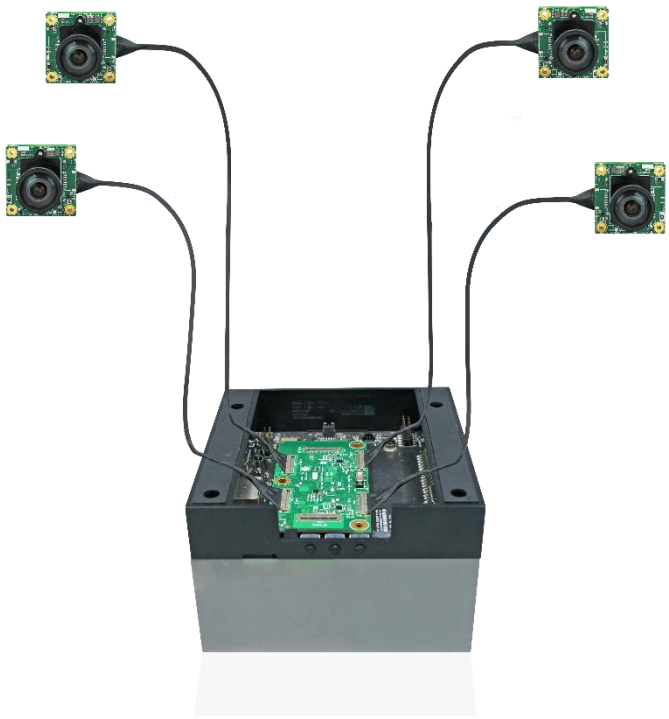
e-CAM56_CUOAGX

eCAM_Argus_Camera Application User Manual



e-con Systems

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Contents

Introduction to e-CAM56_CUOAGX

e-CAM56_CUOAGX is a 5 MP MIPI camera from e-con Systems, a company with over two decades of experience in designing, developing, and manufacturing OEM cameras. e-CAM56_CUOAGX targets the NVIDIA® Jetson AGX Orin™ development kit.

e-con Systems provides a sample application, called eCAM_argus_camera, a customized version of argus_camera sample application provided by NVIDIA®, along with the e-CAM56_CUOAGX camera. It is a video viewer software customized to demonstrate the features of e-CAM56_CUOAGX.

This document describes the usage of eCAM_argus_camera application, and the special features of eCAM_argus_camera application when it is used with e-CAM56_CUOAGX.

Description

Each of the IMX568 based camera module in e-CAM56_CUOAGX can stream two resolutions, bit depth and frame rates in 4-lane mode in the Jetson AGX Orin™ development kit.

The supported resolutions and frame rates in 4-Lane modes are listed in the following table.

Table 1: Supported Resolutions and Frame Rates in 4-Lane Mode (Jetson AGX Orin)

Lane	Resolution	Frame Rate in 10-bit	Frame Rate in 12-bit
4	2432 x 2048	79	67
4	1920 x 1080	142	121
4	1280 x 720	202	172
4	640 x 480	280	240

The camera controls of e-CAM56_CUOAGX are as follows:

- Exposure Time Range
- Gain Range
- ISP Digital Gain Range
- Sensor Mode Index
- Frame Rate
- De-Noise Mode
- De-Noise Strength
- Edge Enhance Mode

- Edge Enhance Strength
- Auto Exposure (AE) Antibanding Mode
- Auto White Balance (AWB) Mode
- Exposure Compensation
- AE Lock
- Trigger
- Trigger Frequency
- AWB Lock
- Output Size

The eCAM_argus_camera is a sample libArgus based camera application used to demonstrate the functioning of e-CAM521_CUMI568C_MOD module boards in the Jetson AGX Orin™ development kit.

Using eCAM_argus_camera application, you can perform the following:

- Enumerate and list all video capture devices connected.
- Stream all available resolutions if different resolutions are supported by the device.
- Change controls for all available cameras.
- Capture images in RAW and JPEG formats.
- Record H264, H265 encoded videos on the Jetson AGX Orin™ development kit.

e-con Systems provides prebuilt binary of the application along with source code. Please refer to the *e-CAM56_CUOAGX_Release_Notes_Rev_<ver>.pdf* for the compatible Linux distribution version (L4T version).

Launching Application

This section describes how to launch the eCAM_argus_camera application.

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

Table 2: Notation of Colors

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

The steps to launch the application are as follows:

1. Connect the e-CAM56_CUOAGX camera to the J509 connector of the Jetson AGX Orin™ development kit.
2. Run the following command to check whether all the cameras are initialized.

```
$ sudo dmesg | grep "Detected eimx568 sensor"
```

The output message appears as shown below.

```
Detected eimx568 sensor
```

The output message shows depend upon number of cameras are properly initialized.

3. Run the following command to check the presence of video nodes.

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

The output message appears as shown below.

```
/dev/video*
```

Where (*) denotes the number of cameras connected to the Jetson AGX Orin™ development kit.

Note: The number of video node entries and number of connected cameras must be same.

4. Run the following commands to achieve maximum frame rate before launching the eCAM_argus_camera application in the Jetson AGX Orin™ development kit.

```
$ sudo nvpmodel -m 0
$ sudo jetson_clocks
$ cd  e-CAM56_CUOAGX_JETSON_XAVIER_ORIN_<L4T_version>_<release_date>_<release_version>
$ sudo /misc/max-isp-vi-clks.sh
```

Then, Run the following command to stream more than two cameras in Multi Session mode.

```
$ sudo service nvargus-daemon stop
$ sudo enableCamInfiniteTimeout=1 nvargus-daemon
```

5. Run the following command to launch the eCAM_argus_camera application.

```
$ eCAM_argus_camera --device=<n>
```

Where **<n>** refers to the device node.

When entering the command in the terminal, the screen appears as shown below.

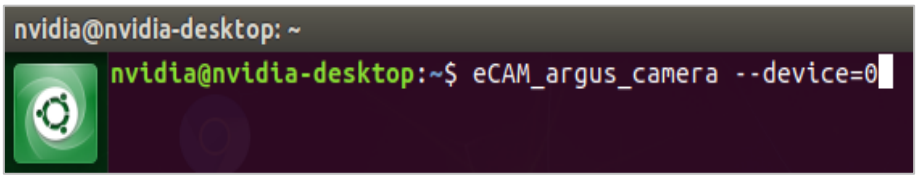

Figure 1: Terminal Window

Once the application is launched, the control window and video display window appear as shown below.

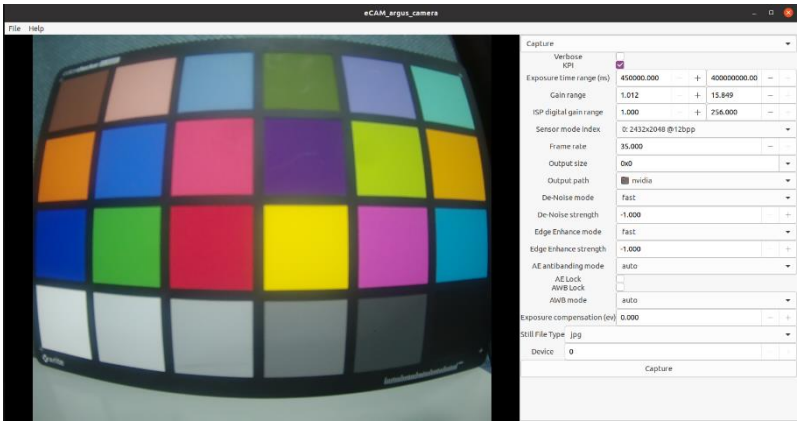

Figure 2: Initial Control Window and Video Display Window Appearance

Application Features

This section describes the controls that are supported in the current version of eCAM_argus_camera application for e-CAM56_CUOAGX.

The sensor camera and ISP features supported in the current release version of eCAM_argus_camera application is shown in the following figure.

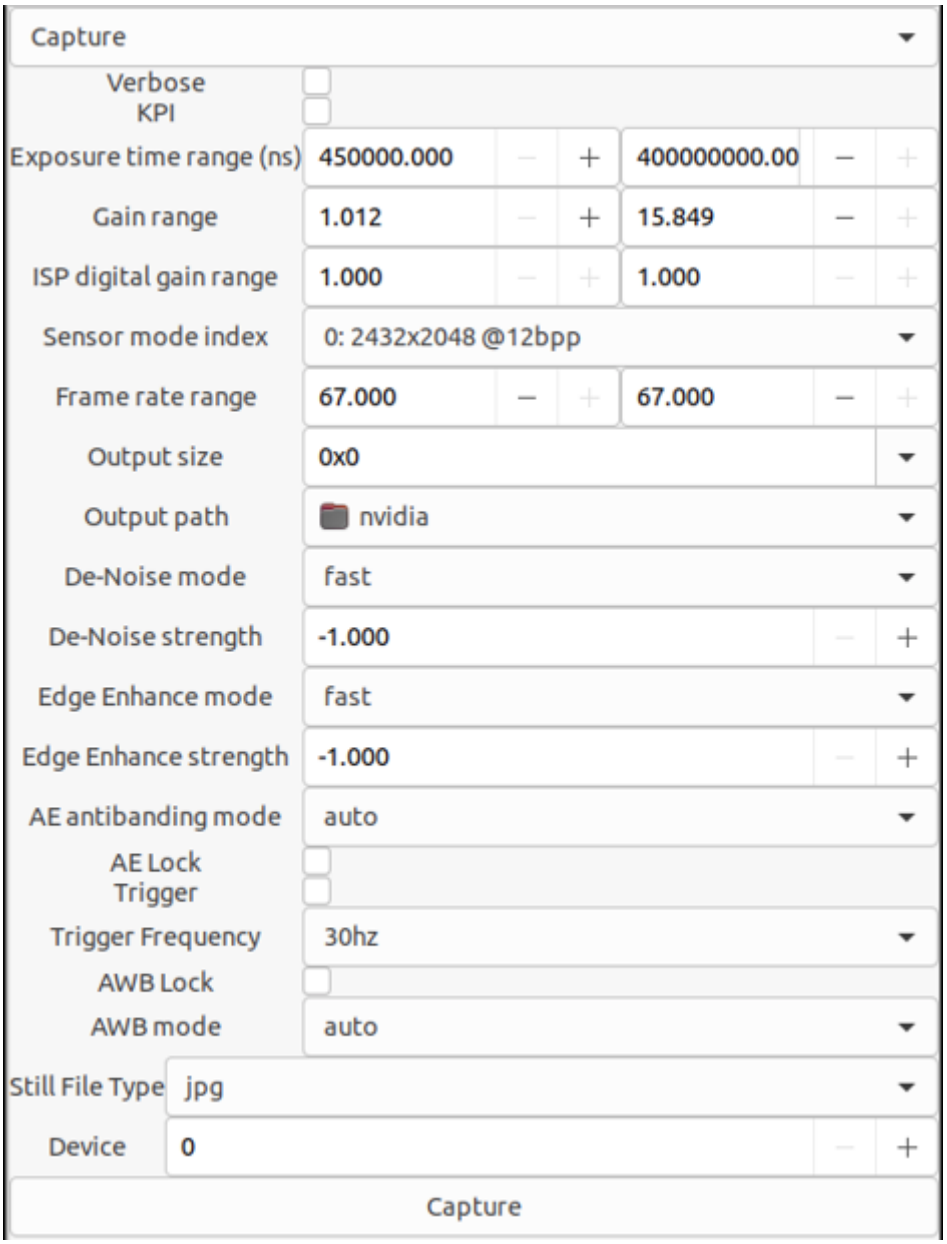

Figure 3: Controls of e-CAM56_CUOAGX

You can click the respective control box and configure the preview settings according to your needs. The value being set will be displayed in the respective text box. Once the value is set to the respective control box, you can notice the change in preview's property.

The values of e-CAM56_CUOAGX controls are listed in the following table.

Table 3: Values of e-CAM56_CUOAGX Controls

Controls	Minimum Value	Maximum Value	Default Value	Manual Control	Auto Control
Exposure time range (ns)	450000	400000000	Auto	Yes	Yes
Gain range (A_f)	1.012	15.849	-	Yes	Yes
ISP digital gain range	1	1	-	No	Yes
Sensor mode index	0	7	0	Yes	No
Frame rate (fps)	2.5	based on sensor mode (refer **Table 1**)	based on sensor mode (refer **Table 1**)	Yes	No
De-Noise mode	Off	High quality	Fast	Yes	No
De-Noise strength	-1.00	1.00	-1.00	Yes	No
Edge enhance mode	Off	High quality	Fast	Yes	No
Edge enhance strength	-1.00	1.00	-1.00	Yes	No
AE antibanding mode	Off	60 Hz	Auto	Yes	Yes
AWB mode	Off	Shade	Auto	Yes	Yes
AE Lock	0	1	0	Yes	Yes
Trigger	0	1	0	Yes	No
Trigger Frequency	0	1	0	Yes	No

Note: The application currently does not support focus position control since the camera has a custom lens which uses only manual focus.

Sensor Features

The sensor features that are supported in the current version of eCAM_argus_camera application are as follows:

- Exposure Time Range
- Gain Range
- Sensor Mode Index
- Frame Rate
- Trigger
- Trigger Frequency

Exposure Time Range

The exposure time range can be changed from a minimum value of 450000 to a maximum value of 400000000 by manually entering the values or selecting the value in the **Exposure time range (ns)** box. The exposure time is represented in Nanoseconds (ns) scale. The default exposure time range set by the application depends upon the luminance of the source. However, to set a specific exposure time

range value, you can manually set both the lower and higher range fields to that same specific value in the **Exposure time range (ns)** box.

You can view the screen similar to the screen shown below.

Figure 4: Exposure Time Range

Note: The exposure control is limited to the frame rate as the application is designed to achieve a constant frame rate. For example, the maximum exposure that can be achieved is limited to maximum of 40 ms even a larger exposure range value is specified in the **Exposure time range (ns)** box, when the frame rate control is set to 25 fps.

Gain Range

The gain range which corresponds to sensor gain range can be changed from a minimum value of 1.012 to a maximum value of 15.849. The gain range is represented in amplification factor (A_f). IMX568 can support a sensor gain range of 0 to 48 dB corresponding to 0 to 251.189 (A_f). However, in e-CAM56_CUOAGX, sensor gain range has been restricted to sensor analog gain, that is 0 - 24 dB, including the image quality and other performance metrics. The default gain value set depends upon the luminance of the source. However, to set a specific constant sensor gain value, you can manually set both the lower and higher range fields to that same specific value in the **Gain range** box. You can view the screen similar to the screen shown below.

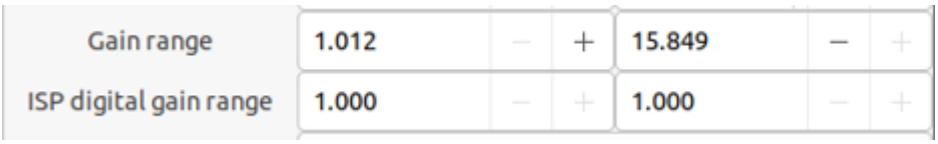

Figure 5: Gain Range in Jetson AGX Orin

Note: The sensor gain range and exposure time range will take only default range values by discarding the corresponding values, when changing the modes.

Sensor Mode Index

The sensor mode index contains all the combinations of resolutions, frame rate and bits per pixel (bpp) that the camera sensor outputs. e-CAM56_CUOAGX currently supports the sensor modes in 4-lane setup in the Jetson AGX Orin™ development kit as listed in the following table.

Lane	Resolution	Frame Rate in 10-bit	Frame Rate in 12-bit
4	2432 x 2048	79	67
4	1920 x 1080	142	121
4	1280 x 720	202	172
4	640 x 480	280	240

Table 4: Modes and Resolutions supported in 4-Lane in Jetson AGX Orin

Note: The output from the NVIDIA® ISP is NV12 format.

You can change the sensor modes from the **Sensor mode index** drop-down list box. When you click the **Sensor mode index** drop-down list box, you can view the list of sensor modes as shown below.

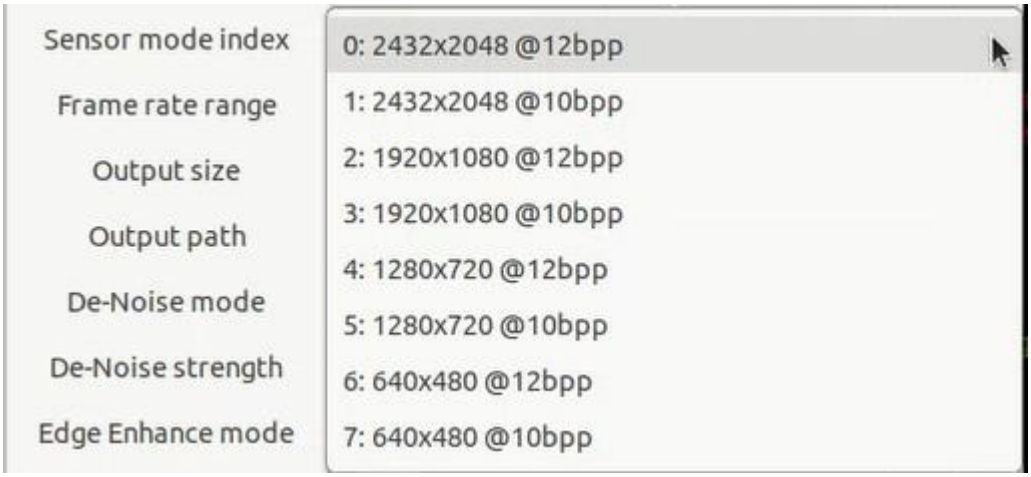

Figure 6: Sensor Mode Index

Frame Rate

The frame rate control can be changed from a minimum value of 2.5 to the maximum value specified by the sensor mode (Refer *Table 3*). The frame rate can be changed by manually entering both lower and higher range fields or selecting the value in the **Frame rate** range box. You can view the screen similar to the screen shown below.

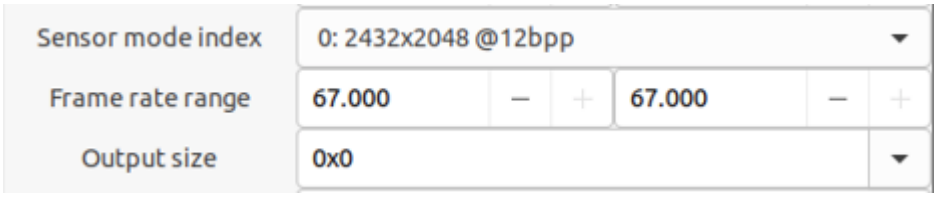

Figure 7: Frame Rate Range

Note: Frame rate displayed (when KPI is enabled) is the number of frames from all streaming cameras per second. For example, 2432x2048 at 67 fps mode, when two

cameras are streaming, the FPS displayed will be (67*2) = 134 fps. Also, the FPS displayed will not go beyond the refresh rate of the monitor used.

Trigger

When you select the Trigger check box, the trigger mode will be enabled. The Trigger option will appear as shown below. For more information about the trigger modes available you can refer to the following documentation e-CAM56_CUOAGX_External_Trigger_Setup_Guide_<rev>.pdf for trigger.

Figure 8: Trigger

Trigger Frequency

Trigger_Frequency control is used to configure the PWM frequency when the camera is streaming using internal trigger from hex cam base board in trigger mode.

Note: To enable trigger mode, enable trigger control first and make sure that the switch (SW1) position is in INT_TRIG on e-CAM30_HEXCUXVR_BASE_BRD to verify stream using internal trigger.

By default, in internal trigger mode the PWM frequency is set 30Hz and can be configured to 60Hz by selecting the same from the drop-down box as shown below.

Value = 0 – configure with 30Hz PWM frequency

1 – configure with 60Hz PWM frequency

Figure 9: Trigger Frequency

The same can be enabled using Trigger Frequency control in v4l2 framework. Please refer “e-CAM521_CUMI568C_MOD_MCU_Protocol_App_Note_Rev_<Ver>.pdf”

Camera ISP Features

The camera ISP features supported in the current release version of eCAM_argus_camera application are as follows:

- ISP Digital Gain Range
- De Noise Mode

- De-Noise Strength
- Edge Enhance Mode
- Edge Enhance Strength
- AE Antibanding Mode
- AWB Mode
- Output Size
- AE Lock
- AWB Lock
- Still File Type
- Video Recording
- Multi Session

ISP Digital Gain Range

The ISP gain value can be changed from a minimum value of 1 to a maximum value of 256. This gain corresponds to the digital gain additionally provided by the ISP (over and above the sensor gain) and the default value depends upon the luminance of the source. Jetson AGX Orin™ development kit ISP can support a digital gain range of 1 to 256 (amplification factor) corresponding to roughly 0 to 48.16 dB. However, in e- CAM56_CUOAGX, ISP gain has been restricted to 1(Af), according to Nvidia standards. To change ISP Digital gain range, you must change the value of the parameter ispDigitalGain.MaxIspDigitalGain, which is in the camera_overrides_jetson-orin.isp file provided by e-con systems.

Ex: ispDigitalGain.MaxIspDigitalGain=256.0000;

Figure 10: ISP Digital Gain Range

Output Size

When you click the **Output size** drop-down list box, you can view the supported output sizes as shown below.

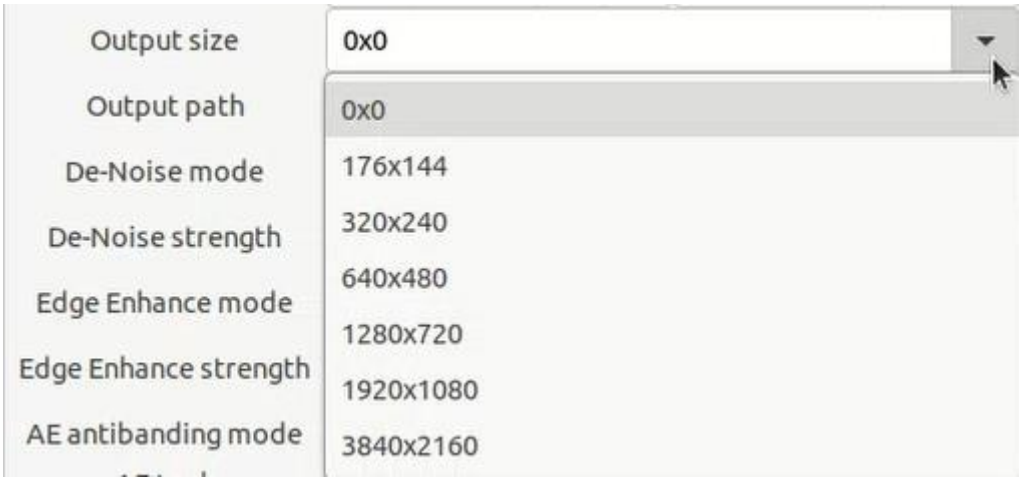

Figure 11: Output Size

Note: 0x0 Output size denotes the original size.

De-Noise Mode

The eCAM_argus_camera application supports the following de-noise modes:

- Off
- Fast
- High Quality

You can select the required de-noise mode from the **De-Noise mode** drop-down list box. The default de-noise mode is fast. When you click the **De-Noise mode** drop-down list box, the supported de-noise modes will be listed as shown below.

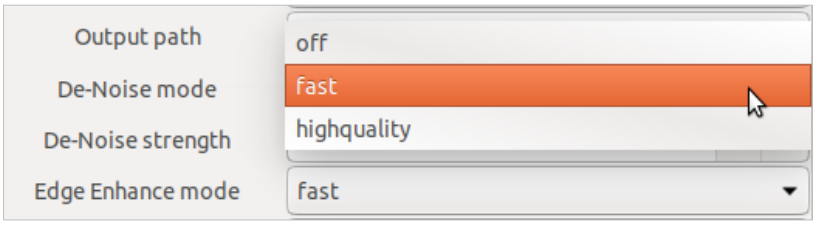

Figure 12: De-Noise Mode

De-Noise Strength

You can change the de-noise strength value from a minimum value of -1.0 to a maximum value of 1.0. The default de-noise strength value is -1.0 and can be changed by manually entering the values or selecting the values in the **De-Noise strength** box. You can view the screen similar to the screen shown below.

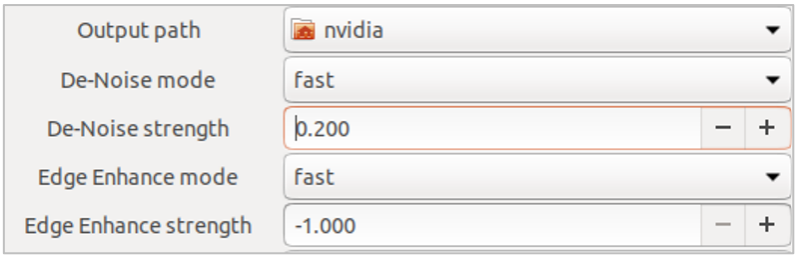

Figure 13: De-Noise Strength

Edge Enhance Mode

The eCAM_argus_camera application supports the following edge enhance modes:

- Off
- Fast
- High Quality

You can select the required edge enhancement mode from the **Edge Enhance mode** drop-down list box. The default edge-enhance mode is fast. When you click the **Edge Enhance mode** drop-down list box, the supported edge enhancement modes will be listed as shown below.

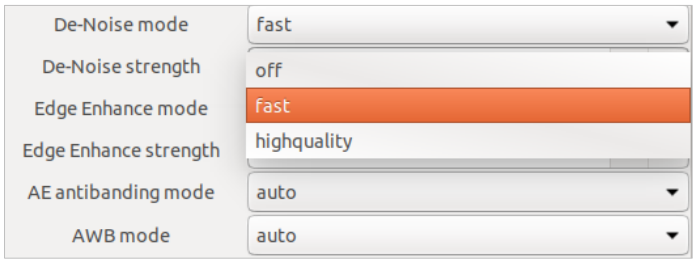

Figure 14: Edge Enhance Mode

Edge Enhance Strength

You can change the edge enhance strength value from a minimum value of -1.0 to a maximum value of 1.0. The default edge enhance strength value is -1.0 and can be changed by manually entering the values or selecting the values in the **Edge Enhance strength** box. You can view the screen similar to the screen shown below.

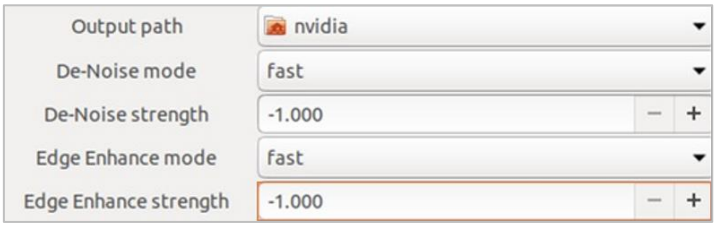

Figure 15: Edge Enhance Strength

AE Antibanding Mode

The eCAM_argus_camera application supports the AE antibanding modes as follows:

- Off
- Auto
- 50 Hz
- 60 Hz

By default, the AE antibanding mode is auto. You can select the required AE antibanding mode from the **AE antibanding mode** drop-down list box. When you click the **AE antibanding mode** drop-down list box, the list of AE antibanding modes appear as shown below.

Figure 16: AE Antibanding Mode

AE Lock

The AE lock control is enabled during the image and video capture of eCAM_argus_camera. When you select the **AE Lock** check box, it locks the exposure to current values. The AE Lock will appear as shown below.

Figure 17: AE Lock

AWB Lock

When you select the **AWB Lock** check box, it locks the AWB to current value. The AWB Lock option will appear as shown below.

Figure 18: AWB Lock

AWB Mode

The eCAM_argus_camera application automatically detects the scene temperature and adjusts the white balance. The application supports the following AWB modes:

- Off
- Auto
- Incandescent
- Fluorescent
- Warm Fluorescent
- Daylight
- Cloudy Daylight

- Twilight
- Shade

By default, auto mode is enabled. You can select the required AWB modes from the **AWB mode** drop-down list box.

When you click the **AWB mode** drop-down list box, the list of AWB modes appear as shown below.

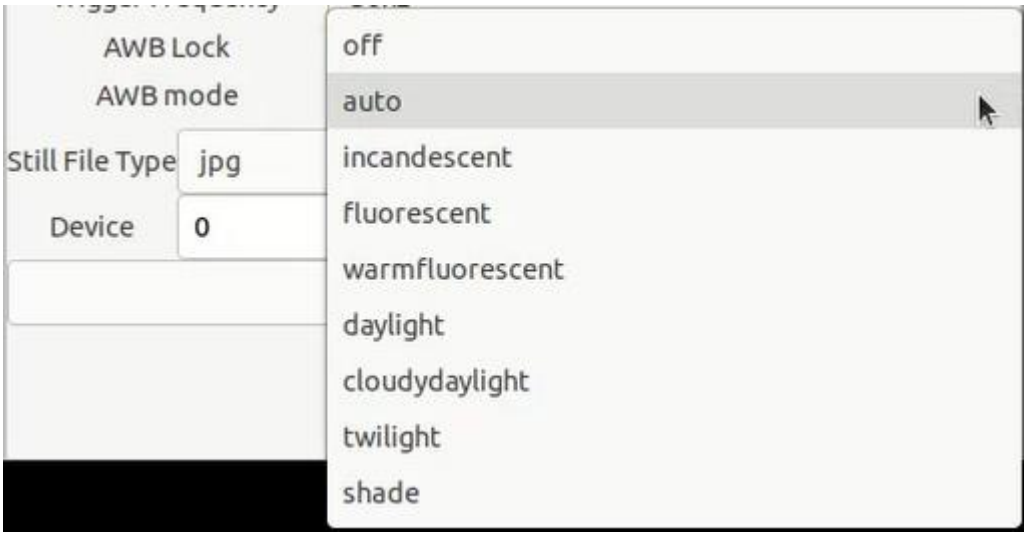

Figure 19: AWB Mode

Still File Type

There are two types of still capture supported in the eCAM_argus_camera. You can select the type of still image capture to be JPEG compressed or uncompressed ISP processed YUV frame using the **Still File Type** drop-down list box provided in the capture tab of eCAM_argus_camera.

When you click the **Still File Type** drop-down list box, you can view the supported still file type as shown below.

Figure 20: Still File Type

Video Recording

The eCAM_argus_camera also provides the feature for recording video.

When you click the **Video Format** drop-down list box, the list of supported formats for the Jetson AGX Orin™ development kit will appear as shown in the following figure.

Figure 21: Video Recording in Jetson AGX Orin Development Kit

The supported video formats supported by eCAM_argus_camera are as follows:

- H264
- H265

When you click the **Video File Type** drop-down list box, the list of supported file types will appear as shown below.

Figure 22: Video File Type

The supported video file types are as follows:

- MP4
- 3GP
- MKV

All the above-mentioned video file types of support H264 video encoding format. **mkv** video file type supports only **h265** video encoding formats.

Note: To view the recorded videos in the Jetson AGX Orin™, please ensure the gstreamer plugins are properly installed. Please refer to the e-CAM56_CUOAGX_*GStreamer_Usage_Guide_Rev_<ver>.pdf* to download the required plugins.

Multi Session

The customized eCAM_argus_camera application provides multi session feature to run multiple cameras simultaneously. You can enable the multi session mode from the drop-down list box provided in the GTK.

When you click the **Multi Session** drop-down list box provided in the GTK, the available modes will appear as shown below.

Figure 22: Multi Session Modes

Note: Run the following command to stream more than two cameras in Multi Session mode, before launching the eCAM_argus_camera application

```
$ sudo service nvargus-daemon stop
$ sudo enableCamInfiniteTimeout=1 nvargus-daemon
```

Comparing eCAM_argus_camera with argus_camera by NVIDIA

This section describes the comparison of eCAM_argus_camera with argus_camera.

Users familiar with NVIDIA® Jetson AGX Orin™ development kit may be familiar with NVIDIA® default camera application, argus_camera.

Additional features in NVIDIA® argus_camera and not in e-con Systems eCAM_argus_camera are as follows:

- YUV Format
- Focus Position
- Aperture motor step
- Aperture motor speed

Troubleshooting

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

v4l2-compliance test fails in buffer ioctl

VIDIOC_REQBUFS ioctl fail in v4l2-compliance test. This fail is because of Nvidia's V4L2 framework implementation. Please write to techsupport@e-consystems.com to get immediate support on other issues.

Streams stops randomly when running the cameras for longer days.

This is a known issue.

To recover the stream, run the following command and re-launch the application.

```
$ sudo service nvargus-daemon restart
```

How to recover when eCAM_argus_camera stream is stuck.

To recover the stream, run the following command and re-launch the application.

```
$ sudo killall eCAM_argus_camera
$ sudo service nvargus-daemon restart
```

What's Next?

After understanding the usage of eCAM_argus_camera application, you can refer to the following documents to understand more about e-CAM56_CUOAGX.

- *e-CAM56_CUOAGX-eCAM_Argus_Camera_Build_and_Install_Guide*
- *e-CAM56_CUOAGX Datasheet*
- *e-CAM56_CUOAGX Release Notes*

Glossary

GIMP: GNU Image Manipulation Program.

GNU: GNU's Not Unix.

GTK: GIMP Toolkit.

ioctl: Input/output Control

ISP: Image Signal Processor.

L4T: Linux for Tegra.

V4L2: Video4Linux2

Support

Contact Us

If you need any support on e-CAM56_CUOAGX 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	22-Aug-2023	Initial Draft	Camera Dev Team
1.1	19-Oct-2023	Updated with 2-lane configuration to support six cameras and resolution to 2432x2048	Camera Dev Team
1.2	31-Oct-2023	Updated the images for multi exposure and minimum gain value	Camera Dev Team
1.3	16-Nov-2023	Updated the supported resolutions	Camera Dev Team
1.4	30-Jan-2024	Updated Multi Session details	Camera Dev Team
1.5	11-Mar-2024	Removed multi exposure and exposure compensation controls and updated trigger and trigger frequency	Camera Products Team
1.6	21-Mar-2024	Updated product image in home page	Camera Products Team