

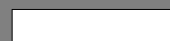
e-
CAM24_CUNX

Getting Started Manual



e-
You

Version 2.0
e-con Systems



Disclaimer

The specifications of e-CAM24_CUNX board and instructions on how to use this board with Jetson Xavier NX™ / Jetson Nano™ development kits are provided as reference only and e-con Systems reserves the right to edit/modify this document without any prior intimation of whatsoever.

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Introduction to e-CAM24_CUNX

e-CAM24_CUNX is a 2 MP customer lens camera module designed and developed by e-con Systems, a leading Embedded Product Design Services Company which specializes in advanced camera solutions. This camera module targets the NVIDIA® Jetson Nano™/Xavier NX™ development kits. It can be directly interfaced with Jetson Nano™ development kit through J13 and J49 connectors and Xavier NX™ development kit through J1 and J9 connectors.

e-CAM24_CUNX is provided with S-mount (also known as M12 board lens) lens holder. The S-mount is one of the most commonly used small form factor lens mounts for board cameras. e-CAM24_CUNX is a color camera that supports uncompressed UYVY format in both still capture and video recording. The supported resolutions and frame rates are listed in following table.

Table 1: Supported Resolutions and Frame Rates

S. NO	Resolution	Frame Rate (fps)
1	1280 x 720	120
2	1920 x 1080	65
3	1920 x 1200	60





This document describes how to interface the e-CAM24_CUNX board on NVIDIA® Jetson Nano™/Xavier NX™ development kit and how to use the e-CAM24_CUNX board.

Parts Supplied

The following table lists the parts supplied with the kit.

Table 2: Parts Supplied and its Quantities

Parts Supplied	Images	Quantity
Custom Lens Camera Module (e-CAM217_CUMI0234_MOD)		1

Adaptor Board (ACC-XVRNX-MIPICAMERA-ADP)		1
152mm FPC Cable		1
16GB SD card		1
Lens (FIFO-03028B8M)		1

Description

NVIDIA® Jetson Nano™/Xavier NX™ is small size, low power, artificial intelligence (AI) system-based evaluation board, developed by NVIDIA®. Both NVIDIA® Jetson Nano™/Xavier NX™ development kits has two individual 2-lane MIPI CSI-2 camera connection option. e-CAM24_CUNX uses these 2-lane MIPI CSI-2 interface for connecting 2 MP camera modules.

e-CAM24_CUNX is a multi-board solution, which has two boards as follows:

- Camera Module (e-CAM217_CUMI0234_MOD)

- Adaptor Board (ACC-XVRNX-MIPICAMERA-ADP)

The camera module is a small, low-power, high performance 2 MP camera with a built-in ISP, which supports uncompressed UYVY format. This camera module is based on AR0234CS CMOS image sensor from ON Semiconductor®. The AR0234CS is a 1/2.6" optical form factor, CMOS image sensor with global shutter.

The front and rear views of e-CAM217_CUMI0234_MOD board and ACC-XVRNX-MIPICAMERA-ADP adaptor board are shown in following figures.

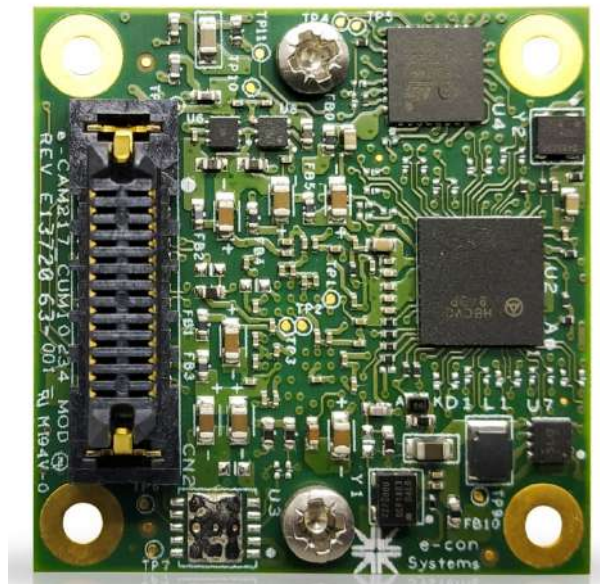


Figure 1: Rear View of e-CAM217_CUMI0234_MOD Board



Figure 2: Front View of e-CAM217_CUMI0234_MOD Board

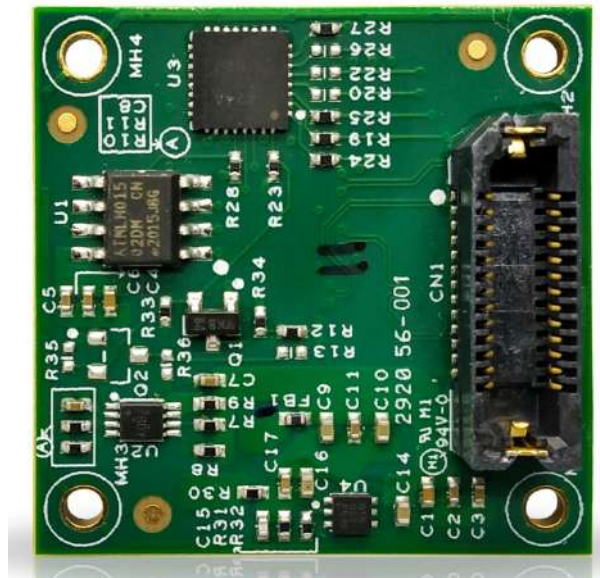


Figure 3: Front View of ACC-XVRNX-MIPICAMERA-ADP Adaptor Board



Figure 4: Rear View of ACC-XVRNX-MIPICAMERA-ADP Adaptor Board

e-CAM24_CUNX camera module has 26-pin Samtec connector (CN2) for mating with e-CAM24_CUNX adaptor board. e-CAM24_CUNX adaptor board acts as a bridge between the camera module and the NVIDIA® Jetson Nano™/Xavier NX™ development kit. The adaptor board provides the voltages required for the camera module. e-CAM24_CUNX adaptor board consists of 15-pin FFC connector (CN2), through which e-CAM24_CUNX is connected to Xavier NX™ development kit over FPC cable of maximum 15 cm length.

e-CAM24_CUNX Board Handling Procedure

This section describes the handling procedure of e-CAM24_CUNX board.

The procedure to assemble camera board to Jetson Xavier™ carrier board is described in the following section.

Camera Board Connection

e-CAM24_CUNX is provided with 152mm FPC cable for connecting with NVIDIA® Jetson Nano™/Xavier NX™ camera board.

The conductive and insulation side location of the FPC cable is shown in following figure.



Figure 5: FPC Cable Conductive and Insulation Side Location

The procedure to assemble camera board are as follows:

1. Unlock the CN2 connector in adapter board for inserting the FPC cable.

CN2 connector has a lock actuator which is used for locking and unlocking the cable as shown in following figure.

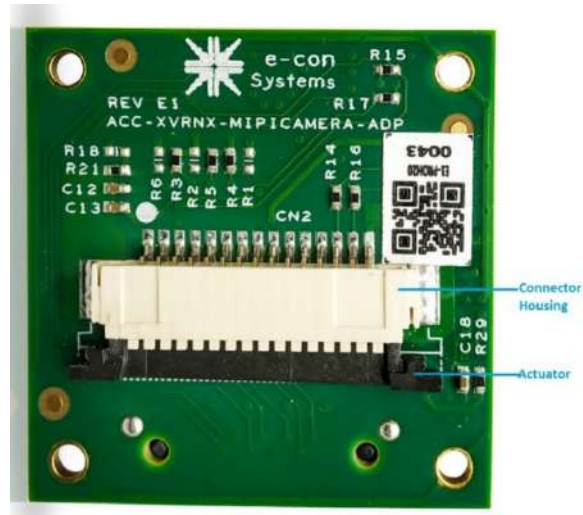
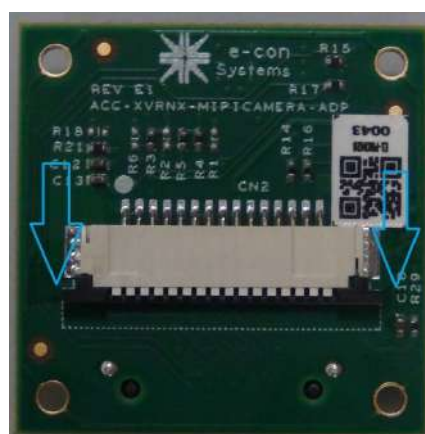


Figure 6: CN2 Connector Location

2. Pull-down the actuator at centre with slight force for unlocking the connector as shown in following figures.



Pull down the actuator for unlocking



Figure 7: Unlocking CN2 Connector Connector Position

Figure 8: CN2 Unlocked

3. Insert the FPC cable to CN2 connector.

The conductive side of the cable must face board as shown in following figure.

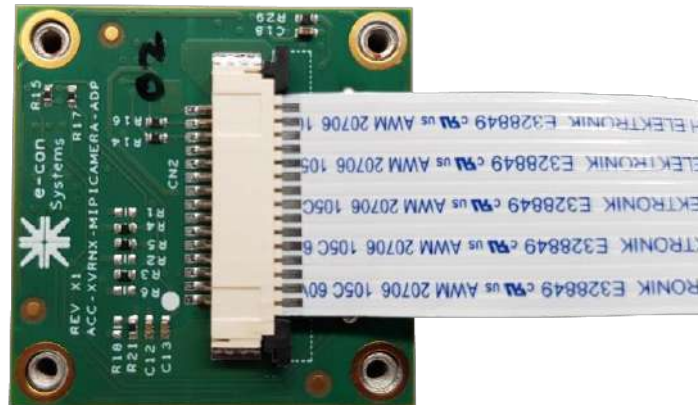


Figure 9: Cable inserted to CN2 Connector of e-CAM24_CUNX

4. Lock the CN2 connector by pushing the lock actuator from bottom to top.

e-CAM24_CUNX CN2 connector locked with cable is shown in following figure.



Figure 10: e-CAM24_CUNX CN2 Connector Locked with Cable

Note: Care must be taken, while connecting cable to e-CAM24_CUNX connector.

Warning: If FPC cable is connected in reverse direction to CN2 connector of e-CAM24_CUNX, it might damage e-CAM24_CUNX as well as NVIDIA® Jetson Nano™/Xavier NX™ development kits.

Interfacing with Jetson Xavier NX Development Kit

Jetson Xavier NX™ development kit has two connectors J1 and J9 to interface with camera module.

The procedure for interfacing with the camera module is as follows:

1. Insert the FPC cable on J1 connector of the Jetson Xavier NX™ development kit before powering ON the Jetson Xavier NX™ development Kit.

The J1 connector location in the Jetson Xavier NX™ development kit is shown in following figure.

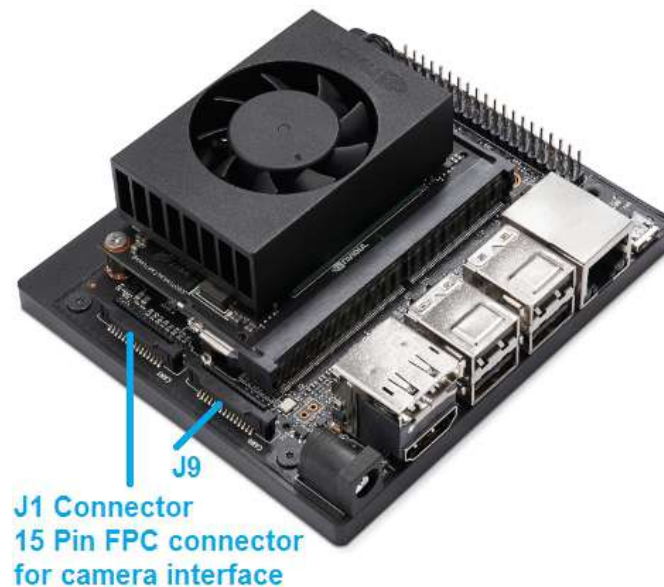


Figure 11: Camera Connector Location in Jetson Xavier Development Kit

2. Unlock the J1 connector for inserting the FPC cable.

The location of actuator in Jetson Xavier™ development kit is shown in following figure.

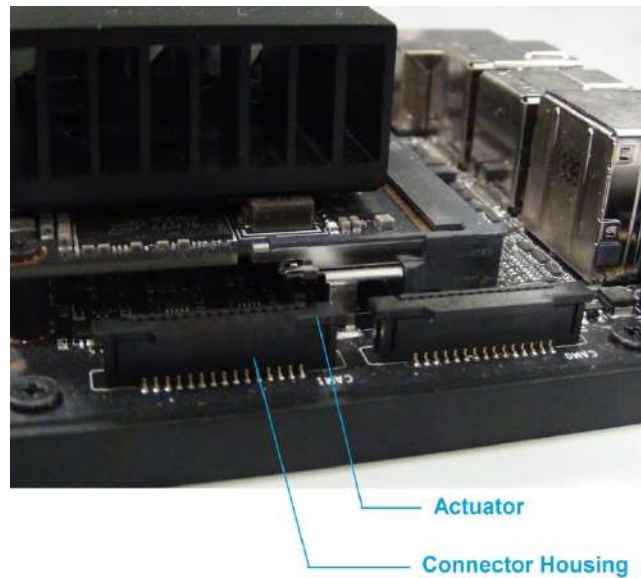


Figure 12: Jetson Xavier Kit Camera Connector Actuator Location

3. Pull-up the actuator at centre with slight force for unlocking the connector as shown in following figures.

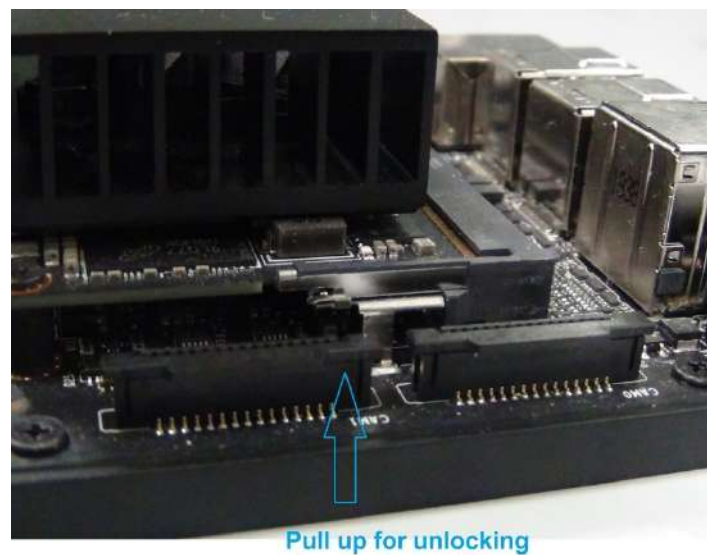
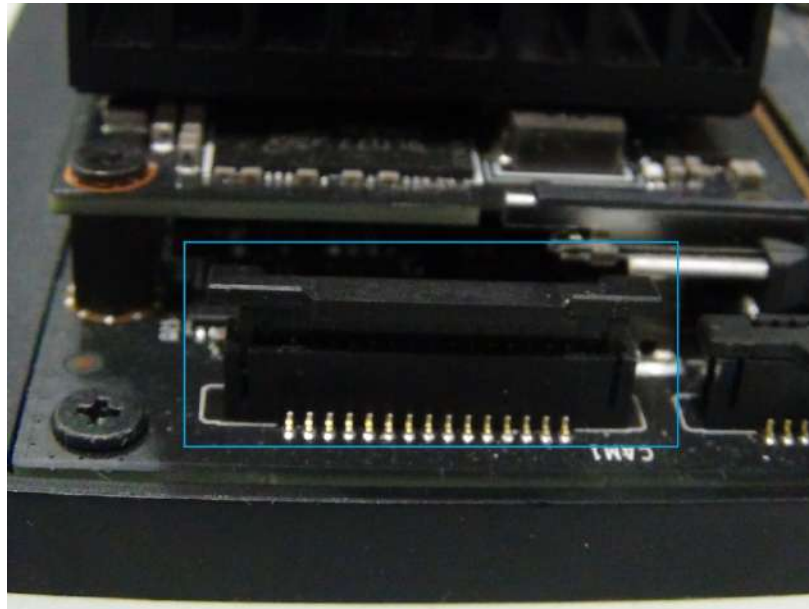


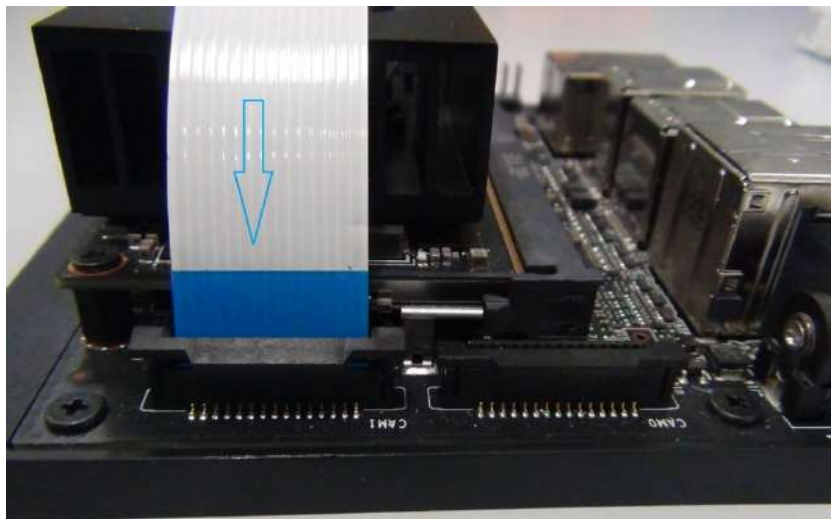
Figure 13: Unlocking Jetson Xavier Development Kit Camera Connector



Unlock Position

Figure 14: Unlocked Position of Jetson Xavier Development Kit Camera Connector

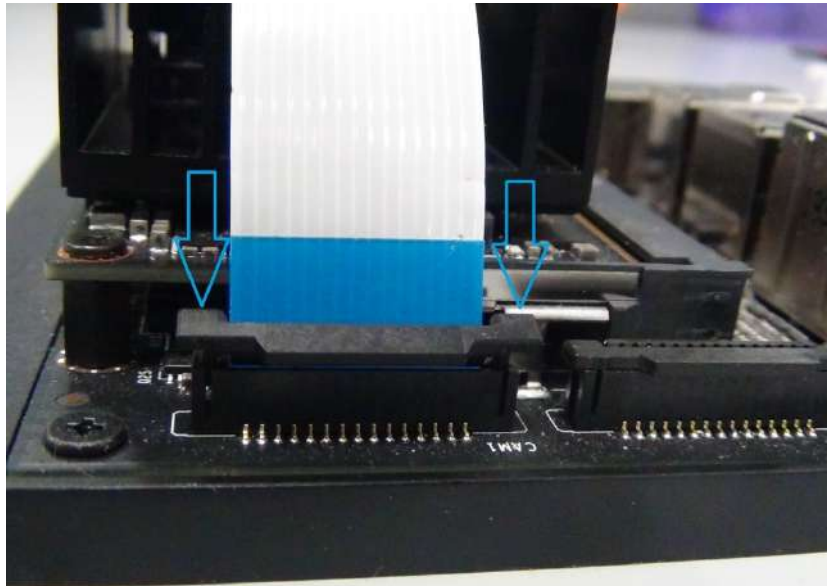
5. Insert the FPC cable to the J1 connector of Jetson Xavier™ development kit as shown in following figure.



Insert FPC cable

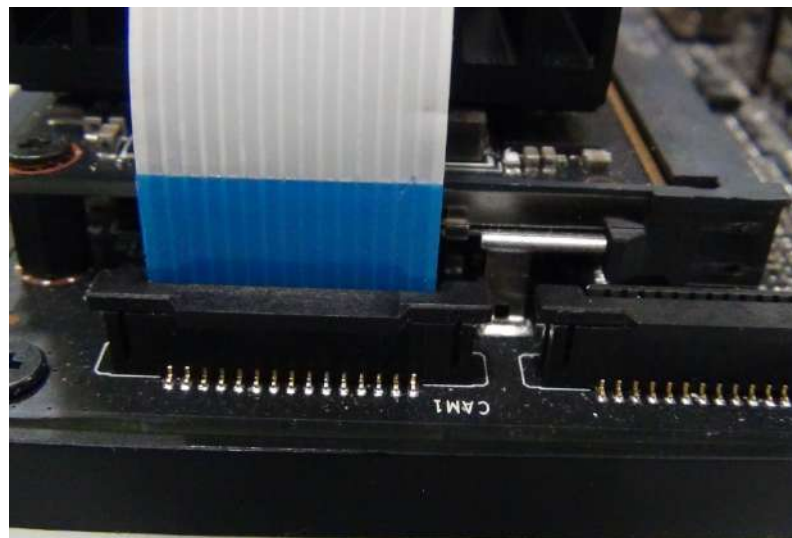
Figure 15: FPC Cable insertion to J1 Connector of Jetson Xavier Development Kit

6. Lock the J1 connector by pressing both ends of actuator with same equal force as shown in following figures.



Press the actuator for locking the cable

Figure 16: Locking the FPC Cable



Cable locked position

Figure 17: FPC Cable Locked Position on Jetson Xavier Development Kit

Note: Care must be taken, while connecting cable to camera connector of Jetson Xavier development kit.

Now, e-CAM24_CUNX is connected to Jetson Xavier™ development kit as shown in following figure.



Figure 18: e-CAM24_CUNX Setup Interfaced to Jetson Xavier Development Kit

Jetson Xavier™ development kit can be powered either from J5 USB micro-B connector or J16 DC power jack connector. Since J5 is used for low power applications, e-CAM24_CUNX supports only low resolutions in this power supply. Connecting 19V 4A power supply to J16 DC jack will be the ideal solution, when using e-CAM24_CUNX with Jetson Xavier™ development kit to use its full listed resolutions.

The power supply connectors in Jetson Xavier™ development kit is shown in following figure.



Figure 19: Power Supply Connectors in Jetson Xavier Development Kit

7. Connect 19V, 4A power supply to DC jack (J16) to power ON the Jetson Xavier NX™ development kit as shown below.

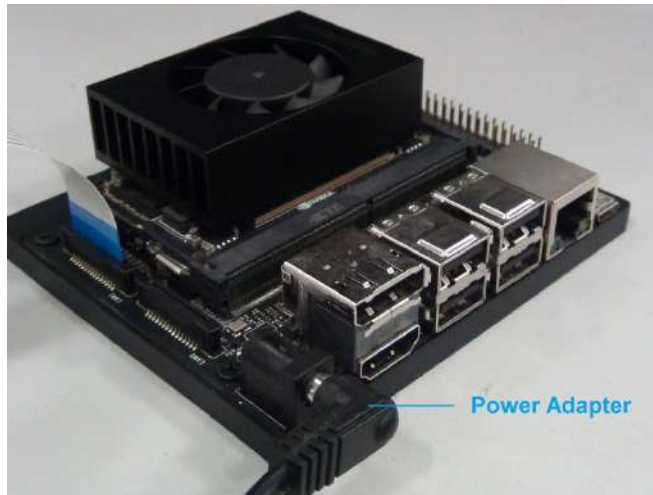


Figure 20: Power Supply connected to Jetson Xavier Development Kit

Note: Jetson Xavier NX™ development kit does not provide any power adaptor. You must take care of power adaptor. The description of power adaptor used by e-con Systems is mentioned in above image.

After powering ON the Jetson Xavier NX™ development kit, the greenish yellow color LED on Jetson Xavier NX™ development kit will glow. This serves as an indication for power-up of base board as shown in following figure.



Figure 21: Status LED indicating Jetson Xavier Development Kit Powered ON

Interfacing with Jetson Nano A02 Development Kit

The procedure for interfacing with Jetson Nano™ A02 development kit is as follows:

1. Insert the FPC cable on J13 connector of the Jetson Nano™ development kit before powering ON the Jetson Nano™ development Kit.

The J13 connector location in the Jetson Nano™ development kit is shown in following figure.

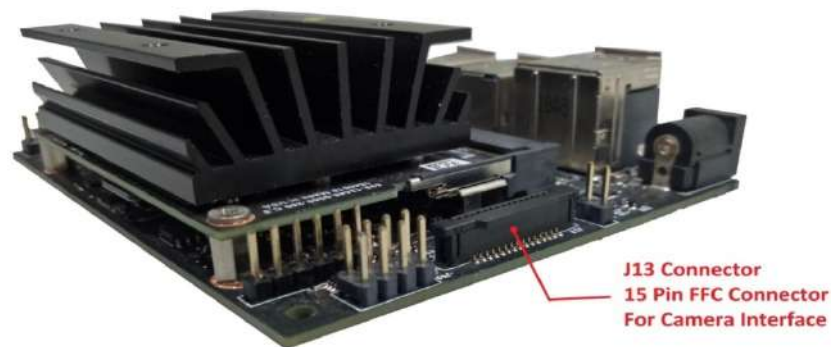


Figure 22: Camera Connector Location in Jetson Nano Development Kit

4. Unlock the J13 connector for inserting the FPC cable.

The location of actuator in Jetson Nano™ development kit is shown in following figure.

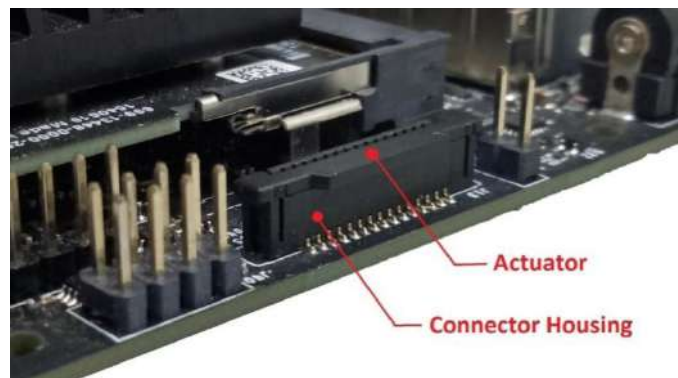


Figure 23: Jetson Nano Kit Camera Connector Actuator Location

5. Pull-up the actuator at centre with slight force for unlocking the connector as shown in following figures.

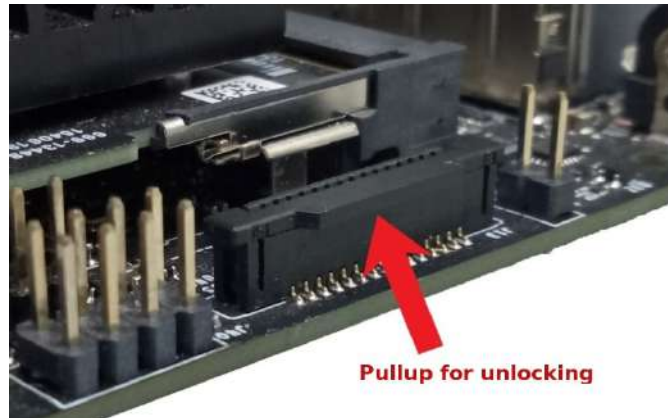


Figure 24: Unlocking Jetson Nano Development Kit Camera Connector

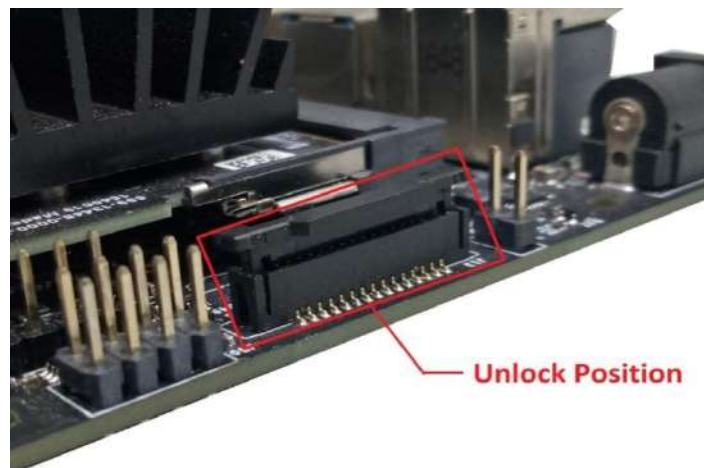


Figure 25: Unlocked Position of Jetson Nano Development Kit Camera Connector

6. Insert the FPC cable to the J13 connector of Jetson Nano™ development kit as shown in following figure.

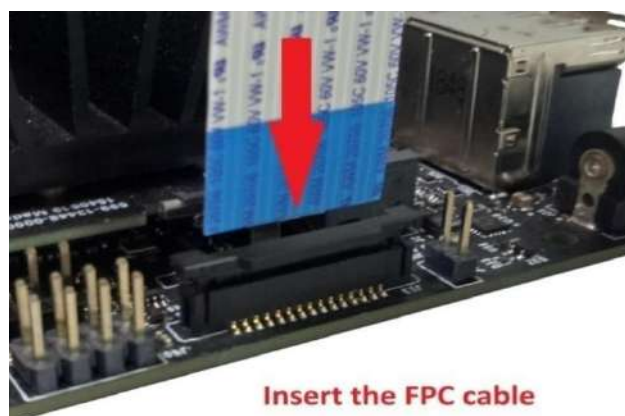


Figure 26: FPC Cable insertion to J13 Connector of Jetson Nano Development Kit

The FPC cable must be inserted in conductive side of the cable to face board side as shown in following figure.

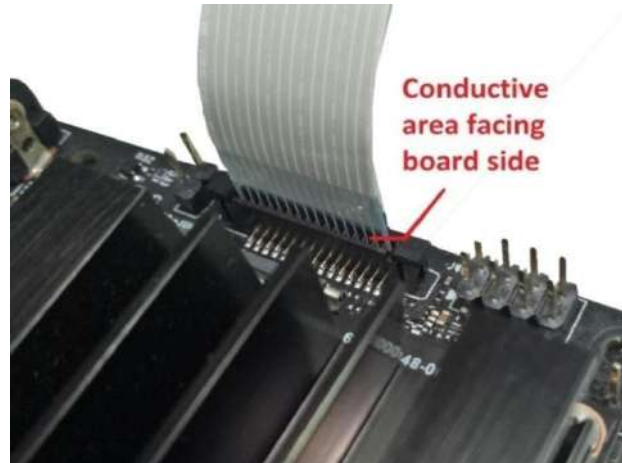
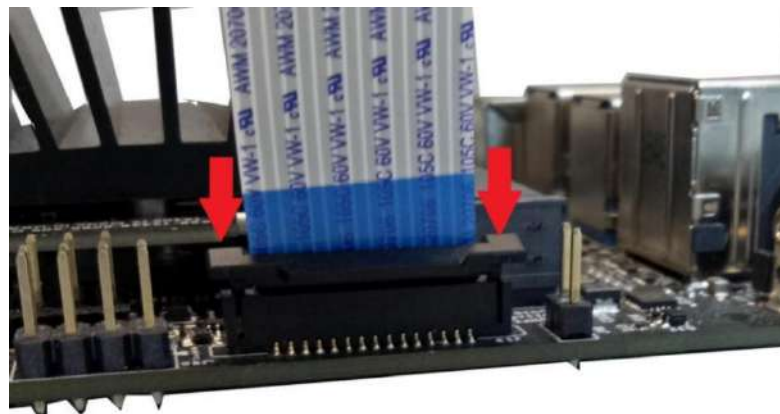


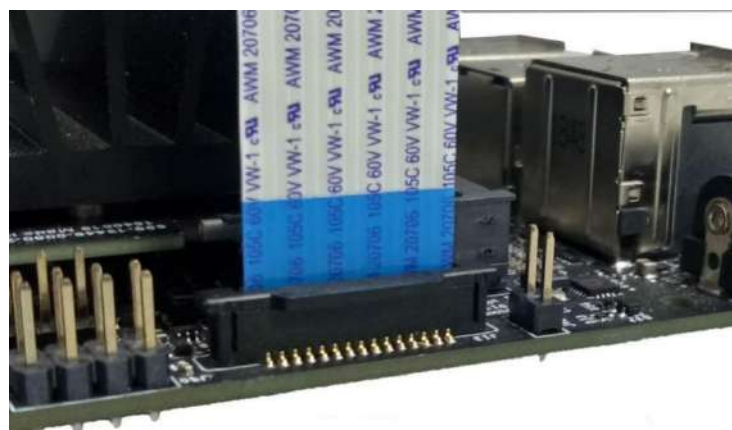
Figure 27: FPC Cable inserted into Jetson Nano Development Kit

7. Lock the J13 connector by pressing both ends of actuator with same equal force as shown in following figures.



Press the actuator for locking the cable

Figure 28: Locking the FPC Cable



Cable locked position

Figure 29: FPC Cable Locked Position on Jetson Nano Development Kit

Note: Care must be taken, while connecting cable to camera connector of Jetson Nano™ A02 development kit.

Now, e-CAM24_CUNX is connected to Jetson Nano™ A02 development kit as shown in following figure.



Figure 30: e-CAM24_CUNX Setup Interfaced to Jetson Nano Development Kit

Jetson Nano™ development kit can be powered either from J28 USB Micro-B connector or J25 DC power jack connector. Since J28 is used for low power applications, e-CAM24_CUNX supports only low resolutions in this power supply. Connecting 5V 4A power supply to J25 DC jack will be the ideal solution, when using e-CAM24_CUNX with Jetson Nano development kit to use its full listed resolutions.

The power supply connectors in Jetson Nano™ development kit is shown in following figure.

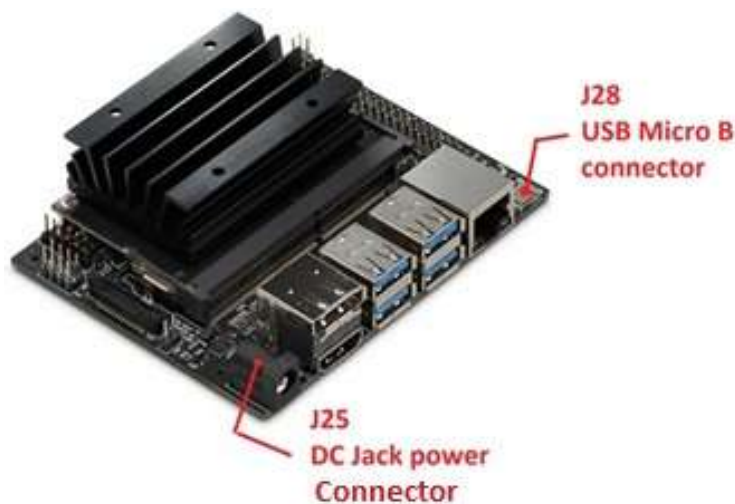


Figure 31: Power Supply Connectors in Jetson Nano Development Kit

8. Power ON the Jetson Nano™ development kit through J25 connector.

Note: J48 male header must be shorted using a jumper as shown in following figures.

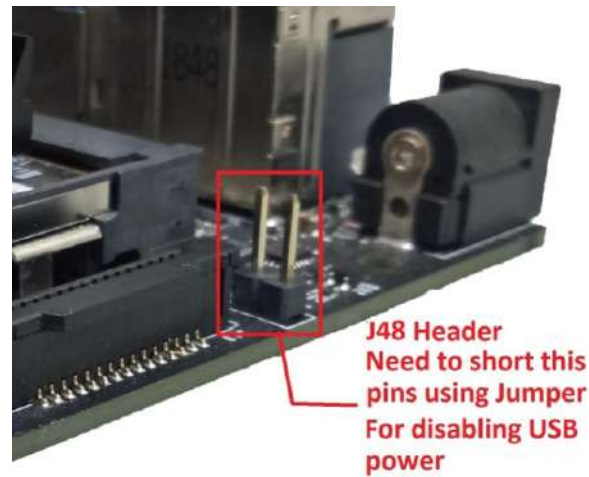


Figure 32: J48 Header Location in Jetson Nano Development Kit



Figure 33: J48 Header shorted with Jumper

Note: Jetson Nano™ development kit does not provide any jumpers. You must take care of jumper. The description of jumper used by e-con Systems is mentioned in above image.

9. Connect 5V, 4A power supply to DC jack (J25) to power ON the Jetson Nano™ development kit as shown below.

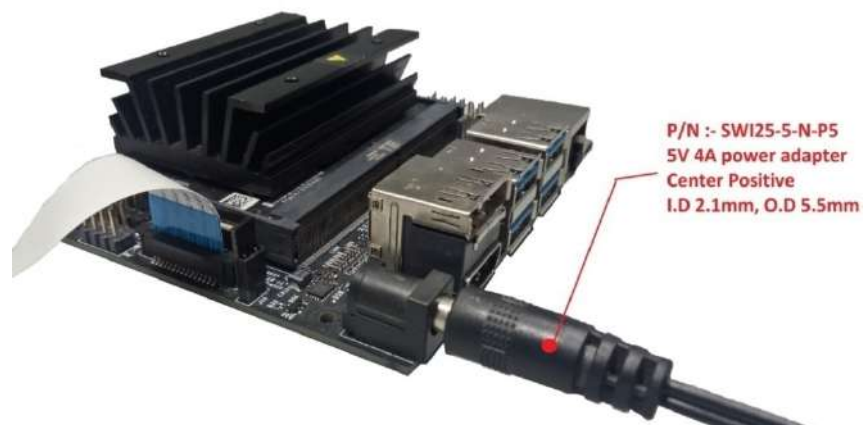


Figure 34: Power Supply connected to Jetson Nano Development Kit

Note: Jetson Nano™ development kit does not provide any power adaptor. You must take care of power adaptor. The description of power adaptor used by e-con System is mentioned in above image.

After powering ON the Jetson Nano™ development kit, the greenish yellow color LED on Jetson Nano™ development kit will glow. This serves as an indication for power-up of base board as shown in following figure.



Figure 35: Status LED indicating Jetson Nano Development Kit Powered ON

Interfacing with Jetson Nano B01 Development Kit

The procedure for interfacing with Jetson Nano™ B01 development kit is as follows:

Jetson Nano™ B01 carrier board has two camera connectors J13 and J49 as shown below.

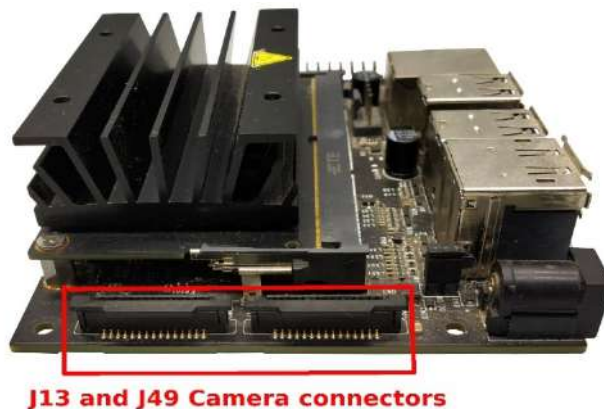


Figure 36: Camera Connector Location in Jetson Nano B01 Development Kit

1. Follow steps [2](#) to [4](#) given in *Interfacing with Jetson Nano A02 Development Kit* section, for inserting FPC cable to B01 development kit.

Now, e-CAM24_CUNX is connected to Jetson Nano™ B01 development kit as shown in following figure.

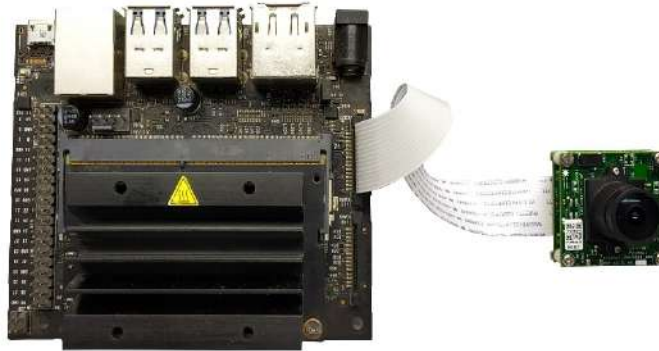


Figure 37: e-CAM24_CUNX Setup Interfaced to Jetson Nano B01 Development Kit

2. Follow steps [5](#) and [6](#) given in *Interfacing with Jetson Nano A02 Development Kit* section, to power ON the Jetson Nano™ B01 development kit.

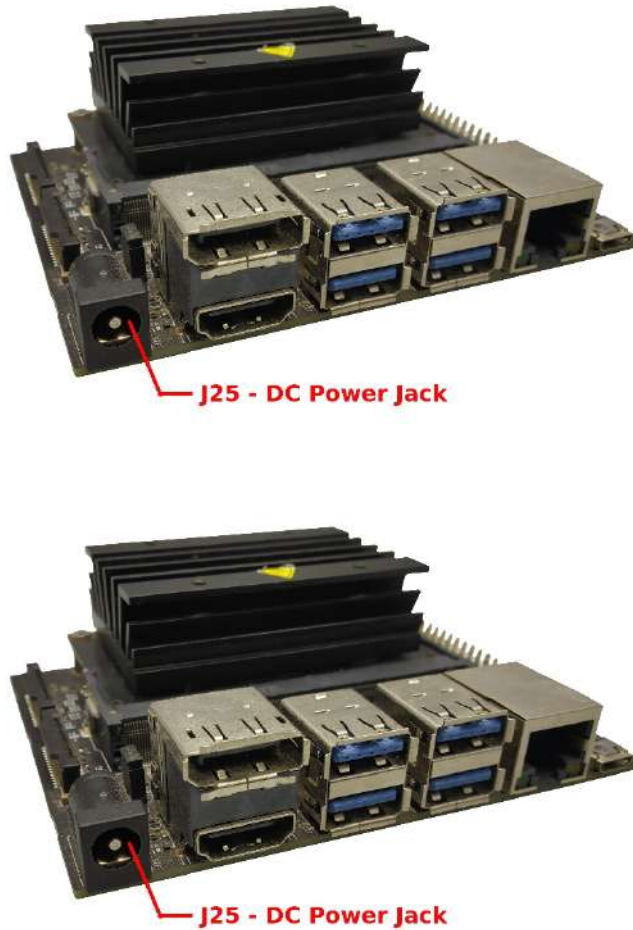


Figure 38: DC Power Jack location in B01 Carrier Board

Note: Jetson Nano™ development kit does not provide any power adaptor. You must take care of power adaptor. The power adaptor used by e-con System is SWI25-5-N-P5, 5V 4A power adapter with 2.1 ID and 5.5 OD plug.

Software Quick Setup

This section provides the steps to boot the NVIDIA® Jetson Nano™ / Xavier NX™ development kit with the bootable SD card provided with the product for supporting e-CAM24_CUNX. The bootable SD card connected to the Jetson Xavier NX™ development kit is flashed with the **L4T_R32.4.4** (aarch64) package which supports Linux distributions for e-CAM24_CUNX.

Note: To prepare a bootable SD Card, follow the steps mentioned in *Preparing a Bootable SD Card* section.

The commands and output messages in this manual are represented by different colors as shown in following table.

Table 3: Notation of Colors

Color	Notation
Green	Commands running in Development Board
Orange	Output message in Development Board

The steps to setup the NVIDIA® Jetson Nano™ /Xavier NX™ development kit for e-CAM24_CUNX camera are as follows:

1. Connect the bootable micro SD card to the slot of NVIDIA® Jetson Nano™ /Xavier NX™ development kit.

The location of micro SD card slot on the NVIDIA® Jetson Nano™ /Xavier NX™ development kit is shown in the following figures.

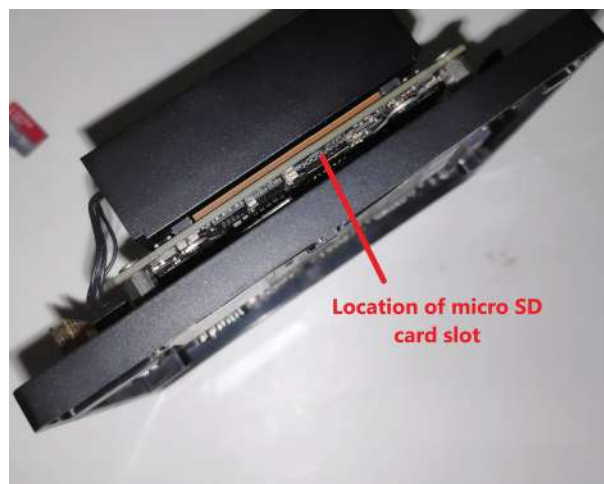


Figure 39: Location of Micro SD Card Slot on Jetson Xavier NX Development Kit



Figure 40: Inserting Micro SD Card on the Jetson Xavier™ NX Development Kit

2. Power ON the Jetson Xavier NX™ development kit.

Note: The module drivers for e-CAM24_CUNX provided by e-con Systems will be loaded automatically during board boot.

Launching the Application

The steps to be followed in the development board for launching the application are as follows:

1. Run the following command to check the presence of camera video node.

```
ls /dev/video*
```

The output message appears as shown below.

```
/dev/video*
```

Where (*) represents the number of cameras connected. The number of times the output message displayed above must be equal to the number of cameras connected to the Jetson development kit.

3. Run the following command to set the power mode to maximum for better performance.

```
$ sudo nvpmodel -m 0
```

4. Run the following Jetson clocks command before launching the ecam_tk1_guvcview application in the Jetson Xavier™ NX development board.

```
$ sudo jetson_clocks
```

- Run the following command to launch the sample camera application.

```
ecam_tk1_guvcview
```

When the application is launched, you can view the screen similar to the screen shown below.



Figure 41: Initial Window when Application is Launched

Note: The default login credentials for Jetson Xavier NX™ development kit is listed in the following table.

Table 4: Default Login Credentials

Fields	Inputs
Username	nvidia
Password	nvidia

Note: If you are using the bootable SD card provided for e-CAM24_CUNX, the release package will already be present in **/home/nvidia/Release** directory.

Preparing a Bootable SD Card

The steps for preparing a bootable SD card are as follows:

- Create a new account (or) Login to NVIDIA® developer account using this [link](#).

For Jetson Xavier NX™ development kit,

2. Download the Jetson Xavier NX™ developer kit SD card image JP 4.4.1 from NVIDIA® website using

<https://developer.nvidia.com/embedded/downloads>

Jetson NX Developer Kit SD Card Image - JP 4.4.1

file name : jetson-nx-jp441-sd-card-image.zip

3. Follow the instructions in this

<https://developer.nvidia.com/embedded/learn/get-started-jetson-xavier-nx-devkit> link to flash the SD card for Jetson Xavier NX™ development kit.

For Jetson Nano™ development kit,

4. Download the Jetson Nano™ developer kit SD card image JP 4.4.1 from NVIDIA® website using

<https://developer.nvidia.com/embedded/downloads>

Jetson Nano Developer Kit SD Card Image - JP 4.4.1

file name: jetson-nano-4gb-jp441-sd-card-image.zip

5. Follow the instructions in

<https://developer.nvidia.com/embedded/learn/get-started-jetson-nano-devkit> link, to flash the SD card for Jetson Nano™ development kit.

6. Copy the e-CAM24_CUNX release package into the HOME directory of the flashed Jetson Xavier NX™ development kit.

7. Run the following commands to extract the release package to Jetson Xavier NX™ development kit to obtain the binaries.

```
tar -xvf e-  
CAM24_CUNX_JETSON_XAVIERNX_<L4T_version>_<release_date>  
>_<release_version>.tar.xz  
cd e-  
CAM24_CUNX_JETSON_XAVIERNX_<L4T_version>_<release_date>  
>_<release_version>
```

To know more about the release package, please refer to the e-CAM24_CUNX_Release_Package_Manifest_<REV>.pdf.

8. Run the following commands in the Jetson™ kit.

```
sudo chmod +x ./install_binaries.sh  
sudo ./install_binaries.sh
```

This script will automatically reboot the Jetson™ kit after flashing the binaries successfully.

Note: If you have flashed L4T32.4.4 in Jetson™ board already, you can skip steps [2](#) and [3](#).

9. Follow the steps in *Launching the Application* section to launch the application.

Reference Documents

This section describes the software and hardware documents of e-CAM24_CUNX. You can download the software and hardware documents from [Developer Resources](#) website.

Software Documents

The software documents and its description are listed in following table.

Table 5: Description of Software Documents

S.N O	What I need	Documents to Refer
1	View the camera stream and change the camera controls using GUI.	e-CAM24_CUNX_Linux_App_User_Manual_<REV>.pdf
2	Build and install the GUI based ecam_tk1_guvcview camera application.	e-CAM_TK1-GUVCView_Build_and_Install_Guide_<REV>.pdf
3	Use gstreamer to control the e-CAM24_CUNX camera on the Jetson Xavier™ NX development kit.	e-CAM24_CUNX_Gstreamer_Usage_Guide_<REV>.pdf
4	Build custom kernel with support for using e-CAM24_CUNX.	e-CAM24_CUNX_Developer_Guide_Rev_<REV>.pdf
5	Information about the directory structure and contents of the release package for e-CAM24_CUNX.	e-CAM24_CUNX_Release_Package_Manifest_<REV>.pdf
6	Integrate e-con's e-CAM217_CUMI0234_MOD with any host system other than what is supported by e-con directly	e-CAM217_CUMI0234_MOD_MCU_Protocol_App_Note_<REV>.pdf

Hardware Documents

The hardware documents and its description are listed in following table.

Table 6: Description of Hardware Documents

S.N O	Documents Name	Description
1	e-CAM24_CUNX_Datasheet_<REV>.pdf	Describes the features, connector pin-out details and mechanical dimensions of e-CAM24_CUNX.
2	e-CAM217_CUMI0234_MOD_Datasheet_<REV>.pdf	Describes the features and specification of e-CAM217_CUMI0234_MOD camera module.
3	e-CAM24_CUNX_Lens_Datasheet_<REV>.pdf	Describes the optical specification of lenses used in e-CAM24_CUNX.
4	ACC_XVRNX-MIPICAMERA-ADP_3D.stp	3D drawing file for adapter board.
5	e-CAM24_CUNX.stp	3D drawing file for e-CAM24_CUNX product.
6	e-CAM217_CUMI0234_MOD_3D.stp	3D drawing file for the e-CAM217_CUMI0234_MOD

Troubleshooting

In this section, you can view the commonly occurring issue and their troubleshooting step.

Can I boot the NVIDIA®/Xavier NX™ development kit directly from the SD card shipped with the product?

Yes, the SD card shipped with the product is bootable SD card. The release package and document package will be available in **/home/nvidia/Release** path of root filesystem. For Jetson Nano™, you need to create the bootable SD card.

1. Do e-con Systems have any plan to support longer length cable?

e-con Systems provide a very flexible 15 cm FPC cable along with this kit. For customization, please write to camerasolutions@e-consystems.com with your requirement.

2. Can I boot the NVIDIA® Jetson Nano™/Xavier NX™ development kit directly from the SD card shipped with the product?

NO, the SD card shipped with the product is NX bootable SD card. Customer has to prepare SD card for Nano™.

3. Does e-CAM24_CUNX camera support OpenCV?

e-CAM24_CUNX works using Video for Linux version 2 (V4L2) APIs and is V4L2 compliant. So, any V4L2 based application can be used to access this camera. OpenCV is also compatible since it uses V4L2 to access the camera.

Please refer to

https://www.e-consystems.com/Articles/Camera/accessing_cameras_in_opencv_with_high_performance.asp for detailed information about OpenCV support in e-con Systems cameras.

What's Next?

After understanding the specifications of camera daughter board and instructions on how to use this daughter board with Jetson Xavier NX™ development kit, you can refer to the following documents to understand more about e-CAM24_CUNX.

- *e-CAM24_CUNX Developer Guide*
- *e-CAM24_CUNX Linux App User Manual*

Glossary

AI: Artificial Intelligence.

API: Application Program Interface.

CMOS: Complementary Metal Oxide Semiconductor.

CSI: Camera Serial Interface.

FFC: Flexible Flat Connector.

FPC: Flexible Printed Circuit.

GUI: Graphical User Interface.

LED: Light-Emitting Diode.

MCU: Micro Controller Unit.

micro SD: micro Secure Digital.

MIPI: Mobile Industry Processor Interface.

USB: Universal Serial Bus.

UYVY: YUV422 16-bit image format with UYVY ordering.

VGA: Video Graphics Array (Industry name for 640 x 480 resolution).

V4L2: Video4Linux2 is a collection of device drivers and API for supporting real-time video capture on Linux systems.

Contact Us

If you need any support on e-CAM24_CUNX product, please contact us using the Live Chat option available on our website -

<https://www.e-consystems.com/>

Creating a Ticket

If you need to create a ticket for any type of issue, please visit the ticketing page on our website -

<https://www.e-consystems.com/create-ticket.asp>

RMA

To know about our Return Material Authorization (RMA) policy, please visit the RMA Policy page on our website -

<https://www.e-consystems.com/RMA-Policy.asp>

General Product Warranty Terms

To know about our General Product Warranty Terms, please visit the General Warranty Terms page on our website -

<https://www.e-consystems.com/warranty.asp>

Revision History

Rev	Date	Description	Author
1.0	07-Dec-2020	Initial draft	Camera Team
2.0	30-Dec-2020	NANO support added	Camera Team
3.0	05-FEB-2021	Download information of sdcard image specified as jp4.4.1	Camera Team