Edge AI Applied Computing

SINTRONES

# IBOX-650P-IP66-2S
# IBOX-650P-IP66-DIO

## User Manual

Version 1.1

# Revision History

| Version | Date | Description of Changes |
|---|---|---|
| 1.0 | 2026-01-16 | Initial release. |
| 1.1 | 2026-03-02 | Added a note in Section 5.1.1, *Setting the GMSL Camera*, reminding users that different camera types must not be mixed. |
| | | |
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| | | |

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## Declaration of Conformity

The CE symbol on your product indicates that it complies with the European Union (EU) directives. A Certificate of Compliance is available by contacting Technical Support. This product has passed the CE test for environmental specifications when shielded cables are used for external wiring. We recommend the use of shielded cables.

This product has been tested and found to comply with the limits for a Class A device, according to Part 15 of the FCC Rules. These limits are designed to protect reasonably against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used by the manufacturer’s instructions, may cause harmful interference to radio communications.

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## Safety Information

Read the following precautions before setting up a SINTRONES® Product.

## Electrical Safety

- Disconnect the power cable from the electrical outlet to prevent shock hazards before relocating the system.
- When adding or removing devices to or from the system, ensure that the power cables for the devices are unplugged before the signal cables are connected. Disrupt all power cables from the existing system before adding a device.
- Seek professional assistance before using an adapter or extension cord. These devices could interrupt the grounding circuit.
- Before connecting or removing signal cables from the motherboard, ensure all power cables are unplugged.
- Ensure your power supply is set to the correct voltage in your area. If you are unsure of the voltage of your current electrical outlets, contact your local power company.
- If the power supply is broken, do not fix it by yourself. Contact a qualified service technician or your retailer.

## Operation Safety

- Before installing the motherboard and adding devices, carefully read all the manuals in the package.
- Before using the product, ensure all cables are correctly connected and the power cables are not damaged. If you detect any damage, contact your dealer immediately.
- Keep paper clips, screws, and staples away from connectors, slots, sockets, and circuitry to avoid short circuits.
- Avoid dust, humidity, and temperature extremes. Please do not place the product in any area that may become wet.
- Place the product on a stable surface.
- Contact a qualified service technician or retailer if you encounter technical problems with the product.

## Environmental Safety

- Use this product in environments with ambient temperatures between -25˚C and 70ºC.
- Do not leave this product in an environment where the storage temperature may be below -40˚C or above 80˚C. To prevent damage, the product must be used in a controlled environment.

**CAUTION:**
Incorrectly replacing the battery may damage this computer. Replace only with the same or equivalent recommended by SINTRONES® Technology Corp. Dispose of the used battery according to the manufacturer's instructions.

## Technical Support

Please call or e-mail our customer service when you cannot fix the problems.


- TEL: +886-2-8228-0101
- FAX: +886-2-8228-0100
- E-mail: sales@sintrones.com

SINTRONES

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# 1. Introduction

The IBOX-650P-IP66-2S/-DIO leverages NVIDIA® Jetson AGX Orin™ module, which offers high-speed data processing with a maximum AI performance of 275 TOPS, to provide real-time response for complex problem-solving. Incorporated with its ruggedized IP66 enclosure and the waterproof and robust connectors carefully selected for all interfaces including power, GMSL-2 camera, Ethernet with PoE, USB, CAN FD, DIO (IBOX-650P-IP66-DIO model only), and dual serial ports (IBOX-650P-IP66-2S model only), the system is an ideal choice for intelligent railway or in-vehicle applications requiring intensive AI workloads, such as real-time train monitoring and advanced predictive maintenance.

This chapter introduces IBOX-650P-IP66-2S/-DIO and gives an overview of its product details.

Topics in this chapter include:


- Product Information *(on page 8)*
- Product Photos *(on page 11)*
- Mechanical Drawings *(on page 11)*
- Package Contents *(on page 12)*
- Power Consumption *(on page 14)*

# 1.1. Product Information

## Table 1-1 Specifications

### System

**Module**

- NVIDIA® Jetson AGX Orin™ 64GB (2048 CUDA cores GPU + 12-core ARM Cortex-A78AE CPU + 64GB LPDDR5)

**Network**

- Marvell® Industrial 10GbE,Intel® Industrial 2.5GbE

**Security**

- Platform Security Controller (PSC), Security Engine (SE)

**Watchdog**

- Auto reset for unresponsive system

### Interface

**Video**

- 1 x HDMI® via Type-A w/ IP67

**Audio**

- 1 x HD audio output from HDMI®

**Ethernet**

- 1 x 10GbE & 2 x 2.5GbE w/ 2 x IEEE 802.3at PoE PSE Class 4 (PoE+ 30 watts per port) via 3 Phoenix Contact® M12 X-coded connectors

**Camera**

- 4 x GMSL-2 via FAKRA-Z connector

**CAN**

- 2 x CAN FD via M8 connector

**USB**

- 2 x USB Type-A/IP67 connector for USB 3.2

  *One port shares 10Gbps bandwidth

**DIO (IBOX-650P-IP66-DIO only)**

- 4 x DI, 4 x DO (DC 12V/100mA)

**ADC (IBOX-650P-IP66-DIO only)**

- 1 x ADC (DC 5-60V)

**PWM (IBOX-650P-IP66-DIO only)**

- 1 x PWM output (DC 12V)

**COM**

- 2 x RS-232/422/485 via M12 connector (IBOX-650P-IP66-2S only)
- 1 x RS-232/422/485 via M12 connector (IBOX-650P-IP66-DIO only)

**Mgmt. Port**

- 1 x USB Type-C for system recovery (device only)

**SIM Card**

- 1 x Nano SIM card slot

### Internal Expansion

**M.2**

- 1 x M.2 3042/3052 Key B for WWAN w/ Nano SIM support
- 1 x M.2 2230 Key E for Wi-Fi/BT

**Mini PCIe**

- 1 x Mini PCIe (full-size, USB 2.0 supported)

### Storage

**Type**

- 1 x 64GB eMMC (Integrated in SoM, with BSP)
- 1 x M.2 2280 Key M for NVMe SSD

### Power

**Power Input**

- DC 9-60V (nominal power input DC 12V/24V/48V) via Phoenix Contact® M12 K-coded connector

**Power Protection**

- OCP, OVP, surge protection, reversed polarity protection

**Power Management**

- Ignition detection with Smart Power Management

**RTC Battery**

- High-capacity coin cell battery for RTC

**Battey Backup Unit (BBU)**

- Backup battery for system power backup

### Software

**Operating System**

- NVIDIA® JetPack 6.2 or above (Jetson Linux and NVIDIA® development tools included)

### Environmental

**Operating Temp.**

- -25°C ~ 70°C (-13°F ~ 158°F) with 0.6 m/s airflow

*Operating temperature varies by accessories installed

**Storage Temp.**

- -40°C ~ 80°C (-40°F ~ 176°F)

**Relative Humidity**

- 10% RH – 90% RH (non-condensing)

**Vibration**

- MIL-STD-810H, Method 514.8, Procedure I, Category 4
- IEC60068-2-64, random, 2.5G@5~500Hz, 1hr/axis

**Shock**

- MIL-STD-810H, Method 516.8, Procedure I, Trucks and semi-trailers = 15G (11ms)

### Certification / Standard

- CE, FCC Class A, E-Mark, ECE R118, EN 50155, EN 45545-2 (R25)

### Mechanical

**Construction**

- Aluminum alloy

**Antenna**

- 7 x SMA connector mounting hole

**Mounting**

- Wall mounting

**Net Weight**

- 5.1 kg (11.25 lb)

**Dimensions (L x W x H)**

- 300 x 190 x 77.5 mm (11.82 x 7.49 x 3.06 in.)

**Ingress Protection**

- IP66

**Table 1-2 Ordering Information**

| | | |
|---|---|---|
| Model Number | IBOX-650P-IP66-2S-01-JAO64 | NVIDIA® Jetson AGX Orin™ 64GB / 1 x 10GbE / 2 x PoE / VDB-101 / 4 x GMSL-2 / 2 x COM |
| | IBOX-650P-IP66-2S-JAO64-LE | NVIDIA® Jetson AGX Orin™ 64GB / 1 x 10GbE / 2 x PoE / 2 x COM |
| | IBOX-650P-IP66-DIO-01-JAO64 | NVIDIA® Jetson AGX Orin™ 64GB / 1 x 10GbE / 2 x PoE / VDB-101 / 4 x GMSL-2 / 4 x DI / 4 x DO |
| | IBOX-650P-IP66-DIO-JAO64-LE | NVIDIA® Jetson AGX Orin™ 64GB / 1 x 10GbE / 2 x PoE / 2 x COM / 4 x DI / 4 x DO |
| Description | NVIDIA® Jetson AGX Orin™ w/ 1 x 10GbE / 2 x 2.5GbE / 1 x HDMI / 2 x CAN FD / DC 9-60V / IP66 Edge AI Computer | |

**Table 1-3 Optional Accessories**

| | |
|---|---|
| Storage | M.2 2280 NVMe SSD 240GB / 480GB / 960GB / 1920GB |
| Wi-Fi | M.2 2230 Wi-Fi Module |
| WWAN | M.2 3042/3052 WWAN Modem |
| GNSS | mPCIe GNSS Module |
| BBU | BAT-2300v2 (Operating Temp.: -10°C ~ 60°C /-4°F ~ 140°F) |
| Power Adapter | AC/DC 100-240V/24V 160W C14 DC plug power adapter |
| USB Type-A Cable | USB3.0 Waterproof (M) to USB3.0 (F); cable length: 1000mm |
| HDMI Type-A Cable | HDMI Waterproof (M) to HDMI (M); cable length: 2000mm |

**Note:**
**All items listed in the Optional Accessories table are sold separately.**

**Table 1-4 Supported Camera List**

| Brand | Camera Part Number | Max. No. of Camera Connections |
|---|---|---|
| oToBrite | oToCAM264ISP Series<br>(2MP, Sony IMX390) | 4 |
| | oToCAM260ISP Series<br>(5.36MP, Sony IMX490) | 4 |
| | oToCAM223 Series<br>(2.95MP, Sony ISX031 | 4 |
| e-con Systems | STURDeCAM25<br>(2MP, Omsemi AR0234CS) | 4 |
| | STURDeCAM31<br>(3MP, Sony ISX031) | 4 |
| | STURDeCAM81<br>(8MP, Omsemi AR0821) | 4 |
| StereoLabs | ZED X Stereo<br>(Dual 2MP) | 2 |
| | ZED X One 4K<br>(8.2MP) | 4 |

*BSP versions may vary depending on supported GMSL cameras.

**All brand and product names mentioned are the property of their respective owners.

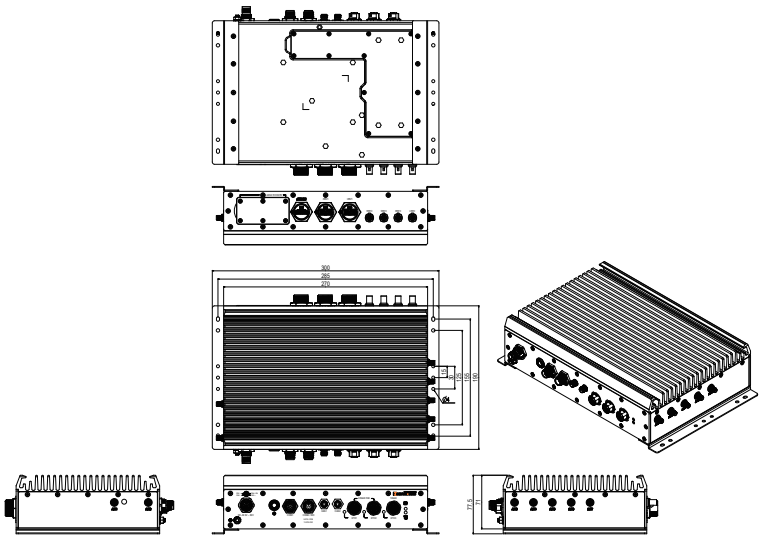
## 1.2. Product Photos

Figure 1-1 Front View of the System

Figure 1-2 Rear View of the System

## 1.3. Mechanical Drawings

Unit : mm

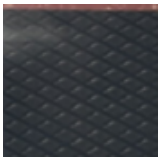


## 1.4. Package Contents

See the following list to check if it matches your product package contents. Please contact SINTRONES® sales representatives or our sales partners if any of the items is missing.

**Table 1-5 Package Contents of the System**

| Item | Photo | Quantity | Description |
|---|---|---|---|
| IBOX-650P-IP66-2S/-DIO | See Product Photos *(on page 11)* | 1 | The edge AI computer |
| Power cable for the system | | 1 | Used to connect the computer with a M12 K-coded connector to a DC power supply |
| Mounting brackets | | 2 | Used to wall mount the system |
| **Accessory Package** | | | |
| M8 to DB9 cable (300 mm) | | 2 | Used to connect to devices with DB9 ports for CAN FD data transfer |
| M12 to DB9 cable (300 mm) | | **2** (IBOX-650P-IP66-2S only)<br>**1** (IBOX-650P-IP66-DIO only) | Used to connect to a device with DB9 port for serial communication |
| M12 to DB15 cable (300 mm) | | **1** (IBOX-650P-IP66-DIO only) | Used to connect to a device with DB9 port for serial communication |

| Item | Photo | Quantity | Description |
|---|---|---|---|
| Thermal pad (25x27x1.0T mm) |  | 1 | Used to transfer heat from the installed M.2 WWAN module. |
| Thermal pad (60x20x1.25T mm) | | 1 | Used to transfer heat from the installed M.2 NVMe SSD |
| Screw F Type 6#-32x8L SUS304 | | 10 | Used to fasten the mounting brackets to the computer |
| Screw I Type M2x4L ISO NI (NYLOK) | | 2 | Used to fasten the mini PCIe module |
| Screw I Type M2.5x5L | | 3 | Used to fasten M.2 modules |

## 1.5. Power Consumption

The system supports the NVIDIA® Jetson AGX Orin™ 64GB module. See the following tables for the power consumption for different modules.

**Table 1-6 System Power Consumption with Jetson AGX Orin™ 64GB (50W)**

| Mode | Input Voltage | | |
|---|---|---|---|
| | 12V | 24V | 48V |
| Maximum w/ PoE | 140.76W | 127.20W | 124.8W |
| Maximum w/o PoE | 40.32W | 41.04W | 43.68W |
| Idle | 17.76W | 18.96W | 21.12W |
| Standby (IGN ON) | 5.52W | 6.00W | 6.72W |
| Standby (IGN OFF) | 0.12W | 0.24W | 0.48W |

# 2. Getting Started

Topics in this chapter include:


- Information about Jetson Modules *(on page 16)*
- System Setup *(on page 17)*
- Booting the System *(on page 28)*

## 2.1. Information about Jetson Modules

The following table provides an overview of the NVIDIA® Jetson system on modules (SoM) installed in IBOX-650P-IP66-2S/-DIO.

**Important:**
DO NOT remove the pre-installed SoM, or it may cause damage to the board-to-board connector used to transmit signals between PCBs. Please contact SINTRONES technical support for any technical issue related to the installed Jetson SoM.

**Table 2-1 NVIDIA® Jetson AGX Orin Modules Pre-installed in IBOX-650P-IP66-2S/-DIO**

| Series | Jetson AGX Orin Series |
|---|---|
| Model | Jetson AGX Orin 64GB |
| GPU | 2048-core NVIDIA® Ampere architecture GPU with 64 Tensor Cores |
| CPU | 12-core Arm® Cortex® - A78AE |
| CPU Frequency | 2.2 GHz |
| Power Consumption | 15W - 60W |
| DL Accelerator | 2 x NVDLA v2 |
| Vision Accelerator | 1 x PVA v2 |
| Memory | 64GB 256-bit LPDDR5 |
| Storage | 64GB eMMC 5.1 (Pre-installed system BSP) |

See Top View of Mainboard *(on page 40)* for the location of the installed SoM.

## 2.2. System Setup

This section provides instructions on how to install expansion modules and the optional backup battery for this computer. You can also refer to Expansion *(on page 39)* for more details such as pin definitions about the internal slots or connectors used for expansion purpose.

Before you start the installation, check the following safety instructions:

**Important:**

- Ensure the device is not connected to any power source such as a power adapter or a battery.
- Prior to installing any modules on the mainboard, always touch an unpainted and grounded metal object or wear a grounded anti-static wrist strap to prevent electrostatic discharge (ESD).

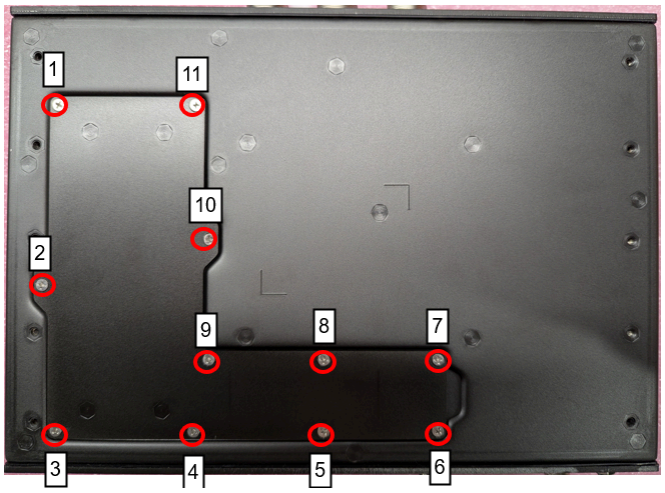
See the following steps to start the installation:

### 2.2.1. Installing an M.2 Storage Module

This section provides instructions on how to install an NVMe SSD into this system.

**Important:**
If the system BSP is pre-installed in the NVMe SSD, please don't remove the pre-installed SSD, or install an empty one without preparing any backup image in advance. It is suggested to consult SINTRONES® technical support for expansion requirements for an NVMe SSD.

1. Remove the screws from the bottom L-shaped cover in the order indicated in the following figure.




2. Locate the M.2 key M slots labelled as **NVMe(M)** on the mainboard.

3. Check if the SSD card to install is double-sided (with chips on both sides of the board) or single-sided (with chips on one side of the board):
    - To install a double-sided SSD card: peel off the first layers of the rubber pads as shown below.

    - To install a single-sided SSD card: proceed to the next step.
4. Align the notch on the SSD card with the tab in the slot and gently insert the SSD card at a 30 degree angle until it is fully embedded.
5. Fasten the SSD module to the mainboard with the M2.5x5L screw included in the package (see Package Contents *(on page 12)*).

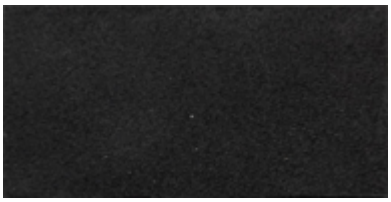
### 2.2.2. Installing a Backup Battery (BBU)

1. Before you begin, check the optional backup battery kit purchased from SINTRONES®, which includes:
   - 1 x battery cover

   - 1 x battery with a power cable

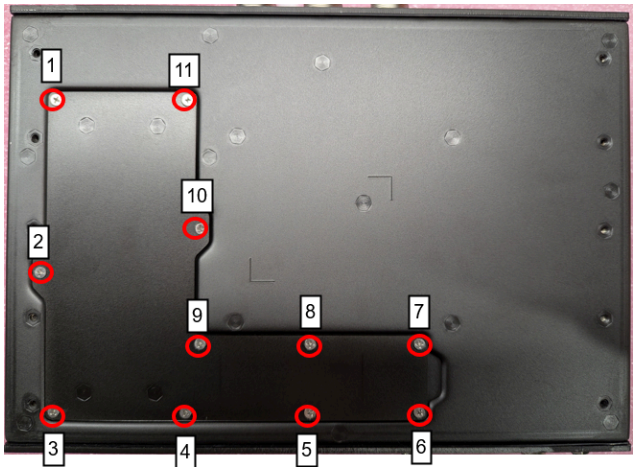
   - 4 x P3*6L screw

   - 1 x sponge

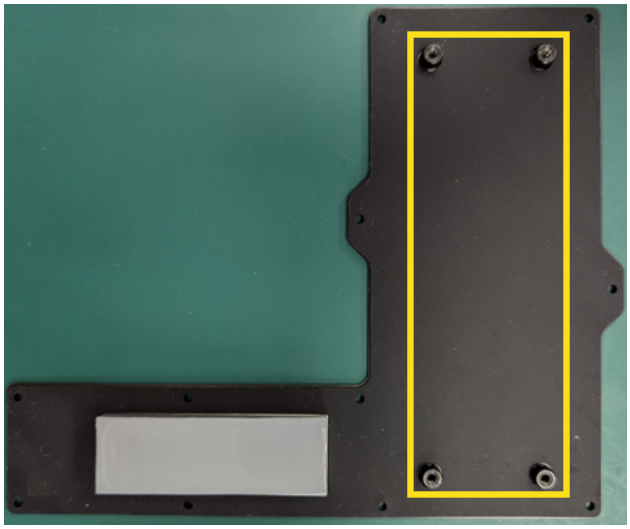
     

2. On both sides of the battery, peel off the release liners of the double-sided tapes.
3. Turn over the battery and adhere it to the battery cover with the information label face up.

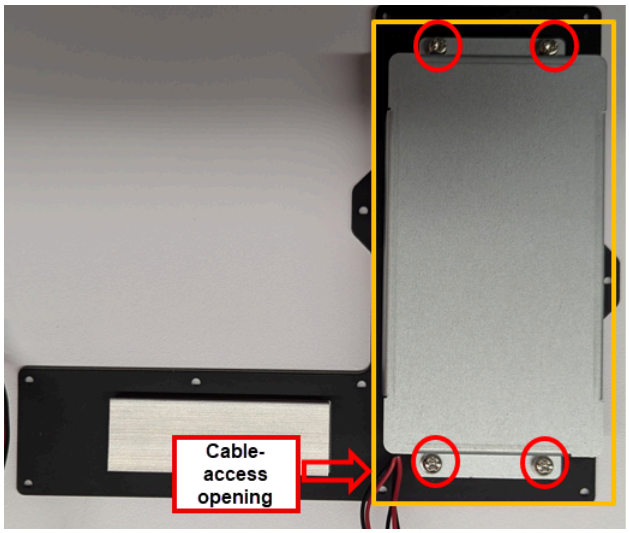
4. Remove the screws from the bottom L-shaped cover in the order indicated in the following figure.




5. Locate the area to install the battery on the bottom L-shaped cover.



6. On both sides of the sponge, peel off the release liners of the double-sided tape.
7. Attach the sponge to the area on the back of the bottom cover.
8. Turn over the battery cover and fasten it to the bottom cover with the P3*6L srews. Get the power cable out from the cable-access opening as shown below.




9. Connect the other end of the power cable to the UPS5 position on the bottom side of the mainboard. See Bottom View of Mainboard *(on page 41)* for more information.

### 2.2.3. Installing Other Expansion Modules

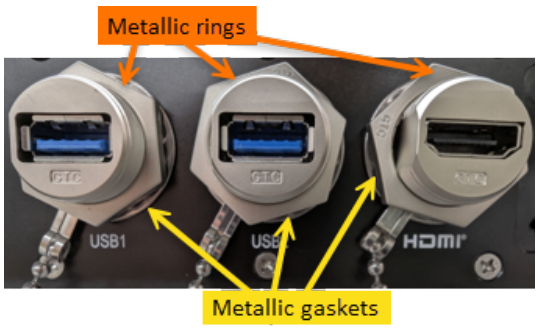
This section provides instructions on how to remove the top cover, install M.2 3042/3052, M.2 2230, and mPCIe expansion modules.

#### 2.2.3.1. Removing the Top Cover

The M.2 3042/3052, M.2 2230, and mPCIe expansion slots are located on the top side of the mainboard. You need to remove the top cover prior to installing these expansion modules.

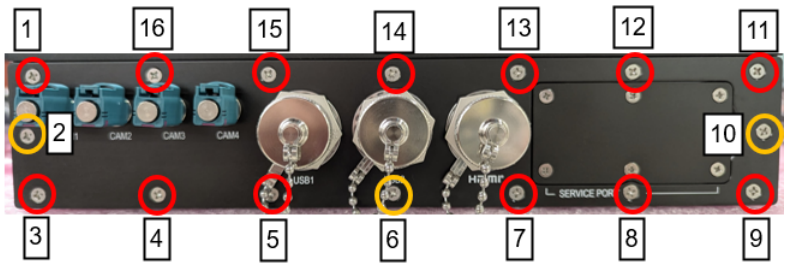
1. Detach the protective caps from the USB1, USB2, and HDMI® ports on the rear panel.

2. Unfasten the metallic rings and gaskets to fully remove the protective caps.



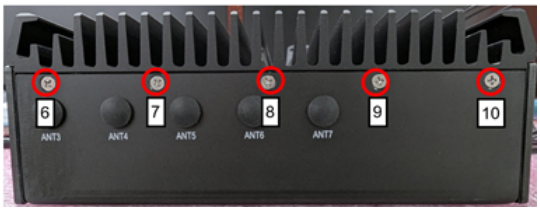

**Note:**
It is recommended to use a specialized removal tool designed for this purpose to avoid damage to nearby components or to the rings and gaskets themselves.

3. Remove the screws from the rear panel in the order indicated in the following figure.

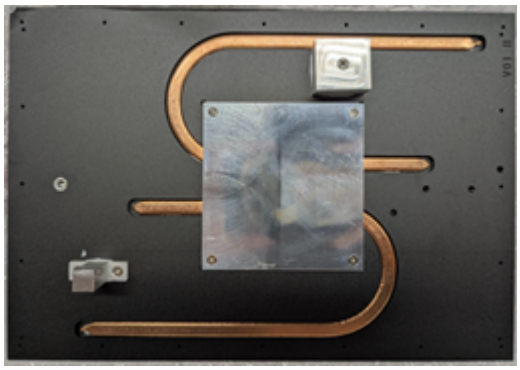



4. Remove the screws from the front panel in the order indicated in the following figure.

5. Remove the screws from the side panels in the order indicated in the following figure.




6. After removing all the specified screws, gently lift the top cover and place it carefully.



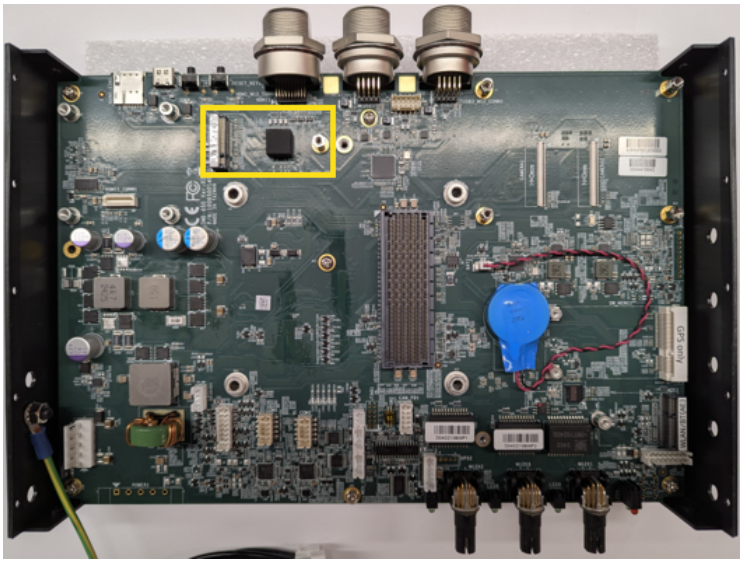
**Important:**

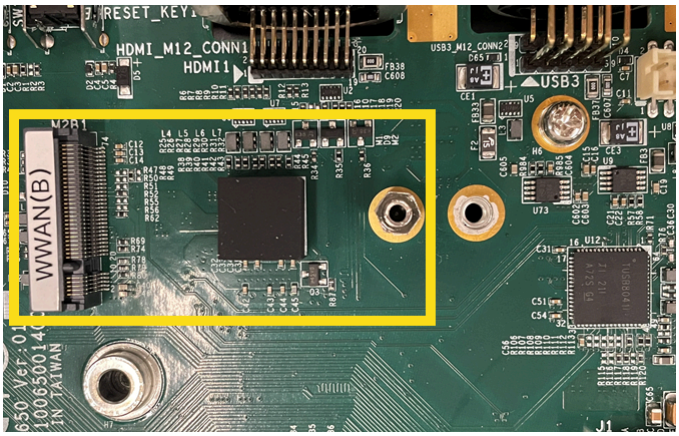
- Reassemble the system by following the steps above in reverse order.
- To ensure IP66 protection, fasten the screws in the order indicated in the figures above, with a tightening torque of 4 kgf-cm.

### 2.2.3.2. Installing an M.2 WWAN Module

1. **Installing an M.2 3042 Key B LTE WWAN card (USB 3.0)**:

   a. Locate the M.2 3042 Key B slot on the mainboard.



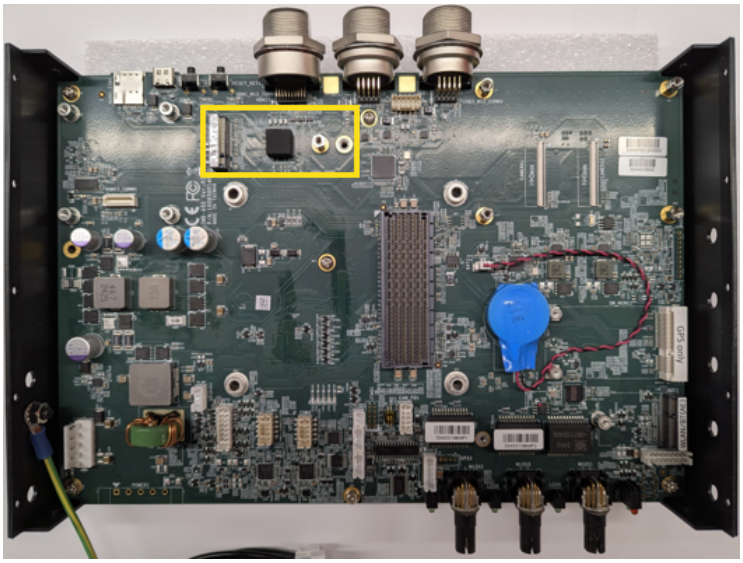


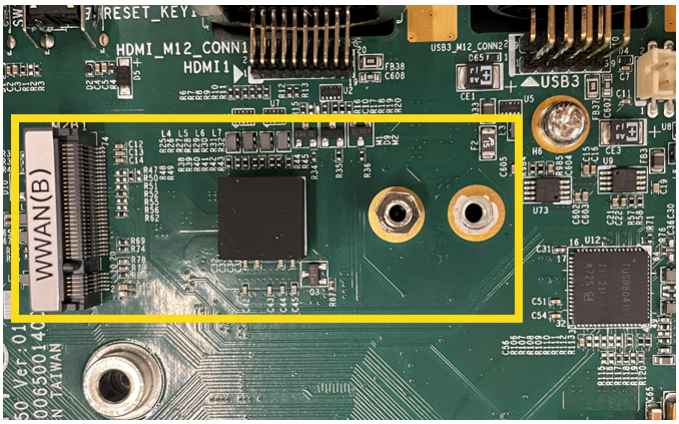

   b. Align the notch on the M.2 3042 WWAN card with the tab in the slot and gently insert the WWAN card at a 30 degree angle until it is fully embedded, and then press it down.

   c. Secure the expansion module to the mainboard with the M2.5x5L screw included in the package (see Package Contents *(on page 12)*).

2. **Installing an M.2 3052 Key B 5G WWAN card (USB 3.0)**:

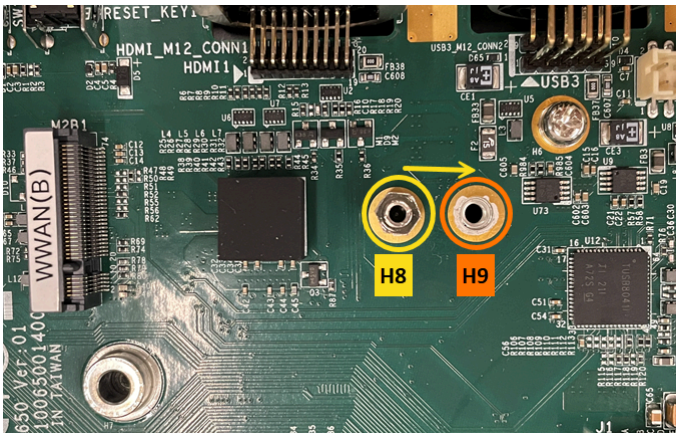
a. Locate the M.2 3052 Key B slot on the mainboard.






b. Move the standoff screw (H73D50) from location H8 to H9 as shown below:

Figure 2-1 Standoff Screw (H73D50)

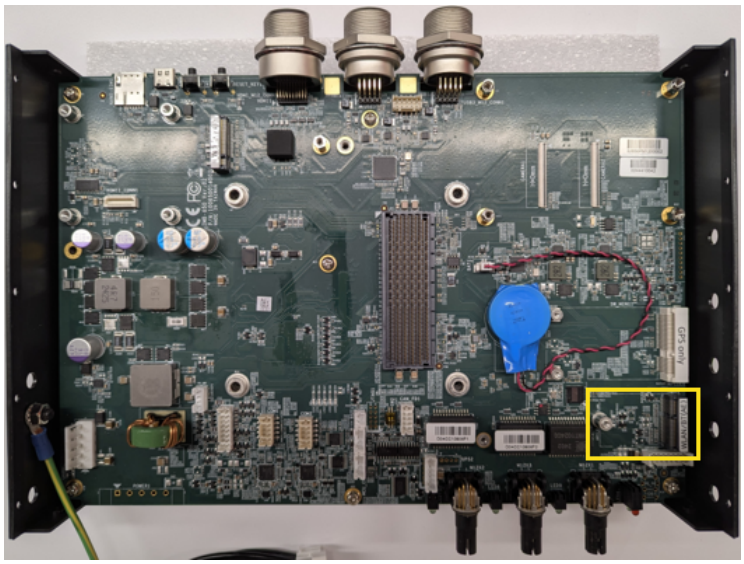


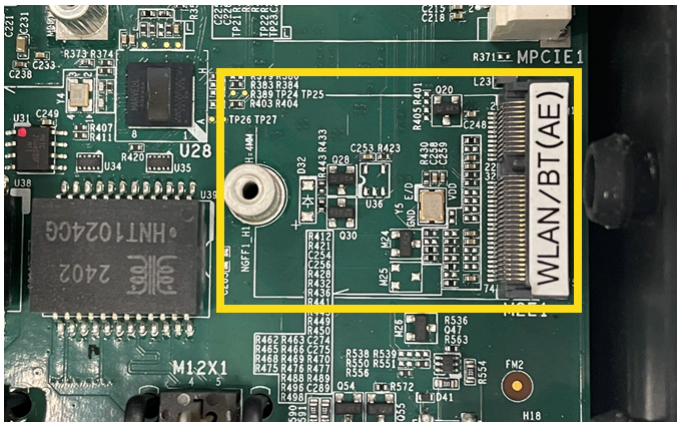

c. Align the notch on the M.2 3052 WWAN card with the tab in the slot and gently insert the WWAN card at a 30 degree angle until it is fully embedded, and then press it down.

d. Secure the expansion module to the mainboard with the M2.5x5L screw included in the package (see Package Contents *(on page 12)*).

### 2.2.3.3. Installing an M.2 WLAN Module

1. Locate the M.2 2230 Key E slot on the mainboard.





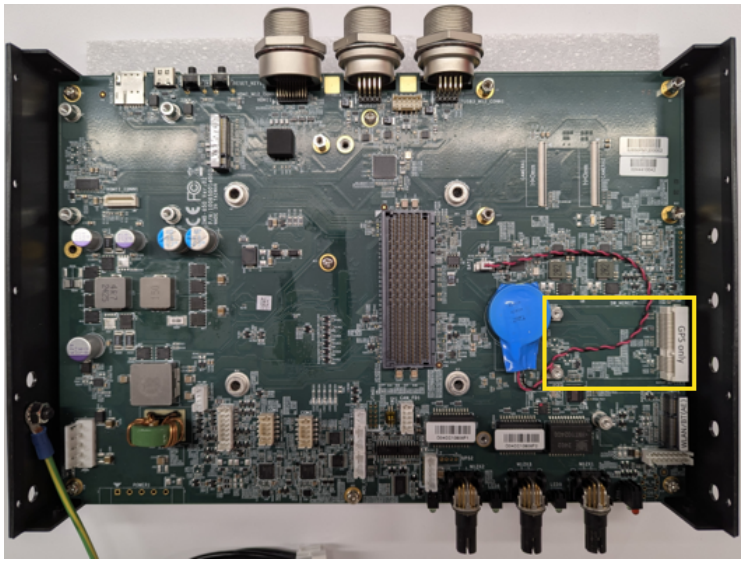

2. Align the notch on the expansion module with the tab in the slot and gently insert the module at a 30 degree angle until it is fully embedded, and then press it down.

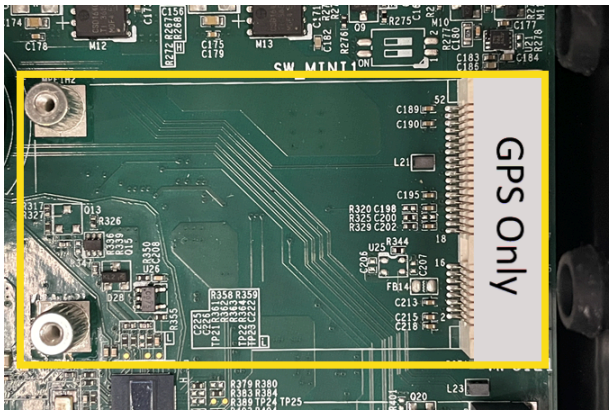
**Note:**
Ensure you align the semicircular mounting hole at the center of the opposite edge on the module with the copper pillar bump when pressing the module down.

3. Secure the expansion module to the mainboard with the M2.5x5L screw included in the package (see Package Contents *(on page 12)*).

### 2.2.3.4. Installing a mPCIe Module

1. Locate the mPCIe connector on the mainboard.





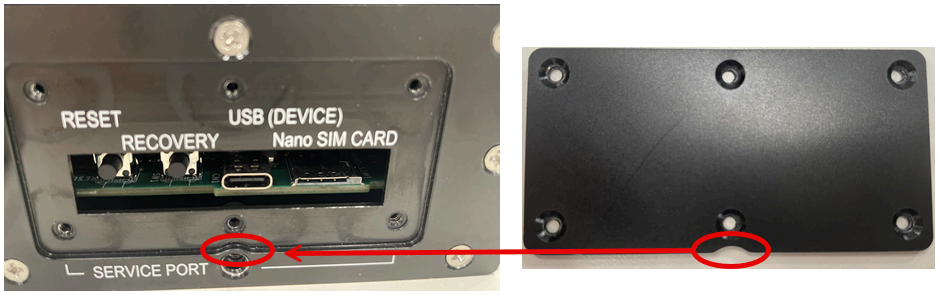

2. Align the notch on the mPCIe card with the tab in the slot and gently insert the card at a 30 degree angle until it is fully embedded, and then press it down.
3. Secure the mPCIe card to the mainboard with the M2x4L screw(s) included in the package (see Package Contents *(on page 12)*).

### 2.2.4. Installing a Nano SIM Card

1. Ensure the system is powered off.
2. Remove the 6 screws in the order indicated in the following figure to remove the protection cover from the rear panel.

3. Locate the **Nano SIM CARD** slot as indicated in the following figure.

4. With the gold/bronze chip side facing up, insert the nano SIM card into the slot.
5. Align the notch on the protection cover with the tab on the frame, and then position the cover so that the notch fits directly over the tab.




6. Fasten the protection cover back onto the rear panel by the specified order given in the figure in **Step 2** *(on page 26)*, with a tightening torque of 4 kgf-cm.

**Note:**
To remove the SIM card, follow the steps above.

## 2.3. Booting the System

This section describes how to boot the system via an ignition switch or the power button.

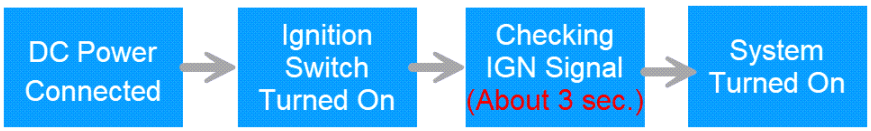
### 2.3.1. Turning On System By Ignition Switch

1. You can use the power cable that came with the package directly in fields without an ignition system.
2. Plug one end of the power cable into the DC-IN port of the computer and then plug the other end to a power source.
3. When the power is ready, turn on the ignition switch.
4. The system starts checking if there's any incoming ignition signal. It takes about **3 seconds** for the system to run the ignition control process.

   **Note:**
   SINTRONES® provides ignition power management that monitors the ignition signal and controls the system boot process to avoid potential risk of downtime or damages to the connected devices and system.

5. After the ignition control process is complete, the system will boot up.

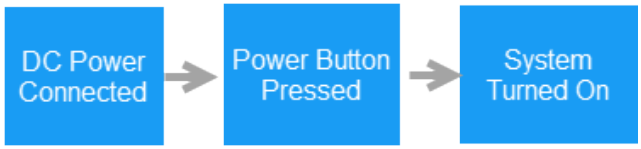
Figure 2-2 Turning On System By Ignition Switch




### 2.3.2. Turning On System By Power Button

1. When the system is connected to a suitable DC power source, press the power button.
2. The **Power Button** turns to blue light when the system boots up.

Figure 2-3 Turning On System By Power Button




## 2.4. Default Login Credentials

To get started after booting the system, log in using the default credentials:

- **Username**: `sintrones` (enter in lowercase)
- **Password**: `24332747`

**Important:**
For security reasons, change both the username and password immediately after your first login.

# 3. External I/O Ports

Topics in this chapter include:


- Front Panel *(on page 30)*
- Rear Panel *(on page 32)*
- Specifications of External I/O Ports *(on page 33)*

## 3.1. Front Panel

This section provides the front panel view and the description of the associated I/O interface.

Figure 3-1 Front Panel of IBOX-650P-IP66-2S/-DIO

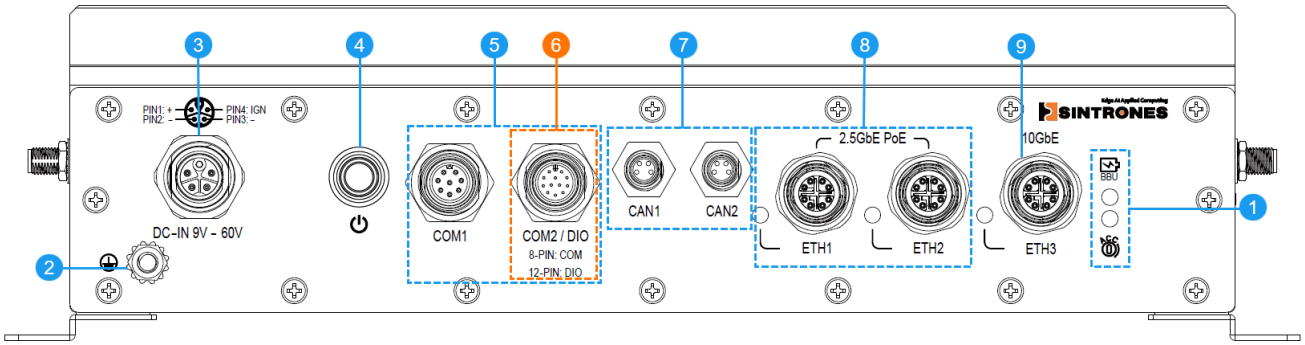



**Table 3-1 I/O Interface on Front Panel**

| Item | I/O Interface | Description | Specification |
|---|---|---|---|
| 1 | LED Indicators | (BBU):<br>• ON: Internal backup battery enabled<br>• OFF: Power supplied from external power source or no backup battery installed | - |
| | | ACC:<br>• ON: Ignition enabled<br>• OFF: Ignition disabled | - |
| 2 | Grounding Terminal | M5 bolt with nut for chassis grounding | - |
| 3 | DC Input | • Input voltage range: DC 9–60V<br>• M12 K-coded connector | DC-IN Port (M12 K-coded Connector) *(on page 33)* |
| 4 | Power Button | System power status:<br>• Red light: Standby mode<br>• Blue light: System turned on | Power Button (LED Light Status) *(on page 33)* |
| 5 | COM Port | • Supports RS-232/422/485 interfaces<br>• Programmable via software configuration<br>• M12 A-coded 8-pin connector | COM Port (M12 A-coded Connector) *(on page 34)* |

| Item | I/O Interface | Description | Specification |
|---|---|---|---|
| 6 | COM/DIO Port | This port supports either a serial (COM) interface or a digital I/O (DIO) interface, depending on the selected SKU.<br>• IBOX-650P-IP66-2S:<br>◦ COM port: RS-232/422/485 serial port<br>◦ M12 A-coded 8-pin connector<br>• IBOX-650P-IP66-DIO:<br>◦ DIO: 4 x DI , 4 x DO (DC 12V/100mA)<br>◦ 1 x Analog Input (DC 0-60V)<br>◦ 1 x PWM Output (DC 12V)<br>◦ M12 A-coded 12-pin connector | • COM Port (M12 A-coded Connector) *(on page 34)*<br>• DIO Port (M12 A-coded Connector) *(on page 35)* |
| 7 | CAN FD Ports | • Supports CAN FD protocol<br>• Backward compatible with CAN bus 2.0<br>• M8 A-coded connector | CAN FD Port (M8 A-coded Connector) *(on page 35)* |
| 8 | LAN Ports with PoE | ETH1/ETH2 PoE:<br>• 2.5GbE with IEEE 802.3at PoE PSE Class 4 (PoE+ 30 watts per port)<br>• M12 X-coded connectors | LAN Port (M12 X-coded Connector) *(on page 36)* |
| 9 | LAN Port | ETH X:<br>• 10GbE<br>• M12 X-coded connector | |

## 3.2. Rear Panel

This section provides the rear panel view and the description of the associated I/O interface.

Figure 3-2 Rear Panel of IBOX-650P-IP66-2S/-DIO

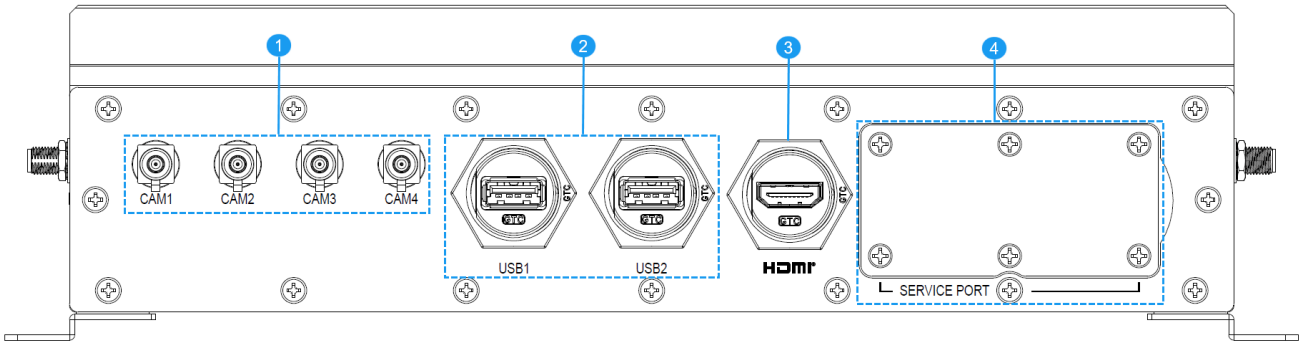


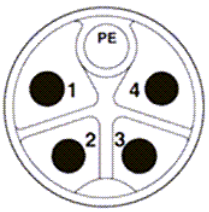

**Table 3-2 I/O Interface on Rear Panel**

| Item | I/O Interface | Description | Specification |
|---|---|---|---|
| 1 | Camera Ports | FAKRA-Z connectors for GMSL-2 cameras | - |
| 2 | USB Ports | • USB 3.2, 5V/900mA<br>• IP67/Type-A connectors | USB 3.2 Type-A Port *(on page 37)* |
| 3 | HDMI® Port | • Supports HDMI 2.1 output<br>• IP67/Type-A connector | HDMI® Port *(on page 37)* |
| 4 | Service Port | Contains the system reset and recovery buttons, USB (Device) port, and a Nano SIM card slot<br>**Note:**<br>• The recovery button works only when the USB (Device) port is connected to a host computer.<br>• The USB (Device) port is used only for system recovery. It does not support power or other kinds of data transfer.<br>• Ensure you power off the system before installing or removing the SIM card. | USB Type-C Port *(on page 38)* |

## 3.3. Specifications of External I/O Ports

This section provides drawings and pin definitions of the external I/O ports.

### 3.3.1. DC-IN Port (M12 K-coded Connector)




- Manufacturer: Phoenix Contact
- Type: M12 K-code
- Part number: 1415293-120

**Table 3-3 Pin Definition of DC-IN Port (M12 K-coded Connector)**

| Pin | Signal |
|---|---|
| 1 | 9 ~ 60 VDC |
| 2 | 0V |
| 3 | 0V |
| 4 | IGN |

### 3.3.2. Power Button (LED Light Status)

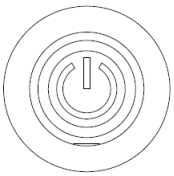
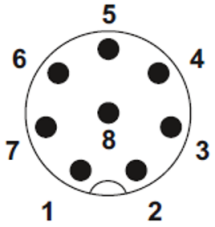


**Table 3-4 Pin Definition of Power Button (LED Light Status)**

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| LED | | | |
| A1 | POWER_LED+ | C1 | POWER_LED- |

### 3.3.3. COM Port (M12 A-coded Connector)




- Manufacturer: Taiming
- Type: M12 A-code
- Part number: TM-10S-12A8P-HX8

**Table 3-5 Pin Definition of COM Port (M12 A-coded)**

| Pin | RS-232 | RS-422 | RS-485 |
|---|---|---|---|
| 1 | NC | TXD- | TXD-/RXD- |
| 2 | COM_RXD | TXD+ | TXD+/RXD+ |
| 3 | COM_TXD | RXD+ | NC |
| 4 | NC | RXD- | NC |
| 5 | GND | GND | GND |
| 6 | NC | NC | NC |
| 7 | COM_RTS | NC | NC |
| 8 | COM_CTS | NC | NC |

### 3.3.4. DIO Port (M12 A-coded Connector)

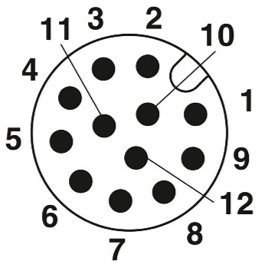
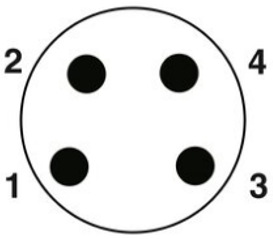



**Table 3-6 Pin Definition of DIO/ADC/PWM**

| Pin | Signal | | | |
|---|---|---|---|---|
| | Digital Input (DI) | Digital Output (DO) | Analog Input | PWM Output |
| 1 | - | - | AI | - |
| 2 | DI_1 | - | - | - |
| 3 | DI_2 | - | - | - |
| 4 | DI_3 | - | - | - |
| 5 | DI_4 | - | - | - |
| 6 | - | DO_1 | - | - |
| 7 | - | DO_2 | - | - |
| 8 | - | DO_3 | - | - |
| 9 | - | DO_4 | - | - |
| 10 | - | - | - | PWM_OUT |
| 11 | GND | GND | GND | GND |
| 12 | GND | GND | GND | GND |

### 3.3.5. CAN FD Port (M8 A-coded Connector)

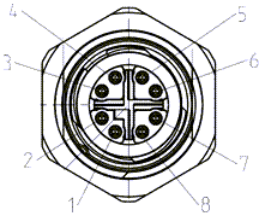



- Manufacturer: Hougun
- Type: M8 4-pin
- Part number: HG24-M080001

**Table 3-7 Pin Definition of CAN**

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 1 | CAN_L | 3 | CAN_H |
| 2 | GND | 4 | GND |

### 3.3.6. LAN Port (M12 X-coded Connector)




- Manufacturer: Phoenix Contact
- Type: M12 X-code
- Part number: 1414020, 1424180

**Table 3-8 Pin Definition of ETH1 PoE (2.5Gb)**

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 1 | LAN1_TD0_DP | 5 | LAN1_TD3_DP |
| 2 | LAN1_TD0_DN | 6 | LAN1_TD3_DN |
| 3 | LAN1_TD1_DP | 7 | LAN1_TD2_DN |
| 4 | LAN1_TD1_DN | 8 | LAN1_TD2_DP |

**Table 3-9 Pin Definition of ETH2 PoE (2.5Gb)**

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 1 | LAN2_TD0_DP | 5 | LAN2_TD3_DP |
| 2 | LAN2_TD0_DN | 6 | LAN2_TD3_DN |
| 3 | LAN2_TD1_DP | 7 | LAN2_TD2_DN |
| 4 | LAN2_TD1_DN | 8 | LAN2_TD2_DP |

**Table 3-10 Pin Definition of ETHX (10Gb)**

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 1 | 10G_TD0_DP | 5 | 10G_TD3_DP |
| 2 | 10G_TD0_DN | 6 | 10G_TD3_DN |
| 3 | 10G_TD1_DP | 7 | 10G_TD2_DN |
| 4 | 10G_TD1_DN | 8 | 10G_TD2_DP |

### 3.3.7. USB 3.2 Type-A Port

- Manufacturer: GT Contact
- Part number: GT218300-20

**Table 3-11 Pin Definition of USB 3.2 Type-A Port**

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 1 | VCC | 6 | RX+ |
| 2 | D- | 7 | GND |
| 3 | D+ | 8 | TX- |
| 4 | GND | 9 | TX+ |
| 5 | RX- | 10 | NA |

### 3.3.8. HDMI® Type-A Port

- Manufacturer: GT Contact
- Part number: GT2H2300-20

**Table 3-12 Pin Definition of HDMI® Type-A Port**

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 1 | TMDS Data2+ | 2 | TMDS Data2 Shield |
| 3 | TMDS Data2– | 4 | TMDS Data1+ |
| 5 | TMDS Data1 Shield | 6 | TMDS Data1– |
| 7 | TMDS Data0+ | 8 | TMDS Data0 Shield |
| 9 | TMDS Data0– | 10 | TMDS Clock+ |
| 11 | TMDS Clock Shield | 12 | TMDS Clock– |
| 13 | CEC | 14 | Reserved |
| 15 | SCL | 16 | SDA |
| 17 | DDC/CEC Ground | 18 | +5V Power |
| 19 | Hot Plug Detect | | |

### 3.3.9. USB Type-C Port

**Table 3-13 Pin Definition of USB Type-C Port**

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| A1 | GND | B12 | GND |
| A2 | NC | B11 | NC |
| A3 | NC | B10 | NC |
| A4 | NC | B9 | NC |
| A5 | NC | B8 | NC |
| A6 | Dp1 | B7 | Dn2 |
| A7 | Dn1 | B6 | Dp2 |
| A8 | NC | B5 | NC |
| A9 | NC | B4 | NC |
| A10 | NC | B3 | NC |
| A11 | NC | B2 | NC |
| A12 | GND | B1 | GND |

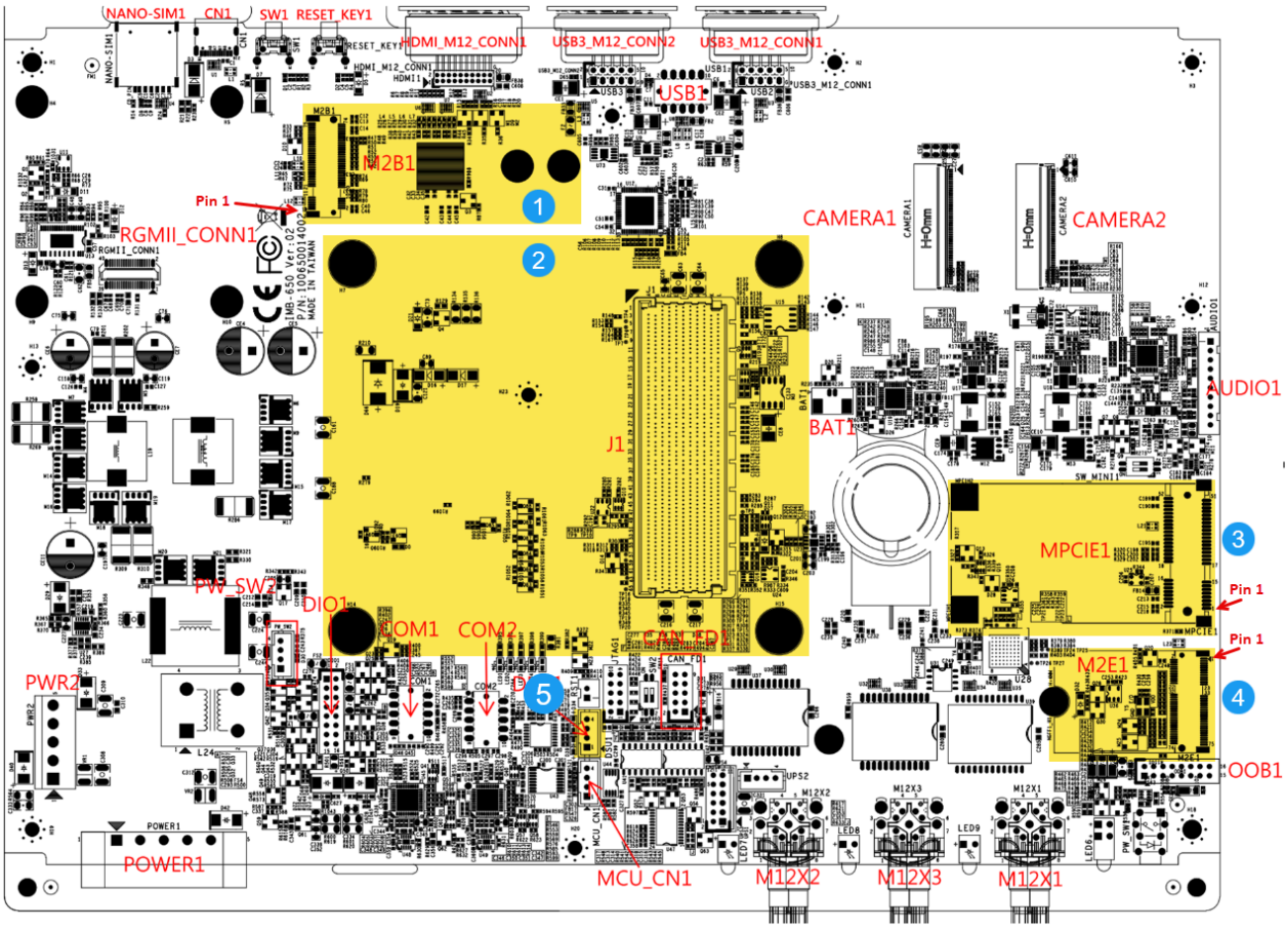
# 4. Expansion

This chapter provides more details about the internal slots or connectors used for expansion purpose.

Topics in this chapter include:

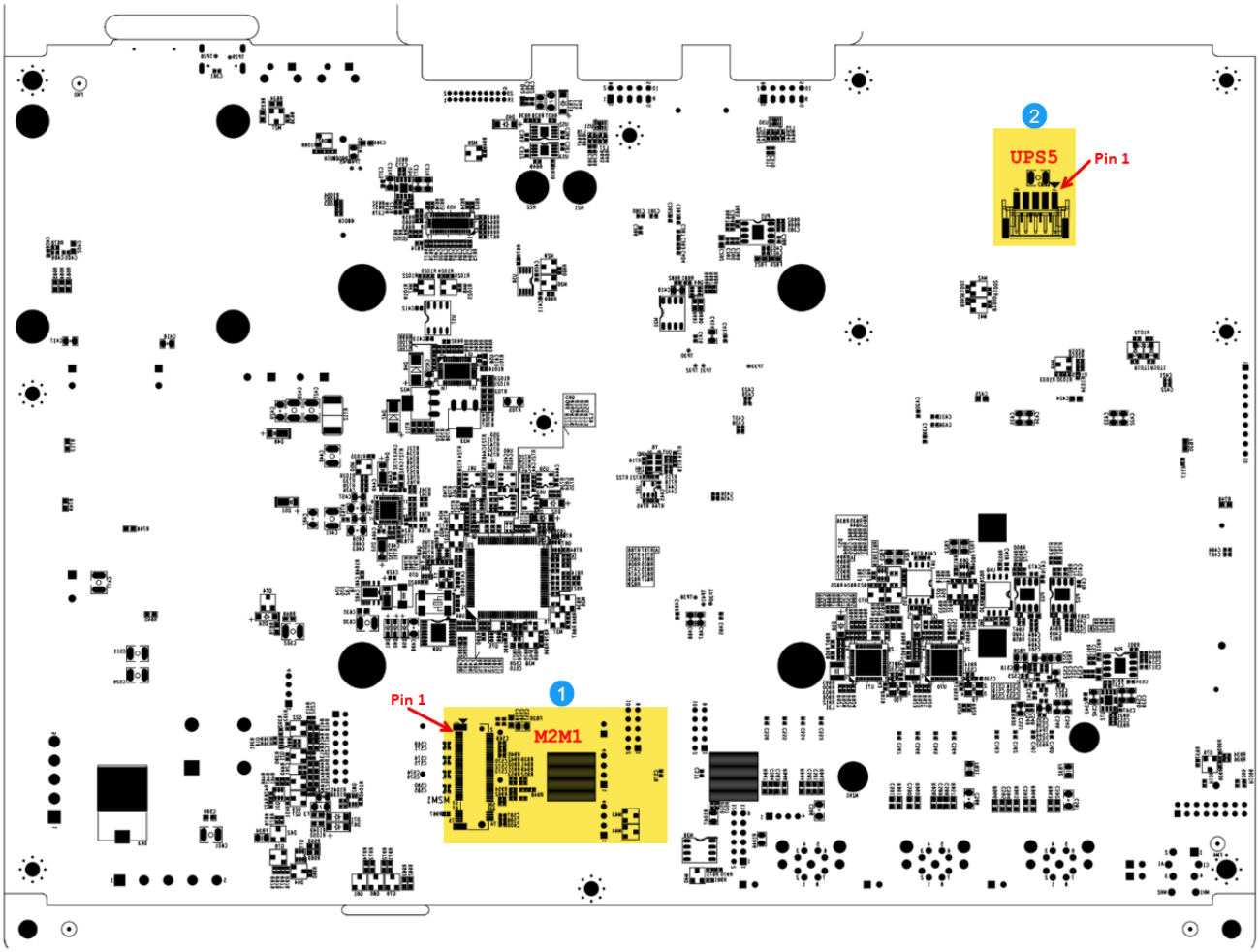

- Top View of Mainboard *(on page 40)*
- Bottom View of Mainboard *(on page 41)*
- Specifications of Expansion Slots/Connectors *(on page 42)*

## 4.1. Top View of Mainboard




| Item | Internal Connector | Description | Specification |
|---|---|---|---|
| 1 | M2B1 | M.2 3042/3052 Key B slot used for installing an expansion module such as a WWAN module | M.2 Key B Slot *(on page 42)* |
| 2 | NVIDIA® Jetson SoM | NVIDIA® Jetson module integrates CPU, GPU, and memory with pre-installed JetPack developer tools. | Information about Jetson Modules *(on page 16)* |
| | J1 | Molex Mirror Mezz 699-pin board-to-board connector (part number: 2034560003) | - |
| 3 | MPCIE1 | mPCIe full-size slots used for installing one mini PCIe card supporting USB 2.0 interface | mPCIe Connector *(on page 43)* |
| 4 | M2E1 | M.2 2230 Key E slot used for installing an expansion module such as a WLAN or Bluetooth module | M.2 Key E Slot *(on page 45)* |
| 5 | DSU1 | Used for monitoring system status and collecting debug logs | DSU JST Connector *(on page 48)* |

## 4.2. Bottom View of Mainboard




| Item | Internal Connector | Description | Specification |
|---|---|---|---|
| 1 | M2M1 | M.2 2280 Key M slot used for installing an NVMe SSD<br>**Important:**<br>If the system BSP is pre-installed in the NVMe SSD, please don't remove the pre-installed SSD, or install an empty one without preparing any backup image in advance. It is suggested to consult SINTRONES® technical support for expansion requirements for an NVMe SSD. | M.2 Key M Slot *(on page 46)* |
| 2 | UPS5 | Used for installing the backup battery | - |

## 4.3. Specifications of Expansion Slots/Connectors

This section provides drawings and pin definitions about the slots or connectors used to install expansion modules.

### 4.3.1. M.2 Key B Slot

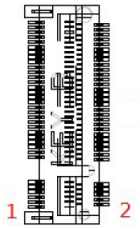
| M.2 Key B Slot | Description |
|---|---|
| Size | NGFF 3042 / 3052 / 75 Pin |
| Type | M.2 Key B H:8.5mm |
| Location | See Top View of Mainboard *(on page 40)* for the information. |
| Drawing |  |

**Table 4-1 Pin Definition of M.2 Key B Slot**

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 1 | NC | 2 | 3VSB |
| 3 | GND | 4 | 3VSB |
| 5 | GND | 6 | Reserve |
| 7 | M2B_USB1_DP | 8 | Reserve |
| 9 | M2B_USB1_DN | 10 | Reserve |
| 11 | GND | 12 | KEY |
| 13 | KEY | 14 | KEY |
| 15 | KEY | 16 | KEY |
| 17 | KEY | 18 | KEY |
| 19 | KEY | 20 | NC |
| 21 | NC | 22 | NC |
| 23 | WWAN_WAKE | 24 | NC |
| 25 | M2B1DPR | 26 | Reserve |
| 27 | GND | 28 | NC |
| 29 | M2B_USB3.2_RXN | 30 | M2UIM_RST_A |
| 31 | M2B_USB3.2_RXP | 32 | M2UIM_CLK_A |
| 33 | GND | 34 | M2UIM_DAT_A |

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 35 | M2B_USB3.2_TXN | 36 | M2UIM_PWR_A |
| 37 | M2B_USB3.2_TXP | 38 | NC |
| 39 | GND | 40 | NC |
| 41 | NC | 42 | NC |
| 43 | NC | 44 | M2B_ALERN |
| 45 | GND | 46 | NC |
| 47 | NC | 48 | NC |
| 49 | NC | 50 | DEV_3V3RST# |
| 51 | GND | 52 | Reserve |
| 53 | NC | 54 | WWAN_WAKE |
| 55 | NC | 56 | NC |
| 57 | GND | 58 | NC |
| 59 | NC | 60 | NC |
| 61 | NC | 62 | NC |
| 63 | NC | 64 | NC |
| 65 | NC | 66 | NC |
| 67 | M2B1RST2 | 68 | NC |
| 69 | CONFIG_1 | 70 | 3VSB |
| 71 | GND | 72 | 3VSB |
| 73 | GND | 74 | 3VSB |
| 75 | NC | | |

### 4.3.2. mPCIe Connector

| mPCIe Connector | Description |
|---|---|
| Size | 2 x 26 / 52 Pin |
| Type | MINI PCI-E CON H:9.2mm |
| Location | See Top View of Mainboard *(on page 40)* for the information. |

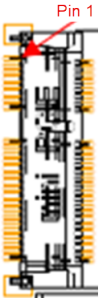
| mPCIe Connector | Description |
|---|---|
| Drawing |  |

**Table 4-2 Pin Definition of mPCIe Connector (MINICARD1 & 2)**

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 1 | WAKE# | 2 | 3V3_VSB |
| 3 | NC | 4 | GND |
| 5 | NC | 6 | 1V5(Reserve) |
| 7 | NC | 8 | NC |
| 9 | GND | 10 | NC |
| 11 | NC | 12 | NC |
| 13 | NC | 14 | NC |
| 15 | GND | 16 | NC |
| 17 | NC | 18 | GND |
| 19 | NC | 20 | W_DIS |
| 21 | GND | 22 | RESET# |
| 23 | NC | 24 | 3V3_VSB |
| 25 | NC | 26 | GND |
| 27 | GND | 28 | 1V5(Reserve) |
| 29 | GND | 30 | I2C_SCL |
| 31 | NC | 32 | I2C_SDA |
| 33 | NC | 34 | GND |
| 35 | GND | 36 | USB_DN |
| 37 | GND | 38 | USB_DP |
| 39 | 3V3_VSB | 40 | GND |
| 41 | 3V3_VSB | 42 | NC |
| 43 | GND | 44 | NC |
| 45 | NC | 46 | NC |
| 47 | NC | 48 | 1V5(Reserve) |

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 49 | NC | 50 | GND |
| 51 | NC | 52 | 3V3_VSB |

### 4.3.3. M.2 Key E Slot

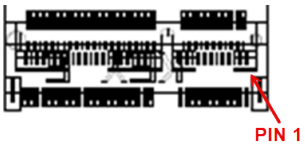
| M.2 Key E Slot | Description |
|---|---|
| Size | NGFF 2230 / 75 Pin |
| Type | M.2 Key E H:8.5mm |
| Location | See Top View of Mainboard *(on page 40)* for the information. |
| Drawing |   |

**Table 4-3 Pin Definition of M.2 Key E Slot**

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 1 | GND | 2 | V3P3_A |
| 3 | HUBA_USB_2P | 4 | V3P3_A |
| 5 | HUBA_USB_2N | 6 | NC |
| 7 | GND | 8 | NC |
| 9 | NC | 10 | NC |
| 11 | NC | 12 | NC |
| 13 | NC | 14 | NC |
| 15 | NC | 16 | NC |
| 17 | NC | 18 | NC |
| 19 | NC | 20 | BT_UART_WAKE_B |
| 21 | NC | 22 | UART0_RXD |
| 23 | NC | 24 | KEY |
| 25 | KEY | 26 | KEY |
| 27 | KEY | 28 | KEY |
| 29 | KEY | 30 | KEY |
| 31 | KEY | 32 | UART0_TXD |
| 33 | GND | 34 | UART0_CTS |
| 35 | PCIE1_TX0_P | 36 | UART0_RTS |

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 37 | PCIE1_TX0_N | 38 | NC |
| 39 | GND | 40 | NC |
| 41 | PCIE1_RX0_P | 42 | NC |
| 43 | PCIE1_RX0_N | 44 | NC |
| 45 | GND | 46 | NC |
| 47 | PCIE1_CLK_P | 48 | NC |
| 49 | PCIE1_CLK_N | 50 | BT_OSC_32KHZ |
| 51 | GND | 52 | PCIE1_RST |
| 53 | PCIE1_CLKREQ | 54 | M2E_WIFI_DIS2(BT) |
| 55 | PCIE_WAKE | 56 | M2E_WIFI_DIS1(WIFI) |
| 57 | GND | 58 | JS_I2C2_SDA |
| 59 | NC | 60 | JS_I2C2_SCL |
| 61 | NC | 62 | M2E_ALERT |
| 63 | GND | 64 | NC |
| 65 | NC | 66 | NC |
| 67 | NC | 68 | NC |
| 69 | GND | 70 | WIFI_WAKE |
| 71 | NC | 72 | V3P3_A |
| 73 | NC | 74 | V3P3_A |
| 75 | GND | | |

### 4.3.4. M.2 Key M Slot

| M.2 Key M Slot | Description |
|---|---|
| Size | NGFF 2280 / 75 Pin |
| Type | M.2 Key M H:8.5mm |
| Location | See Bottom View of Mainboard *(on page 41)* for the information. |
| Drawing | |

**Table 4-4 Pin Definition of M.2 Key M Slot**

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 1 | GND | 2 | 3VSB |
| 3 | GND | 4 | 3VSB |
| 5 | PCIE0_RX3_N | 6 | NC |
| 7 | PCIE0_RX3_P | 8 | NC |
| 9 | GND | 10 | NC |
| 11 | PCIE0_TX3_N | 12 | 3VSB |
| 13 | PCIE0_TX3_P | 14 | 3VSB |
| 15 | GND | 16 | 3VSB |
| 17 | PCIE0_RX2_N | 18 | 3VSB |
| 19 | PCIE0_RX2_P | 20 | NC |
| 21 | GND | 22 | NC |
| 23 | PCIE0_TX2_N | 24 | NC |
| 25 | PCIE0_TX2_P | 26 | NC |
| 27 | GND | 28 | NC |
| 29 | PCIE0_RX1_N | 30 | NC |
| 31 | PCIE0_RX1_P | 32 | NC |
| 33 | GND | 34 | NC |
| 35 | PCIE0_TX1_N | 36 | NC |
| 37 | PCIE0_TX1_P | 38 | NC |
| 39 | GND | 40 | JS_I2C2_SCL |
| 41 | PCIE0_RX0_N | 42 | JS_I2C2_SDA |
| 43 | PCIE0_RX0_P | 44 | M2M_ALERT |
| 45 | GND | 46 | NC |
| 47 | PCIE0_TX0_N | 48 | NC |
| 49 | PCIE0_TX0_P | 50 | PCIE0_RST |
| 51 | GND | 52 | PCIE0_CLKREQ |
| 53 | PCIE0_CLK_N | 54 | PCIE_WAKE |
| 55 | PCIE0_CLK_P | 56 | NC |
| 57 | GND | 58 | NC |
| 59 | KEY | 60 | KEY |
| 61 | KEY | 62 | KEY |
| 63 | KEY | 64 | KEY |
| 65 | KEY | 66 | KEY |

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 67 | NC | 68 | NC |
| 69 | NGFF3_PEDET | 70 | 3VSB |
| 71 | GND | 72 | 3VSB |
| 73 | GND | 74 | 3VSB |
| 75 | GND | | |

### 4.3.5. DSU JST Connector

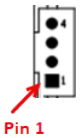
| DSU JST Connector | Description |
|---|---|
| Size | 1 x 4 / 4 Pin |
| Type | JST-2.0mm-M-180 |
| Location | See Top View of Mainboard *(on page 40)* for the information. |
| Drawing |   |

**Table 4-5 Pin Definition**

| Pin | Signal |
|---|---|
| 1 | N/A |
| 2 | JETSON_UART2_TX |
| 3 | JETSON_UART2_RX |
| 4 | GND |

The DSU JST connector is used to monitor the system status and collect debug logs via UART protocol by advanced developers. There's no need to use this connector under normal operation.

To retrieve UART logs, connect a host computert to the system with a USB-UART or RS232-UART converter cable (not included in the package), and then configure the UART settings on the host computer as shown below:

- Baud rate: 115,200bps
- Voltage: DC 3.3V
- Data bits: 8
- Parity bit: 0
- Flow control: No

# 5. Software

Topics in this chapter include:


- System Configuration *(on page 50)*
  - Setting the GMSL Camera *(on page 50)*
  - Smart Power Management Settings *(on page 51)*
  - COM Port (RS-232/422/485) Configuration *(on page 54)*
  - CAN FD Configuration *(on page 54)*
  - PoE Configuration *(on page 55)*
  - DIO/ADC/PWM Configuration *(on page 56)*
- System Recovery *(on page 60)*
  - Hardware and System Requirements *(on page 60)*
  - Configuring a Host Computer *(on page 60)*
  - Downloading a BSP Image *(on page 60)*
  - Setting the System in Recovery Mode *(on page 60)*
  - Executing System Recovery *(on page 61)*
  - Configuring the Recovered System *(on page 63)*

## 5.1. System Configuration

This section provides instructions on how to initialize the GMSL cameras as well as summarizes commands available for configuring smart power management, COM (RS-232/422/485) ports, CAN FD, PoE and 100BASE-T1/ 1000BASE-T1 settings.

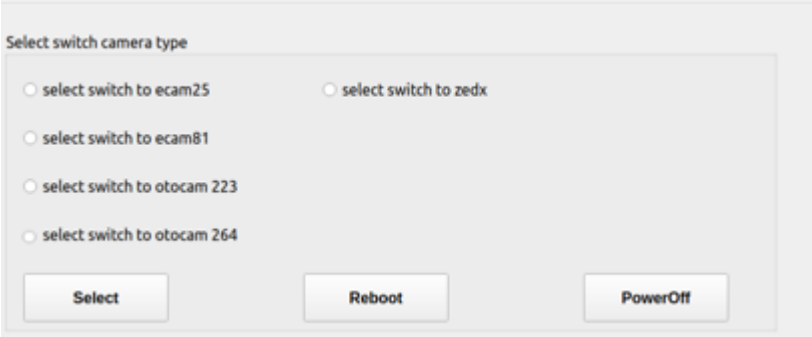
### 5.1.1. Setting the GMSL Camera

This section provides instructions on how to initialize the connected GMSL cameras.

1. Before connecting GMSL cameras, ensure the system is powered off.
2. Connect the GMSL cameras to the camara ports via the FAKRA-Z cables.

   **Important:**
   Connect only one type of cameras at a time. Different camera types cannot be mixed because the system does not support running multiple camera drivers simultaneously.

3. Connect the system to an HDMI monitor, a keyboard, and a mouse.
4. Boot the system.
5. Run the camera selection utility, and then choose the cameras you want to initialize.




   **Note:**
   The camera selection utility can be downloaded from SINTRONES® website.

6. Click **Select** to confirm your choice, and then click **OK**.
7. Click **Reboot** to reboot the system.
8. After the system reboots, enter the following command to verify whether the connected cameras have been successfully initialized.

   ```
   ls /dev/vi*
   ```

   For example, if you connect three cameras to the system via CAM1, CAM2, and CAM3 ports, the corresponding device names shall appear in the command output.

   Port names and corresponding device names shown in CLI:

   - CAM1: video0
   - CAM2: video1

- CAM3: video2
- CAM4: video3

9. To check a live video feed streaming from a specified camera, enter the following command:
   `gst-launch-1.0 v4l2src device="</dev/video?>" ! videoconvert ! xvimagesink &`

   **Note:**
   Replace the texts within the brackets with the actual device name. For example, if the device name is `/dev/video0`, namely the camera connected via the CAM1 port, enter

   `gst-launch-1.0 v4l2src device="/dev/video0" ! videoconvert ! xvimagesink &`

10. (Optional) If you want to add text overlay to the video streaming from CAM1, enter the following command:
    `gst-launch-1.0 v4l2src device="/dev/video0" ! textoverlay text="VIDEO 0" valignment=top halignment=left font-desc="Sans, 18" ! clockoverlay valignment=top halignment=right time-format="%D %H:%M:%S" ! videoconvert ! xvimagesink`

    **Note:**
    Likewise, replace `/dev/video0` with the actual device name to add text overlay to the video streaming from the specified camera.

    **Important:**
    To avoid unintended line breaks that may cause the command to fail, **copy the command into a plain text file to ensure it remains a single, continuous line** before pasting it into the terminal.

### 5.1.2. Smart Power Management Settings

This section summarizes the commands available for configuring the Smart Power Management function.

#### 5.1.2.1. Overview of Smart Power Management Commands

The general formats of the Smart Power Management commands are as follows:

`i2cget -y -f <i2c_num> <device_addr> <reg_addr>`: Used to **check** the current state of certain functionality.

`i2cset -f -y <i2c_num> <device_addr> <reg_addr> <value>`: Used to **change or save** the settings of certain functionality.

#### 5.1.2.2. Smart Power Management Commands

See the following tables as the available commands for Smart Power Management.

**Table 5-1 Checking IGN/UPS Status**

| Command | Value | Description | Outcome |
|---|---|---|---|
| `i2cget -y -f 1 0x4a 0x12` | - | Check the ignition (IGN) status | • `0x00`: Ignition turned off<br>• `0x01`: Ignition turned on |
| `i2cget -y -f 1 0x4a 0x10` | - | Check the UPS backup battery status | • `0x07`: UPS mode |

**Table 5-2 Checking and Setting Ignition Power On Delay Time**

| Command | Value | Description | Outcome |
|---|---|---|---|
| `i2cget -y -f 1 0x4a 0x60` | - | Check the ignition power on delay time by seconds | If the delay time is set as 3 seconds, the output will be `0x03` |
| `i2cset -f -y 1 0x4a 0x60` | For example: `0x03` | Set the ignition power on delay time by seconds | For example, if you enter `i2cset -f -y 1 0x4a 0x60 0x03`, and then save the setting *(on page 53)*, the system will wait for 3 seconds to power on after the ignition is turned on. |
| `i2cget -y -f 1 0x4a 0x61` | - | Check the ignition power on delay time by minutes | If the delay time is set as 2 minutes, the output will be `0x02` |
| `i2cset -f -y 1 0x4a 0x61` | For example: `0x02` | Set the ignition power on delay time by minutes | For example, if you enter `i2cset -f -y 1 0x4a 0x61 0x02`, and then save the setting *(on page 53)*, the system will wait for 2 minutes to power on after the ignition is turned on. |
| `i2cget -y -f 1 0x4a 0x62` | - | Check the ignition power on delay time by hours | If the delay time is set as 1 hour, the output will be `0x01` |
| `i2cset -f -y 1 0x4a 0x62` | For example: `0x01` | Set the ignition power on delay time by hours | For example, if you enter `i2cset -f -y 1 0x4a 0x62 0x01`, and then save the setting *(on page 53)*, the system will wait for 1 hour to power on after the ignition is turned on. |

**Table 5-3 Checking and Setting Ignition Power Off Delay Time**

| Command | Value | Description | Outcome |
|---|---|---|---|
| `i2cget -y -f 1 0x4a 0x66` | - | Check the ignition power off delay time by seconds | If the delay time is set as 3 seconds, the output will be `0x03` |

| Command | Value | Description | Outcome |
|---|---|---|---|
| `i2cset -f -y 1 0x4a 0x66` | For example: `0x03` | Set the ignition power off delay time by seconds | For example, if you enter `i2cset -f -y 1 0x4a 0x66 0x03`, and then save the setting *(on page 53)*, the system will wait for 3 seconds to power off after the ignition is turned off. |
| `i2cget -y -f 1 0x4a 0x67` | - | Check the ignition power off delay time by minutes | If the delay time is set as 2 minutes, the output will be `0x02` |
| `i2cset -f -y 1 0x4a 0x67` | For example: `0x02` | Set the ignition power off delay time by minutes | For example, if you enter `i2cset -f -y 1 0x4a 0x67 0x02`, and then save the setting *(on page 53)*, the system will wait for 2 minutes to power off after the ignition is turned off. |
| `i2cget -y -f 1 0x4a 0x68` | - | Check the ignition power off delay time by hours | If the delay time is set as 1 hour, the output will be `0x01` |
| `i2cset -f -y 1 0x4a 0x68` | For example: `0x01` | Set the ignition power off delay time by hours | For example, if you enter `i2cset -f -y 1 0x4a 0x68 0x01`, and then save the setting *(on page 53)*, the system will wait for 1 hour to power off after the ignition is turned off. |

**Table 5-4 Saving the Setting**

| Command | Description | Outcome |
|---|---|---|
| `i2cset -f -y 1 0x4a 0x28 0x02` | Save the setting. | The specified setting will be saved.<br>**Important:**<br>Ensure you enter `i2cset -f -y 1 0x4a 0x28 0x02` to save and allow the system to excute the specified setting. |

### 5.1.3. COM Port (RS-232/422/485) Configuration

The name of the COM port: ttyTHS1

See the following tables as the available commands list for the COM port.

**Table 5-5 Switching between RS-232/422/485**

| Command | Outcome | Description |
|---|---|---|
| `sudo rs232_set` | RS232 Mode Set | Enable the RS-232 mode |
| `sudo rs422_set` | RS422 Mode Set | Enable the RS-422 mode |
| `sudo rs485_set` | RS485 Mode Set | Enable the RS-485 mode |

#### 5.1.3.1. Testing RS-232/RS-422/RS-485 Communication

Enter the following commands to run the RS-232, RS-422, and RS-485 test programs.

```
$ sudo rs232a-demo
```

```
$ sudo rs422a-demo
```

```
$ sudo rs485a-demo
```

### 5.1.4. CAN FD Configuration

The names of the CAN FD ports: can0, can1

See the following table as the available commands list for the CAN FD ports.

- CAN Bus 1: can0
- CAN Bus 2: can1

| Command | Description |
|---|---|
| `sudo can_set` | Enable the CAN bus mode |
| `sudo ip link set down can0` | Disable the transmission function of the specified CAN bus |
| `sudo ip link set down can1` | |
| `sudo ip link set can0 type can bitrate 1000000 dbitrate 2000000 fd on` | Set the standard bit rate for the specified CAN bus as 1 Mbps and the data phase bit rate for CAN FD (Flexible Data Rate) as 2 Mbps. Enable CAN FD for faster transmission rate and larger data payloads (up to 64 bytes per frame). |
| `sudo ip link set can1 type can bitrate 1000000 dbitrate 2000000 fd on` | |
| `sudo ip link set up can0` | Enable the transmission function of the specified CAN bus |
| `sudo ip link set up can1` | |

| Command | Description |
| --- | --- |
| `cansend can0 123#abcdabcd` | Send data via the specified CAN bus |
| `cansend can1 123#abcdabcd` | |
| `candump can0` | Receive data via the specified CAN bus |
| `candump can1` | |

### 5.1.5. PoE Configuration

To enable PoE function, enter the following command:

```
i2cset -y 1 0x4a 0x3c 0x40
```

To disable PoE function, enter the following command:

```
i2cset -y 1 0x4a 0x3c 0x0
```

### 5.1.6. DIO/ADC/PWM Configuration

The IBOX-650P-IP66-**DIO** supports four programmable digital inputs (DI) and four digital outputs (DO), one ADC channel (analog input) and one PWM output, which can be configured to communicate or exchange data with the connected peripheral devices.

**Note:**
The DIO pins will be reset to default settings after a cold boot.

The general formats of the DIO/ADC/PWM commands are as follows:

`i2cget -y <i2c_num> <device_addr> <reg_addr>`: Used to **check** the current state of the specified channel.

`i2cset -y <i2c_num> <device_addr> <reg_addr> <value>`: Used to **configure** the settings of the specified channel(s).

See the following tables as the register information for the DIO, ADC, and PWM channels.

**Table 5-6 General Register Information**

| Field Names | Register | Description |
|---|---|---|
| `i2c_num` | **1** | System-assigned I²C bus number |
| `device_addr` | **0x4A** | Slave device address for DIO (ADC and PWM channels included) |
| **DIO** | | |
| `di_reg_addr` | **0x30** | Register address for the digital inputs (DI) |
| `do_reg_addr` | **0x31** | Register address for the digital outputs (DO) |
| **ADC** | | |
| `adc_low_reg_addr` | **0x58** | ADC data low byte |
| `adc_high_reg_addr` | **0x59** | ADC data high byte |
| `adc_enable_reg_addr` | **0x25** | **Bit 6:** Register address for enabling the external ADC |
| **PWM** | | |
| `pwm_low_reg_addr` | **0xEA** | PWM duty cycle low byte |
| `pwm_high_reg_addr` | **0xEB** | PWM duty cycle high byte |
| `pwm_enable_reg_addr` | **0xE9** | **Bit 0:** Register address for enabling the PWM |

See the following as the DI data register table:

**Table 5-7 DI Data Register – 0x30**

| Bit | Pin | Value |
|---|---|---|
| 3 | DI_4 | • Low: 0<br>• High: 1 |
| 2 | DI_3 | |
| 1 | DI_2 | |
| 0 | DI_1 | |

See the following as the DO data register table:

**Table 5-8 DO Data Register – 0x31**

| Bit | Pin | Value |
|---|---|---|
| 3 | DO_4 | • Low: 0<br>• High: 1 |
| 2 | DO_3 | |
| 1 | DO_2 | |
| 0 | DO_1 | |

### 5.1.6.1. DIO Commands

The following table lists the available commands for the DIO interface supported by the DIO port.

**Table 5-9 Checking DI and DO Status**

| Command | Outcome | Description |
|---|---|---|
| `i2cget -y 1 0x4A 0x30` | Value of DI status | Get the status of all the digital inputs |
| `i2cget -y 1 0x4A 0x31` | Value of DO status | Get the status of all the digital outputs |

**Table 5-10 Examples of Configuring Digital Outputs (DO)**

| Command | Value | Description |
|---|---|---|
| `i2cset -y 1 0x4A 0x31 <value>` | `0xf` | Set DO1 ~ DO4 as High (1111) |
| | `0x0` | Set DO1 ~ DO4 as Low (0000) |

| Command | Value | Description |
|---|---|---|
| | `0x1` | Set DO1 as High<br>(0001: DO1 = 1) |
| | `0x2` | Set DO2 as High<br>(0010: DO2 = 1) |
| | `0x4` | Set DO3 as High<br>(0100: DO3 = 1) |
| | `0x8` | Set DO4 as High<br>(1000: DO4 = 1) |

### 5.1.6.2. ADC Commands

The following table lists the available commands for the ADC interface supported by the DIO port.

**Table 5-11 Checking the ADC Status**

| Command | Outcome | Description |
|---|---|---|
| `i2cget -y 1 0x4A 0x58` | Value of ADC data low byte | Get the low byte status of the analog input |
| `i2cget -y 1 0x4A 0x59` | Value of ADC data high byte | Get the high byte status of the analog input |

**Table 5-12 Enabling ADC**

| Command | Value | Description |
|---|---|---|
| `I2cset -y 1 0x4A 0x25` | `0x41` | Enable the ADC |

### 5.1.6.3. PWM Commands

The following table lists the available commands for the PWM interface supported by the DIO port.

**Table 5-13 Configuring PWM**

| Command | Value | Description |
|---|---|---|
| `i2cset -y 1 0x4A 0xE9` | `0x01` | Enable the associated pin to output a PWM signal according to the configured duty cycle |
| `i2cset -y 1 0x4A 0xEA` | `0x2C` | Set the duty cycle low byte to 300 |

| Command | Value | Description |
|---|---|---|
| `i2cset -y 1 0x4A 0xEB` | `0x01` | Set the duty cycle high byte to 300 |
| `i2Cset -y 1 0x4A 0x31` | `0x0F` | Open the DIO port to output the PWM signal. |

## 5.2. System Recovery

This section describes how to recover the system when needed.

### 5.2.1. Hardware and System Requirements

A host computer and some accessories are required to perform a system recovery. Before you begin, check the following list as the hardware and system requirements for the host computer and accessories.

**Host Computer**:

- Memory size: 4GB or above
- Storage space: 256GB or above
- Recommended OS: Ubuntu 20.04/22.04

**Accessories**:

- A USB Type-C cable
- An HDMI cable
- A monitor supporting HDMI inputs

### 5.2.2. Configuring a Host Computer

Follow the procedures below to configure the host computer.

1. Connect the host computer to the Internet.
2. Open the terminal window.
3. Enter the following commands to install the required dependencies.

```
$ sudo apt update
$ sudo apt install sshpass
$ sudo apt install abootimg
$ sudo apt install nfs-kernel-server
$ sudo apt install libxml2-utils
$ sudo apt install binutils
```

### 5.2.3. Downloading a BSP Image

You must install a board support package (BSP) image on the host computer before performing the system recovery. Follow the procedures below to download the BSP image.

1. Download the BSP image from SINTRONES® website or contact our sales representative for the BSP image.
2. Save the downloaded BSP image in the host computer.

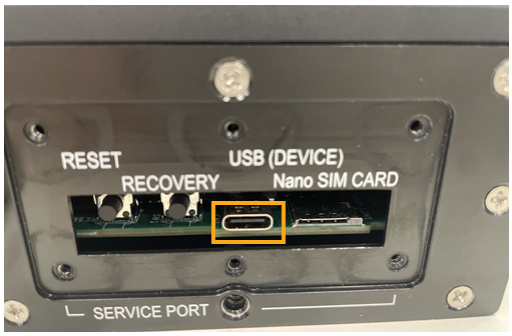
   **Note:**
   Do not extract the compressed `.tbz2` file.

### 5.2.4. Setting the System in Recovery Mode

Follow the procedures to set the system in recovery mode and connect it to the host computer.

1. Ensure the system is powered off.
2. Remove the 6 screws in the order indicated in the following figure to remove the protection cover from the rear panel.

3. Locate the **USB (DEVICE)** Type-C port.




4. Plug one end of a USB Type-C cable into the port, and then plug the other end of the cable to the host computer.
5. Connect the system to a monitor via an HDMI cable for later use (to configure the recovered system).
6. Locate the **RECOVERY** button.

7. Press and hold the **RECOVERY** button, at the same time, connect the system to a power source and enable ignition if any.

   **Note:**
   If the system is not connected with any ignition system, simply press the power button.

8. After powering on the system, hold the **RECOVERY** button for at least 10 seconds, and then release it.

### 5.2.5. Executing System Recovery

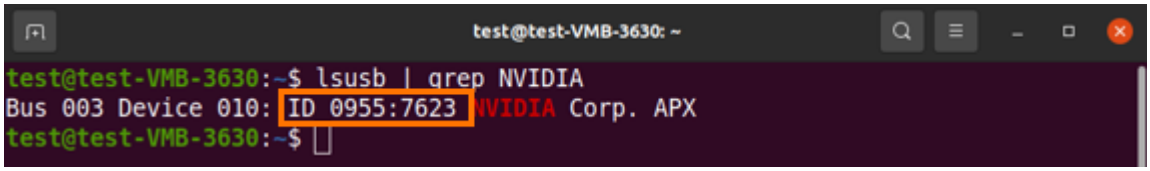
Follow the steps below ro run the recovery commands on the host computer and flash the BSP image to the system.

1. On the host computer, enter the following command in the terminal to check if the system is set in recovery mode.

   ```
   $ lsusb | grep NVIDIA
   ```

2. The following strings with the VID/PID info appear, indicating the system is in recovery mode. If these strings do not appear, repeat the steps in Setting the System in Recovery Mode *(on page 60)*.

Figure 5-1 An Example of Strings with the VID/PID Info




**Note:**
The VID/PID varies depending on different models.

**Important:**
Ensure the system is in recovery mode before you peform the flashing process.

3. Open the downloaded BSP image on the host computer.
4. Enter the following command to decompress the BSP image.

```
$ sudo tar -jxvf <ProjectName-KernelVersion-JetpackVersion-BuildSystem-BuildVersion-PackageVersion>.tbz2
```

**Note:**
Replace the texts within the brackets with the actual BSP file name. For example, if the BSP image file name is `IBOX-650-5.15.148-6.2-ubuntu22.04-R3.00-04`, enter

```
$ sudo tar -jxvf IBOX-650-5.15.148-6.2-ubuntu22.04-R3.00-04.tbz2
```

**Tip:**
After entering the first few characters of a command or file name, you can enter the **[tab]** key to autocomplete the command or filename.

5. After the BSP image is decompressed, the folder `Linux_for_Tegra` will be automatically generated. Enter the following command to navigate to the folder.
```
$ cd Linux_for_Tegra
```
6. You can choose to flash the BSP image to the 64GB eMMC flash memory on the Jetson AGX Orin module, or to the NVMe SSD card on the mainboard.
   a. **To flash the BSP image to the eMMC**, enter the following command:
      - `$ sudo ./ibox650_ao_emmc_flash.sh`
   b. **To flash the BSP image to the NVMe SSD**, enter one of the following version-specific commands:
      - **JetPack 5.1.3**: `$ sudo ./tools/kernel_flash/l4t_initrd_flash.sh --external-device nvme0n1p1 \ -c tools/kernel_flash/flash_l4t_external.xml --erase-all -p "-c bootloader/t186ref/cfg/flash_t234_qspi.xml" \ --showlogs --network usb0 jetson-agx-orin-devkit internal`
      - **JetPack 6.2**: `$ sudo ./ibox650_ao_nvme_flash.sh`

**Important:**
To avoid unintended line breaks that may cause the command to fail, **copy the command into a plain text file to ensure it remains a single, continuous line** before pasting it into the terminal.

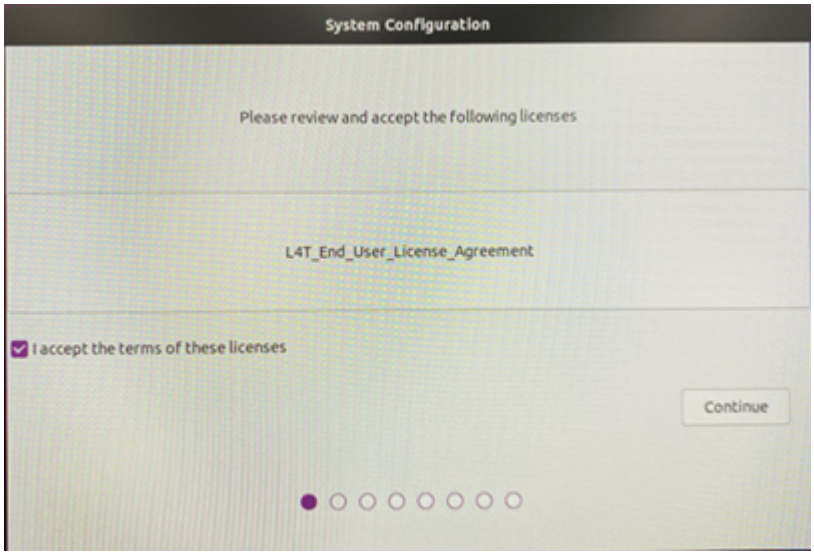
7. When the BSP image is successfully flashed to the system, the system will reboot and the configuration window will then appear on the connected monitor screen.
8. After the flashing process is completed, unplug the USB Type-C cable and fasten the protection cover back onto the rear panel.

**Important:**
To ensure IP66 protection, ensure you tighten the screws in the order indicated in the figure in Step 2 of Setting the System in Recovery Mode *(on page 60)*, with a tightening torque of 4 kgf-cm.

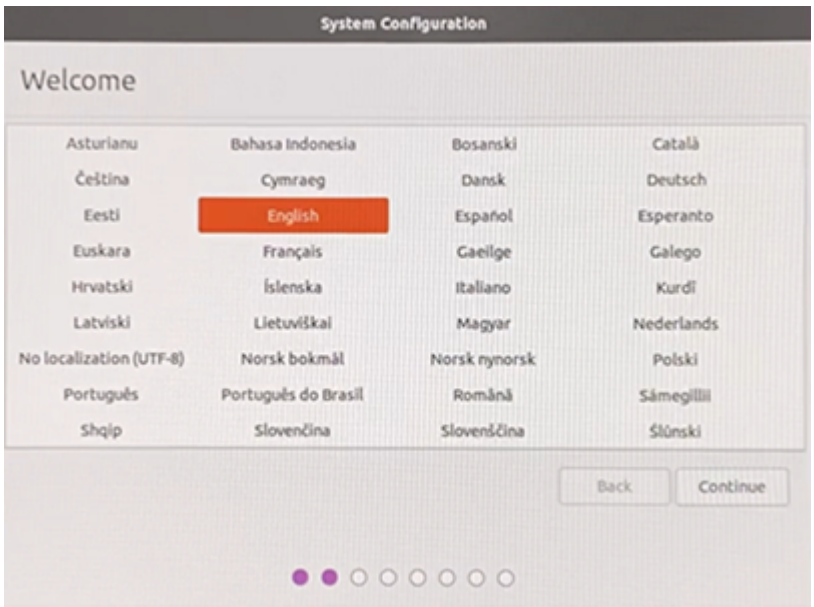
### 5.2.6. Configuring the Recovered System

After the system is recovered, initial settings must be configured prior to using the system. Follow the procedures below to start the configuration.

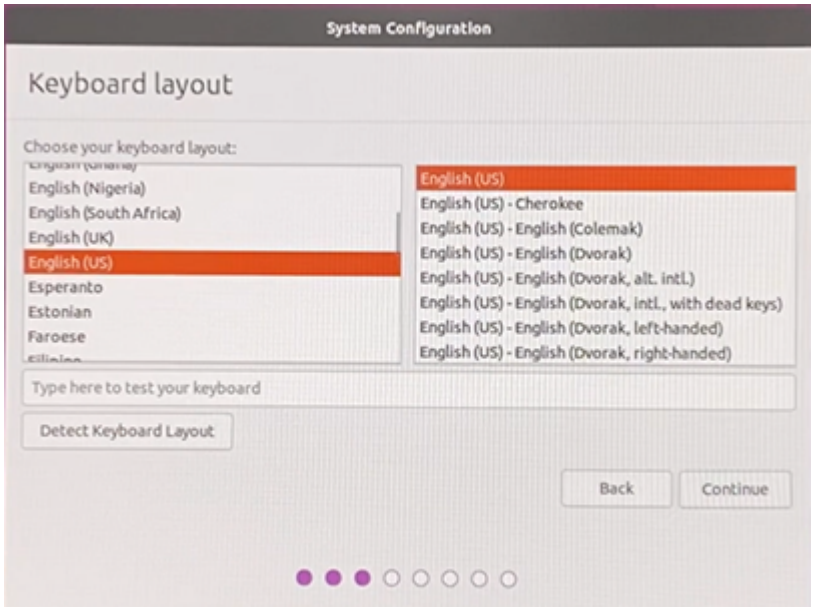
1. After the system reboot, the **System Configuration** wizard appears to guide users to complete the initial basic settings for the Linux for Tegra (LT4) platform.
2. Select **I accept the terms of these licenses** and then select **Continue**.



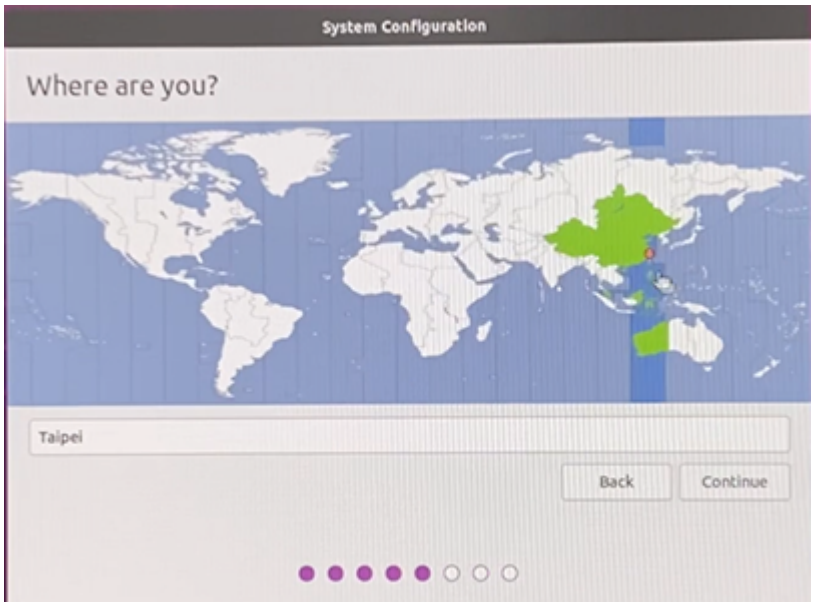

3. Select the preferred language setting and then select **Continue**.



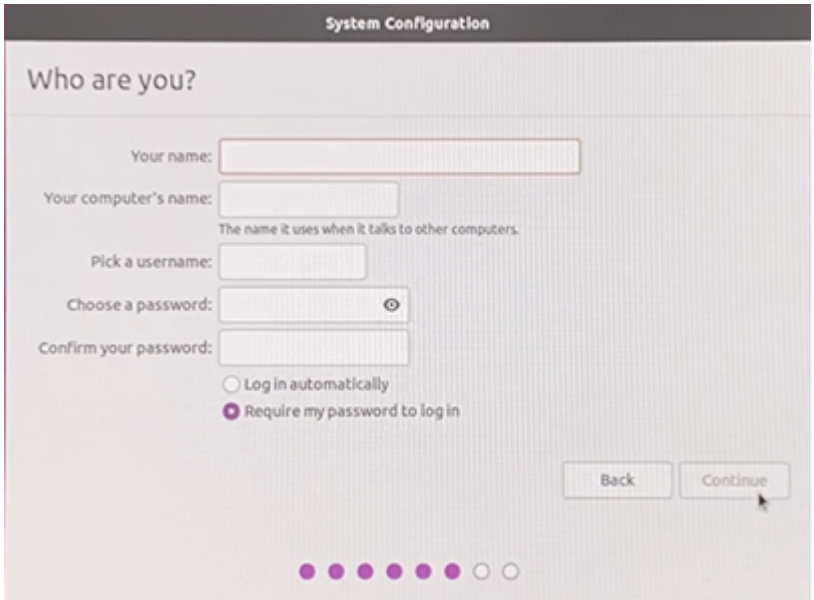
4. Select the preferred keyboard layout and then select **Continue**.



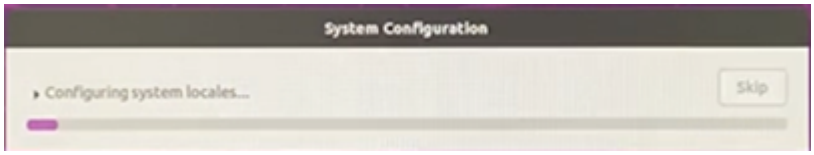

5. Select your location and then select **Continue**.

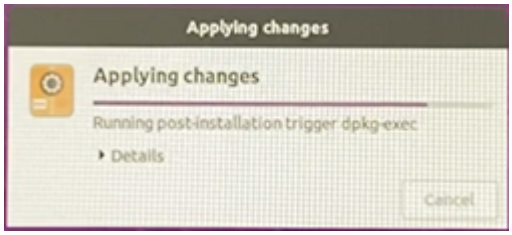



6. Specify the credentials such as a username and a password to create a user account. It is suggested to select **Require my password to log in** for security reasons. Select **Continue** to proceed to next step.




7. Choose **Install Chromium Browser** or **Do not install...** based on your needs, and then select **Continue**.
8. The system starts running the specified configuration and will reboot to complete the system configuration.




9. The **NVIDIA** logo appears and then the restored system will enter the welcome screen, ready to use now.

# 6. Appendix

**Table 6-1 Decimal to Hexadecimal**

| Time | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | None | 0x01 | 0x02 | 0x03 | 0x04 | 0x05 | 0x06 | 0x07 | 0x08 | 0x09 |
| **10** | 0x0a | 0x0b | 0x0c | 0x0d | 0x0e | 0x0f | 0x10 | 0x11 | 0x12 | 0x13 |
| **20** | 0x14 | 0x15 | 0x16 | 0x17 | 0x18 | 0x19 | 0x1a | 0x1b | 0x1c | 0x1d |
| **30** | 0x1e | 0x1f | 0x20 | 0x21 | 0x22 | 0x23 | 0x24 | 0x25 | 0x26 | 0x27 |
| **40** | 0x28 | 0x29 | 0x2a | 0x2b | 0x2c | 0x2d | 0x2e | 0x2f | 0x30 | 0x31 |
| **50** | 0x32 | 0x33 | 0x34 | 0x35 | 0x36 | 0x37 | 0x38 | 0x39 | 0x3a | 0x3b |