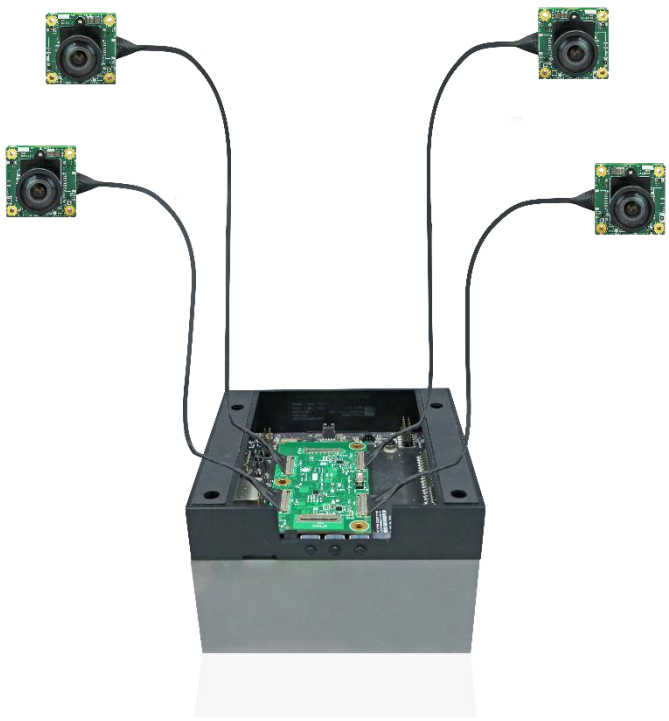
e-CAM56_CUOAGX

Getting Started Manual



Version 1.6

e-con Systems

3/22/2024

e-con Systems

Think Camera. Think e-con.

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Disclaimer

The specifications of e-CAM56_CUOAGX board and instructions on how to use this board with NVIDIA® Jetson AGX Orin™ 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.

Contents

Introduction to e-CAM56_CUOAGX

e-CAM56_CUOAGX is 5 MP, MIPI, global shutter color camera from e-con Systems, a company with over two decades of experience in designing, developing, and manufacturing OEM cameras. It can be interfaced to the J509 camera connector of the NVIDIA® Jetson AGX Orin™ development kit.

e-CAM56_CUOAGX is provided with S-mount lens holder. This color camera delivers RGB RAW data. The supported resolutions and frame rates are listed in the following table.

Table 1: Maximum Frame Rate Supported for e-CAM56_CUOAGX

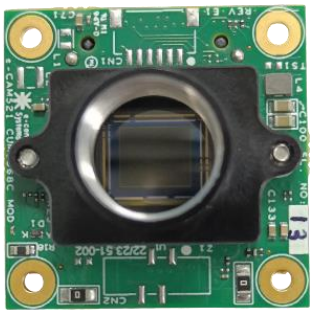
Platform	Lanes	Resolution	Frame Rate(fps) in 10-bit Output	Frame Rate(fps) in 12-bit Output
NVIDIA® Jetson AGX Orin™	4-lane	2432 x 2048	79	67
	4-lane	1920 x 1080	142	121
	4-lane	1280 x 720	202	172
	4-lane	640 x 480	280	240

This document describes how to interface the e-CAM56_CUOAGX board on NVIDIA® Jetson AGX Orin™ development kit and how to use the e-CAM56_CUOAGX board.

Parts Supplied

The parts supplied with the kit are listed in the following table.

Table 2: Parts Supplied and its Quantities.

Parts Supplied	Images	Quantity
Custom lens camera module (e-CAM56_CUOAGX camera module)		X
Base board (e-CAM56_CUOAGX base board)		1

30cm IPEX cable		X
Lens		X

Note: Quantity X depends on the part number ordered as listed in the following table.

Table 3: Parts Numbers and its Quantity

Part Number	X
e-CAM56_CUOAGX_CHLC_1H01R1	1
e-CAM56_CUOAGX_CHLC_4H01R1	4

Description

e-CAM56_CUOAGX connects four 5 MP camera modules using the four individual 4-lane MIPI CSI camera connections supported by Jetson AGX Orin™ development kit. The Jetson AGX Orin™ is a small size, low power, artificial intelligence (AI) system-based evaluation kit developed by NVIDIA®.

e-CAM56_CUOAGX is a multi-board solution, which has three boards as follows:

- Camera module (e-CAM521_CUMI568C_MOD_H01R1)
- Adaptor board (e-CAM80_CUMI334_ADP)
- Base board (e-CAM30_HEXCUXVR_BASE_BRD)

The camera module is a small, low-power, high performance 5 MP camera module. It is based on 1/1.8" IMX568 CMOS image sensor from SONY® Pregius S family. The IMX568 is a 1/1.8" optical form-factor, CMOS image sensor with a global shutter.

The front and rear views of e-CAM521_CUMI568C_MOD_H01R1 mod board, e-CAM80_CUMI334_ADP adaptor board and e-CAM30_HEXCUXVR_BASE_BRD base board are shown in the following figures.

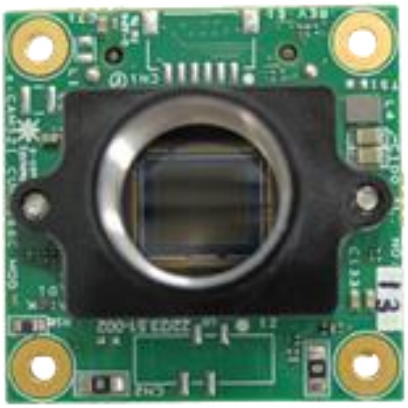


Figure 1: Front View of e-CAM56_CUOAGX Camera

Figure 2: Rear View of e-CAM56_CUOAGX Camera

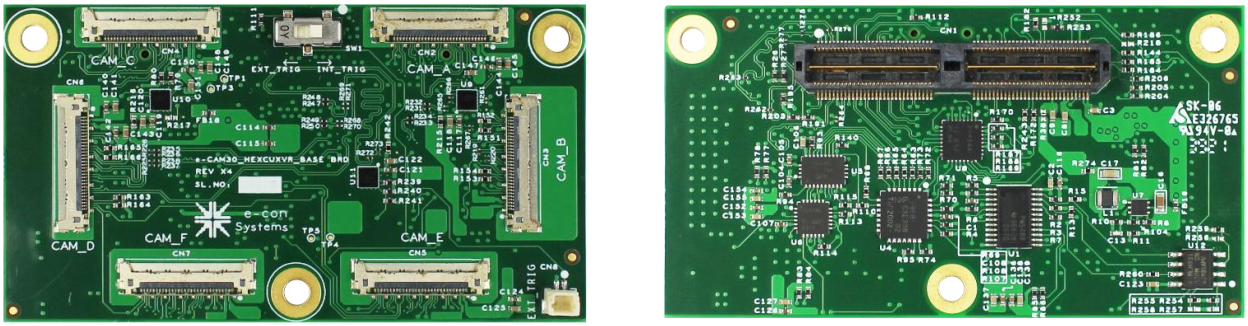


Figure 3: Front and Rear Views of e-CAM56_CUOAGX Adaptor Board

The e-CAM56_CUOAGX camera consists of 30-pin IPEX connector (CN2), through which e-CAM56_CUOAGX is connected to NVIDIA® Jetson AGX Orin™ development kit using the 30 cm IPEX cable.

e-CAM56_CUOAGX Board Handling Procedure

This section describes the handling procedure of e-CAM56_CUOAGX board.

The procedure to assemble camera board to NVIDIA® Jetson AGX Orin™ carrier board is described in the following sections:

- Connecting I-PEX Cable On Adaptor Boards
- Connecting e-CAM56_CUOAGX with Jetson AGX Orin Development Kit
- Powering ON e-CAM56_CUOAGX with NVIDIA Jetson AGX ORIN Development Kit

Connecting I-PEX Cable on Adaptor Board

e-CAM56_CUOAGX is provided with 30cm IPEX cable, for connecting with e-CAM56_CUOAGX base board.

Figure 4: IPEX Cable provided by econ systems

The steps to connect the camera board are as follows:

1. Connect an IPEX cable at CN2 connector of the adapter board and lock the cable.

   The IPEX cable has a lock bar, which is used for locking and unlocking the cable as shown in the following figure.

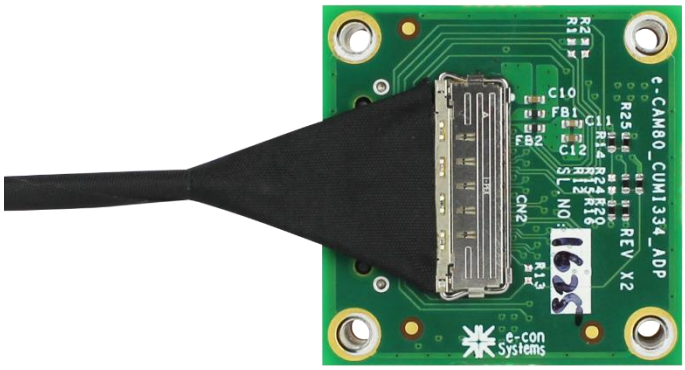


Figure 5: CN2 Connector Location in e-CAM56_CUOAGX Adaptor Board

2. Mount the provided lens by removing the lens cap in the lens holder. After mounting the lens, the product will appear like the image shown below.

Figure 6: e-CAM56_CUOAGX CN2 Connector Locked with Cable

Connecting e-CAM56_CUOAGX with Jetson AGX Orin Development Kit

The e-CAM56_CUOAGX base board is mounted to camera interface connector of Jetson AGX Orin™ development kit as follows:

Insert the CN1.1 pin of e-CAM56_CUOAGX base board with the J509 connector of Jetson AGX Orin™ development kit as shown below.

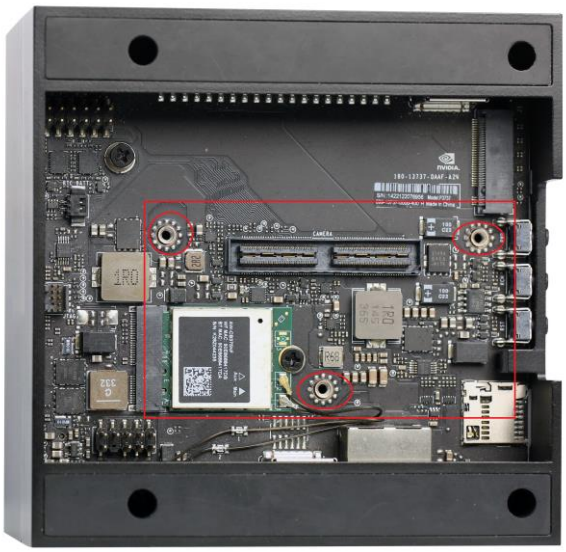


Figure 7: e-CAM56_CUOAGX Base Board Location in Jetson AGX Orin Development Kit

Note: Check the pin 1 marking between base board and Jetson AGX Orin™ development kit before mating, refer the below image.

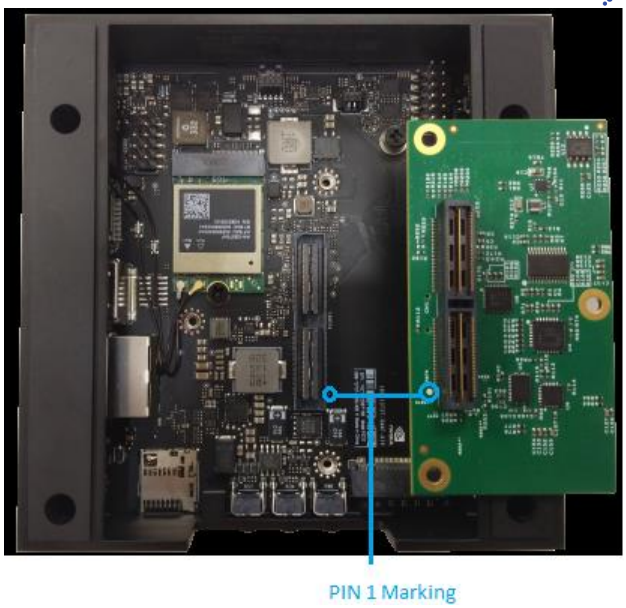


Figure 8: Location of Pins on Base Board and Jetson AGX Orin Development Kit

The e-CAM56_CUOAGX base board connected in the Jetson AGX Orin™ development kit is shown in the following figure.

Figure 9: Base Board Connected with Jetson AGX Orin Development Kit

3. Connect IPEX cable to the below mentioned four connectors in e-CAM56_CUOAGX base board and lock the cable as shown in the following figure.

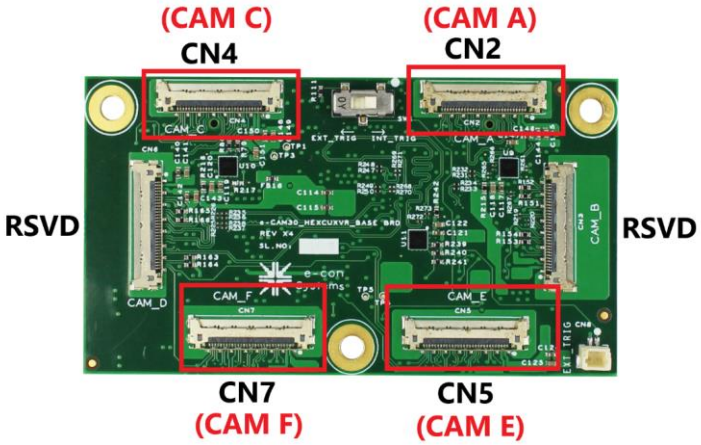


Figure 10: IPEX Connector Location to be connected for four lane video support

Figure 11: IPEX Connector Location

Note: Care must be taken, while connecting cable to camera connector of the e-CAM56_CUOAGX base board.

Now, e-CAM56_CUOAGX is connected to the NVIDIA® Jetson AGX Orin™ development kit as shown in the following figure. Similarly connect the remaining cameras in same fashion.

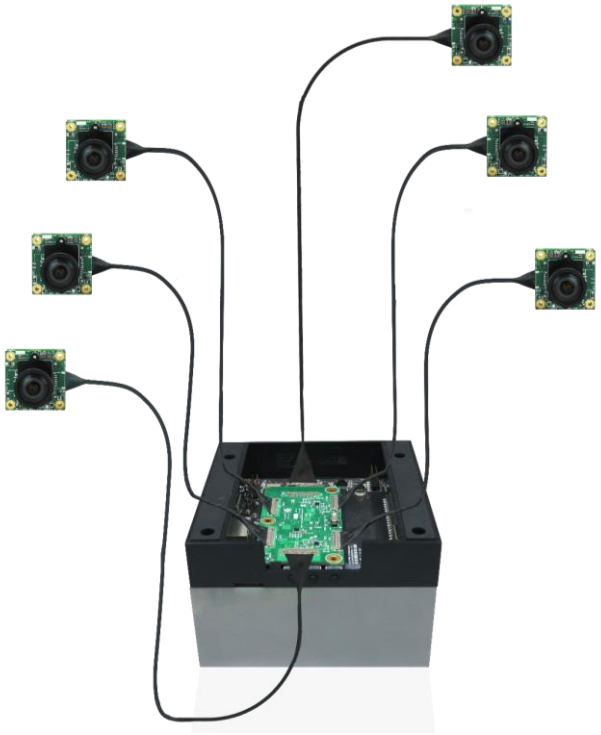


Figure 12: e-CAM56_CUOAGX Setup Interfaced to NVIDIA Jetson AGX Orin Development Kit

Powering ON e-CAM56_CUOAGX with NVIDIA Jetson AGX Orin Development Kit

With e-CAM56_CUOAGX connected to Jetson AGX Orin™ development kit, the steps to power up and configure the Orin™ setup are as follows:

1. Power the NVIDIA® Jetson AGX Orin™ development kit either from USB Type C connector 20V 4.5A or DC power jack connector as shown in the following figure.

Figure 13: Power Supply Connected in NVIDIA Jetson AGX Orin Development Kit

2. Press the power switch of Jetson AGX Orin™ development kit to boot the device.

   The location of power switch on the Jetson AGX Orin™ development kit as shown in the following figure.

Figure 14: Location of Power Switch on Jetson AGX Orin Development Kit

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

Figure 15: Power ON Indication White LED Glowing on Jetson AGX Orin Development Kit

Extracting and Flashing e-con provided Binaries

This section describes the extracting and flashing of e-con Systems provided binaries to the Jetson AGX Orin™ development kit.

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

Table 4: Notation of Colors

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

Note: Before extracting and flashing the e-con provided binaries in the Jetson AGX Orin™ development kit, flash the Jetpack 5.1.2 provided by Nvidia®, using the SDK manager.

Steps for Flashing Jetpack

The steps to flash the jetpack are as follows:

1. Download the SDK manager in host PC using SDK Manager | NVIDIA Developer link.

   Note: Host PC which runs Ubuntu 18.04 or 20.04 (64-bit).

2. Sign up to an account in NVIDIA® developer site to use the SDK manager.
3. Install the SDK Manager in the host PC using the below command.

```
sudo apt-get install ./sdkmanager
[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-sdkm-jetson/index.html.

4. Copy the release package into the HOME Directory of the flashed Jetson AGX Orin™ development kit with JP 5.1.2.

Steps for Flashing Deskew Firmware

Please follow the below steps to flash the deskew firmware for Jetson AGX Orin™ Devkit.

```
mkdir top_dir
export TOP_DIR=/top_dir
```

```
export RELEASE_PACK_DIR=$TOP_DIR/e-CAM56_CUOAGX_JETSON_AGX_XAVIER_ORIN_<L4T_version>_<release_date>_<release_version>

export L4T_DIR=$TOP_DIR/Linux_for_Tegra

export LDK_ROOTFS_DIR=$TOP_DIR/Linux_for_Tegra/rootfs

 mv <location_of>/e-CAM56_CUOAGX_JETSON_AGX_XAVIER_ORIN_<L4T_version>_<release_date>_<release_version>.tar.gz $TOP_DIR
```

Download the packages from the NVIDIA® website as listed in below table.

Table 6: Packages for Jetson AGX Orin

S.NO	Title	Version	Download Link
1	L4T Jetson AGX Orin™ driver Package	35.4.1	https://developer.nvidia.com/downloads/embedded/l4t/r35_release_v4.1/release/jetson_linux_r35.4.1_aarch64.tbz2/
2	L4T Jetson AGX Orin™ sample Rootfs	35.4.1	https://developer.nvidia.com/downloads/embedded/l4t/r35_release_v4.1/release/tegra_linux_sample-root-filesystem_r35.4.1_aarch64.tbz2/

```
cp $HOME/Downloads/Jetson_Linux_R35.4.1_aarch64.tbz2 $TOP_DIR

cp $HOME/Downloads/Tegra_Linux_Sample-Root-Filesystem_R35.4.1_aarch64.tbz2 $TOP_DIR

cd $TOP_DIR

sudo tar -xjpf Jetson_Linux_R35.4.1_aarch64.tbz2

cd $LDK_ROOTFS_DIR

sudo tar -xjpf $TOP_DIR/Tegra_Linux_Sample-Root-Filesystem_R35.4.1_aarch64.tbz2

cd $L4T_DIR

sudo ./apply_binaries.sh

cd $TOP_DIR

tar -xaf e-CAM56_CUOAGX_JETSON_AGX_XAVIER_ORIN_<L4T_version>_<release_date>_<release_version>.tar.gz

sudo cp $RELEASE_PACK_DIR/misc/camera-rtcpu-t234-rce_35_4_1.img $L4T_DIR/bootloader/camera-rtcpu-t234-rce.img -f
```

Flashing the Jetson Orin Development Kit with the deskew firmware

The steps to flash the Jetson development kit are as follows:

1. Connect the USB Type-C cable to the host PC and the USB-Type C port of Jetson AGX Orin™ development kit.

The location of USB-C port on the Jetson Orin™ development kit is shown in below figure.

Figure 17: Location of USB-C Port on Jetson Orin Development Kit

2. Set the board to recovery mode, as mentioned in below steps:
   a. Press and hold the **Recovery** button of Jetson AGX Orin™development kit.
   b. Press the **Power** button of Jetson AGX Orin™ development kit.

      The location of **Recovery** and **Power** buttons on the Jetson AGX Orin™ development kit is shown in below figure.

Figure 18: Location of Recovery and Power Buttons on Jetson Orin Development Kit

   c. Release both Recovery and Power buttons.

   If the board is successfully changed to recovery mode, the Jetson AGX Orin™ development kit will be enumerated as an USB device to the host PC.

3. Run the following command to verify whether the board is in recovery mode.

```
lsusb
```

   The output message appears as shown below.
   For Jetson AGX Orin™

```
Bus 003 Device 006: ID 0955:7023 NVidia Corp.
```

4. Run the following flash.sh scripts to flash deskew firmware your host PC.

```
cd $L4T_DIR

sudo ./flash.sh -k A_rce-fw jetson-agx-orin-devkit
mmcblk0p1
```

Now the deskew firmware will be flashed and the Jetson AGXOrin™ development kit will be rebooted automatically once after flashing completed. Follow the below steps for package extraction.

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 AGX Orin™ development kit to obtain the binaries.

```
tar -xaf e-
CAM56_CUOAGX_JETSON_XAVIER_ORIN_<L4T>_<RELEASE_DATE>_<
VERSION >.tar.gz

cd e-
CAM56_CUOAGX_JETSON_XAVIER_ORIN_<L4T>_<RELEASE_DATE>_<
VERSION >
```

The folder contains the necessary tools to immediately flash the binaries in Jetson AGX Orin™ development kit with the kernel, camera drivers, and application.

2. Run the following commands in the Jetson AGX Orin™ development kit.

```
sudo chmod +x install_binaries.sh

sudo -E ./install_binaries.sh
```

After the successful installation, the board will reboot and the Jetson AGX Orin™ development kit is ready to use with e-CAM56_CUOAGX.

Steps for Launching Application in Development Kit

The steps to launch the application in the development kit are as follows:

1. Run the following command to check whether all the four 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 initialized properly.

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

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

The output message for a four-camera setup appears as shown below.

```
/dev/video*
```

Where (*) denotes the number of cameras connected to the Jetson AGX Orin™ 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 and max-clocks shell scripts before launching the eCAM_argus_camera application in the Jetson AGX Orin™ development kit.

```
$ sudo jetson_clocks
$ sudo /home/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 sample camera application.

```
$ eCAM_argus_camera
```

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

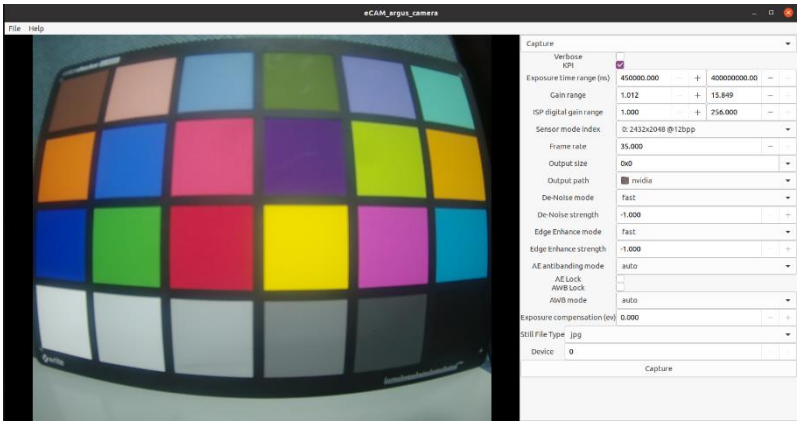


Figure 16: Initial Window Appearance when Application is Launched

Multiple Individual Cameras Streaming:

To stream multiple Individual cameras simultaneously, run the following command in multiple terminals.

```
sudo $ eCAM_argus_camera -d n
```

Note: 'n' denotes the number of cameras connected and initialized, 'n' will be 0-6.

The execution of argus sample application is shown in the following figure.

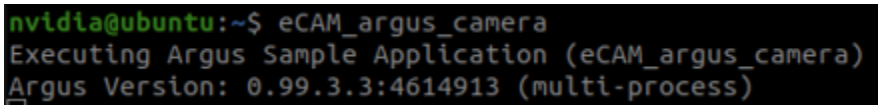


Figure 17: Execution of Argus Sample Application

Reference Documents

This section describes the software and hardware documents of e-CAM56_CUOAGX. 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 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-CAM56_CUOAGX_eCAM_Argus_Camera_App_User_Manual_Rev_<ver>.pdf
2	Build and install the GUI based eCAM_argus_camera camera application.	e-CAM56_CUOAGX_eCAM_Argus_Camera_Build_and_Install_Guide_Rev_<ver>.pdf
3	Use gstreamer to control the e-CAM56_CUOAGX camera on the Jetson AGX Orin™ development kit.	e-CAM56_CUOAGX_GStreamer_Usage_Guide_Rev<ver>.pdf
4	Build custom kernel with support for using e-CAM56_CUOAGX.	e-CAM56_CUOAGX_Developer_Guide_Rev_<ver>.pdf
5	Information about the directory structure and contents of the release package for e-CAM56_CUOAGX.	e-CAM56_CUOAGX-Release_Package_Manifest_Rev_<ver>.pdf
6	Describes the features and specification of e-CAM521_CUMI568C_MOD_H01R1 camera module.	e-CAM521_CUMI568C_MOD_MCU_Protocol_App_Note_Rev_<ver>.pdf
7	View the camera stream and change the camera controls using GUI for multiple cameras	e-CAM56_CUOAGX_eCAM_Argus_MultiCamera_App_User_Manual_Rev_<ver>.pdf

Hardware Documents

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

Table 6: Description of Hardware Documents

S.NO	Documents Name	Description
1	e-CAM56_CUOAGX_Datasheet_Rev_<ver>.pdf	Describes the features, connector pin-out details and mechanical dimensions of e-CAM56_CUOAGX.
2	e-CAM521_CUMI568C_MOD_H01R1_Datasheet_Rev_<ver>.pdf	Describes the features and specification of e-CAM521_CUMI568C_MOD_H01R1 camera module.
3	e-CAM56_CUOAGX_Lens_Datasheet_Rev_<ver>.pdf	Describes the optical specification of lenses used in e-CAM56_CUOAGX.
4	e-CAM56_CUOAGX_Getting_Started_Manual_Rev_<ver>.pdf	Describes on how to do initial setup of hardware and software
5	e-CAM56_CUOAGX_External_Trigger_Setup_Guide_Rev_<ver>.pdf	Describes on how to get the stream using external trigger to the sensor
6	e-CAM56_CUOAGX_3D_revX1.stp	Mechanical 3D file for e-CAM56_CUOAGX product
7	e-CAM521_CUMI568C_MOD_H01R1_Mechanical_DWG	Mechanical drawing for e-CAM521_CUMI568C_MOD_H01R1 module board
8	e-CAM80_CUMI334_ADP_REVX2_MECH_ASY_DWG	Mechanical drawing for e-CAM80_CUMI334_ADP_REVX2 adaptor board

Troubleshooting

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

I have flashed the Jetson AGX Orin™ board with quick start package. After flashing, the board is not booting, or the display is blank. How to solve this issue?

To solve this issue, please try the following:

- Use the correct command with sudo permission whenever required to extract the package.
- Use Ubuntu 18.04 or 20.04 64-bit for flashing.
- Maintain enough free space in hard disk before flashing.

FAQ

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 specifications of e-CAM56_CUOAGX board and instructions on how to use this board with NVIDIA® Jetson AGX Orin™ development kit, you can refer to the following documents to understand more about e-CAM56_CUOAGX.

- *e-CAM56_CUOAGX Developer Guide*
- *e-CAM56_CUOAGX e-CAM_argus_camera App User Manual*

Glossary

AI: Artificial Intelligence.

API: Application Program Interface.

CMOS: Complementary Metal Oxide Semiconductor.

CSI: Camera Serial Interface.

GUI: Graphical User Interface.

MCU: Micro Controller Unit.

MIPI: Mobile Industry Processor Interface.

USB: Universal Serial Bus.

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 Team
1.1	20-Oct-2023	Updated to L4T35.4.1 with 2-lane configuration to support six cameras	Camera Team
1.2	31-Oct-2023	Updated install binaries for 2-lane and 4-lane	Camera Team
1.3	16-Nov-2023	Updated the supported resolutions with frame rates	Camera Team
1.4	30-Jan-2024	Added flashing deskew firmware to kit section and fix to stream more than two cameras in Multi session mode	Camera Team
1.5	10-Mar-2024	2-lane MIPI support removed	Camera Team
1.6	22-Mar-2024	Updated product image in home page, listed mechanical drawings for module and adaptor board under hardware documents	Camera Team