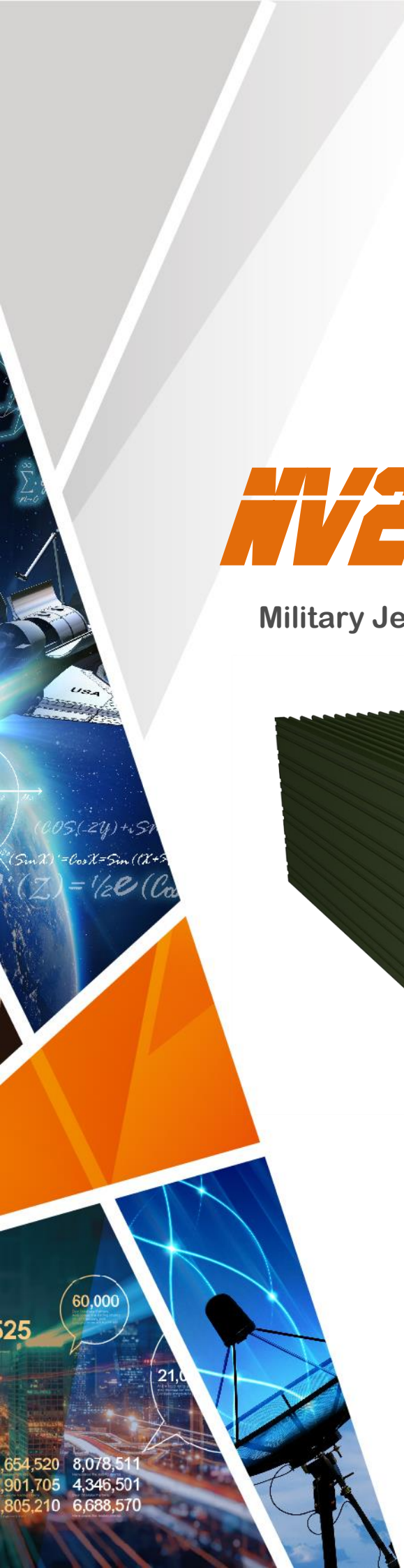
MV200-2LGS16

Military Jetson Orin NX IP65 Rugged Computer



User's Manual

Revision Date: Aug. 30. 2024

Safety Information

Electrical safety

- To prevent electrical shock hazard, disconnect the power cable from the electrical outlet 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. If possible, disconnect all power cables from the existing system before you add a device.
- Before connecting or removing signal cables from the motherboard, ensure that all power cables are unplugged.
- Seek professional assistance before using an adapter or extension cord. These devices could interrupt the grounding circuit.
- Make sure that your power supply is set to the correct voltage in your area.
- If you are not sure about the voltage of the electrical outlet you are using, contact your local power company.
- If the power supply is broken, do not try to fix it by yourself. Contact a qualified service technician or your local distributor.

Operation safety

- Before installing the motherboard and adding devices on it, carefully read all the manuals that came with the package.
- Before using the product, make sure all cables are correctly connected and the power cables are not damaged. If you detect any damage, contact your dealer immediately.
- To avoid short circuits, keep paper clips, screws, and staples away from connectors, slots, sockets and circuitry.
- Avoid dust, humidity, and temperature extremes. Do not place the product in any area where it may become wet.
- Place the product on a stable surface.
- If you encounter any technical problems with the product, contact your local distributor

Statement

Table of Contents

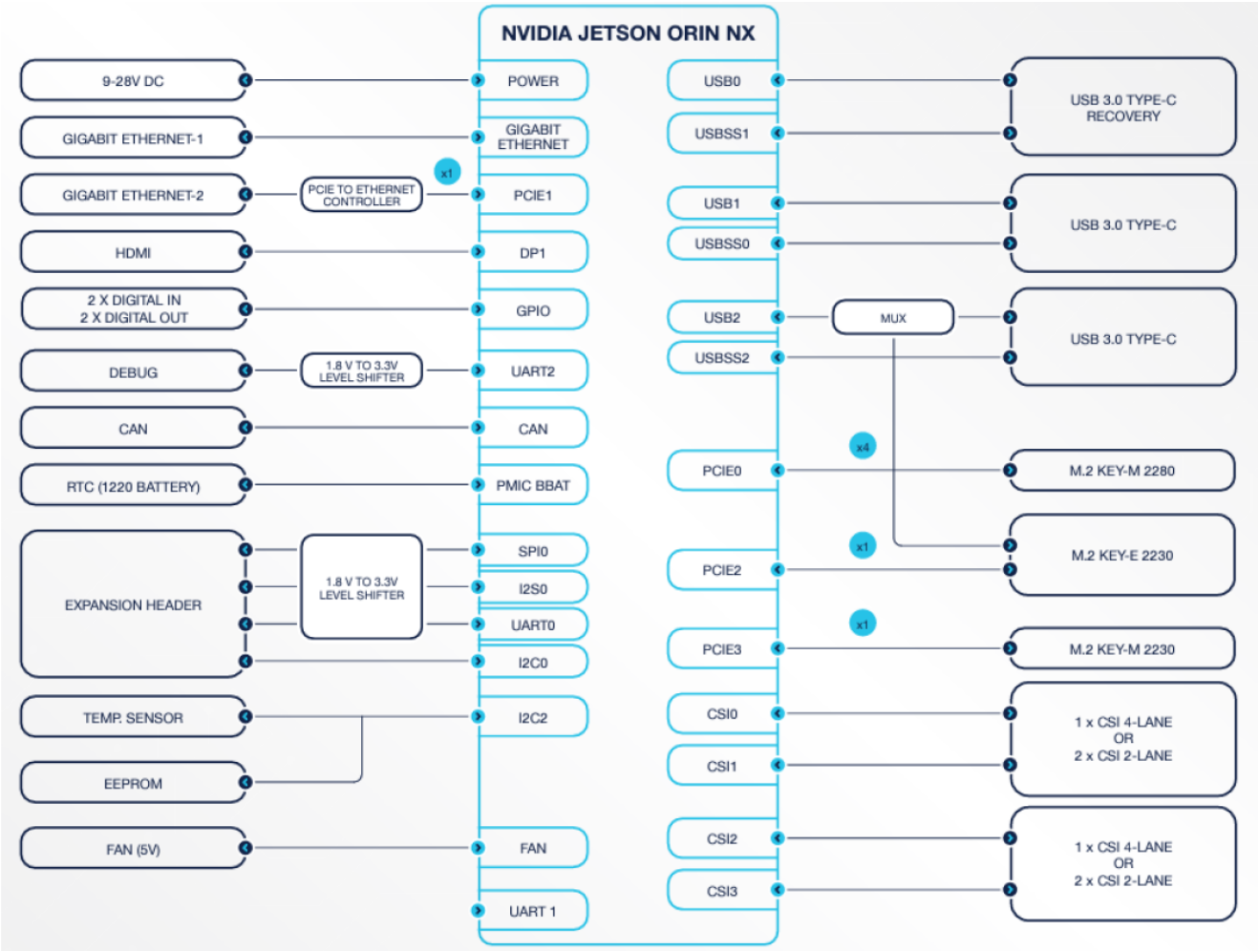
Specifications

System	
AI Performance	100 TOPS
GPU	NVIDIA® Ampere architecture with 1024 CUDA® cores and 32 Tensor Cores, max freq. 915MHz
CPU	8-core Arm® Cortex®-A78AE v8.2 64-bit CPU, 2MB L2 + 4MB L3, max freq. 2.0GHz
Memory	16GB 128-bit LPDDR5, 3200MHz, 102 GB/s
Expansion Slot	1x M.2 2280 M key (PCIe x4) 1x M.2 2230 M key (PCIe x1) 1x M.2 2030 E Key Optional GMSL2 module with 4x FAKRA connector
Display	
Display	1x HDMI 2.0(max resolution 3840x2160)
Storage	
M.2	1x PCIe x1 M.2 2230 M-Key up to 2TB
Ethernet	
Ethernet	2x GbE LAN (10/100/1000 Mbps supported)
Front I/O	
Grounding Screw	1x
Power In	18V~32V DC-IN with D38999 connector
X1	2x 1GbE LAN with D38999 connector
X2	1x CAN + 1x RS232/422/485 + 2x DI + 2x DO with D38999 connector
X3	1x HDMI with D38999 connector
Power Button	1x Power Button with Back light
Rear I/O	
Access Panel	1x Reset Button
	1x Recover Button
	1x USB type-C for Recovery
	2x USB Type-C
	1x Reboot LED
3G-SDI	4x 3G-SDI in with BNC connector
GMSL	2x2 mini-FAKRA GMSL(2) connector
Power Requirement	

Power Input	18V~32V DC-in
Applications, Operating System	
Applications	Energy/Smart Grid/Power Plant Management, Intelligent Automation and manufacturing applications/ AI
Operating System	Ubuntu 20.04 with JetPack 6.0
Physical	
Dimension	220 x 300 x 88 mm (W x D x H)
Weight	3kg
Chassis	Aluminum Alloy
Heatsink	Aluminum Alloy, Corrosion Resistant
Finish	Anodic aluminum oxide
Environmental	
Compliance	MIL-STD-810G, IEC-61850-3, IEEE-1613, CE and FCC, RoHS
Operating Temp.	-20 to 50°C
Storage Temp.	-40 to 85°C
Relative Humidity	5% to 95%, non-condensing

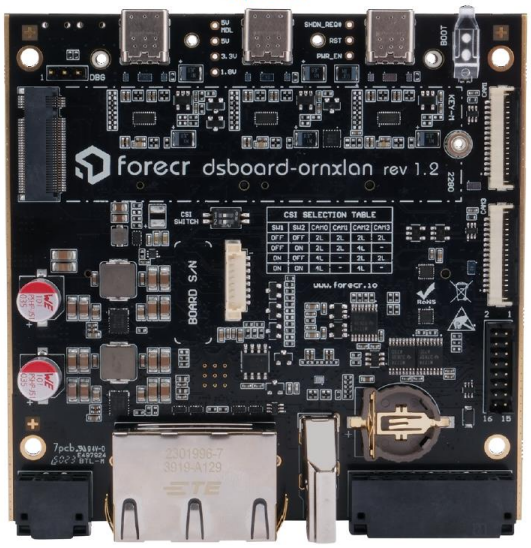
*All specifications and photos are subject to change without notice.

Block Diagram

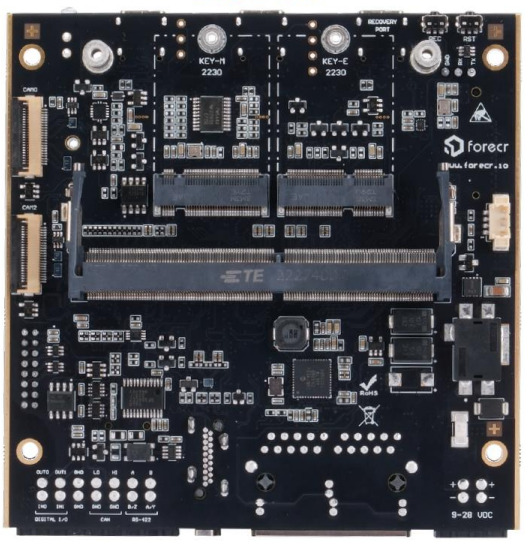


Board Visuals

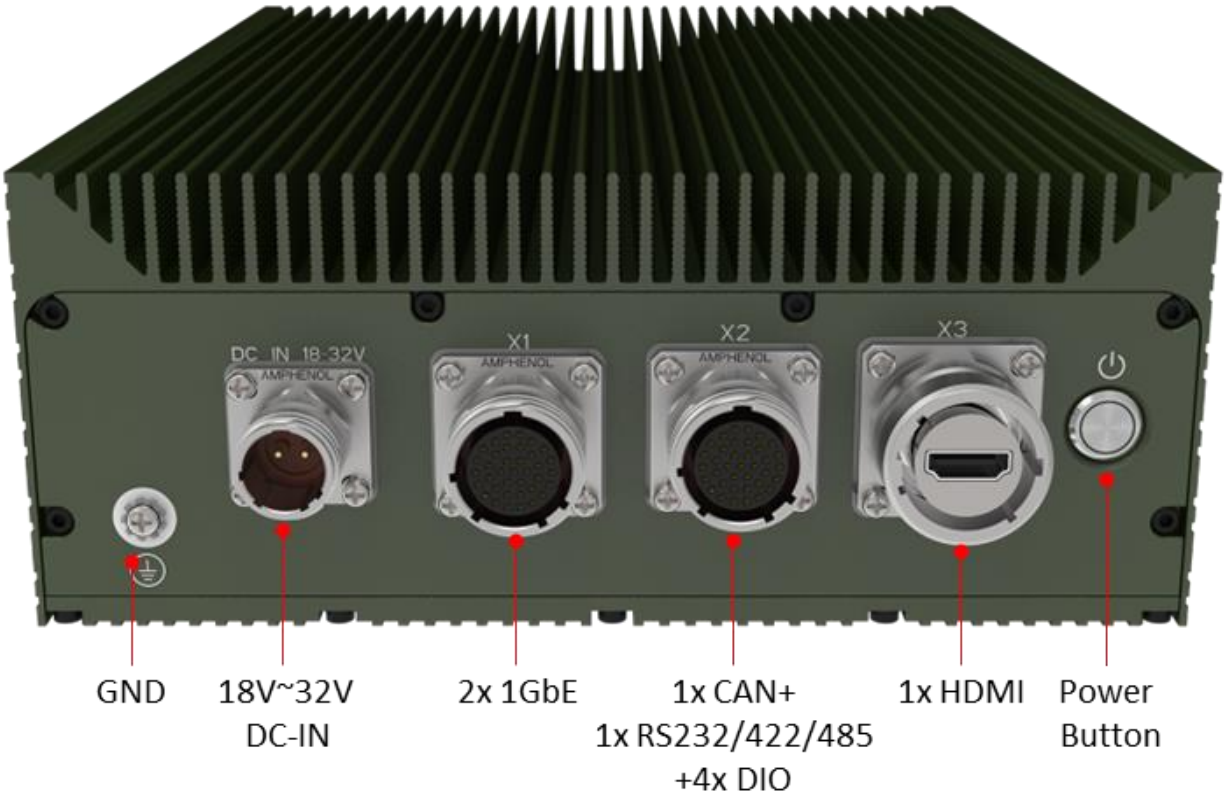
Top Side

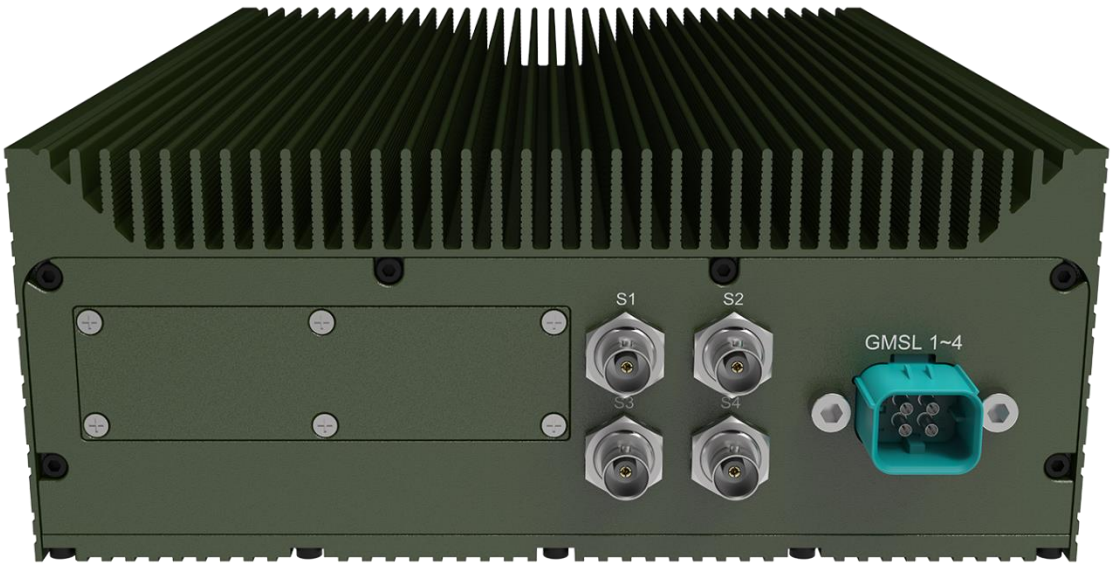


Bottom Side

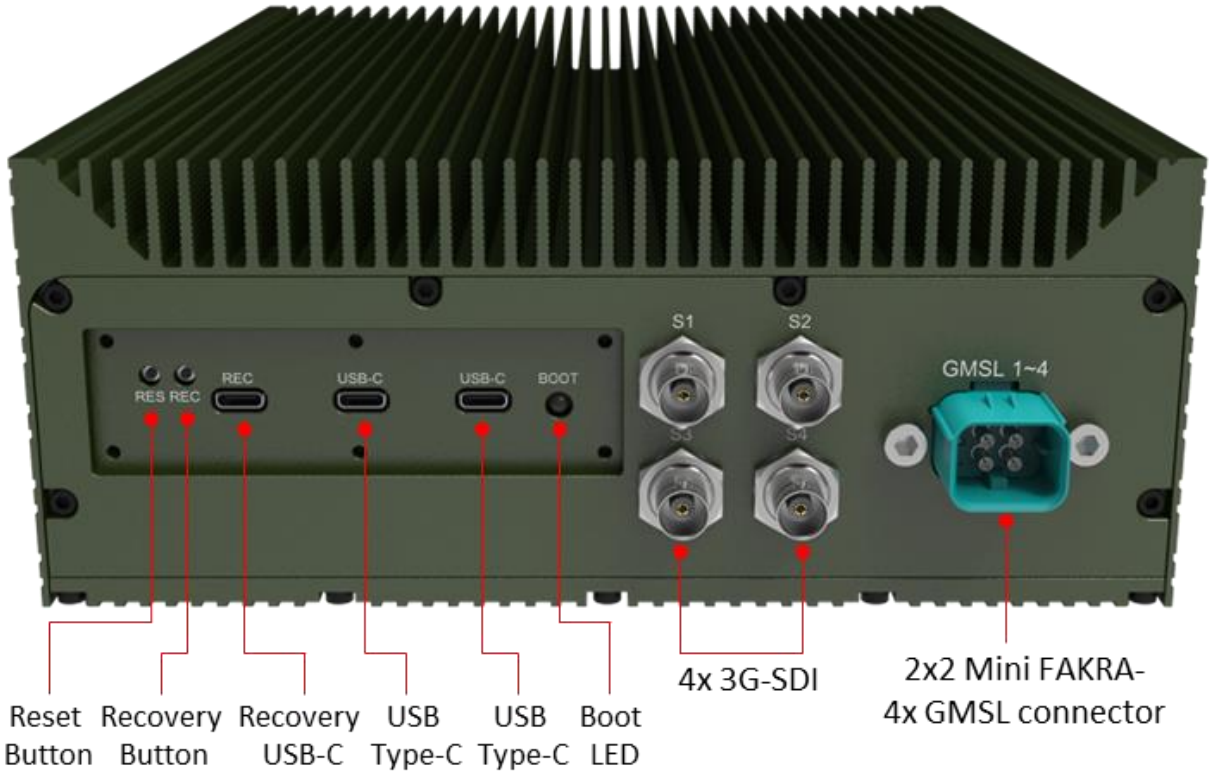


Front/Rear IO Visuals



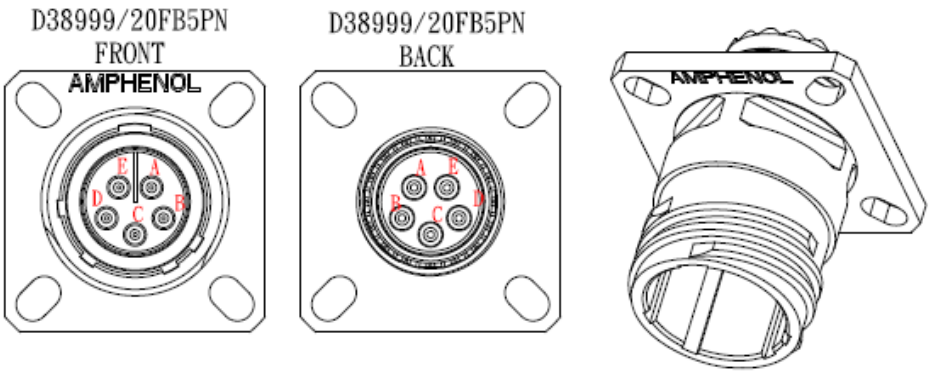


List of Connectors & Buttons



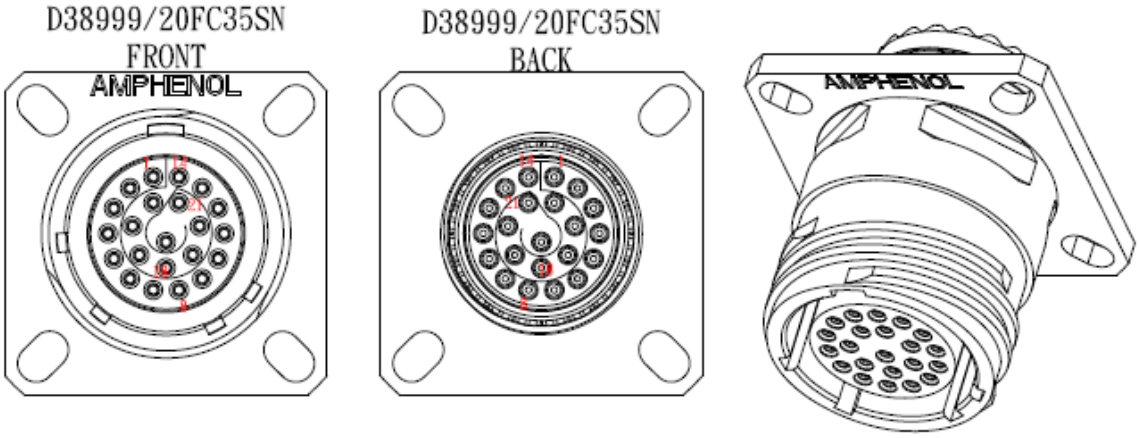
Definition of each I/O

DC Power IN:



D38999/20FB5PN	
A	Vin+
B	Vin+
C	N.C.
D	Vin-
E	Vin-

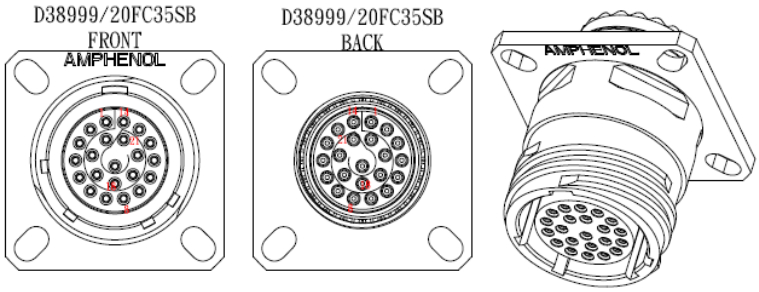
X1: 2x 1GbE LAN



D38999	RJ45-1	WIRE COLOR
1	1	WHITE/ORANGE
2	2	ORANGE
3	3	WHITE/GREEN
4	6	GREEN
5	4	BLUE
6	5	WHITE/BLUE
15	7	WHITE/BROWN
16	8	BROWN
7	SHELL	BLACK
17	SHELL	BLACK
18	SHELL	BLACK

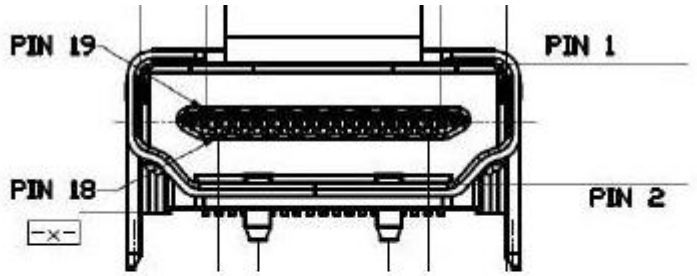
D38999	RJ45-2	WIRE COLOR
8	1	WHITE/ORANGE
9	2	ORANGE
10	3	WHITE/GREEN
11	6	GREEN
12	4	BLUE
13	5	WHILE/BLUE
19	7	WHITE/BROWN
20	8	BROWN
14	SHELL	BLACK
21	SHELL	BLACK
22	SHELL	BLACK

X2: 1x CAN+1x RS232/422/485 + 4x DIO



D38999/20FC35SB		
1	RS422 B	RS232/422/485
2	RS232 RX/RS422 A	
3	RS422 Y/RS485 A	
4	RS232 TX/RS422 Z /RS485 B	
5	GND	
6	CAN_H	CAN_BUS
7	CAN_L	
8	GND	
9	DIO_OUT_1	DIO
10	DIO_OUT_0	
11	DIO_IN_1	
12	DIO_IN_0	
13	GND	
14	GND	

X3: HDMI 2.0



Pin #	Signal	Pin #	Signal
1	HDMI_TX2_P	2	GND
3	HDMI_TX2_N	4	HDMI_TX1_P
5	GND	6	HDMI_TX1_N
7	HDMI_TX0_P	8	GND
9	HDMI_TX0_N	10	HDMI_CLK_P
11	GND	12	HDMI_CLK_N
13	CEC	14	NC
15	HDMI_SCL	16	HDMI_SDA
17	GND	18	+5 V Power
19	Hot Plug Detect	20	GND
21	GND	22	GND
23	GND		

Ordering Information

Model	NV200-2L8	NV200-2L16	NV200-2LG16	NV200-2LGS16
GPU	1024 NVIDIA® CUDA® cores with 32 Tensor cores, 765 MHz	1024 NVIDIA® CUDA® cores with 32 Tensor cores, 915 MHz	1024 NVIDIA® CUDA® cores with 32 Tensor cores, 915 MHz	1024 NVIDIA® CUDA® cores with 32 Tensor cores, 915 MHz
Memory	8GB	16GB	16GB	16GB
AI Performance	70 TOPs	100TOPs	100TOPs	100TOPs
CPU	six-core Arm® Cortex® A78AE v8.2 (64-bit) (4x 256KB L2 +2MB L3) + 4MB LLC	Eight-core Arm® Cortex® A78AE v8.2 (64-bit) (4x 256KB L2 +2MB L3) + 4MB LLC	Eight-core Arm® Cortex® A78AE v8.2 (64-bit) (4x 256KB L2 +2MB L3) + 4MB LLC	Eight-core Arm® Cortex® A78AE v8.2 (64-bit) (4x 256KB L2 +2MB L3) + 4MB LLC
Module total module power	10W | 15W | 20W	10W | 15W | 25W	10W | 15W | 25W	10W | 15W | 25W
Storage	1x M.2 2280 (up to 8TB)	1x M.2 2280 (up to 8TB)	1x M.2 2280 (up to 8TB)	N/A
	1x M.2 2230 (up to 2TB)	1x M.2 2230 (up to 2TB)	1x M.2 2230 (up to 2TB)	1x M.2 2230 (up to 2TB)
Front I/O				
Power In	18V-32VDC with D38999	18V-32VDC with D38999	18V-32VDC with D38999	18V-32VDC with D38999
X1	2x GbE LAN	2x GbE LAN	2x GbE LAN	2x GbE LAN
X2	1x RS232/422/485 +1x CAN+ 2x DI+2x DO	1x RS232/422/485 +1x CAN+ 2x DI+2x DO	1x RS232/422/485 +1x CAN+ 2x DI+2x DO	1x RS232/422/485 +1x CAN+ 2x DI+2x DO
X3	1x HDMI	1x HDMI	1x HDMI	1x HDMI
Rear I/O				
GMSL	N/A	N/A	4x	4x
3G-SDI	N/A	N/A	N/A	4x
Access Panel	1x Boot LED	1x Boot LED	1x Boot LED	1x Boot LED
	1x Reset Button	1x Reset Button	1x Reset Button	1x Reset Button
	1x Recovery Button	1x Recovery Button	1x Recovery Button	1x Recovery Button
	2x USB3.1 Type-C	2x USB3.1 Type-C	2x USB3.1 Type-C	2x USB3.1 Type-C
	1x USB3.1 Type-C for Recovery	1x USB3.1 Type-C for Recovery	1x USB3.1 Type-C for Recovery	1x USB3.1 Type-C for Recovery
Dimensions	220 x 300 x 88mm(WxDxH)	220 x 300 x 88mm(WxDxH)	220 x 300 x 88mm(WxDxH)	220 x 300 x 88mm(WxDxH)

Software Information

Software Configuration

JetPack-5.x Installation can be found here:

https://www.forecr.io/blogs/installation/jetpack-5-x-installation-for-dsboard-ornx-lan

System Recovery

You will need a host PC in order to flash your client device with a new system image.

Host PC

Before flashing the image, you should prepare an OTG cable (USB Type-C) for connecting to NV200-2LGS16 (recovery port), and a host PC with USB Type-A running Ubuntu 20.04.

JetPack-6 Installation for NV200-2LGS16.

In this tutorial, we will install JetPack-6 for NV200-2LGS16. First, we will include our BSP files in Jetson OS image. Then, we will install the Jetson OS into the NV200-2LGS16. Finally, we will install the Jetson SDK

components into it.

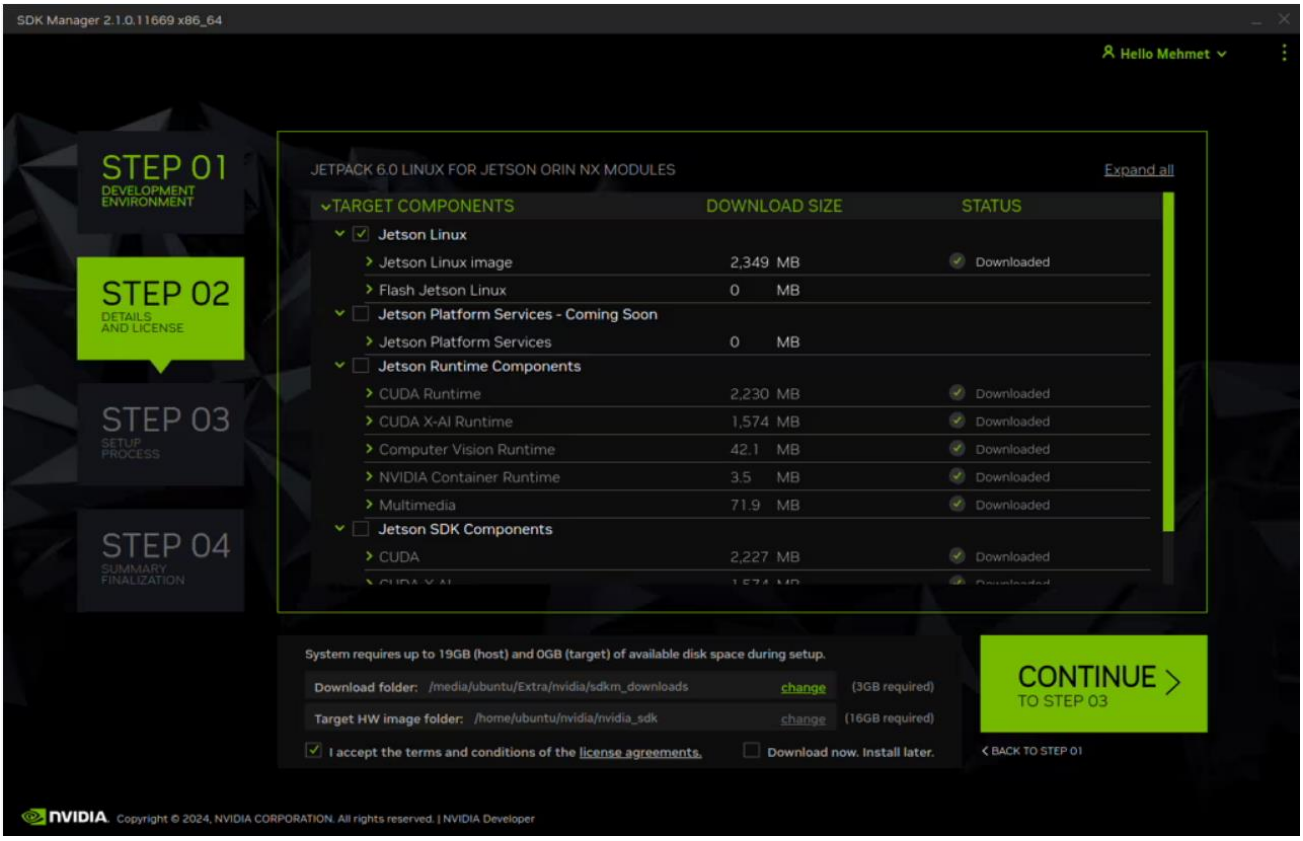
Attention: This tutorial is compatible for all types of Jetson Orin NX and Orin Nano modules. Only the BSP archive differs.

Including the Kernel Files in Jetson OS Image

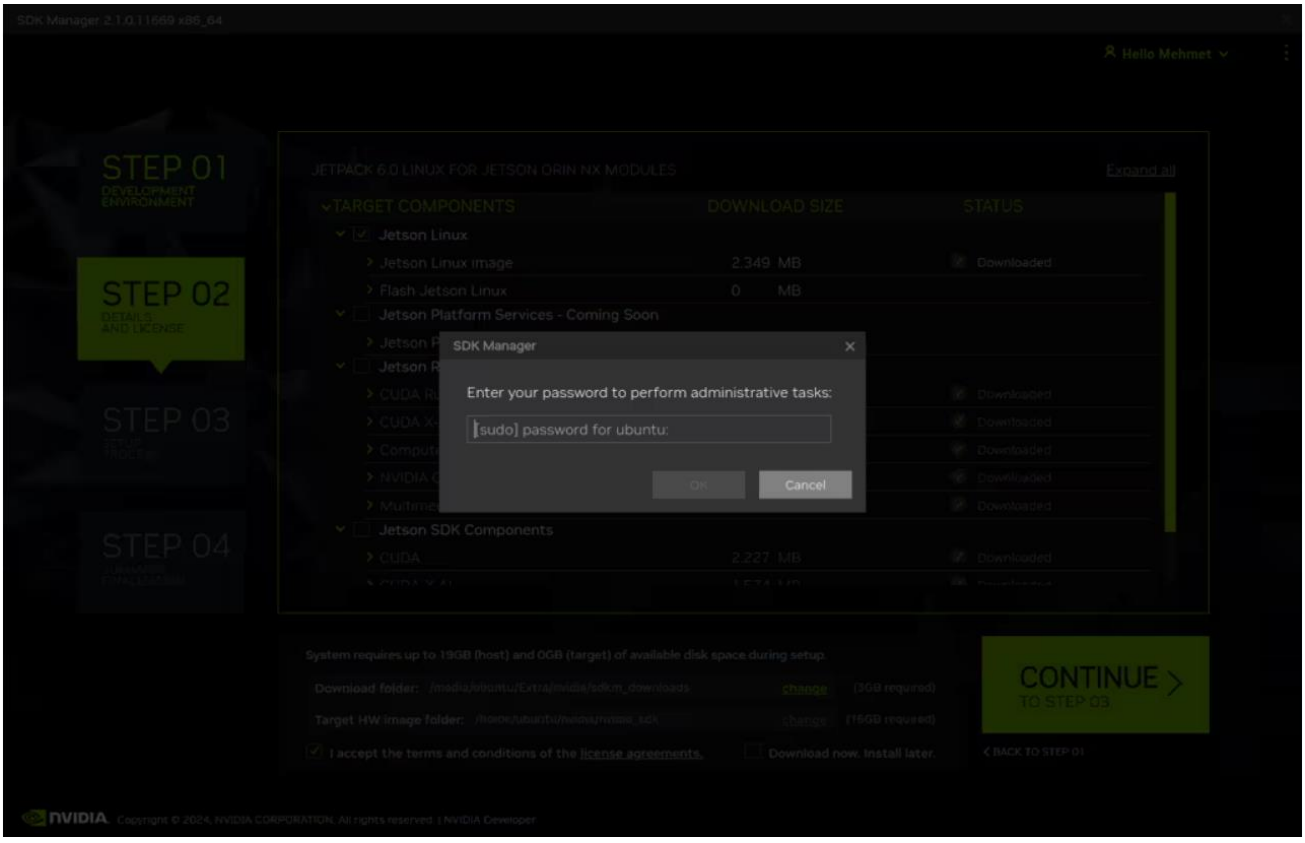
Open the NVIDIA SDK Manager (https://developer.nvidia.com/sdk-manager). Select the correct JetPack version for Target Operating System and select the correct module for your installation ("Jetson Orin Nano modules" or "Jetson Orin NX modules"). The "Host Machine" components are not required.

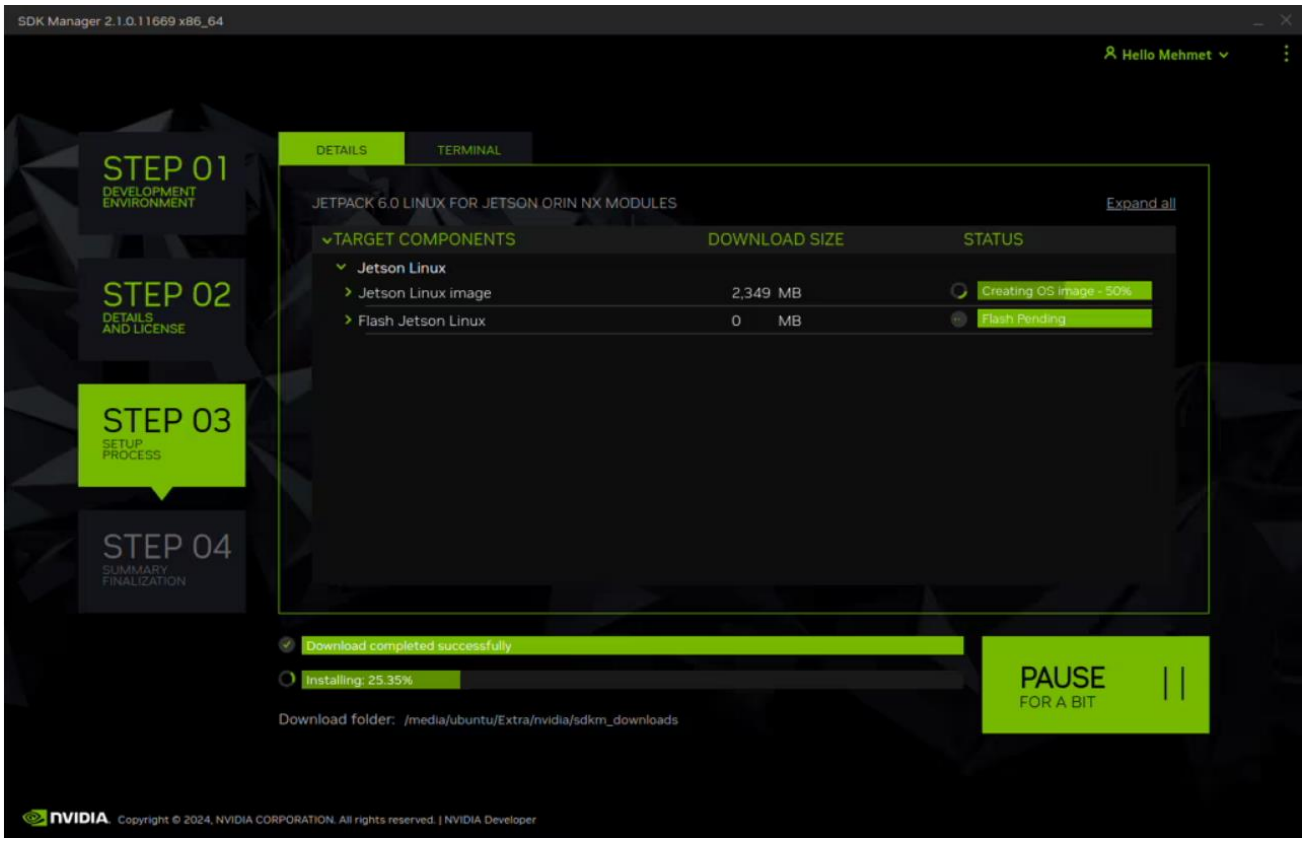
Then, continue to Step 2. (6.0v2)

Choose only "Jetson Linux", accept the terms & conditions and continue to Step 3.

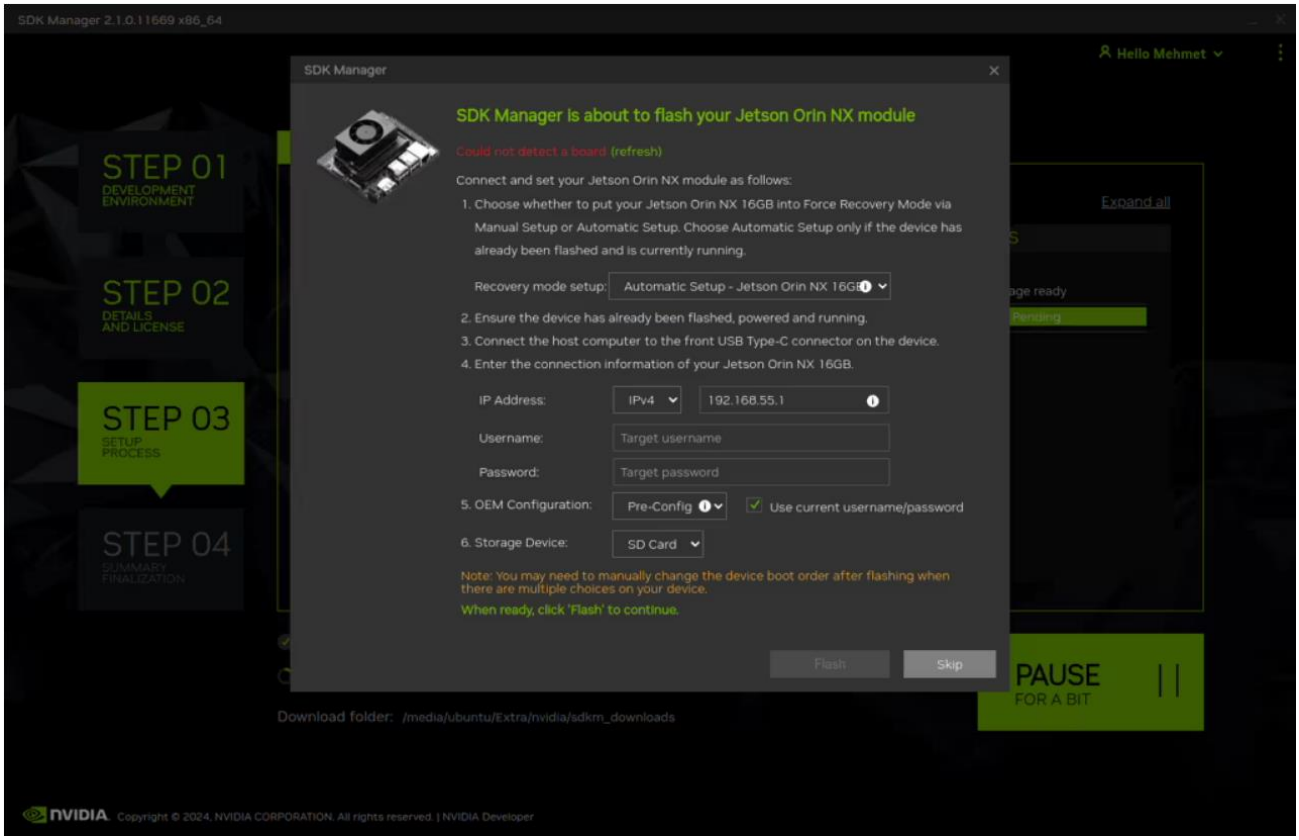


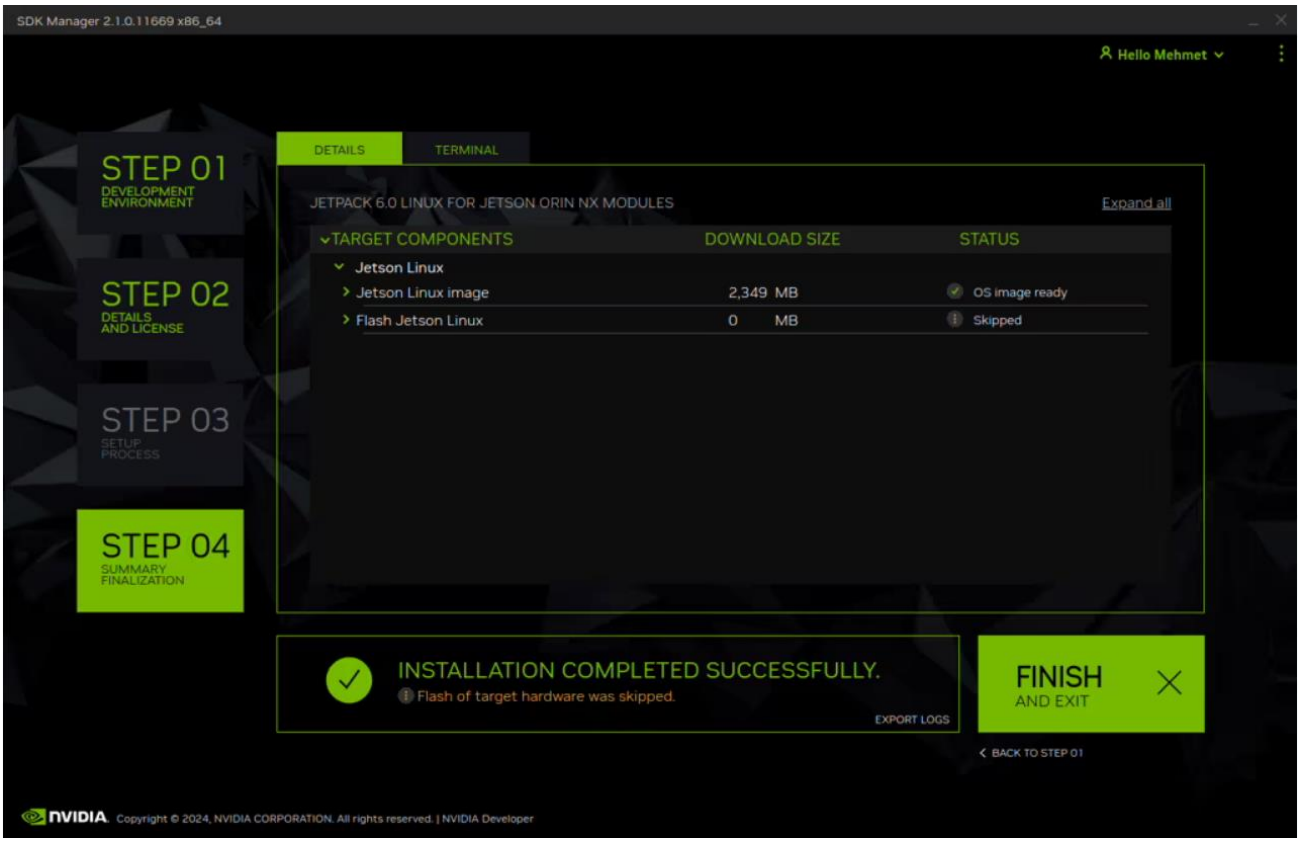
The SDK Manager will ask the username's password. Fill it and continue.





After the Jetson OS has created, the SDK Manager asks the Jetson module's flashing style. Just skip it and exit from the SDK Manager.





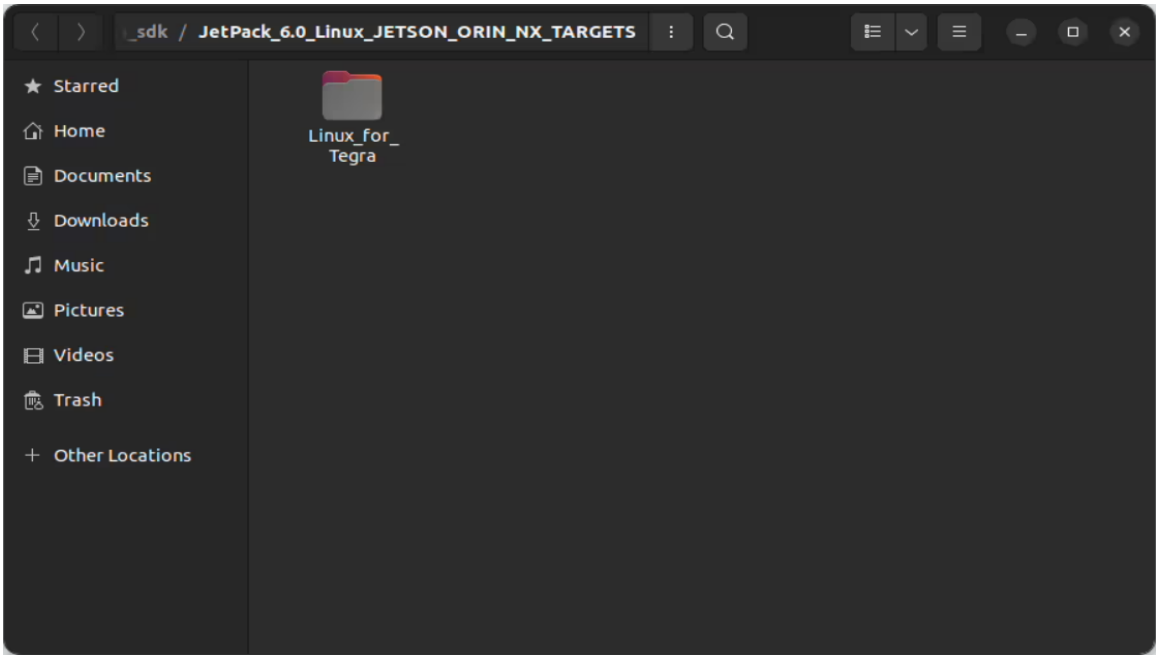
Open the target HW image folder.

For JetPack-6.0

Orin NX: ~/nvidia/nvidia_sdk/JetPack_6.0_Linux_JETSON_ORIN_NX_TARGETS/

For JetPack-6.1

Orin NX: ~/nvidia/nvidia_sdk/JetPack_6.1_Linux_JETSON_ORIN_NX_TARGETS/



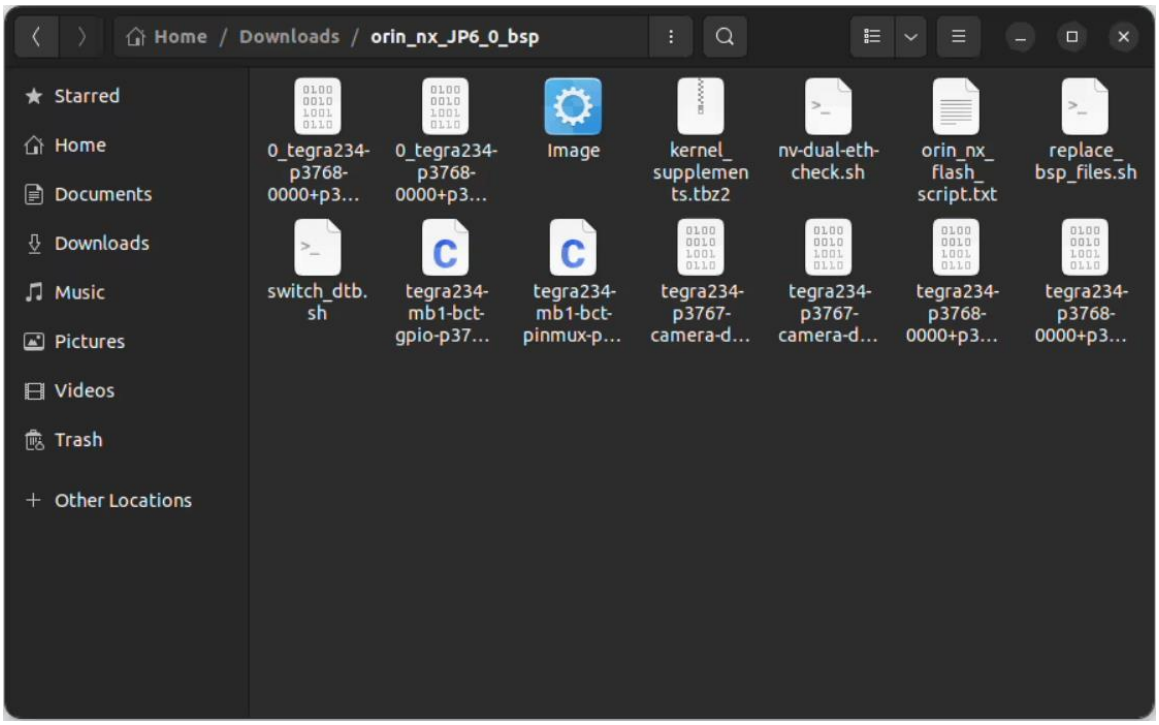
For JetPack-6.0

Download the BSP files from GitHub link and extract it (Orin NX, Orin Nano).

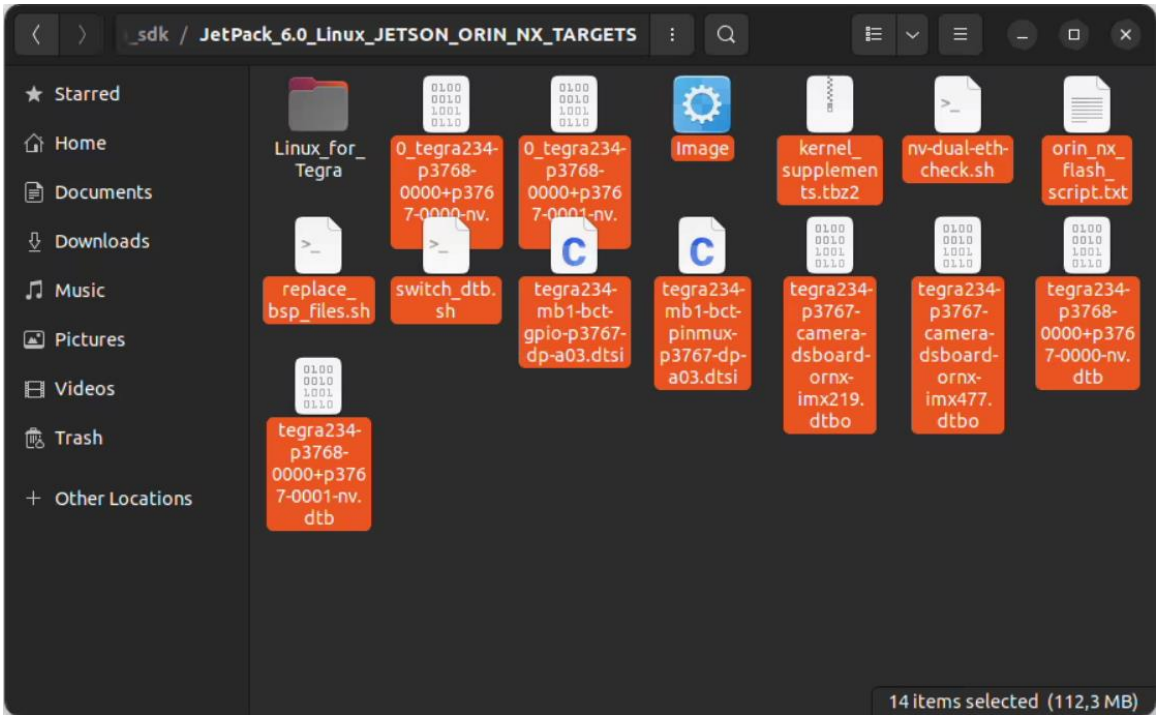
For JetPack-6.1

Download the BSP files from GitHub link and extract it (Orin NX, Orin Nano).

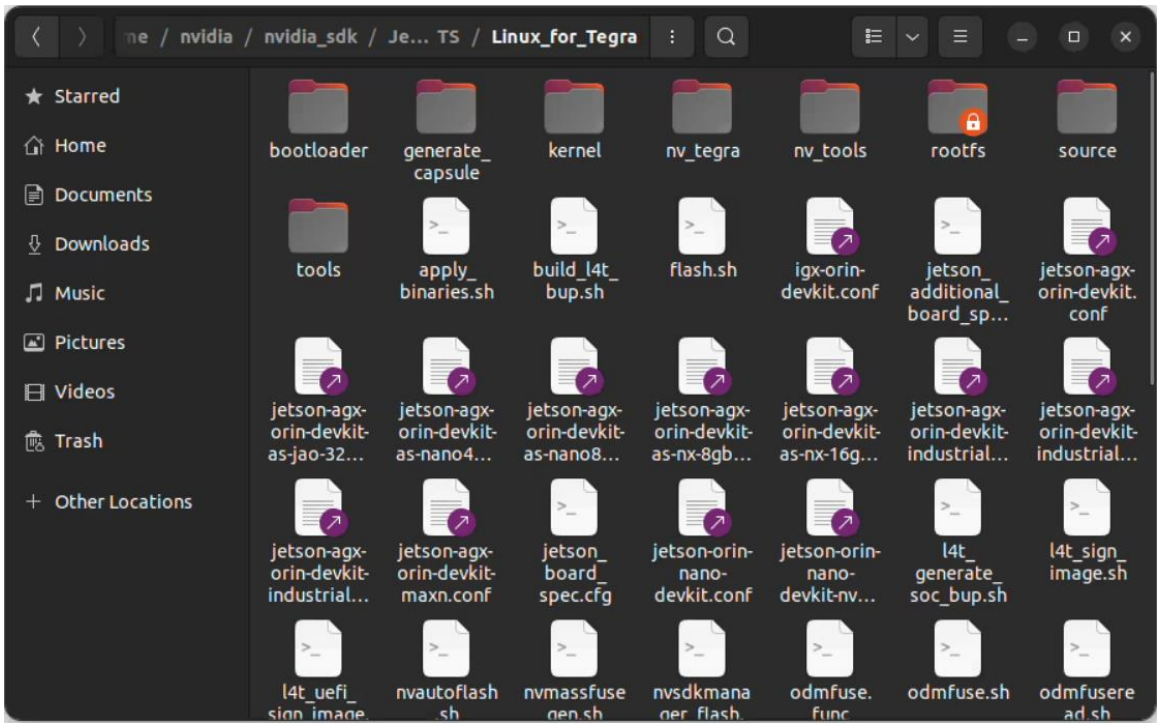
Hint: The following steps have done for Orin NX, but they are the same for the other Jetson module types (only the BSP files and flashing commands are different).



Copy all files to the target HW image folder.



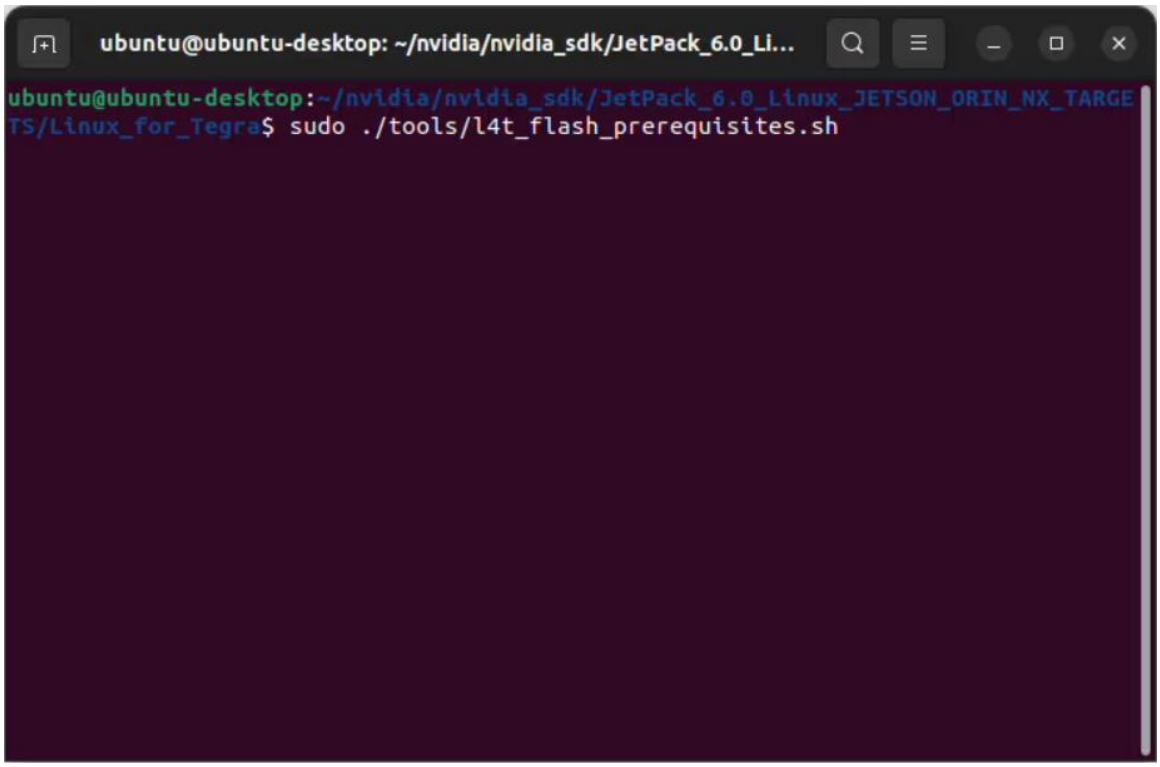
Open a Terminal in the "Linux_for_Tegra" folder.

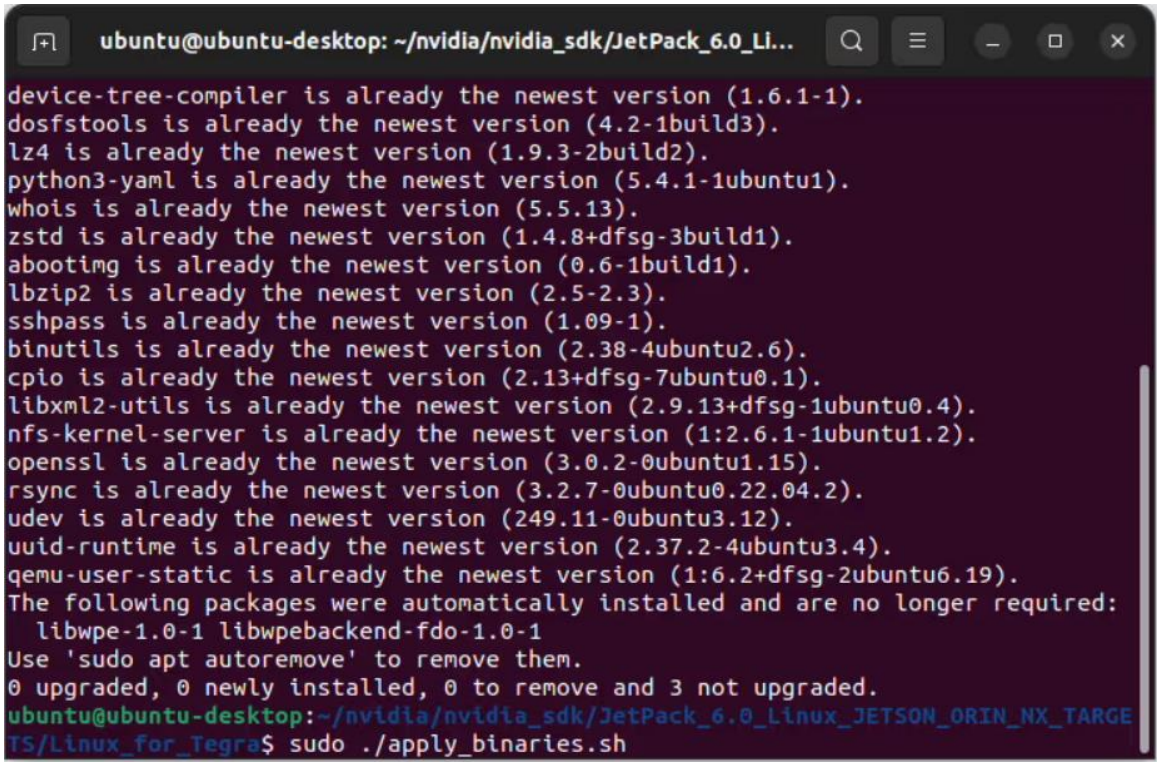


Create the system binaries with these commands below:

sudo ./tools/l4t_flash_prerequisites.sh

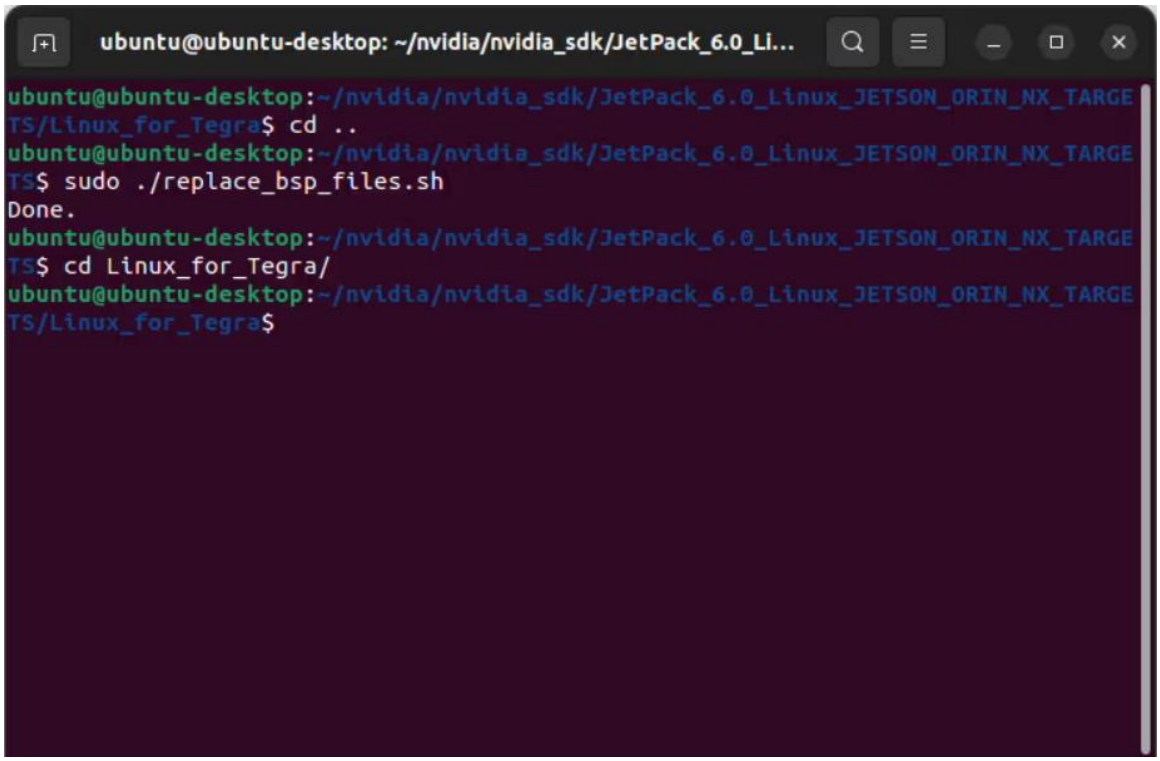
sudo ./apply_binaries.sh





Apply the new BSP files and interface configurations with the following commands below:

cd ..
sudo ./replace_bsp_files.sh
cd Linux_for_Tegra/



Hint: If you want to configure your username-password & hostname with default settings, you can create user without the Ubuntu installation wizard. To do this, the user generation command structure should be:

```
sudo tools/l4t_create_default_user.sh -u {USERNAME} -p {PASSWORD} -a -n {HOSTNAME} --accept-license
```

For example (username:"nvidia", password:"nvidia", device-name:"nvidia-desktop"):

```
sudo tools/l4t_create_default_user.sh -u nvidia -p nvidia -a -n nvidia-desktop --accept-license
```

Jetson OS Installation

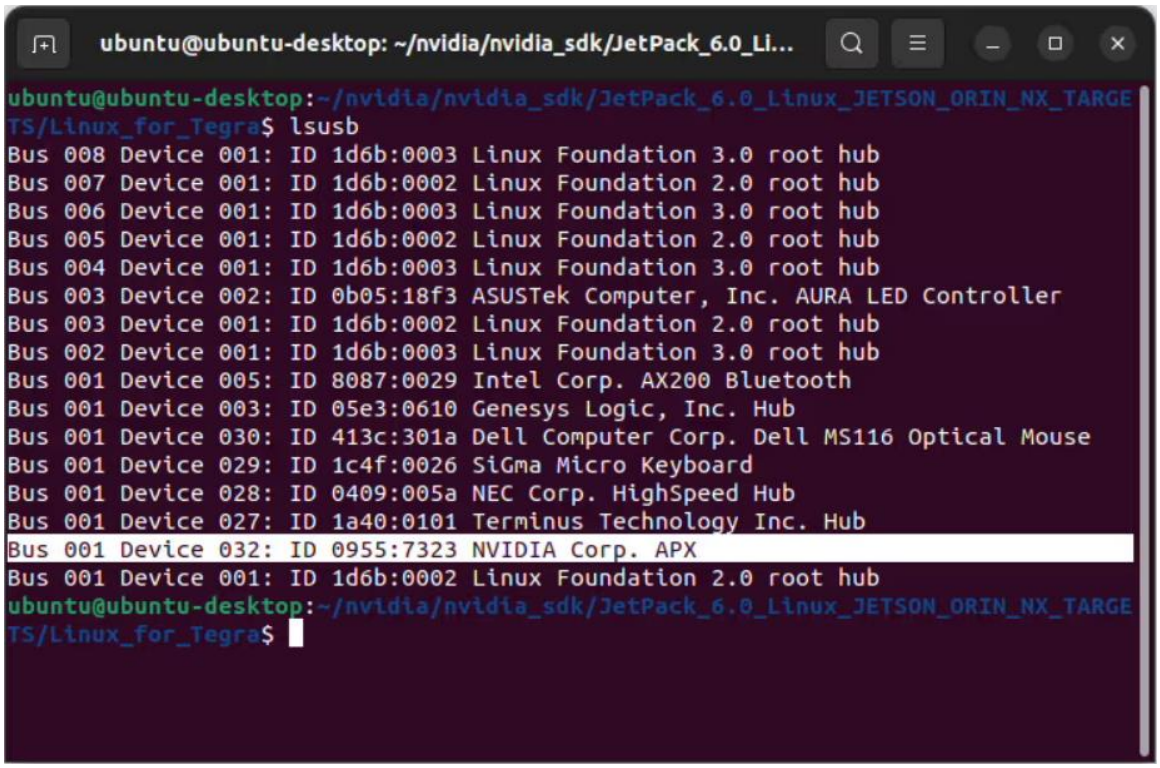
Connect the recovery USB (between installer PC & NV200-2LGS16's recovery USB) and power connection of your NV200-2LGS16.

While the NV200-2LGS16's power connector plugged in,

- press reset & recovery buttons together
- release reset button
- release the recovery button after 3 seconds later. This will set it to Recovery mode.

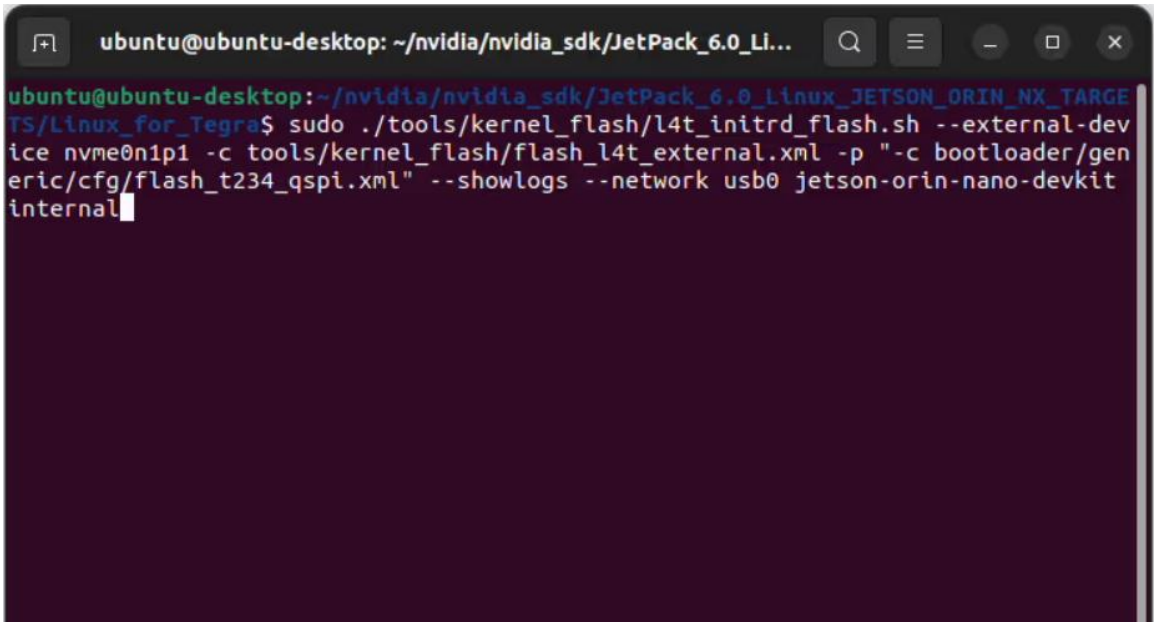
Then, type "lsusb" and check the device connected in Recovery mode.

- **"0955:7323 NVidia Corp." for Orin NX 16GB**
- "0955:7423 NVidia Corp." for Orin NX 8GB

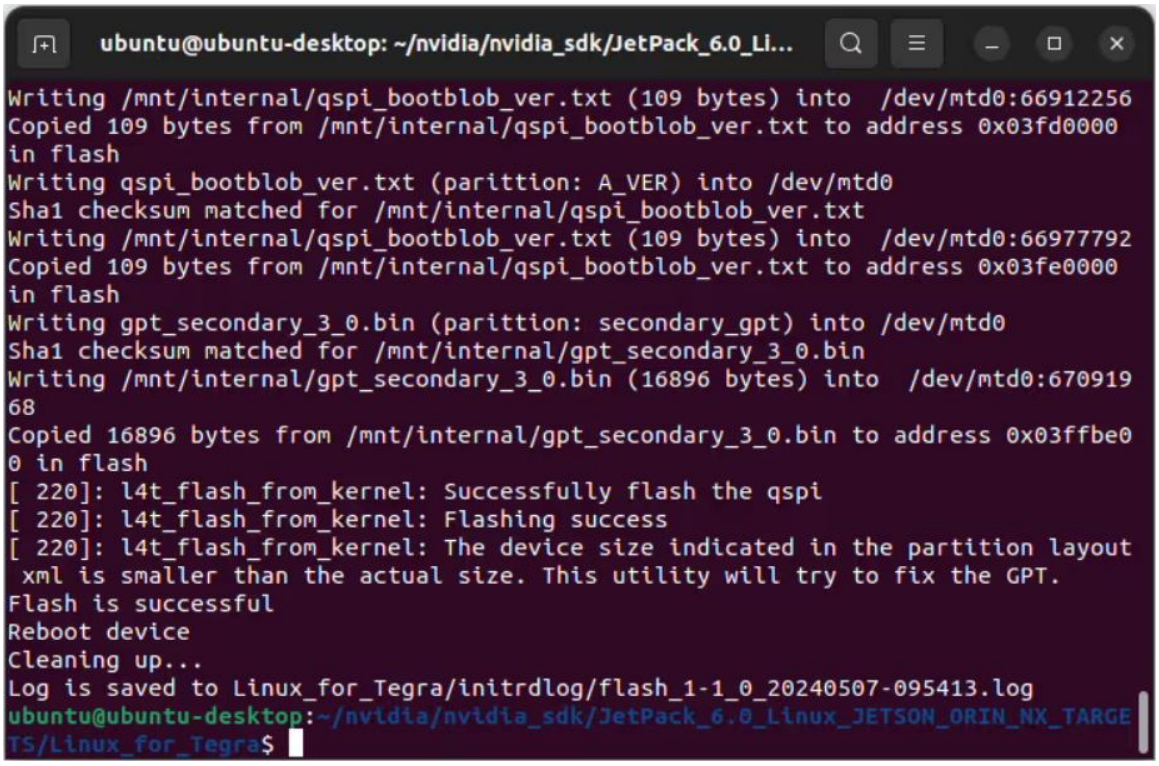


Flash the Jetson OS with this command below:

sudo ./ tools/kernel_flash/l4t_initrd_flash.sh --external-device nvme0n1p1 -c tools/kernel_flash/flash_l4t_external.xml -p "-c bootloader/generic/cfg/flash_t234_qspi.xml" --showlogs --network usb0 jetson-orin-nano-devkit internal

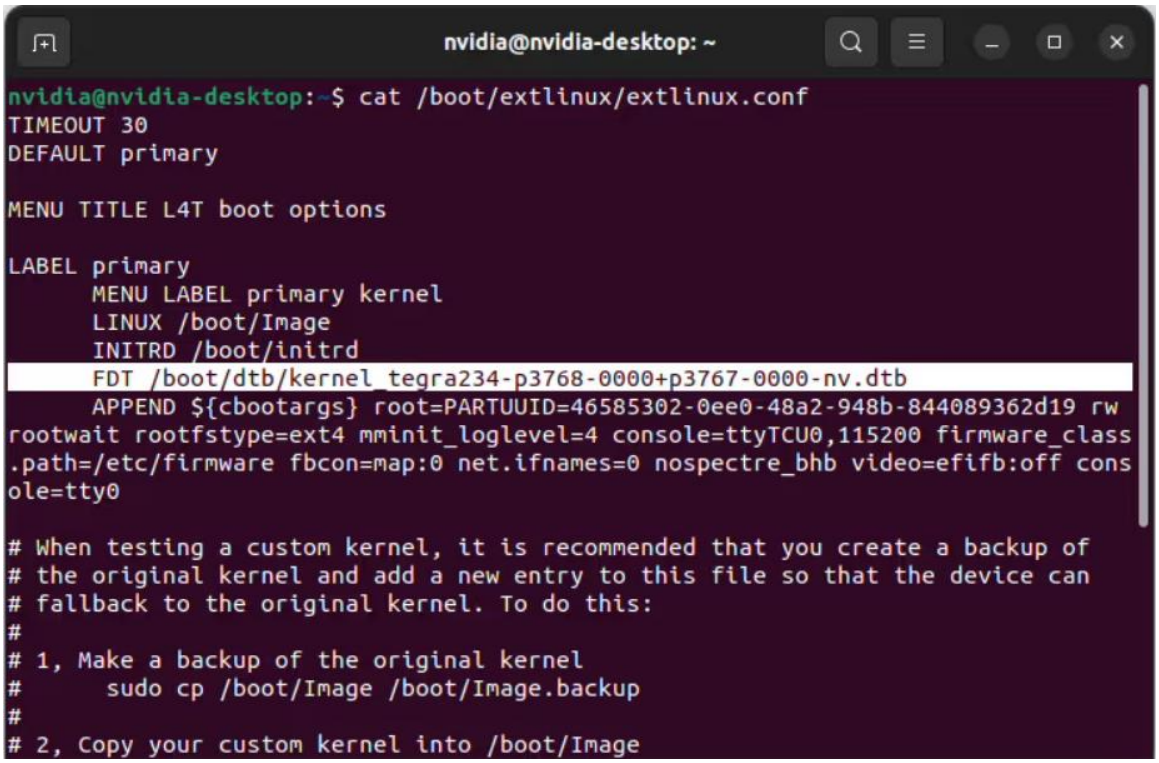


At the end of the script, the device will reboot. Complete your Ubuntu installation wizard (if you have not created a user with tools/l4t_create_default_user.sh script file) from the DSBOARD-ORNX-LAN (language, keyboard type, location, username & password etc.).



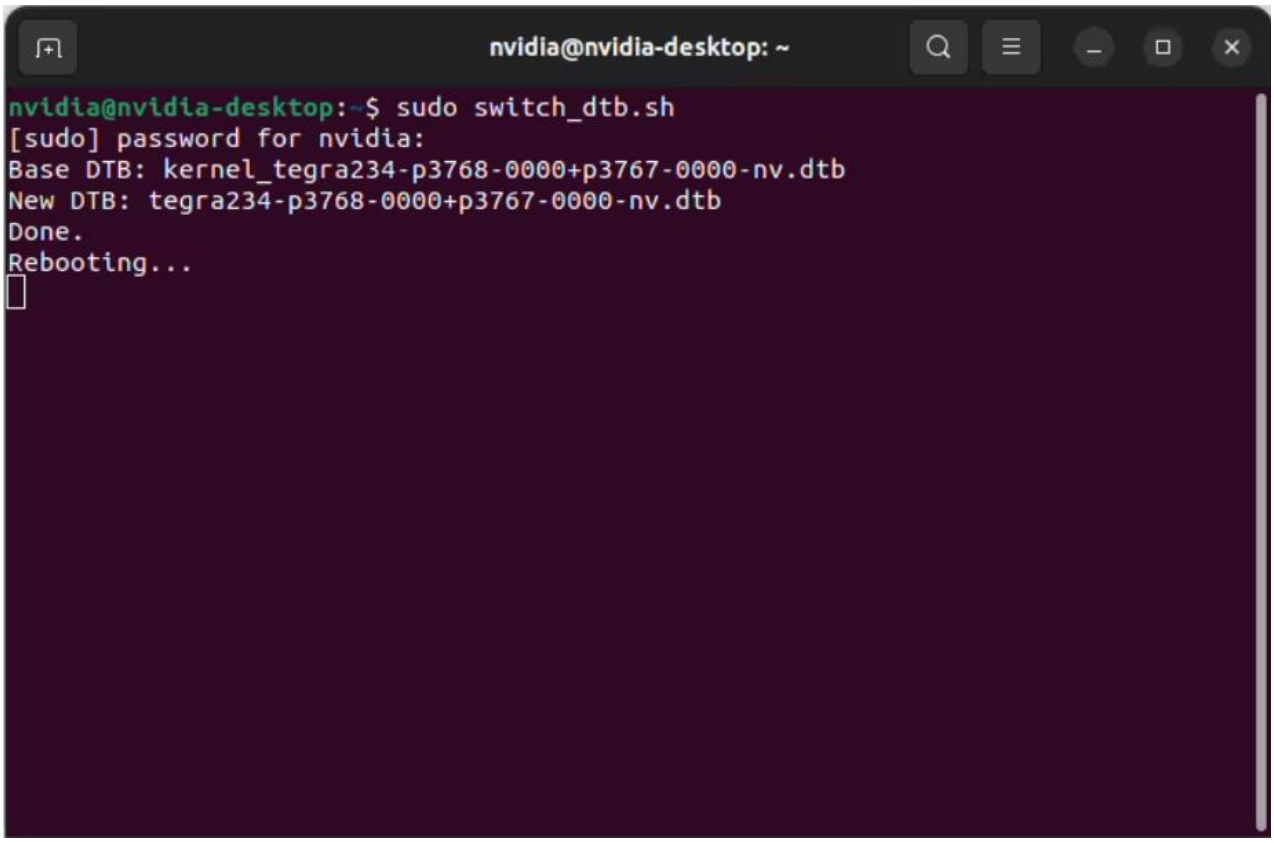
[Optional] If you will use the recovery USB port as host (to be able to connect USB-2 & USB-3 devices),

please verify that the FDT parameter has been applied in the extlinux.conf file. In JetPack-6 installation, this parameter may not included in it. If this parameter is missing in it, please open it with a text editor and write "FDT" with the DTB file (located in the /boot/dtb/ folder).



Then, please open a terminal from the Jetson Orin and type the following command below. This will update its current device-tree and reboot it.
Otherwise, you can use this port for virtual network communication (file transfer etc. between host PC with 192.168.55.1 IP address) in default.

sudo switch_dtb.sh



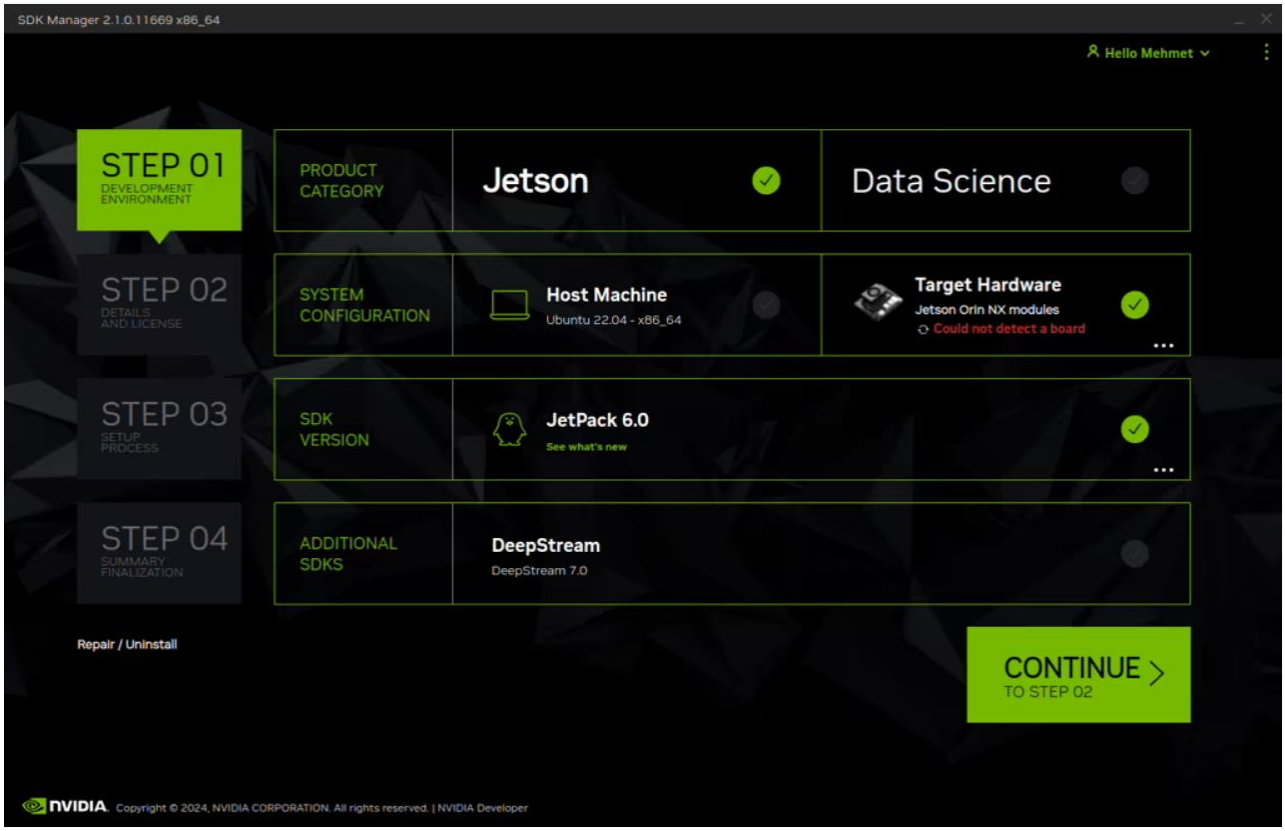
Jetson SDK Components Installation

[Optional] Delete LibreOffice & ThunderBird packages (if you don't need) and remove the unnecessary packages to increase the free space. To do this, type these commands to the NV200-2LGS16 side:

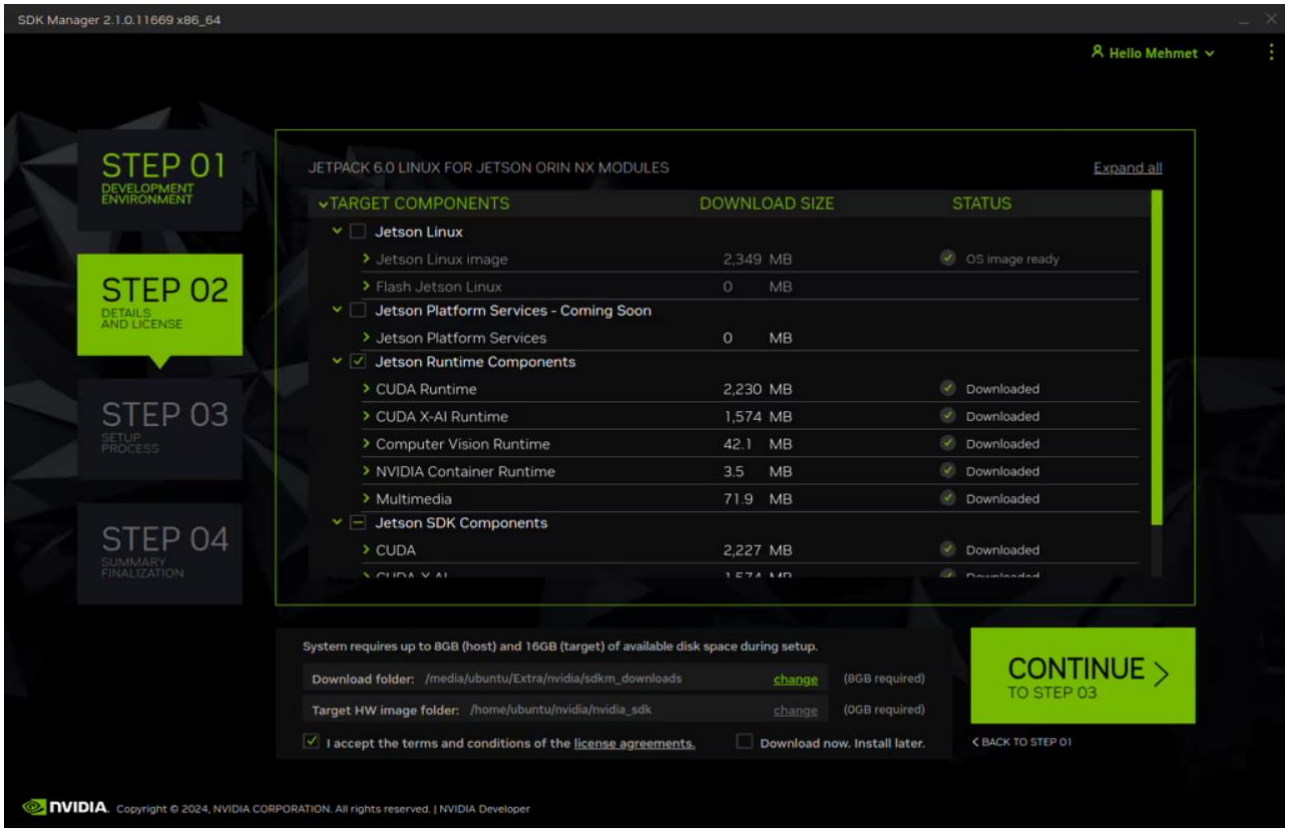
```
sudo apt remove -y libreoffice* thunderbird*
sudo apt autoremove -y
sudo apt clean
```

Connect the NV200-2LGS16 to the Ethernet. Then, Open the NVIDIA SDK Manager. Select the correct JetPack version for Target Operating System and select the correct module for your installation ("Jetson Orin NX modules"). The "Host Machine" components are not required. (Additional SDKs (DeepStream) are optional).

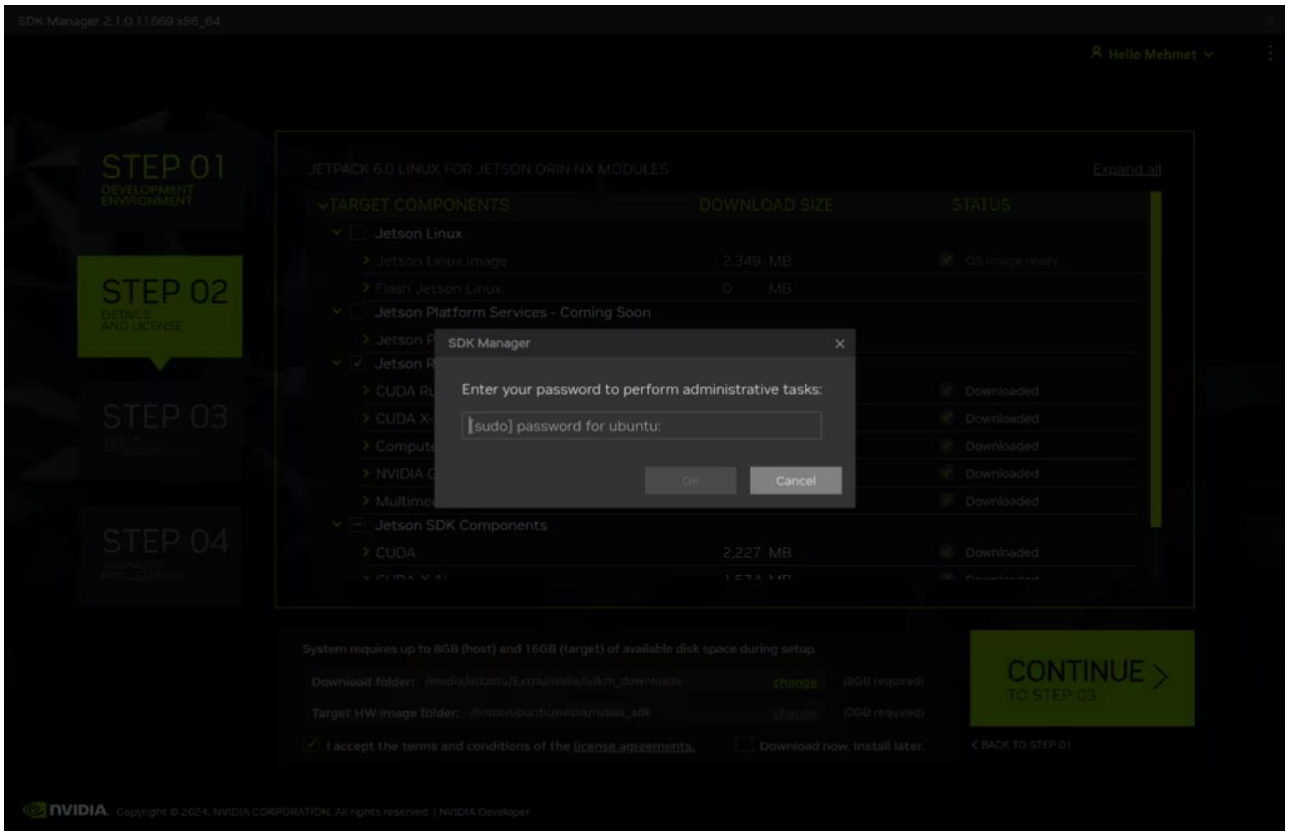
Then, continue to Step 2.



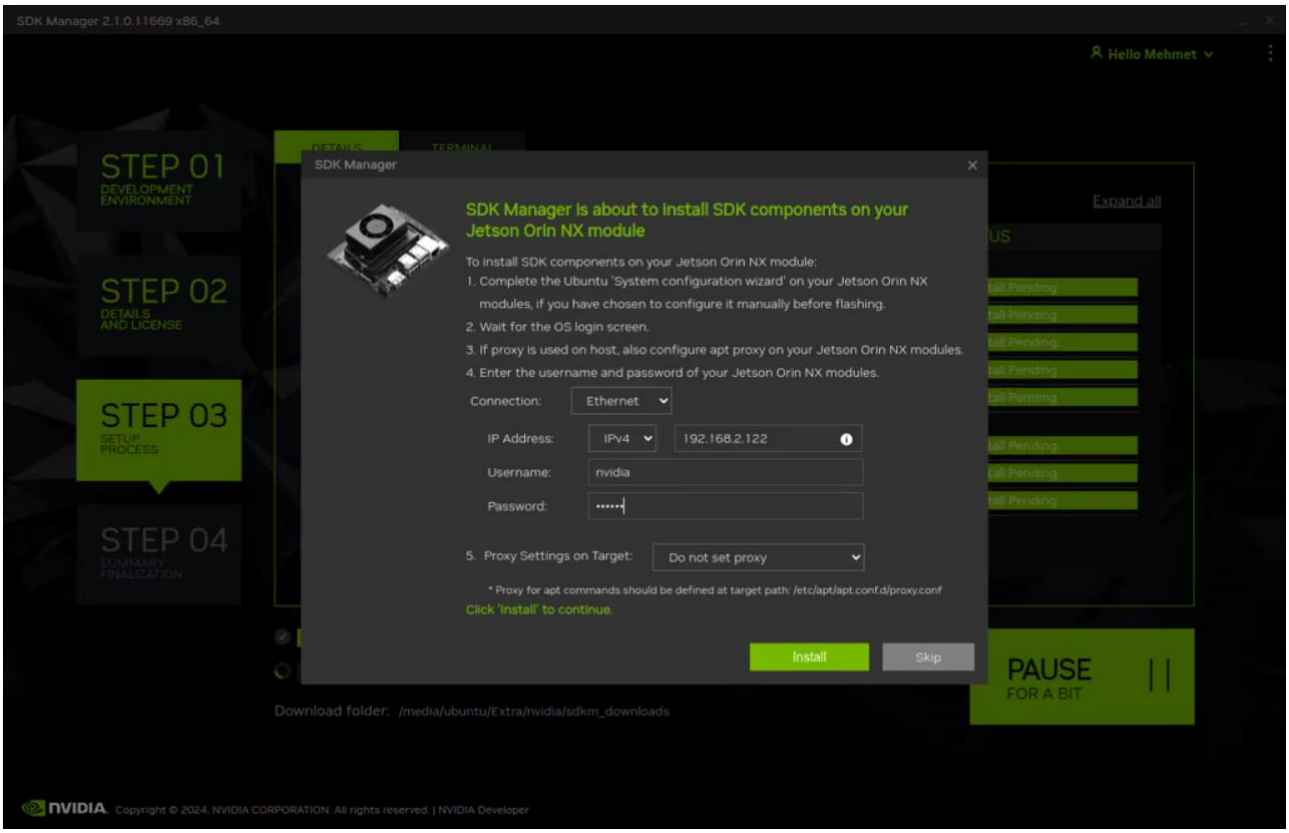
Choose at least "Jetson Runtime Components" ("Jetson SDK Components" are optional. It depends on your use case), accept the terms & conditions and continue to Step 3..



The SDK Manager will ask the username's password. Fill it and continue.



Type the IP address, username and password of Jetson Orin module and install the SDK Components.



At the end of the installation, the NV200-2LGS16 becomes ready.

To avoid kernel update with "apt upgrade" or "apt-get upgrade" commands, please follow this guide on the Jetson module.

Install the driver for GMSL Camera

unzip fg12-4ch-onxa-r36.3.0.zip

sudo apt-get install qt5-qmake qtbase5-dev

(The default is less QT library "libqt5widgets.so.5", which is required for setting)

cd fg12-4ch-onxa-r36.3.0

chmod 777 fg12.4ch.onx.upgrade.sh

sudo ./fg12.4ch.onx.upgrade.sh

Once the installation is complete, you will be prompted with reboot

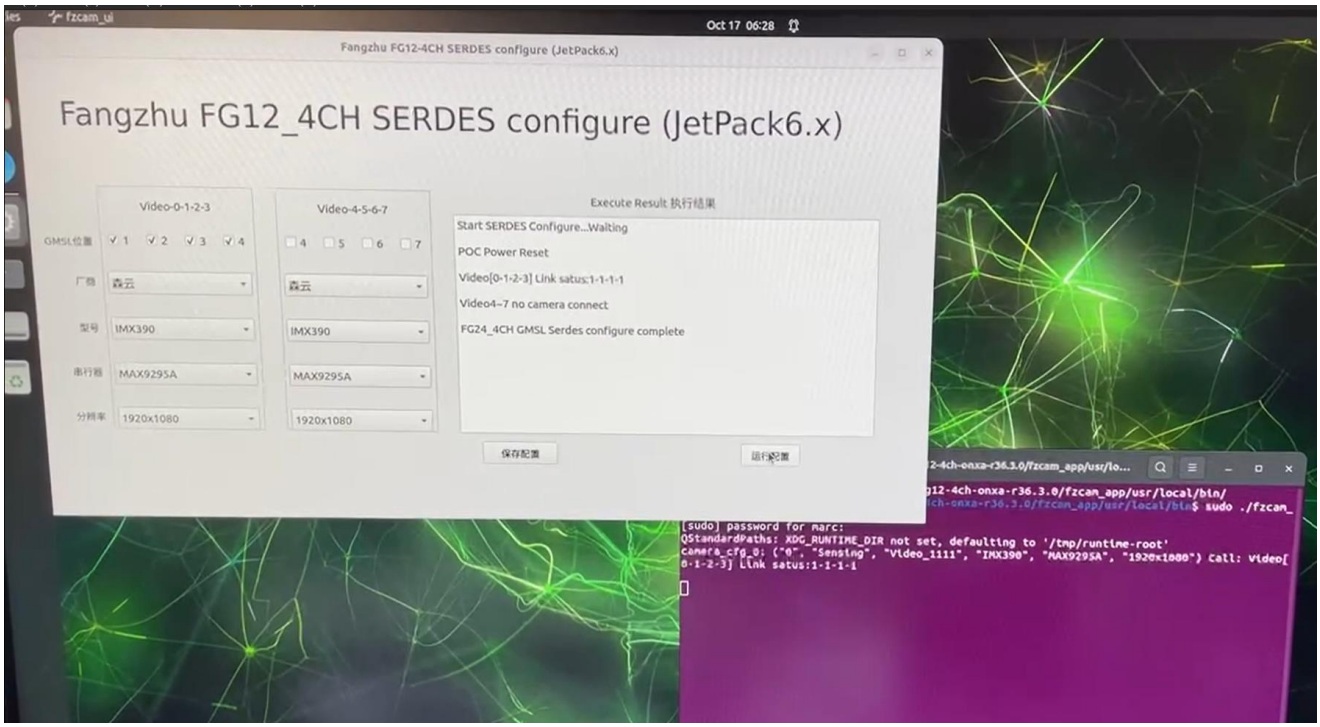
cd fg12-4ch-onxa-r36.3.0/fzcam_app/usr/local/bin/

chmod 777 fzcam_ui

sudo ./fzcam_ui

Set the parameters as follows:

1. GMSL position 1/2/3/4
2. Model IMX390
3. Serializer MAX9295A
4. Resolution 1920x1080
5. Press "Save Configuration" (“保存配置”)
6. Press "Run Configuration" (“運行配置”) -> With four cameras installed, the Link status should be 1-1-1-1



Install the driver for 3G-SDI Camera

unzip 20240925_V1350_orin_5.15.136-tegra_r36.3_arm64.zip
cd 20240925_V1350_orin_5.15.136-tegra_r36.3_arm64/release
chmod +x *.sh
sudo ./setup.sh
reboot

Check device -Camera is connected

sudo apt-get install v4l-utils
(install the v4L2 utility, if you haven't already)
v4l2-ctl --list-devices
It will show as below.
PS: "SC0710" is SDI camera; And you can check device ID after reboot.

```
elease$ v4l2-ctl --list-devices
SC0710:RAW 00.00 0004f71a (PCI Bus 0004:01 12ab0710):
        /dev/video0
        /dev/video9
        /dev/video10
        /dev/video11
```

Capture Camera stream

GMSL Camera:

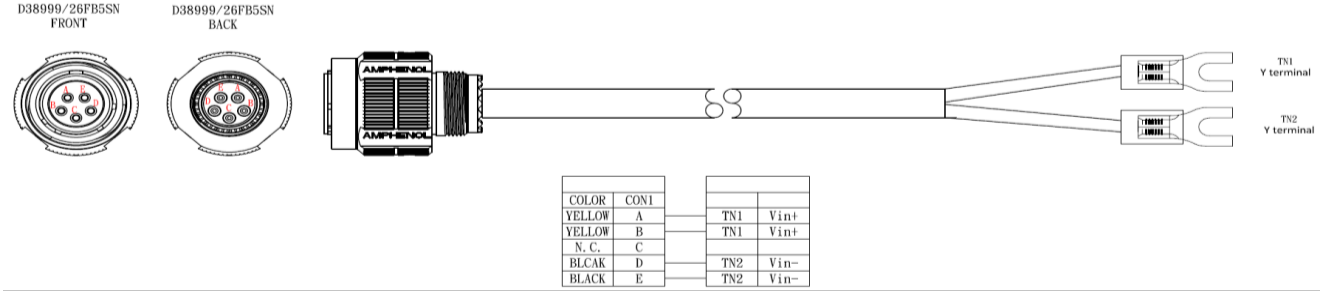
gst-launch-1.0 v4l2src device=/dev/video X(device ID) ! 'video/x-raw,format=UYVY,width=1920,height=1080' ! videoconvert ! fpsdisplaysink video-sink=xvimagesink sync=false\

3G-SDI Camera:

gst-launch-1.0 v4l2src device=/dev/video X(device ID) ! video/x-raw,width=1920,height=1080,format=YV12 ! videoconvert ! xvimagesink

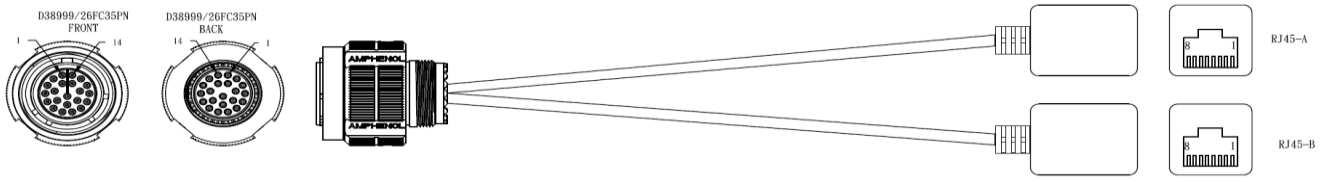
Appendex-A : Cable Pin Define

X0: DC-in Power cable:



COLOR	CON1		
YELLOW	A	TN1	Vin+
YELLOW	B	TN1	Vin+
N. C.	C		
BLCAK	D	TN2	Vin−
BLACK	E	TN2	Vin−

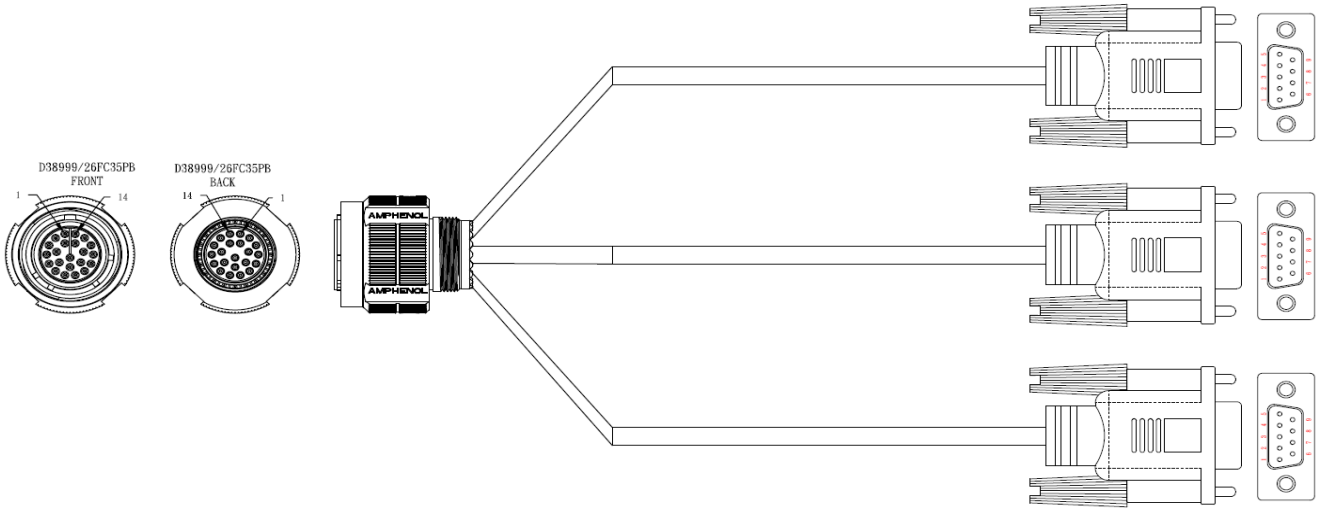
X1: 2x 1GbE LAN cable:



CON1	RJ45-A	WIRE COLOR
1	1	WHITE/ORANGE
2	2	ORANGE
3	3	WHITE/GREEN
4	6	GREEN
5	4	BLUE
6	5	WHITE/BLUE
15	7	WHITE/BROWN
16	8	BROWN
7	SHELL	BLACK
17	SHELL	BLACK
18	SHELL	BLACK

CON1	RJ45-B	WIRE COLOR
8	1	WHITE/ORANGE
9	2	ORANGE
10	3	WHITE/GREEN
11	6	GREEN
12	4	BLUE
13	5	WHITE/BLUE
19	7	WHITE/BROWN
20	8	BROWN
14	SHELL	BLACK
21	SHELL	BLACK
22	SHELL	BLACK

X2: 1x CAN+1x RS232/422/485 + 4x DIO cable:



CON1	9-PIN for COM	
1	4	RS422 B
2	3	RS232 RX/RS422 A
3	1	RS422 Y/RS485 A
4	2	RS232 TX/RS422 Z /RS485 B
5	5	GND

CON1	9-PIN for DIO	
9	1	DIO_OUT_1
10	2	DIO_OUT_0
11	3	DIO_IN_1
12	4	DIO_IN_0
13	5	GND
14	shell	GND

CON1	9-PIN for CANBus	
6	7	CAN_H
7	2	CAN_L
8	3	GND