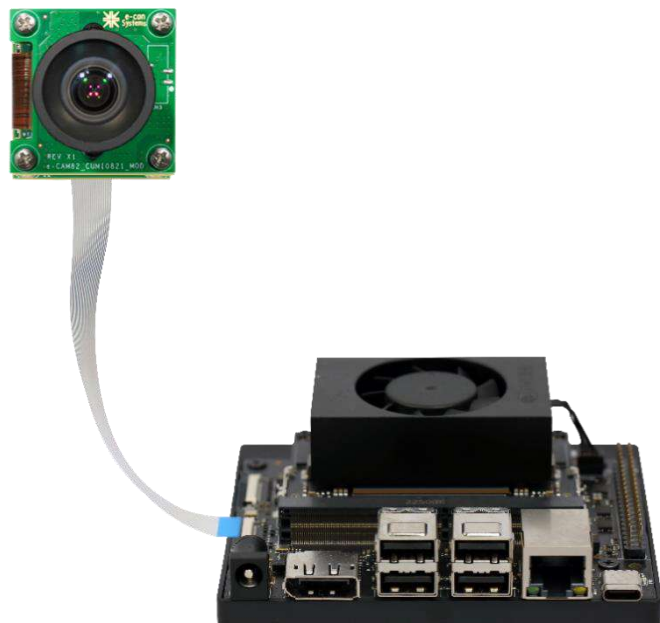


e-CAM81\_CUONX

# Getting Started Manual



### **Disclaimer**

The specifications of e-CAM81\_CUONX board and instructions on how to use this board with Jetson Orin Nano™ and Orin NX™ 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-CAM81\_CUONX

e-CAM81\_CUONX is an HDR, 8 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 Orin Nano™/Orin NX™ development kit and can be directly interfaced with it through CAM1 camera connector in 4 lane configuration and both connectors in 2 lane configurations.

e-CAM81\_CUONX 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 mount for camera boards. This color camera supports UYVY format in both still capture and video recording.

The following table lists the supported resolutions and frame rates.

**Table 1: Supported Resolution and Frame Rates in 2 Lane configuration**

Resolution	Day HDR Frame Rate (fps)	Night HDR Frame Rate (fps)	Linear Frame Rate (fps)
1280 x 720	30	60	60
1920 x 1080	30	60	60
3840 x 2160	16	16	16

**Table 2: Supported Resolutions and Frame Rates in 4 Lane configuration**



Resolution	Day HDR Frame Rate (fps)	Night HDR Frame Rate (fps)	Linear Frame Rate (fps)
1280 x 720	30	60	60
1920 x 1080	30	60	60
3840 x 2160	30	30	30

This document describes how to interface the e-CAM81\_CUONX board on Jetson Orin Nano™/Orin NX™ development kit and how to use the e-CAM81\_CUONX board.

## Parts Supplied

The following table lists the parts supplied with the kit.

**Table 3: Parts Supplied and its Quantity**

Parts Supplied	Images	Quantity
e-CAM81_CUONX Camera Module		1
Adapter board (ACC-RB-WTB-ADP)		1
15cm FPC Cable		1
Lens		1

## Description

Jetson Orin Nano™/Orin NX™ is small size, low power, artificial intelligence (AI) system-based evaluation board, developed by NVIDIA®. The Jetson Orin Nano™ development kit supports two SOMs, with one supporting the Jetson Orin Nano™ and the other supporting the Jetson Orin NX™. Both Jetson Orin Nano™ and Orin NX™ development kits are limited to single 4-lane camera connection and double 2-lane camera connections. e-CAM81\_CUONX uses 2-lane and 4-lane MIPI CSI-2 interface for connecting 8 MP camera modules.

e-CAM81\_CUONX is a multi-board solution, which has two boards listed as follows:

- Camera module (e-CAM82\_CUMI0821\_MOD)

- Adapter board (ACC-RB-WTB-ADP)

The camera module is a small, low-power, HDR, high performance 8 MP camera with a built-in ISP, which supports UYVY format. This camera module is based on AR0821 CMOS image sensor from onsemi™. The AR0821 is a 1/1.7" optical form factor, CMOS image sensor with electronic rolling shutter.

The front and rear views of e-CAM82\_CUMI0821\_MOD board and ACC-RB-WTB-ADP adapter board are shown in following figures.

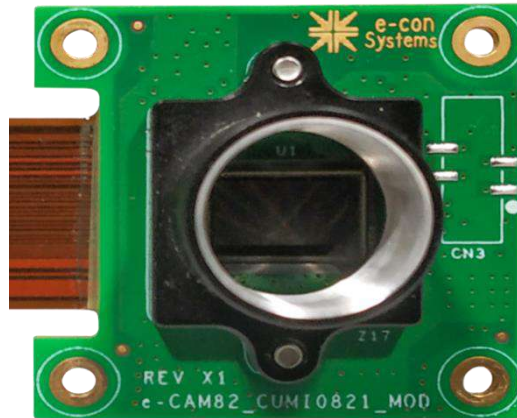


Figure 1: Front View of e-CAM81\_CUONX Module

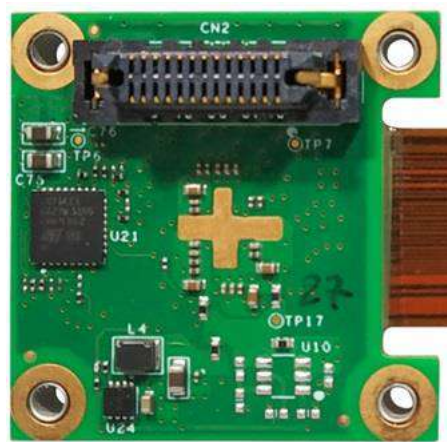


Figure 2: Rear View of e-CAM81\_CUONX Module

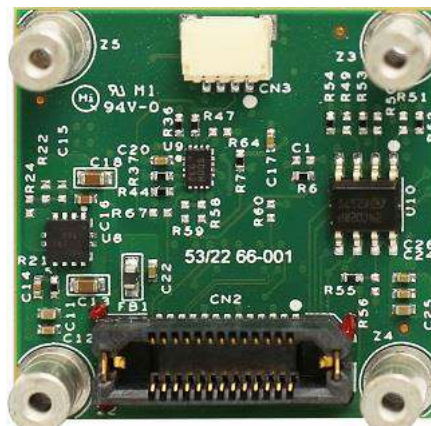


Figure 3: Front View of Adapter Board



**Figure 4: Rear View of Adapter Board**

e-CAM81\_CUONX camera module has 26-pin Samtec connector (CN2) for mating with e-CAM81\_CUONX adapter board. e-CAM81\_CUONX adapter board acts as a bridge between the camera module and the Jetson™ Orin Nano™/Orin NX™ development kit. e-CAM81\_CUONX adapter board consists of 22-pin FFC connector (CN1), through which e-CAM81\_CUONX is connected to Jetson Orin Nano™/Orin NX™ development kit over a FPC cable of 15 cm length.

# e-CAM81\_CUONX Board Handling Procedure

---

This section describes the handling procedure of e-CAM81\_CUONX board.

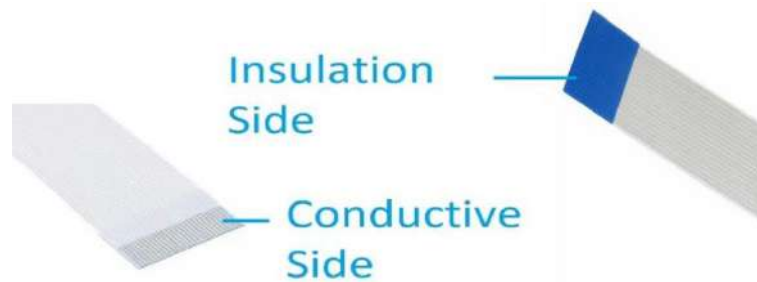
The procedure to assemble camera board to Jetson Orin Nano™/Orin NX™ development kit is described in the following section.

- [Camera Board Connection](#)
- [Interfacing with Orin NX Development Kit](#)
- [Interfacing with Orin Nano Development Kit](#)

## Camera Board Connection

e-CAM81\_CUONX is provided with 15cm FPC cable for connecting with Jetson Orin Nano™/Orin NX™ development kit.

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 is as follows:

1. Unlock the CN1 connector in adapter board for inserting the FPC cable.

The CN1 connector has a lock actuator which is used for locking and unlocking the cable as shown in following figure.



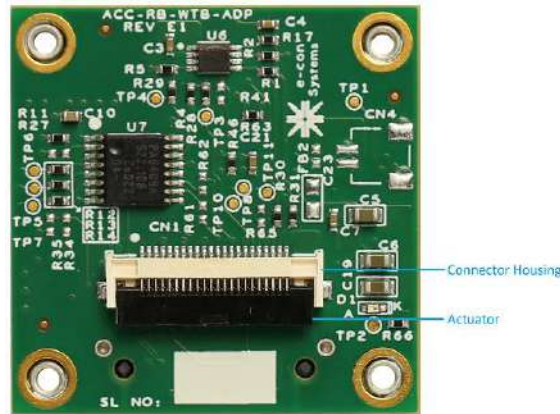


Figure 6: CN1 Connector Location

2. Lift the lock actuator at centre with slight force for unlocking the connector as shown in following figures.



Figure 7: Unlocking CN1 Connector

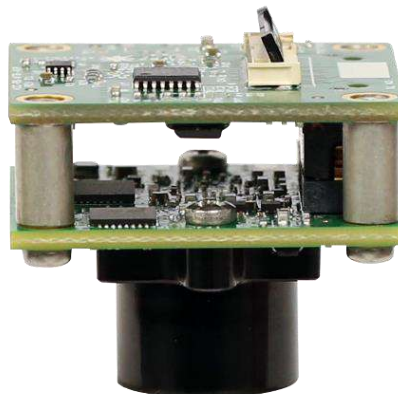


Figure 8: CN1 Unlocked Connector Position

3. Insert the FPC cable to CN1 connector in adapter board.
4. Lock the CN1 connector by pressing the lock actuator from top to bottom.

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

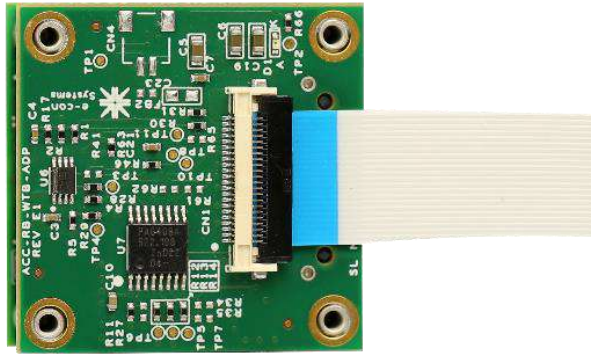


Figure 9: Cable Locked to CN1 Connector of e-CAM81\_CUONX

**Note:** Care must be taken, while connecting cable to the e-CAM81\_CUONX connector.

**Warning:** If FPC cable is connected in reverse direction to CN1 connector of e-CAM81\_CUONX, it might damage the e-CAM81\_CUONX as well as the Jetson Orin Nano™/Orin NX™ development kit.

## Interfacing with Jetson Orin NX Development Kit

Jetson Orin NX™ development kit has a connector CAM1 interface with camera module.

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

1. Insert the FPC cable on CAM1 connector of the Jetson Orin NX™ development kit before powering ON the Jetson Orin NX™ development kit.

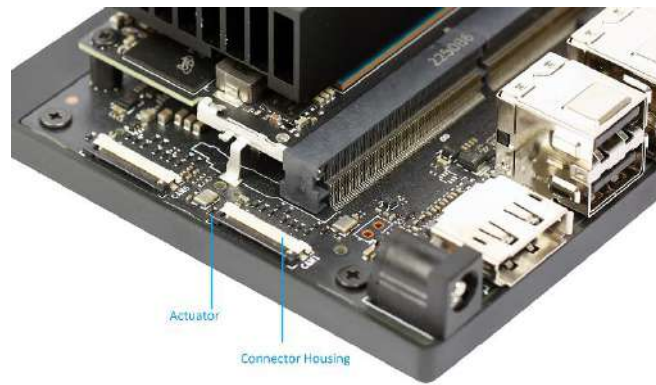
The CAM1 connector location in the Jetson Orin NX™ development kit is shown in the following figure.



Figure 10: Camera Connector Location in Jetson Orin NX Development Kit

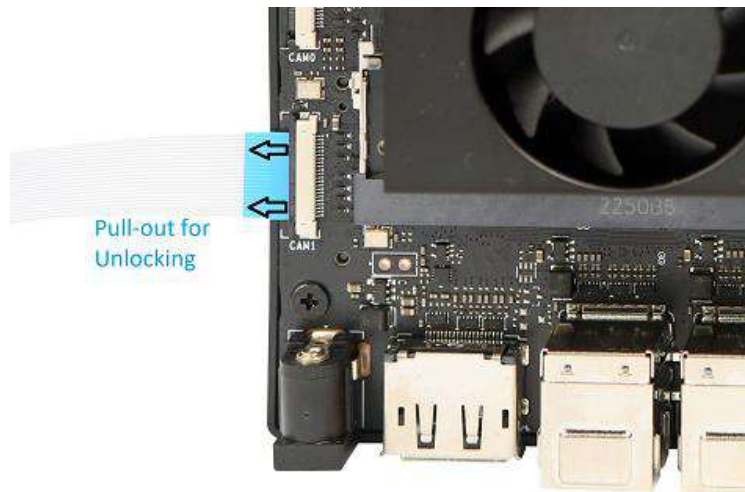
2. Unlock the CAM1 connector for inserting the FPC cable.

The location of the actuator in the Jetson Orin NX™ development kit is shown in the following figure.

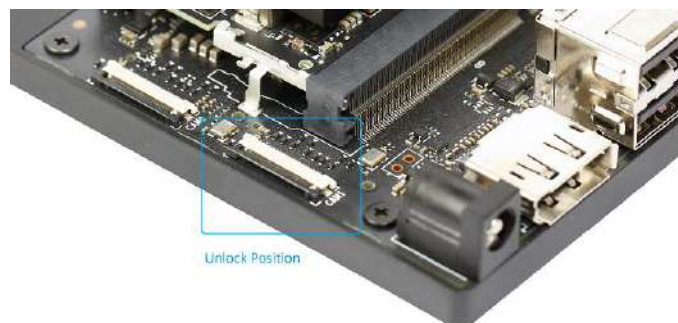


**Figure 11: Camera Connector Actuator Location in Orin NX Development Kit**

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

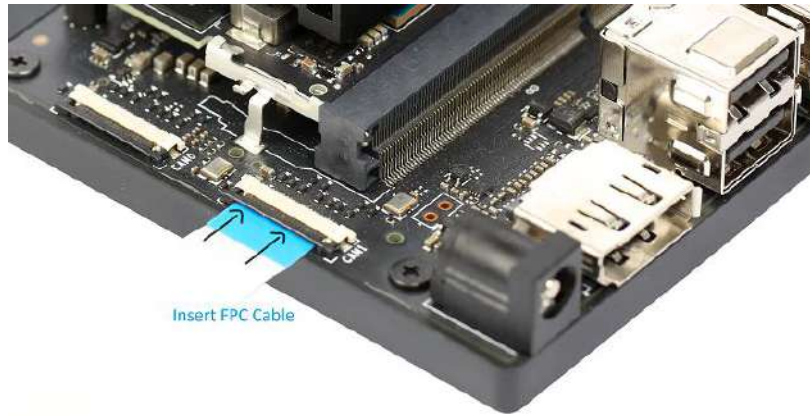


**Figure 12: Unlocking Jetson Orin NX Development Kit Camera Connector**



**Figure 13: Unlocked Position of Jetson Orin NX Development Kit Camera Connector**

4. Insert the FPC cable to the CAM1 connector of the Jetson Orin NX™ development kit as shown in the following figure.

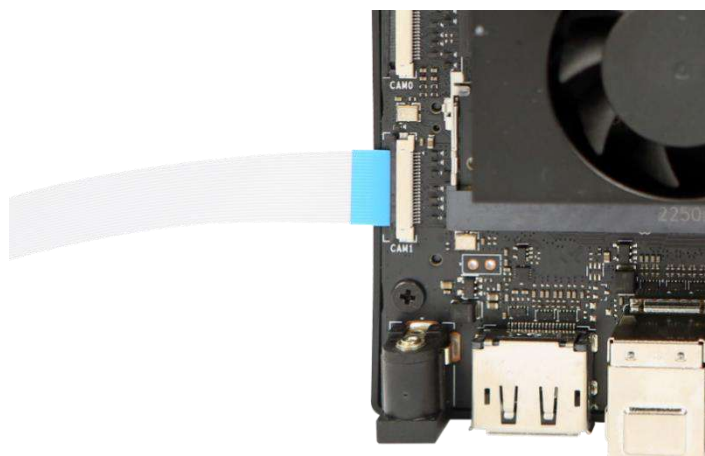


**Figure 14: FPC Cable Insertion to CAM1 Connector of Jetson Orin NX Development Kit**

5. Lock the CAM1 connector by pressing both ends of the actuator with same equal force as shown in the following figures.



**Figure 15: Locking FPC Cable**



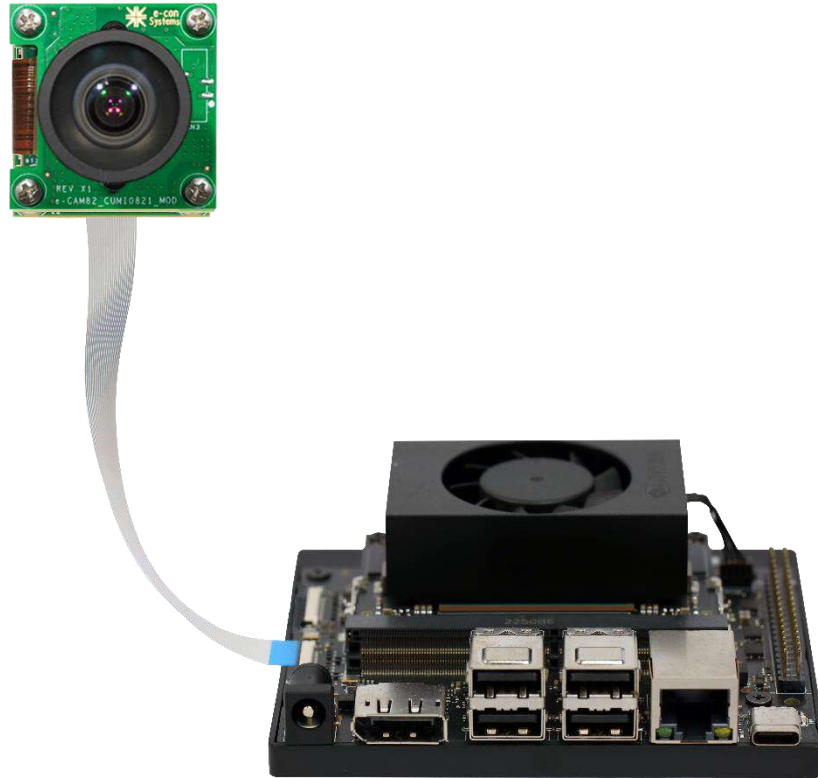
**Figure 16: FPC Cable Locked Position on Jetson Orin NX Development Kit**

**Note:** Care must be taken, while connecting cable to camera connector of the Jetson Orin NX™ development kit.



**Warning:** If FPC cable is connected in reverse direction to the CAM1 connector of the Jetson Orin NX™ development kit, it might damage the e-CAM81\_CUONX as well as the Jetson Orin NX™ development kits.

Now, e-CAM81\_CUONX is connected to the Jetson Orin NX™ development kit as shown in the following figure.



**Figure 17: e-CAM81\_CUONX Setup Interfaced to Jetson Orin NX Development Kit**

Jetson Orin NX™ development kit can be powered either from a USB Type-C connector or a DC power jack connector. Since USB Type-C is used for low power applications, e-CAM81\_CUONX supports only low resolutions in this power supply. Connecting a 19V power supply to DC jack will be the ideal solution when using e-CAM81\_CUONX with the Jetson Orin NX™ development kit to use its full listed resolutions.

The power supply connectors in the Jetson Orin NX™ development kit is shown in the following figure.



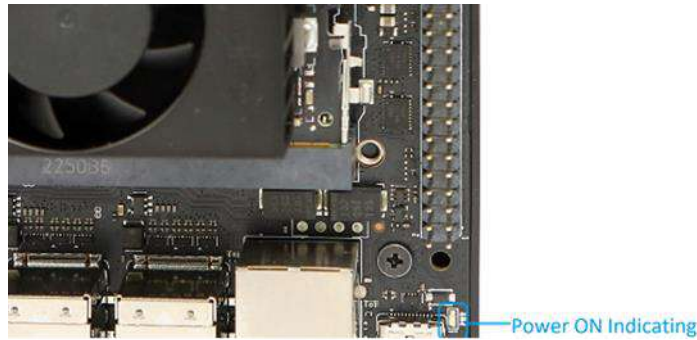
**Figure 18: Power Supply Connectors in Jetson Orin NX Development Kit**

6. Connect the 19V power supply to DC jack to power ON the Jetson Orin NX™ development kit as shown in the following figure.



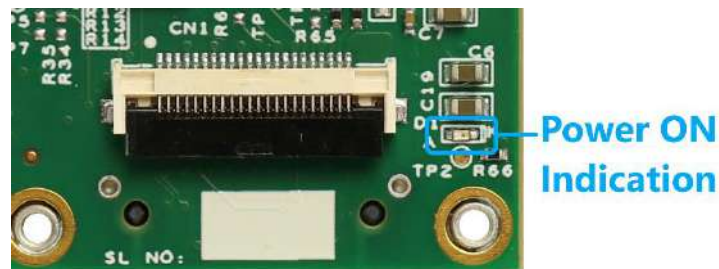
**Figure 19: Power Supply Connected to Jetson Orin NX Development Kit**

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



**Figure 20: Status LED Indicating Jetson Orin NX Development Kit Powered ON**

After powering ON the Jetson Orin NX™ development kit, the greenish yellow color LED on the e-CAM81\_CUONX adapter board will glow. This serves as an indication for power-up of the e-CAM81\_CUONX camera module. The LED location is shown in the following figure.



**Figure 21: Status LED Indicating e-CAM81\_CUONX Module Powered ON**

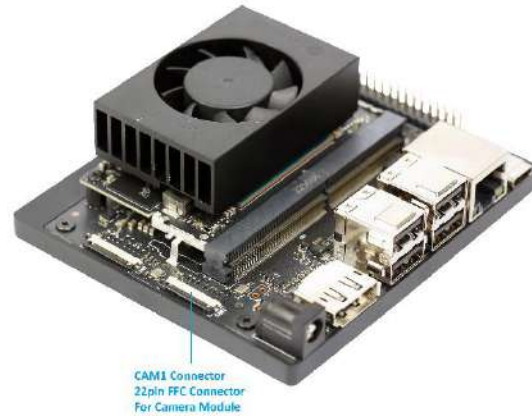
## Interfacing with Jetson Orin Nano Development Kit

The Jetson Orin Nano™ development kit has a CAM1 connector to interface with the camera module.

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

1. Insert the FPC cable on the CAM1 connector of the Jetson Orin Nano™ development kit before powering ON the Jetson Orin Nano™ development kit.

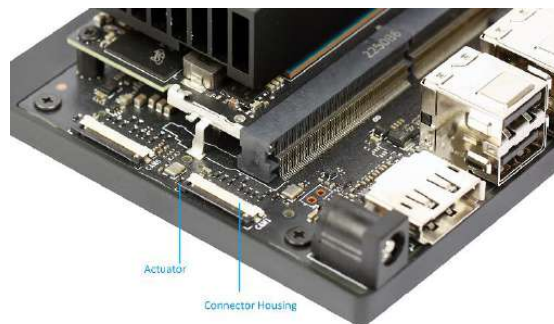
The CAM1 connector location in the Jetson Orin Nano™ development kit is shown in the following figure.



**Figure 22: Camera Connector Location in Jetson Orin Nano Development Kit**

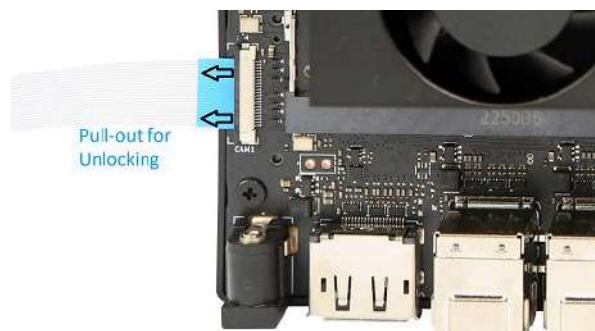
2. Unlock the CAM1 connector for inserting the FPC cable.

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



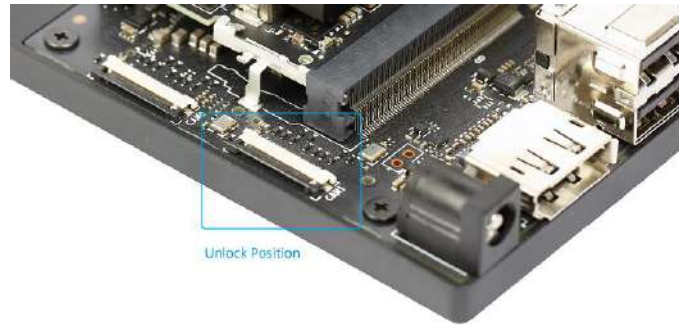
**Figure 23: Jetson Orin Nano Development Kit Camera Connector Actuator Location**

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



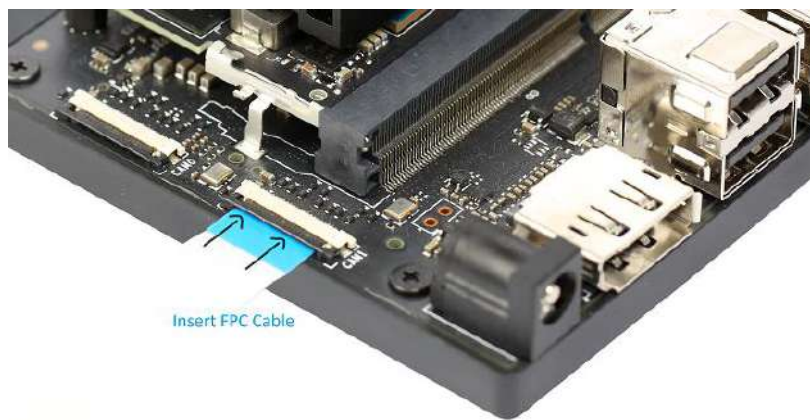
**Figure 24: Unlocking Jetson Orin Nano Development Kit Camera Connector**





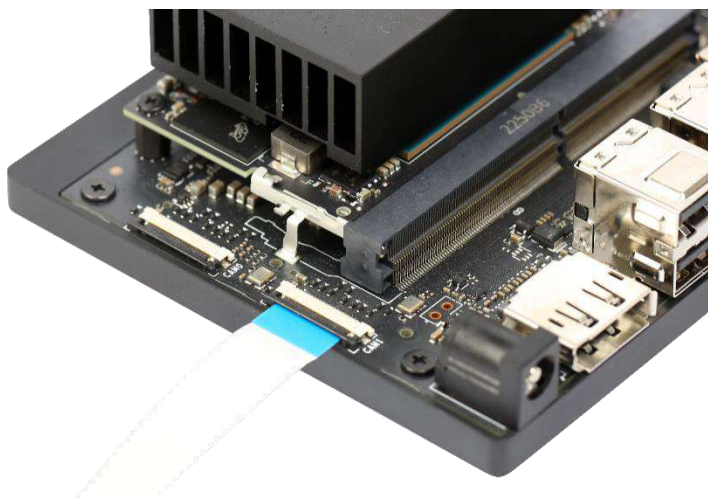
**Figure 25: Unlocked Position of Jetson Orin Nano Development Kit Camera Connector**

4. Insert the FPC cable to the CAM1 connector of the Jetson Orin Nano™ development kit as shown in the following figure.



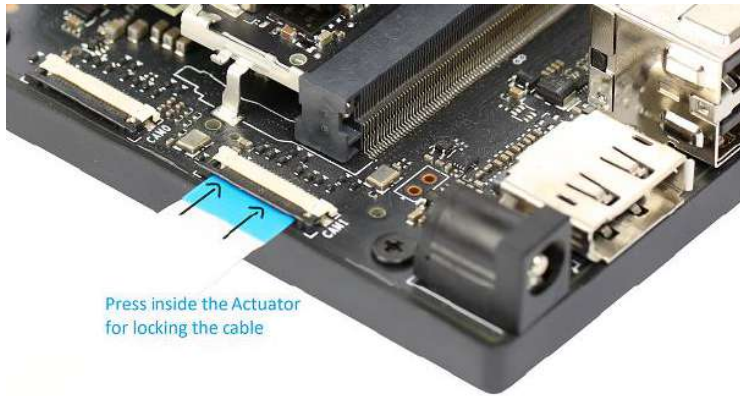
**Figure 26: FPC Cable Insertion to CAM1 Connector of Jetson Orin Nano Development Kit**

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

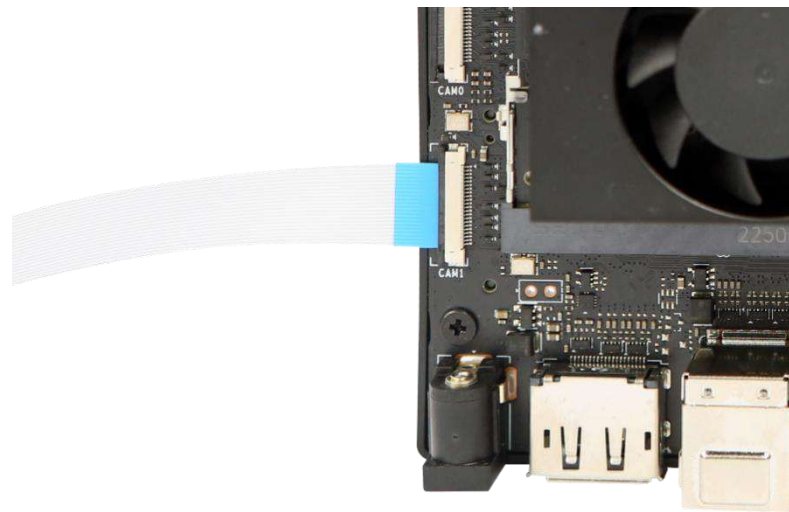


**Figure 27: FPC Cable inserted to Jetson Orin Nano Development Kit**

5. Lock the CAM1 connector by pressing both ends of the actuator with same equal force as shown in the following figures.



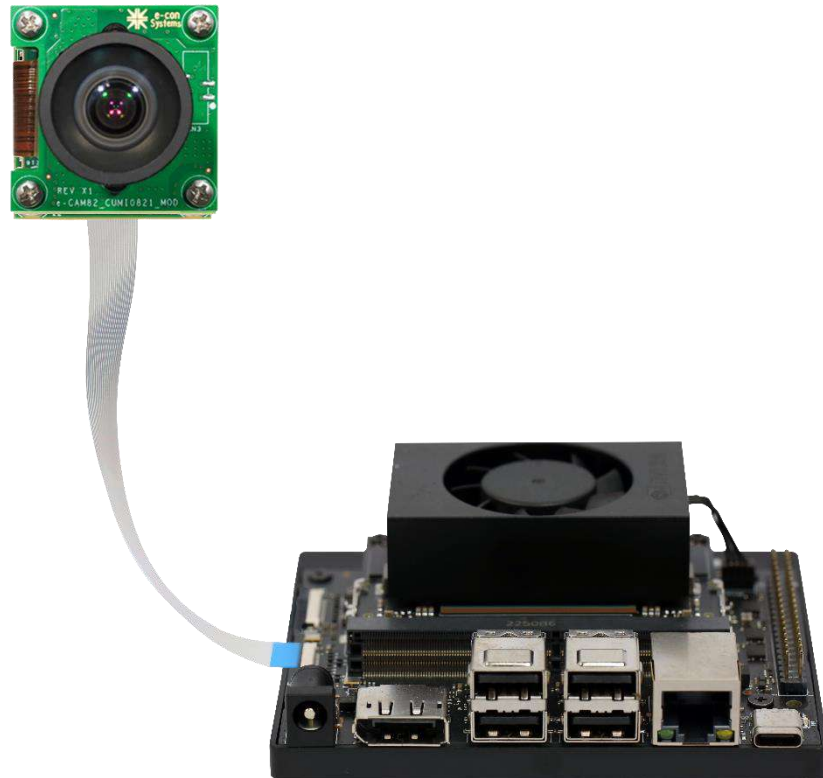
**Figure 28: Locking FPC Cable**



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

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

Now, e-CAM81\_CUONX is connected to the Jetson Orin Nano™ development kit as shown in the following figure.



**Figure 30: e-CAM81\_CUONX Setup Interfaced to Jetson Orin Nano Development Kit**

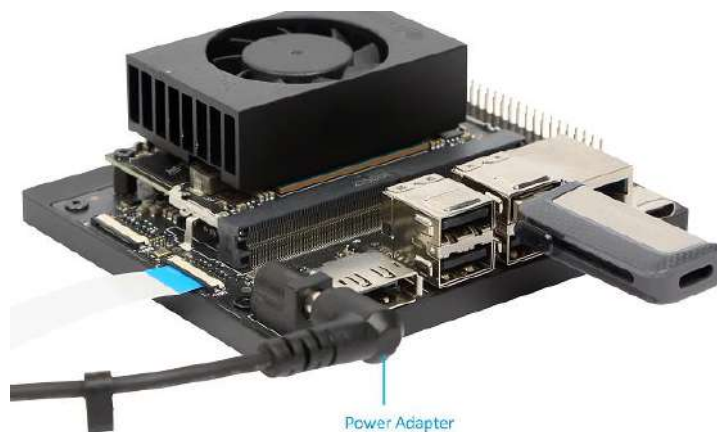
Jetson Orin Nano™ development kit can be powered either from USB Type-C connector or DC power jack connector. Since USB Type-C is used for low power applications, e-CAM81\_CUONX supports only low resolutions in this power supply. Connecting the 19V power supply to DC jack will be the ideal solution, when using e-CAM81\_CUONX with the Jetson Orin Nano™ development kit to use its full listed resolutions.

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



**Figure 31: Power Supply Connectors in Orin Nano Development Kit**

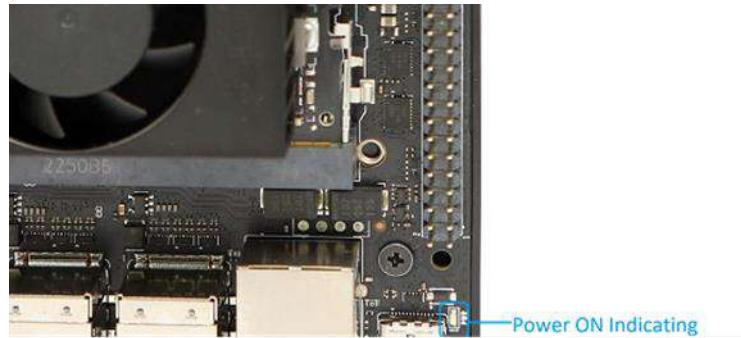
6. Connect the 19V power supply to DC jack to power ON the Jetson Orin Nano™ development kit as shown in the following figure.



**Figure 32: Power Supply Connected to Jetson Orin Nano Development Kit**

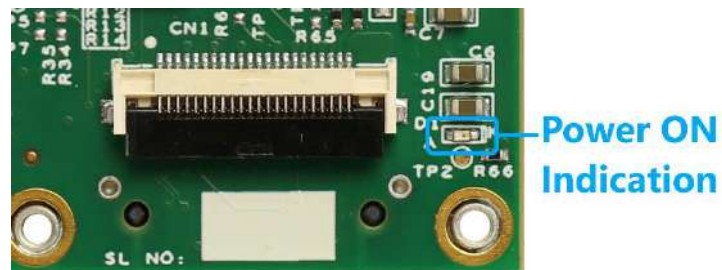
**Note:** Jetson Orin Nano™ development kit does not provide any power adapter. You must take care of power adapter. The description of power adapter used by e-con Systems is mentioned in the above image.

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



**Figure 33: Status LED Indicating Jetson Orin Nano Development Kit Powered ON**

After powering ON the Jetson Orin NX™ development kit, the greenish yellow color LED on the e-CAM81\_CUONX adapter board will glow. This serves as an indication for power-up of e-CAM81\_CUONX camera module. The LED location is shown in the following figure.



**Figure 34: Status LED Indicating e-CAM81\_CUONX Module Powered ON**



# Software Quick Setup

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 following table.

**Table 4: Notation of Colors**

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

Before extracting and flashing the e-con provided binaries, flash the jetpack 5.1.1 in Jetson Orin Nano™/Orin NX™ development kit provided by NVIDIA®, using the SDK Manager.

The steps to setup the Jetson Orin Nano™/Orin NX™ development kit for e-CAM81\_CUONX camera are as follows:

1. Download the SDK Manager using the link <https://developer.nvidia.com/nvidia-sdk-manager>.
2. Sign up to an account in NVIDIA® developer site to use the SDK Manager.
3. 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 link <https://docs.nvidia.com/sdk-manager/install-with-sdtkm-jetson/index.html> to flash the Jetson Orin Nano™/Orin NX™ development kit.

4. Copy the release package into the HOME Directory of the flashed Jetson Nano™/Orin NX™ development kit.

## Steps for Extracting and Flashing Binaries

The steps to extract and flash the binaries are as follows:

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

```
tar -xaf e-  
CAM81_CUONX_JETSON_ONX_ONANO_<L4T_version>_<release_da  
te>_<release_version>.tar.gz  
  
cd e-  
CAM81_CUONX_JETSON_ONX_ONANO_<L4T_version>_<release_da  
te>_<release_version>
```

The folder contains the necessary tools to immediately flash the binaries in Jetson Orin Nano™/Orin NX™ development kit with the kernel, camera drivers and applications.

2. Run the following commands in the Jetson Orin Nano™/Orin NX™ development kit to install e-con provided binaries with support for e-CAM81\_CUONX.

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

This script will reboot the Jetson Orin Nano™/Orin NX™ development kit automatically after installing the binaries successfully.

## Steps for Launching Application in Development Kit

The steps to launch the application in the in the Jetson Orin NX™/Orin Nano™ development kit are as follows:

1. Run the following command to check whether the camera is initialized.

```
$sudo dmesg | grep -i "ar0821"
```

The output message appears as shown below.

```
// For Orin NX™/Orin Nano™ development kit  
subdev ar0821 10-0042 bound
```

The output message indicates that all cameras are initialized properly.

2. Run the following command to check the presence of four video nodes.

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

The output message appears as shown below.

```
/dev/video*
```

where (\*) represents the index number for each camera connected and detected. The number of times the output message displayed above must be equal to the number of cameras connected to the Jetson Orin Nano™/Orin NX™ development kit.

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

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

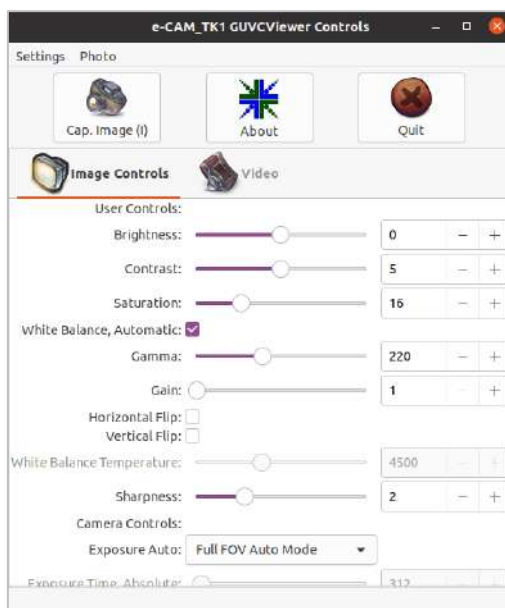
4. Run the following Jetson clocks command before launching the ecam\_tk1\_guvcview application in the Jetson Orin Nano™/Orin NX™ development kit.

```
$ sudo jetson_clocks
```

5. 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 34: Initial Window when Application is Launched**

**Note:** The default login credentials for Jetson Orin Nano™/Orin NX™ development kit is listed in the following table.

**Table 5: Default Login Credentials**

Fields	Inputs
Username	nvidia
Password	nvidia



# Reference Documents

This section describes the software and hardware documents of e-CAM81\_CUONX. You can download the software and hardware documents from [Developer Resources](#) website.

## Software Documents

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

**Table 6: 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-CAM81_CUONX_Linux_App_User_Manual_Rev_<ver>.pdf
2	Build and install the GUI based ecam_tk1_guvcview camera application.	e-CAM_TK1-GUVCView_Build_and_Install_Guide_Rev_<ver>.pdf
3	Use GStreamer to control the e-CAM81_CUONX camera on the Jetson Orin Nano™/Orin NX™ development kit.	e-CAM81_CUONX_Gstreamer_Usage_Guide_Rev_<ver>.pdf
4	Build custom kernel with support for using e-CAM81_CUONX.	e-CAM81_CUONX_Developer_Guide_Rev_<ver>.pdf
5	Information about the directory structure and contents of the release package for e-CAM81_CUONX.	e-CAM81_CUONX_Release_Package_Manifest_Rev_<ver>.pdf
6	Integrate e-con's e-CAM82_CUMI0821_MOD with any host system other than what is supported by e-con directly	e-CAM82_CUMI0821_MOD_MCU_Protocol_App_Note_Rev_<ver>.pdf

## Hardware Documents

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

**Table 7: Description of Hardware Documents**

S.NO	Documents Name	Description
1	e-CAM81_CUONX_Datasheet_Rev_<ver>.pdf	Describes the features, connector pin-out details and mechanical dimensions of e-CAM81_CUONX.

2	e-CAM82_CUMI0821_MOD _Datasheet_Rev_<ver>.pdf	Describes the features and specification of e-CAM82_CUMI0821_MOD camera module.
3	e- CAM81_CUONX_Lens_Datasheet_Rev_<ver> .pdf	Describes the optical specification of lenses used in e-CAM81_CUONX.
4	e- CAM81_CUONX_External_Trigger_Setup_Gu ide_Rev_<ver>.pdf	Describes the procedure to check the stream using External trigger in e-CAM81_CUONX

# Troubleshooting

---

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

## **After flashing, the Jetson Orin NX™/Nano™ development kit it is not booting, or the display is blank. How to solve this issue?**

To solve this issue, please perform the following:

- Remove and reconnect the camera to the development kit and restart the development kit.
- Use the correct command with sudo permission whenever needed to extract the package.
- Use Ubuntu 20.04 (64-bit) or Ubuntu 18.04 64-bit for flashing.
- Maintain enough free space in hard disk before flashing.

## **How to recover if black screen appears/preview freezes in ecam\_tk1\_guvcview application camera window?**

This is a known issue. If this issue occurs, try switching the resolution or boot mode. If still not able to recover in few seconds, close the application, run the following commands, and restart the application.

```
$ sudo rmmod ar0821_module
$ sudo insmod
/lib/modules/${KERNELVERSION}/extra/ar0821_module.ko
```

## **What could be the issue If the LED given in e-CAM81\_CUONX is not glowing?**

The LED indicates the power on state of e-CAM81\_CUONX camera module.

If the LED is not glowing, please follow the following steps:

1. Check whether the power to the camera module is properly connected.
2. Check whether the FPC cable connection is given as per the manual. Still the issue is not resolved, kindly write to <https://www.e-consystems.com/support.asp>

**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](mailto:camerasolutions@e-consystems.com) with your requirement.

**2. Does e-CAM81\_CUONX camera support OpenCV?**

e-CAM81\_CUONX 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](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.

**4. What are the voltage levels of External Trigger Signal?**

e-CAM81\_CUONX supports 3.3V I/O external trigger input. For more details, please refer to *e-CAM81\_CUONX\_Datasheet\_Rev\_<ver>.pdf*.

# What's Next?

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After understanding the specifications of e-CAM81\_CUONX camera board and instructions on how to use this camera board with Jetson Orin Nano™/Orin NX™ development kit, you can refer to the following documents to understand more about e-CAM81\_CUONX.

- *e-CAM81\_CUONX Developer Guide*
- *e-CAM81\_CUONX Linux App User Manual*

# Glossary

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**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.

**MIPI:** Mobile Industry Processor Interface.

**USB:** Universal Serial Bus.

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

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

# Support

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## **Contact Us**

If you need any support on e-CAM81\_CUONX 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	06-June-2023	Initial draft	Camera Team
1.1	20-Dec-2023	Supported 2 lane configuration	Camera Team