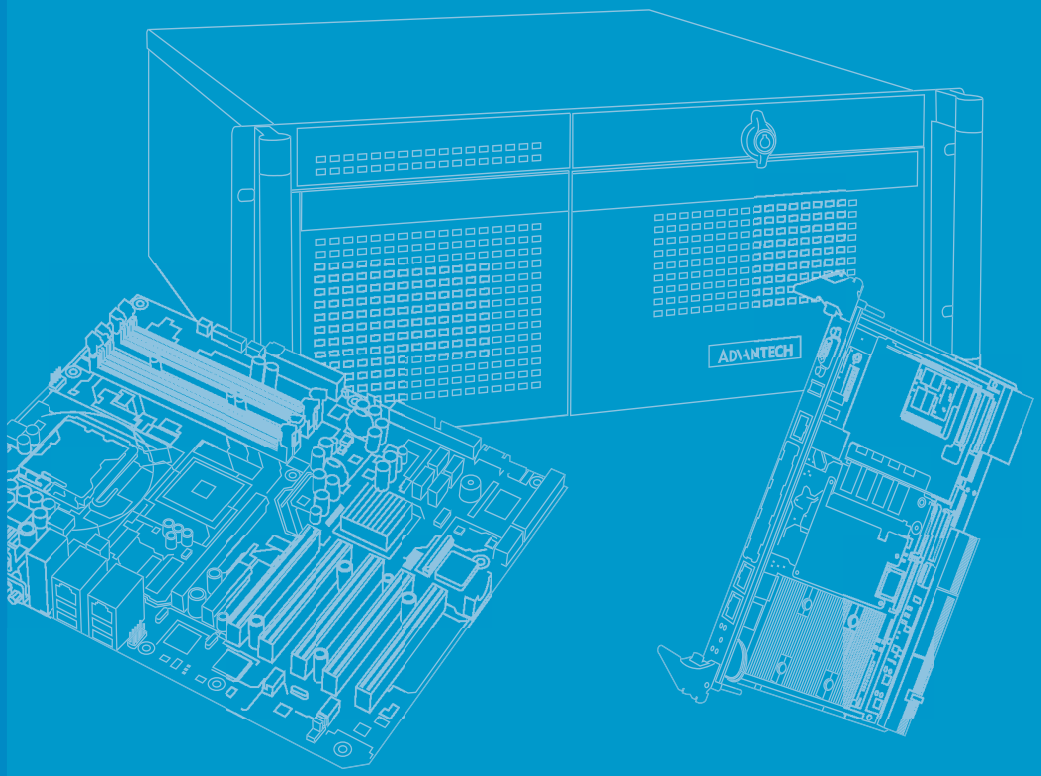
User Manual



ITA-560AGX Series

Industrial AI Railway Computer

ADVANTECH

Enabling an Intelligent Planet

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A Message to the Customer

Advantech Customer Service

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Your satisfaction is our primary concern. Here is a guide to Advantech's customer services. To ensure you get the full benefit of our services, please follow the instructions below carefully.

Technical Support

We want you to get the maximum performance from your products. So if you run into technical difficulties, we are here to help. For the most frequently asked questions, you can easily find answers in your product documentation. These answers are normally a lot more detailed than the ones we can give over the phone.

So please consult this manual first. If you still cannot find the answer, gather all the information or questions that apply to your problem, and with the product close at hand, call your dealer. Our dealers are well trained and ready to give you the support you need to get the most from your Advantech products. In fact, most problems reported are minor and are able to be easily solved over the phone.

In addition, free technical support is available from Advantech engineers every business day. We are always ready to give advice on application requirements or specific information on the installation and operation of any of our products.

Part No. 2001560A00 Edition 1

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Product Warranty (2 years)

Advantech warrants the original purchaser that each of its products will be free from defects in materials and workmanship for two years from the date of purchase.

This warranty does not apply to any products that have been repaired or altered by persons other than repair personnel authorized by Advantech, or products that have been subject to misuse, abuse, accident, or improper installation. Advantech assumes no liability under the terms of this warranty as a consequence of such events.

Because of Advantech's high quality-control standards and rigorous testing, most customers never need to use our repair service. If an Advantech product is defective, it will be repaired or replaced free of charge during the warranty period. For out-of-warranty repairs, customers will be billed according to the cost of replacement materials, service time, and freight. Please consult your dealer for more details.

If you believe your product is defective, follow the steps outlined below.

1. Collect all the information about the problem encountered. (For example, CPU speed, Advantech products used, other hardware and software used, etc.) Note anything abnormal and list any onscreen messages displayed when the problem occurs.
2. Call your dealer and describe the problem. Please have your manual, product, and any helpful information readily available.
3. If your product is diagnosed as defective, obtain a return merchandise authorization (RMA) number from your dealer. This allows us to process your return more quickly.
4. Carefully pack the defective product, a completed Repair and Replacement Order Card, and a proof of purchase date (such as a photocopy of your sales receipt) into a shippable container. Products returned without a proof of purchase date are not eligible for warranty service.
5. Write the RMA number clearly on the outside of the package and ship the package prepaid to your dealer.

Packing List

Before system installation, check that the items listed below are included and in good condition. If any item does not accord with the list, contact your dealer immediately.

- 1 x ITA-560AGX Series Industrial Computer
- 1 x ITA-560AGX Accessory Box
- 1 x Warranty Card

RoHS Claim

Equipment Name	Type Designation (Type)					
Unit	Restricted substances and its chemical symbols					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent chromium (Cr^{+6})	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Circuit Board	-	○	○	○	○	○
Enclosure	-	○	○	○	○	○
Cable	-	○	○	○	○	○
Screw	-	○	○	○	○	○
Accessories (connector, bracket)	-	○	○	○	○	○

Note 1: “Exceeding 0.1 wt %” and “exceeding 0.01 wt %” indicate that the percentage content of the restricted substance exceeds the reference percentage value of presence condition.

Note 2: “○” indicates that the percentage content of the restricted substance does not exceed the percentage of reference value of presence.

Note 3: The “-” indicates that the restricted substance corresponds to the exemption.

Safety Instructions

1. Read these safety instructions carefully.
2. Retain this user manual for future reference.
3. Disconnect the equipment from all power outlets before cleaning. Use only a damp cloth for cleaning. Do not use liquid or spray detergents.
4. For pluggable equipment, the power outlet socket must be located near the equipment and easily accessible.
5. Protect the equipment from humidity.
6. Place the equipment on a reliable surface during installation. Dropping or letting the equipment fall may cause damage.
7. Ensure that the voltage of the power source is correct before connecting the equipment to a power outlet.
8. Position the power cord away from high-traffic areas. Do not place anything over the power cord.
9. All cautions and warnings on the equipment should be noted.
10. If the equipment is not used for a long time, disconnect it from the power source to avoid damage from transient overvoltage.
11. Never pour liquid into an opening. This may cause fire or electrical shock.
12. Never open the equipment. For safety reasons, the equipment should be opened only by qualified service personnel.
    If any of the following occurs, have the equipment checked by service personnel:
    - The power cord or plug is damaged.
    - Liquid has penetrated the equipment.
    - The equipment has been exposed to moisture.
    - The equipment is malfunctioning, or does not operate according to the user manual.
    - The equipment has been dropped and damaged.
    - The equipment shows obvious signs of breakage.
13. Do not leave the equipment in an environment with a storage temperature of below -25 °C (-13 °F) or above 55 °C (131 °F) as this may damage the components. The equipment should be kept in a controlled environment.
14. This is a Class A product, which may cause radio interference in a residential environment. In such a case, the user may need to take practical measures to address the interference.
15. The equipment is not sold with cables. Users should purchase cables with CCC certification.
16. CAUTION: The equipment is equipped with a battery-powered real-time clock circuit. There is a risk of explosion if a battery is incorrectly replaced. Replace only with same or equivalent type as recommended by the manufacturer. Discard all used batteries according to the manufacturer's instructions.

In accordance with the IEC 704-1:1982 specifications, the sound pressure level at the operator's position does not exceed 70 dB (A).

DISCLAIMER: These instructions are provided according to IEC 704-1 standards. Advantech disclaims all responsibility for the accuracy of any statements contained herein.

Safety Precaution - Static Electricity

Follow these simple precautions to protect yourself from harm and the products from damage.

1. To avoid electrical shock, always disconnect the power from your PC chassis before you work on it.
2. Disconnect power before making any configuration changes. The sudden rush of power as you connect a jumper or install a card may damage sensitive electronic components.
3. Always completely disconnect the power cord from your chassis whenever you work with the hardware. Do not make connections while the power is on. Sensitive electronic components can be damaged by sudden power surges. For safety reasons, the equipment should be opened only by qualified service personnel. Always ground yourself to remove any static charge before touching the mainboard, backplane, or add-on cards. Modern electronic devices are very sensitive to static electric charges. As a safety precaution, use a grounding wrist strap at all times. Place all electronic components on a static-dissipative surface or in a static-shielded bag when they are not in the chassis.

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Chapter 1

General Information

1.1 Introduction

The ITA-560AGX is a railway-specific AI industrial computer equipped with NVIDIA Jetson® AGX Orin™ processor. It is a dedicated model launched by Advantech for intelligent transportation-railway vehicle control.

1.2 Specifications

- **Chipset:** NVIDIA Jetson® AGX Orin™ processor
- **Memory:** On-board 32GB or 64GB DDR5
- **Graphic:** NVIDIA Ampere GPU
- **Storage:** M.2 (MKey) 2242
- **Expansion:** 1 x Mini PCIe slot, 1 x M.2 M-Key slot and 1 x Nano SIM slot
- **Ethernet:** 3 x 10/100/1000M Ethernet M12 connectors
- **USB:** 2 x USB3.0
- **Display Interface:** 1 x HDMI
- **IO Port:** 1 x DB9 for CAN, 1 x DB9 for 8bit GPIO
- **Dimension (W x H x D):** 260 x 75 x 197.2 mm
- **Net Weight:** 5kg

1.3 Power Information

The ITA-560AGX adopts direct current power input.

Table 1.1: Power Input

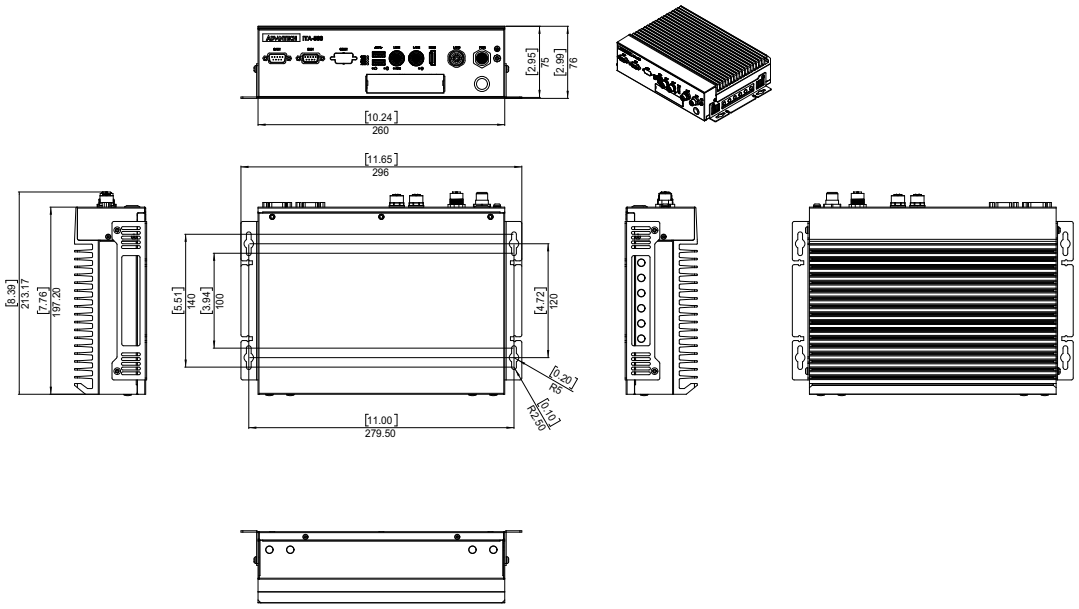
DC-In Voltage	24/110V_{DC}
Input Current	1.05A-4.16A
Power Connector	M12 (S-coded)

1.4 Environmental Specifications

Table 1.2: Environmental Specifications

Operating Temperature	-25 ~ 55°C
Storage Temperature	-40 ~ 85°C
Humidity	95% @40°C, non-condensing
Vibration	IEC 61373 body mount class B
Safety	CCC, CE, FCC and BSMI

1.5 System Diagram



1.6 Exploded Diagram

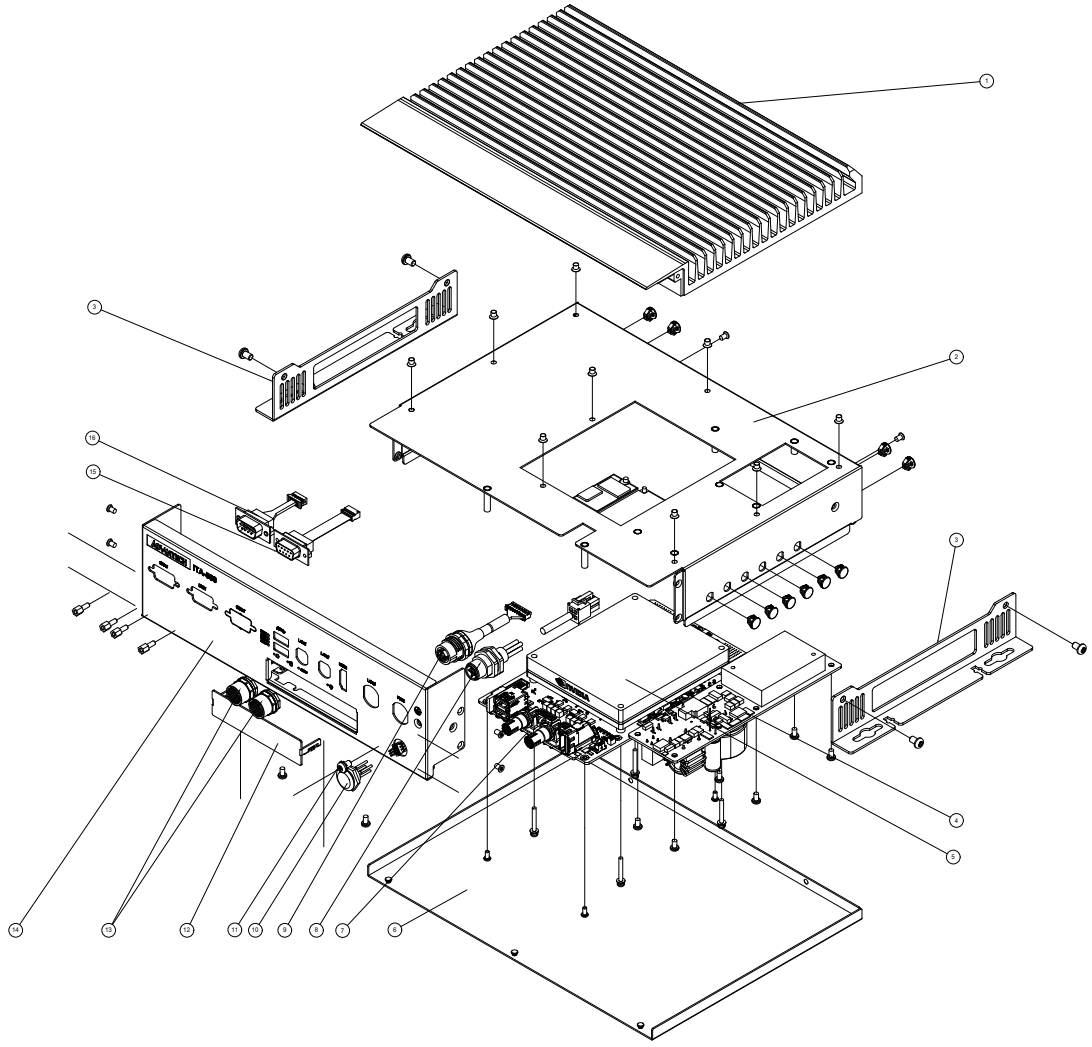


Table 1.3: Parts List			
1	Heatsink module	9	LAN3 cable
2	Bottom cover frame	10	Power button
3	Mounting bracket	11	Ground screw
4	Power board	12	idoor bracket
5	AGX Orin module	13	M12 housing
6	Top cover	14	Front panel frame
7	Carrier board	15	DIO cable
8	Power input cable	16	CAN cable

Chapter 2

Hardware Installation

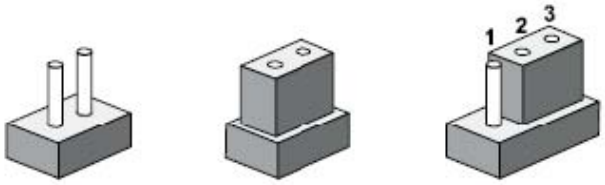
2.1 Introduction

The following sections show the internal jumper settings and the external connectors and pin assignments for integration.

2.2 Jumpers and Connectors

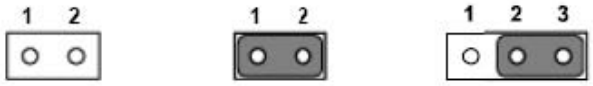
2.2.1 Jumper Description

You may configure the ITA-560AGX to match the needs of your application by setting jumpers. A jumper is a metal bridge used to close an electric circuit. It consists of two metal pins and a small metal clip (often protected by a plastic cover) that slides over the pins to connect them. To close a jumper, you connect the pins with the clip. To open a jumper, you remove the clip. Sometimes a jumper will have three pins, labeled 1, 2, and 3. In this case you would connect either pins 1 and 2, or 2 and 3.



Open Closed Closed 2-3

The jumper settings are schematically depicted in this manual as follows.



Open Closed Closed 2-3

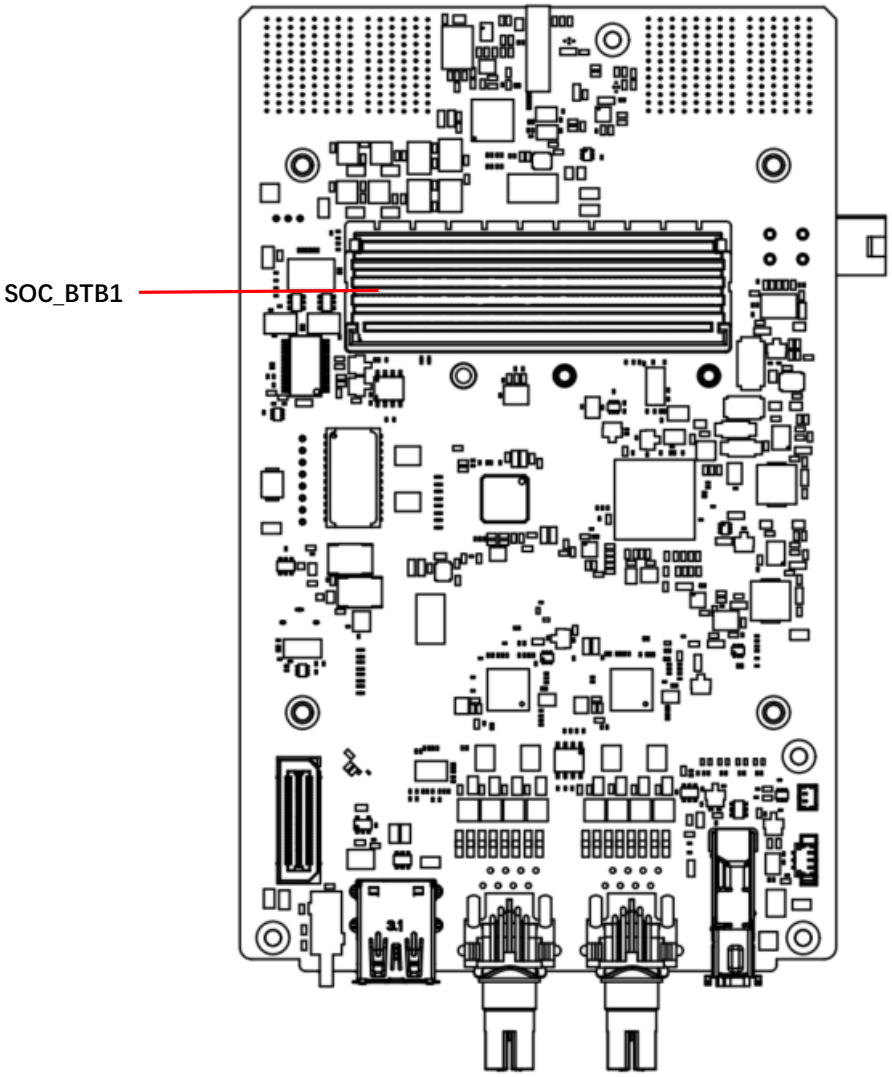
A pair of needle-nose pliers may be helpful when working with jumpers. If you have any doubts about the best hardware configuration for your application, contact your local distributor or sales representative before you make any changes. Generally, you simply need a standard cable to make most connections.

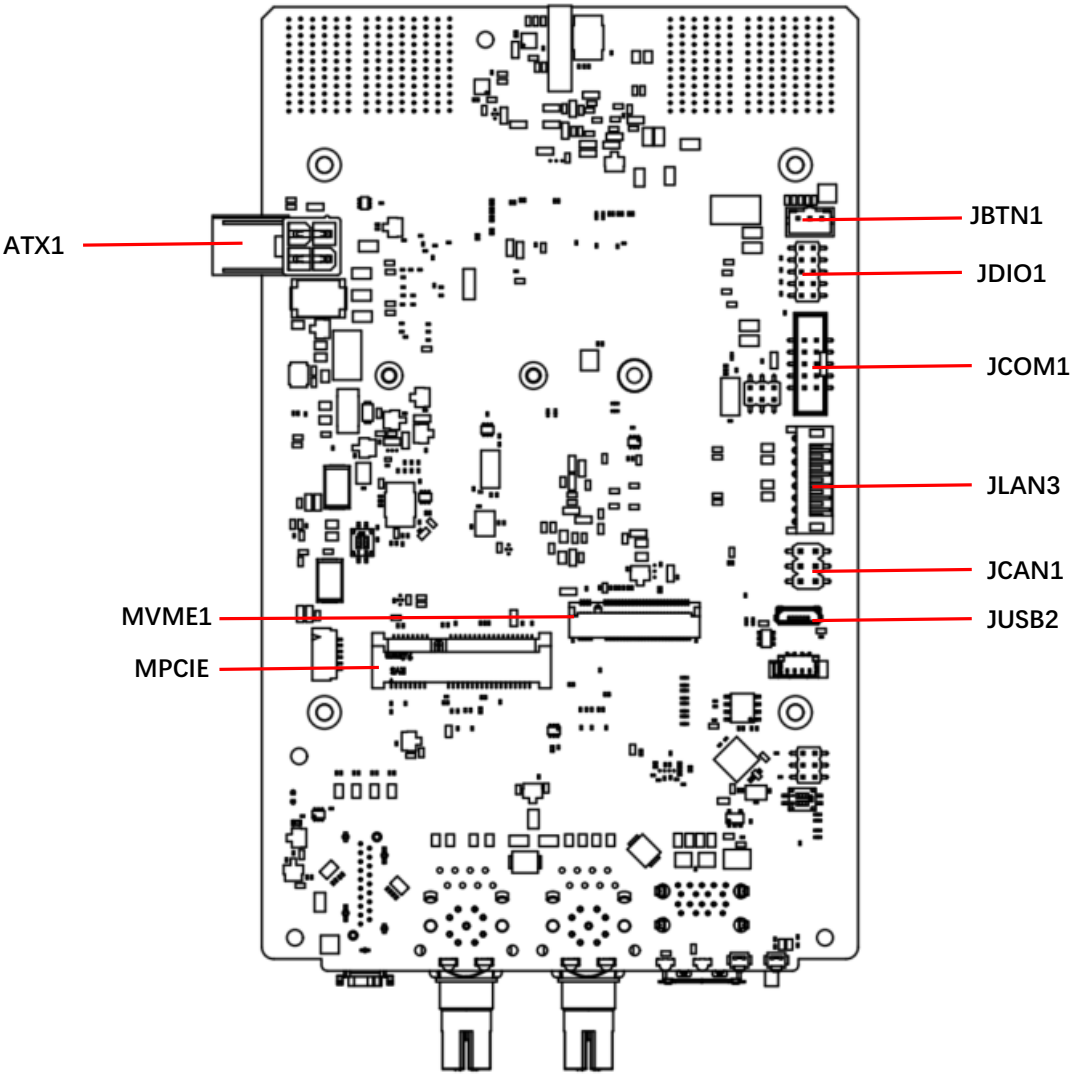
2.2.2 Jumper and Connector Locations

The main board features a number of connectors and jumpers for system configuration. The function of each of the connectors and jumpers are listed in Table 2.1 below.

Table 2.1: Jumpers and Connectors

Name	Function
ATX1	Power input
JBTN1	Power button
JDIO1	8 bit GPIO
JCOM1	COM port RS232
JLAN3	LAN GbE.
JCAN1	CAN port
JUSB2	Internal, flashing port Device mode only
NVME1	M.2 M-key 2242 connector
MPCIE1	Mini PCIe connector
SOC_BTB1	AGX Orin connector




ATX1
JBTN1
JDIO1
JCOM1
JLAN3
JCAN1
MVME1
JUSB2
MPCIE

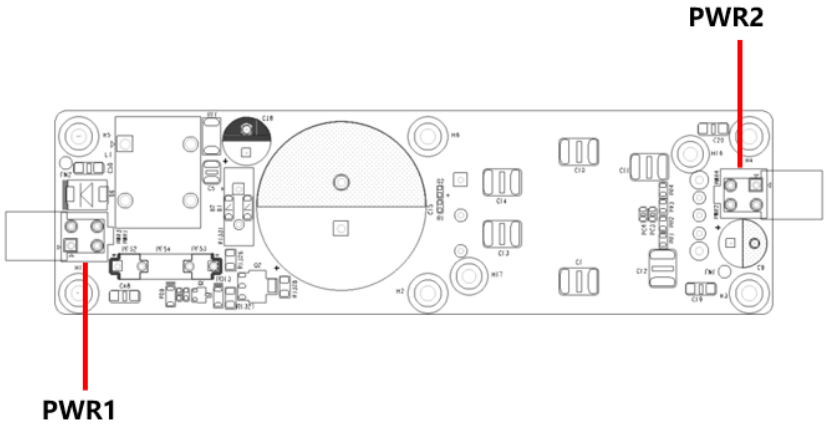

PWR2
PWR1

Table 2.2: PWR1: Power Input	
Pin	**Setting**
1-2	GND
3-4	12V

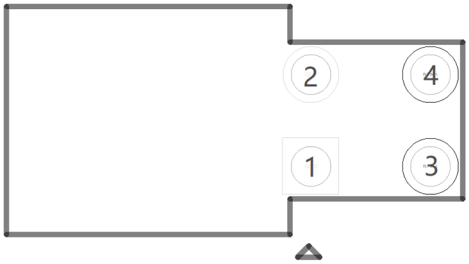


Table 2.3: PWRBTN1: Power Button	
Pin	**Setting**
1	PWRBTN#
2	GND
3	+V3.3

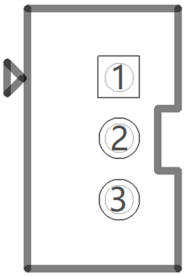


Table 2.4: VCCGPIO1: GPIO Voltage Setting	
Pin	**Setting**
2-4	+V3.3_SB
1-3	+V5_SB
4-6	+V3.3
3-5	+V5 (Default)

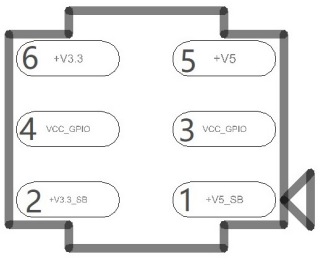


Table 2.5: PSON1: AT/ATX Mode Option	
Pin	**Setting**
1-2	AT mode*
2-3	ATX mode
* Default	

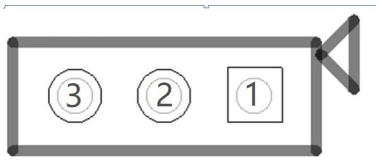
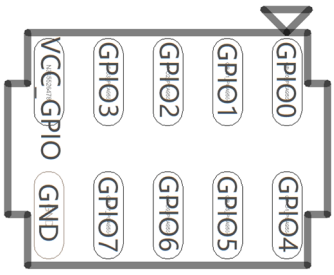
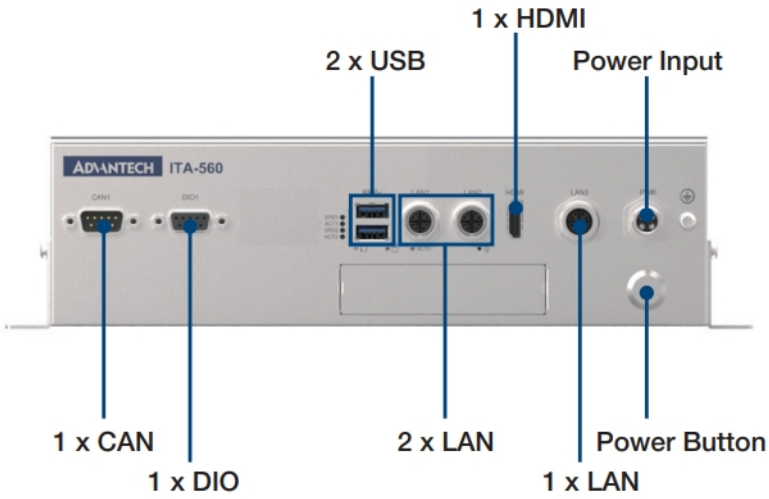


Table 2.6: GPIO1	
Pin	**Setting**
1	GPIO0
2	GPIO2
3	GPIO1
4	GPIO4
5	GPIO2
6	GPIO6
7	GPIO3
8	GPIO7
9	VCC_GPIO
10	GND



2.3 I/O Connectors



2.3.1 USB Port

The ITA-560AGX provides two USB3.0 ports.

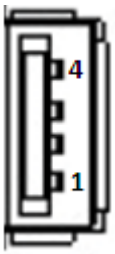


Table 2.7: USB Port

Pin	Setting
1	+V5(VCC)
2	USB_data-
3	USB_data+
4	GND

2.3.2 DIO Port

The ITA-560AGX provides a DIO port.

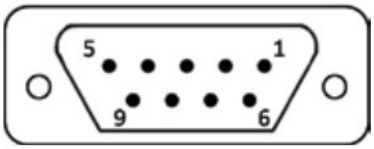


Table 2.8: DIO: DB9/Female Port			
Pin	**Setting**	**Pin**	**Setting**
1	GPIO0	6	GPIO4
2	GPIO1	7	GPIO5
3	GPIO2	8	GPIO6
4	GPIO3	9	GIPO7
5	GND		

2.3.3 LAN Port

The ITA-560AGX is equipped with Intel I226IT & Marvell 88E1512 Ethernet controller compliant with IEEE 802.3u 10/100/1000 Mbps.

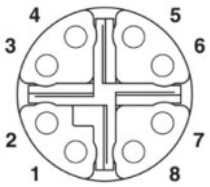


Table 2.9: Ethernet: 10/100/1000Mbps, M12-X/Female Port			
Pin	**Setting**	**Pin**	**Setting**
1	MDI0+	5	MDI3+
2	MDI0-	6	MDI3-
3	MDI1+	7	MDI2-
4	MDI1-	8	MDI2+

2.3.4 Power Terminal Port

The ITA-560AGX provides a M12 power input port.

Table 2.10: Power Input: DC, M12-S/Male Port			
Pin	**Setting**	**Pin**	**Setting**
1	Power	3	GND
2	Power	4	NC

2.3.5 CAN Port

The ITA-560AGX provides a CAN port.

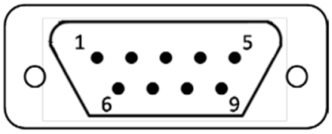


Table 2.11: CAN: DB9P/Male Port

Pin	Setting	Pin	Setting
1	NC	6	NC
2	CAN_L	7	CAN_H
3	GND	8	NC
4	NC	9	NC
5	NC		

Chapter 3

System Setup

3.1 Introduction

The following sections provide instructions for installing the hardware modules into the ITA-560AGX system.

3.1.1 M.2 and Mini PCIe Card Installation

The ITA-560AGX features one M.2(M-Key) and one Mini PCIe socket. Please follow the instructions below.

1. Install the M.2 or Mini PCIe card into the socket.
2. Secure the card with screws.

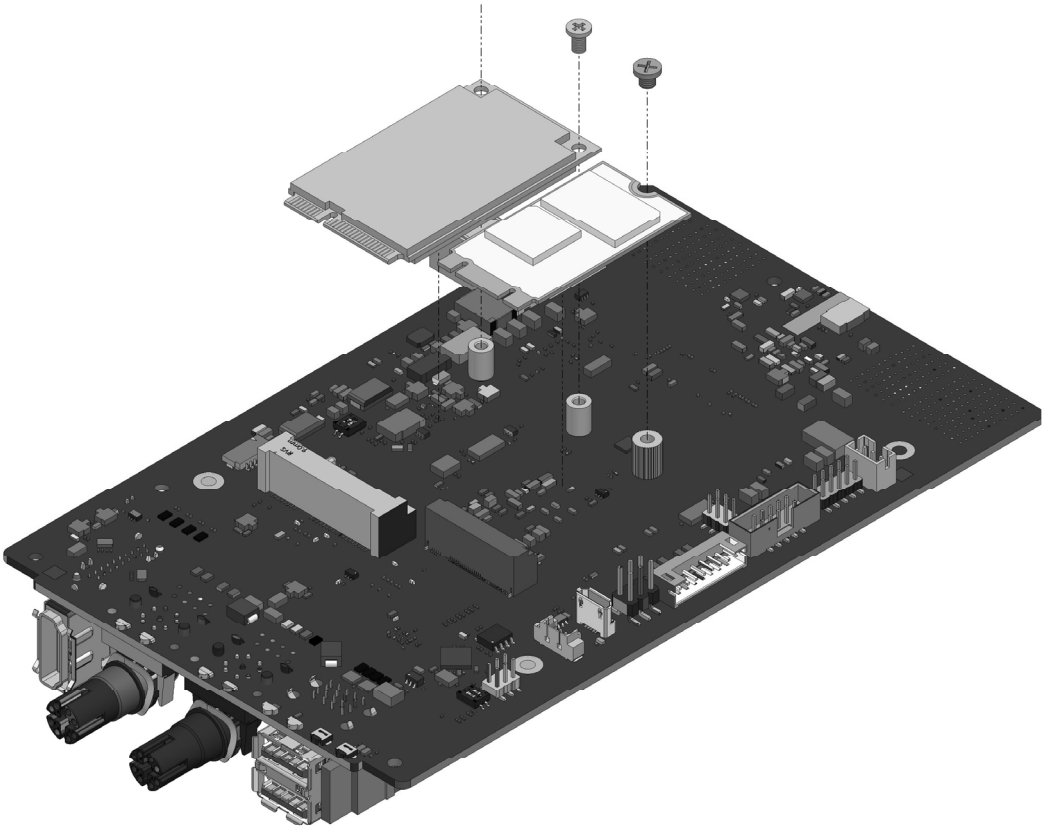
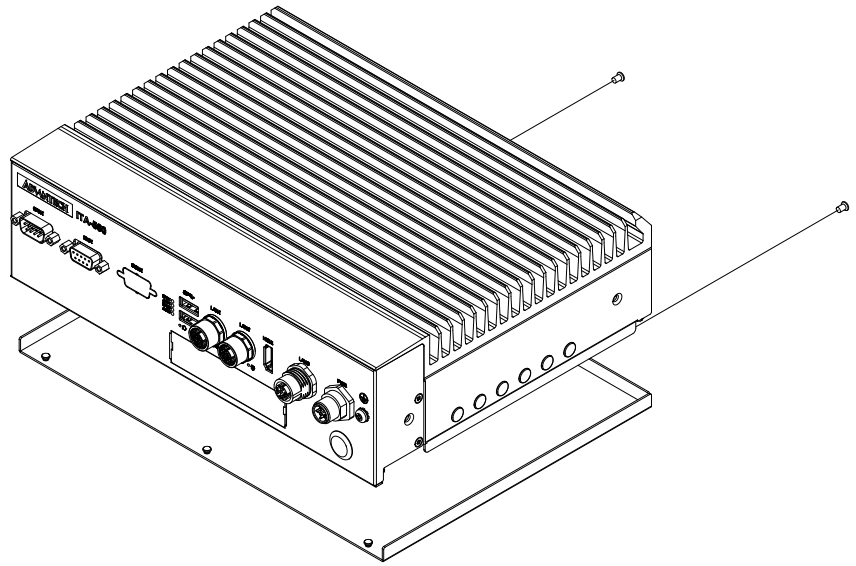


Figure 3.1 M.2 and Mini PCIe Card Installation

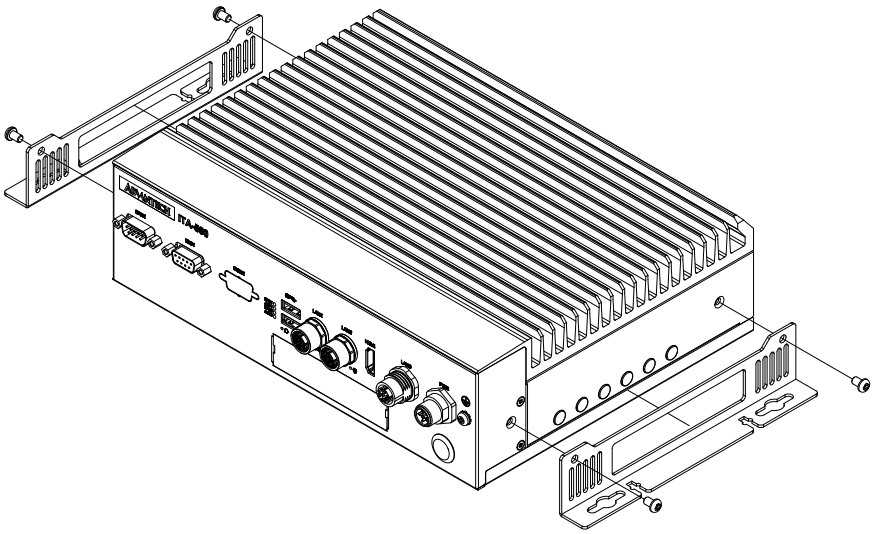
3.1.2 Top Cover Installation

Install the top cover as shown in the pictures below.



3.1.3 Mounting Bracket Installation

Secure the two mounting brackets onto both sides of the chassis with screws. Please refer to Picture 3.3.



Chapter 4

Ubuntu 22.04

4.1 ARM Ubuntu22.04 Overview

4.1.1 Cross-Platform Compatibility, Consistent User Experience on X86 and ARM Platforms

Ubuntu is one of the most popular Linux distributions. Many industrial application solutions are also based on the Ubuntu platform. Running Ubuntu on ARM makes it easier, more convenient, faster, and more friendly for industrial application development and maintenance. Existing application solutions for the X86 platform can also be migrated to the ARM Ubuntu platform more quickly and seamlessly, while reducing development difficulty, cost, and risk.

4.1.2 Rich Software Support

Ubuntu officially provides a very rich set of ARM version software packages. Common components in industrial control such as ssh, telnet, ftp, qt libraries, video playback software, mysql database software, Java, VNC, etc., all have ready-made software packages. When customers need these components, they do not need to cross-compile or port them; just like on x86, they can be installed directly online using the apt command.

4.1.3 Rapid System Customization

Precisely because the ARM version of Ubuntu provides a very rich set of software packages, customers can quickly install the required software packages according to their project needs, perform relevant configurations rapidly, and customize the required system. Furthermore, for developers with X86 Ubuntu experience, there is no need to spend time learning ARM Linux development because the development techniques and methods are identical.

4.1.4 Rapid Development and Maintenance

In addition to providing rich software support, Ubuntu is also very mature in terms of development, with abundant resources. It supports many development environments such as gcc, qt, java, python, mono, php, and provides related software development tools. Customers can choose familiar and suitable development languages, environments, and solutions according to their needs to accelerate software development.

4.1.5 Graphical System Configuration

The Arm version of Ubuntu supports the XFCE lightweight desktop environment, which can run smoothly on Arm. Many system configurations, such as network configuration, can be configured graphically, which is very convenient, fast, and simple.

4.1.6 Long-Term Support Version Available

Ubuntu is developed and maintained by the commercial company Canonical, and its stability and reliability are trustworthy. At the same time, Ubuntu provides Long-Term Support (LTS) versions. Ubuntu 22.04 LTS will provide support and updates for 3 to 5 years or more,??? meeting the long-term support needs of industrial customers.

4.1.7 Advantech Provides Industrial Customized ARM Ubuntu Version

The Arm Ubuntu version provided by Advantech is based on Arm Ubuntu 22.04, adapted for the AGX Orin, and provides the following customized optimizations for common needs of industrial customers:

1. Provides various hardware test programs and test instructions to facilitate customers' hardware testing and verification, and to understand usage methods;
2. Provides sample programs and source code, such as serial port communication, video playback, etc., for customer reference during development;
3. Provides support for peripheral WIFI and other wireless modules, with relevant drivers built-in, facilitating customers in building wireless solutions;

Note: Commercial use of the Ubuntu system requires payment and permission from Ubuntu official. Please contact Ubuntu official for further information. You can also contact the Advantech product PM, as Advantech has established communication and cooperation channels with Ubuntu official.

4.2 Advantech Ubuntu Image Software Support

4.2.1 Pre-installed System Software

The Image defaults to supporting many software commonly used by industrial users

- Firefox browser
- Video playback software
- Audio playback software

4.2.2 Installing Software Packages Online via apt Command

If the required software is not included in the Ubuntu Image provided by Advantech, the Arm Ubuntu system also provides the APT (Advanced Package Tool) package management mechanism. When the device is connected to the network, you can directly use APT-related commands to query and install software online. APT will automatically handle dependencies and install the required software packages on the system.

Ubuntu provides a very rich set of Arm version software packages. It can be said that the vast majority of software required by customers can be installed directly using the apt command, without the need for cross-compilation from source code, which is very convenient.

The apt command can automatically find Ubuntu's software servers through the source configuration file and download software from the servers. The Image has already added the official Ubuntu mirror source by default, so generally users do not need to modify the settings.

However, if some software does not exist in the official Ubuntu source but is available from a third-party Ubuntu software source, users can first modify the software source configuration, add the third-party software source, and then proceed with the online software installation.

The mirror source for the Ubuntu 22.04 system is in /etc/apt/sources.list.

1. Edit the sources.list file to add a new mirror source.
2. After adding, execute the command apt-get update to update the mirror source.

4.2.3 Common Software Online Installation

4.2.3.1 apt Command Usage

- Install a software package:

```
# sudo apt-get install packagename
```

- Remove a software package:

```
# sudo apt-get remove packagename
```

- Get updated package lists:

```
# sudo apt-get update
```

- Upgrade the system with available updates:

```
# sudo apt-get upgrade
```

- Search for a required software package:

```
#apt-cache search packagename
```

- List more commands and options:

```
# apt-get help
```

For more information on apt usage, you can search online for relevant information for a deeper understanding.

The installation of some commonly used software packages for industrial users is listed below

4.2.3.2 Install Firefox Browser

```
# apt-get install firefox
```

4.2.3.3 Install Apache Web Server

```
# apt-get install apache2 apache2-dev
```

4.2.3.4 Install PHP

```
# apt-get install php
```

4.2.3.5 Install QtCreator

```
# apt-get install qtcreator
```

4.2.3.6 Install SSH (Pre-installed)

```
# apt-get install openssh-server
```

4.2.3.7 Install X11VNC

```
# apt-get install x11vnc
```

4.3 Ubuntu22.04 System Flashing and Booting Ubuntu22.04

4.3.1 Required Hardware and Software Environment

- AGX Orin hardware motherboard
- Console / USB OTG cable
- X86 development host installed with Ubuntu 22.04 system
- AGX Orin Ubuntu Image file

4.3.2 Debug Interface Setting

1. Console/USB OTG cable.
   The Console/USB OTG cable uses the same interface. Plug the serial cable into the AGX Orin Debug port, and connect the other end of the serial cable to your host machine.
2. Install the serial debug tool putty on Linux.

```
# apt-get  install  putty
```

3. Open the putty tool on the host, set the serial port number, baud rate 115200. Please use the root user to open putty. The serial port number is the serial port connected by the debug cable. For example, in Linux, it is /dev/ttyUSB0

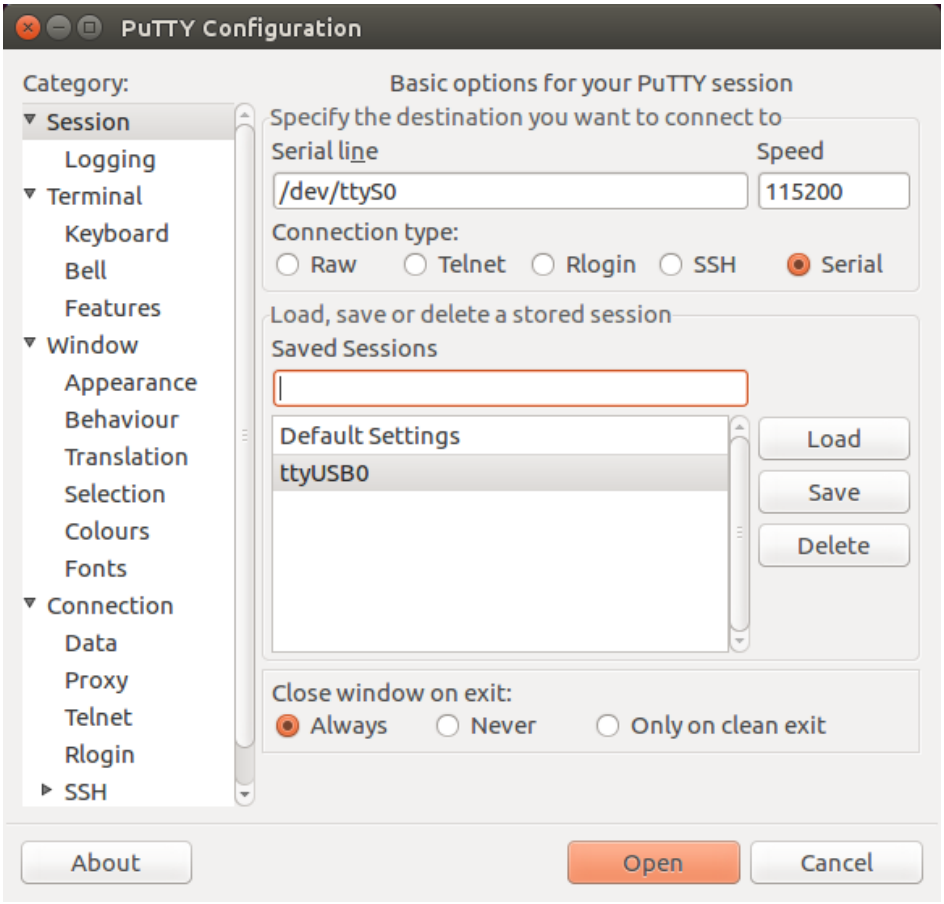


Figure 4.1 Putty Configuration

4.3.3 Ubuntu Image Flashing

Linux Host:

1. Prepare the x86 host environment: Install Ubuntu 22.04 on the x86 machine, connect it to the internet via an Ethernet port, and install the necessary dependencies.

   Execute the command:

```
sudo apt update; apt-get install -y abootimg binfmt-support binutils cpp device-tree-compiler dosfstools lbzip2 libxml2-utils nfs-kernel-server python3-yaml qemu-user-static sshpass udev uuid-runtime whois openssl cpio lz4 python2
```

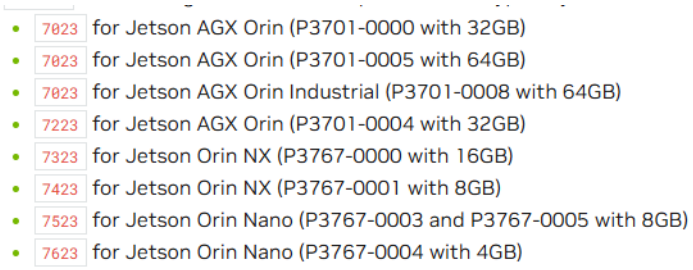
2. Extract the AGX Orin BSP archive.

   First download the BSP archive, then extract it using the following command:

```
sudo  tar  -pxvf  ITA-560AGX-jp6.2-beta-v0.0.2-CUDA.tar.gz
```

3. After extraction, you will obtain the Linux for Tegra/ directory. Navigate into this directory.
4. Use a USB OTG cable to connect the OTG interface on the AGX Orin mainboard to a USB port on the x86 Ubuntu host.
5. Power on the device and hold the Recovery key for 3-5 seconds to enter Recovery Mode for BSP burning. You can use the lsusb command to verify if it has successfully entered Recovery Mode.

```
root@user:/opt/Nvidia-ITA-510-560/JP6.2# lsusb
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub
Bus 001 Device 003: ID 17ef:608d Lenovo
Bus 001 Device 004: ID 17ef:6018 Lenovo
Bus 001 Device 099: ID 0955:7223 NVidia Corp.
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
root@user:/opt/Nvidia-ITA-510-560/JP6.2#
```



6. Execute the burning command:

```
cd  Linux_for_Tegra/
sudo  ./flash.sh  jetson-agx-orin-devkit  mmcblk0p1
```

7. Begin burning: Wait for the burning process to complete. The device will then automatically reboot.

8. Default system credentials:
   Username: ita560
   Password: ita560

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