Edge AI Applied Computing

SINTRONES

IBOX-650P-IP66-2S

IBOX-650P-IP66-DIO

User Manual

Version 1.0

SINTRONES

Revision History

Version	Date	Description of Changes
1.0	2026-01-16	Initial release.

Copyright

Disclaimer

SINTRONES® Technology Corp. shall not be liable for any incidental or consequential damages resulting from the performance or use of this product.

SINTRONES® Technology Corp. makes no representation or warranty regarding the content of this manual. Information in this manual has been carefully checked for accuracy; however, no guarantee is given to the correctness of the contents. For continuing product improvement, SINTRONES® Technology Corp. reserves the right to revise the manual or make changes to the specifications of this product at any time without notice and obligation to any person or entity regarding such change. The information contained in this manual is provided for general use by customers.

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.

Trademarks

SINTRONES® is a registered trademark of SINTRONES® Technology Corp.

The terms HDMI, HDMI High-Definition Multimedia Interface, HDMI Trade dress and the HDMI Logos are trademarks or registered trademarks of HDMI Licensing Administrator, Inc.

All the trademarks, registrations, and brands mentioned herein are used for identification purposes only and may be trademarks and registered trademarks of their respective owners.

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

Contents

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:

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 (2MP, Sony IMX390)	4
	oToCAM260ISP Series (5.36MP, Sony IMX490)	4
	oToCAM223 Series (2.95MP, Sony ISX031	4
e-con Systems	STURDeCAM25 (2MP, Omsemi AR0234CS)	4
	STURDeCAM31 (3MP, Sony ISX031)	4
	STURDeCAM81 (8MP, Omsemi AR0821)	4
StereoLabs	ZED X Stereo (Dual 2MP)	2
	ZED X One 4K (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.

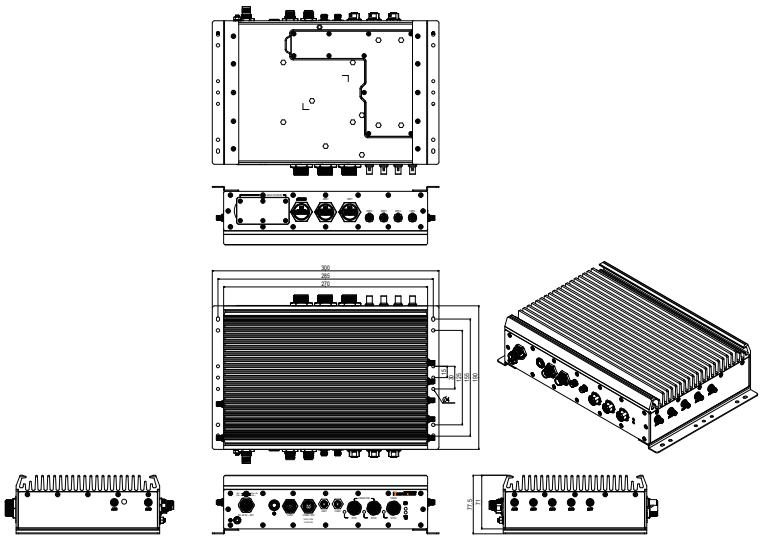
1.2. Product Photos

Figure 1-1 Front View of the System

Figure 1-2 Rear View of the System

1.3. Mechanical Drawings

Unit : mm

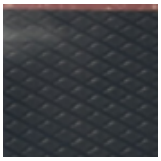
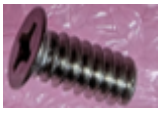


1.4. Package Contents

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) **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:

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).

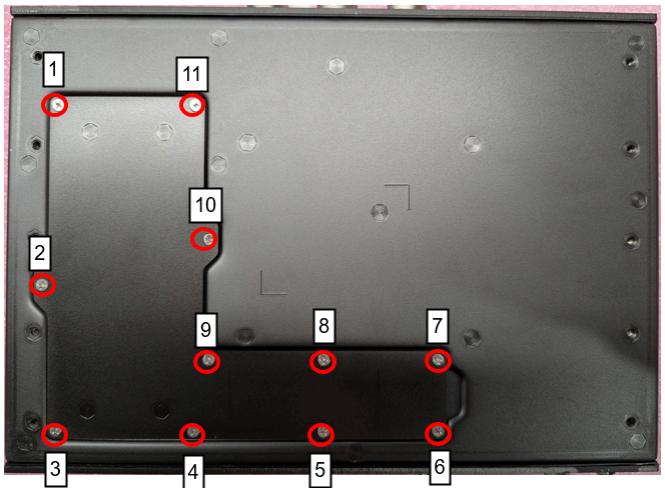
See the following steps to start the installation:

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)*).

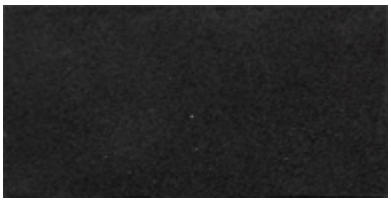
2.2.2. Installing a Backup Battery (BBU)

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

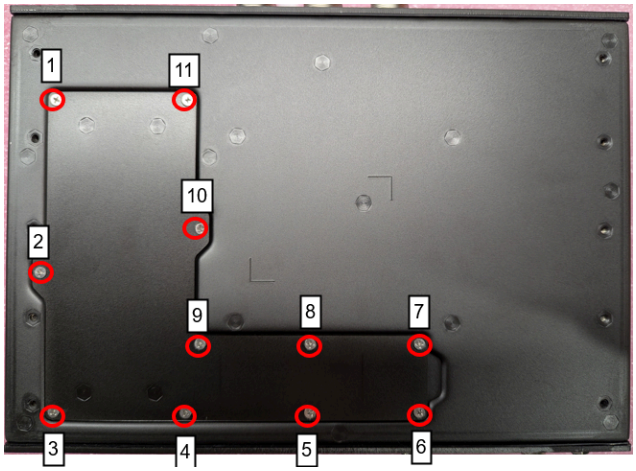
    - 4 x P3*6L screw

    - 1 x sponge

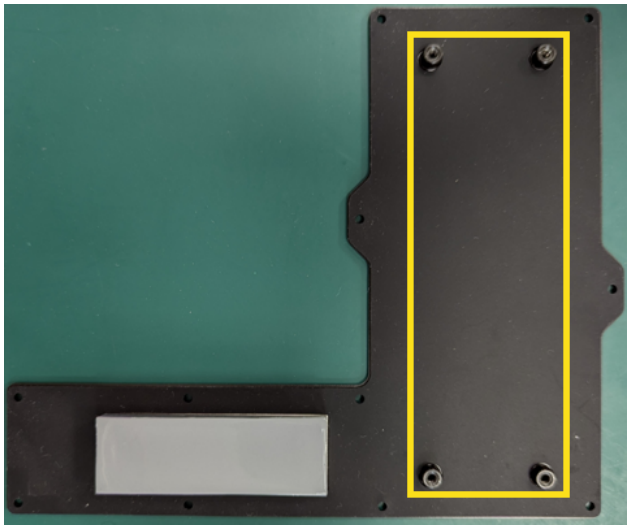


2. On both sides of the battery, peel off the release liners of the double-sided tapes.
3. Turn over the battery and adhere it to the battery cover with the information label face up.

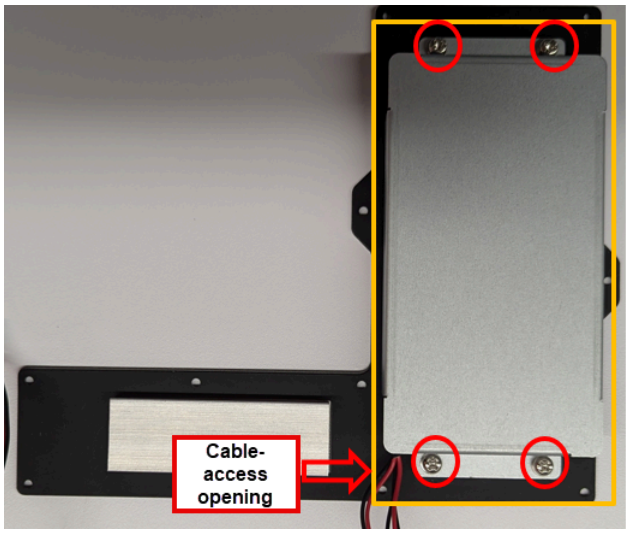
4. Remove the screws from the bottom L-shaped cover in the order indicated in the following figure.



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

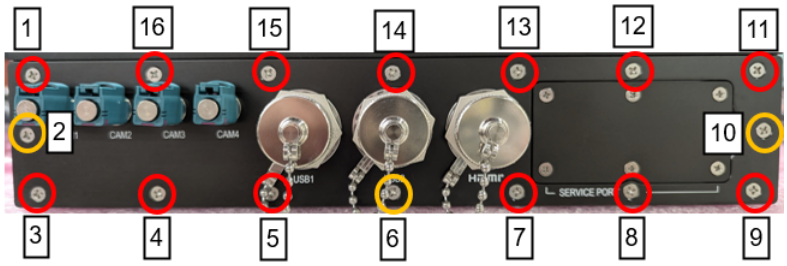
The M.2 3042/3052, M.2 2230, and mPCIe expansion slots are located on the top side of the mainboard. You need to remove the top cover prior to installing these expansion modules.

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.

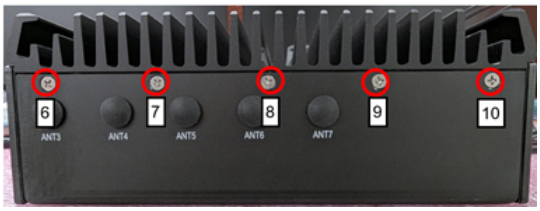
Note:
It is recommended to use a specialized removal tool designed for this purpose to avoid damage to nearby components or to the rings and gaskets themselves.

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

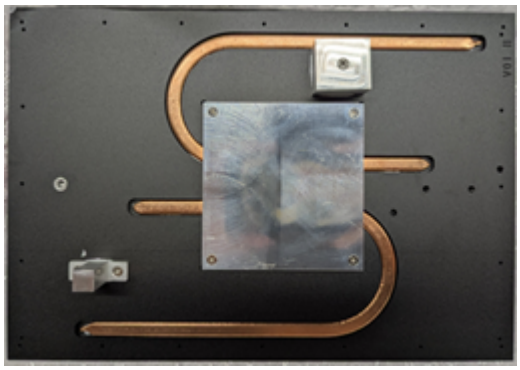


4. Remove the screws from the front panel in the order indicated in the following figure.

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.



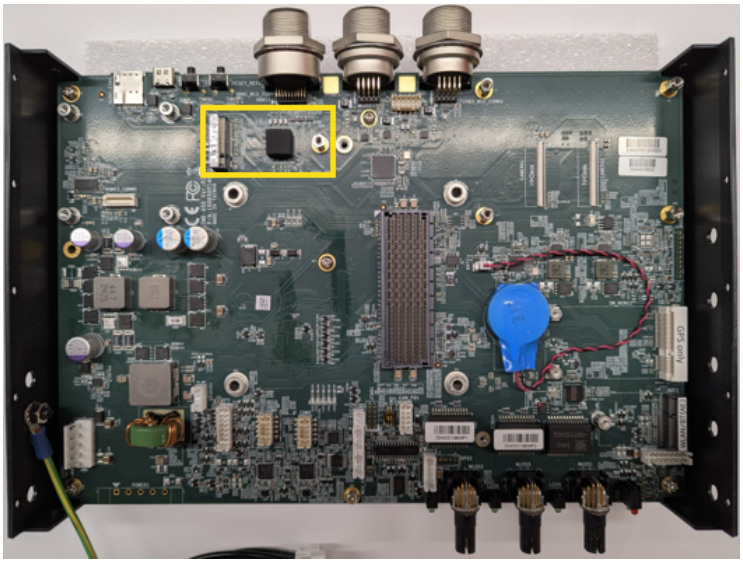
Important:

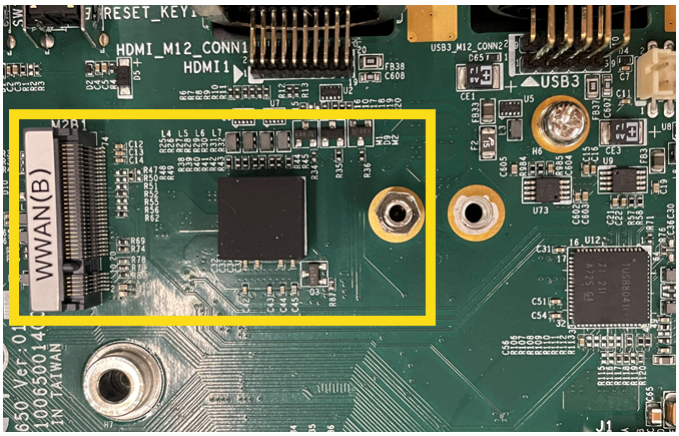
- Reassemble the system by following the steps above in reverse order.
- To ensure IP66 protection, fasten the screws in the order indicated in the figures above, with a tightening torque of 4 kgf-cm.

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.



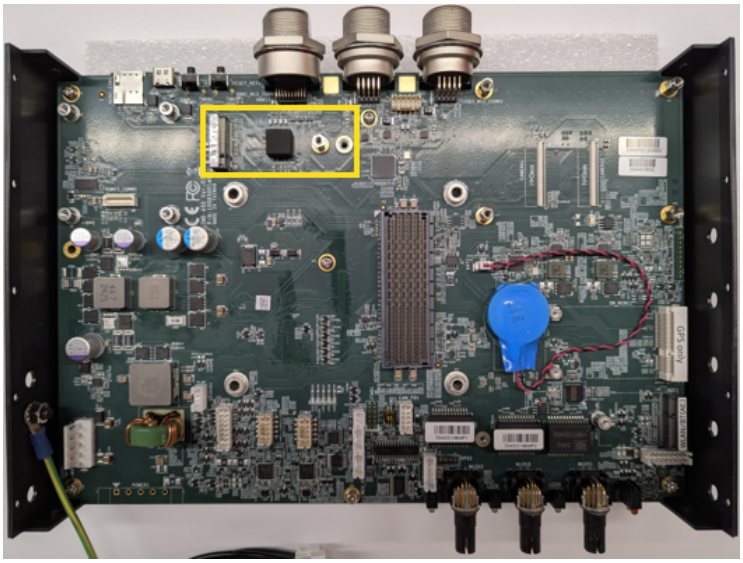


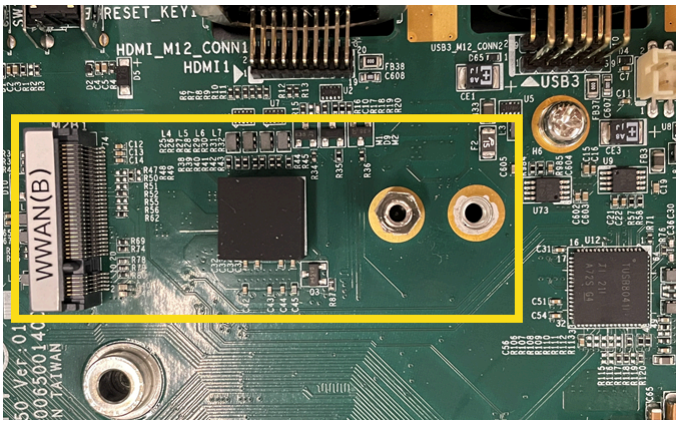
   b. Align the notch on the M.2 3042 WWAN card with the tab in the slot and gently insert the WWAN card at a 30 degree angle until it is fully embedded, and then press it down.

   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)**:

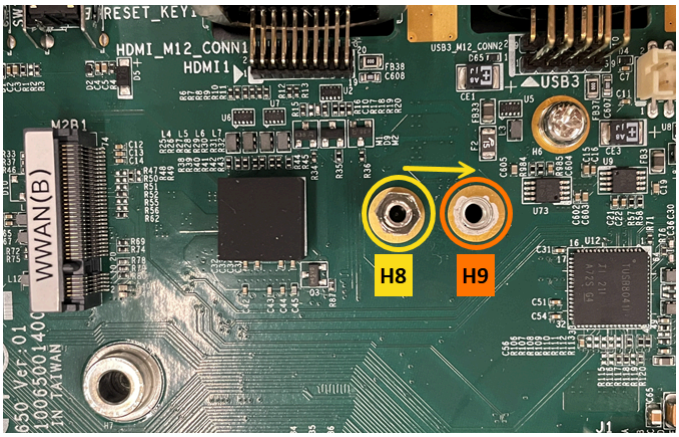
a. Locate the M.2 3052 Key B slot on the mainboard.





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

Figure 2-1 Standoff Screw (H73D50)

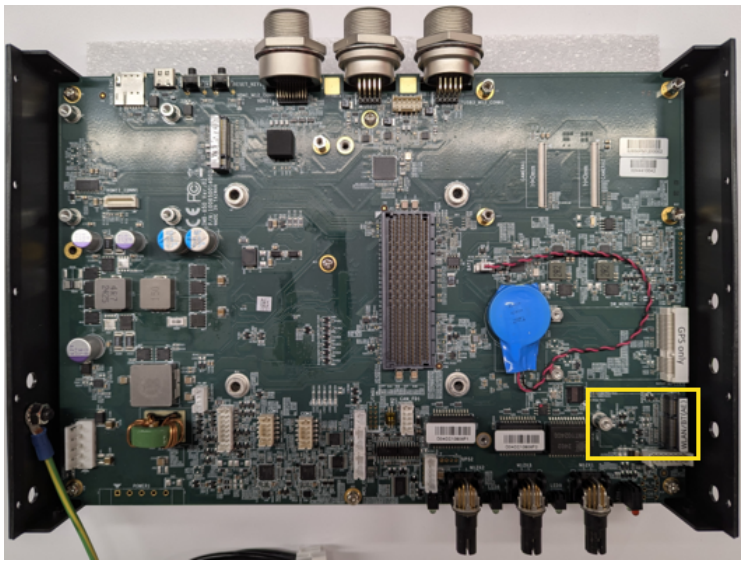


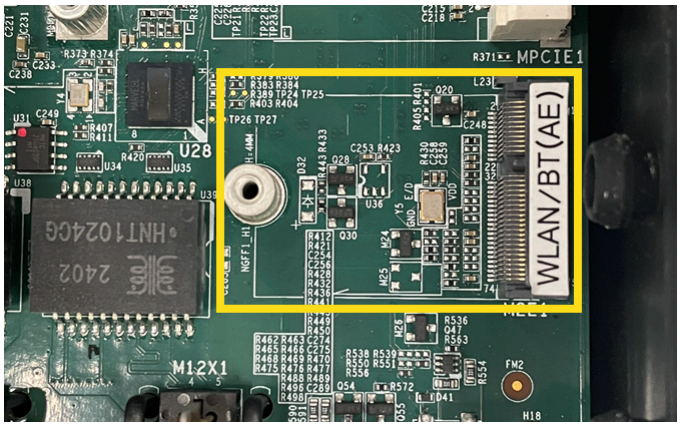
c. Align the notch on the M.2 3052 WWAN card with the tab in the slot and gently insert the WWAN card at a 30 degree angle until it is fully embedded, and then press it down.

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.





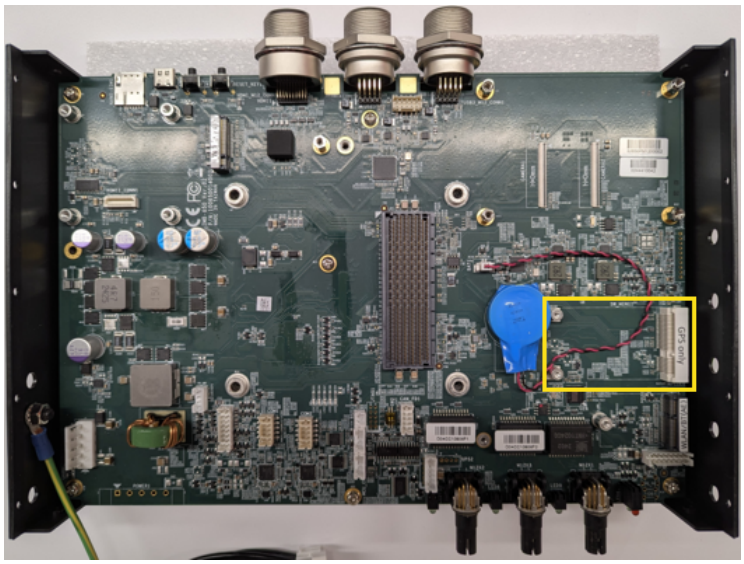
2. Align the notch on the expansion module with the tab in the slot and gently insert the module at a 30 degree angle until it is fully embedded, and then press it down.

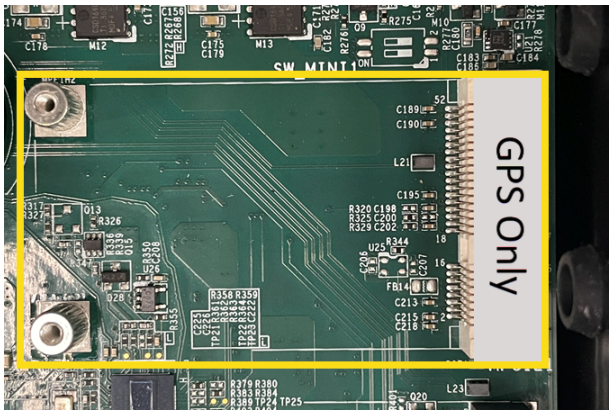
Note:
Ensure you align the semicircular mounting hole at the center of the opposite edge on the module with the copper pillar bump when pressing the module down.

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.





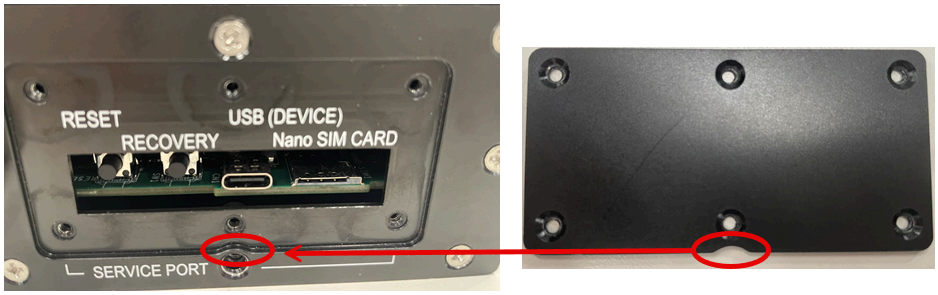
2. Align the notch on the mPCIe card with the tab in the slot and gently insert the card at a 30 degree angle until it is fully embedded, and then press it down.
3. Secure the mPCIe card to the mainboard with the M2x4L screw(s) included in the package (see Package Contents *(on page 12)*).

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.

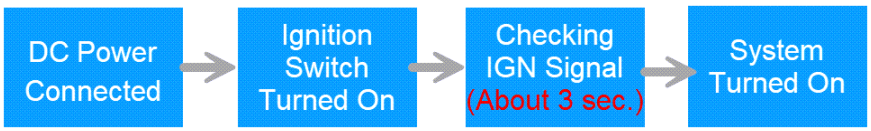
2.3.1. Turning On System By Ignition Switch

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.

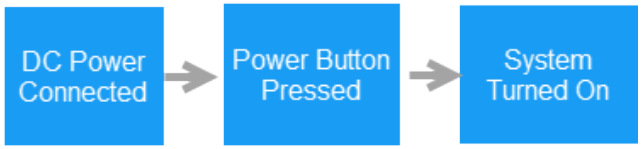
   Figure 2-2 Turning On System By Ignition Switch



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:

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

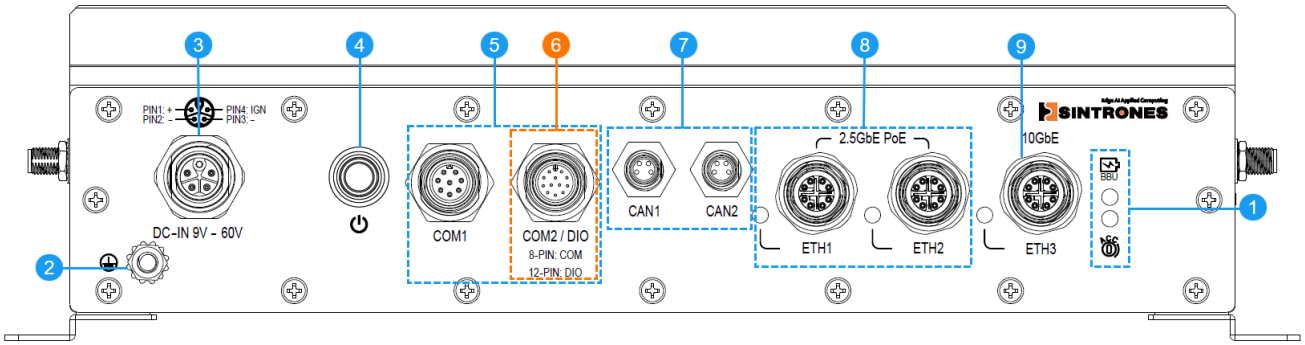


Table 3-1 I/O Interface on Front Panel

Item	I/O Interface	Description	Specification
1	LED Indicators	(BBU): • ON: Internal backup battery enabled • OFF: Power supplied from external power source or no backup battery installed	-
		ACC: • ON: Ignition enabled • OFF: Ignition disabled	-
2	Grounding Terminal	M5 bolt with nut for chassis grounding	-
3	DC Input	• Input voltage range: DC 9–60V • M12 K-coded connector	DC-IN Port (M12 K-coded Connector) *(on page 33)*
4	Power Button	System power status: • Red light: Standby mode • Blue light: System turned on	Power Button (LED Light Status) *(on page 33)*
5	COM Port	• Supports RS-232/422/485 interfaces • Programmable via software configuration • 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. • IBOX-650P-IP66-2S: ◦ COM port: RS-232/422/485 serial port ◦ M12 A-coded 8-pin connector • IBOX-650P-IP66-DIO: ◦ DIO: 4 x DI , 4 x DO (DC 12V/100mA) ◦ 1 x Analog Input (DC 0-60V) ◦ 1 x PWM Output (DC 12V) ◦ M12 A-coded 12-pin connector	• COM Port (M12 A-coded Connector) *(on page 34)* • DIO Port (M12 A-coded Connector) *(on page 35)*
7	CAN FD Ports	• Supports CAN FD protocol • Backward compatible with CAN bus 2.0 • M8 A-coded connector	CAN FD Port (M8 A-coded Connector) *(on page 35)*
8	LAN Ports with PoE	ETH1/ETH2 PoE: • 2.5GbE with IEEE 802.3at PoE PSE Class 4 (PoE+ 30 watts per port) • M12 X-coded connectors	LAN Port (M12 X-coded Connector) *(on page 36)*
9	LAN Port	ETH X: • 10GbE • 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

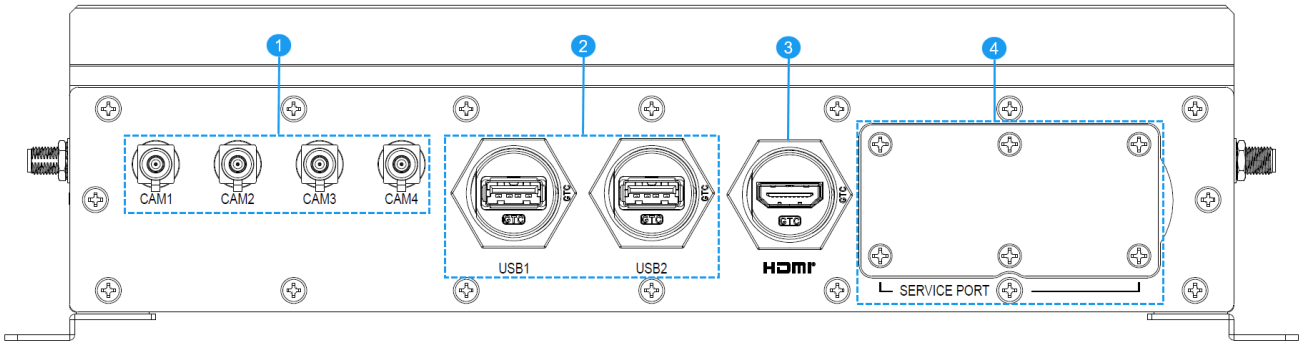


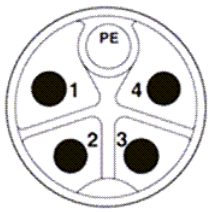
Table 3-2 I/O Interface on Rear Panel

Item	I/O Interface	Description	Specification
1	Camera Ports	FAKRA-Z connectors for GMSL-2 cameras	-
2	USB Ports	• USB 3.2, 5V/900mA • IP67/Type-A connectors	USB 3.2 Type-A Port *(on page 37)*
3	HDMI® Port	• Supports HDMI 2.1 output • 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 **Note:** • The recovery button works only when the USB (Device) port is connected to a host computer. • The USB (Device) port is used only for system recovery. It does not support power or other kinds of data transfer. • 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)

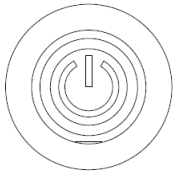
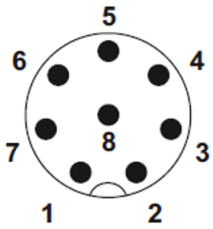


Table 3-4 Pin Definition of Power Button (LED Light Status)

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)

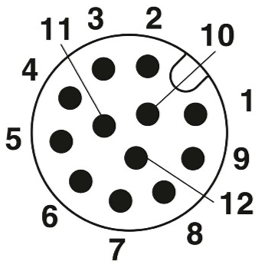
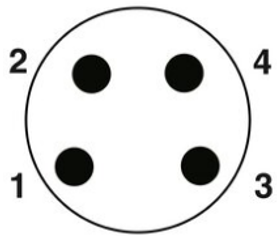


Table 3-6 Pin Definition of DIO/ADC/PWM

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)

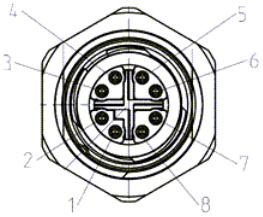


- Manufacturer: Hougun
- Type: M8 4-pin
- Part number: HG24-M080001

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

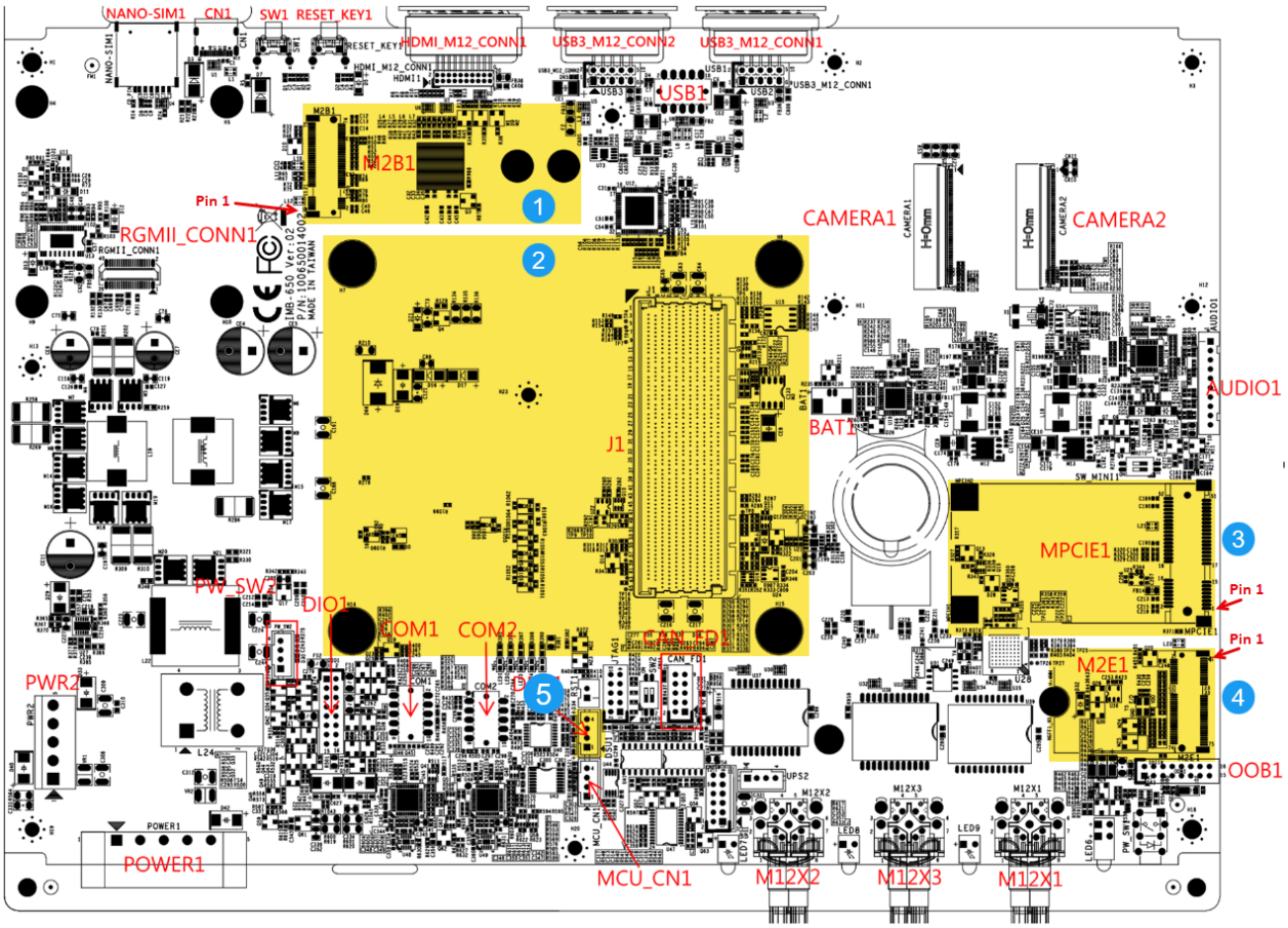
Pin	Signal	Pin	Signal
A1	GND	B12	GND
A2	NC	B11	NC
A3	NC	B10	NC
A4	NC	B9	NC
A5	NC	B8	NC
A6	Dp1	B7	Dn2
A7	Dn1	B6	Dp2
A8	NC	B5	NC
A9	NC	B4	NC
A10	NC	B3	NC
A11	NC	B2	NC
A12	GND	B1	GND

4. Expansion

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

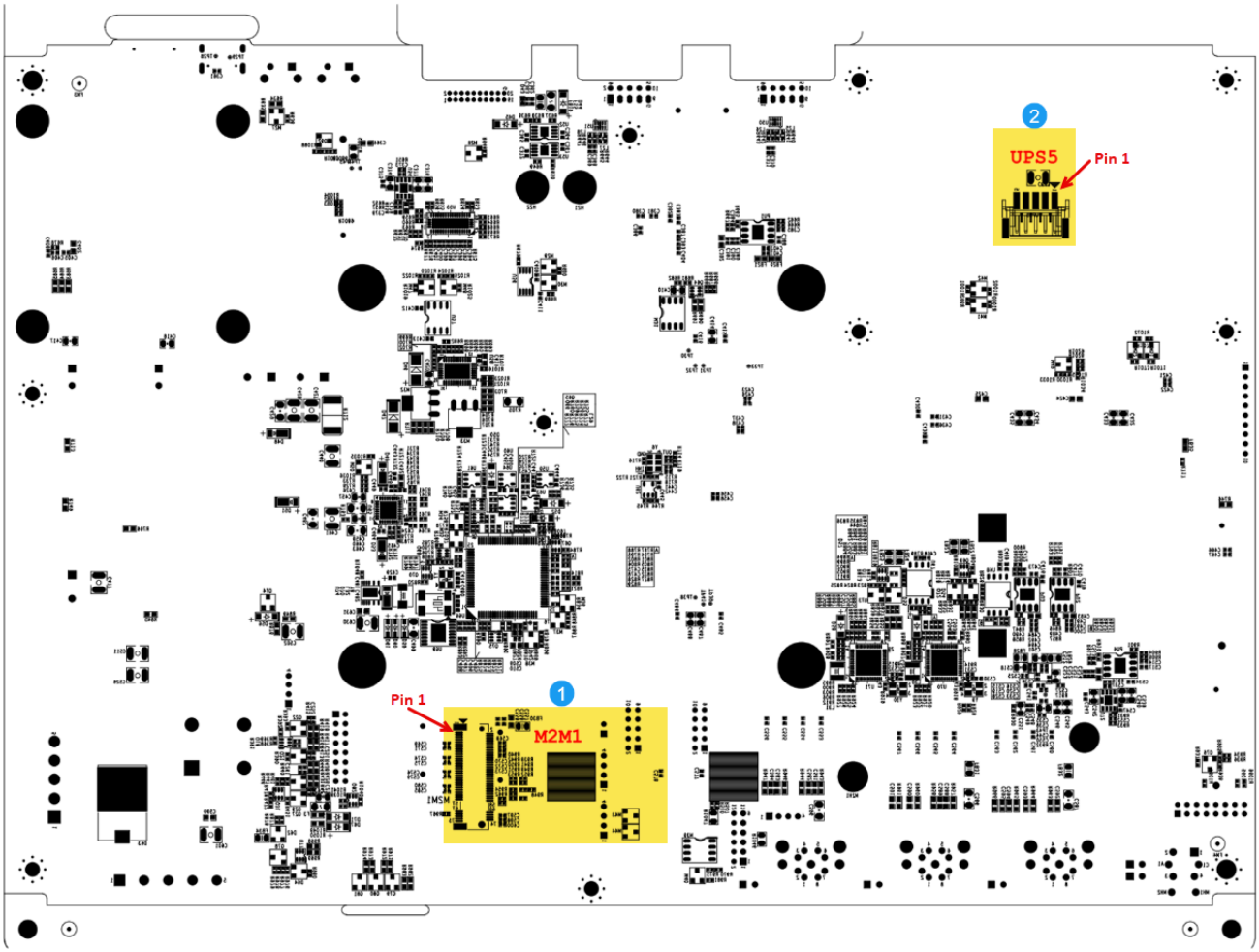
Topics in this chapter include:

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 **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.	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

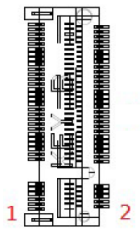
M.2 Key B Slot	Description
Size	NGFF 3042 / 3052 / 75 Pin
Type	M.2 Key B H:8.5mm
Location	See Top View of Mainboard *(on page 40)* for the information.
Drawing	

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.

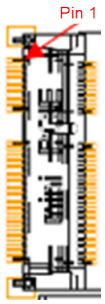
mPCIe Connector	Description
Drawing	

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

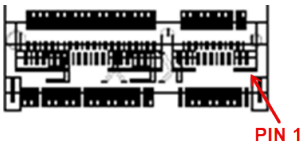
M.2 Key E Slot	Description
Size	NGFF 2230 / 75 Pin
Type	M.2 Key E H:8.5mm
Location	See Top View of Mainboard *(on page 40)* for the information.
Drawing	

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

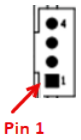
DSU JST Connector	Description
Size	1 x 4 / 4 Pin
Type	JST-2.0mm-M-180
Location	See Top View of Mainboard *(on page 40)* for the information.
Drawing	

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:

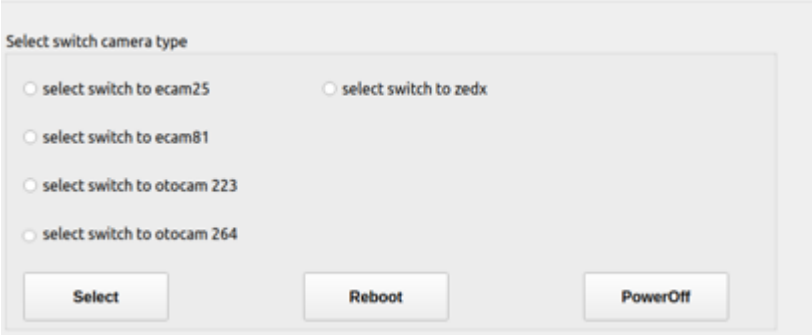
5.1. System Configuration

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. Initializing the GMSL Cameras

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

1. Ensure the system is powered off.
2. Connect the GMSL cameras to the camara ports via the FAKRA-Z cables.
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 • `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. **Important:** 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 • 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 • 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 (0001: DO1 = 1)
	`0x2`	Set DO2 as High (0010: DO2 = 1)
	`0x4`	Set DO3 as High (0100: DO3 = 1)
	`0x8`	Set DO4 as High (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.

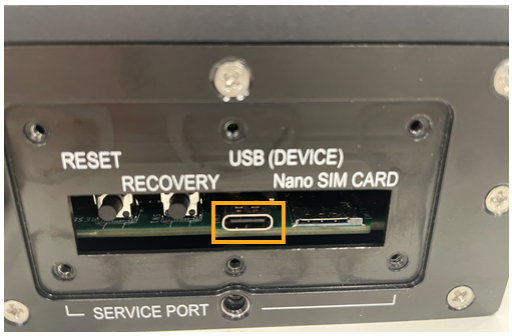
Note:
Do not extract the compressed `.tbz2` file.

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

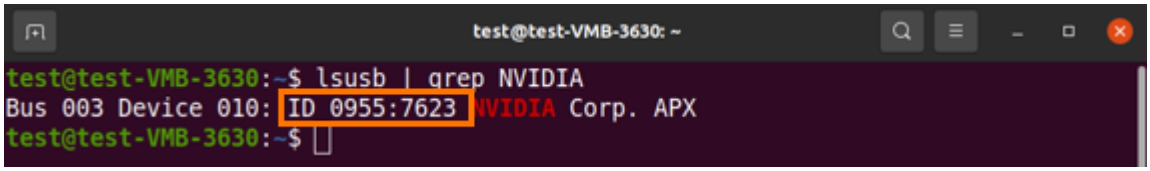
Follow the steps below ro run the recovery commands on the host computer and flash the BSP image to the system.

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.

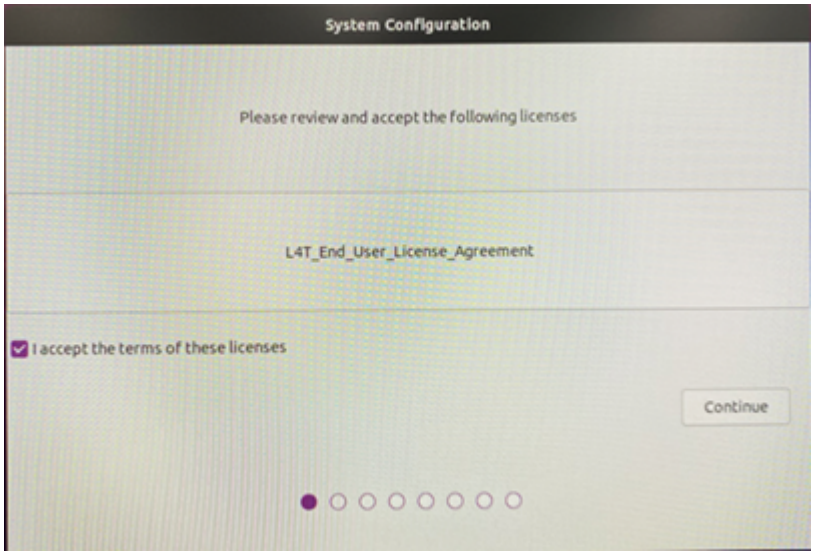
7. When the BSP image is successfully flashed to the system, the system will reboot and the configuration window will then appear on the connected monitor screen.
8. After the flashing process is completed, unplug the USB Type-C cable and fasten the protection cover back onto the rear panel.

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.

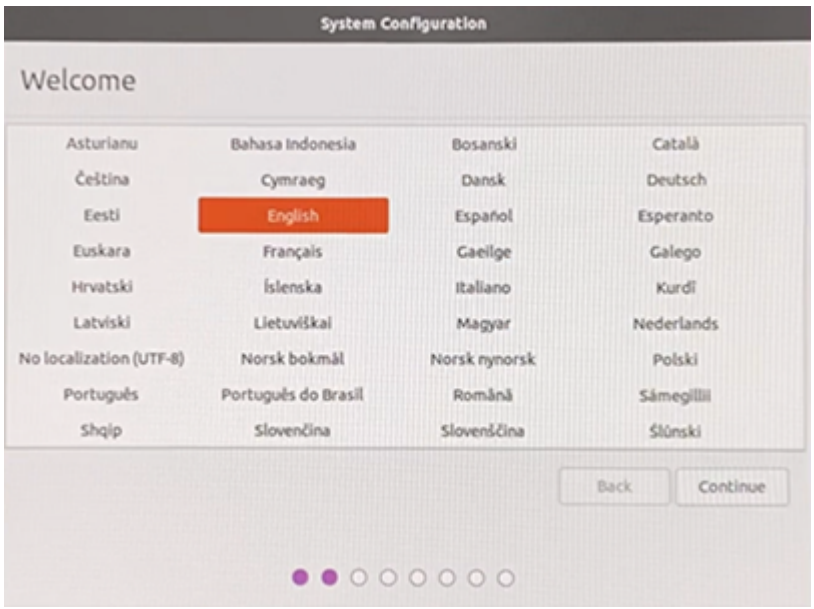
5.2.6. Configuring the Recovered System

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

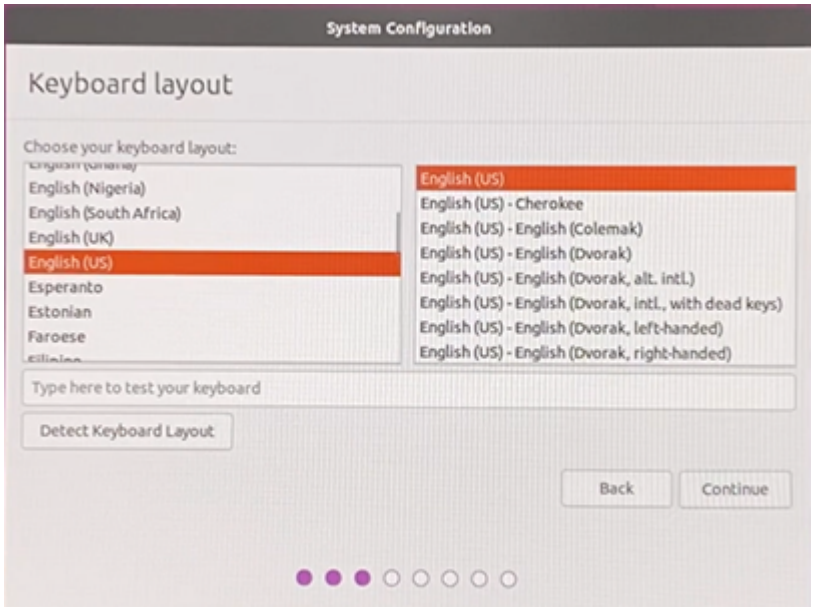
1. After the system reboot, the **System Configuration** wizard appears to guide users to complete the initial basic settings for the Linux for Tegra (LT4) platform.
2. Select **I accept the terms of these licenses** and then select **Continue**.



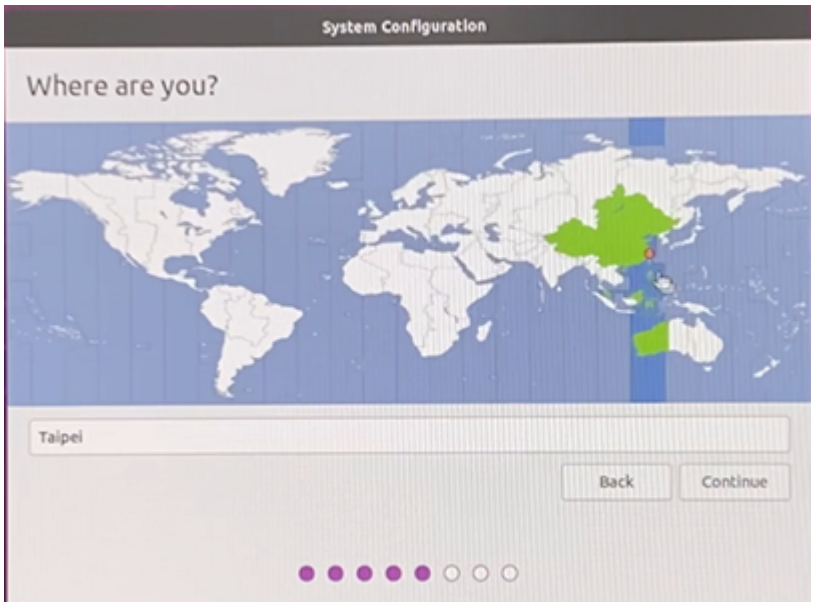
3. Select the preferred language setting and then select **Continue**.



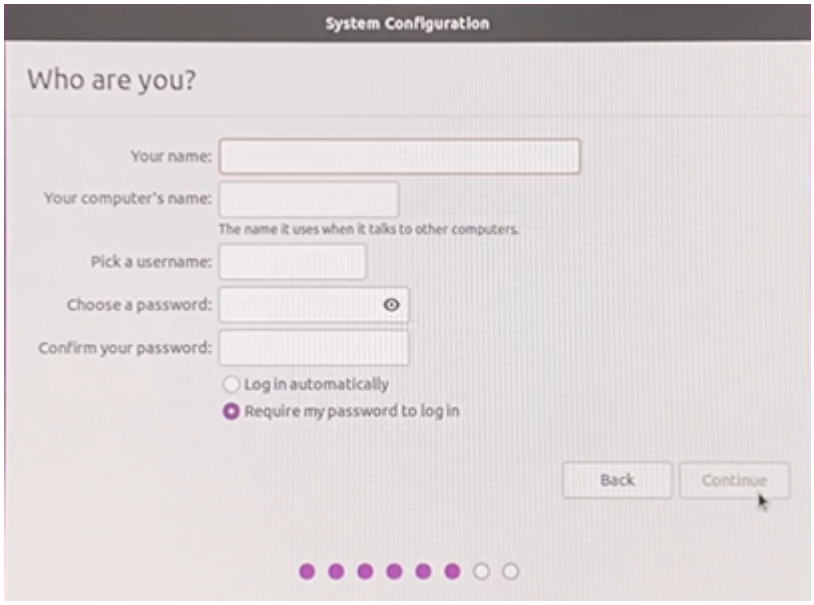
4. Select the preferred keyboard layout and then select **Continue**.



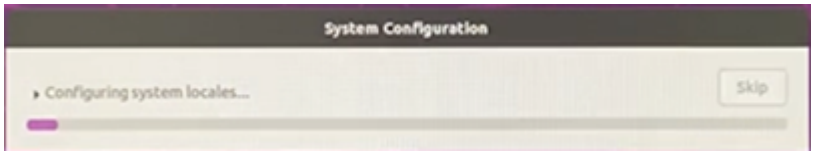
5. Select your location and then select **Continue**.

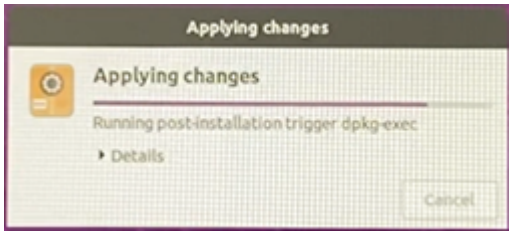


6. Specify the credentials such as a username and a password to create a user account. It is suggested to select **Require my password to log in** for security reasons. Select **Continue** to proceed to next step.



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