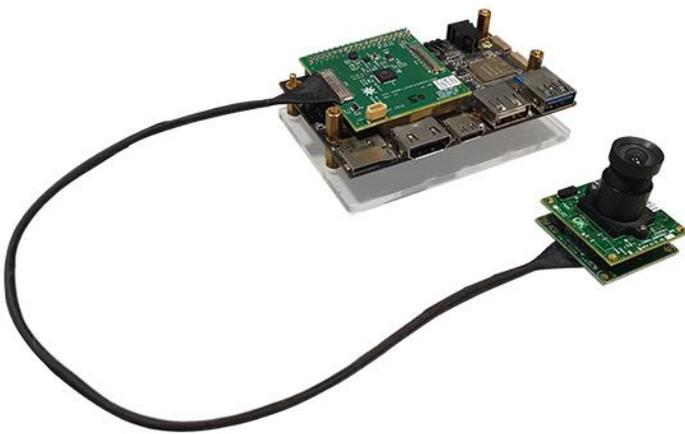


e-CAM50_CU96

Getting Started Manual



e-con Systems

Your Product Development Partner

Version 1.0

e-con Systems

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Disclaimer

The specifications of e-CAM50_CU96 board and instructions on how to use this board with ROCK960 development board 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-CAM50_CU96

e-CAM50_CU96 is 5 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. e-CAM50_CU96 targets the ROCK960 development board. It can be interfaced with ROCK960 development board through the high speed and low speed camera interface connectors.

e-CAM50_CU96 is provided with S-mount (also known as M12 board lens) lens holder. The S-mount is one of the most commonly used small form-factor lens mounts for board cameras. e-CAM50_CU96 is a color camera that supports uncompressed UYVY format in both still capture and video recording. The supported resolutions and frame rates are listed in below table.

Table 1: Supported Resolutions and Frame Rates

S. NO	Resolution	Frame Rate (fps)
1	HD (1280 x 720)	70
2	FHD (1920 x 1080)	60
3	QHD (2560 x 1440)	35
4	5 MP (2592 x 1944)	25

This document describes how to interface the e-CAM50_CU96 board on ROCK960 development board and how to use the e-CAM50_CU96 board.

Parts Supplied

The following table lists the parts supplied with the kit.

Table 2: Parts Supplied and its Quantity

Parts Supplied	Images	Quantity
Custom Lens Camera Module (e-CAM55_CUMI0521_MOD)		1

<p>Adaptor Board (eCAM130_TRICUTX2_ADAPTOR)</p>		<p>1</p>
<p>Base Board (ACC-96DEV_MIPICAMERA_ADP)</p>		<p>1</p>
<p>30 cm Micro-Coaxial Cable</p>		<p>1</p>
<p>8 GB microSD card</p>		<p>1</p>

Description

The ROCK960 development board is 96 boards compliant community board based on Rockchip RK3399 platform. It consists of ARM Cortex-A72 Dual-core up to 1.8 GHz and Cortex A53 Quad-core up to 1.4 GHz CPU. The ROCK960 development board supports two camera interfaces, HDMI, microSD Slot, USB 3.0, Ethernet, Audio Out, and so on.

e-CAM50_CU96 is a multi-board solution, which has three boards as follows:

- Camera module (e-CAM55_CUMI0521_MOD)
- Adaptor board (eCAM130_TRICUTX2_ADAPTOR)
- Base board (ACC-96DEV_MIPICAMERA_ADP)

The camera module is a small, low-power, high performance 5 MP camera with a built-in ISP, which supports UYVY format. This camera module is based on AR0521 CMOS image sensor from ON Semiconductor®. The AR0521 is a 1/2.5" optical form-factor, CMOS image sensor with an electronic rolling shutter.

The front and rear views of the boards are shown in below figures.

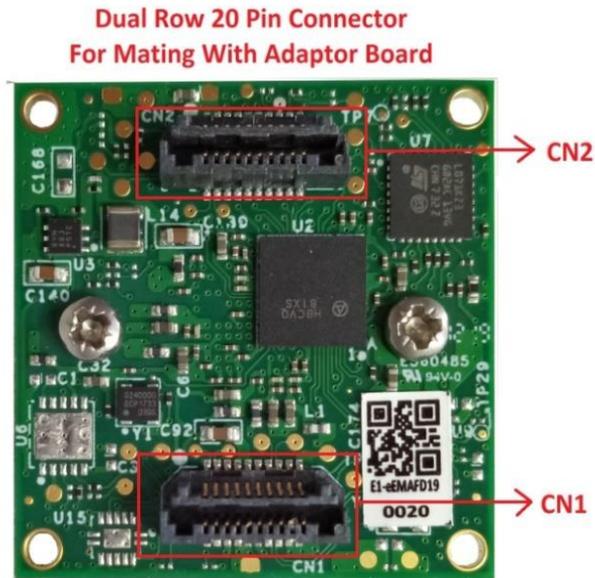


Figure 1: Rear View of e-CAM55_CUMI0521_MOD Board

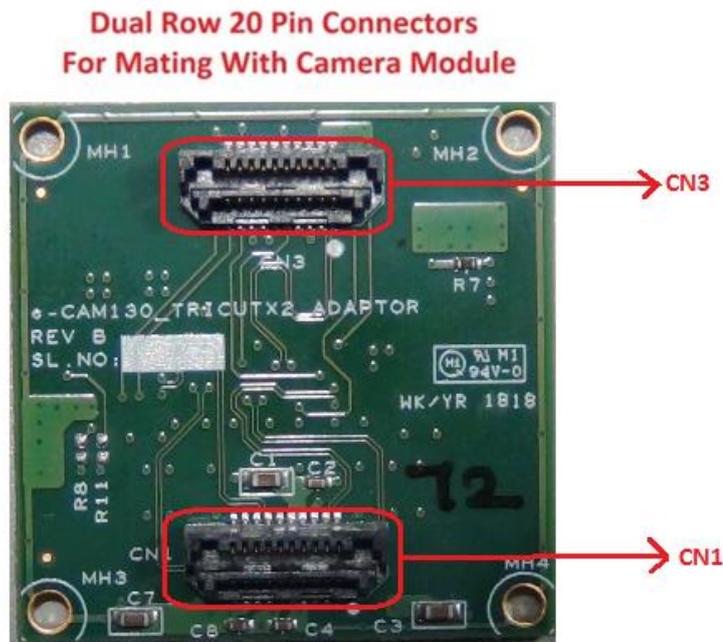


Figure 2: Front View of eCAM130_TRICUTX2_ADAPTOR Adaptor Board



Figure 3: Rear View of eCAM130_TRICUTX2_ADAPTOR Adaptor Board

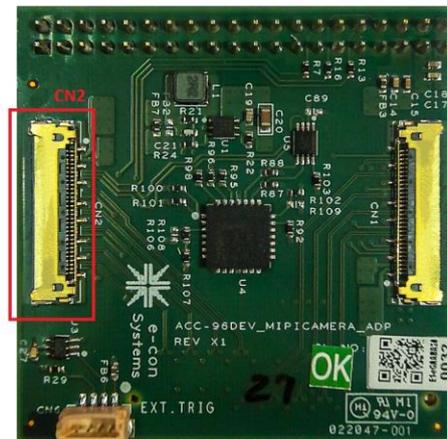


Figure 4: Front View of ACC-96DEV_MIPICAMERA_ADP

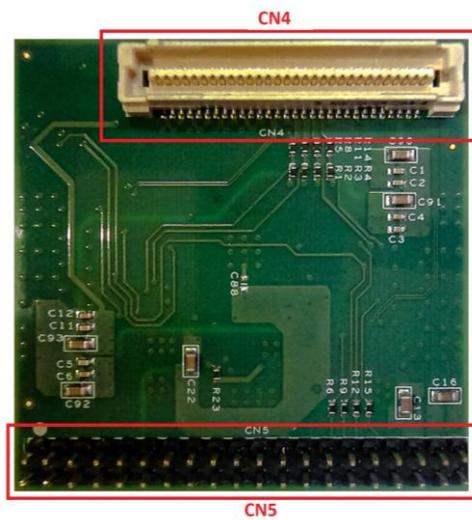


Figure 5: Rear View of ACC-96DEV_MIPICAMERA_ADP

e-CAM50_CU96 adaptor board has two 20-pin Samtec connectors (CN1 and CN3) for mating with e-CAM50_CU96 module board and a 30-pin I-PEX connector (CN2) for connecting with e-CAM50_CU96 base board. Both the module board and adapter board are screwed into a single unit. This single unit should not be separated. This adaptor board acts as a bridge between the camera module and the base board. e-CAM50_CU96 is connected to ROCK960 development board with low and high-speed interface connectors.

e-CAM50_CU96 Board Handling Procedure

This section describes the handling procedure of e-CAM50_CU96 board.

The procedure to assemble camera board are as follows:

1. Connect CN4 and CN5 connectors of e-CAM50_CU96 base board with high speed and low speed camera interface connectors in the ROCK960 development board.

The CN4 and CN5 connectors location in the e-CAM50_CU96 base board is shown in below figure.

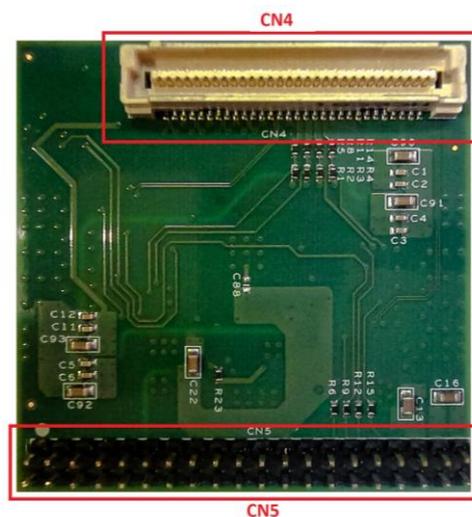


Figure 6: Camera Connector location in e-CAM50_CU96 Base Board

The high speed and low speed camera interface connectors in the ROCK960 development board is shown in below figure.

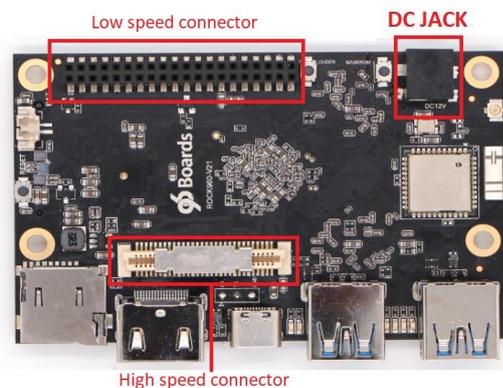


Figure 7: Camera Connectors location in ROCK960 Development Board

2. Connect Pin 1 of CN4 connector with Pin 1 of high speed camera interface connector and Pin 1 of CN5 connector with Pin 1 of low speed camera Interface connector.

The ROCK960 development board with e-CAM50_CU96 base board is shown in below figure.



Figure 8: ROCK960 Development Board with e-CAM50_CU96 Base Board

3. Interface the adaptor board to the base board using the supplied 30 cm micro-coaxial cables.

The supplied micro-coaxial cable is shown in below figure.



Figure 9: Micro-Coaxial Cable

4. Connect the one end of micro-coaxial cable to the CN2 adaptor board connector as shown in below figure.

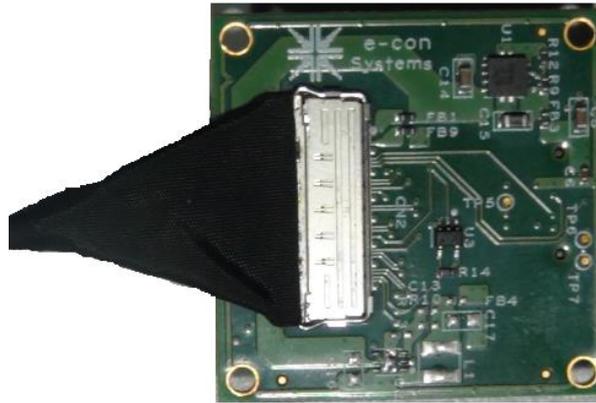


Figure 10: Micro-Coaxial Cable connected on Adapter Board Connector

5. Connect the other end of micro-coaxial cable to the CN2 base board connector.

The location of CN2 connector on the base board is shown in below figure.

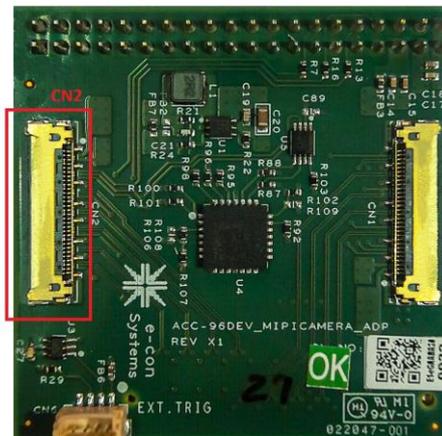


Figure 11: Location of CN2 Connector on Base Board

The locking and unlocking positions of micro-coaxial cable on the base board connector are shown in below figures.



Figure 12: Unlocking Position of Cable on Base Board CN2 Connector



Figure 13: Locking Position of Cable on Base Board CN2 Connector

Now, e-CAM50_CU96 is connected to ROCK960 development board as shown in below figure.

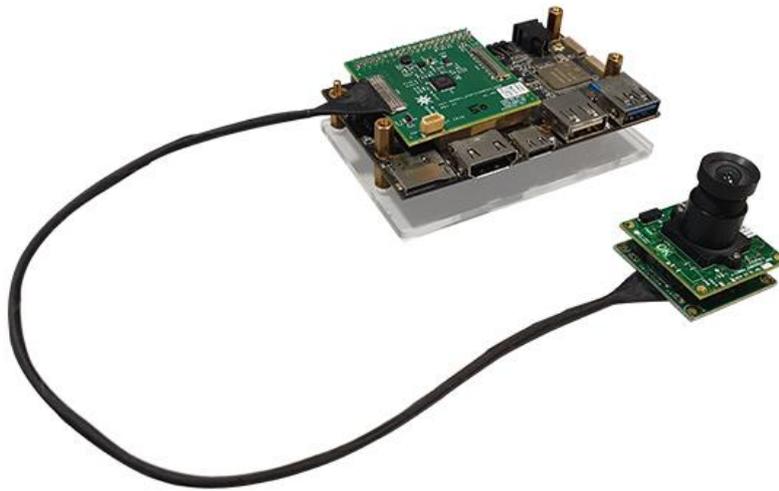


Figure 14: e-CAM50_CU96 Setup Interfaced to ROCK960 Development Board

6. Insert the memory card provided by e-con Systems in the SD card slot before powering ON.

The location of SD card slot in ROCK960 development board is shown in below figure.

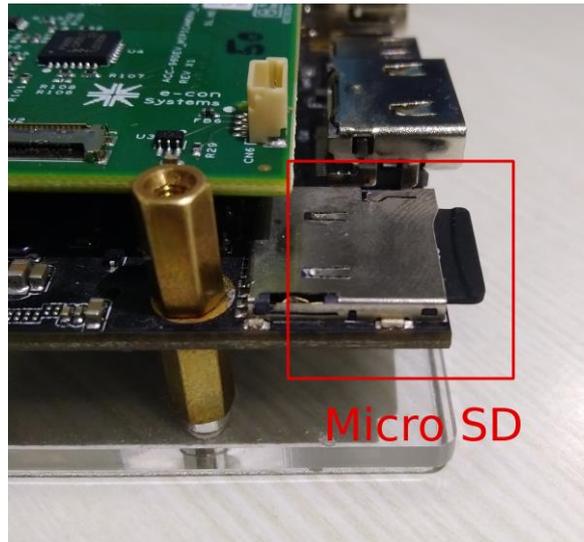


Figure 15: Insertion of Memory Card in ROCK960 Development Board

7. Power ON the Google Coral development kit through the DC Jack.

The location of DC Jack is shown in below figure.

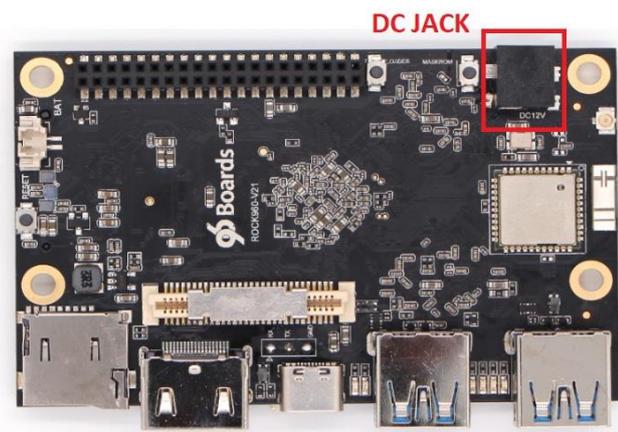


Figure 16: Power Supply Connector in ROCK960 Development Board

8. Connect a DC power with 12V 2A to power ON the ROCK960 development board as shown in below figure.

After powering ON the ROCK960 development board, the green color LED on ROCK960 development board will glow. This serves as an indication for power-up of board.

Preparing SD card with Prebuilt Binary

This section describes the steps to prepare SD card with prebuilt binaries for ROCK960 board using Ubuntu (14.04 or 16.04) host system.

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

Table 3: Notation of Colors

Color	Notation
Blue	Commands running in Development PC
Red	Commands running in Development Board

The steps to prepare SD card with prebuilt binaries are as follows:

Note: Use empty SD card without any data.

1. Open the Terminal application on host computer to find SD card device name.
2. Unplug SD card from the host computer if it is connected.
3. Run the following command to view the list of disk name.

```
$ lsblk
```

4. Insert the SD card into the host computer.
5. Run the previous command to view the newly recognized list of disk name.
6. Run the following command to navigate to the location where prebuilt binary is stored in the host system.

```
$ cd <location of prebuilt_binary>
```

The **system.img** file is the required binary to flash in the SD card.

7. Unmount the SD card if it is mounted.
8. Run the following command to flash the system.img into the SD card.

```
$ sudo dd if=system.img of=/dev/sdX bs=4M oflag=sync  
status=noxfer
```

Note:

- The above flashing command will take few minutes to complete.
- **/dev/sdX** must be replaced with the appropriate device node of the SD card such as **/dev/sda** or **/dev/sdb**. This can be obtained by `dmesg` command on your host Linux PC after the SD card reader is inserted.

Warning: If wrong device node is mentioned, the data loss in corresponding device may occur.

9. Run the following command to synchronize the disk write process, once SD card flashing is completed.

```
$ sync
```

Now the SD card is flashed with system image for ROCK960 board. The operating system flashed on the microSD card is Debian GNU/Linux 9.2 (stretch).

Streaming of e-CAM50_CU96 Board

This section describes the steps to stream e-CAM50_CU96 board.

The steps to stream e-CAM50_CU96 board are as follows:

1. Unplug ROCK960 board from power.
2. Connect the ROCK960 board HDMI interface with HDMI cable.
3. Connect the USB keyboard and mouse using USB hub present in the ROCK960 board.
4. Insert the prepared microSD card into the SD slot.
5. Power ON the supply and wait for board to boot up.

After booting, the LEDs will start blinking and Debian desktop will open in the monitor. You are now booting your newly installed operating system running on SD card on the ROCK960 board as shown below.

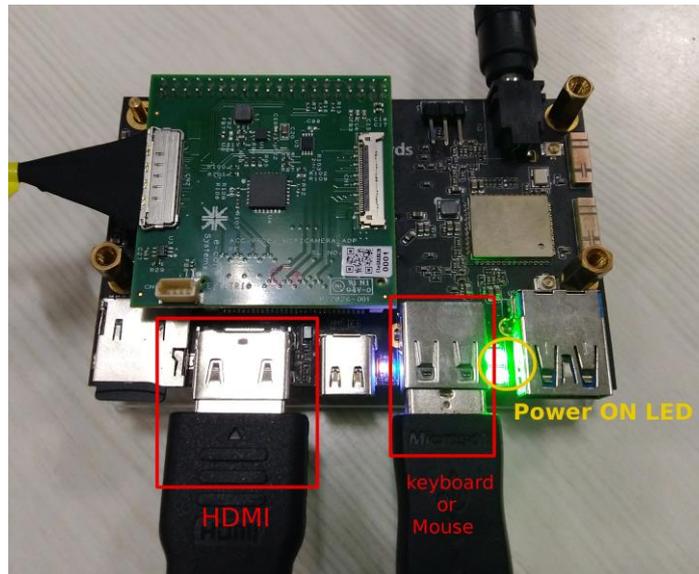


Figure 18: HDMI, Keyboard or Mouse connected to ROCK960 Board

6. Run the following command to check whether the e-cam50 kernel module named ar0521_mcu is loaded.

```
$ lsmod
```

7. Run the following command to load the module if the module is not loaded.

```
$ sudo modprobe ar0521_mcu
```

8. Run the following commands to install media-ctl and V4L2 application.

```
$ sudo apt-get update  
$ sudo apt-get install v4l-utils
```

9. Run the following command to check the media control entities.

```
$ media-ctl -d /dev/media0 -p
```

10. Run the following commands to configure the media control entities.

```
$ chmod +x initialize.sh  
$ ./initialize.sh
```

Note: The media control commands are given as shell script.

Now, the camera module is loaded and ready for streaming.

11. Run the following Gstreamer command to stream the camera.

```
$ gst-launch-1.0 rkcamsrc device=/dev/video0 io-  
mode=dmabuf ! video/x-raw, width=<WIDTH>,  
height=<HEIGHT>, framerate=60/1 ! fpsdisplaysink  
video-sink=rkximagesink text-overlay=false -v
```

Where, <WIDTH>=width of the frame (example: 1920), <HEIGHT>=height of the frame (example: 1080) which can be changed as per the requirement.

1. What is e-CAM50_CU96?

e-CAM50_CU96 is 5 MP camera module designed and developed by e-con Systems, a leading Embedded Product Design Services Company which specializes in advanced camera solutions.

2. What is the camera sensor used in the eCAM50_CU96 design?

eCAM50_CU96 camera module is based on 1/2.5" inch AR0521 image sensor from ON Semiconductor® with built-in Image Signal Processor (ISP).

3. Can the camera support color?

Yes, this camera module supports color.

4. What are the output formats supported in the eCAM50_CU96 camera?

eCAM50_CU96 will provide output in UYVY format.

5. Is it possible to get RAW Bayer frames from the camera?

eCAM50_CU96 camera module does not support RAW Bayer format.

6. Can the camera control options be altered in run time?

The camera controls can be changed after stopping the camera streaming.

7. Can I use the flash trigger to capture images from this camera?

Currently, the trigger option is not supported. For customization, please write to sales@e-consystems.com.

8. What is the lens used in this camera?

The lens used in the camera is 1232818MPF.

9. What is the minimum distance that the lens could focus?

The minimum distance that the lens could focus is 2.8 mm.

10. What type of lens mount is used?

eCAM50_CU96 uses S-mount lens holder.

11. What is the glass-to-glass latency for this camera?

The glass-to-glass latency is ~100 ms for 1080p at 60 fps resolution.

12. What is 96Boards?

96Boards is a range of hardware specifications created by Linaro to make the latest ARM-based processors available to developer at a reasonable cost. Boards produced to the 96Boards specifications are suitable for rapid prototyping applications which includes high end audio, robotics and drones, artificial intelligence, virtual reality, IOT and industrial control.

13. Can I use this camera with other 96Boards?

Yes, 96Boards common mechanical and hardware specifications enables compatibility of e-CAM50_CU96 camera module with other 96Boards.

14. What is the advantage of using 96Boards?

96Boards enables quick prototyping of devices with variety of SOCs along with community support that enables rapid development.

15. What is Rock960?

The Rock960 is a development board based on the RK3399 SoC which is a Dual Cortex-A72 + quad Cortex-A53 CPU with upto 2.0 GHz frequency.

16. What are the supported OSes for eCAM50_CU96 with Rock960?

The supported OSes for eCAM50_CU96 with Rock960 is Debian GNU/Linux 9.2 (stretch). In future, e-con Systems planned to provide AOSP support. For customization, please write to sales@c-onsystems.com.

17. How many cameras can I connect with Rock960 boards?

Currently one camera is supported. Two cameras can be integrated to Rock960. For customization, please write to sales@c-onsystems.com.

18. Can I connect this camera to Raspberry Pi 3B+?

Currently, e-con Systems provide camera driver Rock960 development board.

19. What is the username and password to login the kernel?

The system will login automatically. No need to provide username and password.

20. What are the applications provided for camera streaming?

Gstreamer-1.0 application is provided for display streaming.

21. What is the weight of the camera board?

The camera board weight is 12 grams without lens and 17.5 grams with lens.

22. What is the length of the cable? (If applicable)

The length of the micro-coaxial cable is 30 cm.

23. Can I get the mechanical 2D and 3D files for the eCAM50_CU96 PCB?

Yes. Please write to sales@e-consystems.com for the PCB files.

24. What are the warranty terms of the e-CAM50_CU96 camera?

Please refer this www.e-consystems.com/warranty.asp page for warranty terms.

Glossary

API: Application Program Interface.

ARM: Advanced RISC Machines.

CMOS: Complementary Metal Oxide Semiconductor.

CPU: Central Processing Unit.

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

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

HDMI: High-Definition Multimedia Interface.

microSD: micro Secure Digital.

MIPI: Mobile Industry Processor Interface.

QHD: Quad HD (Industry name for 2560 x 1440 resolution).

SOC: System on Chip.

USB: Universal Serial Bus.

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

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

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

Contact Us

If you need any support on e-CAM50_CU96 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	08-January-2020	Initial draft	Camera Team