Getting Started Manual

e-con Systems

Your Product Development Partner

Disclaimer

The specifications of e-CAM24_CUNX_TX2NX board and instructions on how to use this board with Jetson Xavier™ TX2NX SOM on NX Carrier Board are provided as reference only and e-con Systems reserves the right to edit/modify this document without any prior intimation of whatsoever.

Contents

Introduction to e-CAM24_CUNX_TX2NX

e-CAM24_CUNX_TX2NX 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® Xavier™ TX2NX SOM on NX carrier board. It can be directly interfaced with J1 and J9 connectors on carrier board.

e-CAM24_CUNX_TX2NX 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_TX2NX is a color camera that supports uncompressed UYVY format in both still capture and video recording. The supported resolutions and maximum frame rates at asynchronous mode are listed in following table.

Table 1: Supported Resolutions and Frame Rates in asynchronous mode

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

In Synchronous mode , external trigger signal can be used to achieve the synchronous frame from the camera

Parts Supplied

The following table lists the parts supplied with the kit.

Table 2: Parts Supplied and its Quantity

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

Adaptor Board (ACC-XVRTX2NX-MIPICAMERA-ADP)		1
152mm FPC Cable		1
Lens (FIFO-03028B8M)		1

Description

Xavier™ TX2NX is small size, low power, artificial intelligence (AI) system-based evaluation board, developed by NVIDIA®. Xavier™ TX2NX has two individual 2-lane MIPI CSI-2 camera connection option. e-CAM24_CUNX_TX2NX uses these 2-lane MIPI CSI-2 interface for connecting 2 MP camera modules.

e-CAM24_CUNX_TX2NX is a multi-board solution, which has two boards as follows:

- Camera Module (e-CAM217_CUMI0234_MOD)
- Adaptor Board (ACC-XVRTX2NX-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-XVRTX2NX-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-XVRTX2NX-MIPICAMERA-ADP Adaptor Board

Figure 4: Rear View of ACC-XVRTX2NX-MIPICAMERA-ADP Adaptor Board

e-CAM24_CUNX_TX2NX camera module has 26-pin Samtec connector (CN2) for mating with e-CAM24_CUNX_TX2NX adaptor board. e-CAM24_CUNX_TX2NX

adaptor board acts as a bridge between the camera module and the Carrier Board. The adaptor board provides the voltages required for the camera module. e-CAM24_CUNX_TX2NX adaptor board consists of 15-pin FFC connector (CN2), through which e-CAM24_CUNX_TX2NX is connected to carrier board over FPC cable of maximum 15 cm length.

e-CAM24_CUNX_TX2NX Board Handling Procedure

This section describes the handling procedure of e-CAM24_CUNX_TX2NX board.

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

Camera Board Connection

e-CAM24_CUNX_TX2NX is provided with 152mm FPC cable for connecting with Jetson Xavier™ Development 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.
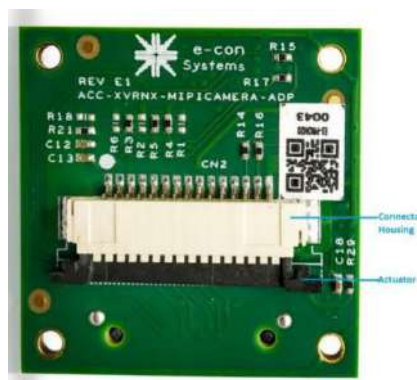

Figure 6: CN2 Connector Location

2. Pull-down the actuator at centre with slight force for unlocking the connector as shown in following figures.
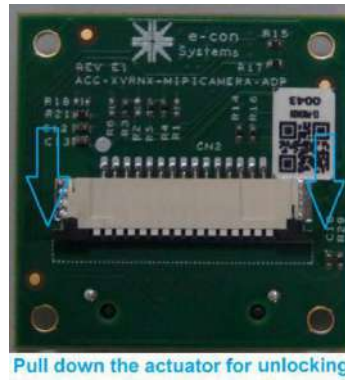
Figure 7: Unlocking CN2 Connector

Figure 8: CN2 Unlocked Connector Position

3. Insert the FPC cable to CN2 connector.

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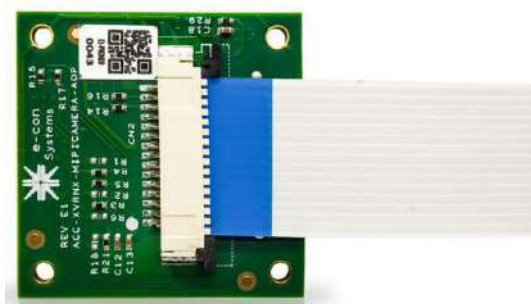

Figure 9: Cable inserted to CN2 Connector of e-CAM24_CUNX_TX2NX

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

   e-CAM24_CUNX_TX2NX CN2 connector locked with cable is shown in following figure.

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Figure 10: e-CAM24_CUNX_TX2NX CN2 Connector Locked with Cable

Note: Care must be taken, while connecting cable to e-CAM24_CUNX_TX2NX connector.

Warning: If FPC cable is connected in reverse direction to CN2 connector of e-CAM24_CUNX_TX2NX, it might damage e-CAM24_CUNX_TX2NX as well as Xavier™ TX2NX development kits.

Interfacing with Jetson Xavier Development Kit

Jetson Xavier™ TX2NX SOM on NX carrier board 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 Carrier Board before powering ON the Jetson Xavier™ development Kit.

   The J1 connector location in the Carrier Board is shown in following figure.
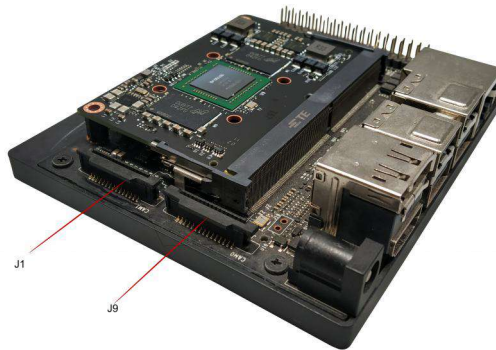
Figure 11: Camera Connector Location in Carrier Board

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

The location of actuator in NX Carrier board is shown in following figure.
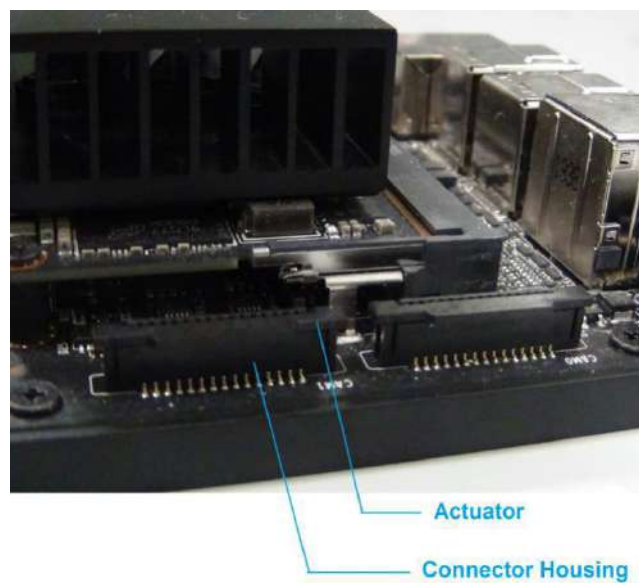

Figure 12: Jetson Xavier Kit Camera Connector Actuator Location

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

Pull up for unlocking

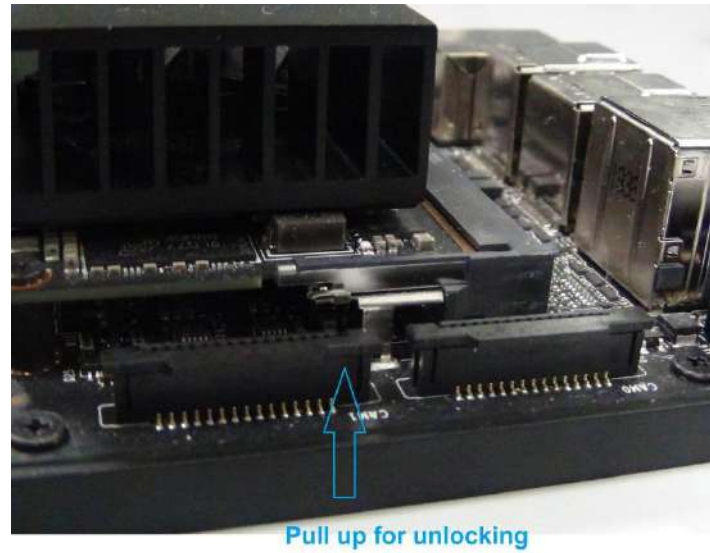**Figure 13: Unlocking Carrier Board Camera Connector**
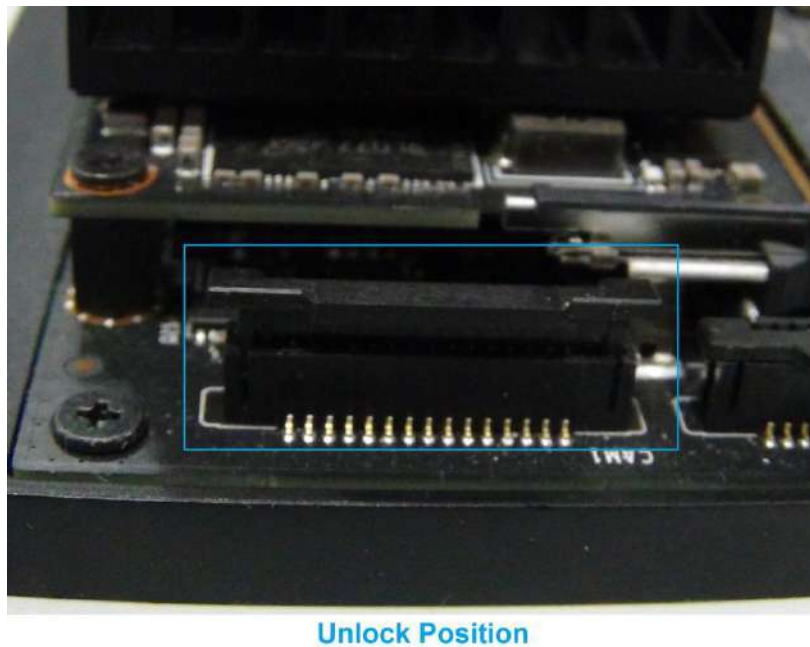

Unlock Position

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

6. Insert the FPC cable to the J1 connector of Carrier Board as shown in following figure.
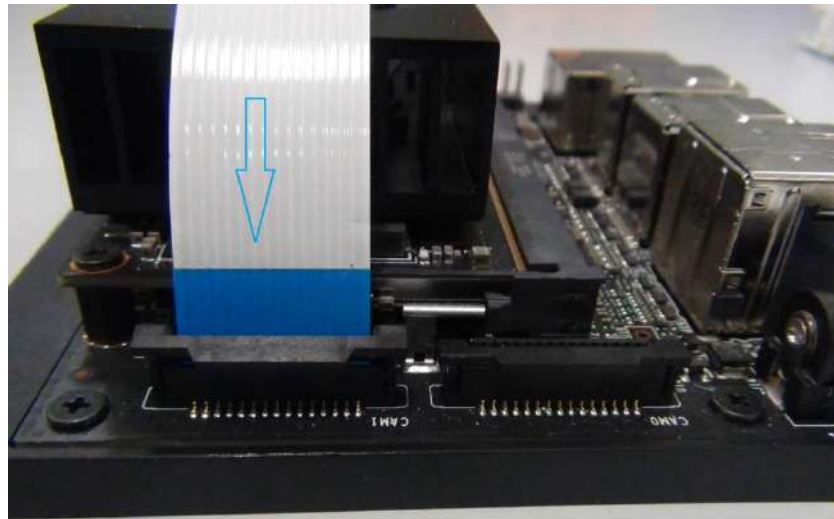
Insert FPC cable

Figure 15: FPC Cable insertion to J1 Connector of Jetson Carrier Board

7. 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
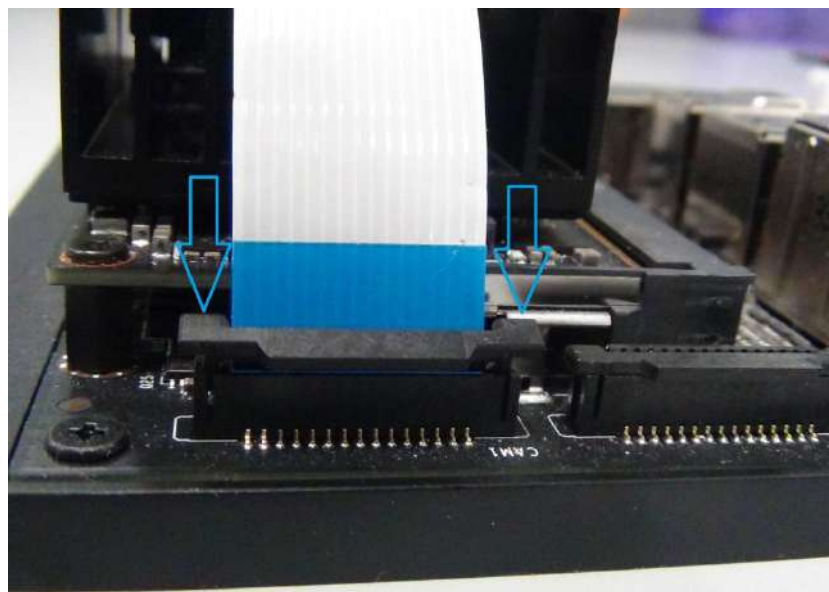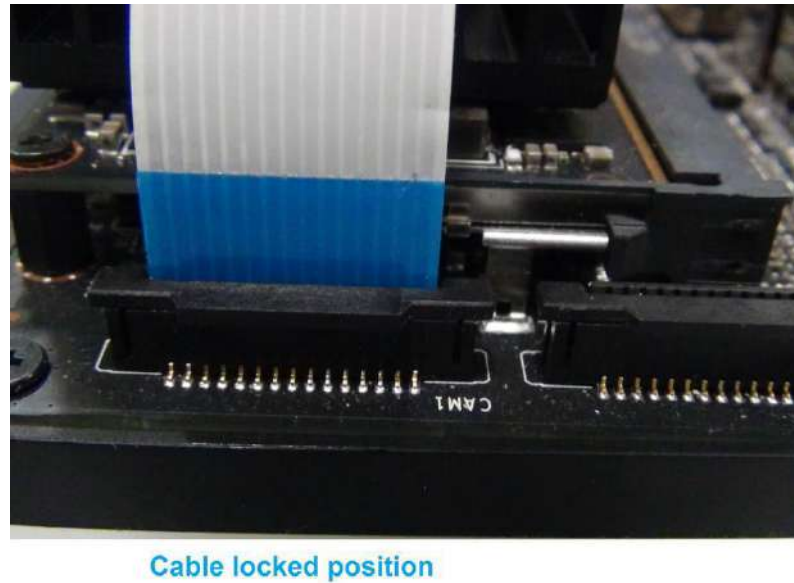
Cable locked position

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

Note: Care must be taken, while connecting cable to camera connector of Carrier Board

Now, e-CAM24_CUNX_TX2NX is connected to Jetson Xavier™ development kit as shown in following figure.

Figure 18: e-CAM24_CUNX_TX2NX 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_TX2NX supports only low resolutions in this power supply. Connecting 5V 4A power supply to J16 DC jack will be the ideal solution, when using e-CAM24_CUNX_TX2NX 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

8. Connect 5V, 4A power supply to DC jack (J16) to power ON the Jetson Xavier™ development kit.

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

Figure 20: Status LED indicating Jetson Xavier Development Kit Powered ON

This section describes the extracting and flashing of e-con Systems provided binaries.

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

Table 3: Notation of Colors

Color	Notation
Blue	Commands running in Development PC
Red	Commands running in Development Board
Orange	Output message in Development Board

Before extracting and flashing the e-con provided binaries in Jetson™ development kit, flash the Jetpack 4.5.1 provided by NVIDIA®, using the SDK Manager. Download the SDK Manager using the link https://developer.nvidia.com/nvidia-sdk-manager .

Sign up to an account in NVIDIA® developer site to use the SDK Manager.

Run the following command to install the SDK Manager in the host PC.

```
sudo apt-get install ./sdk-manager-[version].[build#].deb
```

After installing the SDK Manager in the host PC, follow the instructions in the below link to flash the Jetson™ development kit.

https://docs.nvidia.com/sdk-manager/install-wtih-sdkm-jetson/index.html

Copy the release package into the HOME Directory of the flashed Jetson™ development kit.

Copy the release package into the HOME Directory of the flashed Jetson™ development kit.

To extract and flash the binaries, follow these steps

1. Run the following commands to extract the release package in the Jetson™ development kit to obtain the binaries.

```
tar -xaf e-CAM24_CUNX_TX2-NX_JETSON_<L4T_version>_<release_date>_<release_version>.tar.gz
cd  e-CAM24_CUNX_TX2-NX_JETSON_<L4T_version>_<release_date>_<release_version>
```

The folder contains the necessary tools to immediately flash the binaries in Jetson™ board with the kernel, camera drivers and applications.

Run the following commands in the Jetson™ development kit to install e-con provided binaries with support for e-CAM81_CUNX_H01R1.

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

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

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/video1
    /dev/vidio2
    ```

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

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

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

10. Run the following Jetson clocks command before launching the ecam_tk1_guvcview application in the Jetson Xavier™ TX2NX development board.

    ```
    $ sudo jetson_clocks
    ```

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

    ```
    ecam_tk1_guvcview
    ```

    Note:
    To test external trigger mode, choose frame sync tab with either 30hz or 60hz mode and connect the external trigger to the adapter board

Figure 21: adapter board with external trigger signal. (Black wire – GND , Green Wire – 3.3V trigger signal)
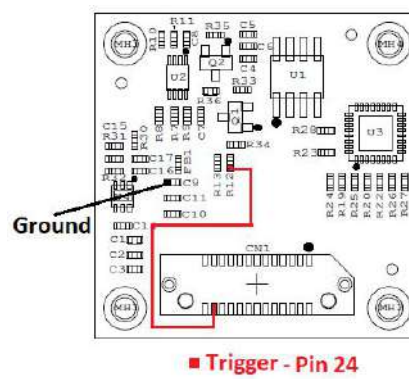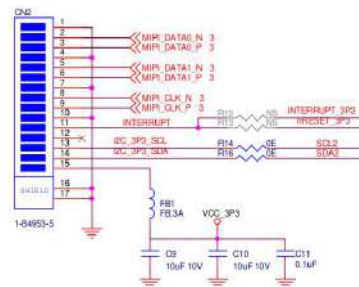

Figure 22: Layout representing trigger pin soldering details

Trigger pin(GREEN) is soldered at R12 , which in turn soldered to pin 24 of CN1 connector . Pin 24 is the trigger pin to camera module. GND (BLACK) is soldered at C9 capacitor.
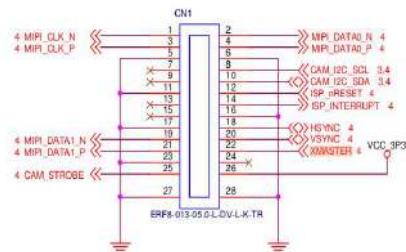

Figure 23 : Schematics of connectors

13. Run the following command to launch the e-multicam.elf to view muticamera streaming

```
e-multicam.elf
```

When the application is launched, you can view the previews of both the cameras connected

Figure 24: Initial Window when Application is Launched

Reference Documents

This section describes the software and hardware documents of e-CAM24_CUNX_TX2NX. 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.NO	What I need	Documents to Refer
1	View the camera stream and change the camera controls using GUI.	e-CAM24_CUNX_TX2NX_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_TX2NX camera on the Jetson Xavier™ TX2NX development kit.	e-CAM24_CUNX_Gstreamer_Usage_Guide_<REV>.pdf
4	Build custom kernel with support for using e-CAM24_CUNX_TX2NX.	e-CAM24_CUNX_TX2NX_Developer_Guide_Rev_<REV>.pdf
5	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.NO	Documents Name	Description
1	e-CAM24_CUNX_Datasheet_<REV>.pdf	Describes the features, connector pin-out details and mechanical dimensions of e-CAM24_CUNX_TX2NX.
2	e-CAM217_CUMI0234_MOD_Datasheet_<REV>.pdf	Describes the features and specification of e-CAM213_CUMI0234_MOD camera module.
3	e-CAM24_CUNX_Lens_Datasheet_<REV>.pdf	Describes the optical specification of lenses used in e-CAM24_CUNX_TX2NX.

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

Why camera is not detected even after setting up the release package ?

If previously older version of Jetpack was flashed in the board and reflashed with newer jetpack SD card image , DTB partition is getting mapped wrongly . This happening because of onboard BIOS updation is not happening properly.

In this case "Developer manual" needs to be followed to flash the board with latest jetpack from development environment via USB.

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. **Does e-CAM24_CUNX_TX2NX camera support OpenCV?**

   e-CAM24_CUNX_TX2NX 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.

3. **How can I get the updated package?**

   Please login to the Developer Resources website and download the latest release package.

After understanding the specifications of camera daughter board and instructions on how to use this daughter board with Jetson Xavier™ development kit, you can refer to the following documents to understand more about e-CAM24_CUNX_TX2NX.

- *e-CAM24_CUNX_TX2NX Developer Guide*
- *e-CAM24_CUNX_TX2NX 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_TX2NX 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	18-May-2020	Initial draft	Camera Team
1.1	03-SEP-2021	Mentioned details about TX2NX SOM on NX carrier board	Product Marketing Team