition

- FPC socket
- Mini PCIe
- 4G LED
- Micro SIM card slot

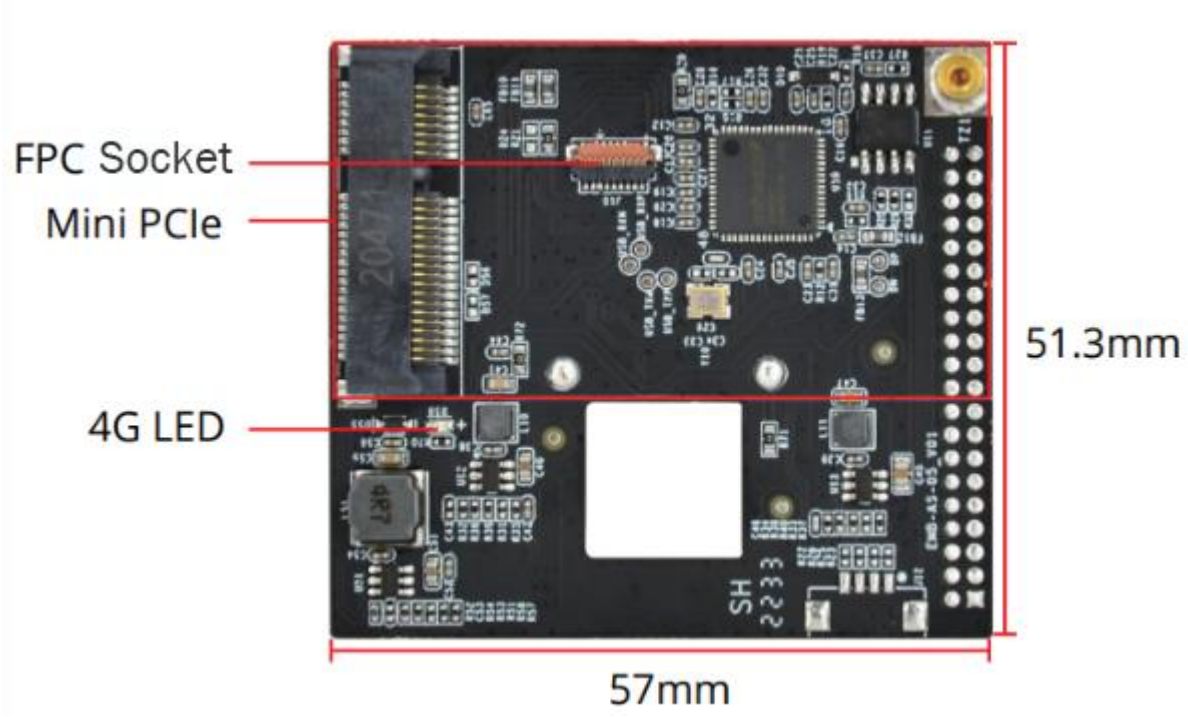


Figure 122

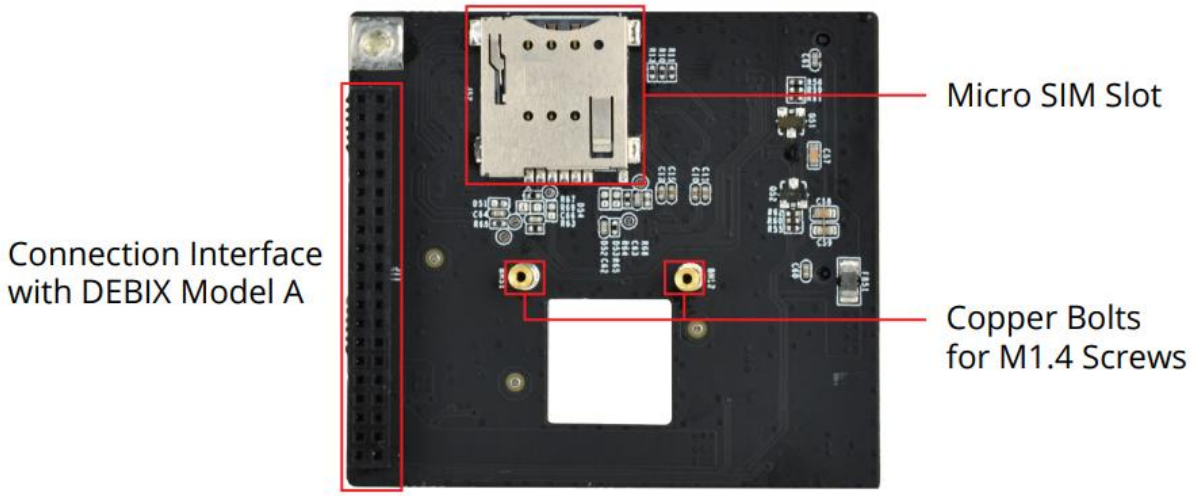


Figure 123

The data specifications are as below:

I/O Interfaces	
Micro SIM Card Slot	1 x Micro SIM pop-up card slot
Mini PCIe	1 x Mini PCIe (4G module)
FPC socket	1 x Clamshell FPC socket, 19Pin 0.3mm Pitch
LED	1 x 4G Operation Indicator

Connection with DEBIX Model A

First, paste the square shape and the round shape Mylar sheet on the front and back of the DEBIX board, as shown in the figure below:

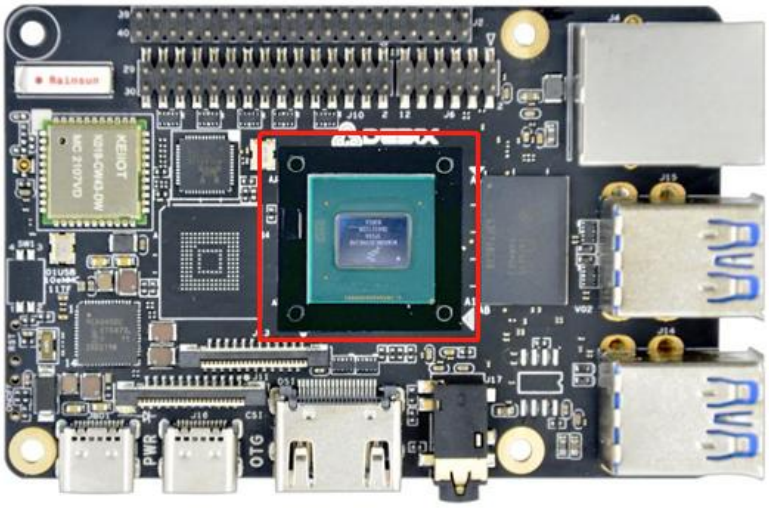


Figure 124 Square shape Mylar sheet

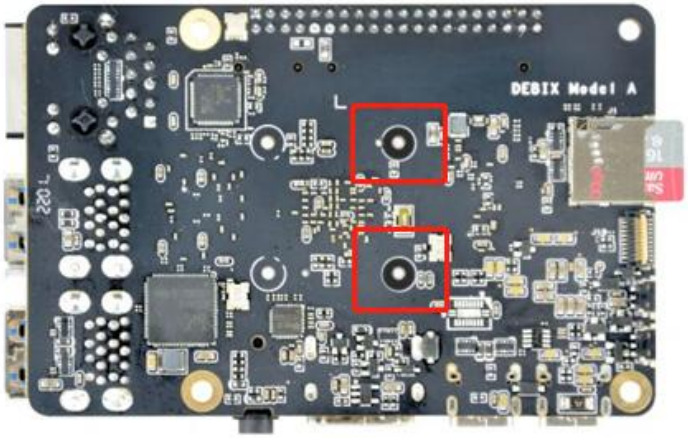


Figure 125 Round shape Mylar sheet

Connect the expansion board to the FPC flat cable, then install the 4G module to the DEBIX 4G expansion board (lock screw CM2.0X4), and insert the Micro SIM card (note the direction, the specific direction is shown in Figure 128).

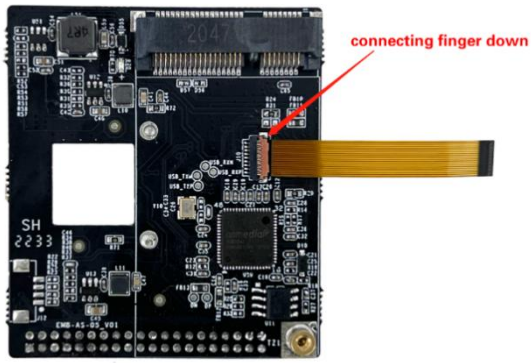


Figure 126

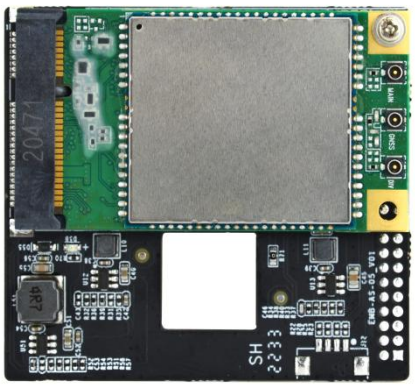


Figure 127

The 4G module models supported by our company are:

- Quectel EC20CEHDLG-128-SNNS
- Quectel EC21ECGA-128-SNNS
- Quectel EC25ECGA-128-SNNS

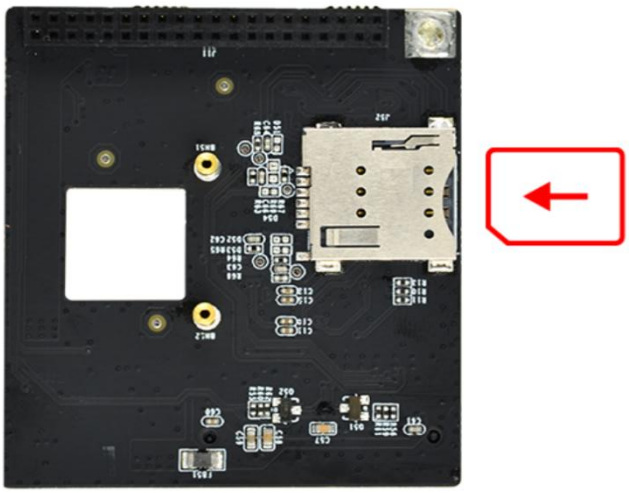


Figure 128

Connect the 4G expansion board with the DEBIX. There is a group of I/O on the 4G expansion board, they are circled out with red line in Figure 129, and there is a group of pins on the edge of DEBIX, they are circled out with red line in Figure 130. Press and install the pins and the corresponding sockets, and fix them with locking screws (PM1.4X4), and connect the FPC flat cable (note the direction of the gold finger is shown in Figure 126), and the external antenna.

Figure 129

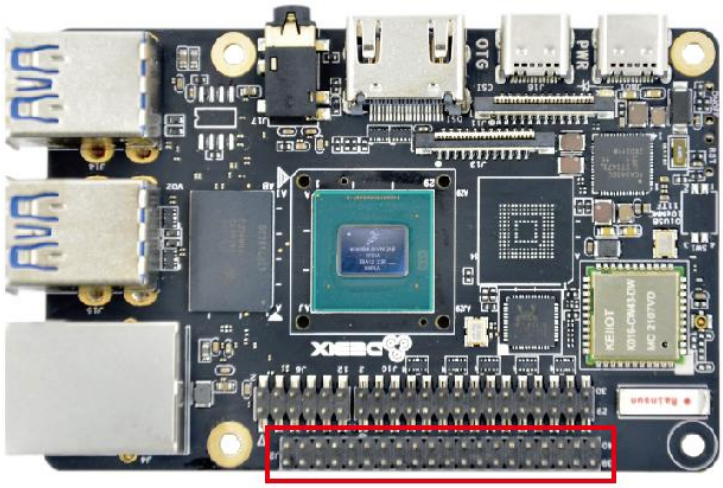


Figure 130

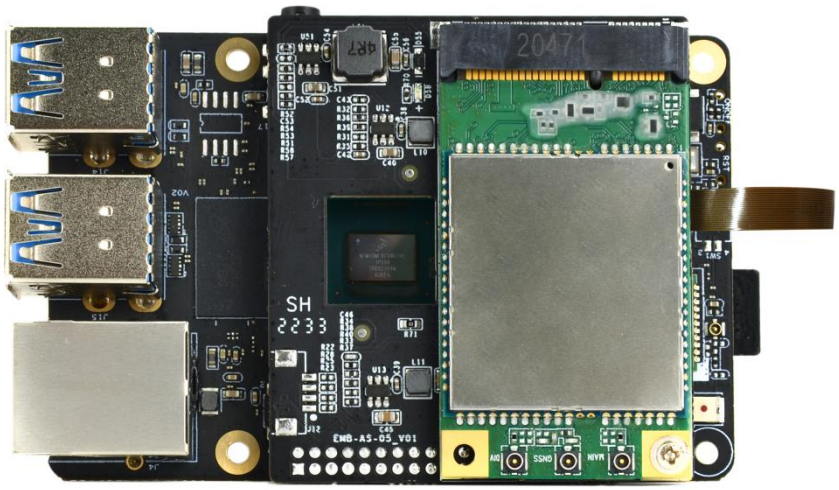
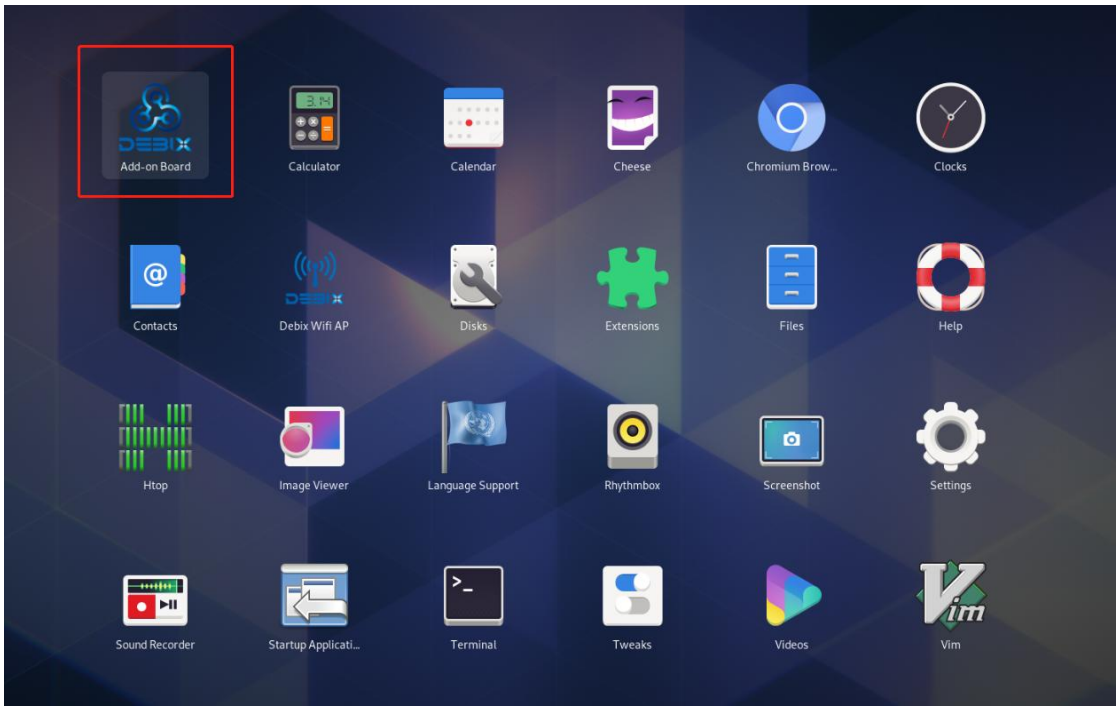


Figure 131

First use of 4G network

Follow the steps below in order:

Step 1: click ‘Add on Board’ to select the "Debix + 4g board".



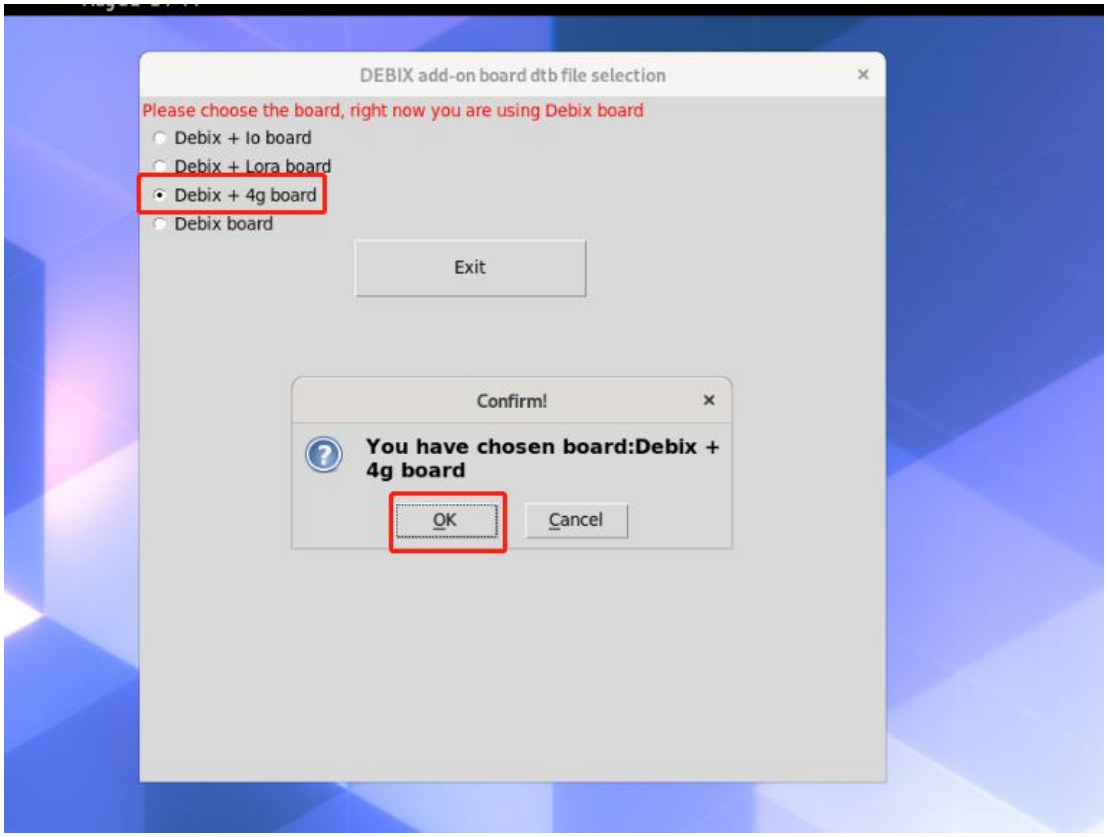


Figure 132

Step 2: select "None", and click "OK".

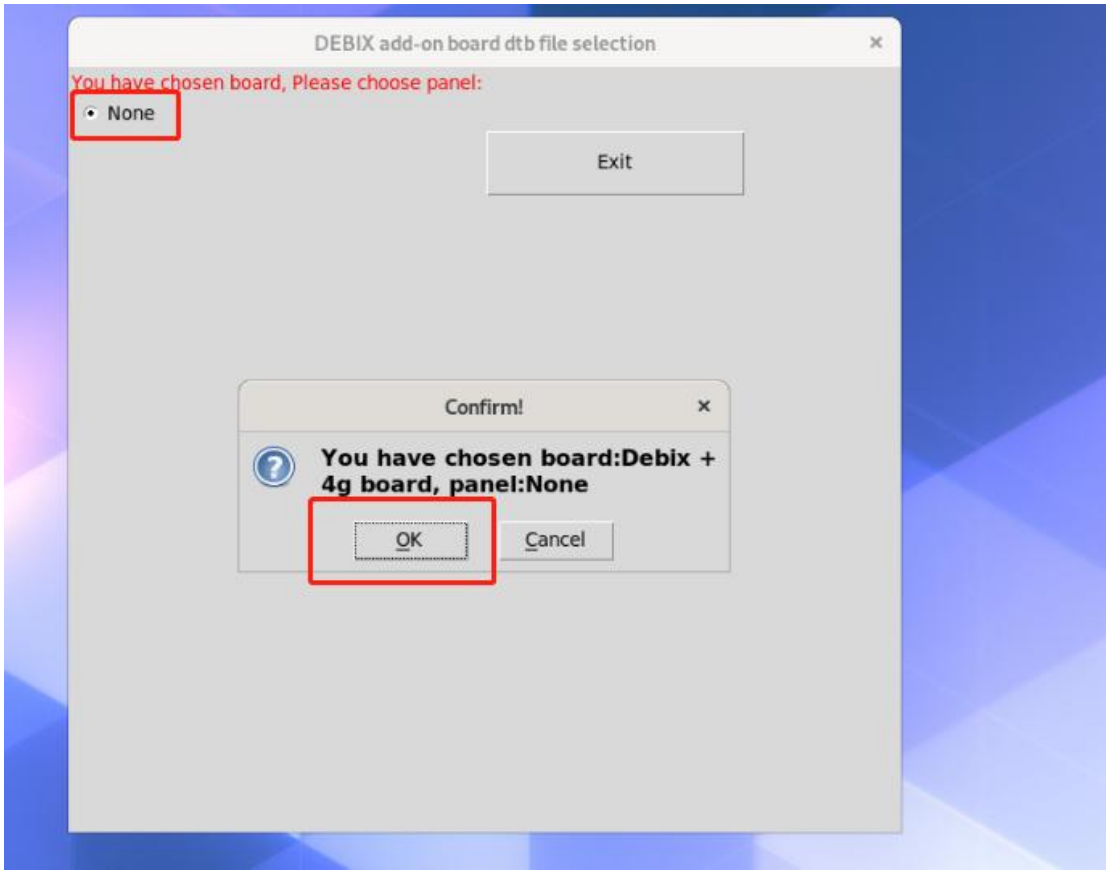


Figure 133

Step 3: click "Start", and then click "OK".

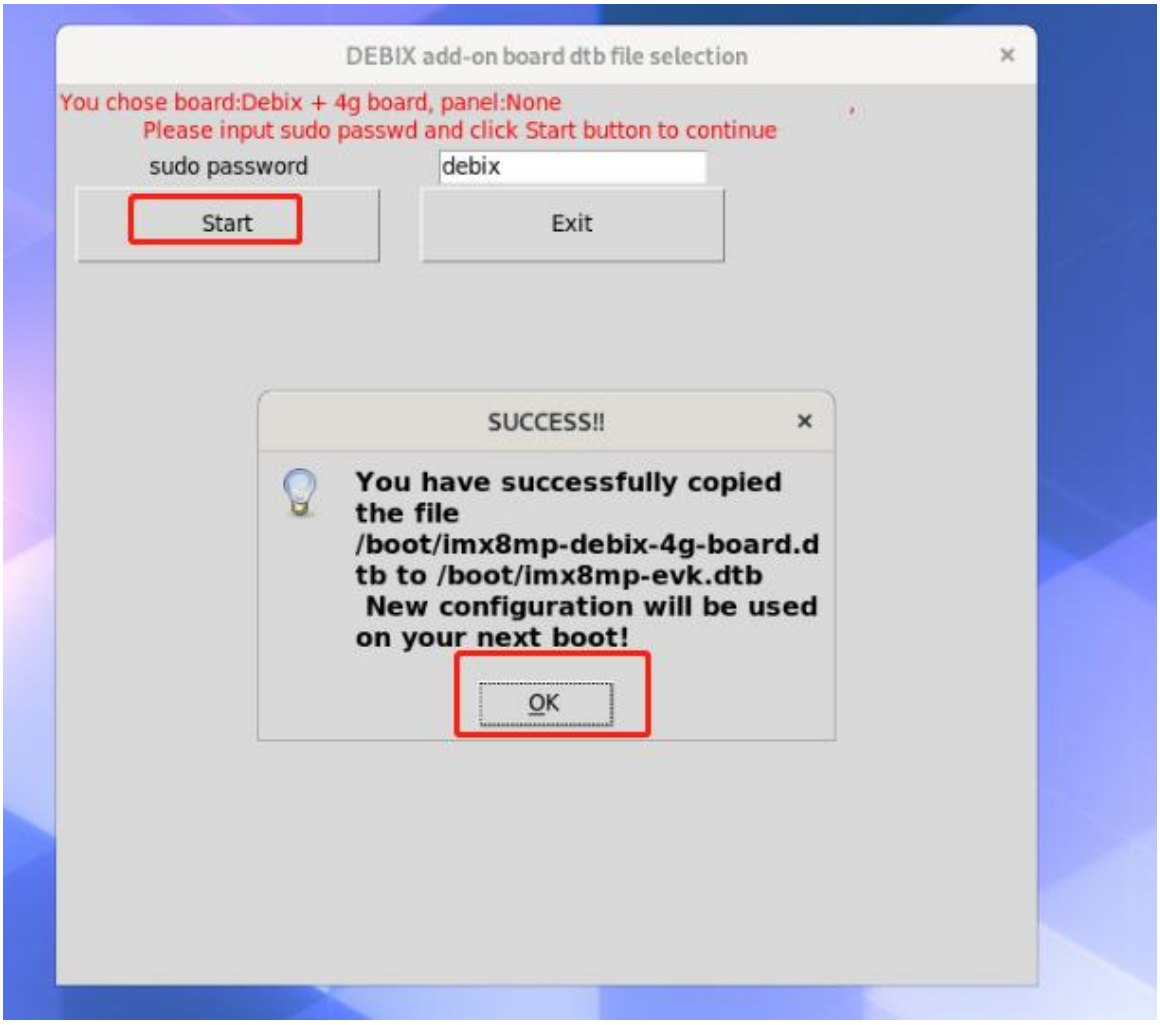


Figure 134

Restart the device to take effect.

Step 4: dial-up Internet access steps:

Enter the settings, select Network, enable Mobile Broadband, and select "Add new connection".

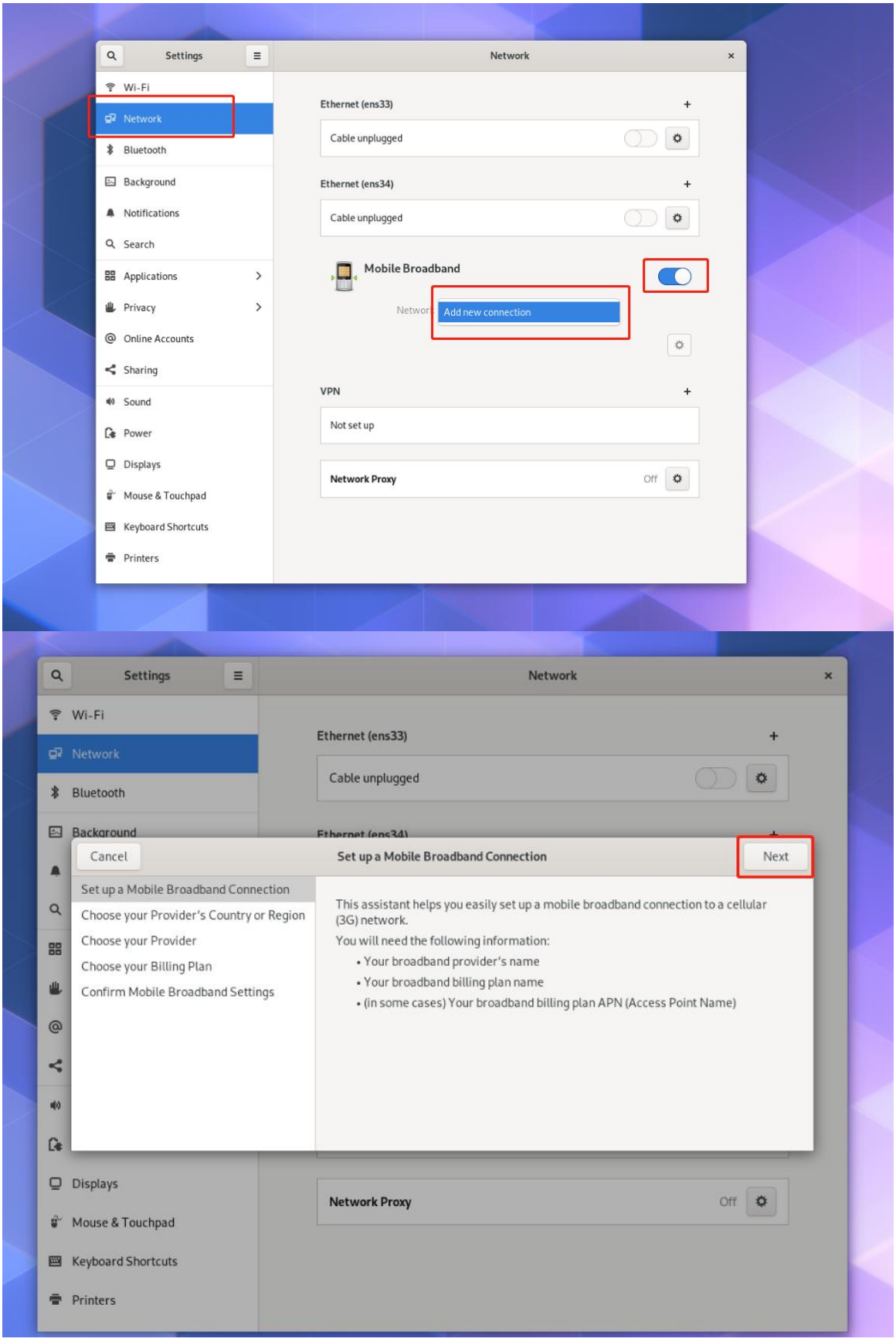

Settings
Network
Wi-Fi
Network
Bluetooth
Background
Notifications
Search
Applications
Privacy
Online Accounts
Sharing
Sound
Power
Displays
Mouse & Touchpad
Keyboard Shortcuts
Printers
Ethernet (ens33)
Cable unplugged
Ethernet (ens34)
Cable unplugged
Mobile Broadband
Add new connection
VPN
Not set up
Network Proxy
Off
Cancel
Set up a Mobile Broadband Connection
Next
Set up a Mobile Broadband Connection
Choose your Provider's Country or Region
Choose your Provider
Choose your Billing Plan
Confirm Mobile Broadband Settings
This assistant helps you easily set up a mobile broadband connection to a cellular (3G) network.
You will need the following information:
• Your broadband provider's name
• Your broadband billing plan name
• (in some cases) Your broadband billing plan APN (Access Point Name)

Figure 135

Step5: select the country according to the actual location, taking "China" as an example:

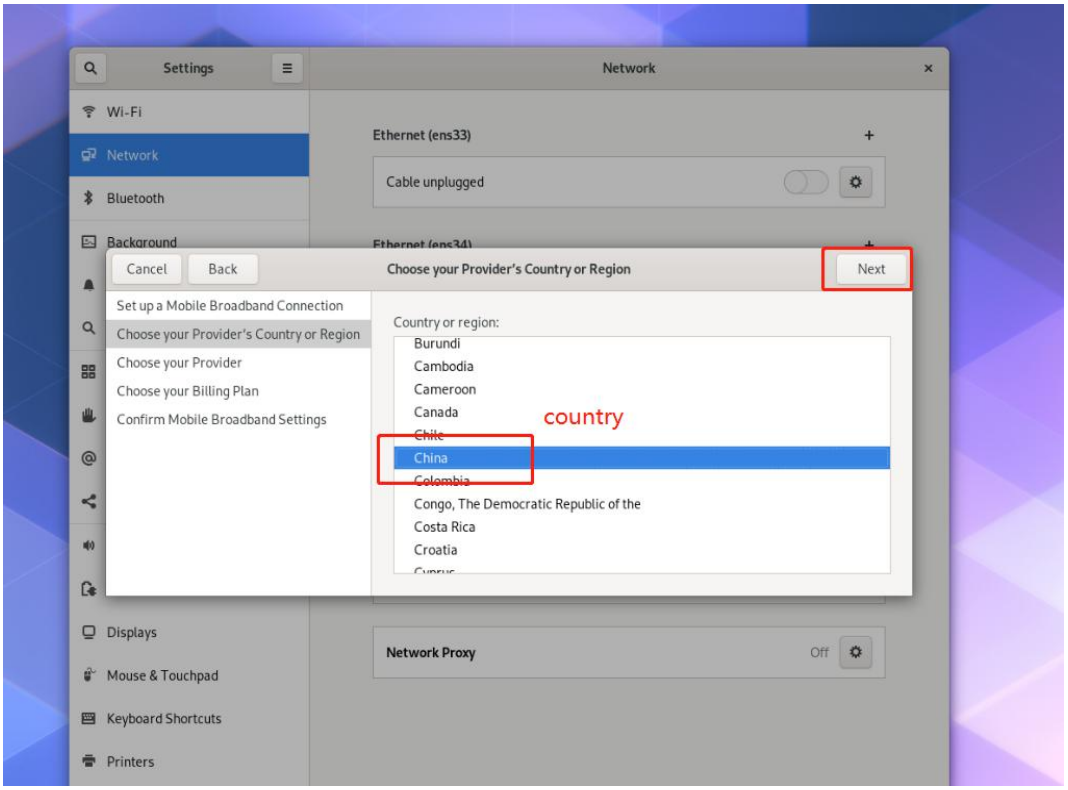


Figure 136

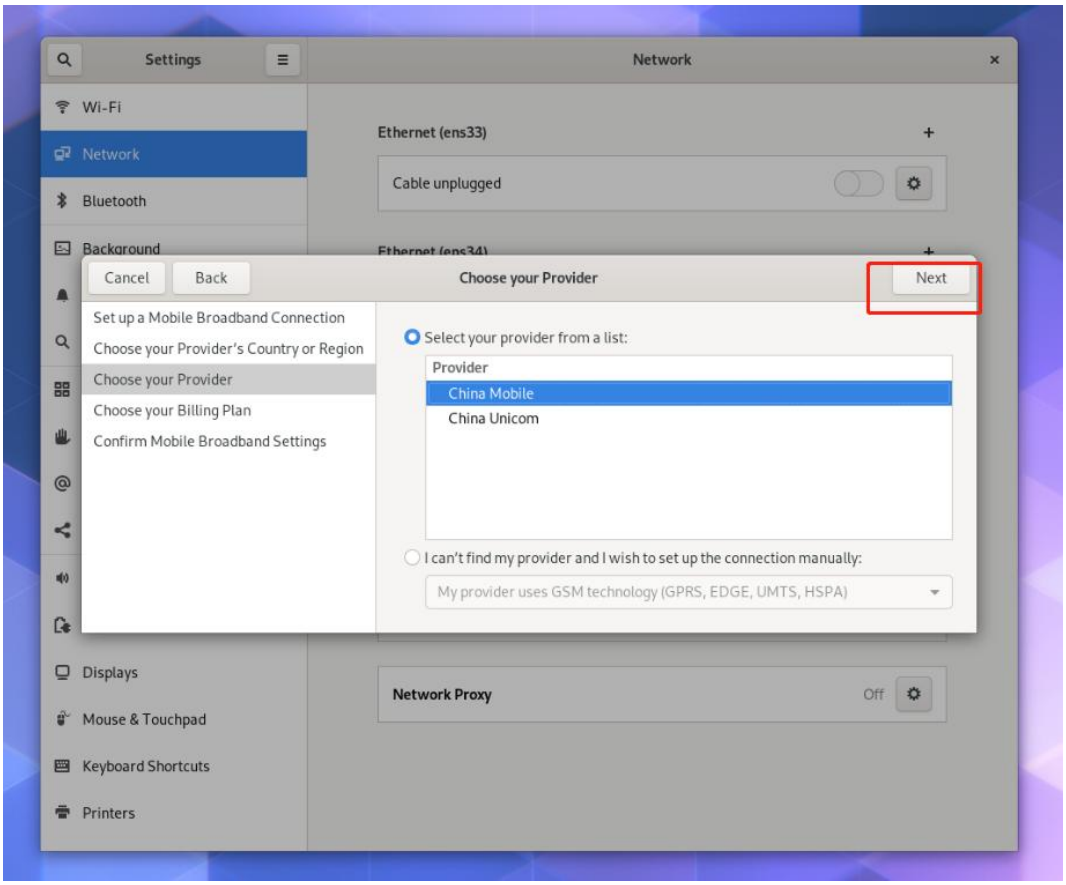


Figure 137

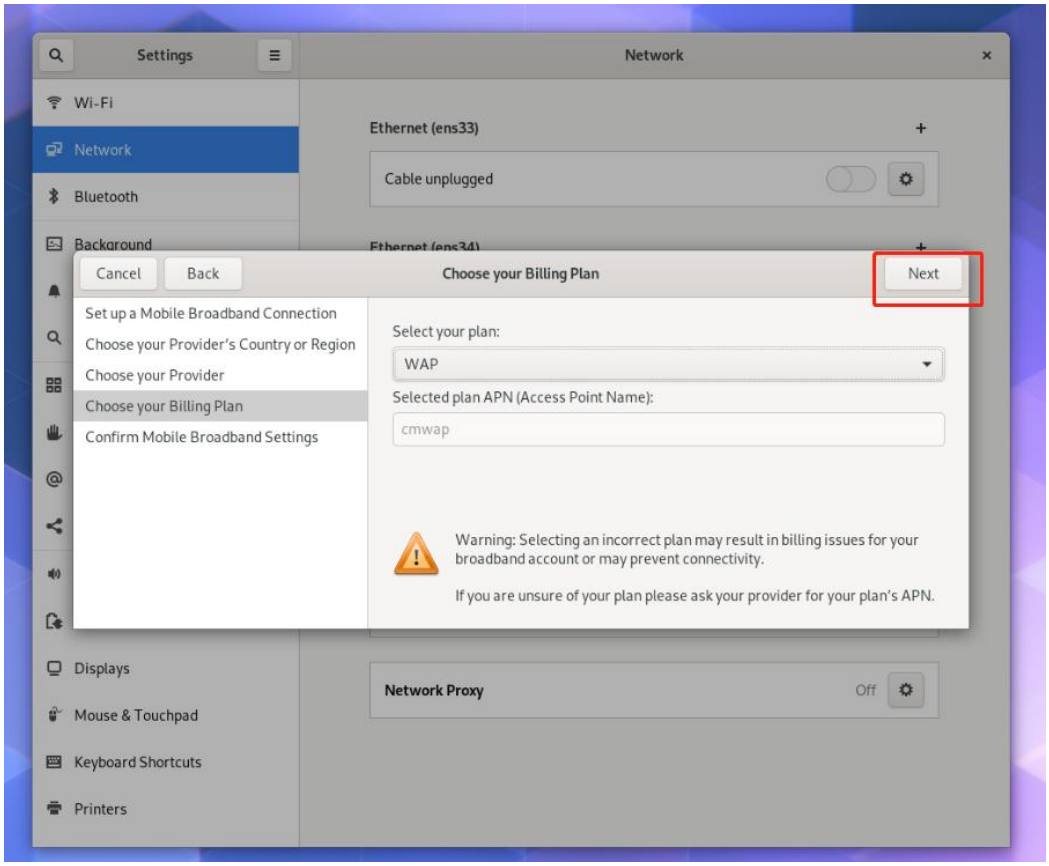


Figure 138

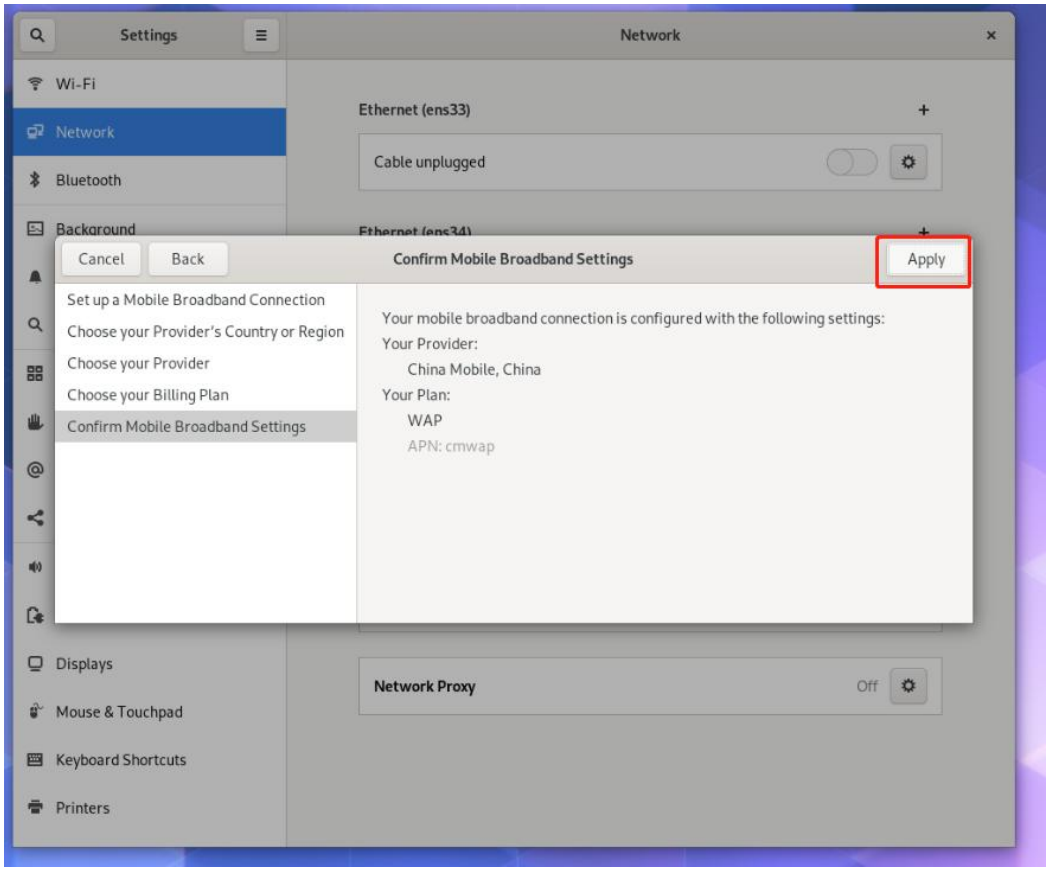


Figure 139

Step 6: Dial up to obtain an IP address.

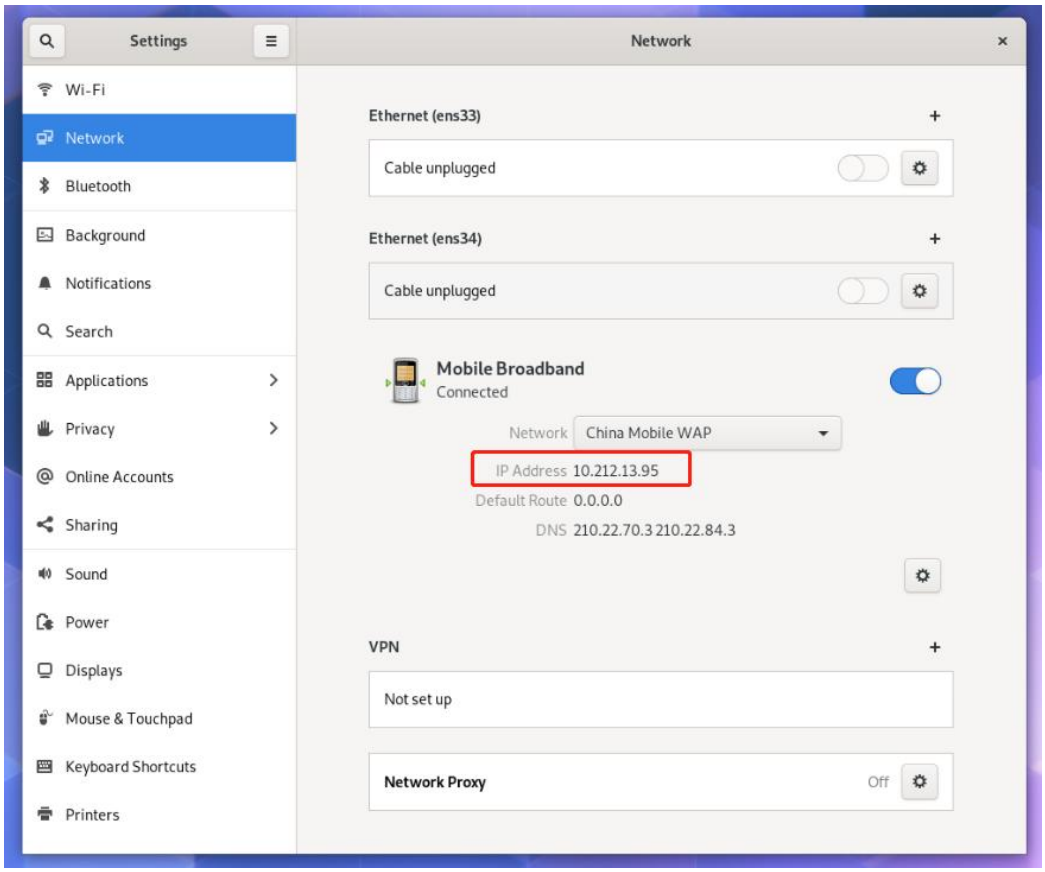
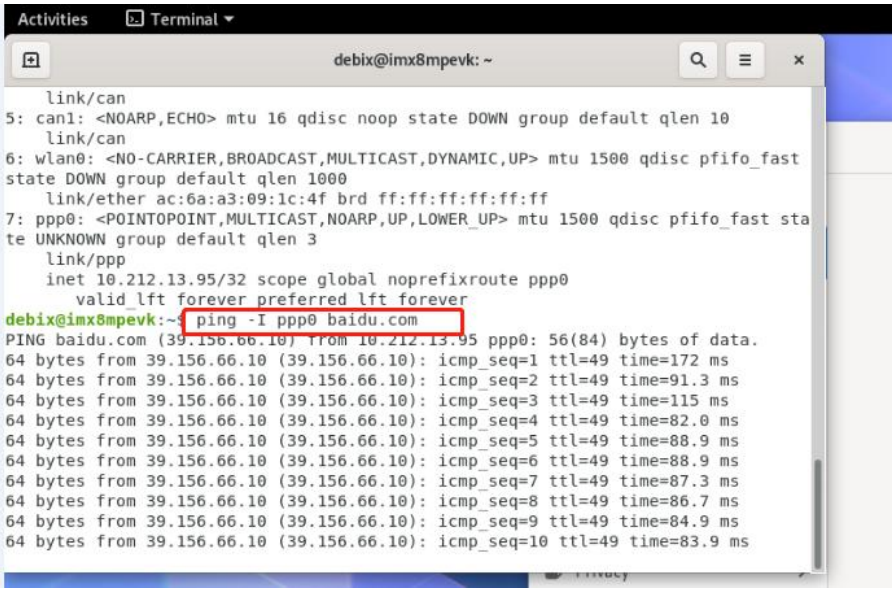


Figure 140

Step 7: network test:

Use the key combination "Ctrl+Alt+T" to open the terminal command line and enter the ping command.

ping –I ppp0 baidu.com



Common Troubleshooting

PCI device query

#sudo apt update

#sudo apt install pciutils

#lspci

```
debix@imx8mpevk:~$ lspci
00:00.0 PCI bridge: Synopsys, Inc. DWC_usb3 / PCIe bridge (rev 01)
01:00.0 USB controller: ASMedia Technology Inc. ASM2142 USB 3.1 Host Controller
```

4G module verification

The module is identified as /dev/ttyUSB2 under the system and can be verified by the relevant instructions of the serial port debugging tool microcom.

#microcom /dev/ttyUSB2

AT+CPIN? #SIM card detection

AT+CIMI #Query SIM card number CIMI

AT+CGSN #Query module IMEI

AT+CSQ # query signal strength

```
# microcom /dev/ttyUSB2

+CPIN: READY

OK

460065021200496

OK

864394040047898

OK

+CSQ: 23,99

OK
```

Chapter 8 DEBIX PoE Module

Brief Introduction of DEBIX PoE Module

DEBIX PoE module can provide stable DC power for DEBIX Model A/B without separate power lines, simplifying system wiring and reducing the cost of building network infrastructure. Support IEEE 802.3at-2009 PoE protocol.

Interface definition

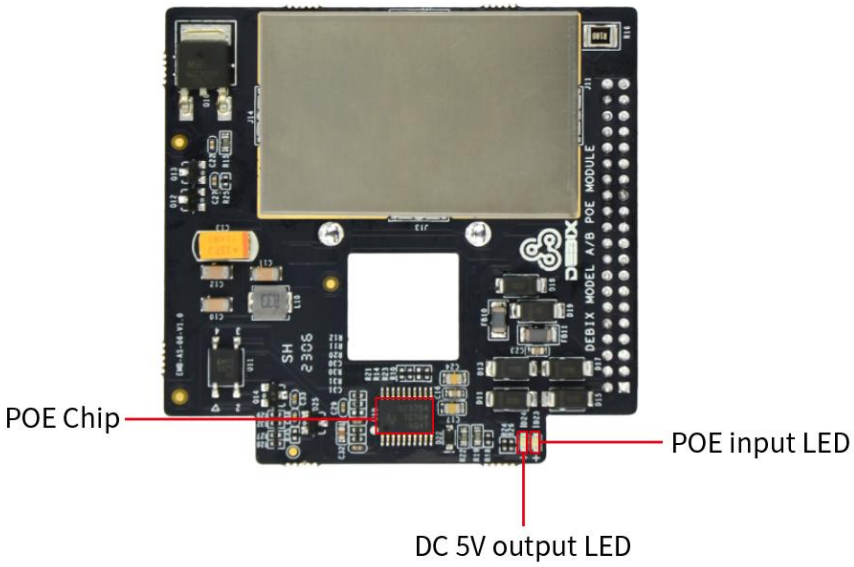


Figure 141

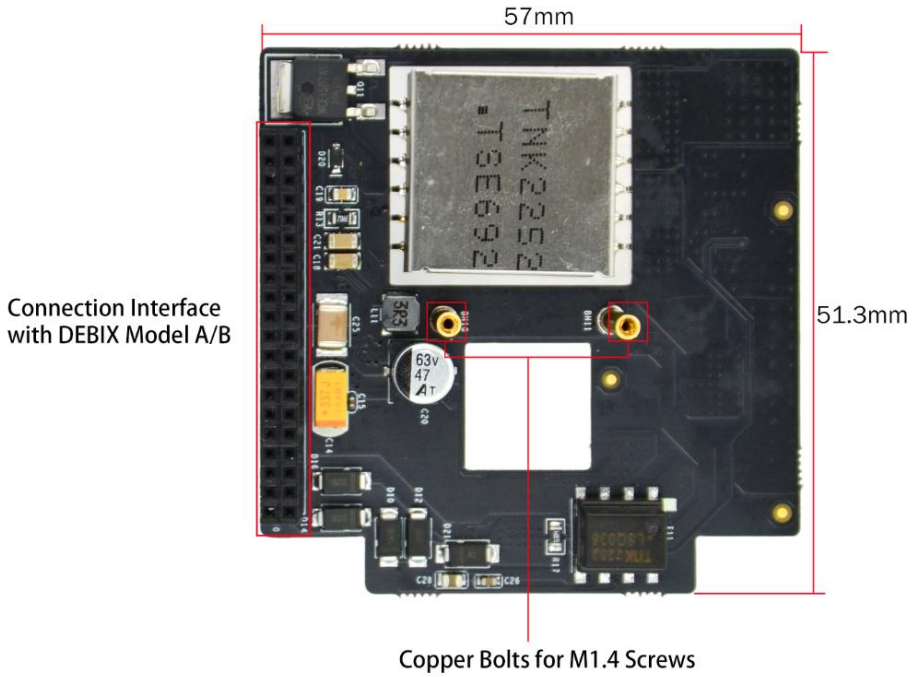


Figure 142

The data specifications are as below:

I/O Interfaces	
Power	Input: DC 50V-57V (Class 4) Output: DC 5V/4A
LED	1 x POE Power Input Indicator 1 x 5V Power Output Indicator
POE Chip	TPS23754PWPR

Connection with DEBIX Model A/B

1. First, paste the square shape and the round shape Mylar sheet on the front and back of the DEBIX board, according to Figure 124, Figure 125 of Chapter7.
2. Connect the PoE Module with the DEBIX. There is a group of I/O on the PoE Module, they are circled out with red line in Figure 143, and there is a group of pins on the edge of DEBIX, they are circled out with red line in Figure 144. Press and install the pins and the corresponding sockets, and fix them with locking screws (PM1.4X4).

Figure 143

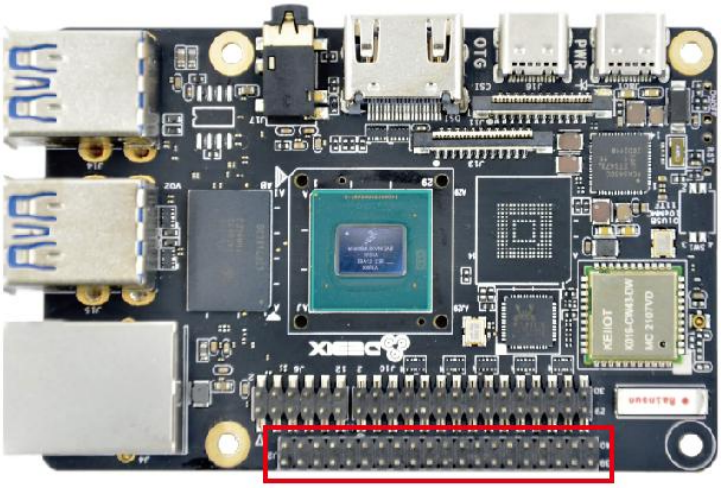


Figure 144

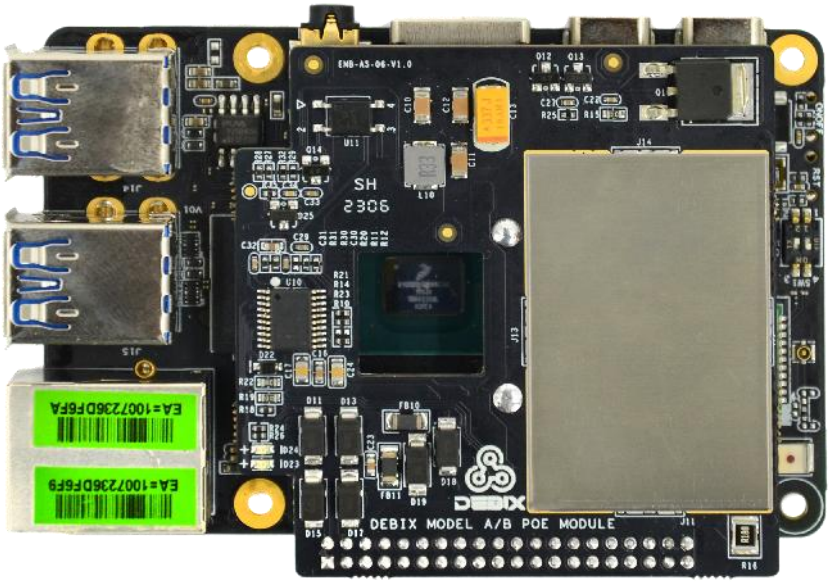


Figure 145

Usage of PoE Module

Prepare a switch (supporting POE) and a network cable (CAT5E and above). Connect the switch to the RJ45 port of the DEBIX with the network cable to power the DEBIX without a power adapter, as shown in the figure below:

Figure 146