




# LEETOP ALP-609 Jetson Orin NX User Manual

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# LEETOP

## LEETOP ALP-609 Jetson Orin NX



## Notice

- Please read the manual carefully before installing, operating, or transporting the Leetop device.
- Ensure that the correct power range is being used before powering the device.
- Avoid hot plugging.
- To properly turn off the power, please shut down the Ubuntu system first, and then cut off the power. Due to the particularity of the Ubuntu system, on the Nvidia developer kit, if the power is turned off when the
- startup is not completed, there will be a 0.03% probability of abnormality, which will cause the device to fail to start. Due to the use of the Ubuntu system, the same problem also exists on the Leetop device.
- Do not use cables or connectors other than those described in this manual.
- Do not use a Leetop device near strong magnetic fields.
- Back up your data before transportation or the Leetop device is idle.
- Recommend transporting the Leetop device in its original packaging.
- Warn! This is a Class A product, in a living environment this product may cause radio interference. In this case, the user may be required to take practicable measures against the interference.
- Working in a high-temperature environment for a long time, it is not recommended to touch the shell to avoid burns.
- Dismantling the machine without consent is regarded as a waiver of the warranty.



## Service and Support

Leetop is glad to help you with any questions you may have about our product, or about the use of the technology for your application. The fastest way is to send us an email: [service@leetop.top](mailto:service@leetop.top)

## Warranties

Warranty period: One year from the date of delivery. Warranty content: Leetop warrants the product manufactured by us to be free from defects in material and workmanship during the warranty period. Please contact [service@leetop.top](mailto:service@leetop.top) for return material authorization (RMA) prior to returning any items for repair or exchange. The product must be returned in its original packaging to prevent damage during shipping. Before returning any product for repair, it is recommended to back up your data and delete any confidential or personal data.

## Packing Lis

- Leetop\_ALP\_609\_F x 1
- Non-standard equipment Power adapter x 1
- Power cord x 1

DOCUMENT CHANGE HISTORY

Document	Version	date	History
Leetop_ALP_609_F	V1.0	20230515	
	V1.0.1	20230609	
	V1.1	20230727	Operating temperature changes
	V1.2	20230818	Add SIM_ Card, change structure diagram

Leetop\_ALP\_609\_F product introduction

Brief

Leetop\_ALP\_609\_F is an embedded artificial intelligence computer that can provide computing power up to 20/40/70/100 TOPS for many terminal devices. Leetop\_ALP\_609\_F provides a fast active cooling design, which can meet industrial standards such as shock resistance and anti-static. At the same time, Leetop\_ALP\_609\_F has rich interfaces and high-cost performance.



Specifications

Processor module

Processor	Jetson Orin Nano 4GB	Jetson Orin Nano 8GB
<b>AI Performance</b>	20 TOPS	40 TOPS
<b>GPU</b>	512-core NVIDIA Ampere architecture GPU with 16 Tensor Cores	1024-core NVIDIA Ampere architecture GPU with 32 Tensor Cores
<b>CPU</b>	6-core Arm® Cortex®-A78AE v8.2 64-bit CPU 1.5MB L2 + 4MB L3	6-core Arm® Cortex®-A78AE v8.2 64-bit CPU 1.5MB L2 + 4MB L3
<b>Memory</b>	4GB 64-bit LPDDR5 34 GB/s	8GB 128-bit LPDDR5 68 GB/s
<b>Storage</b>	(Supports external NVMe)	(Supports external NVMe)
<b>Power</b>	5W – 10W	7W – 15W
<b>PCIe</b>	1 x4 + 3 x1 (PCIe Gen3, Root Port, & Endpoint)	1 x4 + 3 x1 (PCIe Gen3, Root Port, & Endpoint)
<b>CSI Camera</b>	Up to 4 cameras (8 via virtual channels***) 8 lanes MIPI CSI-2 D-PHY 2.1 (up to 20Gbps)	Up to 4 cameras (8 via virtual channels***) 8 lanes MIPI CSI-2 D-PHY 2.1 (up to 20Gbps)
<b>Video Encode</b>	1080p30 supported by 1-2 CPU cores	1080p30 supported by 1-2 CPU cores
<b>Video Decode</b>	1x 4K60 (H.265) 2x 4K30 (H.265) 5x 1080p60 (H.265) 11x 1080p30 (H.265)	1x 4K60 (H.265) 2x 4K30 (H.265) 5x 1080p60 (H.265) 11x 1080p30 (H.265)
<b>Display</b>	1x 4K30 multi-mode DP 1.2 (+MST)/eDP 1.4/HDMI 1.4**	1x 4K30 multi-mode DP 1.2 (+MST)/eDP 1.4/HDMI 1.4**
<b>Networking</b>	10/100/1000 BASE-T Ethernet	10/100/1000 BASE-T Ethernet
<b>Mechanical</b>	69.6mm x 45mm 260-pin SO-DIMM connector	69.6mm x 45mm 260-pin SO-DIMM connector

Processor	Jetson Orin NX 8GB	Jetson Orin NX 16GB
<b>AI Performance</b>	70 TOPS	100 TOPS
<b>GPU</b>	1024-core NVIDIA Ampere GPU with 32 Tensor Cores	1024-core NVIDIA Ampere GPU with 32 Tensor Cores
<b>CPU</b>	6-core NVIDIA Arm® Cortex A78AE v8.2 64-bit CPU 1.5MB L2 + 4MB L3	8-core NVIDIA Arm® Cortex A78AE v8.2 64-bit CPU 2MB L2 + 4MB L3
<b>Memory</b>	8 GB 128-bit LPDDR5 102.4 GB/s	16 GB 128-bit LPDDR5 102.4 GB/s
<b>Storage</b>	(Supports external NVMe)	(Supports external NVMe)
<b>Power</b>	10W – 20W	10W – 25W
<b>PCIe</b>	1 x4 + 3 x1 (PCIe Gen4, Root Port & Endpoint)	1 x4 + 3 x1 (PCIe Gen4, Root Port & Endpoint)
<b>CSI Camera</b>	Up to 4 cameras (8 via virtual channels***) 8 lanes MIPI CSI-2 D-PHY 2.1 (up to 20Gbps)	Up to 4 cameras (8 via virtual channels***) 8 lanes MIPI CSI-2D-PHY 2.1 (up to 20Gbps)
<b>Video Encode</b>	1x4K60   3x4K30   6x1080p60   12x1080p30(H.265) 1x4K60   2x4K30   5x1080p30   11x1080p30(H.264)	1x 4K60   3x 4K30   6x 1080p60   12x 1080p30 (H.265) 1x 4K60   2x 4K30   5x 1080p60   11x 1080p30 (H.264)
<b>Video Decode</b>	1x8K30   2x4K60   4x4K30   9x1080p60   18x1080p30(H.265) 1x4K60   2x4K30   5x1080P60   11x1080P30(H.264)	1x 8K30   2x 4K60   4x 4K30   9x 1080p60   18x 1080p30 (H.265) 1x 4K60   2x 4K30   5x 1080p60   11x 1080p30 (H.264)

<b>Display</b>	1x 8K60 multi-mode DP 1.4a (+MST)/eDP1.4a/HDMI 2.1	1x 8K60 multi-mode DP 1.4a (+MST)/eDP1.4a/HDMI 2.1
<b>Networking</b>	10/100/1000 BASE-T Ethernet	10/100/1000 BASE-T Ethernet
<b>Mechanical</b>	69.6mm x 45mm 260-pin SO-DIMM connector	69.6mm x 45mm260-pin SO-DIMM connector

## I/O

Interface	Specification
PCB Size / Overall Size	210X132X54mm
Display	1x HDMI
Ethernet	5x Gigabit Ethernet (10/100/1000)
USB	4x USB 3.0 Type A (Integrated USB 2.0) 1x USB 2.0+3.0 Type C
20PIN IO CON	20PIN Multifunction
Audio	1x Audio
Function key	1x Power; 1x Recovery; 1x Reset key
Power Requirements	+12~+36VDC Input NO PSE Device Max 80W , With PSE Device(Max 150W)

## Power Supply

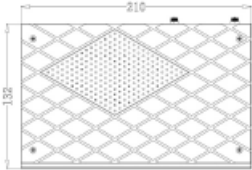


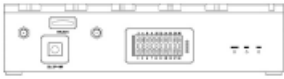
Power Supply	Specification
Input Type	DC
Input Voltage	+12~+36VDC Input NO PSE Device Max 80W , With PSE Device(Max 150W)

## Environmental

Environmental	Specification
Operating Temperature	-25 °C to +65°C
Storage Temperature/Humidity	-25°C-65°C/ 10%-90% Noncondensation environment

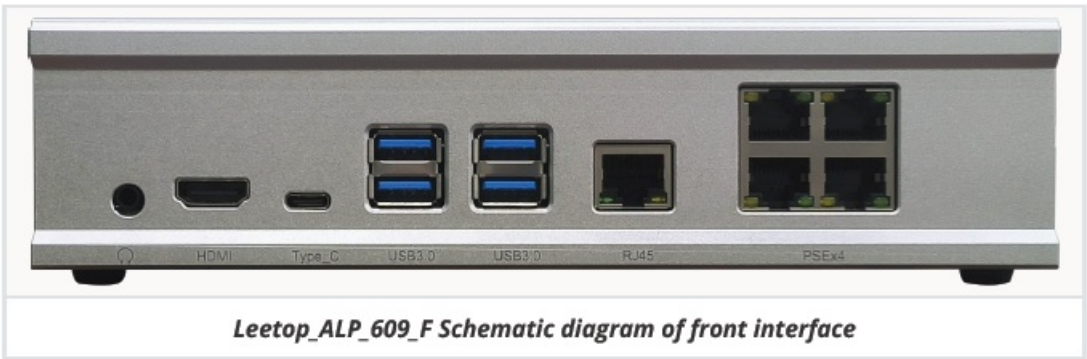
Install Dimension

Leetop\_ALP\_609\_F Dimensions as below:

Up view (Unit:mm)	Front view (Unit:mm)
	
Left view (Unit:mm)	Rear view(Unit:mm)
	

Interface description

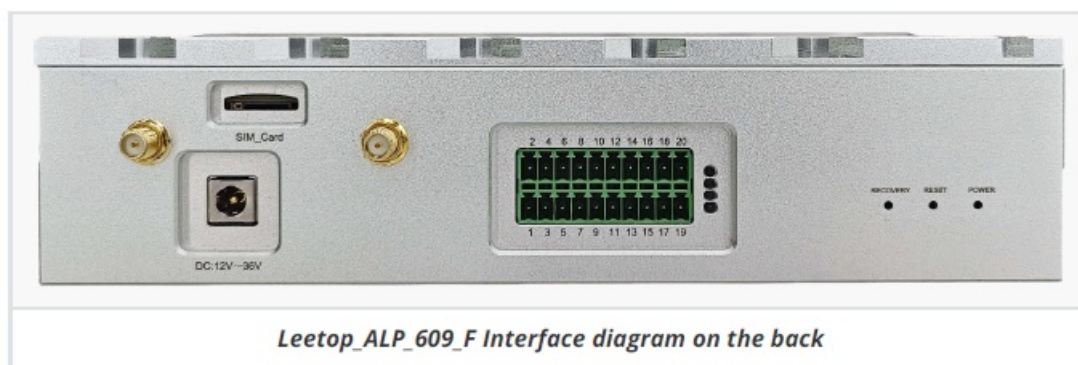
Front interface



Interface	Interface name	Interface description
HDMI	HDMI	1xHDMI interface
USB 3.0	USB 3.0 interface	4xUSB3.0 Type-A interface (compatible with USB2.0) 1xUSB 2.0+3.0 Type C
RJ45	Ethernet Gigabit port	5x Gigabit Ethernet (10/100/1000)
Audio	Audio interface	plug-in audio cable

**Note:** This product starts automatically when plugged in

## Rear interface



Interface	Interface name	Interface description
DC	DC power interface	+12--+36VDC Input NO PSE Device Max 80W , With PSE Device(Max 150W)
Recovery	Recovery button	System recovery button
Reset	Reset button	System reset button
Power	Power button	System power button
20PIN IO CON	20PIN Multifunction	Debug serial port
SIM_Card	SIM card slot	SIM card can be inserted

## 20PIN IO CON



PIN	Signal Name	PIN	Signal Name
1	CAN_H	2	CAN_L
3	RS232_RX0	4	RS232_TX0
5	RS485_B	6	RS485_A
7	I2C1_SCL	8	I2C1_SDA
9	VDD_3V3_SYS	10	GND
11	UART2_RXD_LS	12	UART2_TXD_LS
13	SPI0_SCK_LS	14	SPI0_MOSI_LS
15	SPI0_CS0_LS	16	SPI0_MISO_LS
17	GPIO2_LS	18	SPI0_CS1_LS
19	VDD_5V_SYS	20	GND

### Description of the carrier board interface

Carrier plate specification

Feature	A609 Carrier for NVIDIA Jetson Orin NX/Orin NANO
Module Compatibility	Jetson Orin NX/Orin NANO
PCB Size / Overall Size	183mm x 122mm
Display	1x HDMI
Ethernet	5x Gigabit Ethernet (10/100/1000)
USB	4x USB 3.0 Type A (Integrated USB 2.0) 1x USB 2.0+3.0 Type C
M.2 KEY M	1x M.2 KEY M Interface
M.2 KYE E	1x,M.2 KYE E Interface
Camera	120P Camera interface
USB 2.0+3.0	ZIF 20P 0.5mm pitch
FAN	1 x FAN(5V PWM)
CAN	1x CAN, 1CAN Transceiver
RS485	1 x RS485
RS232	1 x RS232
Misc.	1x I2C Link +3.3V I/O 1X SPI Bus(+3.3V Level) 4x LED STATE
Power Requirements	+12~+36VDC Input NO PSE Device Max 80W , With PSE Device(Max 150W)
Operating Temperature	-25 °C to +65 °C
Warranty and Support	1 Year Warranty and Free Support

## Features

Operating system setup

## Hardware Preparation

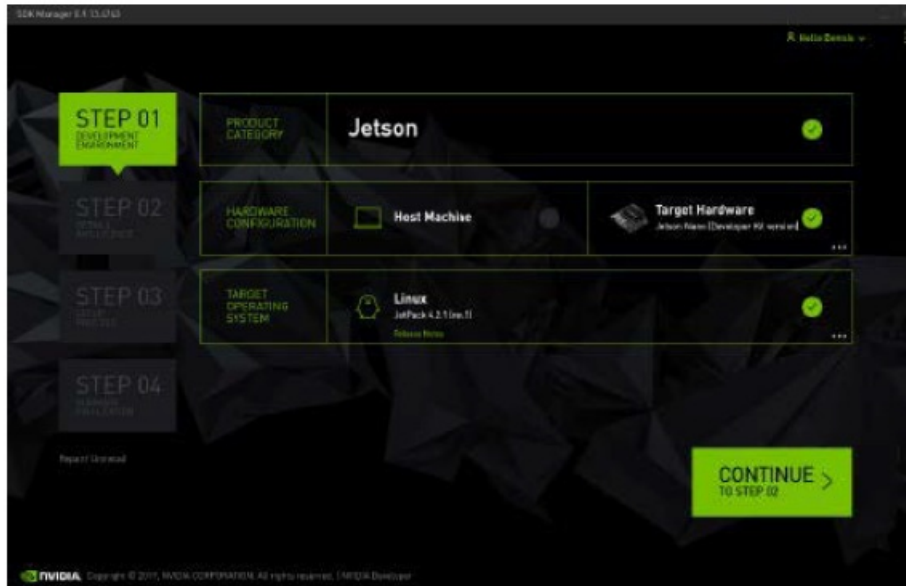
- Ubuntu 18.04 PC x1
- Type-c data cable x1

## Environment requirements

1. Download the system image package to the PC host of the Ubuntu18.04 system:

## Burn-in steps Burn-in steps

2. Use a USB cable to connect the USB Type-A of the PC computer of the Ubuntu18.04 system to the Type c of the Leetop\_ALP\_609\_F Development System;
3. Power on the Leetop\_ALP\_609\_F Development System and enter Recovery mode;
4. Open the Nvidia-SDK-Manager on the PC, as shown in the figure below, and select Jetson Orin Nano/Orin Nx in the interface to download the Jetpack5.xx system image package and development tools, or from <https://developer.nvidia.com/embedded> /downloads Downloads the latest Jetson Linux distribution and the sample filesystem for the Jetson Development Kit. (Jetson Linux Driver Package (L4T)).



```
1 #when using the latest version of SDK to find the corresponding version, you
  can use this command to get it
2 sdkmanager --archivedversions
```

1. Download the matching driver:

orin nx: link: <https://pan.baidu.com/s/1aUCe0kzZmdfPc84Ku2QOBQ> Extraction code: sk9o

orin nano: link: <https://pan.baidu.com/s/1FnjWllsrGr-AUMnqLd6J8g> Extraction code: 4z68

Please contact us for the rest of the information [service@leetop.top](mailto:service@leetop.top)

- Unzip the downloaded image package and enter the Linux for Tegra(L4T) directory

```
1 tar xf ${L4T_RELEASE_PACKAGE}
2 cd Linux_for_tegra/rootfs
3 sudo tar xpf ${SAMPLE_FS_PACKAGE}
4 cd ..
5 sudo ./apply_binaries.sh
6 sudo ./tools/l4t_flash_prerequisites.sh
7 sudo cp -r 609_xxx/Linux_for_tegra /Linux_for_tegra
```

- Enter the Linux\_for\_tegra directory and use the flash command flash to NVMe

```

1 #flash to nvme
2 #orin nano
3 sudo ./tools/kernel_flash/l4t_initrd_flash.sh --external-device nvme0n1p1 -c
  tools/kernel_flash/flash_l4t_external.xml -p "-c
  bootloader/t186ref/cfg/flash_t234_qspi.xml" --showlogs --network usb0
  jetson-orin-nano-devkit internal
4 #orin nx
5 sudo ./tools/kernel_flash/l4t_initrd_flash.sh --external-device nvme0n1p1 -c
  tools/kernel_flash/flash_l4t_external.xml -p "-c
  bootloader/t186ref/cfg/flash_t234_qspi.xml" --showlogs --network usb0 p3509-
  a02+p3767-0000 internal

```

- Enter the Linux\_for\_tegra directory and use the flash command flash to USB

```

1 #flash to USB:
2 #orin nano
3 sudo ./tools/kernel_flash/l4t_initrd_flash.sh --external-device sda1 -c
  tools/kernel_flash/flash_l4t_external.xml -p "-c
  bootloader/t186ref/cfg/flash_t234_qspi.xml" --showlogs --network usb0
  jetson-orin-nano-devkit internal
4 #orin nx
5 sudo ./tools/kernel_flash/l4t_initrd_flash.sh --external-device sda1 -c
  tools/kernel_flash/flash_l4t_external.xml -p "-c
  bootloader/t186ref/cfg/flash_t234_qspi.xml" --showlogs --network usb0 p3509-
  a02+p3767-0000 internal

```

- Enter the Linux\_for\_tegra directory and use the flash command flash to SD

```

1 #flash to SD
2 #orin nano
3 sudo ./tools/kernel_flash/l4t_initrd_flash.sh --external-device mmcblk1p1 -c
  tools/kernel_flash/flash_l4t_external.xml -p "-c
  bootloader/t186ref/cfg/flash_t234_qspi.xml" --showlogs --network usb0
  jetson-orin-nano-devkit internal

```

### 3. Recovery mode

Leetop\_ALP\_609\_F can update the system through USB, and the update needs to enter the USB Recovery mode. In USB Recovery mode, you can perform file system updates, kernel update, boot loader update, BCT updates, and other operations.

Steps to enter Recovery Mode

1. Power off the system, make sure to power off and not go into standby;
2. Use the TYPE-C to USB Type A link cable to link the carrier board and the host;
3. Turn on the power, use Type-c to connect the PC and the device, and press the Reset and Recovery buttons at the same time for two seconds, then release the Reset button first, then release the Recovery button to enter the recovery mode. (You can enter lsusb in the terminal to see if there is Nvidia corp displayed, if so, it means entering recovery).

**Note:** In the USB Recovery mode, the system will not start, and the serial port will not have debugging information output

### Install system image

- Connect the USB Type-A of the Ubuntu18.04 host to the Type-c of Leetop\_ALP\_609\_F;
- Power on Leetop\_ALP\_609\_F and enter Recovery mode;

- The PC host enters the L4T directory and executes the flashing command:

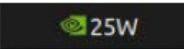
```

1 #flash to nvme
2 #orin nano
3 sudo ./tools/kernel_flash/l4t_initrd_flash.sh --external-device nvme0n1p1 -c
  tools/kernel_flash/flash_l4t_external.xml -p "-c
  bootloader/t186ref/cfg/flash_t234_qspi.xml" --showlogs --network usb0
  jetson-orin-nano-devkit internal
4 #orin nx
5 sudo ./tools/kernel_flash/l4t_initrd_flash.sh --external-device nvme0n1p1 -c
  tools/kernel_flash/flash_l4t_external.xml -p "-c
  bootloader/t186ref/cfg/flash_t234_qspi.xml" --showlogs --network usb0 p3509-
  a02+p3767-0000 internal

```

- After flashing, power on Leetop\_ALP\_609\_F and log in to the system again.

## Switching working modes

After logging in to the system, you can click on the operation modification in the upper right corner of the system interface, as shown in the figure 

Or, enter the command in the terminal to switch:

```

1 #Switch to mode 0, use the -q parameter to view the current mode
2 sudo nvpmode1 -m 0

```

## 6. Install data

```

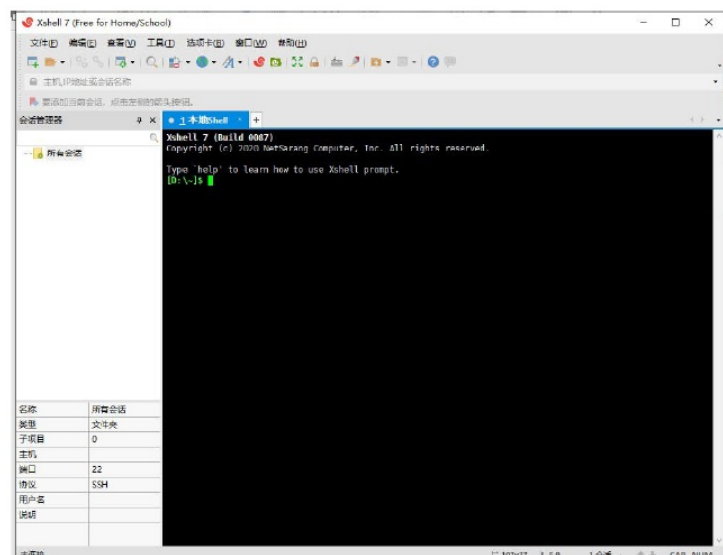
1 sudo apt update
2 sudo apt list --upgradable
3 sudo apt install nvidia-jetpack

```

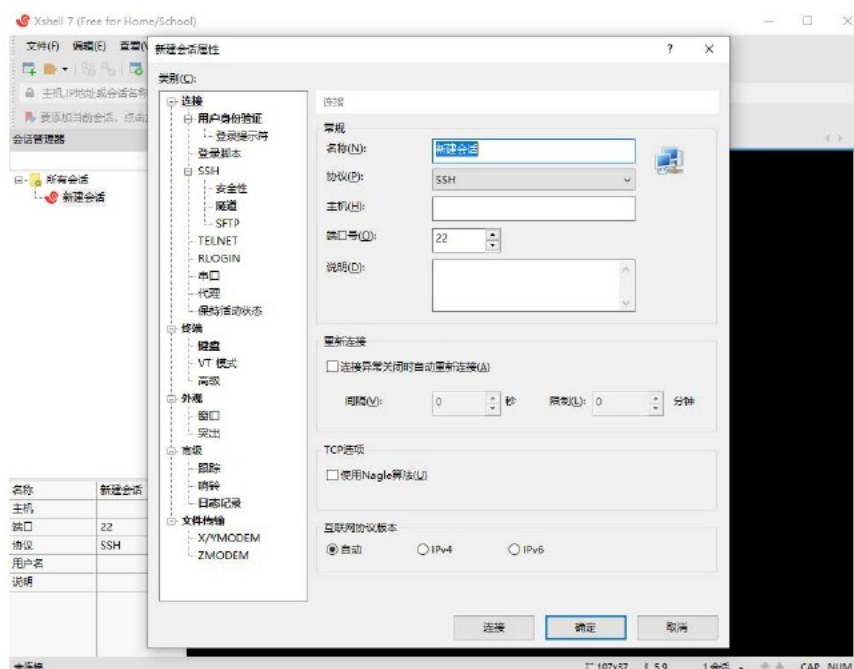
## Use of Xshell

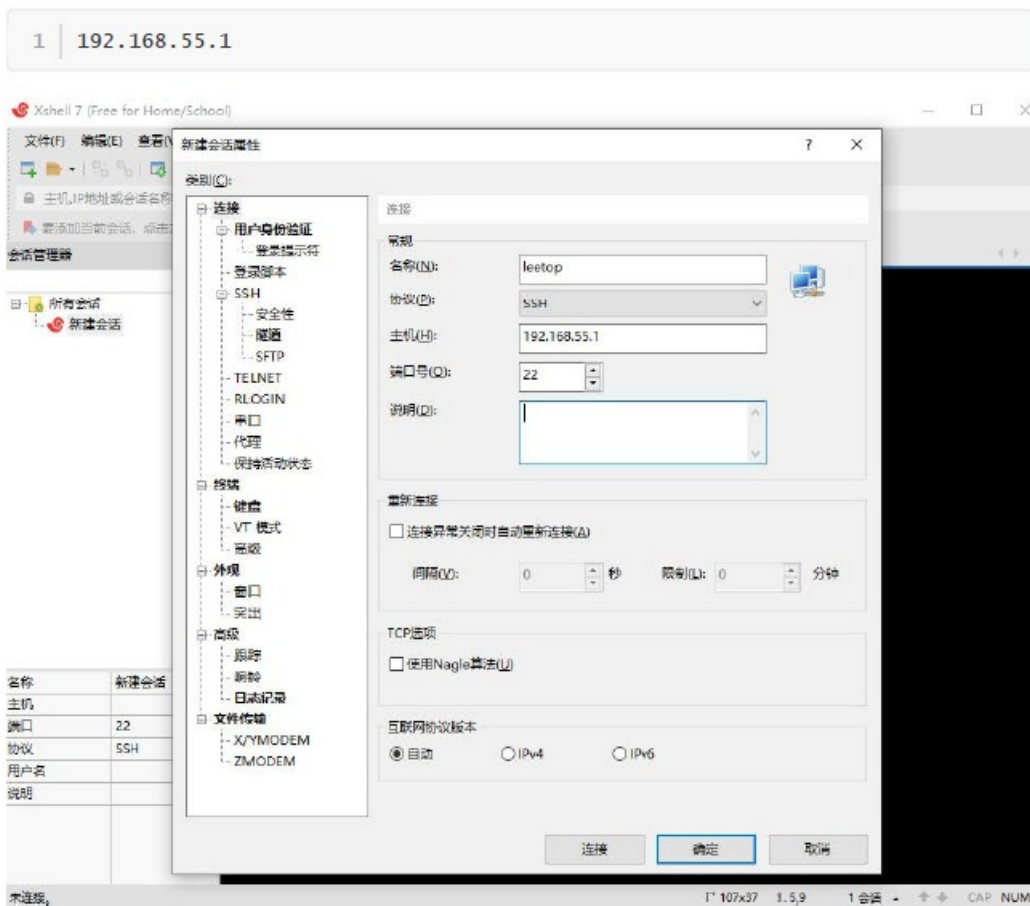
Xshell is a powerful security terminal simulation software, it supports SSH1, SSH2, and TELNET protocol of Microsoft Windows platform. Xshell's secure connection to remote hosts via the Internet and its innovative design and features help users enjoy their work in complex network environments. Xshell can be used in the Windows interface to access remote servers under different systems, so as to better achieve the purpose of remote control terminals. xshell is not necessary, but it can better assist us in using the device. It can link your Windows system with your Ubuntu system, allowing you to operate your Linux system under the Windows system. To install xshell, you can search, download, and install it on the Internet. (When the product cannot enter the desktop system, you can also use Xshell to perform remote control and modify configuration errors).

## Open xshell

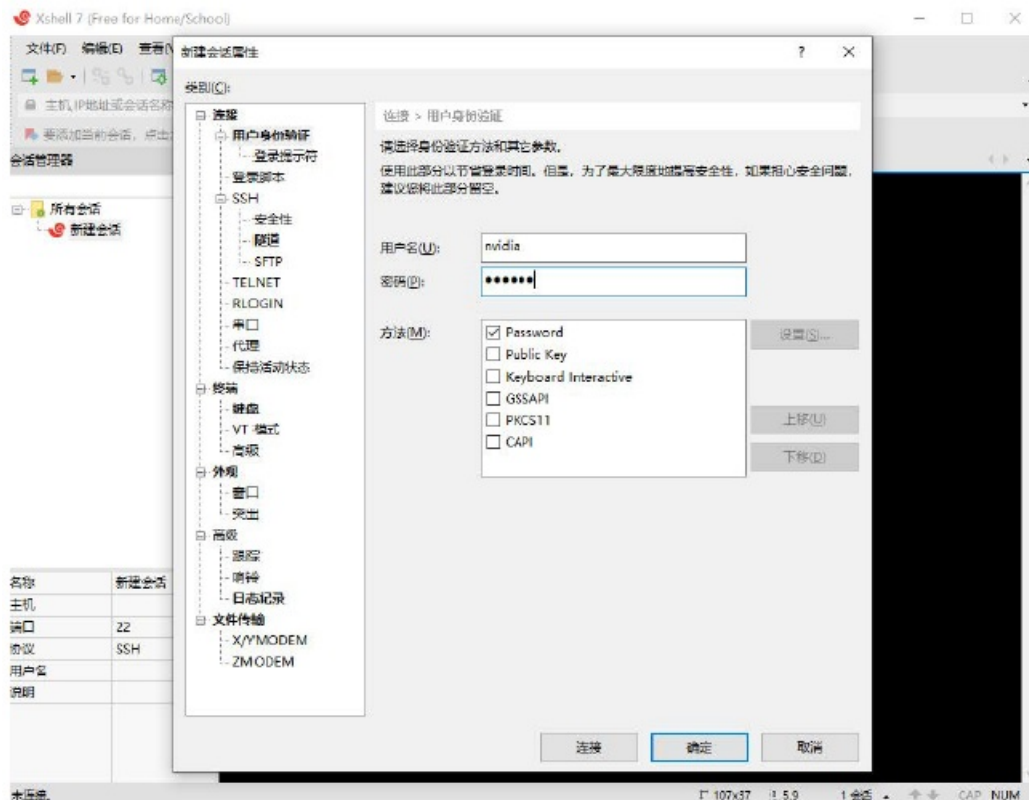


- Newly built

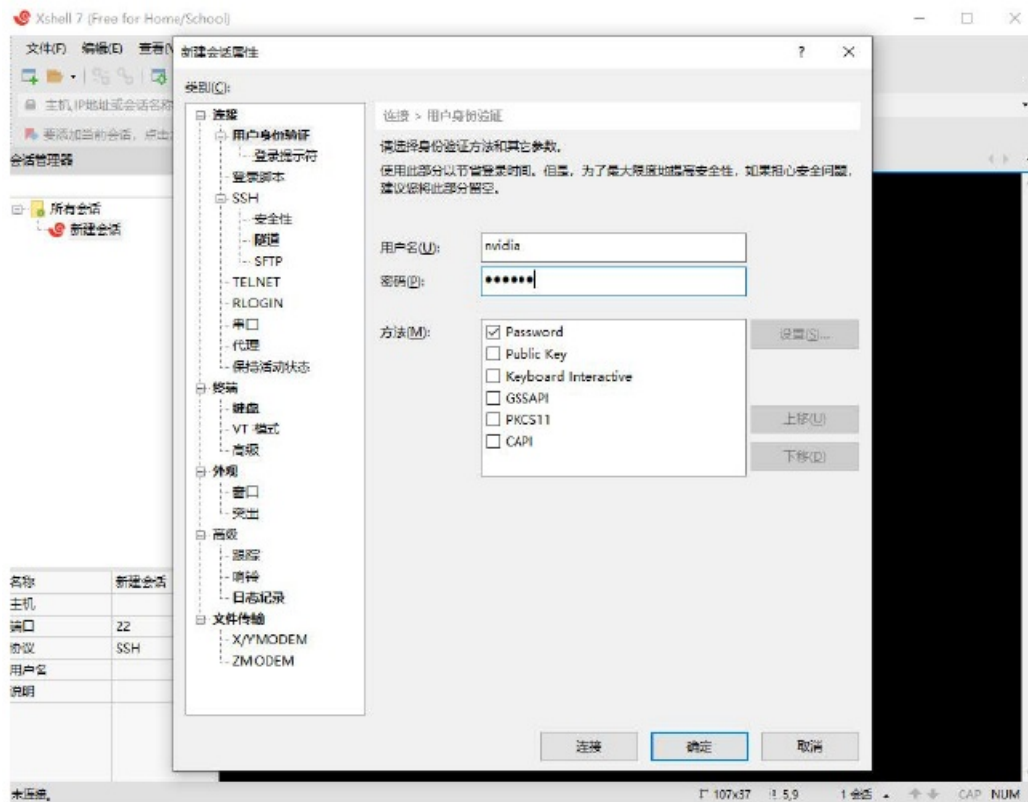




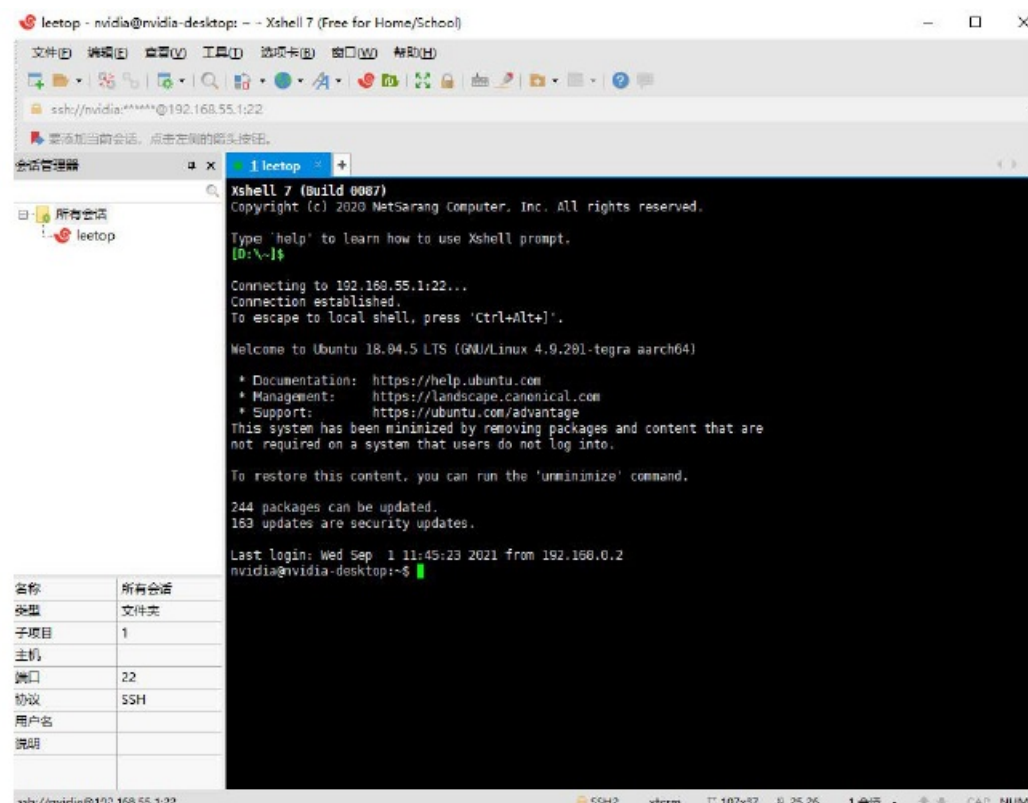
- Fill in the name and host ip (under normal circumstances, you can connect through the network ip, if you don't know the ip, you can connect the computer and the OTG port of the device through the usb data cable, and fill in the fixed ip to connect)



- Enter user and password

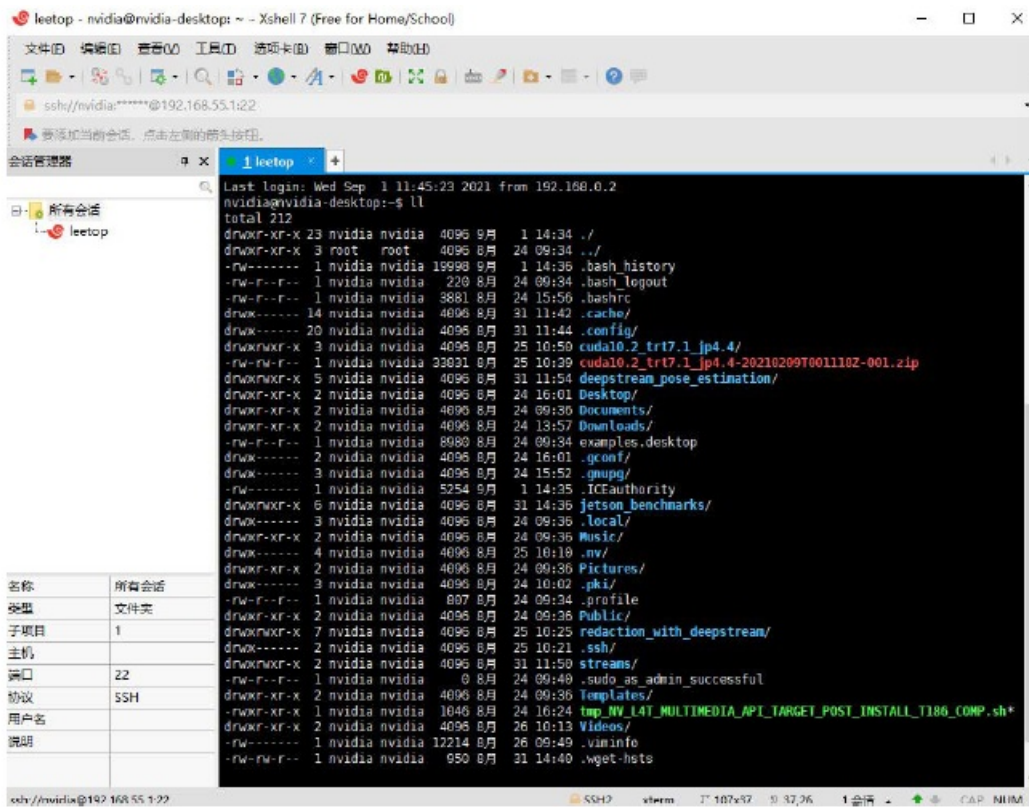


- Click Connect to enter the command line interface



- Operate the jetson device remotely through xshell





## System Configuration

default username Nvidia Password: Nvidia

### • NVIDIA Linux For Tegra (L4T)

The carrier board supports native NVIDIA Linux For Tegra (L4T) Builds. HDMI, Gigabit Ethernet, USB 3.0, USB OTG, Serial, GPIO, and I2C bus are all supported.

Detailed description and tool download link: <https://developer.nvidia.com/embedded/jetson-linux-r3531>

### • NVIDIA Jetpack for L4T

Jetpack is a software package released by NVIDIA, which contains various software tools needed for Orin Nano/Orin NX development using Leetop\_ALP\_609\_F, including various tools on the host side and target machine side, including OS image files, middleware, sample programs, documents, etc.. The latest release of JetPack runs on Ubuntu 18.04 Linux 64-bit hosts

It can be downloaded from the following link: <https://developer.nvidia.com/embedded/jetpack>

### • Default configuration system

Leetop\_ALP\_609\_F uses Ubuntu 20.04 system, default username: Nvidia password: Nvidia

### • Development materials and forum\*

L4T development data: <https://developer.nvidia.com/embedded/linux-tegra>

Developer forum: <https://forums.developer.nvidia.com/>

## View System Version

View the installed system package version

```
1 | cat /etc/nv_tegra_release
```

View information about the installed JetPack

```
1 | sudo apt show nvidia-jetpack
```

## Make a backup image

Making a backup image needs to be done in the environment of the command line flashing, only the system. img file is backed up.

1. Use a USB cable to connect the USB Type-A of the PC computer of the Ubuntu18.04 system to the Type c of Leetop\_ALP\_609\_F;
2. Power on Leetop\_ALP\_609\_F and enter Recovery mode;
3. Enter the Linux\_for\_tegra directory, and refer to README\_backup\_restore.txt in backup\_restore for backup.

Instructions to backup Jetson Orin Nano/Orin NX system:

```
1 | cd Linux_for_Tegra/tools/backup_restore
2 | #Replace mmcblk0 with nvme0n1 in the following file
3 | sudo sed -i 's/mmcblk0/nvme0n1/g' l4t_backup_restore.sh
4 | sudo sed -i 's/mmcblk0/nvme0n1/g' l4t_backup_restore.func
5 | sudo sed -i 's/mmcblk0/nvme0n1/g' nvbackup_partitions.sh
6 | sudo sed -i 's/mmcblk0/nvme0n1/g' nvrestore_partitions.sh
7 | cd ../../
8 | #Automount of new external storage devices must be temporarily disabled
   during backing up and restoring
9 | systemctl stop udisks2.service
10 | sudo tools/l4t_flash_prerequisites.sh # For Debian-based Linux
11 | sudo service nfs-kernel-server start
12 | sudo ./tools/backup_restore/l4t_backup_restore.sh -b <board-name>
13 | #Back up the image and generate an image file under
   Linux_for_Tegra/tools/backup_restore.
14 | sudo ./tools/backup_restore/l4t_backup_restore.sh -r <board-name>
15 | #Backup image restoration.
```

- Use the backup image to flash

```
1 | sudo ./tools/backup_restore/l4t_backup_restore.sh -r <board-name>
2 | #Backup image restoration.
```

If it can be flashed normally, it means that the created backup image is available.

## Installation of Jtop tools

Jtop is a Jetson system monitoring utility that runs on the terminal to view and control the status of the NVIDIA Jetson in real-time. Installation steps

1. Install pip3-tools

```
1 | sudo apt-get install python3-pip
```

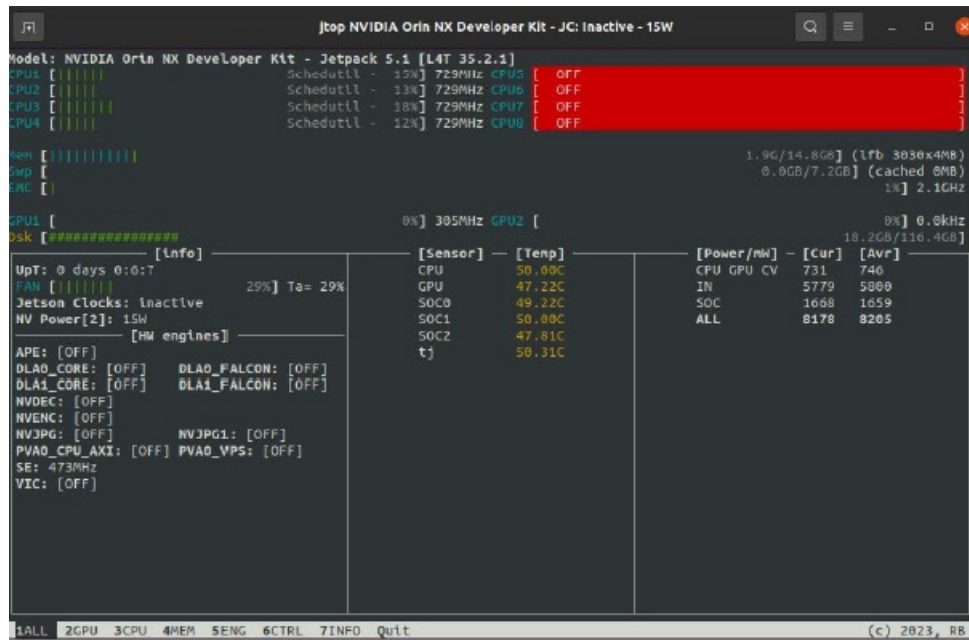
2. Install the stop package with pip3

```
1 | sudo -H pip3 install -U jetson-stats
```

3. stop can be run after reboot

```
1 | jtop
```

After running, as shown in the figure below



## Developer Tools

JetPack NVIDIA JetPack SDK is the most comprehensive solution for building AI applications. It bundles Jetson platform software including TensorRT, cuDNN, CUDA Toolkit, VisionWorks, GStreamer, and OpenCV, all built on top of L4T with LTS Linux kernel. JetPack includes NVIDIA container runtime, enabling cloud-native technologies and workflows at the edge.

## JetPack SDK Cloud-Native on Jetson

### L4T

NVIDIA L4T provides the Linux kernel, bootloader, NVIDIA drivers, flashing utilities, sample filesystem, and more for the Jetson platform. You can customize L4T software to fit the needs of your project. By following the platform adaptation and bring-up guide, you can optimize your use of the complete Jetson product feature set. Follow the links below for details about the latest software libraries, frameworks, and source packages.

### DeepStream SDK on Jetson

NVIDIA's DeepStream SDK delivers a complete streaming analytics toolkit for AI-based multi-sensor processing, video and image understanding. DeepStream is an integral part of NVIDIA Metropolis, the platform for building end-to-end services and solutions that transform pixel and sensor data to actionable insights. Learn about the latest 5.1.1 developer preview features in our developer news article.

### Isaac SDK

The NVIDIA Isaac SDK makes it easy for developers to create and deploy AI-powered robotics. The SDK includes the Isaac Engine (application framework), Isaac GEMs (packages with high-performance robotics algorithms), Isaac Apps (reference applications) and Isaac Sim for Navigation (a powerful simulation platform). These tools

and APIs accelerate robot development by making it easier to add artificial intelligence (AI) for perception and navigation into robots.

## Key Features of Jetpack

OS	<p>NVIDIA <a href="#">Jetson Linux 35.3.1</a> provides the Linux Kernel 5.10, UEFI-based bootloader, Ubuntu 20.04-based root file system, NVIDIA drivers, necessary firmware, toolchain, and more. JetPack 5.1.1 includes Jetson Linux 35.3.1 which adds the following highlights: (Please refer to <a href="#">release notes</a> for additional details) Adds support for Jetson AGX Orin 64GB, Jetson Orin NX 8GB, Jetson Orin Nano 8GB, and Jetson Orin Nano 4GB production modules Security:</p> <p>Over The Air Updates: Image-Based OTA tools supported to upgrade Xavier or Orin-based modules running JetPack 5 in the field</p> <p>1 Camera: Support for Multi-Point Lens Shading Correction (LSC) on Orin. Enhanced resilience of Argus SyncStereo app to maintain synchronization between stereo camera pairs. Multimedia: Support for dynamic frame rate in AV1 encoding New <code>argus_camera_sw_encode</code> sample for demonstrating software encoding on CPU cores Updated <code>nvstcapture-1.0</code> with the option of software encoding on CPU cores</p> <p>1 Previous releases supported upgrading Xavier-based modules in the field running JetPack 4.</p>
TensorRT	<p><a href="#">TensorRT</a> is a high-performance deep learning inference runtime for image classification, segmentation, and object detection neural networks. TensorRT is built on CUDA, NVIDIA's parallel programming model, and enables you to optimize inference for all deep learning frameworks. It includes a deep learning inference optimizer and runtime that delivers low latency and high-throughput for deep learning inference applications. <b>JetPack 5.1.1 includes <a href="#">TensorRT 8.5.2</a></b></p>
cuDNN	<p><a href="#">CUDA Deep Neural Network</a> library provides high-performance primitives for deep learning frameworks. It provides highly tuned implementations for standard routines such as forward and backward convolution, pooling, normalization, and activation layers. <b>JetPack 5.1.1 includes <a href="#">cuDNN 8.6.0</a></b></p>
CUDA	<p>CUDA Toolkit provides a comprehensive development environment for C and C++ developers building GPU-accelerated applications. The toolkit includes a compiler for NVIDIA GPUs, math libraries, and tools for debugging and optimizing the performance of your applications. <b>JetPack 5.1.1 includes <a href="#">CUDA 11.4.19</a> Starting with <a href="#">JetPack 5.0.2, upgrade to latest and</a> greatest CUDA releases from CUDA 11.8 onwards without the need to update Jetson Linux and other JetPack components. Refer to the instructions in the <a href="#">CUDA documentation</a> on how to get the latest CUDA on JetPack.</b></p>

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Multimedia API	<p>The <a href="#">Jetson Multimedia API</a> package provides low-level APIs for flexible application development. Camera application API: lib argus offers a low-level frame-synchronous API for camera applications, with per-frame camera parameter control, multiple (including synchronized) camera support, and EGL stream outputs. RAW output CSI cameras needing ISP can be used with either libargus or GStreamer plugin. In either case, the V4L2 media-controller sensor driver API is used. Sensor driver API: V4L2 API enables video decode, encoding, format conversion, and scaling functionality. V4L2 for encoding opens up many features like bit rate control, quality presets, low latency encoding, temporal tradeoffs, motion vector maps, and more. <b>JetPack 5.1.1 Camera highlights include</b> Support for Multi-Point Lens Shading Correction (LSC) on Orin. Enhanced resilience of Argus SyncStereo app to maintain synchronization between stereo camera pairs. <b>JetPack 5.1.1 Multimedia highlights include:</b> Support for dynamic frame rate in AV1 encoding New argus_camera_sw_encode sample for demonstrating software encoding on CPU cores Updated nvstcapture-1.0 with option of software encoding on CPU cores</p>
Computer Vision	<p><a href="#">VPI (Vision Programming Interface)</a> is a software library that provides Computer Vision / Image Processing algorithms implemented on multiple hardware accelerators found on Jetson such as PVA (Programmable Vision Accelerator), GPU, NVDEC(NVIDIA Decoder), NVENC (NVIDIA Encoder), VIC (Video Image Compositor) and so on. OpenCV is an open-source library for computer vision, image processing, and machine learning. <b>JetPack 5.1.1 includes a minor update to <a href="#">VPI 2.2</a> with bug fixes</b> JetPack 5.1.1 includes OpenCV 4.5.4</p>
Graphics	<p>JetPack 5.1.1 includes the following graphics libraries: Vulkan® 1.3 (including the Roadmap 2022 Profile). <a href="#">Vulkan 1.3 Announcement</a> <a href="#">Vulkan® SC 1.0</a> Vulkan SC is a low-level, deterministic, robust API that is based on Vulkan 1.2. This API enables state-of-the-art GPU-accelerated graphics and computation that can be deployed in safety-critical systems and that are certified to meet <a href="https://www.khronos.org/vulkan-sc/">industry functional safety standards. Refer to https://www.khronos.org/vulkan-sc/ for more information. Vulkan SC can also be invaluable for real-time</a> non safety-critical embedded applications. Vulkan SC increases determinism and reduces application size by shifting preparation of the run-time application environment either offline or into application setup, as much as possible. This includes offline compilation of graphics pipelines that define how the GPU processes data, together with static memory allocation, that together enable detailed GPU control that can be rigorously specified and tested. Vulkan SC 1.0 is evolved from Vulkan 1.2 and includes the removal of runtime functionality that is not needed in safety-critical markets, an updated design to provide predictable execution times and results, and clarifications to remove potential ambiguity in its operation. For more details see <a href="https://www.khronos.org/blog/vulkan-sc-overview">https://www.khronos.org/blog/vulkan-sc-overview</a> <b>Note:</b> Jetson support for Vulkan SC is <b>not</b> safety certified. OpenWF™ Display 1.0 OpenWF Display is a Khronos API for low overhead interaction with the native display driver on Jetson and allows interaction with Vulkan SC to display images. <b>Note:</b> Jetson support for OpenWF Display is <b>not</b> safety certified.</p>

Developer Tools	<p>CUDA Toolkit provides a comprehensive development environment for C and C++ developers building high-performance GPU-accelerated <a href="#">applications with CUDA libraries</a>. <a href="#">The toolkit includes Nsight Visual Studio Code Edition, Nsight Eclipse Plugins, debugging and profiling tools</a> including <a href="#">Nsight Compute</a>, and <a href="#">a toolchain for cross-compiling applications</a> <a href="#">NVIDIA Nsight Systems is a low overhead system-wide profiling tool, providing</a> the insights developers need to analyze and optimize software performance. <a href="#">NVIDIA Nsight Graphics</a> is a standalone application for <a href="#">debugging and profiling graphics applications</a>. <a href="#">NVIDIA Nsight Deep Learning Designer is an integrated development environment that helps developers</a> efficiently design and develop deep neural networks for in-app inference.</p> <p>Nsight System, Nsight Graphics, and Nsight Compute are all supported by Jetson Orin modules to assist development of autonomous machines.</p> <p><b>JetPack 5.1.1 includes NVIDIA Nsight Systems v2022.5</b> <b>JetPack 5.1.1 includes NVIDIA Nsight Graphics 2022.6</b> <b>JetPack 5.1.1 includes NVIDIA Nsight Deep Learning Designer 2022.2</b> Refer to <a href="#">release notes</a> for more details.</p>
Supported SDKs and Tools	<p><a href="#">NVIDIA DeepStream SDK</a> is a complete analytics toolkit for AI-based multi-sensor processing and video and audio understanding. <b>DeepStream 6.2</b> <b>release supports JetPack 5.1.1</b> <a href="#">NVIDIA Triton™ Inference Server</a> simplifies the deployment of AI models at scale. Triton Inference Server is open source and supports deployment of trained AI models from NVIDIA TensorRT, TensorFlow and ONNX Runtime on Jetson. On Jetson, Triton Inference Server is provided as a shared library for direct integration with C API.</p> <p><a href="#">PowerEstimator</a> is a web app that simplifies the creation of custom power mode profiles and estimates Jetson module power consumption. <b>JetPack 5.1.1 supports PowerEstimator for Jetson AGX Orin and Jetson Xavier NX</b></p> <p><b>modules</b> <a href="#">NVIDIA Isaac™ ROS</a> is a collection of hardware-accelerated packages that make it easier for ROS developers to build high-performance solutions on NVIDIA hardware including NVIDIA Jetson. <b>Isaac ROS DP3</b> <b>the release supports JetPack 5.1.1</b></p>
Cloud Native	<p>Jetson brings <a href="#">Cloud-Native</a> to the edge and enables technologies like containers and container orchestration. NVIDIA JetPack includes NVIDIA Container Runtime with Docker integration, enabling GPU-accelerated containerized applications on the Jetson platform. NVIDIA hosts several container images for Jetson on <a href="#">NVIDIA NGC</a>. Some are suitable for software development with samples and documentation and others are suitable for production software deployment, containing only runtime components. Find <a href="#">more information and a list of all container images at the Cloud-Native on Jetson page</a>.</p>



Security	<p>NVIDIA Jetson modules include various security features including Hardware Root of Trust, Secure Boot, Hardware Cryptographic Acceleration, Trusted Execution Environment, Disk and Memory Encryption, Physical Attack Protection and more. Learn about the security features by jumping to the security section of the Jetson Linux Developer guide.</p>
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## Sample Applications

JetPack includes several samples which demonstrate the use of JetPack components. These are stored in the reference filesystem and can be compiled on the developer kit.

JetPack component	Sample locations on reference filesystem
TensorRT	/usr/src/tensor/samples/
cuDNN	/usr/src/cudnn_samples_/
CUDA	/usr/local/cuda-/samples/
Multimedia API	/usr/src/tegra_multimedia_api/
Visionworks	/usr/share/Visionworks/sources/samples/ /usr/share/Visionworks-tracking/sources/samples/ /usr/share/Visionworks-sfm/sources/samples/
OpenCV	/usr/share/OpenCV/samples/
VPI	/opt/Nvidia/vpi/vpi-/samples

## Developer Tools

JetPack includes the following developer tools. Some are used directly on a Jetson system, and others run on a Linux host computer connected to a Jetson system.

- Tools for application development and debugging:
  - NSight Eclipse Edition for development of GPU accelerated applications: Runs on Linux host computer. Supports all Jetson products.
  - CUDA-GDB for application debugging: Runs on the Jetson system or the Linux host computer. Supports all Jetson products.
  - CUDA-MEMCHECK for debugging application memory errors: Runs on the Jetson system. Supports all Jetson products.
- Tools for application profiling and optimization:
  - NSight Systems for application multi-core CPU profiling: Runs on the Linux host computer. Helps you improve application performance by identifying slow parts of code. Supports all Jetson products.
  - NVIDIA® Nsight™ Compute kernel profiler: An interactive profiling tool for CUDA applications. It provides detailed performance metrics and API debugging via a user interface and command line tool.

- NSight Graphics for graphics application debugging and profiling: A console-grade tool for debugging and optimizing OpenGL and OpenGL ES programs. Runs on the Linux host computer. Supports all
- Jetson products.

## FCC Warning:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

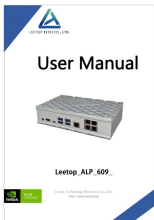
**Caution:** Any changes or modifications to this device not explicitly approved by the manufacturer could void your authority to operate this equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance 20cm between the radiator and your body.
































## Documents / Resources

	<p><a href="#">LEETOP ALP-609 Jetson Orin NX</a> [pdf] User Manual ALP-609 Jetson Orin NX, ALP-609, Jetson Orin NX, Orin NX</p>
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## References

- [æ²Yæ“ç\\$‘æŠ€\(æ·±âœ³\)æœ%œ™â...-â](#)
- [CUDA Deep Neural Network \(cuDNN\) | NVIDIA Developer](#)
- [DeepStream SDK | NVIDIA Developer | NVIDIA Developer](#)



-  [DeepStream SDK | NVIDIA Developer | NVIDIA Developer](#)
-  [Jetson - Embedded AI Computing Platform | NVIDIA Developer](#)
-  [JetPack SDK | NVIDIA Developer](#)
-  [Cloud-Native on Jetson | NVIDIA Developer](#)
-  [Jetson Linux 35.3.1 | NVIDIA Developer](#)
-  [Jetson Linux | NVIDIA Developer](#)
-  [Vision Programming Interface \(VPI\) | NVIDIA | NVIDIA Developer](#)
-  [Isaac Robot Operating System \(ROS\) | NVIDIA Developer](#)
-  [Isaac Robot Operating System \(ROS\) | NVIDIA Developer](#)
-  [Nsight Compute | NVIDIA Developer | NVIDIA Developer](#)
-  [NVIDIA Nsight Graphics | NVIDIA Developer](#)
-  [Nsight Visual Studio Code Edition | NVIDIA | NVIDIA Developer](#)
-  [TensorRT SDK | NVIDIA Developer](#)
-  [CUDA Toolkit Documentation](#)
-  [1. CUDA for Tegra — CUDA for Tegra 12.3 documentation](#)
-  [1. Introduction — Nsight Eclipse Plugins Installation Guide 12.3 documentation](#)
-  [Nsight Systems | NVIDIA Developer | NVIDIA Developer](#)
-  [NVIDIA JetPack Documentation](#)
-  [Welcome — Jetson Linux Developer Guide documentation](#)
-  [Jetson Linux API Reference: Main Page | NVIDIA Docs](#)
-  [VPI - Vision Programming Interface: Release Notes v3.0](#)
-  [NVIDIA Developer Forums - NVIDIA Developer Forums](#)
-  [NVIDIA](#)
-  [New Software Enhancements for Intelligent Video Analytics and IoT | NVIDIA Technical Blog](#)
-  [Data Science, Machine Learning, AI, HPC Containers | NVIDIA NGC](#)
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-  [Khronos Blog - The Khronos Group Inc](#)
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-  [Vulkan SC Overview - The Khronos Group Inc](#)
-  [Metropolis - Video Analytics & Applications | NVIDIA](#)
- [User Manual](#)