

e-CAM24_CUNX_TX2NX

Linux Application User Manual



Version 1.0

e-con Systems

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Disclaimer

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Introduction to e-CAM24_CUNX_TX2NX

e-CAM24_CUNX_TX2NX is a new MIPI camera board which helps to connect AR0234CS camera module to the Jetson Xavier TX2NX™ development kit launched by e-con Systems, a leading Embedded Product Design Services Company which specializes in advanced camera solutions. The prebuild driver for this camera along with the camera board is provided by e-con Systems.

e-con Systems provides a sample Video for Linux version 2 (V4L2) application, called `ecam_tk1_guvcview`, along with the e-CAM24_CUNX_TX2NX camera.

`ecam_tk1_guvcview` is a V4L2 video viewer and capture software of the camera driver for Jetson Xavier NX™ development kit. It is customized to demonstrate the features of e-CAM24_CUNX_TX2NX.

This document describes the usage of `ecam_tk1_guvcview` application, and the special features of `ecam_tk1_guvcview` application when it is used with e-CAM24_CUNX_TX2NX.

Description

e-CAM24_CUNX_TX2NX can stream the resolutions and frame rates as listed in below table.

Table 1: Supported Resolutions and Frame Rates of e-CAM24_CUNX_TX2NX

Format	Resolution	Frame Rate
UYVY	1280 x 720	120 fps
	1920 x 1080	65 fps
	1920 x 1200	60 fps

Note:

- The frame rates listed in the above table can be achieved easily in manual exposure.
- In auto exposure, maximum frame rate could be achieved with maximum lighting.

The camera controls of e-CAM24_CUNX_TX2NX are as follows:

- Brightness
- Contrast
- Saturation
- White Balance (both manual and automatic modes)
- Gamma
- Gain
- Horizontal Flip

- Vertical Flip
- Sharpness
- Exposure (manual, full Field of View (FOV) auto and region of interest (ROI) based auto modes)
- ROI Window Size
- Denoise
- Exposure Compensation

The e-CAM_TK1 guvcviewer or ecam_tk1_guvcview is a simple GTK+ interface for capturing and viewing video from the devices supported on the Jetson Xavier NX™ development kit.

Using e-CAM_TK1 guvcviewer or ecam_tk1_guvcview application, you can perform the following:

- Enumerate and list all video devices connected.
- Display properties of video renderer.
- Change resolution and color space or compression for video stream, if different resolutions are supported by the device.
- Display currently configured values of preview.
- Capture the still images and set the path where still images will be saved.
- Display the average frame rate.

All the above listed properties can be configured by attractive and easy to use Graphical User Interface (GUI).

Please refer to the *e-CAM24_CUNX_TX2NX_Release_Notes_<REV>.pdf* for the compatible Linux distribution version (L4T version).

Launching the Application

This section describes how to launch the `ecam_tk1_guvcview` application.

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

Table 2: Notation of Colors

Color	Notation
Blue	Commands running in development board
Red	Output message in development board

The steps to launch the application are as follows:

1. Connect the e-CAM24_CUNX_TX2NX MIPI camera to the J1 or J9 connector.
2. Power ON the Jetson Xavier TX2NX™ development kit.

The module drivers of e-CAM24_CUNX_TX2NX provided by e-con Systems will be loaded automatically during the board boot.

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

```
$ dmesg | grep -i "ar0234"
```

The output message appears as shown below.

```
subdev ar0234 9-0042 bound
subdev ar0234 10-0042 bound
```

The output message indicates that the camera is initialized properly.

4. Run the following command to check the presence of video node.

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

The output message appears as shown below.

```
video0
video1
```

Please refer to the *e-CAM_TK1_GUVCView_Build_and_Install_Guide_<REV>.pdf* to install the application in the Linux system.

5. Run the following commands to check and set the power mode to maximum for better performance.

```
$ sudo nvpmode1 -q
$ sudo nvpmode1 -m 0
```

6. Run the following Jetson clocks command to achieve maximum frame rate before launching the `ecam_tk1_guvcview` application in the Jetson Xavier NX™ development kit.

```
$ sudo jetson_clocks
```

7. Run the following command to launch the ecam_tk1_guvcview application.

```
$ /usr/local/ecam_tk1/bin/ecam_tk1_guvcview --  
device=/dev/video<X>
```

Note: Replace *X* in `/dev/video<X>` with appropriate number to stream from respective camera for Jetson Xavier NX™ kit. When entering the command in terminal, the screen appears as shown below.

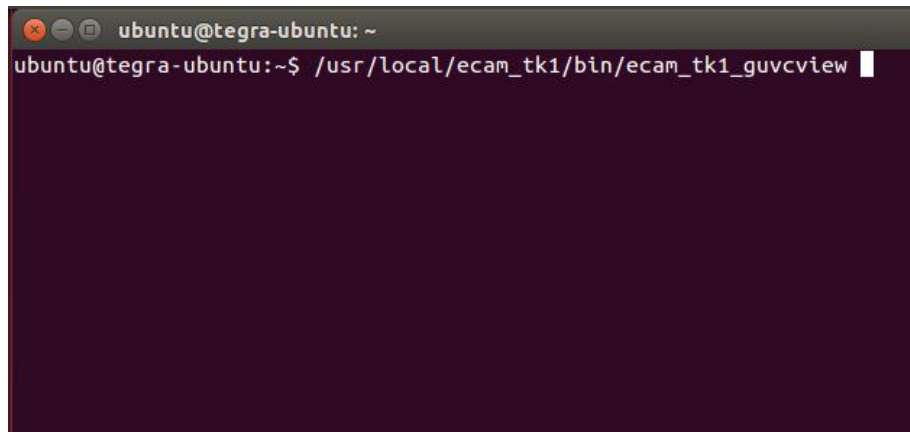


Figure 1: Terminal Window

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

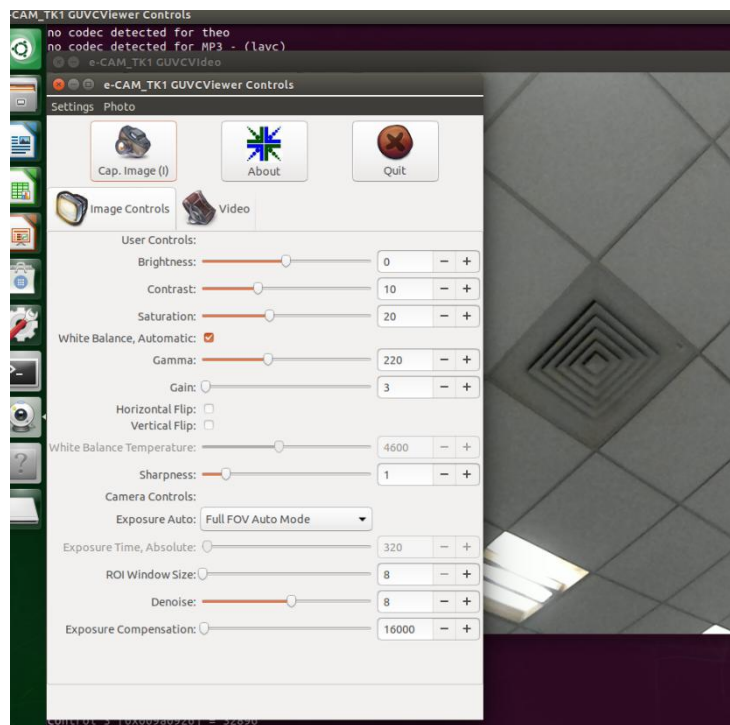


Figure 2: Initial Window Appearance

Application Features

This section describes the controls that are supported in the current version of ecam_tk1_guvview application for e-CAM24_CUNX_TX2NX.

The controls supported in ecam_tk1_guvview application are as follows:

- [Image Controls Tab](#)
- [Video Tab](#)
- [Cap. Image \(I\) Button](#)
- [About Button](#)
- [Quit Button](#)

Image Controls Tab

When selecting the **Image Controls** tab, you can view the available controls as shown below.

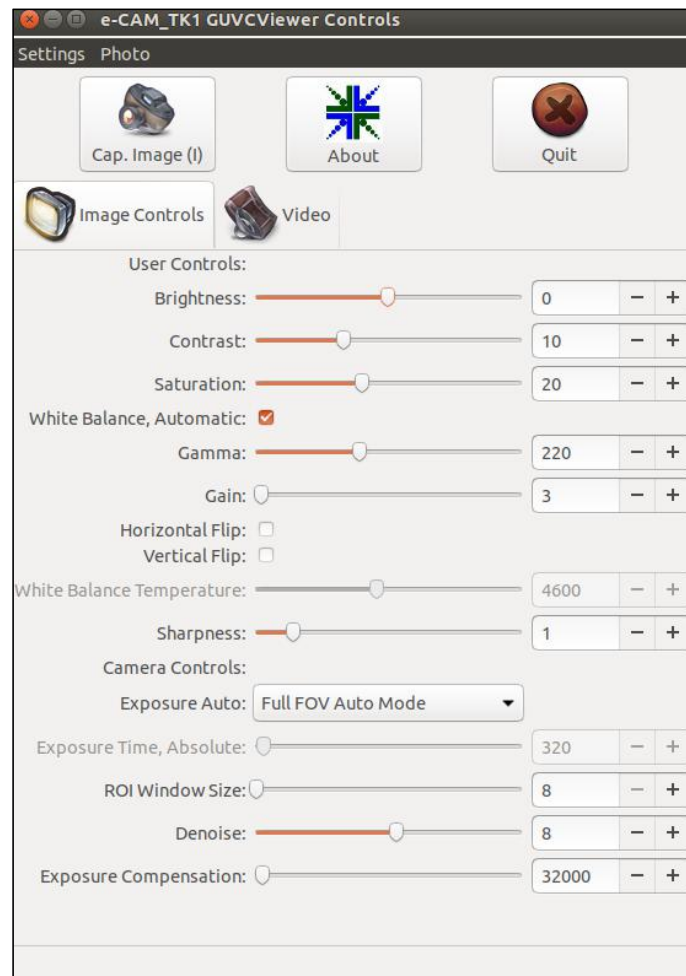


Figure 3: Image Controls Tab

The controls available in **Image Controls** tab are as follows:

- [Brightness](#)
- [Contrast](#)
- [Saturation](#)
- [White Balance](#)
- [Gamma](#)
- [Gain](#)
- [Horizontal Flip](#)
- [Vertical Flip](#)
- [Sharpness](#)
- [Exposure](#)
- [ROI Window Size](#)
- [Denoise](#)
- [Exposure Compensation](#)

You can move the slider and configure the preview settings according to your needs. The sliders whose labels are not greyed can only be configured. The value being set will be displayed in the text box based on the position of the slider. As soon as the slider is moved to configure the values, the preview property will change at that instance.

The values of e-CAM24_CUNX_TX2NX controls are listed in below table.

Table 3: Values of e-CAM24_CUNX_TX2NX Controls

Controls	Minimum Value	Maximum Value	Default Value	Manual Control	Auto Control
Brightness	-15	15	0	YES	NO
Contrast	0	30	10	YES	NO
Saturation	0	60	16	YES	NO
White Balance	1000	10000	4500	YES	YES
Gamma	40	500	220	YES	NO
Gain	1	40	1	YES	NO
Horizontal Flip	0	1	0	YES	NO
Vertical Flip	0	1	0	YES	NO
Sharpness	0	127	16	YES	NO
Exposure	1 (100 μ s)	10000(1s)	312 (31.2 ms)	YES	YES
ROI Window Size	8	64	24	YES	NO
Denoise	0	15	8	YES	NO
Exposure Compensation	8000	1000000	16000	YES	NO

Brightness

The brightness values can be changed from a minimum value of -15 to 15 by moving the slider, and the exact changes will be reflected immediately in the preview. This

brightness control increases the low light performance of e-CAM24_CUNX_TX2NX. The default value is 0.

Contrast

The contrast values can be changed from a minimum value of 0 to 30 by moving the slider, and the exact changes will be reflected immediately in the preview. Increasing the contrast value increases the luminance of e-CAM24_CUNX_TX2NX. The default value is 10.

Saturation

The saturation values can be changed from a minimum value of 0 to 60 by moving the slider, and the exact changes will be reflected immediately in the preview. Increasing the saturation value increases the intensity of the color of e-CAM24_CUNX_TX2NX. The default value is 16.

White Balance

The manual white balance can be selected by deselecting the **White Balance, Automatic** check box as shown below.

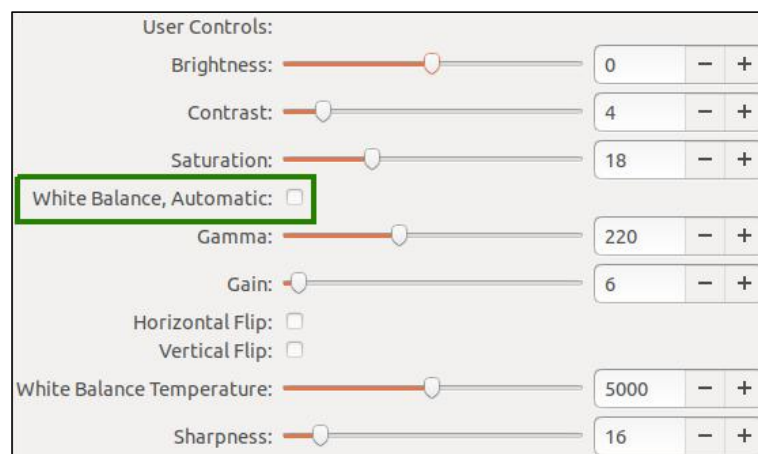


Figure 4: Manual White Balance

The manual white balance values can be changed from a minimum value of 10 to 10000 by moving the slider of White Balance Temperature control, and the exact changes will be reflected immediately in the preview. By default, the camera is in manual mode, and the default value is 4600.

The automatic white balance can be selected by selecting the **White Balance, Automatic** check box as shown below.

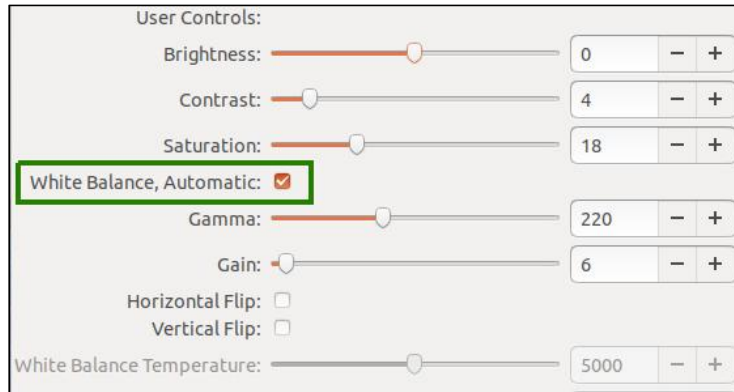


Figure 5: Automatic White Balance

The White Balance Temperature control will be greyed when selecting the **White Balance, Automatic** check box.

Gamma

The gamma values can be changed from a minimum value of 40 to 500 by moving the slider, and the exact changes will be reflected immediately in the preview. The default value is 220.

Gain

The gain values can be changed from a minimum value of 1 to 40 by moving the slider. The changes are updated in the preview only when exposure control is set to manual mode. The default value is 1.

Horizontal Flip

The preview from the sensor can be horizontally flipped by selecting the **Horizontal Flip** check box. By default, this control is deselected.

Vertical Flip

The preview from the sensor can be vertically flipped by selecting the **Vertical Flip** check box. By default, this control is deselected.

Sharpness

The sharpness values can be changed from a minimum value of 0 to 127 by moving the slider, and the exact changes will be reflected immediately in the preview. This sharpness control increases the clarity of e-CAM24_CUNX_TX2NX. The default value is 16.

Exposure

e-CAM24_CUNX_TX2NX supports manual, full FOV auto and ROI based auto mode which can be controlled using the slider of Exposure Time, Absolute control of the **Image Controls** tab of ecam_tk1_guvcview. The default mode of exposure control is

manual mode. When the exposure time is changed, the frame rate will vary accordingly.

To use the slider of Exposure Time, Absolute control, you must select the **Manual Mode** from the **Exposure Auto** drop-down list box. You can view the screen similar to the screen shown below.

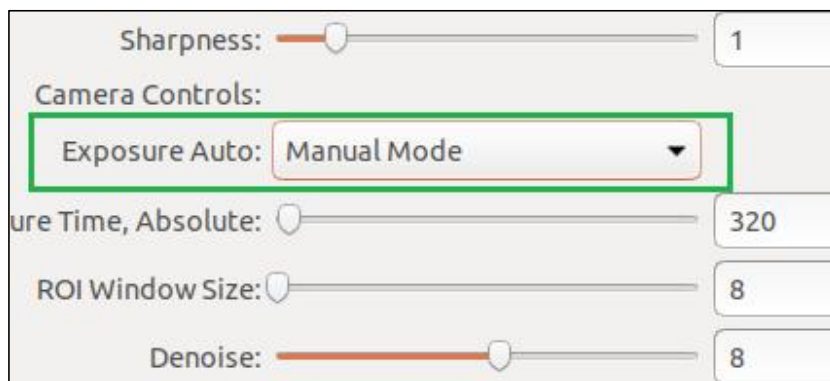


Figure 6: Manual Mode

The exposure value could be manually changed by moving the slider. e-CAM24_CUNX_TX2NX supports exposure values ranging from 100 μ s to 1 s which is represented as 1 to 10000 in the slider. The exposure values are configured inside the CMOS image sensor based on the sensor configuration and clock configuration details. The default manual exposure value will be 312 that is 31.2 ms.

To obtain a good low light performance, it is essential to change the exposure according to the change in lighting conditions. To support this feature, e-CAM24_CUNX_TX2NX has a full FOV auto mode, by which the exposure of the camera will be changed according to the lighting conditions giving the best low light performance.

When you select the **Full FOV Auto Mode** from the **Exposure Auto** drop-down list box, you can view the screen similar to the screen shown below.

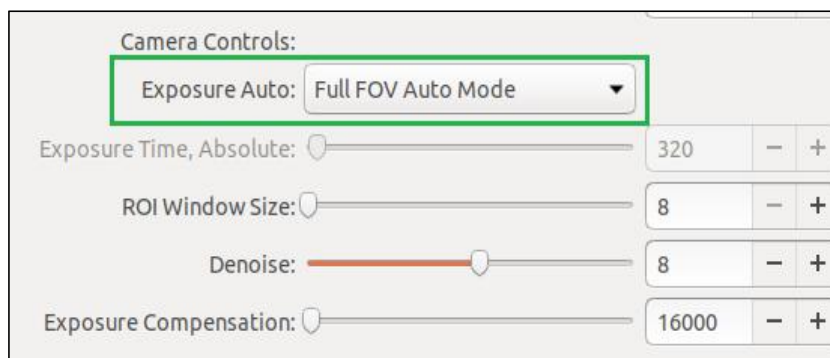


Figure 7: Full FOV Auto Mode

The exposure value applied in the sensor in ms is 1/10 of the set value as listed in below table.

Table 4: Exposure Value-Exposure Time Mapping

Exposure Value	Exposure Time
1	0.1 ms
2	0.2 ms
3	0.3 ms
.	.
.	.
10	1 ms
11	1.1 ms
12	1.2 ms
.	.
.	.
100	10 ms
.	.
.	.
1000	100 ms
.	.
.	.
10000	1s

Note:

- When the exposure time period is more than the time period of camera frame, the frame rate will drop.
- Controls are global across all resolutions and formats, and hence changing the control values will reflect the changes in both the formats and resolutions.

When you select the **ROI Based Auto Mode** from the **Exposure Auto** drop-down list box, you can view the screen similar to the screen shown below.

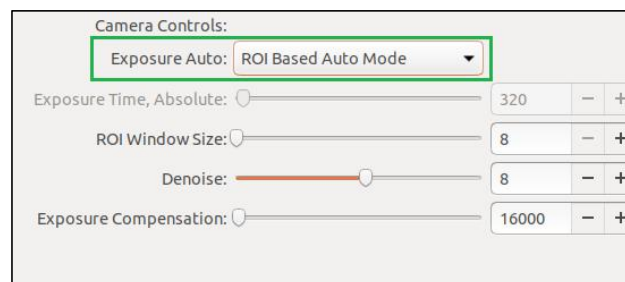


Figure 8: ROI Based Auto Mode

In ROI Based Auto Mode, you can select the ROI and at that region, the exposure value will be applied to the entire frame. You can select the required window size using the slider of ROI window size control. Click the required region on the preview window of the application and based on that region, the exposure will be applied to the entire frame.

The exposure of the image can be varied based on targeted object in the FOV. By selecting the ROI Based Auto Mode, you can also select the target object area of the frame in guvcviewer display area. The exposure algorithm will calculate the

automatic exposure adjustment for the selected display area. The ROI region can be adjusted by increasing/decreasing the slider of ROI window size control.

ROI Window Size

You can change the ROI window size, by moving the slider of ROI Window size control. The default size is 24.

For window size 64, the entire frame will be the ROI. If this region exceeds or falls below the frame boundary, the ROI will be clipped automatically.

For 1280 x 720 frame size, the ROI based on the window size is shown in below table.

Table 5: Window Size - ROI Region

Window Size	ROI Region
8	1/8 (160 x 90)
16	2/8 (320 x 180)
24	3/8 (480 x 270)
32	4/8 (640 x 360)
40	5/8 (800 x 450)
48	6/8 (960 x 540)
56	7/8 (1120 x 630)
64	1 (1280 x 720)

Denoise

The denoise control is used to remove pixel noise from the preview. This control value can be changed from a minimum value of 0 to 15 by moving the slider. The default value is 8.

Frame Sync

The frame sync value can be selected from the **Frame Sync** drop-down list box and the exact changes will be reflected immediately in the preview. By default, the frame sync control value is Frame Sync 30Hz.

Note:

This is a known BUG in GUI , please choose either Frame sync 30HZ or Frame sync 60HZ from the below tab and connect the external trigger source to get desired FPS rate.

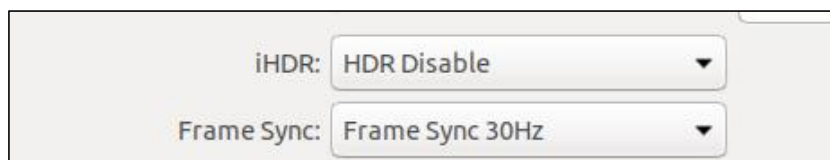


Figure 11: Synchronous Mode

When the **Disable Frame sync** is selected from **Frame Sync** drop down list box, , the frame output will be in asynchronous mode for the corresponding camera module. You can view the screen similar to the screen shown below.

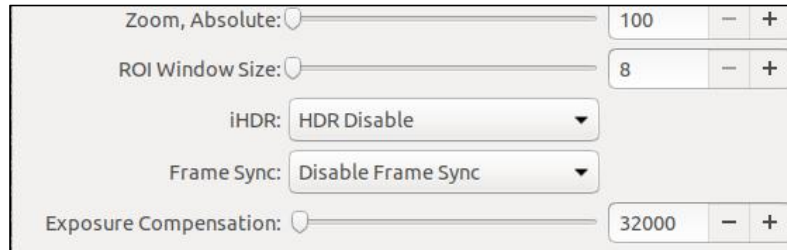


Figure 13: Asynchronous Mode

The frame sync control values and its corresponding modes are listed in below table.

Table 7: Frame Sync Control Value

Control Value	Frame Sync Mode
0	Asynchronous mode
1	Synchronous mode

Tested Exposure values in sync mode with external 60HZ pulse were captured in below table

Resolution	FPS rate (sync mode)	Exposure limit
1280 x 720	60 FPS	1 to 100
1920 x 1080	60 FPS	1 to 25
1920 x 1200	60 FPS	1 to 10

Table 6: Exposure values tested

Exposure Compensation

The exposure compensation control adjusts the upper limit of auto exposure. The value can be changed from a minimum value of 8000 μ s to 1000000 μ s by moving the slider. The default value is 16000 μ s.

Video Tab

On selecting the **Video** tab, the video renderer properties will be displayed. You can adjust the video preview settings in the **Video** tab. The features supported in **Video** tab are as follows:

- [Device Selection](#)
- [Frame Rate](#)
- [Video Capture Properties](#)

Device Selection

When you click the **Device** drop-down list box, you can view the connected device as shown below.

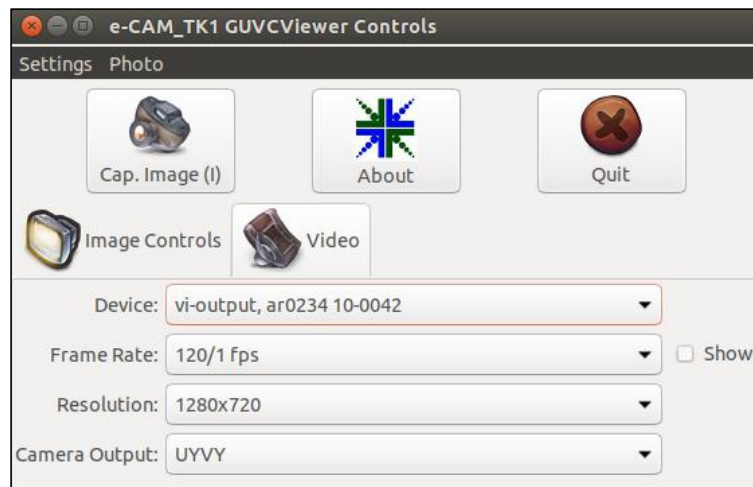


Figure 9: Device Connected

Frame Rate

The frame rate of the preview can be viewed by selecting the **Show** check box in the **Video** tab. Before selecting the **Show** check box, you can view the screen similar to the screen shown below.

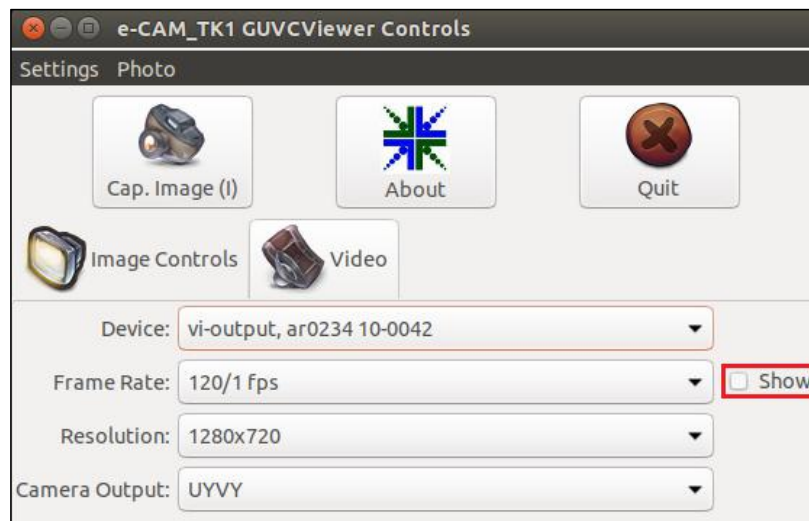


Figure 10: Selecting Show to Display Frame Rate

After selecting the **Show** check box, the frame rate will be displayed in the top of the preview window as shown below.

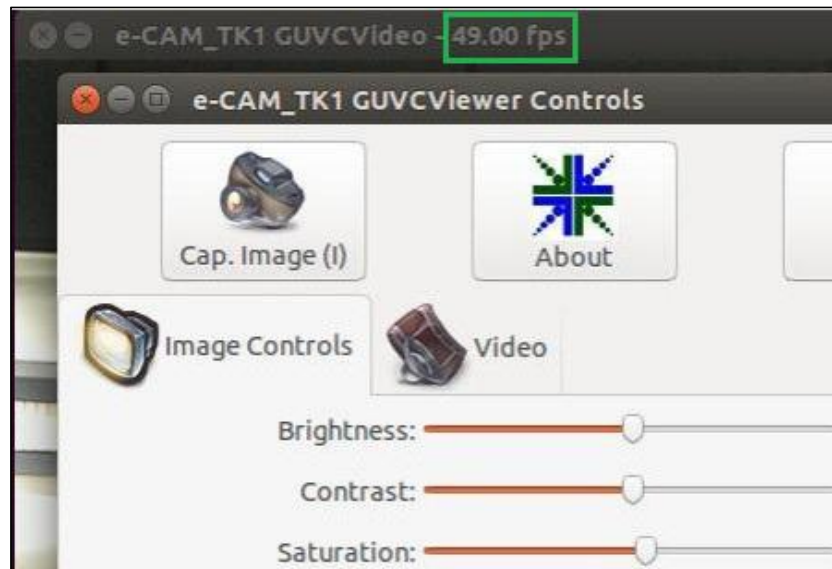


Figure 11: Displaying Frame Rate in Preview Window

Note: The frame rate will be affected by various environmental parameters.

Video Capture Properties

You can configure the output size (resolution) of stream format. Currently e-CAM24_CUNX_TX2NX supports UYVY output format. In UYVY format, six resolutions are supported. When you click the **Resolution** drop-down list box, you can view the supported resolutions as shown below.

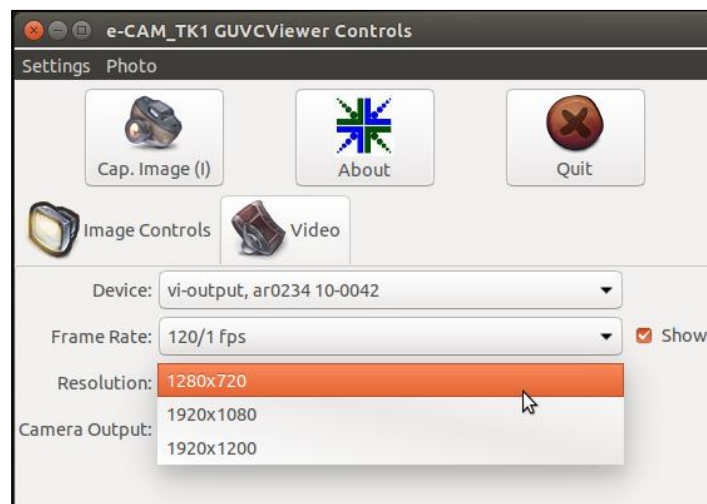


Figure 12: Supported Video Resolutions

The supported resolutions in UYVY format are listed in below table.

Table 6: Supported Format and Resolutions

Format	Resolution
UYVY	1280x720
	1920x1080
	1920x1200

Cap. Image (I) Button

The **Cap. Image (I)** button allows you to capture the still image of the selected device in the **Device** drop-down list box and select the path to store the image. The features supported in **Cap. Image (I)** button are as follows:

- [Still Image Capture](#)
- [Still File Path](#)

Still Image Capture

You can click the **Cap. Image (I)** button in the top of the control panel to capture the still image. You can view the screen similar to the screen shown below.



Figure 12: Capture Still Image

By default, the image will be saved in the home directory. You can configure the folder to save the images. The default name for captured image file is guvcview_image.jpg.

Note: To capture an image of another resolution, you must switch the preview to that resolution. Unlike Windows, the Linux kernel does not support cross resolution images.

Still File Path

To create a folder for saving the captured images, click **Photo > File** as shown below.



Figure 13: Save File Dialog Box to set the Still Image Folder

A **Save File** dialog box will appear for selecting the file format to save the captured image. You can also browse to the required directory and set the file name, so that the captured images will also be saved in that folder.

About Button

When you click the **About** button, you can view the details of e-CAM_TK1 GUVViewer application as shown below.

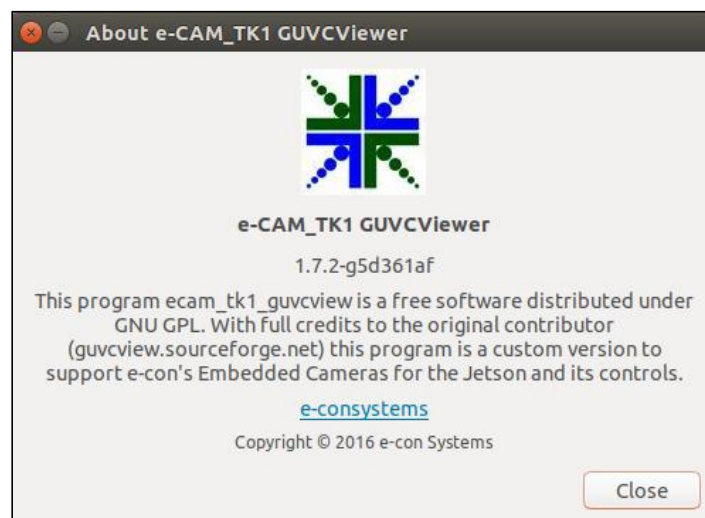


Figure 14: About e-CAM_TK1 GUVViewer

Quit Button

When you click the **Quit** button, you can exit the e-CAM_TK1 GUVViewer application.

Troubleshooting

In this section, you can view the list of commonly occurring issues and their troubleshooting steps.

In lower exposure value, setting a higher gain value causes a blue noise in higher resolutions.

This is a known issue. You need to either reduce the gain value or increase the exposure value to recover from this issue.

How to recover if black screen appears in ecam_tk1_guvcview camera window?

This is a known issue. If this issue occurs, it will auto recover in few seconds and if still not able to recover in few seconds, please restart the application.

Gain change is not observed in preview for inputs above 50.

This is a known issue. No change in preview is observed for gain value above 50.

1. How can I get the updated package?

Please login to the [Developer Resources](#) website and download the latest release package.

What's Next?

After understanding the usage of `ecam_tk1_guvcview` application, you can refer to the following documents to understand more about e-CAM24_CUNX_TX2NX.

- *e-CAM_TK1-GUVCView Build and Install Guide*
- *e-CAM24_CUNX_TX2NX Release Notes*

Glossary

API: Application Program Interface.

CMOS: Complementary Metal Oxide Semiconductor.

FHD: Full HD (Industry name for 1920 x 1080 resolution).

FOV: Field of View.

GIMP: GNU Image Manipulation Program.

GNU: GNU's Not Unix.

GTK: GIMP Toolkit.

GUI: Graphical User Interface.

HD: High Definition (Industry name for 1280 x 720 resolution).

L4T: Linux for Tegra.

MIPI: Mobile Industry Processor Interface.

ROI: Region of Interest.

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

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

SXGA-: Super XGA Minus (Industry name for 1280 x 960 resolution).

XGA: Extended Graphics Array (Industry name for 1024 x 768 resolution).

V4L2: Video for Linux version 2 is a collection of device drivers and API for supporting real-time video capture on Linux systems.

Support

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	21-JUL-2020	Initial draft	Camera Dev Team